The exploitation of resources in the South China Sea: How territorial disputes facilitate a Tragedy of the Commons

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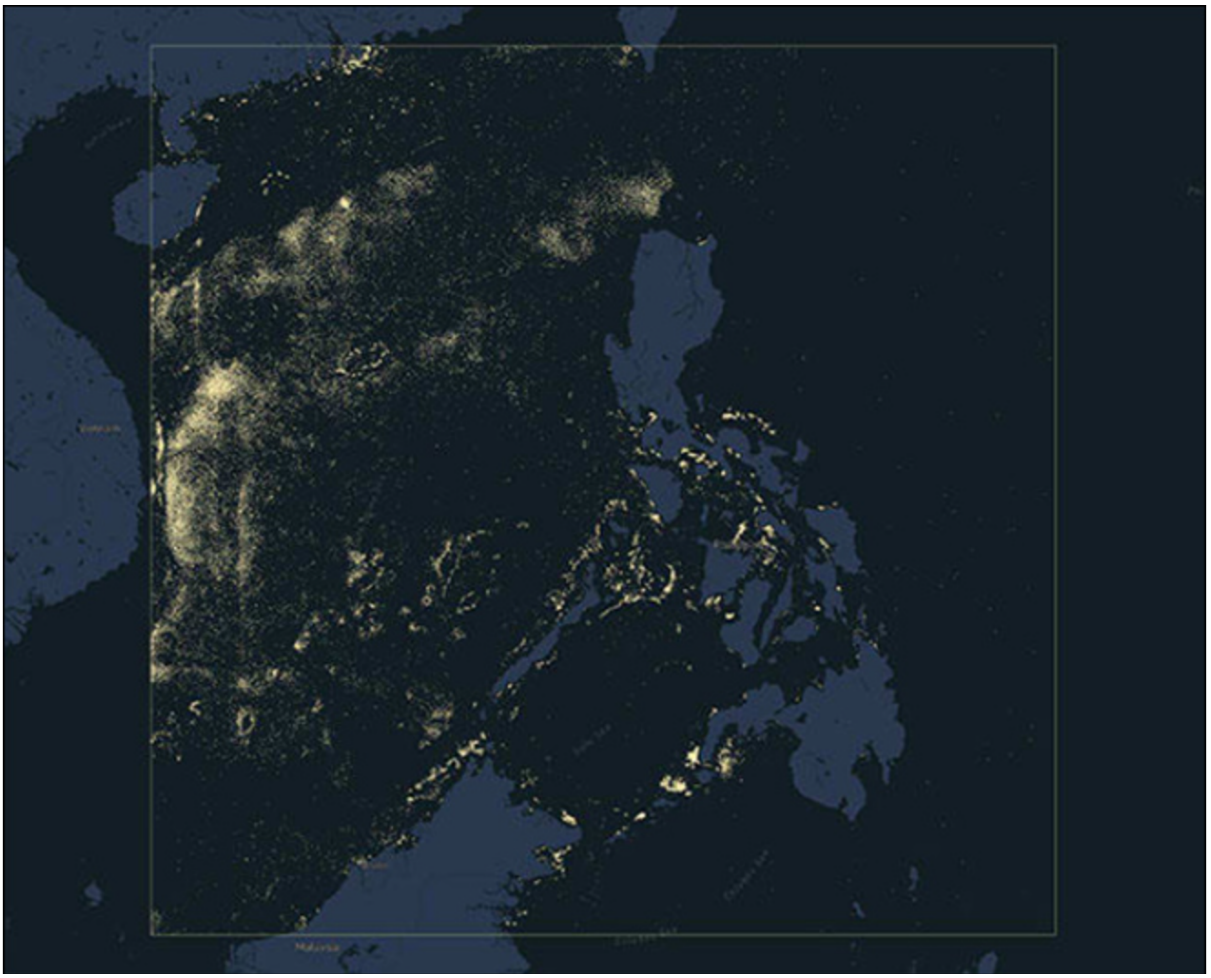

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Abstract

The South China Sea (SCS) is of global importance: it hosts one of the busiest trade routes in the world, and contains large amounts of natural resources such as fish, oil and gas as well. The SCS is also one of the most contested pools of water on the globe. Numerous countries claim (parts of) the SCS, and conflicting claims have resulted in a highly disputed environment. Mainly China has been assertive over the region, claiming a large part of the SCS with the so-called Nine Dash-line. This struggle over the resources in the SCS has caused states to move in rather destructive manners. Overfishing, (testing for) resource extraction and reforming islands have caused massive damage to the SCS and its marine populations. Due to lack of regulation and cooperation, local people as well as corporations are not only unhindered in taking destructive actions, they are incentivized to do so.

The situation in the SCS is a dire one, fish populations are already at an all time low, putting the meals and jobs of millions of people at risk. A solution is called upon, but due to conflicting claims of countries, causing mistrust and increased militarization, this is not in sight. This thesis aims to explain the situation in the SCS, and will do so on two levels. First, it will explain the situation states find themselves in and which choices present themselves when operating in the SCS. As said, that situation creates an environment where locals as well as corporations find themselves being able to overexploit, thus eventually destroying the natural resources the SCS contains. Fish is one of the most overexploited thereof, with marine populations showing sharp decline in numbers since the last decades. Therefore this thesis will secondly present an analysis on what situation fishermen find themselves in. Both these parts will be explained through game theory. Multiple models will be presented to explain the interactions that countries and their populations find themselves in, and why they make the choices they make. Lastly, some propositions will be made on how to create an environment in which these problems can be overcome and create a well-managed sea.

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Introduction

In the South China Sea (SCS) the stage is set for one of the biggest diplomatic issues of the 21st century. The surrounding countries and their citizens, as well as the global economy, heavily depend on the resources and trade routes from Southeast Asia to the rest of the globe it hosts. Through those routes a third of the world's oil and half of the liquified gas passes through (Hayton, 2014, p. 122), and the total trade is valued at over 5.3 trillion US Dollars; 60% of the total maritime and 22% of the total global trade (AALEP, 2021). Next to the trade routes it hosts, the SCS contains large quantities of hydrocarbon energy sources. According to Chinese government official sources, although these are said to be somewhat exaggerated, an estimated 25 billion cubic meters of gas and a fourfold in oil lay under the ocean floor of the SCS (Hayton, 2014, pp. 121-122). The ever energy-hungry economy of China, on top of the other rising economies surrounding the SCS, make these local non-renewable hydrocarbon resources even more desirable than they generally are. Next to these pools of oil and gas, the SCS has an even more important (and used) resource: fish. The SCS is one of the most fished waters on the globe. In 2010, 11.7 million tons of fish were caught, 14% of all fish caught globally (Heiduk, 2016, P. 154). With half the world's fishing vessels and roughly half a billion people relying on the food it provides, the importance of the SCS for the local population's diet and economy is paramount (Xu, 2014; Salleh, 2020).

One of the problems of the SCS is that its waters are highly contested. The waters of the SCS have been subjected to conflicting claims by multiple countries surrounding it. Vietnam, the Philippines, Indonesia, Malaysia but mostly China have been trying to gain (sovereign) control over these waters and her resources (Zhang, 2017). According to the United Nations Convention on Law of the Sea (UNCLOS), a large part of this body of water is not under administration of any countries' exclusive economic zones (EEZ) (UN, 1994). This is international water and falls under administration of the UN and its treaties (UN, 1994). In EEZs however, a country can extract resources however they want (within limits of local and international law). The problem is that some of these resources, including fish, do not adhere to the EEZs. When one country catches all the fish they would be able to, countries neighbouring them would likely see their fish stocks decline. The struggle for these resources result in territorial disputes, which do not come without economic and environmental harm.

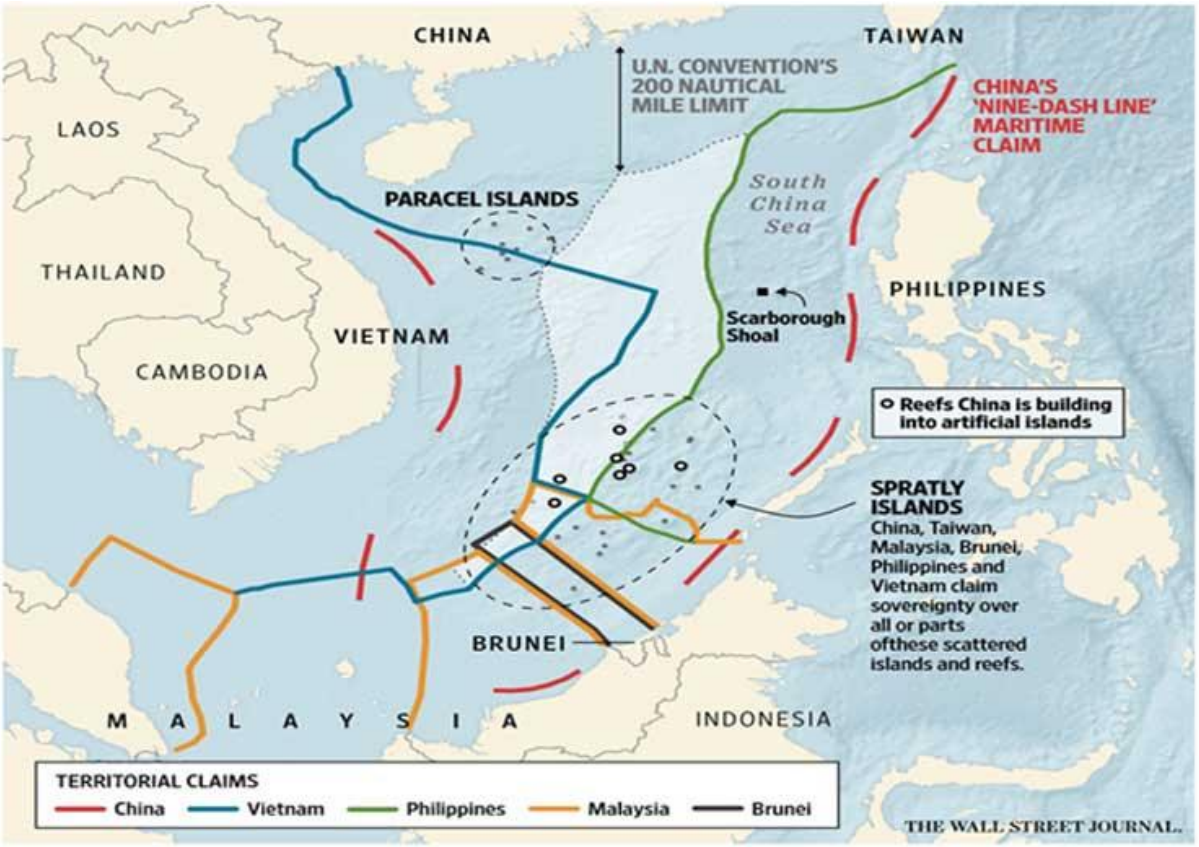


Figure 3.1 The current claims in the South China Sea (Source: The Wallstreet Journal)

The practices of states, as well as local populations are destructive to the overall state of the SCS. On state-level, the territorial disputes in the SCS cause some countries to try to increase their (sovereign) control over parts of the SCS. China has presented multiple ways in which they are able to extend their claims over the SCS as far as possible (O'Neill, 2018, pp. 214-239; Zhang, 2017, pp. 4-22). Firstly, China has been actively modifying islands in and around the commons of the SCS (O'Neill, 2018, pp. 219-220). Small islands, archipelagos and even rocks that stick out inches above sea level, have been enlarged. If we look at these islands after China is done modifying them, the purpose of the transformation is clear: military presence in the region (O'Neill, 2018, pp. 217-220; Zhang, 2021, p. 1). The islands that China has been modifying are enlarged and are now able to not only host an actual population (a requirement by UNCLOS to gain an EEZ), but are also hosting large military bases (Hayton, 2014, pp. 145-146; Zhang, 2017, p. 11; Zhang, 2021, p. 1). For China, these islands are now an asset offensively as well as defensively, giving them more control, defensive capabilities, and offensive muscle with which they can deter other nations surrounding the SCS. A big downside of this practice is that reef banks and ecological systems are literally buried under the soil that China builds their islands on, leaving enormous

ecological harm to the SCS (O'Neill, 2018, pp. 219-220). Further, increased plans for drilling hydrocarbon energy resources by countries such as Vietnam, the Philippines and China have been distorting ecosystems in the SCS as well (Hayton, 2014, p. 241). Increased drilling in the common waters of the SCS release immense amounts of liquids such as gas in the ocean, as well as disrupting and destroying seabeds (Bashu & Chaturvedi, 2021). When countries go further into the SCS and its waters, the sea gets deeper, which increases the environmental damage drilling does to the sea(beds), and its fish and invertebrates even more (Bashu & Chaturvedi, 2021).

The SCS is not only, as earlier said, one of the most contested waters of the globe, but also one of the most overfished (Hayton, 2014, p. 241). Due to the fact that fish migrate between the commons and EEZs of littoral countries, the fishermen are not directly incentivized to reduce their catches. They themselves do not directly experience the consequences of their overfishing. The result is massive overfished stocks declining rapidly, possibly leaving them irreversibly damaged. 30 Percent of the fish population is already gone, and assuming practices continue, a 59 percent decline in 2045 (Heiduk, 2016, p. 155). This will not only have consequences for the food supply of nearly half a billion people, but also whole sectors of littoral countries. The SCS and its resources have been overexploited for decades, and irreversible damage to those resources is imminent. This exploitation is facilitated by the fact that the common waters and even EEZs of the SCS are highly disputed, leaving the waters unadministered and uncorrectly ruled. This opens the opportunity for states, corporations and the local population to exploit those resources, evidently leading to overall destruction of the resource.

In the Tragedy of the Commons, Hardin (1968) has first explained this scenario. Actors share a ground that contains common pool resources (CPR) but overexploitation of these common goods leads to (often environmental) problems, which eventually leads to people leaving, unable to use the resource due to their own behaviour. With cooperation far out of sight, the exploitation of the SCS makes its resources heading for such fate. In order to explain what is needed to manage the SCS well, a research is needed in which the resources of the SCS are analyzed: why are actors in the SCS behaving in such destructive manners, what are their options, and how can we overcome the diplomatic bottleneck that is facilitating these problems? Therefore, the following research question is presented:

How do conflicting interests result in overexploitation of resources in the South China Sea?

Theoretical Framework

4.1 Literature review: The resources and disputes in the South China Sea

As noted, the SCS is of global importance in the trade routes it provides, but is not limited to that role (Jenner & Thuy, 2016, pp. 13-14). The fish and energy resources it contains are an essential part of life and work for the populations of the countries littoral to the SCS (Hayton, 2014, p. 243). All these assets are in danger due to the territorial disputes and the organizational mismanagement that comes with it (Hayton, 2014, p. 241; Heiduk, 2016; Zhang, 2021). To tackle these problems effectively, we need to take into account the multiple resources the SCS provides, since trying to solve one of these problems could worsen another. In order to do so, we need to analyze how the resources of the SCS are defined, as well as how these types of goods/resources are well-managed according to scholars.

Hardin (1968) describes the commons as shared land which contains resources. Excludability or taxation on the use of these resources is hard and/or costly (Ostrom, 2003). This land contains resources, and people surrounding that land can use those as they please. Examples of commons are the parts of the sea that do not fall under the administration of countries' EEZ, outer space or the continent of Antarctica. In the case of the SCS, no country can legitimately claim the SCS outside of their EEZs, which means that a large part of the sea

is under UN administration, making it common waters. The resources that are found in those commons are defined as CPRs (Brando et al., 2019). At first glance, these resources located in the commons seem inexhaustible. The sheer size and amount of most CPRs does not show decline when individuals use it (Ostrom, 2003). The problem is that once more and more people start to extract from/use the CPR, it slowly starts to decline and becomes scarcer and scarcer (Ostrom, 2003). Once people acknowledge the fact that their resources are exploited, it is hard to come up with a solution. Even if all countries littoral to the SCS come to the consensus that fishing in the commons is prohibited, it is still very costly in terms of money and manpower to ensure fishers of those countries actually abstain from fishing these waters. This makes it extremely hard to manage resources in the commons. Hardin (1968; 1999) even argues that in our 20/21th-century society, it is practically impossible to manage these commons well. In order to do so, we need to apply changes to our world, such as socialism or changes in ownership laws.

Studies on CPRs show empirical evidence that managing CPRs well, without damaging or harming the resource, is possible (McGinnis & Ostrom, 1992; Ostrom et al., 1999). However, the fact that diplomatic tensions in the region are at an all time high, does certainly not help with addressing these issues. When the large quantities of hydrocarbon energy sources (an estimated 25 billion cubic meters of gas and a fourfold of oil lay under the ocean floor), were discovered in the SCS, which the upcoming energy-hungry economy of China was starving for, interests in the region rose quickly (Hayton, 2014, pp. 121-122). During the rise of Xi Jinping inside of the China's Communist Party (CCP), this hunger and the withcoming assertiveness China projects to get these resources has only increased (Chan & Li, 2015, p. 36). Internally, naysayers and people that doubt this strategy have been stripped of their powers and platforms (Poh, 2017, p. 148). Externally, this assertiveness has been expressed through diplomatic and military pressure China puts on national governments and international corporations and organizations (O'Neill, 2018, pp. 215-216; Hayton, 2014, pp. 144-147). Due to the fact that China claims almost the entire SCS, including the EEZs of most countries, almost all countries littoral to the SCS are in a territorial dispute with China. These countries are together in an international organization called the Association of Southeast Asian Nations (ASEAN), an organization that mainly promotes economic cooperation. Bilaterally, the countries that are in ASEAN are not able to take a stance against China, but this organization has proven to not be efficient at it as well. Due to the membership of undemocratic states that do not have claims in the SCS such as Cambodia and

Laos, China is able to create internal disorder by buying over representatives from these countries, or offering the building of infrastructures and other projects (O'Neill, 2018, pp. 216-219). This leaves ASEAN as an ineffective organization that is not able to create a unifying stance for all the countries dealing with China's assertiveness (O'Neill, 2018, pp. 216-219). Due to the internal disorder ASEAN has to deal with, China has been able to test if they can cross lines and break promises that were established in the past, without being called to a halt (O'Neill, 2018, p. 232). China has also been involved in a number of bilateral standoffs with member states of ASEAN such as the Philippines in 2012 and against Vietnam in 2015, in both cases Chinese (military) vessels entered the EEZ of mentioned countries (Poh, 2017, pp. 149-154). But confrontations have mostly the same result, being that the smaller countries simply are unable to stop China from violating their territories and sovereignty (Amer, 2015, pp. 617-638).

The interests in the resources of the SCS result in conflict between countries, which overall incentivizes countries to engage in destructive behaviour to get as much as they can possibly get. Furthermore, it also is one of the most-used straits in the world for shipping. Scholars who have studied such resources have found consensus in the fact that these two types need different approaches towards managing them well (Ostrom, 2003; Brando et. al., 2019). The SCS contains both of them, which means that a comprehensive action plan is needed to manage the SCS well, so that solving one issue does not worsen another. The approach toward solving these different types of goods vary greatly. Most scholars argue that CPRs are better to manage in a bottom-on-top structure, in which local and small groups of people manage the CPR (Kaul, 2013, pp. 1-38, Brando et al., 2019). Global resources such as international trade straits are handled best by supranational institutions that have the power to penalize non-adjectant actors (Vu, 2013). The mismanagement of these resources however, can be defined under a common name, Collective Action Problems (CAP). The problems present themselves when resources are overly exploited, with deterioration presenting of the resources itself. Followingly, the actors that exploit/make use of the resources are not able to adequately address these problems, and overall destruction of the resources is imminent (Ostrom, 2003). Due to different circumstances, power shifts, a large number of actors, non-complying states and ineffective organizations show us that CAPs are hard to tackle, and can pertain for a very long period when not addressed adequately (Kaul, 2012).

4.2 Game theory applied in the South China Sea

When CAPs occur, it in most cases means that certain actors do not interact (effectively) with one another in order to solve the problems that are presented. Scholars have studied social interactions, and its complexity since the beginning of the 20th century. In the SCS, these interactions, or the lack thereof, can be one of the contributors of sustaining as well as worsening these CAPs. In this study, the focus will be on game theory. Game theory explains interactions between actors through a framework of mathematical pay-off matrices. Game theory tries to explain the decisions people, companies, states or organizations make when acting in a setting they share with other actors (Myerson, 1991). Within game theory, alterations can explain and simulate different settings, actors, and types of interactions (Myerson, 1991). In this section, this research deems to look at what scholars have found to be adequate types of game theory in order to explain (a part) of the problems in the SCS. These vary between the decisions local fishermen make when setting out to catch fish, to the practices of states in the SCS. This is a crucial part of the research, since it was established that in order to tackle the problems of the SCS, every level of actor that contributes or has to deal with those problems should be accounted for.

4.2.1 The prisoner's dilemma applied on fishing

On the local level, scholars (Zhang 2021; Wu 2016) have identified multiple ways to explain how fishermen make their decisions, and why these decisions lead to overfishing in the area. Zhang (2021) argues that the decisions local fishermen have to make can be explained through the prisoner's dilemma. In this type of game theory, two actors (in its theoretical form prisoners) make the decision between confessing and keeping quiet. Both confessing leaves them with an equally heavy penalty, both staying silent will give them both a lighter penalty, but when one of them confesses and one does not, the confessor will walk free, with the other getting the heaviest penalty that is possible. The two prisoners cannot interact with one another and pick their options simultaneously. This theory can be applied because the fishermen in the SCS face a similar dilemma when going out to fish: whilst the maritime populations are fastly declining, the fishermen, driven by the states they live and work in, rather try to haul in as much fish as they can, instead of a collective action plan that ensures their long-term securitization of an income and food (Heiduk, 2016, p. 147). These fishermen cannot (or hardly) communicate effectively with each other and are uncertain on the state of the fish stocks in the SCS, making the outcome of the game and what other

fishers do unknown. (Zhang, 2021, p. 3). Heiduk (2016) argues that the underlying logic of the prisoner's dilemma can be used to explain certain environmental problems, including natural resources such as fish. Actors generally tend to choose for the policy/action that benefits them directly (their 'dominant strategy') if they are presented with a setting that does not directly promote cooperation (Heiduk, 2016, p. 148). Often this results in fewer benefits for all: countries often choose policies that create fewer benefits for all, whilst in most of these cases, cooperation would have generated (longer-term) benefits for all of the actors (Heiduk, 2016, p. 148). This describes what is happening in the SCS, due to conflicting interest between fishermen (i.e. everybody wants to catch the biggest and most fish), the amount, size and quality of fish being caught have deteriorated very quickly over the last decades (Hayton, 2014, p. 243).

Although, on this scale, the prisoners' dilemma can explain some part of the options and (lack of) interactions these fishermen have, there are still limitations to doing so. Firstly, in a normal prison game there are only two actors, in the case of the SCS there are much more than that (Heiduk, 2016, p. 148; Zhang, 2021, p. 8). Secondly, the actors in the SCS can indeed communicate with one another (Heiduk, 2016, p. 148; Zhang, 2021, p. 8). Thirdly, the two prisoners have the same power, in the case of the SCS China holds much more (military) power compared to the other countries, creating an asymmetrical playing field (Heiduk, 2016, p. 148). Lastly, the situation is, as opposed to the prisoners' dilemma, not a one-time interaction, but a long-lasting situation (Heiduk, 2016, p. 148). Lastly, fishermen are not in a two-option game, Zhang (2021) argues, since fishermen do not solely have the choice between 'overfishing' or 'normal fishing'. They have two others namely moving towards another fishery/starting an ecological fish farm, or stop fishing as a whole and find other occupation (Zhang, 2021, p. 8). Zhang (2021, pp. 6-9) states this noting that fishermen do not go fishing solely to catch fish, but because of the money they earn with it. If at one time due to declining fish populations fishing is not possible anymore, the only option is to find other ways to make ends meet.

The prisoners' dilemma is actually a burden we need to step away from, these scholars argue (Heiduk 2016; Zhang, 2021). Heiduk (2016) argues that we should reframe the problem as a common problem that should be addressed by multilateral international cooperation, instead of focussing on local fishermen returning with empty nets (p. 150). The current situation in which cooperation is not possible will eventually make a worst case

scenario for everybody. Therefore, we need to address the problems on the international level and analyze how the fishermen find themselves in the environment created by anarchy on the international stage.

4.2.2 The security dilemma on international level

When looking at the state- and international organization-level of issues in the SCS, we find that those actors find themselves in dilemmas as well. In this case, other types of game theory can be applied to explain the situation these actors, such as states, but also international organizations like the ASEAN, find themselves in and why this setting creates the abuse of resources we experience in the SCS today. Wu (2016) starts by addressing that state-level conflict mainly in conflicting regions. In the SCS, most countries are interested in the same (limited amount of) resources, which has caused countries to desperately try to secure as much as they can. This has resulted in a security dilemma in the region similar to the prisoner's dilemma. This situation promotes actors to move in ways that lead to eventual demise of the actual resource, in this case, security of countries (Wu, 2016, p. 150). Countries surrounding the SCS have increasingly spent more and more money on maritime militarization in the region. This leads to a problem where leaders of states find their neighbours increasing their defence, and have to choose between improving their own military or not. When not done, the risk of an attack by your neighbour is possible and potentially means annihilation. This eventually results in a loophole. The increased militarization in the region creates tension, and causes an environment of mistrust and no incentive for cooperation. Local-decision makers should be made aware of the long lasting issues their legislation promotes in the form of subsidies and promotion of unsustainable fishing (Wu, 2016, p. 153). Further, international cooperation should be promoted by creating common fishing grounds that are administered by all countries, instead of EEZs that get violated and a commons that gets exploited (Vu, 2013, p. 146; Wu, 2016, p. 156).

4.3 Aim and theoretical basis of the models

This thesis will analyze the setting of the problems the actors in the SCS find themselves in and apply multiple types of game theory on those interactions, settings and actors. After that has been done, a comparison between these will be made to see which games most adequately simulate the settings of the SCS, as well as which limitations these models have. The game theories scholars have presented to model the situation in the SCS

alter greatly between which scope they used in their research to model these situations (Blazevic, 2012; Zhang, 2021; Wu, 2016, Heiduk, 2016). When focussed on small fisheries and the actions of fishermen, the prisoner's dilemma (with some alterations) come up. Looking at conflicting international interests, scholars opt to simulate the situation as a security dilemma. Both these approaches have some limitations, and result in overlooking certain aspects of the situation which could help us to get towards a setting in which the resources of the SCS are managed well.

The models that are going to be used in this research are based on classic Realism. Realism's core notions in terms of security are that the international system is anarchy, and that every state seeks to maximize its own security and power pursuing its national interests. Countries aim to have as many resources and territory (thus military and diplomatic influence) as they possibly can, all for the sake of improving the state's security. Realism states that the best way to maximize overall security is a balance of power between the actors. In the SCS, especially since the rise of China in this century, there is very little balance between the power of actors. China is now able to easily quash every other country littoral to the SCS in bilateral conflict. This has moved other countries in the region towards improving their own military in order to challenge that of the Chinese, or seek the help of powerful nations such as the US. These notions can be applied on the smaller scale as well, fishermen seek to maximize the fish they catch, without caring for the catch of another. The interests of the actors in the SCS conflict on the local as well as the international level. Due to this, actors are, which is normally the case, prone to pick their dominant strategy. This results in their own gain being maximized, but an overuse of resources (local) or worsening diplomatic tensions (international) follows when actors employ these for too long.

Inside of the classical two-way game theory, there is room for alterations that can help to make a model that simulates the situations in the SCS best. Since Flood and Dresher came up with the prisoner's dilemma, scholars have noted, and adapted the prisoner's dilemma model when it could not be applied well. The first change is in when the actors make their decision. In simultaneous games, all the actors that play in the game have to make their decision at the same time. This implies that actors do not have the ability to know what others have chosen, as well as not giving them time to react to other actors' decisions. In subsequential games, one actor is able to pick first, with another one reacting to that decision. Another modification that can be made is a differentiation in the information the actors have

(of one another). The divide in these games can be made between actors having complete, or incomplete information. In complete information games, every actor knows the possible choices he and other actors can make, and what their consequential payoffs are. When actors have incomplete information, they are possibly not sure of what the payoffs are from the choices they make, or that of their counterparts. The amount of information actors have will greatly affect the strategies actors adopt. When uncertain of what their outcome is, actors do have the tendency to engage in destructive behaviour for the collective group. Information is key for actors in these kinds of games in order for them to make rational decisions.

With all these possible alterations, this research aims to apply these alterations on the prisoner's dilemma to simulate two different models. Further, it will explain how these situations came to be, and why the different interests of locals (fishermen) as well as the international order(s) provide the basis for these unwanted situations. In this analysis, the Philippines and Vietnam are chosen as the actors which have to respond to China. These two countries are chosen because they are on the first line of countries that have to deal with China. China's move to secure the SCS for itself naturally starts along their own EEZs, close to the mainland. To the west Vietnam, and to the east the Philippines, are the first countries that see their EEZs violated. Consequently,, they are also the most vocal and active countries surrounding the SCS that try to dam China's influence in the region. Therefore, these countries are chosen to represent the interaction regarding the SCS.

Analysis

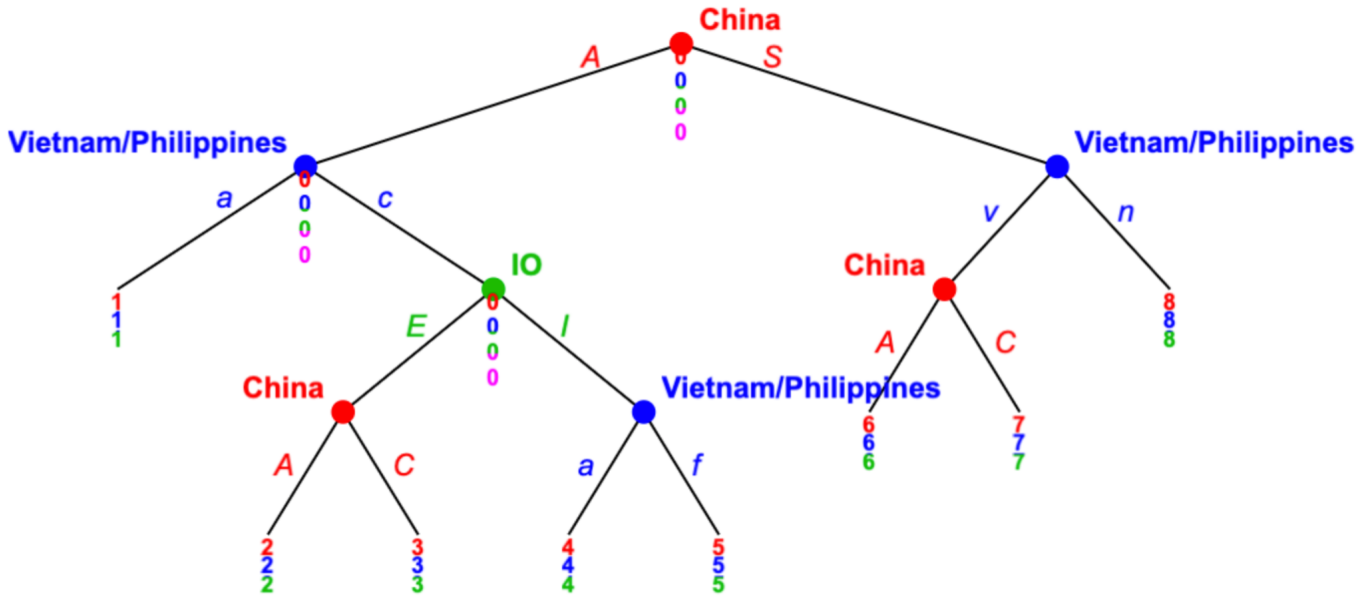
This analysis provides two different models that simulate the situation in the SCS through the prisoner's dilemma model. It aims to provide an as-good-as-possible payoff matrix/decision-tree, with the payoffs and possible strategies of all actors included.

5.1 The security dilemma in the SCS and its actors

As discussed, the SCS is the stage for multiple centuries of turmoil. In this setting, three actors are defined. First is China, who is considered to be the main instigator for the problems in the SCS. There is overall consensus between scholars that China has been the most active claiming parts of the SCS, exploiting its resources and has the most conflicting claims. Second actor in this model is the Philippines/Vietnam. The third actor is the

International Order (IO). The IO represents big military powers, such as the United States of America, but also international organizations which are relevant in the SCS, such as the United Nations (UN) or the North Atlantic Treaty Organization (NATO) (NATO has multiple military bases surrounding the SCS, thus having the possibility of choosing to take action). The IO is of great importance in the decisions the other actors make, since it can change the power structures in the SCS greatly (mainly being able to change the tide against China). These three actors find themselves in a dilemma between taking actions against violations of one another (but mainly China), and having to decide whether taking action is a beneficial strategy in the SCS. In the next section, this environment is simulated by a decision tree.

5.1.1 The decision tree for the international actors in the SCS



In this decision tree the current situation in the South China Sea is simulated. As stated, this is a sequential game, in which every actor picks after the choice of the prior one is made. The Philippines and Vietnam find themselves in similar situations in the SCS, thus have the same choices and place in the decision tree. China has been identified as the main violator of other countries' EEZs and national sovereignty: between other countries there are rarely clashes on the level as that of Chinese-Filipino/Vietnamese clashes. Therefore, China always starts in this game. China has two options, either *Attack* (*A*) or *Suspend* (*S*). After the Chinese have chosen between their move, the choice goes to either Vietnam or the Philippines, depending on which country has its water/sovereignty violated by the Chinese. In the case of China choosing (A) and Vietnam/Philippines choosing (*c*), *Counter*, the

International Order (IO) can choose between either *Engaging* (*E*), or *Ignoring* (*I*). Following China can choose between *Attack* (A) again, to commit itself to their violations, or *Calm down* (*C*). If the International Order chooses to *Ignore* (*I*), Vietnam/Philippines can pick between either *Accept* (*a*) or *Fight* (*f*). When China at the start of the game chooses *Suspend* (*S*), Vietnam/Philippines can pick between either *Violate* (*v*) themselves, or do *Nothing* (*n*). China can respond to the violation by either *Attacking* (*A*) themselves, or *Calm down* (*C*).

5.1.2 The left side of the decision tree

By using backwards induction, the possible Nash Equilibria (NE) can be identified. The last one to decide in this branch is either China or the Philippines/Vietnam. In the case of China, it can choose to stay in conflict, even if it means an international clash. This depends on the payoffs of C2 and C3, if C2>C3, China will stay in conflict, if C3>C2, it will calm down the situation. As stated, China has been actively squashing (what China regards as) internal issues. The CCP, has been infamous for their hard stance on regions such as Xianjang, Hong Kong and Tibet in the past decades. This drive in keeping these regions quiet in the name of internal order, gives basis to suspecting that China will not back down easily in the SCS. Therefore, especially when the IO can be kept out, it will uphold its claims and will not be afraid to back those up by diplomatic, economic or military muscle. However, all out war with other military superpowers would most likely mean that costs would exceed the payoff China has in C2. If the IO does not get involved, the Philippines/Vietnam have the choice of either going bilaterally (*f*) against China, or accept their fate and China's violation (*a*). A war/diplomatic issue with China would most likely mean a swift loss for the other country, meaning that V4>V5. This means that if the IO chooses (*I*), *Ignore*, the choice of the Philippines/Vietnam would be (*a*), accepting the faith of being violated by China. When the Philippines/Vietnam go to the IO for support, it would likely not adequately respond to China's aggression. China's influence on the world stage and its economic capabilities imply that it could cause serious harm to the world's economy and supply chains. The persistence China has shown to get what it wants, combined with hesitance of the IO to even make a stance against current controversies such as the Xinjiang region, makes it unlikely that China would step down after (possible) threats from the IO. This means that the situation would only worsen if the IO chooses (*E*), thus will choose (*I*), given the payoffs of I1, I4 and I5>I2. The first response from the Philippines/Vietnam comes directly after the attack of China. These countries know they cannot put up a fight against China, so they either have to pick

between calling for help from the IO, or accept their fate. As stated, it is unlikely the IO will respond with adequate action. The Philippines/Vietnam are aware of this, and will, if (*c*) is chosen, eventually have to pick between (a) or (f). Both V4 and V5<V1, since it would either mean all out conflict against China (V5), or the same acceptance as when instantly picking (*a*) at the top. The payoff in V4 is lower than that in V1, since now the Philippines/Vietnam have made diplomatic endeavours to get help, which it did not find. Therefore, (*a*) is chosen by the Philippines/Vietnam. The result is that the subgame perfect NE of the left branch of this decision tree is *A, a*: *Attack, accept*.

5.1.3 The right side of the decision tree

In the right branch of the decision tree, China opts to not violate the sovereignty or assigned territories of the Philippines/Vietnam (*S*). In this case, the Philippines/Vietnam get to respond to non-action by Chinese authorities, and have options between violating China's sovereignty (*v*), or doing nothing (*n*). After China can respond with either attacking (*A*), or calming down (*C*). As stated before, the CCP is very rigorous with squashing internal disputes (China regards the SCS as an internal dispute) for the sake of maintaining domestic stability and power. Further, it is known by both parties that China will easily body the Philippines/Vietnam in any sort of dispute. China will always counter any violation by another actor: China picks option (*A*), on the condition that C6>C7. The Philippines/Vietnam are aware of China's stance and capabilities. The only way in which (*v*) would be chosen is if China does not respond and payoff V7, which is higher than V8, results. This would not be the chosen strategy however, since V6, which is <V7 and V8, will be the result. Therefore, the Philippines/Vietnam are deterred to pick (*v*), and will choose (*n*). The subgame NE for this branch thus is *S*, *n: Sustain*, *do nothing*.

5.2.1 The actors and environment in the fishermen's dilemma

As noted, the so-called fishermen's dilemma is a major problem in the SCS. The issue with solving it is the fact that the problem is of international proportion and demands cooperation to solve it, but the actors that cause this problem are local people with little understanding of the gravity of it. This lack of acknowledgement results in overfishing, (possible) permanent decline of fishing stocks and crustacean populations, and damage to seabeds, coral reefs and ocean floors. The underlying problem here is that the fishermen deem their own loot as the most important. The situation that the fishermen find themselves in creates the basis for this problem. On one hand, the vessels and fishermen in the SCS

(especially those of Filipino and Vietnamese origin) have outdated material that does not allow much information over other boats, let alone communication between them (Poling, 2019). On the other, ships that do have the technical capability to do so, do not want to. These (mostly Chinese) vessels enter territory that is disputed to catch fish, leaving off your communication and localization devices helps with entering and fishing these areas of the SCS. This results in a lack of proper information on their situation: they do not know how many other ships have gone fishing, how many fish there are in the sea, and what the consequences are of them going out to fish. These fishermen decide roughly at the same time of day whether they go out for fishing, meaning they find themselves in a simultaneous game. Every fish that is caught by one fisherman can simply not be caught by another fisher, leaving them in a zero sum game.

5.2.2 The game for fishermen in the SCS

The game in which the fishermen find themselves starts with all fishermen choosing whether they go out to fish that day or not. When fishermen set sail, they will, in the current situation, catch as much fish as they can.

Table 5.1

If the next fisherman chooses 'Fish'

	Fish	Do not fish
Fish	34, 33, 33	50, 0, 50
Do not fish	0, 50, 50	0, 0, 100

Table 5.2

If the 'next' fisherman chooses 'Do not fish'

	Fish	Do not fish
Fish	50, 50, 0	100, 0, 0
Do not fish	0, 100, 0	0, 0, 0

Tables 5.1 and 5.2 simulate the current situation fishermen find themselves in. This simultaneous, zero-sum, non-informed game is played every day when a fisherman decides whether he is going to fish that day. In the current situation, a fisherman can choose between *Fish* or *Do not fish*. Fish, as explained, means that the fisherman will set sail and try to catch as many fish as possible. When the fisherman opts to not go fishing, its payoff will always be zero. In this case, the dominant strategy for all the fishermen is always to choose option *Fish*, regardless of what other fishermen choose as their strategy: the payoff for going to fish is always higher than if a fisherman does not go fishing that day. This means that the NE in both of these games will be *Fish, Fish* since both players always have the higher payoff.

Table 5.3

The 3rd-50th fisherman choose 'Fish'

	Fish	Do not fish
Fish	2, 2, 2…	3, 0, 3, 2, 2, 2…
Do not fish	0, 3, 3, 2, 2, 2…	0, 0, 3, 3, 3, 3, 2, 2, 2…

Of course, the number of fishermen in the SCS is not limited to three people. The fish in the SCS is finite, and when more and more people choose *Fish*, between the more people the possible payoff has to be split, resulting in a lower payoff anytime more people join in. This is expressed by table 5.3, where a payoff matrix is made in which 48 other fishermen have already chosen *Fish*. The payoff has now decreased sharply, but the dominant strategy will still be *Fish* for both fishermen, just as the NE will still be *Fish, Fish*, since going to sea at least always gives the chance of a payoff of 0>, whilst *Do not fish* always results in a payoff of zero. Due to lack of guidance and information on how the resources in the SCS are doing, fishermen can and will always pick fish, and are not bound by certain limits in how many fish they can catch. As discussed, this behaviour will eventually result in decline of maritime populations.This consequently has a massive impact on the payoff fishermen have when going out to fish.

Table 5.4

Long term of current situation (everybody opts for fish)

	Fish	Do not fish
Fish	20, 20	40, 0
Do not fish	0, 40	0, 0

According to Hayton (2014), the fish population in the SCS shall decline by almost 60% if current practices continue. This drop in population also will result in a lower catch-rate of fishermen in the region. In the situation as seen in table 5.4, fishermen only can catch 40% of their prior amount. When 50 fishermen will play in this payoff matrix, there will simply not be enough fish anymore, and some will not catch any fish. Still, it persists that even when resources are so scarce, the dominant strategy, as well as the NE will still be *Fish, Fish*, since the chance of having a payoff of 0>, is still more favorable than a certain payoff of 0. However, the consequences would be massive for the populations of littoral countries, which will see a substantial decline in their food stocks, as well as their economic well-being. The premise of this happening therefore calls upon solutions, but the local population are simply not able to provide these. They lack knowledge about the whole of the SCS and its environment, exceeding the boundaries of multiple countries. This, on top of lacking economic and communicative resources, calls for an international approach, led by either states or international organizations

5.3 Suggestions for the international system to solve the fisherman's dilemma

After explaining the situation and problems in the SCS, some solutions come to mind as to how these could be overcome. Multiple scholars have presented such solutions as well, all with the aim to promote cooperation and well-managed SCS. Vu (2013) argues that the Spratley Islands and Gulf of Tonkin (the part of the SCS that is disputed between Vietnam and China) should be turned into Marine Protected Areas (MPA). These MPAs are prohibited to fish in (for at least a period), so marine populations can recover (Vu, 2013, p. 146). The neutral nature of MPAs could provide a framework for littoral countries to work towards a sustainable SCS without instantly putting their national sovereignty in danger (Vu, 2013, pp. 161-612).

If states would start to cooperate, the technological and financial capabilities of the countries can be used to get a better idea of the fishing stocks in the SCS. This will enhance the information fishermen have on the fishing stocks, which can help them know more about the game they are in. With good communication between countries' fishermen, the fishermen are better informed about their potential payoffs, available moves, how many players there are, and what the long term effects of their behaviour are. Secondly, an organization, or multilateral agreements between the surrounding countries would open up opportunities for better management as well. Such an agreement, if it has the competence, could be used to help manage the maritime populations in the long term. It could for example set a roster, in which certain fishermen are assigned certain days to go fishing, ensuring that they catch fish on that day due to less fishermen at sea. Further, it can also be implemented that every fisherman can catch a maximum amount of kilos of fish a day. Table 6.5 simulates an environment in which such quotas are put into place.

Table 5.5

A situation in which a quota on daily catch is installed

	Overfish	Fish	Do not fish
Overfish	50, 50	70, 30	100, 0
Fish	30, 70	30, 30	30, 0
Do not fish	0, 100	0, 30	0, 0

In essence, the game played is the same as it was in Table 5.1 and 5.2, but now a third option is added: *Fish* (*Overfish* is now what *Fish* was in Table 5.1-5.4). With *Fish*, fishermen would adhere to the quotas put-into place by the international actors, and catch only a certain amount of fish (30 in this scenario). This would, in the short-term, mean that their catches decline. This is why the dominant strategy in this game still is *Overfish*, and the NE still lies at *Overfish, Overfish*. To diverge fishermen from using their dominant strategy, this thesis argues for two solutions. First, fishermen should be informed (by either the hypothetical agreement/organization, or through governmental sources) about the dire situation the SCS finds itself in. Fishermen consequently will understand that *Overfish* will eventually cause a tragedy of the commons in the SCS, leaving the fishermen with no steady stream of money or

food. Secondly, the organization/treatment should have the capability to control and punish fishermen that do not adhere to set limits. This is necessary, since an increasing number of fishermen will start to pick *Overfish* again, if they notice they are not punished for that behaviour. With these changes in place, it is possible to incentivize fishermen to adhere to *Fish*, contributing towards a well-managed SCS, ensuring their jobs and food in the future. However, due to the conflicting interests in the region, and tensions being very high at this moment, such an organization or agreement is unlikely to come into place at this moment. For that to happen, countries in the area have to seriously reconsider where their current stances are bringing them, and what harm it is causing in the region. Until the international actors as described in parts 5.1.1 to 5.1.3 do come together, the severity of the problem is unlikely to be acknowledged by either the international, or the regional actors.

Conclusion & Final Remarks

This research aimed to explain how the conflicting interests of countries facilitate an environment in which overexploitation and freeriding are common practices. By looking at the situation through game theory, it becomes clear why on the international level countries do not want or can cooperate. Countries have to make choices, and many of those choices result in a lower payoff than when keeping the status-quo. On the local level, this lack of rule and coordination results in a stage where everybody tries to maximize its own payoff without any concern of the long term consequences of this behaviour. Further research on the SCS could be on how fishermen can manage their well, by using durable fishing methods or other alternatives such as fish farms. This research did not tie ASEAN into the analysis, since at this moment it is not a real actor in this conflict. It could however be studied how ASEAN, or another intergovernmental organization could develop and facilitate the countries in the SCS to make a common stance against the claims China makes in their sovereign territory.

The SCS has been, and continues to be a hotspot for clashes, on local as well as international level. The strategic importance it has, combined with being one of the busiest straits in the world and an abundance of resources in and under its waters are what makes this sea high-valued by these actors. Littoral countries therefore have been actively trying to get as much of these resources as possible, or at least trying to protect what they already have. The rise of China since the early 2000's, combined with an ever-assertive president proposes

the region to new challenges and an economic and military powerhouse. For some countries such as Vietnam and the Philippines, distrust in China, as well as the fright of being pushed around and becoming China's puppet has deterred these states to work together. The fact that countries interested in the SCS conflict greatly with one another on economic, security-based and sociological interests result in an environment that lacks authority, guidance, information and protection for all actors involved. This lack of agreement or organization creates an environment in which free-riders and overexploitation are left unchecked.

The result is massive damage to the ecologies that call the SCS their home: reefs are being destroyed by countries trying to claim EEZs in the SCS, maritime animals that roam the SCS, or live on the bottom of it are buried alive or caught in ever-increasing amounts. If these practices continue for another decade or-so, the damage that will be caused is irreversible, putting the economic and quality of life of millions of people in great danger. The countries littoral of the SCS have the responsibility to bring a halt to this crisis, but distrust and changing power structures result in a system in which negotiation or cooperation are hardly achievable. Through game theory the problems that bring us in this situation become apparent. On the international level, power struggle and conflicting territorial interests facilitate a system (or rather lack of a system) in which local populations are not protected by their destructive behaviour. The conflicts in the SCS have remained for decades, and combined with military tensions and capabilities being at an all time high, I would argue that resolvement is far from here. Until then, the SCS will continue to be a playground for overexploitation and dispute.

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