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IT'S A SAND WORLD, AFTER ALL: THE IMPACTS OF SAND CONSUMPTION ON SOUTHEAST ASIAN REGIONAL DYNAMICS AND SECURITY

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ABSTRACT

Quarrels involving sand, one of nature's simplest and most inconspicuous resources, have dominated Southeast Asian relations for the past two decades. These quarrels involve international trade restrictions, territorial disputes, and China's encroachment into the South China Sea. This simple resource, sand, consists of the collection of many small rocks, more coarse than silt, and finer than gravel. It is used in almost every single aspect of human creation, from roads and buildings to activities like fracking and artificial island creation. As sand becomes more scarce and its mining intensifies, countries and non-state actors are mobilizing to quickly acquire, or restrict, the resource to continue their own agendas.

To understand whether, and if so to what extent, sand consumption is affecting regional dynamics in Southeast Asia, this thesis will investigate three main factors: infrastructure and territorial development, international trade, and environmental relationships. All three ultimately lead to the discussion of regional relations and security. Qualitative and quantitative analysis show that each of these factors are driving scarcity and new regulations. Thus each factor proves to be interconnected, and their activities result in cyclical and causal reactions to one another due to the integral nature of sand as a commodity in modern society. Main consumer countries including Singapore and China continue to acquire sand at unprecedented rates to expand their land mass and maritime borders, and exporting countries weigh undermining national and regional security against boosting their economies. Increased sand consumption should be treated as a holistic or multidisciplinary security challenge, threatening political stability in Southeast Asia.

KEYWORDS: Sand, Nine Dash Line, South China Sea, ASEAN, Environmental Impacts

LIST OF ABBREVIATIONS

ADIZ	Air Defense Identification Zone
ASEAN	Association of Southeast Asian Nations
CCP	Chinese Communist Party
EEZ	Exclusive Economic Zone
EU	European Union
GDP	Gross Domestic Product
OECD	The Organisation for Economic Co-operation and Development
SCS	South China Sea
UN	United Nations
UNEP	United Nations Environmental Programme
USD	United States Dollar

INTRODUCTION

The 21st century has known no shortage of concerns and issues in the realm of global studies. Of late, two such issues are continuously discussed in most fields related to international affairs and security studies: climate change or environmental degradation, as well as resource and energy security (Barnett, Adger 2007; Levy 1995). Naturally, both climate change and resource security are interwoven. The reality of human existence on Earth is characterized by our dominion over every square foot, therefore making man ultimately responsible for the consequences of our stewardship. Climate change, and environmental degradation have become one of the more important talking points, not only in academia, but in terms of political platforms, human security, and the status quo of international relations.

Looking to the region of Southeast Asia and China, these issues are magnified due to high populations and the developing nature of the countries. Not only are resources being consumed at unsustainable rates, but the way in which they are extracted and consumed is harmful for individuals, trade, and regional security. Throughout this study, we will examine the international relations impacts of one rather small, granular resource: sand.

The problem that arises from sand use is not solely due to not just the amount being used, but also where it is taken from, and for what purposes. There are limited sources from which to obtain sand. Due to cost and convenience, it is generally taken from areas adjacent to new construction sites and existing cities. These are typically nearby rivers and their deltas. The average cost of sand is incredibly low in comparison with transportation costs due to its weight and volume, making it easy for transport costs to surpass the value of the sand itself. As the world population rises in tandem with global income, so will sand consumption resulting from construction. The OECD ENV-Linkages model predicts that between 2017 and 2060 the global construction sector will double, with projections up to 84 gigatons of construction material use per year (OECD 2019, 122).

There are only two ways for countries to get quality and low cost sand to fuel their infrastructure and territorial expansion needs: mining and importing. Both of these methods have direct and indirect consequences. The former can be related to exports and the environmental implications resulting from mining and extraction, and the latter include trade relations and political instability. Both, however, impact the ways in which states will interact with each other as part of the sand trade framework.

When it comes to security studies and foreign affairs, the inclusion of natural resources is typically limited to energy resources such as oil and gas. Governments and the public alike now acknowledge that the degradation of our environment has already led to domestic and international security crises. One such instance of degradation is the depletion of sand. Under the assumption that sand, as a commodity, already lies at a certain level to be impactful, this research will test if multifaceted interactions involving sand can affect the behaviors and strategic approaches of individual countries in foreign relations. Provided this context, this thesis will identify how international relations and regional security are impacted by sand consumption in Southeast Asia through three factors: infrastructure development and territorial expansion, trade, and the environment.

The goal of this thesis is to determine the degree in which sand consumption is influencing the behavior of selected individual countries, and the interactions between them. To investigate how sand consumption impacts Southeast Asian countries, we will utilize the following methodology. First, we identify the level at which select countries are using sand, and for what purpose, analyzing both imports and exports, as well as domestic mining. Secondly, trade and sand consumption data will be evaluated alongside the current state of affairs in the region and state interests. Lastly, domestic and international environmental policies of ASEAN and China will be compared to the first two items and their overall impact on climate change and environmental damage.

It is believed that Southeast and East Asian countries are unsustainably mining their own sand and importing sand, sometimes unrestricted and illegally (Peduzzi 2014, 214). These activities may lead to unforeseen international implications and security challenges in the region. Presumably, countries like Malaysia, which export sand, may be doing so against their better

interests, by selling sand to countries that then use the resource to expand their own territories. For example, China would be using the purchased sand to build islands in the SCS, thus taking away from EEZ and international waters. Additionally, as sand becomes more scarce and restricted in coming years, countries may increase hostility with one another and thus may be more inclined to engage in environmentally damaging, illegal or unrestricted trade activities.

1. HOW SAND IS USED

1.1. Understanding Sand

Most people do not realize that the sand filling their beaches and parks is the single most used material resource in the world, even more so than oil or steel. By weight, the global use of sand was totaled at 28 gigatons in 2017, whereas the amount of oil produced was only around 12.4 gigatons (OECD 2018; EIA 2020). Sand is a non-renewable resource, much like oil; it takes hundreds to thousands of years for water and other eroders in rivers, oceans, and deserts, to break down organic and inorganic material into sand. Sand and minerals are in virtually every product we use and a part of almost every manufacturing process. This includes “water treatment, land reclamation, hydrological fracturing techniques, better known as gas fracking, and industrial production of electronics cosmetics and glass production” (OECD 2019, 3). The logical mind might think of the panoply of earth's deserts as containing plenty of sand for all uses. Although it is not well known, however, there are only certain types of sand that are viable for the activities listed above, and so even sand-rich countries like Saudi Arabia are importers of sand. In addition, humans are using sand at a rate that depletes it much faster than it can be created naturally.

Let us begin the sand discussion by breaking out an imaginary microscope. There are many different types of sand, falling under two primary categories: mineral sands and aggregates. Aggregates account for ocean sand, desert sand, manufactured sand, glass sand, and recycled sand, whereas mineral sand encompasses mostly river sand (*Ibid*, 3). If we were to put various sands under a microscopic lense, we would see very different pictures for each. Starting with desert sand, wind has eroded small particles off of rock and has blown around rolling over itself. This leaves each granule very round and smooth. Ocean sand is composed of not only rock, but salt and pieces of organic sea life such as shells. River sand is mainly sediment and mineral rock, giving it a gritty and denser composition. The way river sand is eroded leaves the granules looking jagged and irregular, much like pieces of a puzzle. Manufactured sand can be created to

mimic river sand, and is done by crushing rock or other materials like recycled glass bottles. Manufactured sand could one day become a viable alternative to natural sand, and already has its uses. This type of sand though requires large machines to create, causes pollution, and takes time to produce. It is currently uneconomical, and for some undeveloped countries, impossible to produce. Therefore already existing sand is much more accessible.

Why do these differences matter? Though seemingly insignificant, the composition and structure of the types of sand granules is what deems it worthy for certain processes. The most sought after type, and also the most scarce, is river sand. This type of mineral sand is not only close to many construction sites near coasts and deltas, but more importantly, it is the best type for cement and concrete production. The structural integrity of concrete is compromised when it is made with ocean sands due to salt dissolving with water, and small organic matter like shells crushing easily under stress. Desert sand is also not an ideal for construction, as the round nature of the granules limit surface area contact. This creates a weak bond, much like trying to glue two marbles together.

Due to these factors, this study will focus on only two types of sand, these two being first, river and mineral sands for infrastructure development, and then, secondly, ocean sands, which are assumed to be used mainly for beach and island nourishment as well as land expansion. It should be noted that river and mineral sands are used for land expansion and island creation as well, though the sources of island creation and or beach nourishment sand are not closely followed. One can assume that ocean and marine sand is the primary source for these activities as it is much easier to acquire and transport. Both types of sand have their own unique economic, political, and environmental consequences in relation to the activities associated with them.

1.2. Construction and Infrastructure

Simply stated, human civilization is built with sand, and as populations and world GDP grows, so will the need for it. Developing countries, because of their rapidly growing economies and populations, are engaging in rapid infrastructure development. Because of the lack of preexisting or modern infrastructure, these developing states “need sand to build infrastructure, roads and

houses" (Chateau from Bruce-Lockhart, 2019). While developing and emerging economies may be more prone to rapid sand consumption for construction, one should not ignore the fact that virtually every country is using sand in the same ways, just at different rates. Similar to the ways in which some developing countries skipped stages of telecommunication infrastructure, bypass building telephone poles and jumping straight to cell towers and mobile phones, some countries have also skipped gradual development and are building massive cities with modern construction techniques. Periods of rapid growth, like the one China's middle class experienced over the past few decades, correlate directly with sand use. These explosions of growth are recognized as "the main driver of increasing sand appropriation, because sand is a key ingredient of concrete, asphalt, glass, and electronics", associating sand as a means for growth (Torres *et al*. 2017, 970). States that lack infrastructure, as well as states that have preexisting infrastructure will continue to build and rebuild, with little exception.

The OECD points out the positive correlation between economic development and investment with the demand for construction materials. As China has experienced its continuous population boom, housing projects rose along with construction material demand (OECD 2019, 90). Along with immense sand use statistics, China produced 51% of all global steel in 2018, showing its monumental capacity for infrastructure development (UNCTAD 2019, 11). It should also be noted that in countries like Russia with low population growth, as well as GDP and income growth, construction material consumption declines or stays relatively the same (OECD 2019, 127). We can assume that this correlation will be the same for most countries, and amplified with growth or decline in income.

Sand, as a raw material resource for construction, is not ready to be consumed in its natural state, unlike when it is simply dredged and relocated for land reclamation projects. Sand first must be mined or collected, sometimes manufactured, then transported to construction sites or factories where it will undergo processes in cement mixing, glass manufacturing, or the like. The amount of CO_2 emissions from the cement industry in China has averaged over 1 billion tons per year since 2012, and accounts for 11.06% of all of China's emissions (Shan *et al*. 2019, 964). This number includes coal, gas, and electricity related emissions, which are inevitable with large fossil-fueled equipment necessary to crush rock and transport materials.

The most recent 5-year statistic from 2015 and 2019 shows that China produced roughly 11.5 billion metric tons of cement (Statista 2020). If we take the modern concrete making formula, one would need between 6 to 7.5 times the amount of sand and aggregate material than cement to create the mixture (PCA 2019). This ratio produces an estimate of 69 to 86 gigatons of sand and aggregates used by China for infrastructure in that 5-year time period, or 14 to 17 gigatons per year. To give these numbers some scope and reference, the United States for the past few years has been using just under 1 gigaton per year for construction (USGS 2020). In the later chapter on trade, we will see that Singapore, at its peak in 2000, imported 168 billion metric tons of sand from all trading partners, or only 0.168 gigatons. This is dwarfed in comparison to the sand goliath that is China. The most daunting and commonly cited statistic that is reproduced in media outlets is that China used more sand between 2011 and 2013 than the United States did in the entire 20th century (Gates 2014). If this same trend continues, China will have used more sand this year alone, than the United States will by 2075. This number only reflects the sand being used for construction purposes, and does not even touch on that used for island building in the pacific, which remains unreported. This facet of sand consumption can encapsulate human security, as well as environmental issues, in that this large scale development is a necessity to account for population booms and produces added pollution.

It is important to note that even with the ranging estimates in this study, the numbers may still be inaccurate. It is necessary to estimate sand use in this way, due to the unreliability of sand data. Once sand mining was recognized as being unsustainable and environmentally harmful, the ways states went about reporting their extraction changed. While some responsible states continue to report accurate data, others do not, and statistics do not take into account activity by smugglers and black market trade. As trade restrictions and embargoes have increased, so has the amount of illegal mining and misreporting (Peduzzi 2014, 208). This makes data difficult to confirm and forces us to use methods such as satellite imaging to analyze trucking and shipping activities as well as infrastructure development to estimate numbers. This method of satellite imaging is one of the only ways to monitor the other largest use of sand, which is island creation and territorial expansion.

1.2.1. Populations

The projected global population will be over 10 billion by 2060 (OECD 2019, 64). The population of small island developing states in 2020 is just over 72 million and projected to reach almost 90 million by 2050. The population of Southeast Asia, in the same time period, is predicted to grow from the existing 662 million to almost 800 million. That of Southern Asia will rise by almost half a billion. In the greater region, only East Asia's population is expected to stagnate, due to a slower but still growing population rise in China, but falling birth rates in Japan and Korea (United Nations 2019). This overall population increase can naturally be assumed to coincide with expected increases in infrastructure development. Such a continuous rise will also introduce new security challenges in the forms of energy and natural resource scarcity, amplifying our current needs across the board.

1.3. Land Expansion

Sand trade and sand consumption impacts are not limited to the economic and theoretical space. Sand, after being mined and traded, becomes involved in physical interactions, and thus is being used as a medium or tool for foreign policy through island building, and shoreline expansion. This relationship is simple and with no cause for concern when sand consumption activities are located in cities and areas within one's own legal territory, or expanding a coastal city that has a large buffer of territorial waters around it. Many of China's coastal economic strongholds lie along its east coast and fall into this category. However, in heavily populated twin cities like Johor and Singapore, or perhaps even Shenzhen and Hong Kong, their close proximities paired with land reclamation introduce opportunity for new territory disputes.

A recent study analyzing 16 of the world's largest coastal megacities shows that all of them have used extensive land reclamation practices to manage increases in population and other factors. Between the 1980's and 2017, Chinese megacities have reclaimed almost 1,200 sq. km of land area. Included in this figure are the cities of Shanghai, Tianjin, and Shenzhen, resulting in an increase between 4% to nearly 7%. These three Chinese cities were the largest increases in both total area, as well as in the percentage of total area. Following China at the top of the list, are the cities of Jakarta, Osaka, Chennai, Manila, and Tokyo, and Mumbai a bit further down (Sengupta

et al. 2018, 234). All of these cities are located in East and Southeast Asia, save for Mumbai in South Asia.

Most countries in the region have restrictions or bans against the exporting of sand to either a select few countries, or all countries. ASEAN countries make up most, if not all, of the restrictions and bans, most of which are aimed towards Singapore. At the time of this writing, there are four countries with bans on exporting sand to Singapore. Strangely enough, multiple countries with sand export limitations to Singapore took several years to show decreases in its trade data, and it seems that some amount of sand trade returned without being shown in policy changes (UN Comtrade 2020). Countries have imposed secondary trade bans in recent years. The redundancy of such trade restrictions is interesting to analyze. Similar to someone with a substance addiction, states that need resources they cannot produce themselves will find ways to obtain them. The increase of embargoes and restrictions in international trade should hinder state relations, therefore disturbing international organization cohesiveness in the case of ASEAN, and ultimately regional security. Increasingly limited trade partners has resulted in a rise of illegal domestic mining while ignoring environmental regulations, smuggling, black market trade, and potentially finding new and willing trading partners (Peduzzi 2014). New and willing trading partners would either be countries that wish to further engage in economic activities that will undermine state security, or countries whose economic positions make their exploitation an unfortunate necessity to provide jobs and income to individuals and the state.

Aside from expanding cities and shorelines, China's island building, as part of new territorial zones established in the SCS, is a unique and dangerous new territorial expansion technique. This new wave of economic statecraft is an interesting take on smart or hybrid power, and is difficult to deal with on the international stage (Bräutigam, Xiaoyang 2012). Using land expansion that extends beyond a country's mainland has yet to be extensively analyzed and will need to continue to be raised as an issue in international relations as the century continues. The methods deployed to stop Chinese land expansion practices in the SCS rest on international law cases, and the necessity to not normalize China's military and civilian presence in the region. China is using ASEAN trade restrictions and this period of membership fragility as an advantage to capitalize on its economic statecraft, and extending a *de facto* foothold in the region.

In a positive alternative view, one can view China's land reclamation projects in the SCS as a double-sided coin. The positive outlook would be that in a turbulent SCS environment, an increase of hegemonic presence can bring stability to international trade and freedom of navigation (Yamaguchi 2016, 28). On the flip-side, it would be hard to argue against the assertion that island building, while perhaps not illegal, is immoral or nefarious at worst. The proclaimed civilian purposes of these islands by the CCP, as well as the not-so-proclaimed military build up we have witnessed will be discussed in the later chapter on China and the 9-dash line. In 1997, ASEAN came to the concept of the ASEAN 2020 vision with goals such as a "Southeast Asia where territorial and other disputes are resolved by peaceful means", and where "rivers and seas no longer divide us" (ASEAN 1997). It would be unfair to say ASEAN has failed in this vision, for the region has prospered economically and has begun to make steps for more individual freedoms. Yet now, as we have reached 2020, it seems that land and maritime territorial disputes will continue as a result of sand consumption and border expansion tactics.

1.4. Singapore

Due to its existence as a city-state, Singapore is at a natural disadvantage when it comes to land mass. From 1960 to present day, Singapore expanded its total national land mass by over 20%. The total area increased from 580 sq. km to around 720 sq. km, and by 2030, it will potentially have increased by another 10% (Koehnken, Rintoul 2018, 18). According to several studies using satellite imagery, Singapore has been the largest beneficiary of land expansion in recent decades. For the past 20 years, southwest Singapore, and the area around the Changi airport received the most expansion (Sidhu *et al*. 2018, 492). Sidhu et al. also note that the core areas of the city-state are monitored closely by the government with great efficiency, due to the small size of the country. Inland wildlife forest areas are protected from development, and environmental regulations are claimed to be strongly followed (*Ibid*, 493). This is likely to aid in supplying tourism attractions, as well as maintaining and strengthening national identity for Singaporeans.

For Singapore, some land reclamation areas and developments proceed without issue. However, there are several locations in which territorial disputes with Malaysia exist. These disputes lie

along Singapore's maritime border in the Strait of Johor, and navigation turning points on the west side (ITLOS 2003). In 2018, both countries continued their own developments, and both countries extended their territorial claims into port limits (Kaur 2018). These debates over a few meters or maybe a kilometer are dwarfed by the scale of territory conflicts in the SCS.

The question that is raised in the case of Singapore, is whether this is a matter of sand scarcity, or land scarcity. According to UN population dynamics, Singapore's population projections show a peak around 2040. Singapore's population has seen a near perfect linear growth of about 700,000 citizens per decade since 1950. This is expected to flatten in the coming years and grow from 6 to maybe 6.5-7 million by 2040 (United Nations 2019). This could also be under or overestimated. Regardless, Singapore will continue to require more land, and more development to fit these new residents. The city-state is already at max capacity, so out and up are the only directions to go. Since neighboring countries have stopped exporting sand, it will be interesting to see where Singapore will source it from in the future. It is possible that after a few more years of importing it they will not need nearly as much as it used to and will be able to obtain just what it needs for normal construction and beach nourishment requirements. The only factor not included in the UN projections is the possibility that Singapore will continue adding landmass, creating the availability for more citizens and permanent residents to live there. Economic citizenship has changed traditional views of citizenship, helping to make Singapore a highly desired location to move one's assets, perhaps helping to drive infrastructure growth. One can gain residency and eventual citizenship in return for large domestic investments (EDB 2019).

1.5. China

Reigning as the regional hegemon in East Asia, and perhaps also the overlapping regions of Western Pacific and Southeast Asia, China has taken full advantage of its power and status to advance its political agendas vis-à-vis physical expansion. This is true in the South China Sea, now becoming a reality in the Arctic and crawling into the rest of Eurasia. Much like an army needs food to march, China needs sand to advance its presence in these areas, save for the Arctic, where climate change, in the form of melting ice, is the only needed variable for change. Therefore, the two main projects to note are the BRI and island building. The former expands

across all of Asia and into Eastern Europe, and the latter focused primarily in the Spratly Islands and SCS.

There is a general agreement amongst western international relations and security studies thinking that China's ambitious intentions are revisionist and against most other states' national interests. China's projects, policies, and investments are economically predatory, and generally are disruptive to the current status-quo, aiming to continue changing the regional and global power structure in its favor. For China to carry on with these projects, such as the BRI and island building, the constant challenge of acquiring sand remains. The further away a project is from rivers and coasts, the more costly transporting and finding viable sand becomes. As recommended in the recent UNEP report, increased awareness of sand trade issues as well as better governance should help define the future of trading this commodity (UNEP 2019, 1). The responsibility of individual states should extend to the oversight of cheap and predatory investment practices, such as those that come with the BRI. States willing to allow foreign investment from a country like China should hold high standards for sourcing sustainable sand extraction, and for responsible pricing. The BRI, as it continues to sprawl across all of Asia and into Europe, will need large quantities of mineral sand for construction. In efforts to make investments and projects cost as little as possible, China would likely source sand near the construction sites. Countries allowing Chinese foreign investment to complete the BRI should be vigilant about mining practices their own companies engage in, and to what extent Chinese companies acquire mining sites themselves to get the sand they need. Lower income countries will need to decide if the foreign investment and new trade routes are worth not only the environmental degradation that comes with excessive sand use, but also Chinese companies having a large stake in those countries' own domestic economy and natural resources.

In March of 2020, intelligence reports came out with information and satellite images showing North Korean trading vessels transporting sand to Chinese ports. This activity has been going on for several years at a much smaller scale, but has largely increased in 2019 (Smith 2020). Along with all other sanctions against North Korea the report from the Center for Advanced Defense Studies reports this sand trade as a violation, quoting the "2017 U.N. Security Council resolution that prohibits North Korea from supplying, selling, or transferring sand" (*Ibid*). Cheap foreign investment and trade deals are enticing, especially for low income and developing countries.

The desire to raise GDP and living standards for citizens is universal across virtually all states. The lack of regulations and proper governance in developing states have been known to have individuals mining sand both legally and illegally, and under unsafe or harsh conditions for little pay. The cause of this negligence can be directly linked to the lack of policy and enforcement and the recent increase of trade bans. States that do not evaluate such activities within their own borders allow non-state actors and individuals to take matters into their own hands, conducting smuggling operations and using environmentally damaging mining practices for domestic use. If governments allow their sand resources to be exported at low prices, or allow these non-state actors or sand "mafias" to carry on, it directly undermines their own national security.

Sand trade has its benefits, including its export value and capacity to create employment opportunities, though its repercussions can manifest own environmental damage in one's own territory, and neighboring countries using it for land reclamation purposes, therefore potentially taking away territorial and economic waters and land area and causing unnecessary tensions. Addressing potential repercussions along these lines, while still a concern of individual states, clearly must become a focus of multinational organizations and economic organizations. ASEAN, like the EU, relies heavily on its economic partnerships and trade. If one country decides to sell out, then it affects all countries involved. In a hypothetical situation, if a country in the SCS were to sell marine sand to China or permit dredging, and it were to use said sand to construct another island in the SCS, would it not then be directly undermining its own security?

1.5.1. China's Nine Dash Line & Belt and Road Initiative

In 2015, a new term was coined by US Navy Admiral and Commander of the US Pacific Fleet, Harry Harris, to explain China's actions in the Pacific. In his words, China is creating a new "Great Wall of sand" (Harris 2015). This new Great Wall will protect China's interests via a maritime border delimited via the 9-dash line, a line loosely drawn by China that encloses most of the SCS, and is demarcated through island building and claimed territorial seas. This time the great wall, rather than using stone and human toil, is being built with ships, dredging and dumping sand to create islands, and bulldozers paving over them in cement. In line with the United States' stance on regional security in the greater Pacific, China's intentions and

capabilities are recognized as economically and territorially predatory. China's claim to much of the SCS through its 9-dash line policy goes back almost a century and is based on historical ownership, but has become a heated topic just in the past decade.

Under President Xi Jinping, China has become extremely assertive in the SCS and Western Pacific regions. The all-encompassing 9-dash line leaves everything except countries' territorial and some exclusive economic waters to be claimed by China. Economic and military actions have been increasing year by year to push these claims to the point where one can deny them but do nothing about them. The Center for Strategic and International Studies lists some of these actions, but while its list is summative, it is not complete. These acts continue to be carried out by China without cease.

The list of nefarious activities by China in the SCS up until 2017 contains the following (Shearer 2017, 2):

> " - Establishment of an air defense identification zone in the East China Sea (2013) and rejection of an international tribunal's ruling on Beijing's South China Sea claims (2016);
> - Island building at seven disputed features in the Spratlys (since 2013);
> - Deployment of an oil rig into disputed waters near Vietnam (2014);
> - Harassment of supply missions to a Philippine military outpost (2014);
> - Convoying more than 300 fishing vessels to the Japanese-controlled Senkaku Islands (2016);"

Added to the list would be further land reclamation activities in the Scarborough Shoal, and an ADIZ in the entirety of the SCS (Morris *et al*. 2018, 146). China's use of non-linear warfare involves the inclusion of economic and civilian tactics rather than kinetic and military forces. By employing these tactics, China's main goal is to weaken the US and EU's economic relationships with ASEAN and Western Pacific nations (Chollet *et al*. 2017, 9). China has a history of creating ideal economic opportunities for neighboring countries and enacting debt-trap policies. Accepting China's investment and trade deals are quite enticing in the short term, but has potential to become detrimental in the long term, as well as having successful companies backed by the CCP operating in one's own borders.

Per civilian and joint civilian-military tactics, China operates in what is known as gray zone warfare or aggression (Morris *et al*. 2018). Operating just below wartime or complete military tactics, China is using these gray strategies to 'test the waters' of what is possible. This testing includes all of their recent SCS actions, which are done in a manner that compartmentalizes each action to appear as isolated or naive acts. If these actions were an aggregate, it would likely be recognized as warring aggression. Referring to this act of chopping up aggressive acts, the metaphor "A thinly sliced salami is still sliced" is used(Chollet *et al*. 2017, 10). In the SCS, a type of *de facto* "fake it till you make it" practice has been established. China's first step was to lay claim to all islands and geographical features that fell within its 9-dash line. Bringing forth historical documents stating that most disputed areas with 6 neighboring countries perhaps violates international law, but also provided its needed justification for the ensuing gray zone tactics. As of now, China has taken seven physical features in the SCS that existed previously as reefs or a collection of rocks, and dumped sand on them to create artificial islands. The Philippines, and other countries, have appealed to international tribunals to condemn and claim illegality over these actions, which favored against China, claiming that the preexisting islands were no more than "rocks which cannot sustain human habitation or economic life of their own", but were ultimately not illegal *per se* (Beckman 2017, 41). Deeming these newly developed islands as such, semi-grants them only a 12-mile territorial radius. China uses the developed islands as the foothold it needs to support the 9-dash line. Claiming the islands as territories, China thus extends its territorial waters and EEZ, which typically protrudes out 200 nautical miles, and even into the EEZs of other countries, pushing the 9-dash line further into the SCS. China is threatening maritime trade routes by pushing out territorial water claims, impacting the free flow of goods by water.

There are numerous claimed goals for the CCP's island projects, including "strengthening sovereignty claims, improving living conditions of local residents, contributing to the security of international navigation, and enhancing military power projection" (Yamaguchi 2016, 28). China's power projection will extend capabilities both militarily and non-militarily as it completes construction of bases, airstrips, radar facilities, and ports on these newly created artificial islands (*Ibid*, 29).

A future study analyzing the exact source of sand for many of China's recently built islands in the SCS could spark new debates and claims to the ownership of the islands. To be more economically feasible, it would make more sense for dredging ships to acquire sand nearby the island that China or another state wishes to build upon. Say China were to use sand from its own coasts, rivers, and lakes, and were to ship that sand to the Spratleys, or to the Paracel islands to build the islands; then perhaps China would have additional claim to the territory. In contrast, if they were to extract sand from the nearby project, it could strengthen claims of illegality of international waters. This could be analyzed and discussed using a type of land transference, with countries behaving as if one's land and borders are fluid. This is similar to states selling their own land in the form of sand trade (Franke 2014). If China does in fact have claim to any of the islands it is building on, would it be in accordance to international law to take land from mainland China to move to those islands? Regardless of where the island building sand comes from, the same type of mineral sand used in construction is going to be needed to be built on top of these islands, in the form of cement, runways, and buildings. It is assumed that China or any other nation would likely never relinquish control of one of these islands once outposts or runways have been built on them, unless there were formidable pressures from international summits or the like.

In a territorial dispute, there is a general chain of events that occur. First is the existence of the pre-territorial dispute stage. This is characterised by satisfaction with the status quo or latent conflict over territory. In this stage, countries make claims to a territory via declarations issued by the government that leads to the main territorial dispute stage. Active diplomatic and military conflict or low level conflict follows. There then is the resolution of the territorial dispute, in one of three ways: the challenger seizes the territory; there is stagnation; or the challenger withdraws claims, or compromises with the other state to reach a settlement (Huth 2009, 30). Could there be another stage to this model, however? China seems to have skipped a step, or created an entirely new one that had not even been conceived of before.

The already existing pre-territorial dispute stage can be seen as the status quo in the SCS. China engaged in joint civilian and military presence on the disputed islands in tandem with dumping sand over reefs and low-lying rocks to create new infrastructure, seeming to hurdle over the all dispute stages, and now behaves as if there were no wrongdoing. The Chinese government

claims these territories, and are taken to international tribunal courts, which rule in favor of the countries who already own them but justify no true illegality, though such rulings are entirely arbitrary. It is believed that international relations in the 21st century will be heavily focused on maritime control and boundaries. We have already witnessed precursors to this phenomenon, with these island disputes in the SCS, and even more-so in the melting of the Arctic, as it opens new trade routes. According to the aforementioned US Navy Admiral, a framework already exists to maintain peace in the region (Harris 2015):

> "The United States and other countries continue to urge all claimants to conform to the 2002 China-ASEAN "Declaration of Conduct," where the parties committed to "exercise self-restraint in the conduct of activities that would complicate or escalate disputes and affect peace and stability." How China proceeds will be a key indicator of whether the region is heading towards confrontation or cooperation" (4)

This 2002 ASEAN declaration of conduct, signed by the member states as well as China should have served as legislation to peacefully resolve territorial disputes, or prompted the self-restraint to stop them in the first place, via refraining from inhabiting islands and reefs, protecting the environment, and so on (ASEAN 2002). Thus, while a good notion, this declaration fell short of halting island building.

It should be noted that most ASEAN countries engage in the same activities in the SCS, but not at the same level as China, and not as offensively or militaristic. The United States recognizes the threats in the region both directly and indirectly affected by sand, and plans to have 60% of the entire Navy based in the Pacific Fleet by the end of 2020 (Harris 2015). Island building, trade disputes, and challenges integrating ASEAN are all prompting action by the US and EU to continue developing relationships to thwart advances by China.

2. HOW SAND IS TRADED

The easiest dimension to view sand consumption would be how the world trades it. By analyzing sand trade we can begin to understand its uses and its lead exporters and importers, and predict future consumption as well. States, international systems, and organizations, all track and monitor sand trade, giving us valuable quantitative data, but with a few inherent pitfalls. Those pitfalls include black markets, smuggling, and misreporting. Comparing trade data on sand allows us to establish the quantitative baseline on which the qualitative research lies.

One third of all maritime shipping occurs in the SCS. The constant popular figure of $5.3 trillion USD is used as an estimate of the worth of goods that travel through this area annually, though it could be slightly less (CSIS 2017). According to shipping data from the American Association of Port Authorities, China owned 10 out of 20 of the largest ports by total cargo volume in 2015, as well as having, as the busiest, Shanghai, which was closely followed by Singapore (AAPA 2015). In 2018, Asia accounted for 65% of all port throughput (UNCTAD 2020, 16). In the same year, China owned 8 of the top 20 global ports by volume with Singapore ranking consistently in the top 3 in recent years (WSC 2020; SISI 2019). Simply put, both the SCS and Strait of Malacca, the Singaporean choke point for many vessels traveling through to gain access to the Indian Ocean, are two of the busiest maritime trade routes in the world. It is an extremely important area for China's energy security as well. Roughly 80% of all Chinese oil imports passed through the SCS via the Malacca Strait (CSIS 2017). China's civilian and economic build-up in the SCS is threatening maritime security in the area. ASEAN countries, as well as China, rely on economic partnerships in the SCS to create a prosperous and therefore a secure neighborhood, as stability is typically tied to affluence. If territorial disputes caused by land reclamation and island building continue to worsen in this region, trade routes can become disrupted, along with cooperation amongst states.

Resource security, when it comes to sand, is not straightforward. In export oriented and low-income countries, it may be simpler. For instance, prior to bans and restrictions, countries like Malaysia and Indonesia focused on exporting large amounts of sand for easy income with not much of a need to import it, creating a straight forward gain. Now that trade limitations, bans, and self-mining have increased in recent years, reliable sand trade behaviors become tenuous. For countries like China and Singapore, the goal is to import or produce as much sand as possible. This is a joint effort by both state and non-state actors, as private companies are in high demand for the commodity to boost infrastructure development, and it is assumed that the government is backing development to raise income and GDP, especially in state centric countries like China and Singapore (Wilson 2013, 16). In the first decade of the 21st century, Northeast Asian countries began importing massive amounts of natural resources like iron and coal. This new wave of resource security caused Chinese and Northeast Asia to increase their natural resource imports by seven-fold in ten years (*Ibid*, 21). Along with oil and steel, China's sand imports and mining have followed suit, predictive of continued infrastructure development and ambitions in the SCS.

Countries that lack large amounts of landmass containing natural resources are most often import-dependent. These import dependencies encompass energy needs and raw materials to create goods and supply citizens with electricity and other essential modern functions. Prime examples would be Singapore, both North and South Korea, and Japan to an extent. Due to the rise in populations and industry booms over the past 20 years, states and private companies began making considerable increases in foreign investment. The best example to analyze would be the modern resource security policies adopted by China. During China's 10th and 11th Five-Year Plans, the CCP began a series of actions to secure foreign and domestic resources (*Ibid*, 21). Financial assistance for foreign resource investment, resource diplomacy initiatives, and resource-related free trade agreements, are all tactics that the CCP aids and promotes. If done correctly and without tension, investing in foreign markets while advertising supportive win-win scenarios is a brilliant soft power approach that has been an extremely successful tactic in the Chinese repertoire for the 21st century.

Interestingly, amidst territorial disputes as well as concerns over sand smuggling and trade, economic and political relations among ASEAN countries are doing quite well. Singapore,

Indonesia, and Malaysia, all have had record amounts of total trade and investment (Guido 2012, 38). In Indonesia, there are strong sentiments of socio-political and economic nationalism that dominate in public opinion. There is a clear consensus that foreign countries claiming territory or undermining sovereignty is objectively wrong. However, there is an unclear disposition of economic nationalism regarding buying products from other countries, or selling to them. Nationalism is naturally occuring for healthy nation building, but is recognized to be detrimental for regional and multinational cooperation. Issues originating from nationalism are pertinent in both ASEAN and the EU. Indonesians identify Malaysia and Singapore as the greatest threats to their sovereignty and economy, leagues more than China (*Ibid*). Incongruent with the study, Indonesia exported only $4 USD worth of sand in the year of the survey on nationalism. It did, however, import most of its sand from China, and continues to do so today (UN Comtrade 2020). Trade and investment between Singapore, Malaysia, and Indonesia are high as well, with Singaporeans and Malaysians investing in Indonesia following their large market liberalization efforts in recent years (Guido 2012, 38). Like within the EU, the opinions of citizens are split, as are the aspirations of the government. There is debate amongst countries whether further integration of ASEAN should be a goal of one's own state, though, unlike with the EU, it seems ASEAN nations are making positive efforts regardless of public sentiment.

After recognizing the baffling volume in which Singapore was importing sand from its neighbors, most countries enacted export restrictions to either stop Singaporean expansion, halt their own environmental degradation, or both. The following figure (see *Figure 1*) shows the results of limiting sand exports to Singapore.

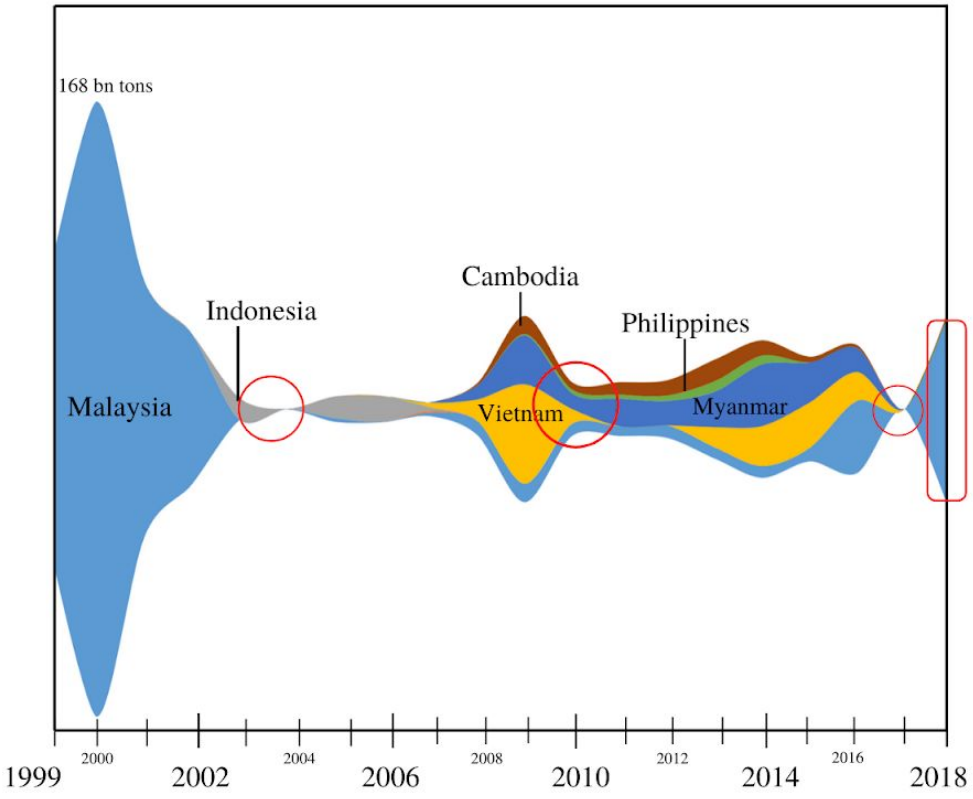

Figure 1. Singapore Natural Sand Imports

Source: UN Comtrade (2020)

There are several noticeable choke points and increases on the graph, which are marked by the four circles. Malaysia was the first to introduce a ban, and did so in 1997 (Bruce-Lockhart 2020). This can be seen as the graph begins with a large increase that caps in the year 2000 at 168 billion metric tons of imported sand. This ban was lifted in 2015 which is represented by the small double bump between the second and third circle. Indonesia introduced ocean sand exports in 2003, which can be seen by the first circle, and in 2007 extended this ban to include all sand exports. Vietnamese miners were instructed to stop exporting sea sand in 2010, shown in the second circle. Cambodia brought in a temporary ban in 2016 and then fully banned exports in 2017 (Chan Thul 2017). Singapore's imports of sand in 2017 were just under 1 million metric tons. Then, after almost 59 billion tons of sand was exported to Singapore in 2018, the Malaysian government reintroduced the ban in early 2019 (UN Comtrade 2020; Ungku, Latiff 2019). This is represented by the sudden increase and final circle at the end of the graph.

The average price of sand exported to Singapore has exploded as well. Between 1995-2001, sand was $3 USD per ton, and after some restrictions towards Singapore, it was $190 per ton between 2003 and 2005 in a surprising supply and demand reaction (Peduzzi 2014, 211). Concrete sand imports have relatively settled since then, and average just under $15 USD per ton (Statista 2020). According to the UNEP, cross referencing Singaporean imports and sand use against both Indonesian and Cambodian export data, leads to trade recording gaps (UNEP 2014, 8). The discrepancy in these numbers total hundreds of millions in tons of illegally traded sand.

The 2007 export ban on sand Indonesia imposed was effective, closing off millions of tons of sand exports, though interestingly, China was one of the largest importers of Indonesian sand prior to the ban, a fact which is not reflected in public opinion regarding foreign threats. Additionally, diplomatic relations amongst these ASEAN countries were positive, displaying leadership's desires to further integrate to advance regional cooperation and security (Guido 2012). It is interesting to note then, the discrepancy between the actions of the states and governments in comparison to public opinion. Compared to the EU, where individuals and cultural differences remain one of the largest roadblocks to further integration, does the same situation arise in ASEAN, though the lack of freedoms and democracies allow the governments to carry on with economic and political integration more efficiently?

To address the possible resentment of rich and powerful countries like Singapore or China taking away land via trade, we can turn to social sciences. In some instances, it may not even be the fault of another country for land loss or environmental degradation. In the following chapter, climate change will be discussed in coastal areas. In the case of North Korea, where it would be impossible to gather data on nationalism or public opinion, there is a risk of land loss both due to mining and climate change. Countries that experience a "loss of place" will experience people moving away from lost areas, but respond to the causes as well (Elliott 2018, 307). In the cases of Tonga, Tuvalu and Nauru, countries that are virtually disappearing due to rising sea levels, we see large emigrations (Kelman 2015). When we see land loss in Indonesia, a country with an enormous amount of land area in comparison to other Southeast Asian and Pacific countries, there is not a notable amount of instability due to loss of land, but perhaps the reaction to loss manifests in public resentment towards foreigners and neighboring states like Singapore and Malaysia. When we find that small islands in Indonesia are disappearing at the same time

Singapore imports sand and adds land mass, would it then be reasonable to acknowledge linkages between land transference and land loss caused by sand trade, and additionally to negative sociopolitical opinion by the affected countries populaces?

Sand can easily fall under resource scarcity as a non-traditional security challenge (Caballero-Anthony 2009, 35). Sand trade not only fits the bill under resource scarcity, but can be included with climate change, smuggling, natural disasters, and so on. There are clear reasons that countries have enacted policy changes when it comes to trading sand. The previous and following chapters enumerate the concerns for the sand case, and continue to weave together its functional and interconnected reality.

3. ENVIRONMENTAL IMPACTS OF SAND CONSUMPTION

It would be naive to assume that natural resource markets start and end at the quantity available and countries' willingness to import and export them. Natural resources are tied, of course, to the natural world. Countries have continuously implemented new domestic policies, become involved in international organizations, and developed and altered new and existing security frameworks, all due to the world's growing collective consciousness towards climate change and environmental damage.

The burning of fossil fuels releases carbon that has taken thousands, if not millions, of years to sequester into the earth via decomposing biomass and other means. The logging of trees reduces the natural function of absorbing carbon and producing oxygen. Why would mining river basins and beaches, thus disrupting wildlife and local ecosystems be any different?
Such reactions from the planet spark domestic policies, as well as affect global trade. In the Asian continent, primarily China and India, major investments in renewable energy have been made to abate air pollution to protect the health of citizens. China began its first air-quality policy in its 11th Five-Year Plan in 2006 and has gradually increased efforts to reduce emissions year by year (Jin *et al*. 2016). China continues to ameliorate such policies to enhance its status and appearance as an economic superpower and make it seem more humanitarian and progressive, but it is unclear if that is the leading cause, or whether the primary motive is only to reduce respiratory related deaths.

Environmental degradation and the effects of climate change continue to impact states' security, as well as interstate security cooperations and organizations. The concept of ASEAN itself was built on functional cooperation, much like the European Union (ASEAN 2003). Countries banded together for enhanced cooperation for mutual gain. Environmental protection policies are important and show willingness to cooperate for the greater good of both the environment and

the people, but when another country in the group does not cooperate or play by the rules, it challenges the bond and legitimacy of the organizational framework. Inversely, one could argue that while environmental policies are good for many reasons, they inhibit economic activity, which would be open sand trade in this case. If a country in the region that is not part of the multinational organization, in this case China in its relationship with ASEAN, does not follow environmental policies or even international law for that matter, there are limited options in dealing with them. Hypothetically, if ASEAN were to prohibit all land expansion activities for member countries due to environmental reasons along with others, primarily island building to protect reefs, China would use this to its advantage seeing the area is ripe for the picking. This theory is extended in the following chapters.

Between 1997 and 1998, haze due to fires and pollution in Southeast Asia cost regional economies up to $10 billion USD. ASEAN enacted the Agreement on Transboundary Haze Pollution in 2002, though the leading contributing country, Indonesia, did not sign until over a decade later (Caballero-Anthony 2009, 43). Steps towards addressing climate change in Asia have been taken, albeit slower than many other developed or western countries, but taken, nonetheless. In 2007, ASEAN adopted its Declaration on Environmental Sustainability (*Ibid*, 44). ASEAN countries, and all other countries in the area, are experiencing firsthand the effects of climate change, and perhaps more-so than other regions of the world.

Among the long list of concerns regarding unsustainable sand mining, environmental factors will also indirectly affect states abilities to function normally. Biotic diversity, soil degradation, and biological systems' ability to support human needs are believed to be at risk (Lambin *et al*. 2006). China has effectively destroyed coral reefs and ecosystems in its island building practices by dumping sand over them then paving it over in cement and concrete. The destruction of these ocean habitats can be detrimental to other activities and functions, such as food supply and perhaps carbon sequestration, for “the Spratly Islands' high diversity of marine organisms, the islands are considered a priority area for marine conservation and management" (Shao 2017, 151). Essentially, Chinese presence in the area has two primary impacts. The first of these is the so-called islands in the Spratlys on top of which the Chinese decided they would construct airfields and other infrastructure projects on top of, are home to coral reefs, atolls, and other features that encourage the activities of marine biodiversity. Some features just barely surfacing

out of the water. Second, to further establish domain over these contested waters, China encourages, convoys, and even escorts fishing boats and other types of boats into the SCS to engage in economic activities. These boats are always condemned, often turned around, and sometimes apprehended by coast guards of other states and cited for illegal fishing.

Southeast Asian seas yield 7 million tons of fishery resources annually, and export $1 billion USD of fish products (*Ibid*, 152). Unsustainable fishing practices like overfishing and illegal fishing methods are used by Chinese fishers, but are also used by immoral fishers from other countries. As our oceans are overfished and reefs are paved over in concrete, food security for coastal and island populations that rely on sea life as a source of caloric necessity may become yet another problem on a long list. The main justification for these practices lies with creating the manufactured to provide economic and territorial waters, which goes back again to sand consumption.

Near the highly populated east coast of China and equidistant between Shanghai, Guangzhou, and Shenzhen, lies Poyang Lake. The lake feeds into the Yangtze river, and is home to perhaps the largest sand mining operation in the world. Parts of the Yangtze river had mining bans imposed in 2000, forcing miners to move up to Poyang, where mining was also banned in 2008 (de Leeuw *et al*. 2009, 95-96). Until then, it was estimated that a low approximation of 448 million metric tons of sand was removed per year from the lake, accounting for 9% of China's reported sand demand at the time. This was found by referencing satellite images of dredging ships and comparing them to loss in water levels (*Ibid*, 98). This activity has harmed the lake's ecosystem and threatened endangered bird species, not to mention the amount of pollution and emissions from the transportation. This is not an isolated case, as this practice is carried out in numerous rivers in China, as well as other states in the region. The Mekong river that flows through Cambodia, and Vietnam, both ASEAN countries, and many more rivers in the greater area are all mined at the expense of environmental degradation (Koehnken, Rintoul 2018, 96-106).

Rising populations and global GDP prompts the need for infrastructure development and land reclamation to provide much needed infrastructure for cities and entirely new land areas. The simplest and cheapest way to do this is to relocate nearby sand to where developments require it.

This has direct negative environmental impacts, therefore prompting governments to cease or limit mining activities in the area. Sand miners, needing to maintain their income as well as supply industries with sand, mine illegally, or move to new areas, where the cycle continues. This industry has an impact not only on the environment, and trade numbers, but on people's livelihoods as well, with the low cost of the commodity and illegality endangering workers who have no other option to provide for themselves or their families (Lamb *et al.* 2019). The existence of non-state actors engaging in sand smuggling becomes prevalent, as do restrictions and bans amongst countries engaging in the once friendly and mutually beneficial trade.

3.1. Climate Change

One of the biggest issues in Southeast Asia and the greater Pacific region, due to the nature of most developed areas being so near to the oceans, is sea level rise. In 2017, at the most recent UN Ocean Conference, it was identified that over 600 million people, or just around 10 percent of the world's population, live only a few meters above sea level (UN 2017). Displacement due to storms and other weather events will continue to worsen and be amplified by rising sea levels, 90 percent of which the UN estimate "are classed as climate related [and] now cost the world economy US$520 billion per year and push 26 million people into poverty every year" (*Ibid*). These events include flooding and tidal waves from ocean swells.

As water levels rise, cities on coastlines need protective measures and proactive building to defend against such natural events. This is done in the form of building sea walls and creating artificial harbours or land masses away from the coast as a shield of sorts. The downside of building more infrastructure is counterintuitive, however, to protecting cities to events such as floods from rain storms. As more non-porous infrastructure exists on floodplains, water from natural events like hurricanes or monsoons becomes unable to return underground or back to water bodies. Streets and concrete bases on which buildings lie are typically unable to behave in this absorptive way, so it is up to the responsibility of city planners to implement more effective sewage and drainage infrastructure to protect cities. Such is the case with frequent floods during Singapore's monsoon season (Koh 2019). Coastal cities worldwide have likely poured billions, if

not trillions, of dollars into protecting themselves against rising sea levels and increased storm frequency and severity.

Save for climate deniers, it is widely accepted that climate change has been affecting our geographies in both expected and unexpected ways. The Yellow Sea area, highly populated and characterized by low elevations and tidal flats has experienced massive amounts of land loss due to the aforementioned causes. From the 1950s to 2014, China, North Korea, and South Korea experienced a net loss of anywhere from 28 to 65% of all tidal flat areas around the Yellow Sea (Murray *et al.* 2014, 269-270). The number varies due to quality of images from weather events, as well as availability of older records. Amongst possible climate-related causes, the study correlates the increase in agricultural and infrastructure developments in the region (*Ibid*, 270). These large amounts of land loss correlate positively with the need for land expansion and infrastructure development to counterbalance nature.

The UN estimates that 11 to 15% of people living on Small Island States live at an elevation at or below 5 meters. Since 2008, almost 22 million people globally have been displaced by weather hazards including climate change and sea level rise (UN 2017, 7). In addition to the displacement of people, sea level rise also impacts infrastructure, decreases land mass, and can increase soil salinity, impacting the capacity for food production. With the amount of people being displaced, there are only a few ways in which their accommodation can be resolved. The most obvious would be the construction of new infrastructure and land expansion. Newly expanded land will require more new infrastructure. States can also continuously engage in beach nourishment and island creation and nourishment to combat sea rise. These practices are likely overwhelming tasks for small and underdeveloped island nations, not to mention that they presumably go against the nations' own positions on environmental protection, as nature is closely tied to many island nation cultures. Environmental factors not only can be seen to affect international relations, but can come down to a human security issue, affecting the individual.

4. DISCUSSION

Considering the amalgamation of data that has been collected in this research, the most apparent notion is that sand is entering the same tier of importance as oil or gas. The importance of sand in this aspect is due to its relation to necessity for fundamental state activities, and its scarcity, which can be expected to change or eliminate its trade. Further deepening this evolution of importance, it should be understood that the usefulness of sand, much like oil, does not lie in its innate existence, but rather in its capacity for modern functions. Societies do not consume sand or oil because they are sand or oil, but because they are necessary to build our infrastructure, to operate most of our transportation, power our militaries, and so forth. Unless manufactured sand becomes economically viable, or techniques to increase rates of erosion to produce natural sand are conceived and implemented, natural sands will continue to increase in importance in this way. This rise of importance comes with new opportunities for manipulating regional power struggles as well.

The narrative of sand consumption is one of economic growth, and also political expression. Sand is a building block to metamorphose growth into physical structures; therefore as populations and incomes rise, as we saw most notably in the cases of China and Singapore, so has the need for sand. Within the area of sand consumption itself, the research shows a heavy bias towards Singapore and China being the leading drivers for sand policies and consequential behaviors. Without sand sources of its own or readily accessible alternatives to natural sand, Singapore is entirely dependent on foreign exporters. During Singapore's peak growth, in both population and land expansion, during the past 20 years, a massive fluctuation of the price of sand was observed between $3 and $190 USD per metric ton (Peduzzi 2014, 211). The price changes seemed to be primarily due to the willingness of other states to export the resource. That willingness to export is itself linked to exporting nations' realizations that sand mining was

detrimental to their environmental health, as we see reflected in the series of incremental or entire bans on sand mining or exportation.

4.1. Power Dynamics

The current finity of sand creates the opportunity for states to engage in activities for power balancing in the Southeast Asian region. Due to the necessity of sand as a building block for construction practices, the control of sand could be one parallel to the control of energy resources. Countries rich in natural sand resources may eventually control availability and prices for import-reliant countries, therefore limiting or encouraging infrastructure growth, in behavior similar to that of major oil exporting countries. For countries reliant on sand imports or exports, individual state decisions or interstate corporations could have significant impacts on states that rely on the import or exportation of sand. Singapore, a rather wealthy and influential country, is able to weather these kinds of fluctuations to an extent. If it were not, perhaps we would see halted growth in this respect. Using realism's basic definitions of balancing and bandwagoning, we can compare individual ASEAN states' tendencies to engage in these power balancing actions in regards to sand (Waltz 1979). Proper sand governance and environmental policies within ASEAN would encourage further cooperation, as the trade data already shows that most of the regional sand trade has stayed within member states. As an added caution, states need to be wary of the rise of non-state actors capitalizing on these power struggles and lack of sand governance in the form of smuggling and black market trade.

4.1.1. Balancing China

If ASEAN or other neighboring countries were to impose bans on exporting sand to China, there would be little or no effect on its building activities. China remains largely outside of the sand supply chain, as the vast majority of its sand is acquired domestically. If China acts in line with expected tendencies, it will continue to sacrifice its own environmental health for continued development and island building in the SCS. Most Southeast Asian countries perceive China as a threat, though some more than others (Chen, Yang 2013, 275).

China's presence in the SCS should be observed with a clear notion of taking advantage of Hobbesian anarchic realism, or offensive realism (Hobbes from Malcolm 2002; Mearsheimer 2003). The Spratly Islands, prior to the modern SCS disputes, were largely disregarded, leaving the area open for the taking. China's island building practices and other condemned civilian and military actions in the region are best described as gray zone tactics, not quite characteristic of war (Morris *et al*. 2019). Countries' political dedication to ASEAN relies partly on their degree of perceived physical and economic threat from China. Due to China's offensive realism approach in the SCS, it would be assumed that smaller states in the region would engage in defensive realism approaches. In reality this relationship is not perfect, due to China's economic prowess and soft power techniques, which have influence over some ASEAN members. Malaysia, Vietnam, Brunei, Taiwan, and the Philippines all have territorial waters in the SCS, or engage in island building in the Spratlys and behave in a balancing manner towards China.

4.1.2. Power Struggle Through Trade

When discussing trade, as well as functionalism, these power dynamics provide insight on how countries will behave in future instances. Singapore, for example, expects positive economic outcomes as China grows economically, though its presence in the SCS could potentially threaten regional security (Chen, Yang 2013, 282-283). Cambodia, on the other hand, has a positive economic relationship with China and does not perceive it as a threat, likely due to its lack of presence in the SCS since Vietnam separates it geographically (*Ibid*, 280). The large discrepancies towards China amongst the ASEAN countries have the potential to muddy policies when it comes to protecting the SCS from Chinese encroachment. In addition, because China is mostly separated from the sand trade market, there is little opportunity for ASEAN states to utilize soft power balancing in the form of restricting trade to slow China's development in the SCS.

4.2. Environmental Connections

Environmentally, we can compare sand consumption to that of other resources that science has deemed to be harming the planet. Directly linked to river and ocean ecosystems, shared by the region, and the world, unsustainable sand mining is an abuse of a commonly shared or affected

resource (Hardin 1968). Linking the sand trade to the *Tragedy of the Commons*, the depletion of sand ties into shared material resource shortages. The Malthusian notion that population will outgrow our natural resources has been wrong on many accounts as technological advancements allow us to adapt, though it may become true as it pertains to sand (*Ibid*, 1243). The fact that we are running out of natural sand paired with the environmental regulations proves that the abuse of this common resource system will force us to adapt once again, most likely in the form of manufactured sand or sand alternatives. As Hardin said, "One does not know whether a man killing an elephant or setting fire to the grassland is harming others until one knows the total system in which his act appears" (*Ibid*, 1245). This concept of a total system becomes what we now know as systems integration (Liu *et al*. 2015). Smaller interconnected systems start chain reactions and can spillover into our complex human systems, and in this case, environmental damage at sand mining dumping sites have begun to trigger environmental policies limiting sand trade and consumption, affecting the entirety of each topic covered.

Modern threats to security are similar, in that the goals and ambitions of humans stay relatively the same. The mediums and vectors that actors utilize to achieve these goals are constantly evolving or taking form in new ways that were unforeseeable prior to new security events. Sand consumption is no different. It is appropriate to attach a security threat label to sand consumption in the way it is analysed in this research. Sand consumption is non-militaristic by nature, though one could argue that sand can be used for militaristic purposes, such as creating military bases or runways. This topic can easily be broadened and deepened to encompass almost every field and be subject to a multidisciplinary approach, though for our intended purpose, sand is viewed as a non-traditional security challenge, as well as a tool for non-linear warfare.

CONCLUSION

Linking the many uses of sand to real-world events and the current security paradigm in Southeast Asia, as well as trade and state relations, resulted in many expected notions. Multidisciplinary approaches to sand have been neglectfully omitted, though single-focused researches have been prevalent in the past two decades. In all three focuses of this study, it has proven abundantly clear that there are linkages between each variable. Land expansion and construction, trade, and environment are all covered under the umbrella of International Relations. Sand consumption, in this way, has proved to be worthy of a security label, but in varying levels between each facet of consumption. Sand consumption also proved that its linkages need to be taken into consideration when considering future studies or policies.

The most surprising aspect of sand consumption lies with infrastructure and construction industries. The statistics and sheer scale of sand use for this activity are staggering. China's sand use for infrastructure, while massive, is not much of a concern politically, as it is mostly a domestic operation; it is the environmental impact of China's infrastructure practices is the larger concern, with massive amounts of pollution, and destruction of ecosystems due to sand mining are prevalent. For ASEAN, sand trade restrictions may impact future growth and cooperation, including additional infrastructure requirements resulting from climate change and the displacement of people. For countries with large amounts of land mass and sand resources, this impact will be less severe, but for Singapore and other small states, proper sand management and governance will be needed for responsible and sustainable consumption. A program of international sand governance seems to be the overwhelmingly apparent solution to the sustainability problem (UNEP 2019). Global sand governance should involve all levels of and stages of sand use, from the miners and construction companies, the environmental scientists, and up to state and multinational leaders, as the entire system is interconnected.

Land reclamation and expansion are distinctive when it comes to sand consumption. The main difference lies in the type of sand that is used. There are limited resources available to determine

where land reclamation sand is being sourced from. When used for city expansion and beach nourishment, the acquisition of sand becomes more the responsibility of companies and governments to document use and trade. Island building practices are a different story, in that it is not the goal of China or other states to proudly record where it is sourcing their sand for controversial practices. China's island building in the Spratleys has a clear relationship with regional security, affecting international trade, damaging reefs and the marine environment, undermining functional cooperation and decelerating ASEAN integration. Until data can be produced by China or other countries engaging in these practices, satellite imagery is the most reliable tracking method for determining mining and dredging locations, and tracing them to dumping sites. In the meantime, multinational organizations like ASEAN and the UN should continue to work on global sand governance to maintain a stable and prosperous SCS and Southeast Asian region.

Investigating countries' accountability in the sand trade and strengthening the foundations for better sand governance is where the most work can be done with future research. In the discussion of land expansion and China, the topic of land transference could provide answers to the interesting debate in territorial disputes. Solving the problem of the lack of information on the sources of sand used for island building practices could be beneficial to the ruling of international waters and maritime boundaries as well. Unless data can be produced by China or other countries engaging in these practices, it could be necessary to continue using satellite imagery to track transport vessels dumping sand on these islands, and trace them back to their mining and dredging locations. In the meantime, while ASEAN and the UN work on global sand governance, it should be the responsibility of Western Pacific countries, the EU, and the United States to play a greater role in economic partnerships and greater military presence in the Pacific to maintain a stable and prosperous SCS. Without offering these economic and multinational relationships, it leaves a vacuum for China or Russia to make these partnerships instead.

Concerning trade, it appeared that the majority of sand trade remained within Southeast Asia. Most of the sand trade between ASEAN and neighboring countries involved Singapore, as it is the largest importer of sand across the globe. As a result, ASEAN sand exporters began restricting sand trade. It can be concluded that this was primarily due to negative environmental impacts that exporting countries were experiencing, as this was the topic most closely linked to

trade, and secondarily due to minor territorial disputes. Despite sand trade restrictions, ASEAN countries have not experienced noticeable political setbacks. The concern over sand trade amongst themselves seems to be dwarfed by that regarding the looming presence of China in the region and its invasive island building practices.

The UNEP has given a few recommendations that are congruent with the findings in this research to help solve the problems surrounding sand consumption and scarcity. The first is to limit consumption whenever possible, mostly through smarter building practices, and then to use more sustainable aggregates like manufactured sand. Second, and more importantly, is to introduce better governance and transparency of trade and usage through international organizations, governments, and private companies (UNEP 2019). Governments should not only track the use of sand more closely, but evaluate more efficient uses, invest in recycling policies and new technologies, and continue to note linkages (Torres *et al*. 2017, 971). Research should continue to "illuminate complex interlinkages between sand demand, mining, trade, transport, and consumption", which is precisely what this research aimed to accomplish (*Ibid*, 971). It will be the responsibility of states to monitor trade and consumption in all levels of governance, from local to international, and at all stages, from mining to finished product.

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APPENDICES

Appendix 1. *Figure 1*

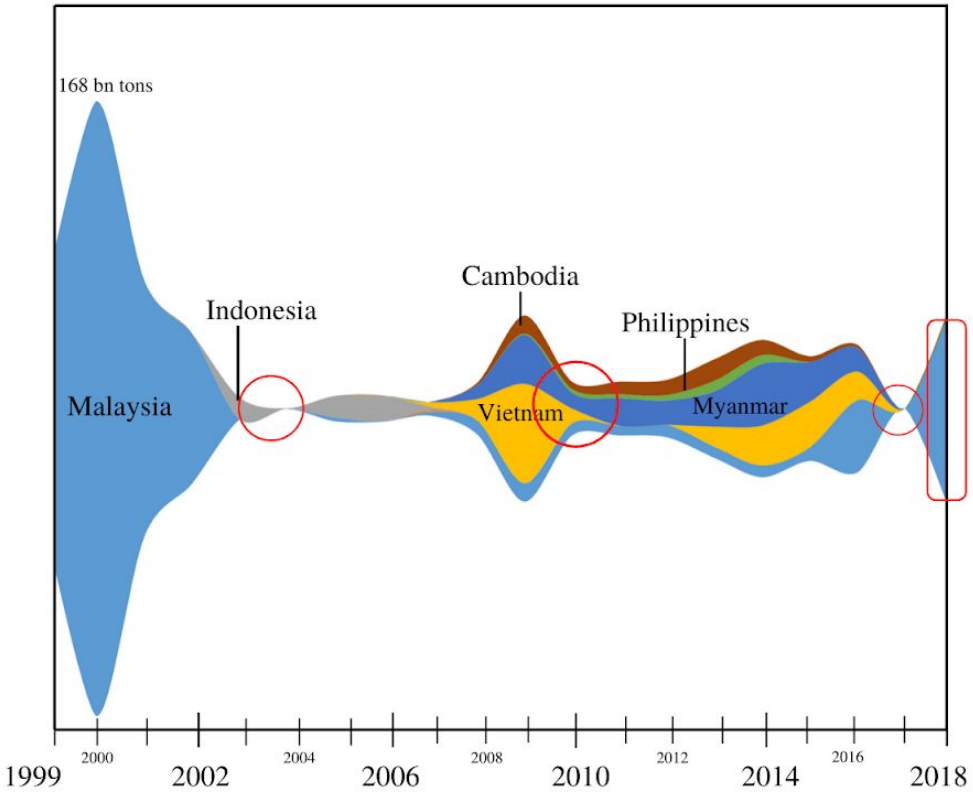

Figure 1. Singapore Natural Sand Imports

Source: UN Comtrade (2020)

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