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# When one country's land gain is another country's land loss...

The social, ecological and economic dimensions of sand extraction  
in the context of world-systems analysis exemplified by Singapore's  
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## **When one country's land gain is another country's land loss...**

### **The social, ecological and economic dimensions of sand extraction in the context of world-systems analysis exemplified by Singapore's sand imports**

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**Abstract:** Singapore industrialised rapidly with continuously high growth rates since its independence in 1965 and its population during the same period of time almost tripled. With development at this scale, Singapore had to grow in number of industrial and residential buildings as well as in size through land reclamations; both requiring high amounts of sand. The country itself contains hardly any natural resources and, consequently, depends highly on other countries (mainly Malaysia, Indonesia, Cambodia and Vietnam) for its sand supply. All major sand supplying countries successively prohibited sand exports to Singapore beginning in 1997, since they were burdened with the social and economic costs that resulted from sand extraction. World-systems theory helps to explain the sand situation within the framework of the core/periphery hierarchy and the zero-sum game world-systems approach by arguing that Singapore, being an upper semi-peripheral country, could develop rapidly at the expense of the other countries which are found below Singapore in the core/periphery concept. Furthermore, it is shown that Singapore's resource strategy of importing large quantities of sand has helped its upward movement from a peripheral to an upper semi-peripheral country.

**Keywords:** world-systems theory, Singapore, sand extraction, sand export bans

**JEL classification:** F18, L72, P10, Q34

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## **1. Introduction**

Singapore is one of the original four Asian tigers, indicating that the country industrialised rapidly with continuously high growth rates since its independence in 1965. During the same period of time the country's population almost tripled. In order to keep up with the fast development, buildings in Singapore grew in both height and number while area was also increased through land reclamation strategies. Over the last decades, an additional area of 120 square kilometres was added which equates to one fifth of the country's size at the time of independence. Further area expansions of 100 square kilometres are planned through land reclamations until 2030. For both, new and bigger buildings and a larger area, huge amounts of sand are required.

Sand is a natural resource that is usually not traded internationally, since transportation costs would quickly exceed its low extraction costs. However, due to the fact that Singapore has a very small territory containing hardly any natural resources, it had to rely on sand imports mainly from surrounding countries to minimise transportation costs for its projects of growth. After receiving sand from Malaysia for many years, the Malaysian government banned sand exports in 1997 and Singapore turned to its second neighbour Indonesia. With the extraction of large amounts of sand, uninhabited islands started disappearing in Indonesia and the country implemented a sand export ban in 2007. Singapore then turned to Cambodia as its main supplier of sand, but two years later the country's prime minister outlawed sand exports and eventually Vietnam followed suit a couple of months afterwards.

This paper investigates the social, ecological and economic effects sand extraction had on Malaysia, Indonesia, Cambodia and Vietnam and the political reasons for the prohibition of sand exports to Singapore. Furthermore, the paper examines in which way the above stated situation can be explained by world-systems analysis and focuses in particular on Singapore's upward movement within the current system and the so called zero-sum game world-systems approach.

The current world-system is a capitalist world-economy consisting of a high division of labour, multiple political centres and many cultures. Countries in the current world-system can be either core countries, semi-peripheral or peripheral countries. Core countries highly profit from our world-system and have the power to control the system to some extent, while only a small share of the global wealth belongs to peripheral countries. Semi-peripheral countries have some characteristics of both types and are in a rather difficult position. They

have to protect their current status to prevent regressing back to the periphery and, simultaneously, they have to fight for their upward movement to the core. Within world-systems analysis, Singapore can be seen as one of the very few countries that have managed to improve their position from the periphery to the upper semi-periphery, while most of the surrounding countries that have imposed the earlier mentioned sand export bans have remained peripheral countries. With respect to the natural resource sand, this paper looks at whether Singapore's resource strategy helped its upward movement within the current world-system.

Furthermore, the capitalist world-economy is based on the objective of endless accumulation of capital, which can only be reached through constant expansion resulting in an increased demand for natural resources. However, natural resources are not endless and the world-system is a closed, integrated zone. Therefore, supporters of world-systems analysis identify a zero-sum game approach stating that environmental destruction in the periphery is caused by economic development in the core. It will be analysed whether this approach applies to the particular case discussed in the paper.

The paper is divided into three main parts. The first part describes the theory of world-systems with a focus on the current world-system and points out criticisms of the theory. It continues with an examination (qualitative and quantitative) of the position of the countries Singapore, Malaysia, Indonesia, Cambodia and Vietnam within the current world-system and finishes by putting the environment as well as natural resource extraction in the context of world-systems theory. The second part of this paper goes into detail about the particular situation of Singapore's high demand for sand and the countries supplying it. This is done after introducing the natural resource sand. The third part analyses the social, ecological and economic dimension of sand extraction of the sand exporting countries. Finally, a conclusion is drawn.

## **2. World-systems analysis**

### **2.1. Overview of the theory of world-systems**

World-systems analysis has been discussed in academic literature for the last forty years. It originally started as a sociological approach which looked at social change in a historical context, but quickly spread and included other areas of social science. In the presented paper, it provides the theoretical basis for analysing the situation of Singapore and its surrounding

countries with respect to the natural resource sand. However, before going into detail about placing the countries relevant for this thesis in the context of world-systems analysis and connecting the theory to its ecological dimension, the following questions will be answered: where does the complex theory come from and which earlier ideas is it based on? What exactly is a world-system? What are the main economic and political characteristics of the modern world-system? And in which way has the theory been criticised among academics?

### **2.1.1. Development of the world-systems theory**

World-systems theory was first introduced in the seventies by the American sociologist and social historian Immanuel Wallerstein. At the time, Wallerstein provided a critical response to the *first modernisation theory* that had predominated development theories in the fifties and sixties (Chirot and Hall, 1982). According to the first modernisation theory, all states develop in a very similar way passing through various stages of development which have been best described by the American economist Walt Whitman Rostow (1960) as being the following: the traditional society, preconditions for take-off, take-off, drive to maturity and the age of high mass-consumption. Consequently, the difference between states at the first stage of development, in other words underdeveloped states, and those at the last stage, developed states, will become smaller or at some point be non-existent, because underdeveloped states will eventually be developed (Wallerstein, 2004a). However, in the seventies it was proven that the difference, in contrast to modernisation theory, had actually grown wider.

Wallerstein developed his analysis of world-systems by taking into account four debates which had been reopened after the end of the Second World War (Wallerstein, 2004b). The first debate questioned the traditional view of international trade which followed the logic of Ricardo's *comparative advantage*, meaning, in short, that if all countries produce and export goods in which they have a relative advantage (in terms of average labour time per unit) with respect to their trading partner and import the other goods, then all countries will receive benefits from trade (Krugman and Obstfeld, 2009). Raúl Prebisch, in cooperation with the United Nations Economic Commission for Latin America (ECLA), argued that not all countries benefit from trade, since trade occurs between unequal states that can be divided between the core and the periphery. Countries in the first category are better off economically and can, therefore, influence the terms of trade in order to receive surplus-value from the periphery (Wallerstein, 2004b) which results in a long-term deterioration of the terms of trade of peripheral countries. The idea of unequal states was further developed in the so-called *dependency theory* which started as an economic approach but then rapidly spread to

sociology and political science and states that the core gets wealthy at the expense of the periphery (Chirot and Hall, 1982). Two important contributors to dependency theory later became main proponents of world-systems theory, the German-American economist and sociologist Andre Gunder Frank and Samir Amin, an Egyptian economist.

The second debate important to Wallerstein's development of world-systems theory deals with Marx's *Asiatic mode of production*, an additional category which Marx identified but could not place in his analysis of human history with respect to modes of production and which, consequently, led to many controversies among Marxists and non-Marxists (Wallerstein, 2004b). This category refers to earlier Asian empires with high levels of bureaucracy and autocracy and could eventually be included well in the context of history in world-systems analysis (Wallerstein, 2004b).

The third debate occurred originally between two important Marxist economists, Maurice Dobb and Paul Sweezy, who could not agree on the origins of capitalism in Europe in the 16<sup>th</sup> century. While Dobb believed that factors internal to the countries (above all the class conflict between peasants and landlords which caused changes in production structures) resulted in the end of the era of feudalism and the beginning of capitalism, Sweezy saw the reason for the transition in external forces (mainly long-distance trade) of a whole zone that changed structures inside countries (Hilton, 2006). Frank and Gills (1993) took the debate even one step further by arguing that the same capitalist mode of accumulation was applied in the world for the last five thousand years and, consequently, the idea of a transition from feudalism to capitalism in Europe was rejected by them. To Wallerstein's development of world-systems analysis this debate was of importance, because, on the one hand, it showed that history had to be considered more among economists, while, it further implied that the unit of analysis does not necessarily have to be a nation, but could also be a large zone (a group of countries) (Wallerstein, 2004b).

Finally, the debate about the analysis of history is important, in particular, the view of the Annales School when led by the French historian Fernand Braudel after 1945. The Annales School argued for a *total history* meaning that historical analysis should, besides political events, include socioeconomic factors in order to, first, create a complete panorama of the development of history and, second, identify underlying long-term structures and trends (Harsgor, 1978). Wallerstein (2004b) later adopted Braudel's term *économie-monde* (world-economy), used to describe the Mediterranean zone in the sixteenth century in one of



Braudel's main works, to underline the above mentioned fact that the unit of analysis should not be small-scale.

Elements of all four debates can be found in world-systems analysis, as one can see when looking at the theory in more detail. Therefore the question of the following section arises: what exactly is a world-system?

### **2.1.2. What is a world-system?**

In its original definition developed by Wallerstein (1974, p. 347), a world-system is “a multicultural territorial division of labour in which the production and exchange of basic goods and raw materials is necessary for the everyday life of its inhabitants”. This definition has been slightly altered by various supporters of world-systems theory over the years, but an important aspect of the theory has remained the same and can be identified in the quoted definition: the change from the state to a spatial and temporal zone (or an interactive system) as the unit of analysis. It should be noted further that the word “world” in world-systems does not imply that those systems have to be global; it simply means that they are closed, integrated zones functioning with respect to their rules (Wallerstein, 2004b).

According to world-systems theory three varieties of systems have existed until today, which follow the forms of economic organisation (reciprocal, redistributive and market exchange) analysed by Karl Polanyi in 1944 (Wallerstein, 2004b). The first variety, so called mini-systems, use reciprocity as “economic” exchange and are mostly tribes. They cannot be considered world-systems, since they consist of only one political centre and culture (Goldfrank, 2000). The other two forms of systems, world-empires which work according to the principle of redistribution and world-economies which make use of market exchanges, are both world-systems with multiple cultures following Wallerstein's definition. Despite the form of their economic organisation, the number of political centres is a crucial difference between world-empires and world-economies. While world-empires are governed by one political entity and can be any social formation ranging from an integrated group of tribes to well-known empires (for instance the Roman Empire), the latter has multiple independent centres with different degrees of power within the system which are bound together by the exchange of goods using the market mechanism and flows of capital and labour (Goldfrank, 2000). Throughout history earlier existing world-economies had the tendency to eventually become empires (Chase-Dunn and Grimes, 1995). However, the modern world-system, a world-economy, is resistant to the possibility of an empire formation, due to some unique characteristics which will be described below.

### **2.1.3. The modern world-system**

According to Wallerstein (2004b), the modern world-system came into existence during the sixteenth century in parts of Europe and America and gradually expanded to reach its current worldwide presence. As already mentioned, it is a world-economy, more precisely a capitalist world-economy with specific features, both economic and political, which will be described in the same order.

The fact that it is a capitalist system means endless accumulation of capital is the system's priority (Wallerstein, 2004b) and explains the expanding character of the modern world-economy. The system is built on mechanisms that only allow for actors following the "spirit" of endless accumulation of capital an increase in wealth. The market, the form of economic organisation in the current world-economy, should never be entirely free, since in a perfect market the bargaining power of the buyers would be so high that sellers would receive only very low profits, making endless accumulation of capital impossible (Wallerstein, 2004b). Monopolies would always be preferred by the sellers, but they can hardly be found in their perfect form (Wallerstein, 2004b). Consequently, Wallerstein (2004b) identifies the existence of so called quasi-monopolies which are backed up by strong states (i.e. through subsidies, patents, trade restrictions, the state being a main consumer). However, the profit advantages of sellers are high in a quasi-monopoly leading over time to the entry of more sellers, eventually to the disappearance of the quasi-monopoly and, simultaneously, to the appearance of a new quasi-monopoly which results in a process taking the form of a continuous cycle (Wallerstein, 2004b).

All supporters of world-systems theory agree on the existence of cycles and take the following types into account for the historical development of a system: first, business cycles which last between seven and ten years and are related to the depreciation and replacement of machinery, second, Kuznets cycles of the duration of twenty to twenty-five years which are said to demonstrate reinvestment patterns whose nature is so far unknown to academics and, third, Kondratieff cycles with a duration of forty to sixty years due to high investments in infrastructure and technology (Chase-Dunn and Grimes, 1995). Furthermore, long-term trends have been identified in the modern world-system. Goldfrank (2000) summarises them into geographic expansion and population growth, commodification, mechanisation and technological change as well as bureaucratisation. All mentioned trends have a limit and once the limit is reached, the capitalist world-economy could be hit by a serious crisis (not just on the economic level) and maybe even be overthrown (Chase-Dunn and Grimes, 1995).

The already mentioned relational concept of core and peripheral states reflects the profitability of production in Wallerstein's theory. Core states which are characterised by a high degree of power and wealth specialise in core-production (capital-intensive) in quasi-monopolies, while peripheral states mainly concentrate on labour-intensive production in competitive markets (Wallerstein, 2004b). When those states trade with each other, core countries are in a more powerful position due to their highly profitable products. Consequently, surplus-value flows from peripheral to core states, resulting in a weakening of the former and a strengthening of the latter (Wallerstein, 2004b). This aspect of the core-periphery relation has been named unequal exchange, a term coined by Arghiri Emmanuel in 1962, and leads to a process of exploitation and continuous impoverishment of the peripheral countries (Chase-Dunn and Grimes, 1995). The political centre of core states protects its quasi-monopolies, and peripheral countries usually do not have another choice than to accept the conditions of trade (Wallerstein, 2004b). An upward movement from the periphery to the core under such conditions is very difficult and, therefore, rarely happens. While supporters of world-systems theory agree on the existence of higher levels of economic and political power in the core, in comparison to the periphery, they still argue about the degree of possible movability of individual countries to a more powerful position within the capitalist world-economy (Chase-Dunn and Grimes, 1995).

Wallerstein found a third type of states whose characteristics lie between the core and the periphery. He called it semi-periphery, and countries in this group contain an almost equal mix of core-production and periphery-production (Wallerstein, 2004b). Hence, they trade capital-intensive products to peripheral states and labour-intensive goods to the core. According to Wallerstein (2004b), semi-peripheral countries are in the most challenging position within the capitalist world-economy, since they have to constantly fight to retain their position and prevent downwards movement to the periphery, while trying everything to ascend to the core. In order to win this struggle, semi-peripheral states apply a large number of protectionist policies (i.e. tariffs, quotas, subsidies, changes in exchange rate) to strengthen their production processes against competition from the core and, simultaneously, countries in the semi-periphery aim at increasing the efficiency of other production processes to be more competitive than the periphery when trading with the core (Wallerstein, 2004b). However, the strongest competition for semi-peripheral states is neither the core nor the periphery, but other countries in the same category, because they are all competing to receive "old" core-production which is disappearing with its quasi-monopoly. Production processes are constantly "lowered" from the core to the semi-periphery until reaching the periphery, while

the capitalist world-economy expands and incorporates new production processes (Goldfrank, 2000). An often stated example is the production of textiles which started as a capital-intensive production process mainly in England (core country) two centuries ago and is nowadays considered a labour-intensive production process of the periphery (for instance Bangladesh). Nations and regions can move in and out of the semi-periphery, but as stated previously, moving upwards is difficult and some world-systems theorists argue it might come at the cost of a downward shift of other nations and zones (Goldfrank, 2000).

On the political side, the capitalist world-economy is characterised by an inter-state system, which has been defined by Chase-Dunn (1998, p. 142) as “a system of unequal powerful [political as well as military] and competing states in which no single state is capable of controlling all others”. Although no country has managed to control all remaining countries in the modern world-system, the core always has, and always will, dominate the periphery (Goldfrank, 2000). Semi-peripheral states are again in between both types and have to accept power dominance from the core, while exercising it on peripheral countries (Wallerstein, 2004b). Those dominances reinforce the concept of unequal exchange, where surplus-value flowing from the periphery to the core is also used as a modern form of “tribute” to ensure peace among the nations (Amin, 1976).

Cycles also occur on the political level and take the form of fluctuations in the centralisation and decentralisation of the political management in the system (Chase-Dunn and Grimes, 1995). The capitalist world-economy does not allow for empire formation (although some strong countries would probably like to transform the current system into a world-empire), mainly because even the most powerful state within the economy needs the inter-state system with its competitive capitalist character in order to guarantee endless accumulation of capital by controlling international trade (Chase-Dunn and Grimes, 1995). Hence, a world-empire with its single political centre would repress capitalism. However, as mentioned before, cycles of centralisation and decentralisation do exist and result in a rise and fall of hegemonic power of core states within the current system, a process labelled the hegemonic sequence (Chase-Dunn and Grimes, 1995). Hegemonies arise usually after long wars in which the world order has been destroyed (Wallerstein, 2004b). They stabilise the system, they are the leaders in finance, trade, production and usually military power, they control international trade to favour the core countries and, therefore, they create a strong environment of quasi-monopolies in which capitalist firms settle (Wallerstein, 2004b, Goldfrank, 2000). Just as quasi-monopolies disappear over time, hegemonic power cannot last

forever, since more and more countries catch up with the economic leadership of the hegemon resulting in a decrease in hegemonic power (Wallerstein, 2004b). Until today Wallerstein's (1983) hegemonies in the capitalist world-system have been the United Provinces of the Netherlands (seventeenth century), the United Kingdom (eighteenth and nineteenth century) and the United States of America (since 1945), while Modelski and Thompson (1988) also include Portugal of the sixteenth century in the list of hegemonic powers of the current system.

Wallerstein (2004b, p. 59) summarises some of the main political features of our current system as follows: "The capitalist world-economy needs the states, needs the inter-state system, and needs the periodic appearance of hegemonic power. But the priority of capitalists is never the maintenance, much less the glorification, of any of these structures. The priority remains always the endless accumulation of capital [...]".

#### **2.1.4. Summary of the theory's criticism**

Wallerstein's theory first bore fruit among students of Columbia University (Chirot and Hall, 1982), where Wallerstein himself had received his academic degrees and had given lectures until 1971. A few years later, the theory had spread widely and already a variety of books had been published on the topic of world-systems theory by its main supporters, some of the most important until today being Janet Abu-Lughod, Samir Amin, Giovanni Arrighi and Andre Gunder Frank. Quantitative studies of the theory began to be developed by a research centre at Stanford University at the end of the seventies (Chirot and Hall, 1982). Christopher Chase-Dunn, Albert Bergesen and Richard Rubinson are some of the most quoted researchers in quantitative world-systems theory. Furthermore, two journals are being published on a quarterly basis dealing with the newest findings in world-systems analysis, first, *Review*, a journal from the Fernand Braudel Centre which had been led by Immanuel Wallerstein for many years and, second, the *Journal of World-Systems Research*.

However, world-systems analysis has also been constantly exposed to criticism over the years. Wallerstein (2004a) argues that the main point of criticism is the change of the unit of analysis from state-level to larger spatial and temporal zones, a main concept which world-systems analysis is built on. His theory has been further attacked by four groups: "the positivists, the orthodox Marxists, the state autonomists and, the culturalists" (Wallerstein, 2004a, p. 10).

Positivists criticise the lack of sufficient quantitative data to underline the theory which, in their view, results in world-systems theory not being credible enough and leads to a theory based on too many generalisations.

For orthodox Marxists, like Robert Brenner (1977), the theory lacks, first, a sound analysis of class structures and class struggles as well as the connection of both to economic growth and, second, the consideration of relations of production as a central factor of social change. He further argues that peripheral countries are not underdeveloped due to their dependence on core states, but that underdevelopment in the periphery calls for some form of dependence, a difference that is crucial for recommendations for development given to peripheral countries. According to Brenner (1977), Wallerstein does not explain the reasons for technological change and economic growth when capitalism began to rise and which kind of system will eventually replace the capitalist world-economy. Scholars in the group of orthodox Marxists are more in line with Dobb's argumentation for internal factors having caused the transition from feudalism to capitalism and think this aspect should be included more in world-systems theory. Contrary to the opinion of orthodox Marxists, Zolberg (1981) claims that Wallerstein's theory contains too many Marxist elements (mainly the elimination of Ricardo's comparative advantage and its consequences of unequal exchange between nations).

Theda Skocpol (1977) and Aristide Zolberg (1981) belong to the group of state autonomists and criticise, above all, an insufficient focus on the political level. In their opinion, the political sphere in world-systems analysis is excessively derived from the economic sphere. But politics is independent of economics and cannot be reduced to a reply to market behaviour. In general, Skocpol (1977), Zolberg (1981) and Brenner (1977) consider Wallerstein's theory as being disproportionately based on economic elements.

Culturalists argue in a similar way to state autonomists, but they look at the cultural sphere. According to culturalists, whose earliest representative that criticised Wallerstein's theory is Stanley Aronowitz (1981), culture should be of more importance in the theory and cannot be traced back to economics. Furthermore, culturalists claim that the theory is centred too much on the historical development of Europe and does not take into account other cultural identities.

With respect to the modern world-system, Wallerstein received criticism for dating its beginning to the sixteenth century. On the one hand, Abu-Lughod (1989) identifies the origin

of the capitalist world-economy in the thirteenth century, while Frank and Gills (1993) believe that earlier systems had a similar capitalist structure to the current world-system which in the end has not changed for the last five thousand years. Brenner (1977), on the other hand, argues that the industrial revolution in England in the eighteenth century marked the starting point of the world-system of our times.

## **2.2. Position of Singapore, Malaysia, Indonesia, Cambodia and Vietnam in the modern world-system**

In the following section, the countries relevant for this paper are positioned in the capitalist world-economy with respect to the core/periphery concept and Wallerstein's identified three zones: the core, the semi-periphery and the periphery. All authors of main empirical studies about this topic agree on the existence of the three zones, but find it difficult to draw the line between the core and the semi-periphery as well as the semi-periphery and the periphery, since the concept has a relational character. Consequently, countries can hardly be grouped with a high level of certainty in one of the zones. Nevertheless, in order to be able to eventually draw a conclusion, the countries Singapore, Malaysia, Indonesia, Cambodia and Vietnam will be grouped by the author using, first, already existing quantitative studies which include the mentioned countries and, second, selected data to show graphically the differences between those countries. Both parts will be carried out after a short summary of the zones in the current world-system.

### **2.2.1. The world-systems zones: core, semi-periphery, periphery**

All three zones have already been defined and discussed. Therefore, only the main characteristics are mentioned to recall the earlier described theory. Core countries (in core zones) are considered wealthy. They consist of stronger states with high levels of power and focus on capital-intensive, high-profit and high-technology production in quasi-monopolies that are protected by the state. Peripheral countries (in peripheral zones) are considered poor. They have weaker states and produce labour-intensive, low-profit and low-technology goods in competitive markets. Between both extremes lies the semi-peripheral zone with countries characterised by a mixture of both production types, whose main competitors are located in the same zone. In quantitative studies of zones, almost all countries have at least once been identified as being semi-peripheral, but no country belongs to the semi-periphery in all studies (Terlouw, 2003).

Semi-peripheral countries are considered the most dynamic ones within the capitalist world-economy maximizing "the need and the necessity for development" (Terlouw, 2003, p.

5), due to their constant struggle to move upwards and fight downwards movement. However, upward movements of any kind are the exceptions within the system (Arrighi and Drangel, 1986; Chase-Dunn and Grimes, 1995; Wallerstein, 2004a) and require the possibility to challenge the core with innovation and new technology (Chase-Dunn, 2013). Nevertheless, Singapore has been repeatedly identified as having accomplished a shift from one zone to the other (Chase-Dunn and Grimes, 1995) although Wallerstein states that upward movements cannot be called “‘development’ but successful expropriation of world surplus” (Wallerstein, 1976, p. 466), because it happens at the expense of other countries or zones.

Globalisation and deindustrialisation of the core zone have been considered by some authors as factors which flatten the current world-system (Chase-Dunn, 2013). But, the whole system has, in fact, not become more equal in terms of development and income (Bornschier, 2010) and the structure of the capitalist world-economy exists just like before. According to Kentor (2000, 2008), the core zone can be found in the so called “global north” meaning North America and Europe, while the “global south” is divided into the semi-periphery (most of Central and South America) and the periphery (most of Africa). In Asia a mixture of all three zones can be found. Babones (2005, p. 53) concludes that “keeping in mind that the vast majority of the world’s population lives in the periphery of the world-economy, it would not be an unworthy goal to focus on ways to help peripheral countries attain semiperipheral income levels”.

### **2.2.2. Grouping of countries in world-systems literature**

Some of the main empirical works considering the grouping of the countries Singapore, Malaysia, Indonesia, Cambodia and Vietnam in world-systems zones have been summarised in Table 1 on the following page. Four of the five countries relevant for this paper can be found in two zones, depending on the methodology and time frame applied by corresponding authors of the quantitative studies. Only Cambodia has been continuously labelled a peripheral country. Malaysia, Indonesia and Vietnam seem to be somewhere between the periphery and the semi-periphery, but this fact has only been spelled out for one country, Indonesia, by Kentor (2000). Singapore is the only country that has been categorised as a core state by Babones (2005), but it appears to lie in between the core and the semi-periphery with respect to the other literature. Two of the five studies in the table, those prepared by Kentor (2000) and Chase-Dunn, Kawano and Brewer (2000), have included all relevant countries in their data research, while in all other works only some of the countries have been considered and, consequently, the authors are not named in every country row. All empirical studies



mentioned in the table will be discussed in more detail. Furthermore, some other important quantitative analysis for world-systems zones will be pointed out which cannot be found in the table, since the five countries needed for the paper are not included.

**Table 1:** Grouping of countries by world-systems zone (core, semi-peripheral, peripheral) with respect to literature on the topic

Country	World-systems zone		
	Core	Semi-peripheral	Peripheral
Singapore	- Babones (2005)	- Chase-Dunn, Kawano, Brewer (2000) - Kentor (2000)	
Malaysia		- Kentor (2000) - Babones (2005)	- Chase-Dunn, Kawano, Brewer (2000)
Indonesia		- Wallerstein (1976) - Chase-Dunn, Kawano, Brewer (2000)  - Kentor (2000)	- Arrighi, Drangel (1986) - Babones (2005)
Cambodia			- Chase-Dunn, Kawano, Brewer (2000) - Kentor (2000)
Vietnam		- Wallerstein (1976)	- Chase-Dunn, Kawano, Brewer (2000) - Kentor (2000)

In 1976, Wallerstein wrote an article on semi-peripheral countries mentioning a large number of countries belonging to that zone, among others Indonesia and Vietnam. Arrighi and Drangel (1986) saw little empirical evidence of Wallerstein’s list which puts almost two-thirds of the world population in the semi-periphery. According to them, “the list simply includes all states that seem to occupy an intermediate position in the world-economy from the point of view of either their income levels or their power in the interstate system” (Arrighi and Drangel, 1986, p. 14). Arrighi and Drangel (1986) conducted their own research looking at changes in the income level of countries over four decades by taking into account the distribution of GNP per capita. Overall, they identified three income zones in their work which proved the existence of the world-systems zones and Indonesia is considered an “organic member” of the periphery. Some years later, Korzeniewicz and Martin (1994) when looking at more countries and data, confirmed the results of Arrighi and Drangel’s study. Babones (2005) found both approaches lacked a clear statistical definition of the boundaries of zones and provided his own quantitative work of the income structure approach by using different analytical tools based on national income statistics over 28 years. 70% of the countries (103) he studied are labelled “organic” and, therefore, clearly belong to one of the

three zones, some of which are Singapore (core), Malaysia (semi-periphery) and Indonesia (periphery).

A second group of empirical studies focuses on the combination of economic and political power indicators for the grouping of countries. Terlouw (1992) developed the first main work in this group using the mean level of six different indicators which are: Gross domestic product (GDP) per capita as a percentage of the world GDP per capita (economic indicator), the trade level (economic indicator), the stability of trade relations (economic indicator), number of embassies sent and received (political indicator), number of diplomats sent and received (political indicator) and government expenditure for the military (political indicator). For Babones (2005), Terlouw's study provided a good first insight to world-systems zones, but he criticised an unequal weighting of all indicators as well as a bias in the selection of countries. Chase-Dunn, Kawano and Brewer (2000) applied Terlouw's indicators in their analysis on trade globalisation over a longer period of time and came to the conclusion that Singapore and Indonesia are semi-peripheral countries, while Malaysia, Cambodia and Vietnam are peripheral countries. Until today, Kentor (2000, 2008) conducted the largest quantitative measure of world-systems structure taking into account ten different variables (economic and political) over the duration of the twentieth century with the following results:

- i. 1980: Malaysia and Indonesia are in the lower semi-periphery with the latter having a slightly higher rank, while Singapore is not listed.
- ii. 1990: Singapore is in the upper semi-periphery and Malaysia and Indonesia have improved their rank reaching a steady semi-peripheral position.
- iii. 2000: Singapore stays in the upper semi-periphery, Malaysia slightly increases its rank, while Indonesia falls back almost reaching the periphery.
- iv. Cambodia and Vietnam are continuously grouped in the peripheral category.

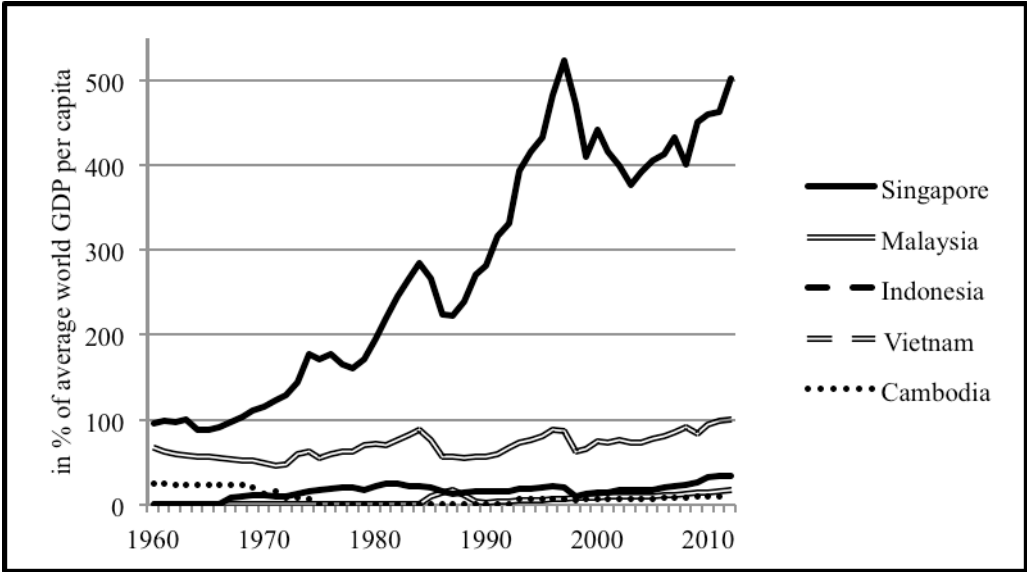
Due to insufficient data for all ten variables during the whole century, results have not been published for the years before 1980.

Social network approaches are the final group of empirical analyses on the structure of the capitalist world-economy. These types of studies use indicators of interaction between nations to filter similarities and differences of countries within a social network and, by doing so, try to identify a country's relational position. Main network-based analyses have been carried out by Smith and White (1992) and Van Rossem (1996), but they do not show results for the countries considered in this paper.

**2.2.3. Selected data on the grouping of countries**

To visualise and support the above mentioned categorisation of Singapore, Malaysia, Indonesia, Cambodia and Vietnam and in order to reach a final grouping of the countries for the purpose of this paper, four indicators are selected and will be analysed. The indicators are chosen in line with the economic and political power approach of quantitative studies, since the definition of each world-systems zone is well represented in this way of measuring.

Economic power is shown by relating the countries' capacity of production to the world's average measured in GDP per capita as a percentage of the average world GDP per capita from 1960 to 2012 which is illustrated in Figure 1. Singapore is well above the world's average GDP per capita, the 100% line, reaching values up to five times of it. All other countries are continuously below the global average. Most of the countries are even below the 35% line, except for Malaysia (values above 46%) which catches up with the average in the last year of data shown (2012). Data for Indonesia is missing during the first six years and Vietnam has only data from 1985 onwards. Furthermore, data for Cambodia is not given between 1975 and 1992.



**Figure 1:** GDP per capita as % of average world GDP per capita, 1960-2012 (data from World Bank, 2014a)

The percentage of high-technology exports of total manufactured exports of every country is considered between 1990 and 2011 which is shown in Figure 2 on the next page. High levels of technology are a characteristic of core-production which can be found mainly in the core and the semi-periphery. The indicator is also a measure of power at the economic level. Singapore and Malaysia have similar developments of high-technology exports which

are roughly between 40% and 60% of all manufactured exports and their values are significantly higher than the worldwide average, which is located at around 20%. Indonesia, Vietnam with data since 1997 and Cambodia with data since 2000 onwards always stay below the average, while the latter has high-technology exports of less than one percent of total manufactured exports.

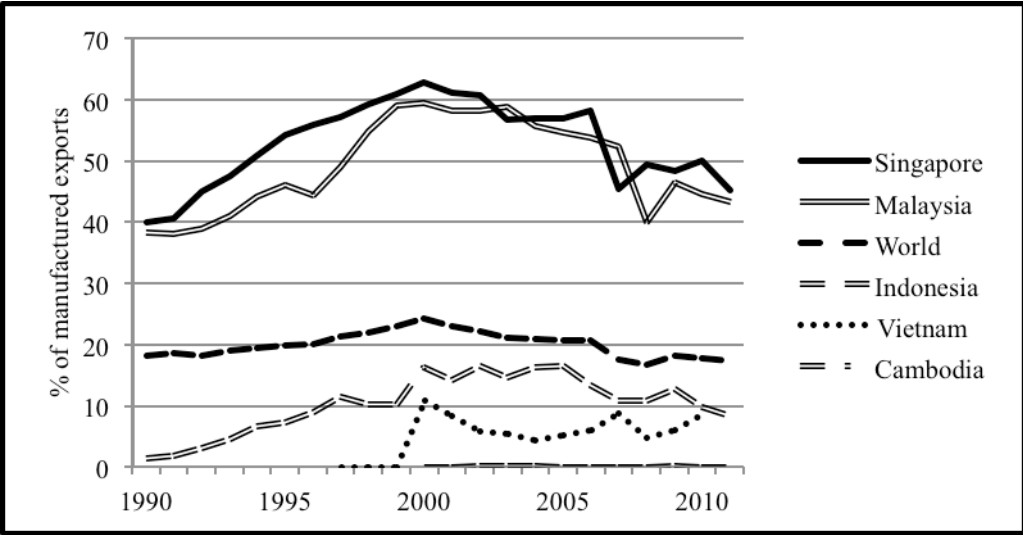
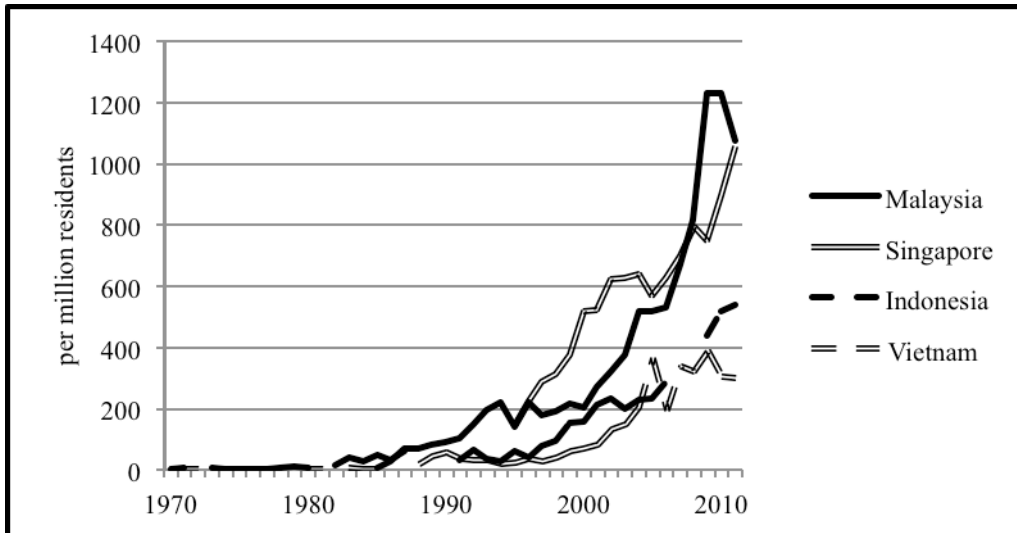


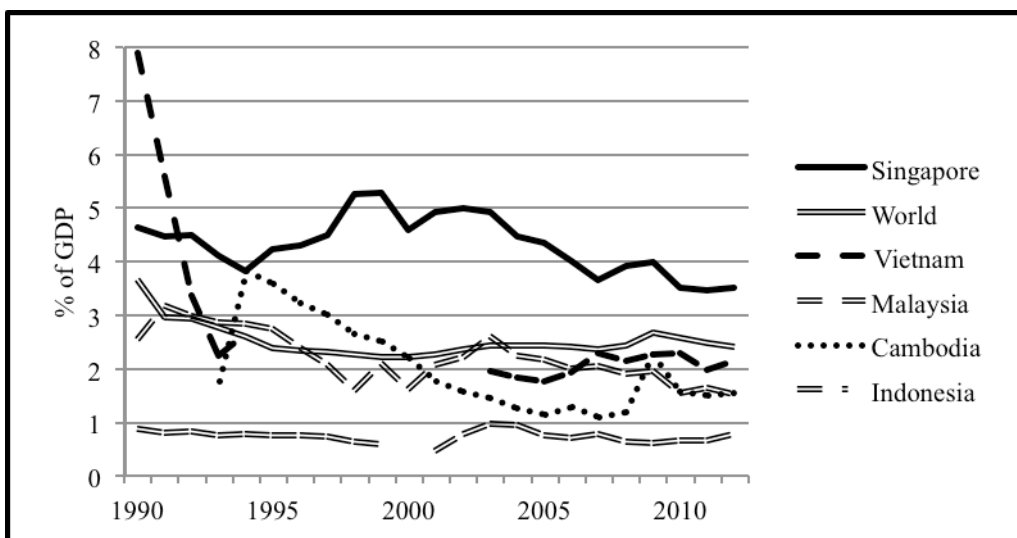
Figure 2: High-technology exports in % of manufactured exports, 1990-2011 (data from World Bank, 2014a)

Figure 3 on the following page presents patent applications per million residents from 1970 to 2011 in order to demonstrate the countries’ level of innovation which is needed for possible upward movement in world-systems zones. While in all countries an overall upward trend in patent applications can be noted, Singapore and Malaysia compete with each other on a higher scale than Indonesia and Vietnam, especially since the nineties with peaks of 1,234 applications per million residents in Malaysia in 2009 and 1,056 in Singapore in 2011. No data about patent applications was available for Cambodia.



**Figure 3:** Patent applications per million residents, 1970-2011 (data from World Bank, 2014a)

The importance of military power in every country as an indicator of political power is taken into account by measuring the countries' military expenditure as a percentage of GDP between the years 1990 and 2012 demonstrated in Figure 4. Singapore spends between 3.4% and 5.3% of GDP on its military force, whereas the world's average lies between 2.2% and 2.9% except for the year 1990 (3.7%). All other countries are most of the time below the global average of military expenditure in relation to GDP, apart from the period between 1994 and 1999 in Cambodia and the sharp decrease from levels high above the worldwide average in Vietnam at the beginning of the nineties, after which data for the country is missing until 2003. Indonesia's values of military expenditure as percent of GDP are constantly below one percent.



**Figure 4:** Military expenditure in % of GDP, 1990-2012 (data from World Bank, 2014a)

The indicators and data selected can only provide a general idea of the position of states in the modern world-system and should be considered more as a way of visualising the earlier mentioned quantitative studies. The number of indicators, the data found and the time periods selected are limited and cannot serve as strong empirical evidence of the position of countries. However, in line with the relational character of the concept of core/periphery, the lower positions of Indonesia, Cambodia, Vietnam and sometimes Malaysia with respect to Singapore can be seen in the graphs.

Bringing together the countries' position in the analysis of existing empirical studies and the data shown, the author of this paper suggests the following final grouping of countries which will be applied going forward: Singapore and Malaysia are semi-peripheral countries. However, Singapore can be found in the upper semi-periphery (sometimes named semi-core) and Malaysia is a very steady semi-peripheral country. Indonesia, Vietnam and Cambodia belong to the periphery and are ranked in exactly that order within the zone which means that Indonesia is located in the upper, Vietnam in the steady and Cambodia in the lower periphery. In order to confirm this positioning of countries, more empirical research would be needed, but as mentioned already no country can be placed with high certainty in one of the world-systems zones.

### **2.3. Environment and natural resource extraction in the modern world-system**

Two decades after the introduction of world-systems theory, scholars intensified research on the environmental dimension of the theory which led to a "greening" of world-systems analysis with some of the important academics in the area being: Albert Bergesen, Stephen G. Bunker, Sing C. Chew, Alf Hornborg, Andrew K. Jorgenson and Jason W. Moore. Today, one can find a variety of publications on the topic ranging from general and very theoretical articles about how to include the environment in world-systems analysis (discussed only briefly in the following paragraph) to specific examples concerning environmental problems (i.e. global warming, environmental degradation, resource extraction limits) especially in the current world-system.

Chew (1997) shifts the analysis of world-systems from socio-economic relations to ecological relations by arguing that in the long run nature defines the limits of the possibility of reproduction within a system and, when reproduction does not occur anymore, the system's transition. Hence, nature's limits are the limits of every system and the interaction between cycles and trends in a system (the system's dynamics) and limits of nature are responsible for the direction in which world-systems move historically (Chew, 1997). Moore (2011) goes one

step further by renaming the modern world-system a “world-ecology”. In his view, social change should be considered as socio-ecological change and, therefore, capitalism arises as a consequence of human’s relation to nature, instead of being built upon nature as a passive factor of change (Moore, 2011). By seeing nature as an active change factor, he further suggests that “we move from the ‘environmental history’ of modernity, to capitalism ‘as environmental history’” (Moore, 2011, p. 112).

However, most of the more specific current literature on the environment and the modern world-system is concerned with, first, the way in which nature has helped capitalism to develop and, second, the consequences the capitalist world-economy has for nature. The second direction of current literature is considered the most important for the presented paper. Nevertheless, the first direction will be shortly outlined.

Bunker (1984, 1985) has shown that capitalism was only able to progress because the modern world-system consisted (and still consists) of so called productive economies and extractive economies in relation to natural resources which are essential for capital accumulation. The mode of production in a higher world-systems zone is linked to the mode of extraction in a lower zone. This link will eventually lead to ecological degradation which can nowadays be found in general between the global north (producing goods and accumulating wealth) and the global south (extracting resources and exporting them to the global north). Furthermore, ecological degradation is considered as being the cause and, at the same time, the consequence of underdevelopment in extractive economies (Bunker, 1985; Chase-Dunn and Hall, 1997a; Burns, Kentor and Jorgenson, 2003).

Concerning the second direction mentioned, the capitalist world-economy is unable to resolve the problem of ecological degradation, because it requires constant expansion, due to priority being given to endless accumulation of capital. But, its expanding character has already reached the global level and there are no zones left outside the system which could be incorporated and used for further expansion or as extractive economies (Wallerstein, 1999, 2004a; Chase-Dunn and Hall 1997b; Chew, 1997; Jorgenson and Kick, 2003). Nevertheless, the expanding character cannot only be found on an economic level. Population growth, a trend in the modern world-system, also results in ecological degradation, since the natural resources available are limited and an increasing number of inhabitants of the capitalist world-economy has to live with a constant amount of natural resources (Bartley and Bergesen, 1997). Consequently, the current system is close to its economic and demographic growth

limits and, with that, it also reaches its environmental limits which could result in a crisis of the whole system (Chase-Dunn and Grimes, 1995).

Other consequences the capitalist world-economy has on nature can be linked to the system's core/periphery concept. The core uses high amounts of natural resources for capital accumulation which leads to high economic growth and better standards of living. For instance, Burns, David and Kick (1997) have looked at carbon dioxide emission levels which decrease with the zones from the core to the semi-periphery to the periphery. The periphery is faced with low growth rates and low standards of living, but also less use of resources for its own consumption (Bergesen and Parisi, 1997). Therefore, excluding possible exploitation of lower zones by higher zones within the capitalist world-economy, the core/periphery concept has reverse effects on humans and the environment or as Bergesen and Parisi (1997, p. 365) say "Being in the core is good for humans [...] but bad for the nature, which pays the price for these human advantages. Being in the periphery is bad for humans [...] but this is good for the environment, as less is extracted and used".

In order to find out to what extent natural resource consumption is affected by a country's position in the modern world-system, Jorgenson (2003) has conducted a cross-national comparison of the so called *ecological footprint* including 208 countries of all zones of the current world-system. The ecological footprint has been developed in the early nineties by Mathis Wackernagel and William Rees (Wackernagel and Beyers, 2010) and is a demand side measure which identifies "how much land and water area a human population uses to provide all it takes from nature [...] [including] the areas for producing the resource it consumes, the space for accommodating its buildings and roads, and the ecosystems for absorbing its waste emissions such as carbon dioxide" (Global Footprint Network, 2014a). The ecological footprint further identifies levels of biodiversity and already today 1.5 earths would be needed to allow for the current lifestyle worldwide (Wackernagel and Beyers, 2010). Jorgenson (2003) concluded that a country's position in the capitalist world-economy significantly affects in a direct and indirect way (via domestic inequality, urbanisation and literacy rates) the per capita ecological footprint and, therefore, natural resource consumption and waste generation. Consequently, countries in the core have high, and countries in the periphery low, per capita ecological footprints. A comparison of values of ecological footprints given in global hectares per capita of the years 1960 and 2007 including the world's average and the countries relevant for this paper can be found in Table 2. It should be highlighted that in 1960 all five countries still had ecological footprint values below the



global average, while about five decades later Singapore and Malaysia reached values almost twice the worldwide average and got close to the average of high-income states with 6.1 global hectares per capita. Only Indonesia and Cambodia managed to reduce their ecological footprint over the last decades.

**Table 2:** Per capita ecological footprint of the world, Singapore, Malaysia, Indonesia, Vietnam and Cambodia in 1960 and 2007 (data from Global Footprint Network, 2014b)

Country	Ecological Footprint (global hectares per capita)	
	1960	2007
World	2.3	2.7
Singapore	1.8	5.3
Malaysia	1.6	4.9
Indonesia	1.4	1.2
Vietnam	0.7	1.4
Cambodia	1.7	1.0

The core/periphery concept is also a model of exploitation. As mentioned already, countries in higher world-systems zones use natural resources from extractive economies which are located in lower zones. The core is exploiting the periphery (Chew, 1997; Bergesen and Parisi, 1997, Jorgenson, 2003, Jorgenson and Kick, 2003) and the process's resulting ecological degradation is the cause and the consequence of underdevelopment in the periphery. Hornborg (2003) develops this idea further into the zero-sum game perspective of world-systems analysis. The neoclassical approach to resolve environmental problems is so called *sustainable development*, a combination of economic, social and ecological spheres which should all be preserved while development occurs. Further growth, following sustainable development, will be beneficial to both the economy and ecology on a global level (Hornborg, 2003). However, the world is finite and for world-systems scholars a closed system. Hence, economic growth in one part of the system can only happen at the expense of another part within the same system which is in the end a zero-sum game. Relating this back to ecological degradation, Hornborg (2003) argues that the environmental problems in the periphery are the result of economic growth and development in the core and are, therefore, intensified by further growth. Only cooperation on a global scale, including the participation of all countries in the capitalist world-economy, can be considered a remedy to environmental problems (Bartley and Bergesen, 1997).

### **3. Sand extraction for export reasons to Singapore**

#### **3.1. The natural resource sand**

When thinking about natural resources and problems related to them which have to be faced nowadays, sand is usually not the first one that comes to mind. Current discussions worldwide revolve around topics like insufficient amounts of easily accessible fossil fuels, water scarcity, deforestation and overfishing. However, in some parts of the world sand is seen as a continuously increasing problem which will be shown after a general introduction about the natural resource sand.

Sand is a granular material, which contains rock reduced to very small pieces and many different types of minerals. Sand grains vary in size ranging from very fine grains with 0.06 millimetres in diameter to fine, medium, coarse and very coarse sand grains with up to 2 millimetres in diameter classified by Chester K. Wentworth in 1922 (Wentworth, 1922). Grain sizes above 2 millimetres in diameter are considered as being gravel and below 0.06 millimetres in diameter are named silt and mud (Wentworth, 1922). Wind is much stronger and aggressive in shaping sand grains than water power (Welland, 2009). Therefore, sand found in the desert is finer and rounder than sand in oceans, seas, lakes and rivers. The composition of minerals depends on the type of sand which can develop over very long periods of time, for instance, through the grinding of rocks by glaciers, through the decomposition of sea shells and through the eruption of volcanos or meteorite impacts (Welland, 2009). However, the most common form of sand development results from the earth crust being affected by weathering (Welland, 2009). The earth crust is composed of about 50% oxygen and 25% silicon and, consequently, sand's main "ingredient" consists of two oxygen atoms and one silicon atom and is called quartz with its chemical name being silicon dioxide ( $\text{SiO}_2$ ) (McWhan, 2012). Other minerals which can be extracted from sand are feldspar, pyroxene, amphibole, olivine, titan, uranium, chlorite, zircon and thousands more (Sepp, 2014).

Sand is a constituent element in a vast array of products present in everyday life. It is most heavily utilised in the construction industry for structural and civil engineering projects. Today two thirds of buildings and industrial plants are made of reinforced concrete, which in turn consists of two thirds of sand (Ertinger, 2013). The production of concrete reached 2.8 billion tons in 2008 of which China alone produced more than one billion (Bardi, 2013). The construction industry highly depends on economic growth within a country and, hence, the demand of sand increases with economic growth (Lebensministerium and BMWFJ, 2011).

Emerging countries with strong and rapid growth have the highest demand for sand and gravel which is used for new constructions (Lebensministerium and BMWFJ, 2011). For purposes of maintenance and reconstruction developed countries consume more than ten tons per capita in contrast to less than one ton per capita needed in developing countries (Lebensministerium and BMWFJ, 2011). Sand is also utilised for land reclamations, beach erosion protection and beach replenishment (U.S. Geological Survey, 2012). Furthermore, sand is processed in high quantities in the glass industry and nowadays also in fracking (hydraulic fracturing) (U.S. Geological Survey, 2012; McWhan, 2012), where it is mixed with water and chemicals and pumped into a well at high pressure which cracks rocks and, therefore, enables the extraction of gas and petroleum. Quartz crystals extracted from sand are used for microchips which can be found in most electronic devices like computers, televisions, mobile phones, cars, etc. (U.S. Geological Survey, 2012; McWhan, 2012). The silicon in sand can be found in many products of the cosmetic and textile industry (McWhan, 2012). And the list goes on.

However, before sand can be processed for the purposes just mentioned, the natural resource has to be “produced” or extracted through sand mining. More than 15 billion tons of sand and gravel were produced worldwide in 2008 (Bardi, 2013), but the exact number is assumed to be much higher, due to illegal sand mining activities. For instance, a large part of the construction industry in Mumbai is controlled by the sand mafia which extracts the natural resource in around 8,000 illegal sites on the coast of India (Ertinger, 2013). Illegal sand extraction is also problematic for Morocco, where the largest operations of illegal beach sand extraction can be found (Pilkey, Young, Kelley and Griffith, 2007). Apart from huge environmental problems like the loss of ecosystems and the increased danger of erosions, the situation in Morocco further led to a significant decline in tourism, because beach areas are lunar-like landscapes today (Pilkey, Young, Kelley and Griffith, 2007).

In most cases sand is mined from an open pit, meaning that it is directly taken away from the surface layer by layer in a mining site on solid ground. In some countries sand is extracted legally from beaches and it can also be dredged from riverbeds, lakes, sea beds and oceans. Extraction of sand by dredging it from the ground of deep water bodies is done by using dredgers which can pump up to 400,000 cubic metres of sand in one day (Ertinger, 2013). But it is a very costly method, since the price of a dredge in Europe ranges from 20 to 150 million euros (Ertinger, 2013).

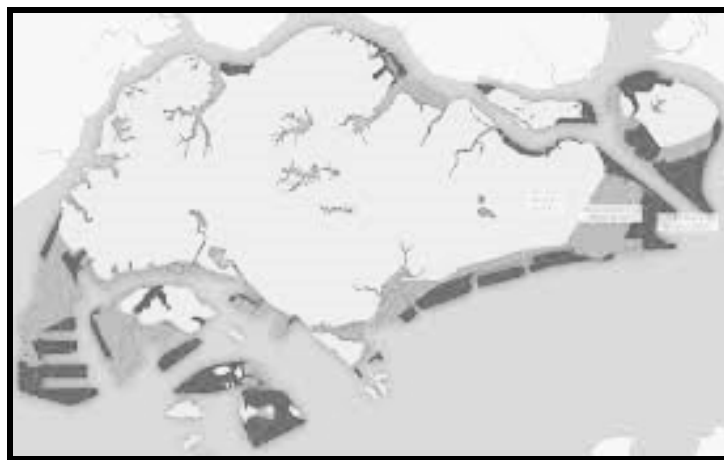
Nevertheless, the amounts of sand extracted from sand mines or dredged from water bodies are “free”, if money which needs to be paid for any kind of consequences of sand extraction - for instance collapse of river beds, erosion of land, disappearance of beaches, decrease in water quality, loss of habitat and related social consequences (San Diego State University, n.d.) - is not considered. Due to the very low price of sand in general, the distance between the place of extraction and processing is usually not more than 30 to 50 kilometres (Lebensministerium and BMWFJ, 2011). The cost of transportation over large distances would quickly exceed the price of sand. Consequently, sand is highly important for domestic commerce, but normally not for international trade.

The U.S. Geological Survey (2012) categorises sand resources worldwide as being abundant, while their extraction is not always economic, due to quality requirements of the resource for further processing of some specific goods, environmental constraints and unequal geographic distribution. Consequently, international trade of sand is sometimes necessary despite high transportation costs. The United Arab Emirates imported immense amounts of sand from Australia for the construction of the skyscraper Burj Khalifa, the tallest building in the world, in Dubai (Ertinger, 2013). With the earlier construction boom in Dubai and the land reclamation projects “The Palm” and “The World”, which together needed more than 600 billion tons of sand, the country’s own sand resources extracted from the Persian Gulf had been exhausted. Although the United Arab Emirates is surrounded by desert sand, it depends on sand imports, because desert sand is too roundly shaped by the wind and, hence, useless for the construction industry (Ertinger, 2013). Another example for a country highly dependent on sand imports is Singapore which will be analysed in the following section.

### **3.2. Singapore’s sand consumption**

The city-state Singapore is located at the southern part of the Malay Peninsula separated by the Straits of Johor from its neighbouring country Malaysia and by the Singapore Strait from Indonesia. The country gained independence from the United Kingdom in 1963 and from Malaysia in 1965. Ever since its independence, Singapore developed at a high pace with average GDP growth rates of 7.7% (World Bank, 2014a) and moved from being a low income country to one of the most competitive economies in the world (World Bank, 2013a). While the population of Singapore in 1965 was 1.887 million, the country was home to 5.312 million people in 2012 (World Bank, 2014a). With an area of 716.1 square kilometre in 2012 (World Bank, 2014a), which is about 80% of the area of Germany’s capital Berlin, it has a rather high population density of 7,418 people per square kilometre.

Economic and population growth at this scale require the construction of buildings for private and commercial use, industrial plants and infrastructural improvements (roads, airport facilities, schools, bridges, hospitals, ports, etc.). Consequently, high amounts of sand are needed. Furthermore, these constructions require land to be built upon, which in the case of Singapore is not sufficiently available. Hence, the country started large-scale land reclamations since the sixties and increased its area already by more than 120 square kilometres (Welland, 2011) which is shown in Illustration 1 by the medium grey area. The Singaporean government plans more land reclamation of an additional 100 square kilometres by 2030 (Gray, 2011) marked as dark grey areas in the illustration.



**Illustration 1:** Land reclamation in Singapore; original land size (light grey), land reclamation until 2013 (medium grey), reclamation project until 2030 (dark grey) (Rafferty, 2013)

Land reclamations consume even more sand. In order to gain one square kilometre of land from a former sea area, more than 70 million tons of sand are required, an amount that can be compared to three and a half times the volume of the entire Empire State Building in New York City (Milton, 2010). Since Singapore is a very small country, it owns hardly any resources. For the first land reclamation projects, sand had been extracted from the country's hills which have their highest point at 166 metres above sea level (CIA, 2014a) and are therefore rather small. However, the available sand resources are long gone (Gray, 2011). Dredging sand from the sea is not an option in Singapore, because, on the one hand, it is very expensive and, on the other hand, the sea area belonging to the country covers only 10 square kilometres (CIA, 2014a). Consequently, Singapore has depended on sand resources from other countries for many years already; a situation that will continue.

Malaysia was an important supplier of sand to Singapore in the nineties, due to its convenient location which decreased transportation costs. However, the Malaysian

government banned sand exports to its neighbouring country in 1997 (The Economist, 2009). Afterwards, most of Singapore's sand demand was met by its second neighbour, Indonesia, until coastal sand exports were prohibited in 2003 and all types of sand exports were banned in 2007 (Leong, 2007). Singapore then had to accept larger transport distances and turned to Cambodia for its sand imports. But the Cambodian Prime Minister, Hun Sen, officially forbade sand exports from rivers to Singapore in 2009, while sand extraction from some sea beds for export reasons to Singapore was still allowed (Gray, 2011). Eventually, Singapore's sand came also from Vietnam, which followed Cambodia in outlawing sand exports temporarily only a few months later (The Economist, 2009).

Nevertheless, Singapore keeps growing and needing sand, therefore, 14.6 million tons of sand were imported legally to Singapore in 2010 from various supplying countries which are not published as public information (Gray, 2011). The real number could be much higher when taking into account the quantities of illegal sand flowing into Singapore. Due to the issuing of export bans by all the named countries above, the price of the natural resource went up significantly which, in turn, increased incentives for illegal sand export/import activities (Murray, 2011). Therefore, illegal sand exports are continuously reported of all four countries, Malaysia, Indonesia, Cambodia and Vietnam, in a variety of newspapers.

### **3.3. Singapore's sand suppliers**

The following section provides summaries of Singapore's main sand suppliers, Malaysia, Indonesia, Cambodia and Vietnam, including their location, economic situation as well as details about their sand production. The countries are presented in chronological order with respect to the date export bans for sand had been issued.

#### **3.3.1. Malaysia**

Malaysia is split in two areas. The first can be found north of Singapore on the Malay Peninsula bordering Thailand, while the second area accounts for one third of the territory of the island of Borneo which also belongs to the countries of Indonesia and Brunei. The country's area consists of almost 330,000 square kilometres, of which about 1,200 square kilometres is territorial water (CIA, 2014b). The country had been a major exporter of agricultural products until the eighties when Mahathir Mohamad became the country's prime minister for a continuous 22 years. He diversified the economic structure of Malaysia, focusing on manufactured goods and services (CIA, 2014b). The economy grew on average 6.28% (World Bank, 2014a) during the years of his term of office. The World Bank (2014b) lists Malaysia in the upper-middle income countries, but the nation developed economic plans

to become a high income economy by 2020. Singapore is currently its main export partner (13.6% of total exports) and the second most important import partner (13.3%) after China (15.1%) (CIA, 2014b).

Sand resources to be exported to Singapore have mainly been extracted near the Straits of Johor, just north of Singapore (Gray, 2011) until the government imposed its sand export ban in 1997. Official production of sand and gravel between the years 2007 and 2010 ranged from 17.4 million tons to 30.7 million tons (U.S. Geological Survey, 2013a). However, during the same period, more than 6 million tons (estimated) of sand were exported illegally from Malaysia to Singapore via the Sungai Johor (Murray, 2011).

### **3.3.2. Indonesia**

Indonesia is widely spread between the Indian and the Pacific Ocean and consists of more than 17,500 individual islands of which 6,000 are inhabited (CIA, 2014c). It shares borders with Malaysia, Papua New Guinea and Timor-Leste. Of the five countries discussed in this paper, Indonesia is the largest with an area of more than 1.9 million square kilometres, of which 93,000 square kilometres are water territory. Indonesia belongs to the middle income countries (World Bank, 2014c) and the country's GDP grew on average 5.9% from 1965 to 2012 (World Bank, 2014a). 9% of its exported goods went to Singapore in 2012, while 13.6% were imported from Singapore (CIA, 2014c). With a population of almost 247 million people in 2012 (World Bank, 2014a), Indonesia is also the most populated of the five countries. However, the growth of job opportunities has been less than the population growth and Indonesia faces widespread poverty, with almost half of its population living below the national poverty line at US\$ 22 per month (World Bank, 2014c).

The U.S. Geological Survey (2013b) categorises Indonesia as a country abundant in natural resources and minerals. Deforestation and the resulting increase in forest fires, whose smoke and haze also affect neighbouring countries, are a major problem in Indonesia (CIA, 2014c), as is the exploitation of natural resources (U.S. Geological Survey, 2013b). Indonesia had been the main sand supplier to Singapore for many years, even when Malaysia still exported sand to Singapore. Sand was mainly extracted from the province Riau in the East of the Indonesian island Sumatra and the nearby Riau islands (Abbugao, 2007). Approximately 600 million tons of sand per year were exported to Singapore (Leong, 2007) until Indonesia prohibited sand exports in 2007. The country had already banned exports of marine sand in 2003, but exporting companies simply labelled marine sand as coastal or land sand afterwards (Leong, 2007).

### **3.3.3. Cambodia**

The southern part of the Indochina Peninsula belongs to Cambodia which borders with Vietnam, Thailand and Laos. Cambodia is the second smallest of the five countries after Singapore in size (181,000 square kilometres) (CIA, 2014d) and population (14.8 million people in 2012) (World Bank, 2014a). The Khmer Rouge regime, which captured the country's capital in 1975 and caused the death of approximately 1.5 million inhabitants, left the country economically destroyed. After the last elements of the regime had disappeared in 1999, the country's average GDP growth was 8.25% until 2012 (World Bank, 2014a) with a strong textile and agricultural sector. However, poverty remains a serious issue in Cambodia (World Bank, 2013b).

The country has a high sand and gravel production which is partly needed for improvements in Cambodia's infrastructure (U.S. Geological Survey, 2013c). Sand production alone reached more than 38 million tons in 2010 and it is expected to continue to increase (U.S. Geological Survey, 2013c). Most of the sand exported to Singapore comes from Koh Kong province and the Tatai River (Gray, 2011) located in the southwest of the country. Although the country's prime minister Hun Sen, who already governs the country since 1985, prohibited river sand exports in 2009, sea sand as well as river sand licenses for extraction purposes had been issued by the government in 2009 and 2010 and approximately 800,000 tons a year of sand had been traded to Singapore (Global Witness, 2010). In 2010, Cambodia still accounted for 25% of total sand imports in Singapore (Gray, 2011).

### **3.3.4. Vietnam**

Vietnam can also be found on the Indochina Peninsula, in its most eastern part, and the country shares borders with Cambodia, China and Laos. It is the second most populated nation of the countries considered in this paper with 88.8 million inhabitants in 2012 (World Bank, 2014a). Vietnam's division into the communist North and the anti-communist South led to many years of low economic growth even after the reunification in 1976 (CIA, 2014e). However, the political and economic reform called *doi moi* implemented in 1986 managed to transform the country to reach lower middle income status (World Bank, 2014d) and GDP growth has been 6.6% on average from 1986 to 2012 (World Bank, 2014a). In 2011, the country presented its Socio-Economic Development Strategy which aims at constructing the basis for a modern and industrialised nation by 2020 (World Bank, 2014d).

The Mekong delta in the south of the country which encompasses more than 10% of Vietnam's total territory (CIA, 2014e) is very rich in biodiversity and natural resources. Most



of the sand exported to Singapore is extracted in this area (Hai, 2012). After its neighbouring country Cambodia outlawed sand exports in May 2009, the Vietnamese sand and gravel production increased sharply reaching a total of 123 million tons in 2009 (U.S. Geological Survey, 2013d). At the time, Singapore was the main consumer of Vietnamese sand (The Economist, 2009). However, sand and gravel production decreased again to its usual levels of 110 million tons in 2010, due to the sand export ban issued by the Vietnamese government in September 2009 (U.S. Geological Survey, 2013d).

#### **4. Social, ecological and economic dimensions of sand extraction in Malaysia, Indonesia, Cambodia and Vietnam**

Information on the social, ecological and economic dimensions of sand extraction is almost entirely based on online newspaper articles published in English mainly from Singapore, Malaysia, Indonesia, Cambodia and Vietnam as well as newspapers focusing on the environment, sand dredging and mining activities. It should be noted that newspaper articles can contain a political bias and are sometimes written in an exaggerated form in order to reach many individuals. Data in newspaper articles has to be investigated in a proper manner, but high levels of reliability cannot always be considered a given, and references are normally not provided. Furthermore, newspaper articles written in English are usually read by an international audience, while the points of view from local communities could differ.

##### **4.1. Social dimension**

The main problems of large-scale sand extraction affecting countries socially are, first, consequences due to riverbed erosions and the disappearance of islands and, second, destruction of fishing grounds.

Sand dredging activities in rivers and the resulting changes in the shape of the river can lead to riverbed erosion and eventually the collapse of riverbanks (San Diego State University, n.d.). Together with the announcement of the sand export ban in Cambodia in May 2009, Sam Rith (2009) from the Phnom Penh Post reported an increasing number of complaints from citizens of the Koh Kong province (where main extraction activities take place in Cambodia) about severe losses of houses and farmland, due to erosions of rivers in the province. Also, Vietnam's provincial departments of natural resources and environment have counted a total of 16 erosion spots in and around Can Tho City, 18 in the province of Vinh Long, 53 in An Giang province and more than 100 in the province of Dong Thap (Hai,

2012). All mentioned provinces as well as Can Tho City are located in the Mekong Delta, where the majority of sand to be exported to Singapore originates from. Erosions of rivers damaged residential areas, river islands and the main highway connecting the province An Giang with the city of Can Tho (Hai, 2012). Furthermore, more than 10,000 families had to be moved to safer places in the Mekong Delta, which was a difficult task, due to insufficient numbers of residential homes in the area (Hai, 2012). In Indonesia around 25 islands have disappeared already (Ertinger, 2013). Dredging activities near those islands created holes in the seabed, which slowly filled up with sand flowing from the islands with the movement of the sea's current (Henderson, 2010). Although the disappeared islands were not inhabited, they served a purpose of protection from wind and erosion for larger, populated islands (Henderson, 2010), which are now being exposed to similar consequences river sand mining had in Vietnam.

Already more than a decade ago, coastline erosions in Indonesia's Riau province have damaged the seabed area used for fishing by local communities (DTE, 2001). The small-scale fishers in the region depend on fish sales, but were not able to catch any within a reasonable distance leading to a slow impoverishment of those communities (DTE, 2001). At the time, the value of reconstructing one square kilometre of destroyed seabed would have been one million US\$ (DTE, 2001). In Cambodia, a comparable trend has been observed over the last years. In the province of Koh Kong, the amount of fish caught on the coast has declined by 50% (Global Witness, 2010) due to erosion and pollution caused by sand dredging, while sand extraction from the Tatai River located in the same province has resulted in an 85% decrease of fish, crab and lobster stock (Gray, 2011). Communities in Koh Kong province complained about sand mining activities not profiting the locals at all (Global Witness, 2010). Yim Sovann, legislator of the Cambodian party Sam Rainsy, which nowadays forms the Cambodian National Rescue Party together with the Human Rights Party, said in 2009 that "the only people who benefit from the sand-dredging businesses are businessmen and corrupt officials, while only the people suffer the impacts" (Rith, 2009).

#### **4.2. Ecological dimension**

One after another, the countries Malaysia, Indonesia, Cambodia and Vietnam have prohibited sand exports to Singapore due to the severe impact mining activities had on the environment in every country. Main reported ecological consequences are damaged river and marine ecosystems, erosions of coastlines and riverbeds, disappearance of islands and decreases in water quality.

In Malaysia, the turbidity (cloudiness) of rivers has increased close to sand dredging sites resulting in changes of the water temperature and loss of habitat (Asraf, et al., 2011). Riverbank collapses have led to the loss of fertile land, a decrease in fish stocks, a decline in biodiversity and an increase in water velocity, while the pollution resulting from sand mining activities lowered the water quality of rivers in general (Asraf, et al., 2011). As already mentioned, islands have started to disappear in Indonesia which are needed for erosion and wind protection (Henderson, 2010). The Indonesian Centre for Forestry Study has already stated in 2001 that 4,000 square kilometres of seabed in the province of Riau have been damaged (DTE, 2001). The loss of islands and destruction of seabeds interrupts the whole marine ecosystem including the loss of various fish species and barrier reefs in the region. Consequently, all types of sand exports were outlawed in 2007 with the aim of “resource conservation” according to the Indonesian Trade Minister at the time (Chua and Maulida, 2007). However, illegal sand mining has continued and Indonesia now fears a further shrinking and maybe vanishing of 83 border islands located between Singapore and Indonesia which could cause an environmental catastrophe (Henderson, 2010). According to Levitt (2010), the legal and illegal extraction of river and marine sand in the province of Koh Kong in Cambodia had the following effects: decrease in water quality, plants, corals, fish stock and increase in turbidity, water velocity, erosions, and risk of flooding. Furthermore, the mangrove forests along the main rivers used for dredging have moved back from the river bank by up to 300 metres over the last decade (Global Witness, 2010), affecting negatively the surrounding biological environment. In Vietnamese newspapers the same effects of river sand mining as in Malaysia and Cambodia have been reported. Additionally, a decrease in water levels resulting from lower riverbeds has interrupted the country’s irrigation system needed for the widespread rice production in the Mekong Delta (Nguyen, 2011).

All the above mentioned ecological consequences of sand extraction activities have been reported mainly in newspaper articles. Environmental impact assessments of sand extraction have not been conducted in any of the four countries, but they are definitely needed in order to provide a complete picture of the environmental effects in Malaysia, Indonesia, Cambodia and Vietnam and for the development of guidelines for future, more sustainable sourcing of sand. The Singaporean government claims that sand imports are entirely carried out on commercial grounds and, consequently, it does not take any responsibility for environmental problems caused by sand mining in other countries (Global Witness, 2010). However, the government of Singapore itself is the owner of a majority of the construction and land reclamation projects which are put in practise with imported sand from surrounding

countries (Global Witness, 2010). Furthermore, Singapore ratified two conventions, the United Nations Convention on the Law of the Seas in 1994 and the Convention on Biological Diversity in 1995, which makes the country as responsible as its sand supplying countries in avoiding ecological degradation and for the protection of the marine ecosystem inside and outside its land boundaries (Global Witness, 2010). Singapore calls itself the environmental leader of the region, but has so far not addressed the issue of sand extraction in its sustainable growth strategy (Global Witness, 2010). Chua and Maulida (2007) suggest that an ethical buying approach should be applied with respect to sand which could include, for instance, that a portion of the export tax on sand paid by the importing country is used for environmental protection in exporting countries.

#### **4.3. Economic dimension**

Although the sand exporting countries have to pay the undefined costs of analysed social and environmental consequences of sand extraction, the decision about outlawing sand exports in Malaysia, Indonesia, Cambodia and Vietnam could not have been an easy one, since the sand industry moves millions of dollars yearly. Milton (2010) estimates that the sand industry was worth at least one billion US\$ over the last decade. Singapore states that in 2008 alone, its imported sand already had a value of US\$ 273 million (Milton, 2010), of which the government earns a certain percentage through export tax payments in every country that supplies Singapore with sand. But it is not just government revenue that is affected when a country imposes an export ban. The prohibition of all types of sand exports in Indonesia in 2007 has caused unemployment of approximately 3,000 miners and the government had to start paying money in training those jobless miners to become fishermen or farmers (Abbugao, 2007). Similar situations can be assumed for the other sand exporting countries.

Furthermore, every issued export ban has driven up the price of sand in the market (Murray, 2011). This can be considered temporarily good news for the remaining suppliers of sand to Singapore which were able to export more sand and, additionally, at a higher price. Nevertheless, for Singapore it has rather negative effects. After Indonesia's export ban in 2007, Singapore reported a 50% increase in the price of sand which pushed up project costs for construction and land reclamation by 3% (Chua and Maulida, 2007). In order to keep the negative effects of price increases at minimum, Singapore released sand from its stockpile (Chua and Maulida, 2007) until the price stabilised again. Singapore's construction industry continuously works on alternative construction materials and methods to avoid those situations (Abbugao, 2007). However, the use of alternative materials also implies moving

from comparably low-cost and resource-intensive to expensive, high-technology construction and Singapore does not seem to be ready yet for this kind of transition (The Economist, 2009).

Malaysia, Indonesia, Cambodia and Vietnam also suffered a negative effect of price increases resulting from the prohibition of sand exports. Since higher prices lead to more incentives to carry out illegal sand trade, growth in illegal sand extraction can be noticed in all countries. The exact numbers for illegal sand moving from these countries to Singapore cannot be identified, but some estimates will be given. Singaporean statistics show sand imports from Malaysia of 3 million tons in 2008, while Malaysian statistics report 133 million tons of sand exports to Singapore for the same year (Milton, 2010). The difference between those numbers is huge and, keeping in mind that at this point the Malaysian government had already banned sand export for eleven years, large illegal sand trade has to be assumed. An estimated 600 million tons of sand illegally leave Indonesia yearly heading for Singapore (Henderson, 2010). Approximately 9.5 million tons of sand extracted illegally in the province of Koh Kong in Cambodia with a total value of about US\$ 28.7 million at the point of extraction are shipped to Singapore annually where the same sand imports are worth US\$ 248 million (Global Witness, 2010). Looking at those numbers, one can assume that governments lose millions of US\$ in tax revenue and fees for issuing extraction licences, while their sand keeps leaving the country to be sold to Singapore. Singapore denies any knowledge of illegal sand import activities (Murray, 2011) and claims that the responsibility to control illegal sand extraction lies entirely in the power of governments of sand exporting countries when giving out licenses for extraction (Global Witness, 2010). However, at the point where trucks and barges carrying illegally extracted sand cross the border to Singapore, it becomes the Singaporean government's obligation to check for authenticity of documents about their cargo and, further, it is the government's duty to ensure that sand importing companies in Singapore carry out legal business (Milton, 2010). Singapore's constant need for sand which means accepting illegal sand imports seems to be in contrast to the fact that Singapore shared the rank of the fifth least corrupt country worldwide with Norway (after Denmark, New Zealand, Finland and Sweden) in 2013 (Transparency International, 2014). Milton (2010) concludes that Singapore "is booming economically and has positioned itself as a world leader in urban sustainability. But to fulfill that promise, however, it must first swallow an unpalatable truth — that its prosperity has come at the cost of its neighbors' corruption and environmental destruction".

While all countries prohibited sand exports to Singapore for reasons of environmental degradation, it is rumoured that Malaysia and Indonesia further used the export bans as a way of pressuring Singapore over some existing disputes at the time. After the implementation of the Malaysian export ban in 1997, a disagreement about Singapore's land reclamation works between both countries was settled in 2005 by the International Tribunal for the Law of the Sea (Leong, 2007). Singapore was allowed to continue with its land reclamation projects in the Straits of Johor bordering with Malaysia, if monitoring of environmental impacts is guaranteed and works are entirely carried out in Singapore's territorial waters to not affect the maritime boundaries with its neighbouring country (Leong, 2007). Furthermore, a second dispute over the sovereignty of the small, uninhabited islands Pedra Branca, Middle Rock and South Ledge between those countries has been resolved in 2008 by the International Court of Justice putting Pedra Branca under the jurisdiction of Singapore and giving Middle Rock to Malaysia, while sovereignty over South Ledge is shared by the two countries (ICJ, 2008). A third ongoing disagreement between Malaysia and Singapore is the removal of a causeway over the Johor Straits connecting both countries and the replacement of it with a bridge which would benefit the Malaysian port allowing ships to easily pass from east to west (New York Times, 2007). However, Singapore refuses to cooperate in the construction of the Johor Strait Bridge until today. Indonesia fears that the disappearance of border islands resulting from sand extraction and Singapore's reclamation works will narrow the country's maritime boundaries and hand over territory to Singapore, whose coastal territory lines will simultaneously widen (Leong, 2007).

## **5. Conclusion**

After an extensive analysis of Singapore's high demand for sand and the countries supplying it, followed by the presentation of social, ecological and economic dimensions of sand extraction in countries exporting the natural resource, one can now look at the explanatory power of world-systems analysis for the analysed case.

As shown in the grouping of countries in relation to world-systems analysis, Singapore is the highest grouped country out of the five countries considered in this paper. Furthermore, Singapore has managed to move upwards in the core/periphery framework since its independence in 1965, and is currently considered an upper semi-peripheral country. In order to reach this position, constant growth was needed related to the priority given to

ongoing accumulation of capital. This in turn has required an expansion of the country, shown in an increase of, on the one hand, industrial and residential buildings and, on the other hand, territorial size accomplished through land reclamation projects. For both types of increases, high quantities of sand have been consumed which were mainly imported from countries nearby in order to keep transportation costs at a minimum. Therefore, Singapore's resource strategy of importing the sand required for growth can be considered a necessity, since Singapore does not hold many sand resources itself. It definitely helped the movement to its current position in the capitalist world-economy, which otherwise would not have been possible.

All countries extracting sand in order to supply Singapore with the natural resource are peripheral countries with the exception of Malaysia. The analysis of social, ecological and economic dimensions visualises the existence of productive and extractive economies within the modern world-system. The extractive countries, especially Indonesia, Cambodia and Vietnam, have to give away their natural resources to productive economies, like Singapore, which results in the cause and the consequence of their underdevelopment, since they are burdened with the social and ecological costs of extraction. Regarding the particular case presented in this paper, the zero-sum game world-systems approach applies. The economic growth and development of Singapore came at the expense of environmental problems in the countries which are found below Singapore in the core/periphery hierarchy. Singapore shows ignorance for social and economic costs of sand extraction in exporting countries to ensure further "cheap" growth in order to keep climbing up the ladder to the core.

The export bans carried out by the sand supplying countries to Singapore could be seen as an escape from ecological degradation caused by the extraction of large amounts of sand and as an opportunity to move away from the status of extractive economies. It could also be interpreted as a strategy of peripheral countries to hinder Singapore from further growth and maybe even an upward movement to the core in the future, but this point would have to be further investigated.

However, the environmental reasons for outlawing sand exports to Singapore can be considered to have only been an excuse to stop exporting sand to Singapore, since illegal extraction carried on in every one of the sand exporting countries causing the same environmental problems as the legal sand trade. No governmental efforts have been found to control illegal extraction and, hence, it can be supposed that corruption plays an important part in this situation which would be an interesting aspect for further investigations. Apart

from corruption, one may find the cause of imposed export bans in an ongoing struggle between extractive industries and productive industries in each sand supplying country. In such a scenario, it could be assumed that productive industries pressured the government into outlawing sand exports, while extractive industries ignored export bans by carrying on with illegal extraction and trade of sand. World-systems analysis reaches its explanatory limit at this hypothetical point, since class structures and struggles are not considered in the theory, which has been highly criticised by orthodox Marxists.

Furthermore, the Malaysian export ban, and to some extent also the Indonesian export ban, seem to have been implemented more for political than environmental reasons in relation to the ongoing disputes between Malaysia (Indonesia) and Singapore. In connection to world-systems analysis, this could be an indicator for competition between countries in the core/periphery concept to obtain the highest position and hinder other countries from upward movements. Further research to strongly support this argument would be needed.



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