Can the sea spark a conflict or nudge us into cooperation? A Cross-National Analysis of Sea Pollution, Fishing, Marine Treaties and Militarised Dispute

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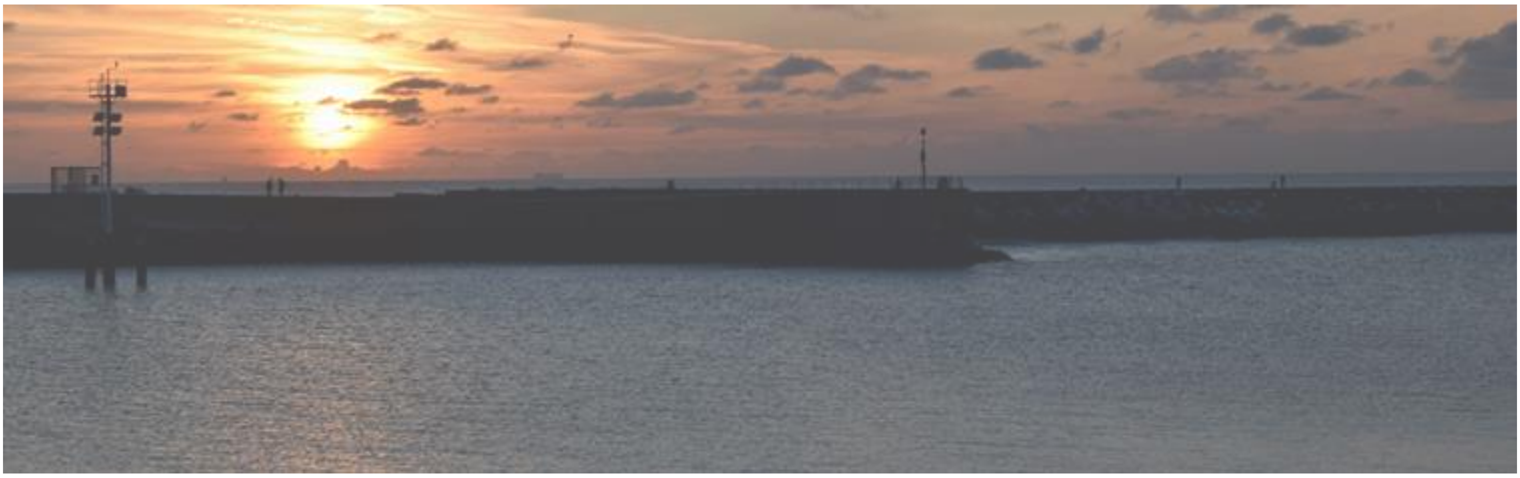

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Can the sea spark a conflict or nudge us into cooperation?

A Cross-National Analysis of Sea Pollution, Fishing, Marine Treaties and Militarised Dispute

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Abstract

How does sea pollution and fishing affect the marine governance in the South China Sea? Sea pollution and overfishing are some of the biggest threats that the world's oceans are currently facing. As the neo-Malthusian theory implies, they can threaten the national security and create global crises. This thesis will explore closer the relationship between pollution, fishing, marine treaties and militarised dispute by exploring closer, how sea pollution and fishing affect the creation of regional treaties and to what extent does the quantity of treaties mitigate the risk of a militarised dispute in the specific case of South China Sea region? Analysing these questions will intend to fill the empirical gap that exists in the marine security and governance literature by focusing on China, Taiwan, Brunei, Malaysia, Vietnam and the Philippines.

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Table of Contents

Introduction 5

Literature review 6

- Tragedy of Commons 6
- Sea Governance 7
- Conflict or Cooperation? 8
- South China Sea 9

Theoretical discussion 10

- From fishing and pollution to a peaceful solution 10
- More treaties, less conflict 11

Research design & Methodology 13

- Variables 14
- Model 16

Results and Discussion 17

- OLS Models: Hypothesis 1 17
- OLS Models: Hypothesis 2 19

Conclusion 22

References 25

Appendix 1: Assumptions 29

Appendix B: Scatterplots of *Model 3* and *Model 4* 32

Appendix C: R script of the OLS regression model 33

Introduction

The fact that seas are currently in danger because of pollution and human activity is a well-known statement. Humans have been influencing the oceans in direct ways such as oil spills, overfishing, contamination of water with industrial sewage and pesticides, plastic pollution etc. (National Geographic, 2021). All the actions combined have worsened off the "health" of seas, which in this context refers to uncontaminated waters with minimally interrupted ecosystems and environments by humans. Scientists, media, and pop-culture have been informing the mass about the impacts of these direct consequences, but what exactly will be the indirect implications?

All the direct consequences will eventually spark other issues such as the shift of the species distribution, water acidification, scarcity of fish in the seas etc., which can lead to bigger socio-economic and political issues on a global scale (Kebede et al., 2015). In order to study this topic, the focus will be put on the case study of the South China Sea. South China Sea is one of the regions that could potentially be in danger because of its reliance on the fishing industry. It contains a complex coral reef structure with high biodiversity, which has become the living environment for many marine species (Arai, 2015). Additionally, fish are a very important cultural and socio-political aspect of the region because they take an important role in the daily diet and therefore have a significant role in the market (Teh et al., 2017). Thus, increasing sea temperatures, acidification and water pollution, all together with overfishing have been influencing the regional ecosystems and local territory (Yu et al., 2019; Arai, 2015). However, the South China Sea is also linked to the long-lasting regional tensions over the sovereignty of the sea territory between Malaysia, Philippines, Taiwan, Brunei, China and Vietnam. The nature of the dispute is based on the complex convergence of national interests over territory, oil, and trading roads (Jenner & Tran, 2018). Although the peace has been maintained, it holds on a weak balance, which could break with any minor trigger and spark a military interstate dispute (Jenner & Tran, 2018). But could pollution and fish scarcity be the spark? This study will focus on the following question:

How does sea pollution and fishing affect the marine governance in the South China Sea?

To explore the research question more carefully, the study will analyse how sea pollution and fishing affect the creation of regional treaties and to what extent does the quantity of treaties mitigate the risk of a Militarised Dispute? The term marine governance has been used, because it refers to the control system that defines the rules about decision-making by states and other actors (Chotray & Stoker, 2009). This means, that the term can cover any outcome of named decision-making, including treaty creation nor militarised dispute, which will be the two focus outcomes.

This study will start by exploring the current literature on the topic of renewable resources, (which include clean water and fish), water governance and link it to the context of the South China Sea. Secondly, it will intent to apply well-known theories such as Tragedy of Commons, Governing the Commons, neo-Malthusianism and less known theories like Weathering climate change into the context of the region (Hardin, 1968; Ostrom, 2015; Koubi et al., 2014; Tir and Stinnett, 2012). Subsequently, the longitudinal research design will be inspired by the work of Tir and Stinnett, who quantitatively analysed how water scarcity can affect the water governance (2012). This research will substitute water scarcity with the amount of fish and how different types of sea pollution influence it by running an ordinary least squares (OLS) regression analysis. The results will show whether overfishing and the number of treaties in the region contribute to or mitigate the potential risk of a militarised dispute among the previously named states. The purpose of the research is to explore how the impact of human direct activity, namely pollution and overfishing, can indirectly affect the politics and security of one of the most populated regions in the world and thus the lives of millions of people.

Literature review

This section will explore the existing theoretical and empirical literature relevant to the subject of the study. It will firstly analyse the well-known Rational Choice theories *Tragedy of Commons* and *Governing the Commons*. Secondly, it will tackle relevant types of water governance and more specifically marine governance. Thirdly, the study will discuss whether resource scarcity combined with a specific type of water governance leads to conflict or cooperation. And lastly, it will dive into the case of marine governance in the South China Sea.

Tragedy of Commons

The *Tragedy of Commons* by Hardin is a well-known theory relevant to environment related studies (1968). Hardin argues that humans contaminate the commons (air, land, water) because they want to benefit from them in the short-term because a rational person knows that if she does not take advantage of the common, someone else will (1968). However, the resources are not limitless and if all rational humans act the same, it will lead the world to ruin, therefore the "tragedy" (Hardin, 1968). According to his argument, in the context of sea pollution and fishing, if humans keep acting the same way, the seas will be empty and dead and there is nothing that can be done to prevent it. Additionally, Olson presented a similarly pessimistic view in *The Logic of Collective Action,* where he argued that self-interested humans will not collaborate to reach the common goal of reducing pollution (1971).

One of the scholars that opposed Hardin's and Olson's pessimistic point of views was Ostrom with her work *Governing the Commons* (1968; 1971; 2015). She argued that the tragedy can be prevented through privatization of the commons. That way, humans will take more care of them because they can gain more profit from well sustained resources. Her work had a strong influence on water management theories such as Local Community Governance (Bréthaut & Schweizer, 2018). Since 30 years ago, when her book was published, many marine governance treaties and organisations have been formed, but human impact is still not changing (2015; National Geographic, 2021).

Sea Governance

Governance has been defined by Chotray and Stoker as the only control system that defines the rules about decision-making by states, multiple actors, and organisations (2009). In the context of sea governance, according to Mendenhall, most of it is based on systematized international customary laws (2019). The institutional umbrella that supervises other marine agreements is the United Nations Convention on the Law of the Sea (UNCLOS). Mendenhall analyses the different types of sea agreements and institutions and concludes that the current marine governance regimes do not meet the requirements that would be needed to combat the consequences of climate change (2019).

Bréthaut and Schweizer start their book about water governance on a similar note (2018). They agree with Hardin's theory, but their argument differs in the origin of the tragedy, since according to them, it is caused by an unsuccessful governance regime (1968; 2018). Therefore, their critique mirrors Mendenhall's and additionally they propose an approach and explain how it had been successfully implemented (2019; 2018). Their answer to Ostrom's call consists of implementing a local-level solution, Local Community Governance (LCG), where small communities will be given the authority to manage their water resources and therefore, they will be more conscious about their impact on them (2015; 2018). In addition to their argument, Mirumach and Van Wyk proposed that besides small communities, relevant stakeholders should be also included in the decision-making and the different levels need to be well-coordinated (2010). However, the limitation of both studies is that the theory has been tested on fresh-water governance, which raises the question whether the same theory could be applied to marine governance (Bréthaut & Schweizer, 2018; Mirumach & Van Wyk, 2010).

The work by Jouanneau and Raakjær seems to fill the empirical gap by applying a similar theory to the study of the Mediterranean and Baltic sea (2014). The aim was to observe which region and type of governance would be more successful when dealing with the impacts of climate change. The results showed that the cooperation among states in the Baltic sea region was too dependent on the European Union, which would potentially complicate systematic changes on the local level because of the bureaucratic inefficiency. On the other hand, although the Mediterranean Sea lacks a systematic organisation on the higher level, such as the European Union, it has shown a potential higher success in dealing with climate change consequences, because stakeholders on the local level are more engaged. Their argument supports the theory of LCG and focuses it on the marine governance context. In addition, it proves that there is no need for an umbrella institution like UNCLOS or EU, because regional cooperation is more efficient since it adapts to the problems that the region is facing (Jouanneau & Raakjær, 2014).

Conflict or Cooperation?

Harris mentioned in his study that climate change, and hence weakening of the ocean's health, will raise difficult political decisions, which will create winners and losers (2019). So far this literature review has focused on the types of marine governance, but can the system of governance fail and spark a conflict over the commons, which will define the losers and winners?

Koubi et al. presented the neo-Malthusian theory that increasing scarcity of renewable resources originates tension and can create an intrastate conflict (2014). Unpolluted seas and fish are renewable sources, which would mean that their scarcity could create tensions in the affected regions. However, the supporting research has proven that economic and political factors are more significant at the time of initiating a conflict, which belongs to the cornucopian narrative (Koubi et al., 2014). Tir and Stinnett applied a similar theory to neo-Malthusianism in their study, but unlike Koubi et al., they empirically proved that water scarcity, which has increased due to climate change, does contribute to the tension creation and the potential escalation of a militarised interstate dispute (2014; 2014). However, their findings proved that interstate cooperation on a regional level with a higher regional authority mitigates the risk of a militarised interstate dispute. They referred to the theory as "Weathering climate change".

Their finding contradicts the argument of Jouanneau and Raakjær, that a higher authority, such as the EU, slows down efficient decision making in the context of climate change (Tir & Stinnett, 2012; 2014). However, the EU does not tackle only marine governance in the region of the Baltic sea, therefore in this context, it would mirror the umbrella institution of UNCLOS, which has been referred to as inefficient and then the region lacks the regional authority (Mendenhall, 2019).

The literature above has proven the relationship between renewable resource scarcity and conflict, but in both cases, the studies have tackled fresh-water scarcity (Tir & Stinnett, 2012; Koubi et al., 2014). This highlights a new empirical gap, which is whether the theory could be also applied to the marine context. Can increasing water pollution and overfishing be the cause for a militarised interstate dispute escalation? And can regional cooperation overcome the risk? This study will address the empirical gap with the case study of the South China Sea.

South China Sea

South China Sea, as already mentioned, is an ecologically rich region, which is being affected by increasing sea temperatures, acidification and water pollution, which together with overfishing, are seriously damaging the local ecosystems (Yu et al., 2019; Arai, 2015). According to the literature, pollution and overfishing can significantly affect the political and military stability of the region (Teh et al., 2017; McManus, 2017; Vu, 2013). According to Teh, the region lacks political initiative to solve the collective action problem because of the territorial dispute among the six countries (2017). McManus agrees and highlights the need for collaborative management in the region and necessity of stopping the arm race, which only contributes to the potential initiation of the militarised interstate dispute and pollution (2017). Vu adds to the narrative the solution of establishing a transboundary marine protected area (MPA), which would force the states to comply in preserving the area and perhaps soften the tensions, which reflects the main idea of *Governing the Commons* (2013; Ostrom, 2015).

The mentioned literature emphasises regional cooperation and takes away significance from organisations like UNCLOS. On the other hand, Nguyen proposes the argument that UNCLOS is the only organisation that maintains peace in the region and smoothens all the threats such as overfishing and pollution that South China Sea is currently facing (2016). Her argument is that the organisation ensures maritime security on the local level. However, the organisation does not imply solutions to the issue or how to tackle the increasing problem, therefore as Mendenhall issued, it is not very relevant (2019).

The presented arguments mirror Bréthaut's and Schweizer's LCG theory as the solution to the *Tragedy of Commons* (2018). The mentioned papers about the South China Sea have acknowledged the potential threat that climate change can be to the region and propose solutions to the regional marine governance. However, the literature lacked empirical evidence of the effect of pollution and fishing on regional treaties and conflict (Teh et al., 2017; McManus, 2017; Vu, 2013; Tir & Stinnett, 2012; Koubi et al., 2014). Therefore, this study will explore whether the theory applied to freshwater resources could be applied in the context of seas and oceans and more specifically the South China Sea. Thus, this analysis will intend to fill the empirical gap by theory testing.

Theoretical discussion

This part will explore the two sub-questions of the thesis by putting them in a theoretical context and conceptualising the used variables. The discussion of each question will be concluded by a hypothesis based on the used theory. The first part will tackle how sea pollution and fishing affect marine treaties by using the LCG theory while the second part will focus on how marine treaties affect the outbreak of a militarised dispute through neo-Malthusian and Weathering climate change theories.

From fishing and pollution to a peaceful solution

How do sea pollution and fishing affect the creation of regional treaties?

There is extensive literature invested in explaining marine pollution and overfishing. Most of the definitions and explanations coincide because they are based on scientific facts developed from empirical research. Sea pollution is conceptualised as high concentration of a specific contaminant, which is normally absent in the environment and can affect living organisms relevant to the marine ecosystems (Weis, 2015). There are many different sources of marine pollution. Among the most influential pollutants belong land-based pollutants such as toxic chemicals, pesticides, industrial products, factory sewage and "ocean dumping" which refers to the deposit of physical waste into the water (trash, fishing nets etc.); oil spills, oil leakage and side pollution originated from the oil industry; aquaculture and its direct effects such as the release of chemical substances into the water and high concentration of nutrients which can cause algal bloom followed by reduction of oxygen in the water and subsequently death of local marine life (Weis, 2015). Although there are more sources of pollution, these are considered the most relevant and dangerous for the marine ecosystems because they affect the biodiversity of seas and potentially contribute to the decreasing number of fish population.

The decreasing amount of marine biodiversity is also credited to overfishing, which is defined as fishing above the long-term sustainable levels (Zhou et al., 2015). The world's demand for seafood is increasing so the fishing industry is trying to satisfy societal needs by increasing the number of fish catches (Zhou et al., 2015). These actions logically contribute to the reduction of marine organisms and together with pollution worsen the oceans "health".

The listed human actions are well-known issues to the international community and therefore many treaties have been signed with the aim of improving the situation (Weis, 2015). This study will not focus on the legal framework of the marine treaties or the different types. Instead, it will observe the quantity of treaties related to marine governance on a global level. Even though the marine security is threatened in the region by the listed issues and the peace is weakly balanced, by observing the quantity of treaties on a global level, the assumption is that they can also influence the creation of other more regional agreements through peer pressure (Wang, 2016; Jouanneau & Raakjær, 2014).

The theory argues that large umbrella institutions such as UCLOS are not sufficiently efficient because they are too broad and not adapted to the regional needs and more concrete situations (Jouanneau & Raakjær, 2014; Mendenhall, 2019). In the context of freshwater management, the LCG theory argues that water scarcity leads to more local cooperation (Bréthaut & Schweizer, 2018; Mirumach & Van Wyk, 2010). Fresh water, similar to fish and oceans, is considered common and therefore the LGC theory should be applicable to the context of increasing marine pollution and decreasing fish population. Thus, this study will intend to apply the LCG theory to the context of marine governance. Therefore, increasing human impact should lead to more regional cooperation among states. Hence the first aspect that this study will investigate is the following hypothesis:

Hypothesis 1: Increasing level of sea pollution and fishing lead to more regional treaties.

In order to explore the first hypothesis, the study will observe the effect of global water pollution and fishing in the South China Sea on the number of fishing related treaties.

More treaties, less conflict

To what extent does the quantity of treaties mitigate the risk of a Militarised Dispute?

The first theory, LCG, assumes that fishing and marine pollution lead to more regional marine treaties. However, that raises the question of how they impact the potential outbreak of a Militarised Dispute (MD).

As introduced in the literature review section, Koubi et al. presented the idea of the neo-Malthusian theory (2014). It argues that scarcity of renewable resources can create frustration and lead to an intrastate armed conflict. The authors argue that although there is sufficient theoretical evidence of this phenomenon, the empirical evidence has been showing mainly contradicting results (Koubi et al., 2014).

However, the theory Weathering climate change, presented by Tir and Stinnett, follows the neo-Malthusian idea by arguing that water scarcity increases the risk of a Militarised Interstate Dispute (MID) (2012). Additionally, it adds the argument that the risk is mitigated by institutionalised agreements (2012). Therefore, it expands the neo-Malthusian theory. They reported that climate change can seriously threaten international security and so they focused on only one potential aspect – freshwater scarcity. However, they acknowledge that climate change will also influence other spheres, such as soil acidification or marine pollution, that could also threaten international security (Tir & Stinnett, 2012).

Their theory was tested on river management in different regions by analysing the increasing water scarcity, number of treaties and their effect on the outbreak of MID. This study intends to apply the Weathering climate change theory to marine governance but instead of increasing water scarcity, it will observe the rising amount of fishing and water pollution. Additionally, it will analyse fishing related treaties and agreements rather than river management institutions (Tir & Stinnett, 2012).

According to Gleditsc, there are four types of armed conflict: extra systemic, intrastate, interstate and internationalised intrastate (2002). Extra systematic refers to conflict among a state and non-state party outside of the state's territory; intrastate is defined as the government agains a rebel group within the government's state without foreign intervention; interstate is a conflict among two internationally recognised and sovereign states; and internationalised intrastate is defined as intrastate conflict with foreign intervention (Gleditsc, 2002). Although, Tir and Stinnett's investigation focused on MID, this analysis will include all four types of conflict because Koubi et al., who have also explored the relationship between scarcity of renewable sources and conflict, studied only intrastate conflict due to theory that water scarcity creates internal conflict (2012, 2014). Thus, this analysis will intend to combine the dependent variables of both studies because the conflict can be caused on different levels and among different parties. MD is conceptualised by Gleditsc as a dispute among two parties, in which armed force is being used and it has a minimum of 25 casualties (2002). The parties can include the government of an internationally recognised and sovereign state or another non-governmental group. The disputes can be among two governments, two groups or transboundary (Gleditsc, 2002).

The purpose of including all types of conflict instead of following Tir and Stinnett's model is that as Koubi et al. presented, the scarcity of renewable resources can spark intrastate armed conflict while Tir and Stinnett focused only on interstate (2012, 2014). However this analysis will include all four types of conflict, because any type of dispute can spill over to another kind.

The impacts of a potential MD caused by pollution and overfishing in the region of South China Sea could be very harmful due to the weak stability of the currently peaceful relations. The conflict would most likely be fuelled by the historical nature of the existing tension and, as most MD, have a tragic impact on the society and economy. Therefore, in order to answer Mendenhall's call for a better marine governance regime, it should be studied whether the risk of a MD exists (2019). The results should provide an idea of how urgent the situation is which can then help model future paths towards more efficient policies.

Hence, to study the Weathering climate change theory and explore the consequences of the LCG theory, a second hypothesis has been developed:

Hypothesis 2: The increasing number of regional treaties lowers the likelihood of a Militarised Dispute outbreak.

Research design & Methodology

The research question and the two hypotheses will be explored through a quantitative longitudinal research design. This will be conducted by observing different combinations of variables and how they influence each other over the years 1995-2016. The aim of the quantitative analysis is to observe how the chosen variables evolve over time and thus how they affect the signature of marine treaties and outbreak of a militarised dispute. To obtain the results, a two-part ordinary least squares (OLS) regression will be run. Even though, only 22 years will be observed, the OLS regression analysis shown to be the most suitable to define the correlation among the variables. The test will consist of six models, where different combinations of variables will be run and the results analysed to explore both parts of the theoretical discussion.

Model 1 and *Model 2* will focus on *Hypothesis 1* based on LCG theory, while *Model 3, 4, 5* and *6* will challenge *Hypothesis 2,* which originates from the Weathering climate change theory.

Variables

Dependent variable

This study identifies Militarised disputes as the potential outcome. To identify the variable *MD*, the Uppsala Conflict Data Programme (UCDP) and more specifically the "UCDP/PRIO Armed Conflict Dataset" has been used (Pettersson & Öberg, 2020; Gleditsch et al., 2002). The dataset contains information about conflicts from 1946-2019. The analysis will focus only on the time period 1995-2016 due to data availability. Therefore, the study will observe how many Militarised disputes started in those years without differentiating the type of conflict, which include the four different types conceptualised by Gleditsc (2002). A limitation would be that the study will not distinguish the origin of the conflict. Therefore, it will be unknown whether the conflict originated over marine disputes or not. The reason is, that conflicts might start over a specific dispute, but they can spill over to other areas (Tir & Stinnett, 2012).

Independent variables

Following the research model of Tir and Stinnett, the independent variables will be fishing and number of marine treaties (2012). The variable *fishing* will substitute water scarcity from their study while the number of *treaties* will just focus on the quantity of marine treaties signed, rather than river treaties.

The variable *fishing* represents the amount of fish captured by the six affected countries: China, Taiwan, Brunei, Malaysia, Vietnam and the Philippines. The values have been extracted from the dataset "FAO Regional capture fisheries statistics" by the FAO Aquaculture, Capture and Global production databases (FAO, 2021). The dataset provides the quantity of fish in tonnes that each state captured in the years 1995-2016. However, for an easier interpretation, the values have been recoded to hundred thousand tonnes.

The other independent variable, *treaties*, has been retrieved from the list of fisheries related treaties listed in the Yearbook of International Organisations (2021). The variable represents the number of treaties signed and organisations formed in the time period 1995-2016 on a global level.

Controlling variables

Marine *pollution* is a latent variable. Therefore, it will be composed of other variables that represent different types of water pollution globally and regionally. These variables are *plastic*, *marine acidification*, *oil spills*, and *aquaculture*. They are based on the Weis' and Harris' lists of main marine pollutants and because there is a scarcity of marine pollution data, some of the variables are the originators of the pollution (2015; 2019). All the variables are measured over the years 1995-2016. *Plastic*, *marine acidification* and *oil spills* are measured on a global scale, because their presence in the sea is rather challenging to measure especially on regional levels due to the dispersion by currents (Talhiaferro de Araújo et al., 2014).

The variable *plastic* measures the global production of polymer resin and fiber (plastic) in metric tonnes over the years 1995-2016 (Ritchie & Roser, 2018). Weighing the amount of plastic in the sea is a challenging task, therefore the increasing quantity of its presence in the ocean can be estimated by measuring its global production because the more plastic is produced, the more it becomes a waste (Ritchie & Roser, 2018). The management of plastic waste differs from countries, but it is estimated that minimum 3% of the annual production ends in the sea within the same year (Ritchie & Roser, 2018). The dataset's values were presented in metric tonnes, thus they need to be converted into tonnes to match the metric system of other variables (Ritchie & Roser, 2018). Additionally, the values were recoded to hundred thousand tonnes for an easier interpretation.

Next, acidification of the sea is caused mainly by the increasing CO_2 presence in the atmosphere (Harris, 2019). Thus, the variable *marine acidification*, measures the global atmospheric CO_2 concentration in parts per million between 1995-2016 (Ritchie & Roser, 2020).

Subsequently, *oil spills* represents the tonnes of oil spilled by tankers in 1995-2016 on a global scale (ITOPF, 2017). Although none of the oil spills took place in the South China Sea, the spilled oil enters the food webs and because many organisms migrate, it influences a larger area than the one affected directly (Talhiaferro de Araújo et al., 2014). The variable, same as *fishing* and *plastic*, has been recoded to hundred thousand tonnes.

Lastly, the variable *aquaculture* will measure the quantity of fish farmed by the case study countries except China and Taiwan because their data are not available (FAO, 2021). The farmed fish are measured in hundred thousand tonnes over the years 1995-2016 (FAO, 2021). This variable is measured regionally, because the pollution caused by aquaculture mostly affects the area, where the farming takes place (Weis, 2015).

Table 1: Summary statistics for the data used in the analysis

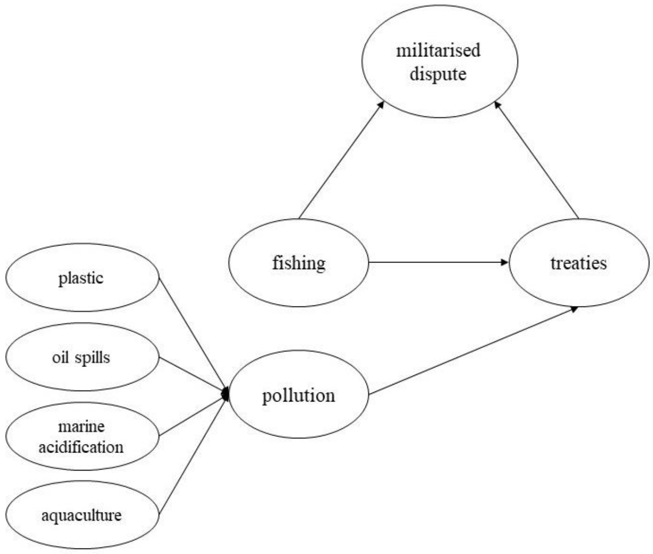
Variable	(n)	Mean	Minimum	Maximum
MD	22	1,727	0	7
treaties	22	2,409	0	8
fishing	22	48,25	35,93	58,26
plastic	21	29059	17196	41998
marine acidification	22	38,11	36,08	40,42
oil spills	22	0,2	0,01	0,8
aquaculture	22	15,818	6,303	24,277

Model

This longitudinal analysis explores two hypotheses that are mentioned above. In order to do so, an OLS regression will be conducted. The analysis has been divided among six Models, which focus on different combinations of variables to study the hypotheses. The relations can be observed on *Image 1.* The analysis contains data from the time period 1995-2016 on a global and regional scale. The test assumes that all the variables are independent, meaning that for instance the variable *plastic* does not have dependency on the variable *marine acidification.*

Because *MD* is a count variable, it has contributed to the violation of some OLS assumptions (see Appendix A). Therefore, the Poisson model has also been included into the exploration of the hypotheses. Poisson model, in contrast to OLS, does not assume homoscedasticity of residuals (UCLA: IDRE Statistical Consulting, n.d.). However, the results of the models have not been influenced by the different tests. Therefore, the OLS model is the only test reported in the study following the model constructed by Tir and Stinnett (2012).

Image 1: Structural model of the analysis



Results and Discussion

As mentioned above, the analysis has been divided into six models. The first two models will explore Hypothesis 1 while the remaining 4 will explore Hypothesis 2.

OLS Models: Hypothesis 1

Model 1 and *Model 2* explore the effects of pollution and fishing on the creation of treaties. They both consider *pollution* and *fishing* as independent variables, while *treaties* is the dependent variable. The latent variable *pollution* is formed by the four controlling variables mentioned in the Research Design. The models containing these variables as controlling, will always include all of them simultaneously because it is not relevant for the study to observe which pollutants influence more in combination with others. Therefore, the analysis will explore the effect of marine pollution rather than individual pollutants.

Table 2: OLS Regression with treaties as the dependent variable

	Model 1	*Model 2*
(Intercept)	224,807	222,955
	(145,587)	(149,548)
oil spills	0,538	0,485
	(2,034)	(2,092)
marine acidification	-0,66	-0,646
	(0,435)	(0,448)
plastic	0,086	0,092
	(0,063)	(0,066)
aquaculture	0,189	0,215
	(0,215)	(0,229)
fishing		-0,108
		(0,257)
R2	0,264	0,272
Adj. R2	0,079	0,029
N	22	22

Note: Regression coefficient with standard errors between brackets. ***p<0,001, **p<0,01, *p<0,05

Model 1 explores the effects of pollution on the creation of treaties. All the variables, except *marine acidification* have shown a positive relation to the treaties. Which means that more pollution leads to more treaties. The variable *marine acidification* is the only variable that has a negative relation with fishing related treaties, hence more acidification leads to more treaties. However, since three out of four variables that create *pollution* have a negative effect, it will be perceived in general as a negative influence. In case this phenomenon occurs in other models, the majority of variables will define the decisive value of the latent controlling variable *pollution*. The adjusted R2 value is 0,079, which represents that 7,9% of the variation of how many treaties can be explained by pollution. Additionally, none of the results is statistically significant, which means that the correlation is insignificant. Thus, pollution does not explain the treaties' creation, although the results insignificant.

Model 2 includes the variable *fishing* to the test. The effect of variables *oil spills*, *marine acidification* and *plastic* are not much affected by *fishing*. However, the variable *aquaculture* has increased its impact, thus more aquacultures create more cooperation. On the other hand, fishing has proven a negative correlation, in other words more fishing decreases treaties by -0,108 ($p \leq 0{,}680$), although the result is statistically insignificant. The adjusted R2 of *Model 2* shows that 27,8% of variation is explained by the independent variables. However, same as in *Model 1*, the results are insignificant.

Although the outcomes show that pollution generally leads to the creation of treaties, while fishing reduces the possibility of a treaty signation, the results of both models are rather insignificant. This implies that the increasing pollution leads to regional cooperation, while fishing does not. But because the outcomes are statistically insignificant, the null *Hypothesis 1* has to be accepted.

These findings have demonstrated that although pollution in the South China Sea could lead to cooperation, it is unlikely that it will be the case because of the insignificance of the results. On the other hand, the results have shown that the increasing amount of fishing, and thus the decreasing number of fish population, has a negative impact on cooperation. However, the result is also insignificant. Thus, the theory on which *Hypothesis 1* has been based on, LCG in marine governance context, seems at first only partially relevant because it can be applied only to pollution (Bréthaut & Schweizer, 2018; Mirumach & Van Wyk, 2010). But due to the insignificance of the results, it remains an unanswered issue which could be explored with some further and more detailed research. Perhaps by leading qualitative research and focusing on the specific aspects of the individual regional treaties.

OLS Models: Hypothesis 2

Once *Hypothesis 1* has been studied, the remaining four models will be used to explore *Hypothesis 2*. *Model 3* explores the relationship between *MD* and *treaties* by observing what is the impact of regional treaties on the potential outbreak of a militarised dispute. *Model 4* explores the effect of only the variable *fishing* on *MD*. *Model 5* explores the effect of both independent variables and their united effect on the dependent variable. Lastly, *Model 6* adds the controlling latent variable *pollution* to the equation and observes how it influences the effect of variables *fishing* and *treaties*.

Table 3: OLS Regression with Militarised Disputes as the dependent variable

	Model 3	*Model 4*	*Model 5*	*Model 6*
(Intercept)	1,368	14,558***	17,452***	-23,637
	(0,807)	(1,565)	(1,567)	(77,976)
treaties	0,149		-0,387**	-0,335*
	(0,274)		(0,119)	(0,126)
fishing		-0,266***	-0,307***	-0,439**
		(0,0321)	(0,029)	(0,126)
oil spills				-1,78
				(1,02)
marine				0,133
acidification				(0,232)
plastic				-0,006
				(0,034)
aquaculture				-0,088
				(0,115)
R2	0,015	0,774	0,855	0,894
Adj. R2	-0,035	0,763	0,839	0,849
N	22	22	22	21

Note: Regression coefficient with standard errors between brackets. ***p<0,001, **p<0,01, *p<0,05

Model 3 has shown that regional treaties have a positive correlation, which means that by every signed treaty or organisation created, 0,149(p≤0,592) armed conflict is initiated. Additionally, -3,5% of the variation is explained by the number of treaties. A negative adjusted R2, if it is close to zero, can be interpreted as zero value, which means that there are too little observations and too little variables. Thus, this model does not properly fit the analysis of the collected data. Which explains why Model 3 violated many of the OLS regression assumptions. Besides showing a positive correlation and a negative variance explanation, the result is insignificant. Therefore, the correlation is not significant. This model could be potentially explored further by qualitative analysis by observing the nature of the individual treaties. According to Tir and Stinnett, different types of treaty designs are more likely to prevent militarised conflict than others, namely the more institutionalised ones (2012). This study has focused on the quantity of treaties rather than the type of design, thus that is a potential reason for the given results.

The results of *Model 4* show that *fishing* affects negatively *MD.* It shows that for every tonne fished by one of the six countries, the likelihood of an armed conflict outbreak decreases by -0,266 (p≤6,78e-08). The results are very significant, which means that there is a high correlation between the variables. The adjusted R2 value gave a 76,3% of variation explanation, which is a high percentage. The higher the adjusted R2 values is, the more value each input variable provides to the model. However, the results show the opposite of the expected outcome based on the neo-Malthusian theory (Koubi et al., 2014). Increasing scarcity of renewables sources, such as fish, should lead to the outbreak of an armed conflict. But these results challenge the theory and raise the point that perhaps all the renewable sources do not have the same impact.

On the other hand, *Model 5* shows that adding both independent variables have a different effect than individually. Although, equally to *Model 4, fishing* still has a negative and significant effect that has only decreased to -0,307 (p≤ 2,46e-09), the variable *treaties* has now also a negative effect. By each additional treaty, *MD* decreases by -0,387 (p≤0,0043) and the effect of regional treaties is significant in this model. The higher adjusted R2 value gave 85,5%, which shows that combining both independent variables added value to the model. The outcome of the result is that increasing fishing still significantly decreases an armed conflict outbreak. However, fishing affects the impact of treaties. Each signed fishing related treaty creates less conflict. Thus, increasing fishing by the six countries of South China Sea contributes to regional cooperation and that reduces armed conflict, which supports Weathering climate change theory (Tir & Stinnett, 2012).

Model 6 adds the latent controlling variable *pollution*. The controlling variables have not affected radically the effect of the independent variables on *MD* from *Model 5,* except by decreasing mildly the relevance. The significance of *treaties* decreased to p≤0,018 and *fishing* to p≤0,004. In *Model* 2 and *Model 1, pollution* has shown a positive relation to regional treaty creation, while this model implies that *pollution* has a negative impact on *MD*, which means that increasing pollution, in combination with treaties and fishing, reduces conflict. However, the interpretation of the outcome is that although increasing pollution and fishing decrease MD, they increase the significance and reinforce the negative relation of regional treaties on conflict outbreak. The Adjusted R2 gives a value of 84,9%, which equally to *Model 5* means, that adding the controlling latent variable *pollution* to the model added value to the model.

Model 3 and *Model 4* explored the effects of each independent variable alone on the dependent variable. The result of *Model 3* showed that *treaties* increase *MD* but it was insignificant and not very fitting to the collected data. On the other hand, increasing *fishing* significantly decreases the dependent variable. Therefore, the significant correlation was mainly between fished quantity and armed conflict outbreak (see *Appendix B* for visual interpretation of *Model 3* and *Model 4*). Once, that the effects of the independent variables had been explored, *Model 5* and *Model 6* focused on testing the *Hypothesis 2*. *Model 5* showed that *fishing* affected the variable *treaties* by turning its positive effect into negative and making it significant. The last model added the controlling variable *pollution* into the equation and showed that it affects *MD* similarly to *fishing* but less significantly. Although the variable *marine acidification* generally showed opposite significance in *Models 1,2, 6,* in general it has not been considered, because of its insignificance and minority within the *pollution* variable, as explained above.

Based on the outcomes of *Model 5* and *Model 6,* the null *Hypothesis 2* has been rejected and the alternative hypothesis accepted.

The findings have partially supported the theory presented by Tir and Stinnett and Koubi et al. (2012, 2014). According to the results of the models, increasing pollution and fishing do not have a positive relation to MD, which contradicts the neo-Malthusian theory (Koubi et al., 2014). However, they reinforce the effect of treaties on decreasing MD, which supports the Weathering climate change theory and its argument that treaties on water scarcity management decrease the likelihood of a MID (Tir & Stinnett, 2012). Thus, it contradicts the theory that renewable sources scarcity, such as fish and clean oceans, lead to conflict but it supports the theory about treaties as prevention of MD caused by resource scarcity (Tir & Stinnett, 2012; Koubi et al., 2014).

In the context of the South China Sea, this means that although the increasing amount of fishing by China, Brunei, Taiwan, Vietnam, Malaysia and Philippines tends to decrease the likelihood of a regional armed conflict escalation, it simultaneously contributes to the creation of fishing related treaties, which do decrease the chances of a MD outbreak. Thus, according to the OLS regression models, the regional solution to avoid conflict and reduce the tension among the states in the region, is to sign regional treaties that would tackle fishing and additionally pollution.

Conclusion

This thesis originated from a simple wonder of how the ocean's health affects conflict and cooperation among states. The personal interest leaned towards the South China Sea due to the fascination about how states with such different political ideologies can maintain relatively peaceful relations and how pollution and overfishing potentially interrupt them (Marshall, Gurr & Jaggers, 2019). After the investigation of the current literature about sea governance, *Tragedy of Commons,* with a more negative connotation, and *Governing the Commons,* on a more positive note, were set as the two main theories (Hardin, 1968; Ostrom, 2015).

Subsequently, more specific theories were chosen to explore the issues. The results of the analysis demonstrated that the Local Community Governance theory, originally applied to freshwater scarcity, did not have the same results in the context of South China Sea (Bréthaut & Schweizer, 2018). Although pollution did increase the likelihood of fishing related treaties, fishing itself decreased the chances of cooperation. Additionally, the results were not significant, thus the theory was rejected. Some of the reasons why this was the case could include the absence of local treaties in the analysis. Although China, Taiwan, Malaysia, Brunei, Philippines and Vietnam signed together 33 fishing related treaties from 1922 till 2011, very few were actually tackling the problem on a more local level (Yearbook of International Organisations, 2021). Thus, the irrelevance of the results could be avoided in the future by conducting a qualitative analysis and focusing on the nature and subjects of the signed regional treaties.

The next two theories, neo-Malthusianism and Weathering climate change explored the relationship between the scarcity of fish, "healthy" water and the potential outbreak of an armed conflict (Koubi et al., 2014; Tir & Stinnett, 2012). Since the results of this analysis gave a significant negative relationship between fishing in South China Sea and conflict outbreak, the neo-Malthusian theory cannot be applied to this case study. However, increasing quantity of fish captured with worsening sea pollution, affect the likelihood of a treaty creation, which reduces the chances of the outbreak of a potential militarised dispute. Thus, Weathering climate change has been accepted even though the theory was originally applied to freshwater scarcity.

After a short summary of the analysis, the answer to the research question is that sea pollution and fishing affect marine governance in South China Sea only partially. The interpretation of the results showed that pollution and fished amount do not influence treaty creation alone, however the worsening "health" of the sea, in combination with existing marine treaties, decrease the likelihood of a militarised dispute outbreak. Therefore, the theory of Weathering climate change can be applied to marine governance as the analysis of the South China Sea case study has implied.

Although the analysis supported the argument of the Weathering climate change theory, perhaps for future research, additional aspects could be added. For instance, Tir and Stinnett included into their analysis different kinds of treaty designs based on joint monitoring, conflict resolution, enforcement, authority and researched the individual effects of each type (2012). Therefore, future analysis could explore the individual treaties that have been signed in the region and observe how they influence the situation and relations among the six states of the South China Sea. This could be also done by considering the legal aspects of the treaties and expanding the research into other disciplines such as marine law.

Another limitation of the study could be considered data availability. Some aspects of sea pollution are very well-known because they are more obvious, and the data can be collected more easily. However, there are some aspects of pollution that can be more challenging to measure and thus the real impact are only estimates (Weis, 2015). Additionally, the data availability could be restricted by the limited access to data collections that the regional countries of the South China Sea have. According to the polity IV project, countries such as China and Vietnam have low polity index, which means that they are autocratic states (with values -7, where 10 are very democratic and -10 very autocratic), while Malaysia (7) and Philippines (8) score higher values (Marshall, Gurr & Jaggers, 2019). More autocratic regimes tend to either have more strict policies about data availability or present modified information (Hague, Harrop & McCormick, 2016). For instance, China and Taiwan did not provide data about aquaculture to the FAO, which could be linked to their political regime and hence raise the question, to what extent are state collected data reliable (2021).

The purpose of this thesis was to fill the empirical gap and provide a deeper understanding of the potential impacts that unhealthy oceans can have on marine security in the concrete case of the South China Sea. It could contribute to the development of new policies and cooperative sea governance between the states to smoothen the regional relations. A militarised impact would cause many damages on social, pollical, economic and environmental spheres and lead to, as Hardin warned, a cross-sectional tragedy (1968).

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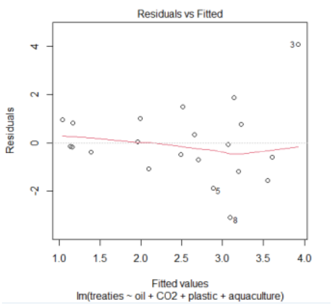
Appendix 1: Assumptions

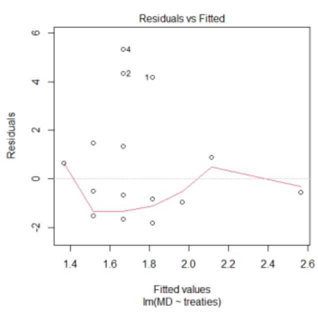
Linearity

Linearity assumption expects the presence of a linear relationship between the predictor and outcome. In all models, the assumption has been affected by influential values, which could have not been omitted due to the potential threat of selection bias.

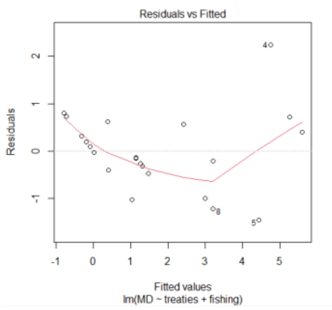
Model 1



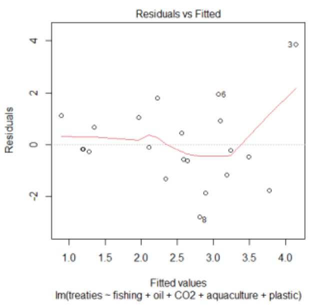
Model 3



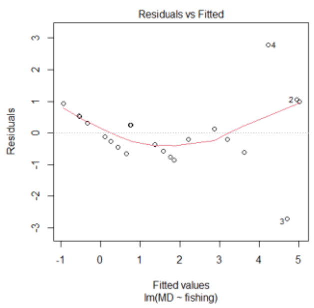
Model 5



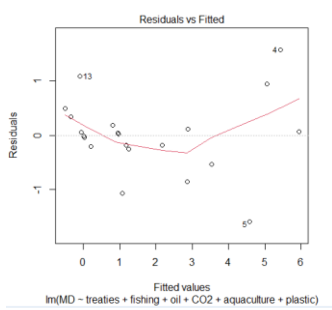
Model 2



Model 4



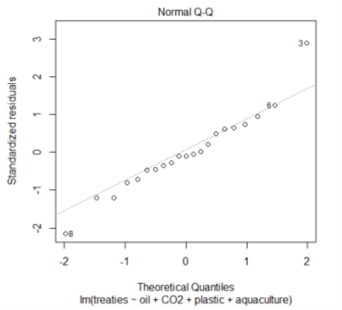
Model 6



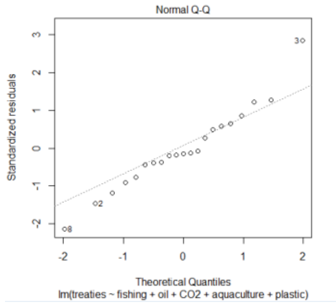
Normality of residuals

Normality of residuals assumes that all residual errors are normally distributed. Except *Model 3*, all models meet the assumption.

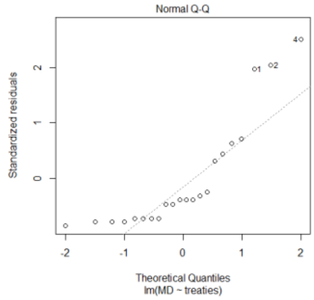
Model 1



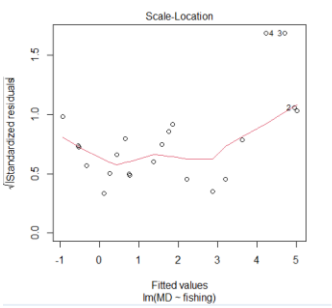
Model 2

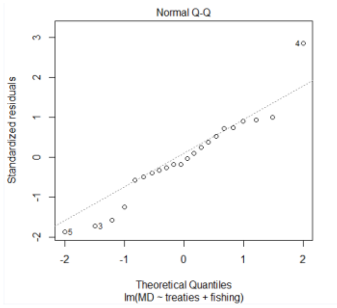


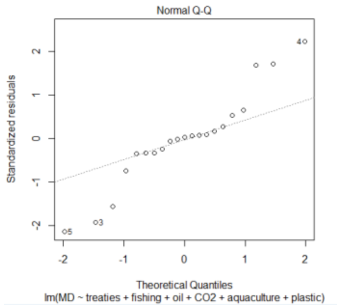
Model 3



Model 4 *Model 5* *Model 6*



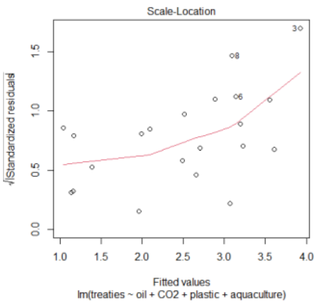


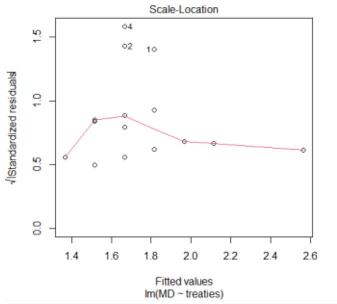


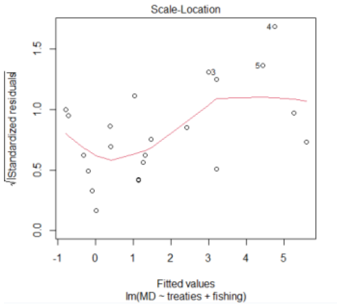
Homoscedasticity

Homoscedasticity implies the homogeneity of the residual's variance. In other words, whether residuals are distributed along the predicting line. In all cases the assumption has been violated and therefore the heteroscedasticity occurs.

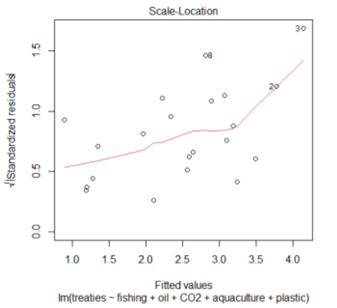
Model 1 *Model 3* *Model 5*

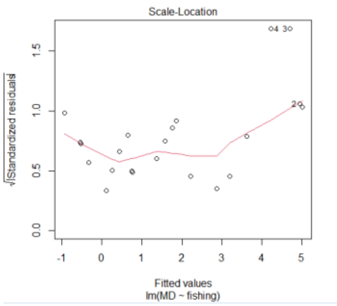


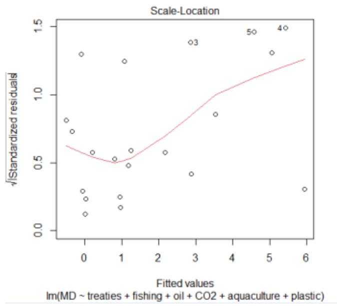




Model 2 *Model 4* *Model 6*







Independent errors

As the name implies, this assumption expects errors to be independent. Thus, the absence of autocorrelation. This can be tested by using the Durbin-Watson test. All the values show a value smaller than 4 but larger than 2, which means that there is a negative autocorrelation. However, except *Model 3* all results are rather statistically insignificant.

```
> durbinWatsonTest(model.1)
 lag Autocorrelation D-W Statistic p-value
   1      -0.2934978      2.571588   0.454
 Alternative hypothesis: rho != 0
> durbinWatsonTest(model.2)
 lag Autocorrelation D-W Statistic p-value
   1      -0.3165248        2.6221   0.632
 Alternative hypothesis: rho != 0
> durbinWatsonTest(model.3)
 lag Autocorrelation D-W Statistic p-value
   1       0.4804168     0.8305252       0
 Alternative hypothesis: rho != 0
> durbinWatsonTest(model.4)
 lag Autocorrelation D-W Statistic p-value
   1      -0.3845373      2.683115   0.128
 Alternative hypothesis: rho != 0
> durbinWatsonTest(model.5)
 lag Autocorrelation D-W Statistic p-value
   1      -0.3917132       2.70049    0.12
 Alternative hypothesis: rho != 0
> durbinWatsonTest(model.6)
 lag Autocorrelation D-W Statistic p-value
   1      -0.5658204      3.119791   0.056
 Alternative hypothesis: rho != 0
```

Multicollinearity

Multicollinearity explores the correlation among the predicting variables in a model. *Model 3* and *Model 4* have been excluded from this test because they consist of only one independent variable. In general *CO2* and *plastic* have an extremely high Variance Inflation Factor (VIF), which means that these variables violate the assumption and therefore are not correlated to the rest. *Aquaculture* has a high VIF value as well, however not as extreme as *CO2* and *plastic*. The other variables, depending on the model, have resulted in low numbers, therefore they are correlated.

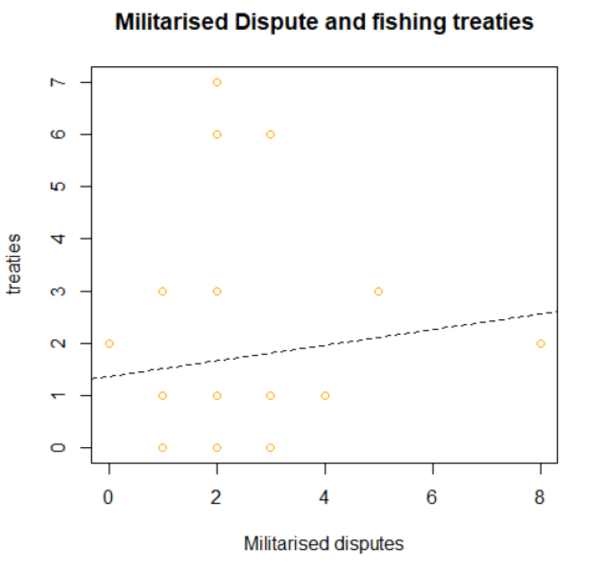
```
> vif(model.1)
        oil         CO2     plastic aquaculture 
   1.665538  207.206822  152.328316   14.796074 
> vif(model.2)
    fishing         oil         CO2 aquaculture     plastic 
  21.117102    1.671548  208.269645   15.982281  157.924074 
> vif(model.5)
treaties  fishing 
1.225088 1.225088 
> vif(model.6)
   treaties     fishing         oil         CO2 aquaculture     plastic 
   1.373696   21.366051    1.677538  237.157273   16.919154  178.431838 
```

Influential cases

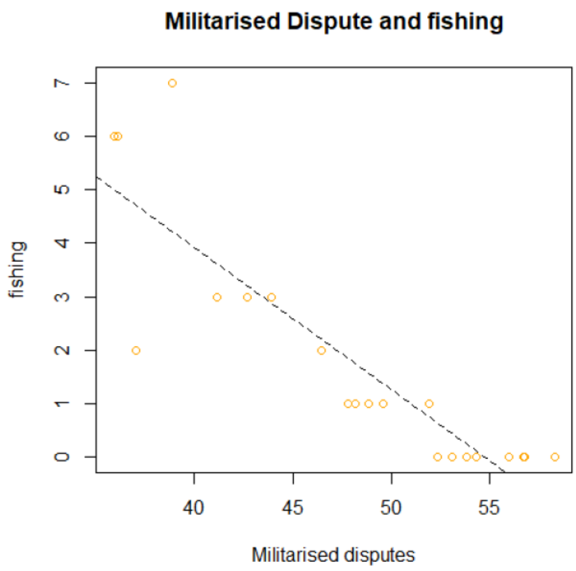
As observed in the previous tests, the collected data contain influential cases. However, they have not been excluded from the study in order to prevent a potential selection bias.

Appendix B: Scatterplots of *Model 3* and *Model 4*

Model 3



Model 4



Appendix C: R script of the OLS regression model

```
##Model 1

model.1<-
lm(treaties~oil+CO2+plastic+aqu
aculture, data=Dataset1)

summary(model.1)

##Model 2

model.2<-
lm(treaties~fishing+oil+CO2+aqu
aculture+plastic,
data=Dataset1)

summary(model.2)

##Model 3

model.3<-lm(MD~treaties,
data=Dataset1)

summary(model.3)

#Plot of Model 3

plot(x=Dataset1$treaties,

     y=Dataset1$MD,

     main="Militarised Dispute
and fishing treaties",

     xlab="Militarised
disputes",

     ylab="treaties",

     col="orange")

abline(lm(MD~treaties,
data=Dataset1),lty=2)

##Model 4

model.4<-lm(MD~fishing,
data=Dataset1)

summary(model.4)

#Plot of Model 4

plot(x=Dataset1$fishing,

     y=Dataset1$MD,

     main="Militarised Dispute
and fishing",

     xlab="Militarised
disputes",

     ylab="fishing",

     col="orange")

abline(lm(MD~fishing,
data=Dataset1),lty=2)

##Model 5

model.5<-
lm(MD~treaties+fishing,
data=Dataset1)

summary(model.5)

##Model 6

model.6<-
lm(MD~treaties+fishing+oil+CO2+
aquaculture+plastic,
data=Dataset1)

summary(model.6)

##Testing Assumptions

#Linearity

plot(model.1,1)
```

```
plot(model.2,1)
plot(model.3,1)
plot(model.4,1)
plot(model.5,1)
plot(model.6,1)
#Normality of Residuals
plot(model.1,2)
plot(model.2,2)
plot(model.3,2)
plot(model.4,2)
plot(model.5,2)
plot(model.6,2)
#Homoscedasticity
plot(model.1,3)
plot(model.2,3)
plot(model.3,3)
plot(model.4,3)
plot(model.5,3)
plot(model.6,3)
#Independent errors
durbinWatsonTest(model.1)
durbinWatsonTest(model.2)
durbinWatsonTest(model.3)
durbinWatsonTest(model.4)
durbinWatsonTest(model.5)
durbinWatsonTest(model.6)
#Multicollinearity
vif(model.1)
vif(model.2)
vif(model.5)
vif(model.6)
```