



Swedish University of Agricultural Sciences
Faculty of Forest Sciences

Department of Forest Products, Uppsala

**A study of the recycling and separation systems for
waste materials in Asia - are they compatible with
BillerudKorsnäs' sustainability strategy?**

*En studie av Asiens återvinnings- och separationssystem
för avfall - är de kompatibla med BillerudKorsnäs
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Keywords: Recycling, Waste Management, Municipal solid waste (MSW), Paper, Plastic, Packaging materials, Asia

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Abstract

Global megatrends are driving change in the packaging industry. The demands are increasing in Asia and one of the packaging companies that wants to take part in this expansion is BillerudKorsnäs.

The aim of the study was to give an overview of the recycling and separation systems for packaging materials of paper and plastic in some key Asian countries. The study also investigated if the systems are compatible with BillerudKorsnäs' sustainability strategy. Five countries in Asia were selected (India, Indonesia, China, Thailand and Malaysia). Secondary data was gathered and analysed. The data used was gathered from official documents and literature studies of researchers and consultants' reports. Data about separation and recycling in Sweden and EU was collected as a benchmark. The data from the selected countries was limited and in many cases not up to date. The collected data from the selected countries and the benchmark was mapped and analysed in an analytical framework. The findings show the different countries recycling rates, in relations to their legislation on waste management. All selected countries are encouraging and implementing stricter legislation on recycling activities and countries with stricter legislation on waste management also present higher recycling rates. The informal and private sectors play an important role for the recycling activities in the selected Asian countries. The most valuable waste materials are also the materials that foremost gets collected and recycled of the informal and private sectors. Comparisons between BillerudKorsnäs' sustainability strategy and the existing recycling and separation systems were conducted. The first commitment in BillerudKorsnäs' sustainability strategy (*Promote responsibility from raw material supply and production to recycling*) is compatible with the selected countries' recycling and separation systems, since the countries have at least encouraging legislation on recycling activities.

Keywords: *Recycling, Waste Management, Municipal solid waste (MSW), Paper, Plastic, Packaging materials, Asia*

Sammanfattning

Globala megatrender driver förändring inom förpackningsindustrin. Efterfrågan har ökat i Asien och ett av förpackningsföretagen som vill ta del av denna efterfrågeexpansion är BillerudKorsnäs.

Syftet med studien är att skapa en översikt av Asiens återvinning- och separationssystem för förpackningsmaterial av papper och plast. Syftet var även att undersöka om systemen är kompatibla med BillerudKorsnäs hållbarhetsstrategi. Fem länder valdes ut för studien (India, Indonesia, China, Thailand och Malaysia). Sekundär data insamlades och analyserades. Källorna som användes för insamling av data var officiella dokument, litteraturstudier av forskare samt konsultrapporter. Data om Sveriges och EUs återvinning- och separationssystem användes som benchmark. Data från de utvalda länderna var begränsad och i många fall inte uppdaterad. De insamlade data kring de utvalda länderna och benchmark kartlagdes och analyserades i ett analys-ramverk. Resultatet visar ländernas återvinningsandel i relation med ländernas lagstiftning inom avfallshantering. Analysen visar att alla undersökta länder uppmuntrar och implementerar striktare regler kring återvinning. Länder med striktare regler har högre andel återvinning. De informella och privata sektorerna spelar en viktig roll för återvinningen i de asiatiska undersökta länderna. De mest värdefulla avfallsmaterialen har också störst chans att bli insamlat och återvunnet av de informella och privata sektorerna. Jämförelser gjordes mellan BillerudKorsnäs hållbarhetsstrategi och de existerande återvinning- och separationssystemen i de undersökta länderna. Det första åtagandet i BillerudKorsnäs hållbarhetsstrategi (*Främja ansvarstagande från uttaget av råvaror och produktion till återvinning*) är kompatibel med de undersökta ländernas återvinning- och separationssystem, eftersom alla länderna har lagstiftning som uppmuntrar eller beslutar om tillämpning av återvinningsaktiviteter.

Nyckelord: Återvinning, Avfallshantering, Fast kommunalt avfall, Papper, Plast, Förpackningsmaterial, Asien

Preface

The study has been a big challenge for me, but it has also been a developing experience in many ways. The difficulties in the information gathering process have tested my patience which has become better and “longer”. The study has had its ups and downs during the process, and it had not been possible without the support I have had.

First I like to thank my supportive family for pushing me and giving me time to do this study. I would especially like to thanks my boyfriend, Robert Eriksson, for his enormous patience and his believes in me. My mom, Elisabet Salander Björklund, for all hours she have read and discussed the study and my dad, Anders Björklund, who have been an great adviser with the formulation of the text.

Thanks to Louise Wohrne at BillerudKorsnäs for giving me this assignment and believing in me and my possibility to do a study in this study area. I would also like to give thanks to Henrik Essén at BillerudKorsnäs, who saw my passion for sustainability at a seminar and got me in contact with Louise.

Finally I would like to thanks Torbjörn Andersson, my supervisor at SLU, how have given me many good points to make my study doable.

Without all of these people this study would not been possible and the outcome would not have become what it is!

Britta Björklund, 2016-11-29

Definitions & Abbreviations

Definitions

Collected waste

Waste that is collected/gathered.

Official sector

A sector consisting of public companies.

Generated waste

Waste that is generated/produced when a product is used.

Incineration

Combustion/burning of waste, which is usually done for making of energy.

Informal sector

A sector consisting of working individuals.

Private sector

A sector consists of private own companies.

Recycled waste

Waste materials that is processed into a new product.

Recycling

The process of transforming separated used products (solid waste) into a new product or raw material for producing new products.

Recycling rates

The percentage of how much of the generated waste that is recycled.

Recovered waste

Waste that is recycled or energy recovered e.g. by incineration.

Separation

The sorting/separation process when different types of waste materials get separated. Could be made by households or in the process industry for example separating paper and plastic layers of laminated paper.

Treated waste

Waste that is in some way handled by people.

Waste collectors

Individuals or groups that are collecting reusable and recyclable waste, to sell it further to recyclers or through intermediaries, for earning their livelihood. Can also be called different type of pickers (e.g. waste pickers, rag-pickers, dump pickers).

Waste generators

All individuals, groups, residential and commercial establishment that generates waste.

Abbreviations

ABC Plan – Action Plan for a Beautiful and Clean Malaysia

ALM – Advanced Locality Management

BMA – Bangkok Metropolitan Administration

CSR - Corporate Social Responsibility

EPR – Extended Producer Responsibility

GoM – Government of Malaysia

IndII – Indonesia Infrastructure Initiative

JPSPN – National Solid Waste Management Department

MHLG – Ministry of Housing and Local Government

MoEF – Ministry of Environment and Forests (and Climate Change)

MoNRE – Ministry of Natural Resources and Environment

MoSTE – Ministry of Science, Technology and Environment

MSW – Municipal solid waste (MSW is produced in the daily life of citizens including: dust, paper, plastic, textiles, glass, wood, metal and residual food)

PIB – Press Information Bureau

PRC – People’s Republic of China

RoI – Republic of Indonesia

SPCB – State Pollution Control Boards

SME – Small and medium-sized enterprises

SMoE – State Ministry of Environment

SSCC – Sino-Swedish CSR Cooperation

SWM – Solid waste management

TPS – Temporary collection site

TPA – Final disposal/processing site

ULB – Urban local bodies (different municipal authorities).

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1 Introduction

This chapter includes an introduction to the subject and the background of the study. It presents the aim and research questions, which the study is established on. The chapter ends with the focus and delimitations.

1.1 Global megatrends

It is important for all companies to understand new trends and especially global megatrends. These global megatrends are global trends that have a big impact on all countries. A good knowledge of these trends can help a company to get competitive intelligence and if the company uses the knowledge wisely, it can lead to a competitive advantage on the market. During the last decade new global megatrends have changed the outlook of the business world. These megatrends have created a social change, which has had significant effects on the world's population. The social change has created new consumption patterns and new markets. These global megatrends puts pressure on the world's existing companies. To survive these global megatrends companies need to see the change as opportunities and not as threats (Olsmats & Kaivo-oja, 2014).

An industry sector that is affected by these new megatrends is the packaging industry. Olsmats & Kaivo-oja (2014) presents five especially important megatrends affecting the packaging industry. In Innventia's (2013) report Packaging 2020 seven forces that will have a major impact on the packaging industry in year 2020 are identified, particularly effecting wood fibre-based packaging. Innventia's (2013) forces are close linked to Olsmats & Kaivo-oja's (2014) megatrends and together they can be combined in eight trends relevant for this study; 1. The world's growing population, 2. The urbanization, 3. The increasing mobility, 4. The divergent demographics, 5. The intensive legislation on packaging material, 6. The emergence of e-commerce, 7. The growing requests for sustainable products and 8. The demand on personalisation of services.

1. The first trend is the world's growing population, which means that more people need to share the world's limited resources. For the packaging industry, this encourages the companies to use sustainable materials and designs in their packages, so that it may be reused or recycled (Olsmats & Kaivo-oja, 2014).
2. The second trend is the urbanization. In year 2014 almost 50 % of the world's population lived in urban areas, in year 2050 the same number expects to be 70 %. The economic growth within cities, leads to a growing middle class, especially in developing countries. This creates new consumption patterns and an increasing waste handling challenge (Olsmats & Kaivo-oja, 2014; Shekdar, 2009; Innventia, 2013).
3. The increasing mobility is the third trend. It creates new demand for logistic-effective packaging, since people are living shorter time at each place and moving around more than before (Olsmats & Kaivo-oja, 2014; Shekdar, 2009; Innventia, 2013).
4. The fourth trend is the divergent demographics around the world, which create different consumption demands on different markets. In the world's developed, wealthy countries the population is ageing and the workforce shrinking. In contrast the world's developing, poor countries have high fertility rates with a rapid population growth and an increasing unemployment. There are also large countries moving from poverty, with a growing middle class. The wealthy countries demand packaging for consumption patterns of older people, while other countries demand packaging for the consumption connected to the growing middle class. Countries with a rapid growing

middle class are e.g. China, India and Indonesia (Ols mats & Kaivo-oja, 2014; Shekdar, 2009; Innventia, 2013).

5. The fifth trend is the intensive legalisation on packaging material. According to Innventia's (2013), this trend can prevent packaging innovations to reach the consumer market. In many countries regulators are not willing to take any risks concerning packaging material, which has resulted in a strict legislation within the area. As a result of the strict legislation many of the packaging innovations stays in the lab and do not enter the consumer market. This applies especially to products connected to food and other contents that may end up in consumer's digestive system. Packaging companies need to know and work according to the regulations in order to have functional innovation programs.
6. The sixth trend is the emergence of e-commerce. Packaging has taken an important part of the emergence of e-commerce. Home delivery, with a good packaging can be both time saving and comfortable for the consumer. During the last 10 years consumer, retailers and regulatory bodies have increased their requirements on sustainability of packaging products (Innventia, 2013).
7. The seventh trend is the growing demand for sustainable products. Sustainable products are products that do not have a negative impact on the society, the environment or the economy (Grant, 2013). The packaging industry has started to react to this trend. Since sustainability is a complex issue, the debates within the industry are lively regarding the contents in "sustainable packaging" (Innventia, 2013).
8. The last trend, the consumers are purchasing services instead of goods. This is in line with the Service Dominant Logic (SDL), which states that consumptions pattern have shifts from a Goods Dominant Logic (GDL) to SDL. This means that consumers are focusing on buying the services that includes the product, than buying the product itself (Vargo & Lusch, 2004). This has motivated the packaging companies to offer packaging solutions possibilities, instead of just offering the package to their customers (Ols mats & Kaivo-oja, 2014).

These megatrends and forces are changing the rules for the companies in the packaging industry (Ols mats & Kaivo-oja, 2014; Innventia, 2013). According to Ols mats & Kaivo-oja (2014) this brings big opportunities to the companies in the packaging industry, especially for companies entering the emerging markets.

1.2 Background to the study

1.2.1 Solid waste management system

With the growing urbanization and the new consumption patterns more waste is created in the cities. Solid waste management (SWM) have been an important and challenging part of societies since early civilization. Big challenges for the SWM systems first arrived when cities developed and large populations started to live at relative small areas. Solid waste that is generated in living communities as household and commercial establishments are usually called municipal solid waste (MSW). MSW is produced in the daily life of citizens including: dust, paper, plastic, textiles, glass, wood, metal and residual food. SWM is an important part of the environmental health services to managing the MSW. In many developing countries the SWM system does not function with the increasing of the MSW, especially not in the fast growing cities (Ahmed & Ali, 2004; Bouaini, 2013; Gupta, Yadav & Kumar, 2015). Figure 1 shows a typical SWM system.

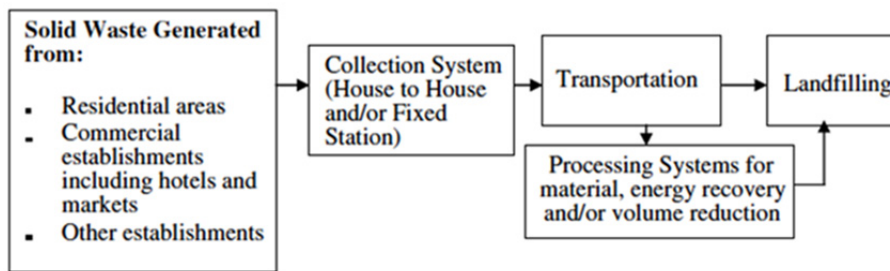


Figure 1. An example of a typical solid waste management. (SWM) system (Shekdar, 2009)

The eight global megatrends and forces are affecting the world's waste handling and are pushing towards reoriented sustainable SWM systems. One part of the world that is deeply involved in this transformation is the Asian countries. The level of sustainability is depending on the economic status in each country. The developing countries as India, China and Indonesia have not the same ability to work with sustainable SWM as developed countries as Japan and South Korea. During the last 60 years Asia have experience a fast economic growth with social change that have had a significant impact on the urban life in Asia. China and India alone have over 200 cities with 1 million or more residents and 21 cities with 5 million or more residents. Studies shows that this growth is still strong and in year 2030 Asia expects to have grown with an additional 1.25 billion people in urban areas. This massive population and urbanization growth puts a huge press on the cities SWM system. Global cities with an increasing international trade as Beijing, Mumbai, Bangkok and Hong Kong, have slowly started to improve their infrastructure and their public services including their SWM (Shekdar, 2009).

1.2.2 Package and packaging materials

A significant part of the MSW is packaging waste materials (Davis & Song, 2006). The function of the package is to protect and inform about the product, but after the package has been opened and emptied, it often becomes waste. According to World Packaging Organisation (WPO) this way of looking at used packages needs to change. The world needs to create a longer life for packaging material after the package has been used. WPO are presenting 3R's to create a longer life for packaging materials: *Re-use*, *Recover* and *Recycle* (World Packaging Organisation, 2014). The 3R's usually presented in waste management studies are: *Reduce*, *Re-use* and *Recycle* (Mohanty, 2011). WPO use *Recover* instead of *Reduce*, since they try to solve the problem after a package is created. According to WPO *Re-use* and *Recover* can be done locally, if instructions are available. *Recycle* requires a system or business process that links the user's waste with the buyers of recycled material. The existence of these types of systems varies in different parts of the world. WPO believes the best way to organize a recycling system is to have many collecting points, where all waste can be collected and sorted. To recycle waste, different materials in the products needs to be separated. This is the difficult part of recycling since much of waste e.g. package, may consist of many such different materials. According to WPO the easiest way to achieve a good functional recycling system is to create a national legalisation and to let organisations finance and unify the recycling materials with producers that use recycling material (World Packaging Organisation, 2014).

Packaging materials can be made from many different materials as metal, glass, paper, plastic etc. Paper is made of wood fibre, which is biodegradable and recyclable. Packaging materials made of paper is therefore categorised as sustainable. Biodegradable materials are decomposable through biological activities of microorganisms such as bacteria and fungi,

which can give rise to natural metabolic products (Davis & Song, 2006). A wood fibre could be recycled 5-6 time and where one tree is felled, could another tree be planted, which create new wood fibres. Plastic materials are not seen as sustainable, since it is made of non-renewable oil. Oil is a limit resource and no new oil can be made. Plastic is usually not categorized as biodegradable, since most of the plastic materials cannot or take up to 450 years to decompose by biological activities. Plastic packaging materials could be recycled with the right measures to new plastic products, but plastic is not biodegradable. A large amount of plastic packages are mixed with different types of plastic layers which make the materials even more difficult to recycle and reuse. Many countries have no developed system to recycle packaging materials that contain more than one material. The more different materials a package contains of, the more difficult it is to recycle it (Davis & Song, 2006).

1.2.3 Motive for the study

Megatrends and forces have created a social change in the world that has affected the packaging industry (Olsnats & Kaivo-oja, 2014; Innventia, 2013). Many packaging companies worldwide are using these megatrends in their scenario planning. A focus in the packaging industry is to develop sustainable, renewable and biodegradable packaging materials that can create a competitive advantage in the expanding sales market of Asia (Olsnats & Kaivo-oja, 2014; Davis & Song, 2006). BillerudKorsnäs is one of these packaging companies producing bio-degradable packaging paper materials that have entered the Asian market, based on the economic growth, urbanization and the new consumer habits. The company has recently opened sales offices in Bangkok, New Delhi, Shanghai, Jakarta and Singapore (BillerudKorsnäs, 2014b; BillerudKorsnäs, 2015a).

Previous research has focused on how the new megatrends affects SWM in developing countries, from a society point of view (Olsnats & Kaivo-oja, 2014; Innventia, 2013; Shekdar, 2009), but not from the point of view of producer companies. BillerudKorsnäs is a Swedish packaging material producer with a clear sustainability focus and sustainability strategy. Sustainability-driven companies can create several benefits, for example increased efficiency of resource use, increased sales and improved corporate image (Albino et al. 2009). Because of BillerudKorsnäs' sustainability focus the company has an interest to investigate what happens to their products further out at the value chain. BillerudKorsnäs produces packaging materials made of paper and paperboard and the company promotes re-use and recycling of their materials. BillerudKorsnäs' products are not sold to end consumer and therefore could also their customers' product be made of laminated paper, which is paper with plastic layers. To recycle laminated paper the paper and the plastic layers need to be separated, which is done in a separation process. BillerudKorsnäs shows their commitment for recycling through its membership in and financing of organisations that collects packaging materials, such as Förpacknings & tidnings insamlingen (FTI) in Sweden, and by developing improved and smarter packaging solutions. BillerudKorsnäs only use virgin fibres in their packaging products. The company believes they are an important part in the transition to a sustainable bio-based society as a supplier of virgin fibre, since each fibre only can be recycled 5 to 6 times (BillerudKorsnäs, 2014a).

In many developing countries nearly no information is officially published of what happens to products after they have been used. It is important to BillerudKorsnäs to understand what kind of SWM systems are operating in their new markets in Asia that will handle the waste created of their products. Since the company's mission is to challenge conventional packaging for a sustainable future, the company want their products to be handled in a sustainable way. It is therefore important for the company to understand how the SWM system and, especially the

recycling and the separation systems, works on their new sales market in Asia (BillerudKorsnäs, 2014a). This study is a part of BillerudKorsnäs' way to create an understanding of the SWM system in Asia.

1.3 Aim and research questions

1.3.1 Aim

The aim of the study is to give an overview of the recycling and separation systems for packaging materials of paper and plastic in some key Asian countries. The aim is also to investigate if the systems are compatible with BillerudKorsnäs' sustainability strategy.

1.3.2 Research questions

- What are the legislation (laws, regulations and policies) on recycling and material handling for packaging waste of paper and plastic?
- How does the waste management system actually work and how does the flow of recycling materials go? Is there a separation system for laminated paper and if so, how is the separation system involved in the recycling process?
- How much paper and plastic packaging waste is generated, collected and recycled?
- How do the recycling and separation systems in Asia fit with BillerudKorsnäs' sustainability strategy?

1.3.3 Focus and delimitations

BillerudKorsnäs is a producer of packaging materials made of paper and paperboard. Since their products are not sold directly to the end consumers, their products can be changed before they reach the end consumer, for example laminated. Laminated packaging materials made of paper or paperboard includes layers of other material, mostly plastic but sometimes also aluminium. Laminated paper is therefore interesting for this study. In Sweden laminated paper products are sorted as paper packages. In other countries paper products laminated with plastic can be sorted as plastic. BillerudKorsnäs' wants to challenge plastic packaging materials, which is the main reason to investigate waste of both paper and plastic packaging materials in this study.

The focus is on MSW and especially household waste from paper and plastic packaging materials. To do this the whole MSW has been studied to provide an overview how packaging is handled in the waste streams of the different countries. When information about packaging waste of paper and plastic is limited, data about paper and plastic waste materials as total is presented. This since packaging waste is part of the paper and plastic waste.

Asia is the world's biggest continent counting population. This study aims to show an overview of the recycling and separation systems in some key Asian countries. The key Asian countries selected to the study are: India, Indonesia, China, Malaysia and Thailand. They are chosen since BillerudKorsnäs is focusing their sales expansion in these countries.

The study focus is on the official waste management systems. For this reason legislation on waste management is a separate part of the study. Informal systems are presented in the study when they are relevant to show how the waste management systems work in practise.

2 BillerudKorsnäs

This chapter presents the company that the study refers to. First is the company's background and its current strategy presented, then presents the company's products and segment focus. The chapter ends with a detailed description of the company's sustainability strategy.

2.1 Background and strategy

BillerudKorsnäs is a Swedish packaging material company that was created in year 2012 through a merge of the two companies Billerud and Korsnäs. The company's mission is to *challenge conventional packaging for a sustainable future* and its main long-term target is to create profitable growth (BillerudKorsnäs, 2014a; 2014b; 2015c). BillerudKorsnäs aims to offer high-performance packaging materials based on renewable raw materials from responsible managed forests in Northern Europe to customers around the globe. BillerudKorsnäs' strategy is built on four areas: Position, Innovation, Sustainability and Efficiency, driven by the people in the company. The company's strategic platform was introduced in 2014 and is illustrated in Figure 2. BillerudKorsnäs believes that innovation and sustainability are the keys to create smart solutions to their customers that together with the packaging materials can optimize the customers' business.



Figure 2. An illustration of BillerudKorsnäs' corporate strategy. (BillerudKorsnäs, 2015a)

The company's main sales market is Europe and in year 2015, almost 75 % of the sales were placed there. To reach the mission and long-term target the company plan is to grow both organically and by mergers and acquisitions (M&A) in developing markets, especially in Asia. Asian markets are especially interesting markets since the demands of packaging materials are growing in line with the global megatrends. In year 2014 about 16 % of its sales were made in Asian markets and the sales have increased during the last years (BillerudKorsnäs, 2014a; 2014b; 2015c; 2015e). BillerudKorsnäs' investment in Asian markets has been driven by the economic growth and the global megatrend especially urbanization, a growing middle class, increasing demand of sustainable products and overall new consumption habits (BillerudKorsnäs, 2014b; 2015c). In year 2014 the company delivered 2.7 million tonnes of paper and paperboard materials to customers around the world (BillerudKorsnäs, 2014a). The company have opened their own sales offices in India, Indonesia, China and Thailand. The sales to Malaysia go through their own sales offices in other countries and by using local agents (BillerudKorsnäs, 2015a).

2.2 Products and segments

BillerudKorsnäs provides packaging materials made of paper in three business areas: Packaging Paper, Consumer Board and Corrugated Solutions (former Containerboard). The net sales by business area are presented in Figure 3. BillerudKorsnäs describes their products in the Packaging Paper business area as premium quality kraft and sack paper, combined in a smart solution for customers from industrial, medical & hygiene and consumer segments. The business area Consumer Board offers packaging solutions of high-quality board for customers from segment food & beverages and consumer & luxury goods. The business area produces liquid packaging board and cartonboard. The business area Corrugated Solutions, offers creative solutions in order to optimize packaging for fragile and demanding distribution system. It offers corrugated packaging of fluting and liner, which many of customers use during transit of their products (BillerudKorsnäs, 2012; 2014a; 2015b; 2015c; 2015e). Many of BillerudKorsnäs' paper packaging materials are laminated by their customers (converters), who make the actual packages that is sold to the end consumer. Laminated paper contains of packaging materials of paper mixed with plastic layers. A laminated paper can for example give the package a liquid proof surface (Pers. Comm. Wörne, 2016-03-21)

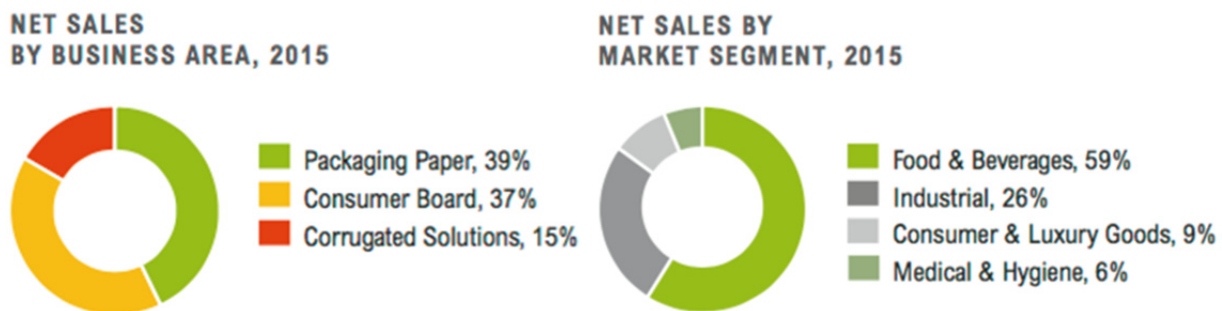


Figure 3. BillerudKorsnäs' net sales by business area & net sales by market segment, both in 2015. (BillerudKorsnäs, 2015b)

BillerudKorsnäs has divided their products in four market segments over the three business areas. Figure 3 also shows how the net sales are divided by market segment. Business area Packaging Paper has mostly customers from the industrial, medical and consumer segments. Consumer Board has their primary customer in the food & beverage and consumer segment. Corrugated Solutions has customers from all market segments but mostly from the food & beverage segment. The customers in the different segments are packaging manufacturers, brand owners and large retailers or/and supermarket chains (BillerudKorsnäs, 2014a; 2015b; 2015c; 2015e).

2.3 Sustainability strategy

As Figure 2 shows the company's strategic platform is based on: challenging conventional packaging for a sustainable future. BillerudKorsnäs developed the strategic platform in year 2014 and since then sustainability has had a clear part as one of the four areas to reach their mission and the long-term target. By being a part of the solution for managing the earth's resources, the company wants to secure its competitiveness in the long run (BillerudKorsnäs, 2014a). During year 2015 the company developed their way of working with sustainability and concluded it in a model based on three focus areas: 1. *Responsible value chain*, 2. *Increased customer value*, and 3. *Sustainable & bio-based society*. Figure 4 shows the model of the focus areas and how BillerudKorsnäs plan to work with them (minimizing the negative impact and maximizing the positive impact). Within each focus area the company has made two commitments to work towards (BillerudKorsnäs, 2015d).

“The starting point for BillerudKorsnäs’ view of sustainability is in an understanding that everything has potential for improvement”, which is why BillerudKorsnäs constantly work on developing their sustainability work with the emphasis on the three, selected focus areas. BillerudKorsnäs aim within the sustainability strategy is for the company to be a responsible and profitable player in a long-term sustainable society. To achieve this, the company has made six commitments within the focus areas to work towards. By working on the commitments BillerudKorsnäs’ believes they can maximize the positive contribution to a sustainable future, while simultaneously minimizing the company’s negative impact (BillerudKorsnäs, 2014a; 2015d).

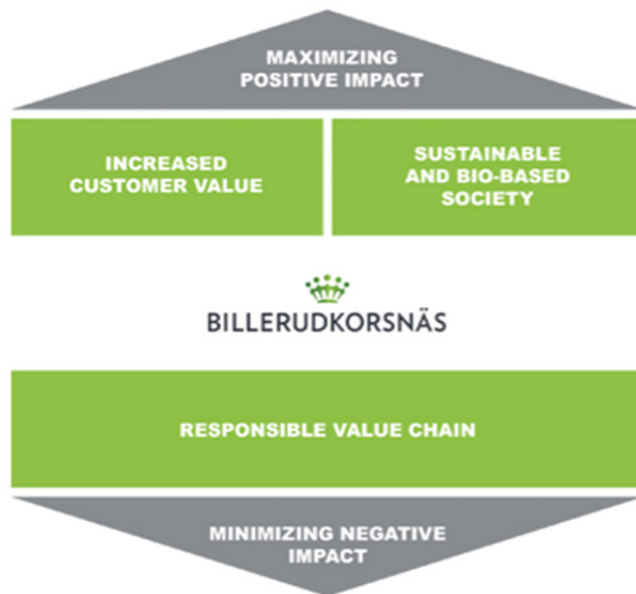


Figure 4. BillerudKorsnäs’ sustainability focus areas 2015. (BillerudKorsnäs, 2015d)

BillerudKorsnäs takes part of a value chain that starts with the extraction of natural resources. The resources continue via transport through the company’s own production of paper packaging materials to their customer’s production of end consumer packages. Then the package is passed on to end-use and finally to recycling. BillerudKorsnäs is promoting recycling of their paper packaging material product, although the company only use virgin fibres in their production. The company contributes to a sustainable bio-based society by adding new virgin fibres to the system. Since the company is part of the value chain it has an impact on the entire field of the chains sustainability. The value chain is complex and includes thousands of companies, which puts demand on BillerudKorsnäs and their processes to reach their mission about a sustainable future (BillerudKorsnäs, 2014a; 2015d).

2.3.1 Responsible value chain

BillerudKorsnäs’ first commitment in this focus area is to: *Promote responsibility from raw material supply and production to recycling*. During year 2014 the company developed both a new supplier assessment policy and a new purchasing policy. The new policies were made to evaluate the companies within BillerudKorsnäs’ value chain, to make sure responsibility is worked with throughout the chain. The supplier assessment policy contains an evaluation, where the suppliers are evaluated according to eight perspectives (finance, strategy, quality, production, hygiene, health & safety, environment and sustainability). One important question in the policy is if the suppliers have the same requirements as their suppliers. The purchasing policy contains guidelines and allocations of responsibility. To implement these policies

BillerudKorsnäs has invested in educations and informing the different functions throughout the company (BillerudKorsnäs, 2014a; 2015d).

BillerudKorsnäs does not own any forests, but the company is part owner of Bergvik Skog. BillerudKorsnäs works with managing forests owned by Bergvik Skog and small private forest owner under long-term contracts. These contracts and wood purchase contracts help to secure BillerudKorsnäs' wood supply. To promote responsibility throughout the value chain BillerudKorsnäs encourage and helps private wood suppliers to become sustainability certified through BillerudKorsnäs' group certification for FSC® and PEFC™. FSC® is an independent membership-based organisation that works for environmentally appropriate, socially beneficial and economically viable use of the world's forests. PEFC™ is an international certification system for sustainable forestry. All imported raw wood materials that is not from Sweden needs to be certified by FSC® Chain of Custody/Controlled Wood. In year 2014, 74 % of the raw materials for board, paper and pulp production came from Sweden. In 2015 BillerudKorsnäs' group certification for FSC® and PEFC™ consisted of 91 forest owners, which is an increase by 14 forest owner from the year before. In the same year the company also made initiative to increase awareness about biodiversity considerations in the forest management (BillerudKorsnäs, 2014a; 2015d).

To work with responsibility within the company itself, BillerudKorsnäs has required investments to improve efficiency and environmentally adapt production, improve results and reduce the risk of negative environmental impact in areas surrounding the production areas during 2015 (BillerudKorsnäs, 2015d). No action is presented how the company is working with the commitment further out in the value chain, after their own production.

The second commitment within the focus area of responsible value chain is to: *Provide engaging workplaces where safety, diversity and human rights are a priority*. BillerudKorsnäs has established four core values that should lead the employees to work together efficiently, create a focus around result and to work innovatively to create value. The core values are: Think new, Feel responsibility, Cooperate and Create value. By implementing the new strategic platform in 2014 BillerudKorsnäs believes they make the company's focus clear to both employees and external stakeholders. BillerudKorsnäs reports that through customer and employee surveys is it shown that BillerudKorsnäs is an attractive employer and that the customer and employees are ambassadors for the company. BillerudKorsnäs has a zero vision for work-related accidents leading to sick leave and the company has therefore deep evaluations of the work-related accidents that do occur. A cross-functional group has been put together to increase the health and safety within the company and a new health and safety policy has been developed in 2015. The company work on creating high gender equality and diversity at the workplace, by implementing guidelines to help company-wide diversity groups and local forum of diversity issues. In 2015 19.9 % of the employees were female, compared to 18,3 % the year before. Of the managers were 22 % female in year 2015, compared to 21.7 % in year 2014 (BillerudKorsnäs, 2014a; 2015d).

BillerudKorsnäs believe it is also important to work with ethical responsibility and human rights. By working with different perspectives in the supplier assessment policy BillerudKorsnäs gets control of the suppliers and their regard on human rights. The company aim to be one step ahead of the legislation of business-critical issues and contribute to sustainable development in all places the company is active in. To reach the aim the company has a Code of Conduct that covers all employees. The code is based on the UN Global Compact, OECD's guidelines and the International Labour Organization's fundamental

conventions on decent work. To insure that the Code of Conduct is known by all employees, the company's employees need to perform a web-based training of the Code of Conduct. In year 2015 80 % of the employees had completed the training (BillerudKorsnäs, 2014a; 2015d).

2.3.2 Increased customer value

In the focus area of increased customer value the first commitment is to: *Improve our customers' business using knowledge on sustainable packaging solutions*. BillerudKorsnäs has a Solution Service concept that helps customer find the best packaging solution for their particular business and value chain. By developing smart packaging solutions based on renewable materials BillerudKorsnäs creates value for their customer. BillerudKorsnäs take one step closer in the relationship to their customers by trying to create profitability and concrete sustainability benefits for their customers, through their solutions offers. In year 2015 BillerudKorsnäs has moved forward in the value chain developing strategic partnerships where the brand owners are in focus. Based on this BillerudKorsnäs is able to create offers of sustainable solutions direct or indirect developed for the brand owners, which are closer to the end-consumer. This creates customer value further out in the value chain. BillerudKorsnäs constantly work on product safety throughout their value chain, to ensure that their packaging products are used for intended purpose (BillerudKorsnäs, 2015d).

The second commitment in the focus area of increased customer value is: *Through innovation expand the market of renewable packaging materials*. BillerudKorsnäs believes that innovation is crucial when producing sustainable products, an example is the fact that innovation has taken a place in the strategic platform since 2014. The company believes they can challenge the conventional packaging choices by offering sustainable products created through innovation. Investments and collaborations with employees from departments of Marketing, Production, Supply Chain and Strategic development have therefore been developed to create an innovate culture. BillerudKorsnäs' ambition is to develop sustainable, resource-efficient, thin, strong and safe materials, that protects goods and reduce losses. The challenge in this commitment is to create safe packaging materials within all restrictions and regulations, on all sales markets. BillerudKorsnäs has started to work on a model for overall control and follow-ups to monitor the changes in the regulations and legislations worldwide. BillerudKorsnäs evaluate this commitment by investigating the proportion of sales accounted for by new products, in year 2015 the company had an outcome of 17 % (BillerudKorsnäs, 2014a).

2.3.3 Sustainable bio-based society

In the focus area of sustainable bio-based society the first commitment is to: *Combat climate change throughout the value chain*. BillerudKorsnäs aim to play an active part in the transition to a fossil free society. The company has a vision of phasing out fossil fuels from the industrial production and work on reducing the greenhouse gas emissions throughout the value chain. BillerudKorsnäs has an ambition to create efficient and eco-friendly transports that meets the customers' needs. The company constantly works with optimising the wood flow on the logistic department. For example in Sweden BillerudKorsnäs works frequently with timber swaps with other forest companies, to reduce transport distance from the forest to the production site. In June 2015 in Sweden, was a new gross weight of 64 ton approved on vehicles. BillerudKorsnäs immediately took this in their contracts to get a positive effect on the environment, by producing less CO₂ per ton. In the beginning of 2016 the company subcontracts about 50:50 of vehicles of 62 and 64 tonnes vehicles, before the company only used the approved 62 tonnes vehicles (BillerudKorsnäs, 2014a; 2015d).

BillerudKorsnäs ambition is to have an efficient production that use as little resources as possible and at the same time creates as little waste and emission as possible. In year 2014 and 2015 the company invested in several of their plants to get higher production efficiency. Of the fuels used in BillerudKorsnäs' production 97.6 % of the energy was produced by renewable bioenergy in 2015 (BillerudKorsnäs, 2014a; 2015d).

BillerudKorsnäs' last commitment in their sustainability model is to: *Generate value for the society through collaboration, both locally and globally*. Since BillerudKorsnäs is an employer in many small communities, the company contributes to the social development of the communities together with the municipality, local organisations and the people living there. The company believes in cooperation to create value in a society. BillerudKorsnäs therefore wants to take part and help in developing local businesses, social initiatives and environmental issues. For example the company is actively promoting local business communities by purchasing goods and services locally and by developing commercial partnerships for example when it comes to energy production and supplement. Young people have been chosen as an important group that BillerudKorsnäs supports through sponsorship, school projects and work placements. BillerudKorsnäs does contribute to the global social development by supporting ActionAid, which is an organisation working to fight poverty. With the company's globalisation BillerudKorsnäs is seeking for new international initiative to support towards a positive social development (BillerudKorsnäs, 2014a; 2015d).

3 Literature review

This chapter presents a literature review which will be discussed in relationship to the result in the discussion chapter (7). The first part of the chapter present a Swedish study on effects of environmental regulation and policies, which point out different methods for different types of countries. The second part presents arguments for why companies work with CSR and sustainability.

3.1 Effects of environmental SWM regulations and policies

For this study it is important to understand differences in different countries. A study by Finnveden et al. (2013) presents an evaluation of a large-scale multi-disciplinary Swedish research program, which suggests and discusses policy instruments that lead to a more sustainable waste management in Sweden. Since Sweden is BillerudKorsnäs' home bas it interesting for the study to understand how environmental policies in Sweden effects their SWM, but also how these environmental policies can effects other countries' SWM in a different way.

According to Finnveden et al. all sectors of the society, including waste management, need to implement measurements that help leading towards a more sustainable society. The waste management has a unique possibility not only by reducing its own environmental impact, but also decreasing emission in other sectors by increasing the utilization of the waste. The Extended Producer Responsibility (EPR), a landfill tax, a ban of landfill disposal of organic materials and taxes for energy and carbon dioxide from fossil fuel used for heating, are all policy instrument that overall have been effective and changed the waste management towards a more recycling and sustainable management.

Finnveden et al. concludes that policy instruments are needed for a more sustainable waste management and that several policy instruments studied can be effective and possible to implement. The best potential of the policies studied for decreasing the environmental impact was the policy: *Compulsory recycling of recycling materials*, provided that the recycled material can replace virgin material.

Finnveden et al. further points out that handling of solid waste is surrounded by rules and regulations, but that those often are based on traditions and contexts which can be varying in different countries. Which policy instruments that is most effective to increase the global recycling rates, depends on whether if it is a well-established international recycling market or not. In Sweden, where such a market does exist, the best impact is to increase the collecting of recycling materials. In countries where recycling markets do not exist or is not well established, it usually depends on low demand of recycling materials. In these countries it is better to focus on policy instruments that stimulates demand of recycling materials, which can help an establishment of a recycling market. A Green Public Procurement requirement that demands a certain amount of recycled material in products and materials could also be helpful to establish recycle markets in developing markets.

According to Cleff & Rennings (1999) market-based instruments such as taxes and tradable permits are the most effective environmental policy instruments for reducing the environmental impact. Their arguments show that these instruments create long-term incentives for further cost-efficient emission reduction.

3.2 Sustainability strategies

Corporate Social Responsibility (CSR) and sustainability work has become an important part of companies' strategic work. By working with CSR the company views itself within an ecosystem of its social and natural environments, and tries to imply congruence between the interest of the company and the interest of the ecosystem. CSR is usually divided in three working areas: economic, environmental and social. According to Grant (2013) three arguments of why a company work with CSR exists: the *sustainability* argument, the *reputation* argument and the *license-to-operate* argument. The *sustainability* argument is applied on companies where the company have a mutual interest in sustaining the ecosystem. The *reputation* argument means that companies reputation are affected by their work with CSR. Good CSR work leads to good reputation. The last argument for why companies are working with CSR is the *license-to-operate* argument. Other parties as the industry, media, NGOs, customer and end-consumers can pressure companies to work with CSR, because without them the companies cannot stay existing (Grant, 2013).

Table 1 describes which part of CSR that is relevant for this study in relationship to the three arguments according to Grant (2013).

Table 1. Arguments for CSR work

	Economic	Environment	Social
Sustainability	Non relevant	Relevant	Non relevant
Reputation	Non relevant	Relevant	Non relevant
License-to-operate	Non relevant	Relevant	Non relevant

4 Recycling of packaging materials in EU & Sweden

This chapter covers the present situation in the European Union (EU) and especially Sweden, regarding waste management and especially recycling of packaging materials. Further in the study is EU and Sweden seen as a benchmark to the result about the selected countries. The first part of the chapter presents an overview of the legalisation on waste management and specially packaging waste materials. The second part shows an overview of the actually waste management system and the last part present the waste management system in figures, focusing on recycling rates.

4.1 Legislation on waste management in EU & Sweden

The EU has a long history of several directives about waste management in the Member States. In year 2008 the EU made a foundation of the European waste policy with *the Waste Framework Directive 2008/98/EC*. The directive aims to decrease all type of waste in Europe and to make Europe a recycling society. The directive presents a *Waste Hierarchy* that should apply as an order in how to manage waste legalisations and policies within the Member States. The *Waste Hierarchy* is presented in Figure 5 and the hierarchy order is: 1. Prevention, 2. Preparing for re-use, 3. Recycling, 4. Other recovery e.g. energy recovery, 5. Disposal (EU, 2008; EU, 2016c).

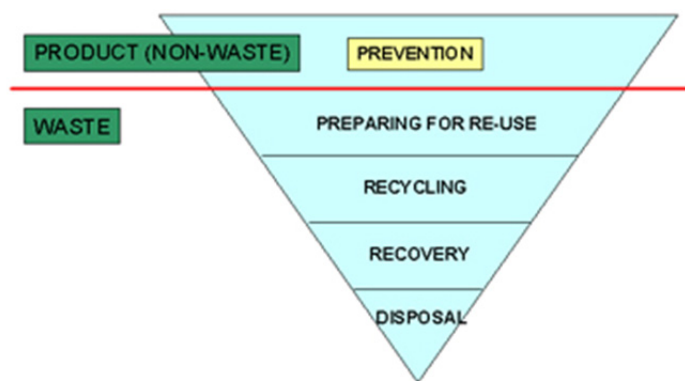


Figure 5. An illustration of the Waste Hierarchy. (EU, 2016c)

Together with the *Waste Hierarchy*, the directive specifies a target of recycling at least 50 % of the household MSW by year 2020 and it aims for a minimum of separate collection for paper, metal, glass and plastics before year 2015. *Waste Framework Directive 2008/98/EC* also clarify the definition such as “waste”, “by-products” and “end-of-waste” to make the collecting process easier. To create a circular economy the directive declares that everyone that develops, produce, imports, sell or treats a product has an EPR of the product. The EPR may include making sure that the waste and the remains of used products are managed both physical and financial. It may also include providing information on how to reuse and recycle the product (EU, 2008; EU, 2016c). *The 2014 Review of Waste Policy and Legislation – proposal* is a revised version of the directive 2008/98/EC with higher recycling targets to year 2030 such as recycling 65% of the municipal waste and recycling 75% of the packaging waste. It also has a landfill target to reduce the landfill to minimum 10 % of all waste by the same year. The review was made to ensure an effective implementation of a sustainable waste handling to faster reach a circular economy (EU, 2016a). In the end of 2015 the European Commission adopted a *Circular Economy Package*, which aims to stimulate a transforming towards a recycling society, with a circular economy within EU, where one company’s waste

is another company's raw material. Its purpose is to maintain the value of materials for as long as possible and therefore minimise waste and resource use. The European Commission's package aims to ensure sustainable economy growth and a global competitiveness, but also to generate new jobs within the EU (European Commission, 2015).

The EU has since the 1980s issued directives specifically on packaging materials. The Directive 85/339/EEC provided a series of measures relating to production, use, recycling and refilling of liquid containers. The directive's purpose was to reduce the containers impact on the environment and contribute to a reduction in consumption of energy and raw material in the field (EU, 1985). After that directive was implemented more Member States started to manage packaging waste, which led to diverging national legalisations. In year 1994 the EU created a new directive 94/62/EC to harmonize the handling of packaging waste through all Member States, which reduce the environmental impact, and secure a functional internal market, by avoiding obstacle of trade and restriction for competitors. The directive 94/62/EC states that all Member States should set up return, collection and recovery systems, which do not discriminate imported products that maximize the return of packaging and packaging waste to the system. It also contains targets of how much packaging waste the Member States should recover and recycle. Since 1994 the directive has been revised to clarify different term as "packaging" and to increase the targets of recovery and recycling of packaging waste. The latest amendment was presented in 2004 as the *Directive 2004/12/EC* (EU, 1994; 2004). Packaging waste is included in the *Waste Framework Directive 2008/98/EC*, which means that producers of packages also have an EPR of their products waste (EU, 2008; EU, 2016c).

Sweden is one of the EU's Member States that works on minimizing waste impact on the environment. The Swedish waste management legislation is primarily based on the directives from EU. In Sweden it is prohibited to place unsorted burnable waste at landfills since year 2002 and the ban was extended to organic waste with some exceptions in 2005 (Naturvårdsverket, 2012). In year 1994 Sweden developed a regulation which includes a similar EPR that gives the one that produce, imports or sells a product with a package a responsibility to make sure there is a collecting system to handle the waste the packaging material creates (SFS 1994:1235). The regulation has been developed many times and was latest revised in year 2014 (SFS 2014:1073). The last regulation has targets such as before the year of 2020 should at least 55 % of all packaging waste in Sweden be recycled and after that at least 65 %. It also states specific targets for packaging waste from paper, paperboard, cartonboard and corrugated board in Sweden, that at least 65 % should be recycled before year 2020 and after that at least 85 %. For plastic packaging, except liquid packaging, the specific recycle rate target is at least 30 % by 2020 and after that 50 % (SFS 2014:1073). In Sweden all people, households and organisations that have used packaging materials has an obligation to sort out packaging waste from other waste materials after using it (SFS 2011:927). The Swedish municipalities have an obligation to inform the user of packaging materials how to sort it, where the collecting sites are and how the sorting work contributes to the recycling rates (SFS 2014:1073).

Figure 6 presents a framework for a scale of legislation on waste management. The Legislation framework is closer presented in chapter 5. The EU's and Sweden's legislation on waste management for MSW are placed on the highest level of the scale. They have clear legislations that describe the EPR for all products, including packages and high targets for collection and recycling.

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
EU	MSW				
Sweden	MSW				

MSW = Legislation for all MSW

Figure 6. Legislation framework.

4.2 Municipal solid waste management system in EU and Sweden

There is no common SWM system in the EU's Member States. All states have their own systems. Because of the common targets within EU, many of the Member States have developed own functional SWM system (EU, 2016d).

The MSW management in Sweden is built on waste sorting by the households. All waste generators should sort their MSW at sorting stations or sorting centrals. The sorting stations are placed close to living areas, to make it easy for the citizens to reach. The sorting centrals are suited for large bulky waste and are usually placed outside living areas. The sorting stations and sorting centrals are managed by organisations created by producers with EPR and the municipal authorities. All households in Sweden should have containers for biological waste and waste for incineration at home. A municipal collecting system is managing the weekly collection of these categories. Living communities as apartment buildings usually have their own sorting station in connection with the building, meanwhile all other citizens need to get their waste to a nearby sorting station. The MSW in Sweden should be sorted by the citizens in following categories (Naturvårdsverket, 2012):

- Biological waste
- Burnable waste (waste for incineration)
- Bulky waste (large and heavy waste that is not suitable to put in a bag)
- Packaging waste made of
 - o Plastic (hard and soft)
 - o Paper and cartonboard
 - o Metal
 - o Glass (coloured and non-coloured)
- Newspapers
- Electrical waste
- Batteries
- Medicines
- Other hazardous waste
- Bottles for recycling (bottles part of the pledge system)
- Metal canes/jars for recycling (canes part of the pledge system)

Organisations with an EPR of packaging materials and paper (companies producing, imports or sells packaging materials) have created a company called FTI (The Packaging and Newspaper Collection). It has taken over the EPR from their owners' companies, which means that FTI is responsible to collect the packaging waste and newspaper waste in Sweden and make sure it is recycled. To finance the FTI and the Swedish recycling system the owners

pay fees based on the tonnage of the packaging they are providing (FTI, 2016). FTI has no profit motive and no economic dividend can be divided among the owners (FTI, 2016).

A pledge system is also implemented for some of the metal cans and plastic PET bottles. When a person buys a PET bottle (involved in the system, which is marked on the bottle), the person pays extra for using the bottle. When the person returns the bottle at a pledge station for a refund and the bottle will be sorted and recycled. Since the pledge system started in 1984, Sweden has increased its recycling rates for the involved materials. The pledge stations are placed in grocery stores and are managed by the store and Returpack, an organisation created of the Swedish brewers (Sveriges Bryggerier), the Swedish retailers (Svenska dagligvaruhandel) and the grocery retailers (Livsmedelshandlarna). The returned waste materials are then transported to Returpacks plant for sorting and pressed in to bales before it is send to a recycling facility where the waste materials are made in to new bottles and cans (Returpack, 2016a; 2016b).

4.3 Waste management data in EU and Sweden

Despite the EU directive to reduce the amount of waste, each European citizen creates around 500 kilograms (kg) of MSW each year and almost one third of this quantity is directly placed at a landfill. In 2014 the estimated numbers within EU were 475 kg MSW generated per person, 132 kg went directly to landfill and 131 kg was recycled. This shows a recycling rate at almost 28 %. The recycling rates are varying over the different member states within EU, from 5 to 80 %. Overall between 25-40 % of the MSW generated by household within EU was recycled in the last years (EU, 2016b; Eurostat, 2015a). In 2014, 71.7 % of all generated paper materials in Europe were recycled, which is about 58 million tonnes (ERPC, 2015). Of the total generated plastic waste was 29.7 % recycled in 2014 (PlasticsEurope, 2015). During 2012 the Member States of EU generated 156.8 kg packaging waste per person (Figure 7). The EU's total recycling rate of all packaging waste within the Member State was in 2013 about 65.3 %. The recycling rate from paper and cartonboard packaging waste was 84.7 % and the same number for plastic packaging waste was 37.3 % the same year (Eurostat, 2015b; 2015c; 2016).

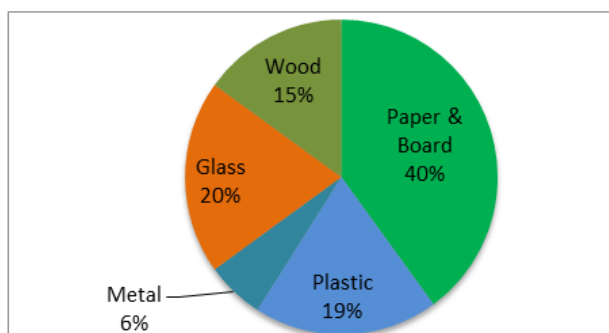


Figure 7. Composition of generated packaging waste in EU 2012. (Eurostat, 2015b)

In year 2014 the citizens of Sweden created 438 kg of MSW per person and 3 kg of that went to landfill and 146 kg was recycled. This shows that the recycling rate of all MSW in Sweden was about 33 %. Most of the MSW in Sweden is incinerated for energy recovery. The country's recycling rates of total plastic waste was in 2014 38.4 %. According to the Swedish Forest Industry Association the estimated recycling rate for newspaper was 95 % in 2014 (Skogsindustrierna, 2016). The same year the packaging waste from paperboard and

cartonboard had the recycling rate of 79 %. Sweden had a goal to reach a recycling rate of 75 % of the paper waste in 2014, the official numbers are lacking, but looking at the estimated figure it seems as Sweden has reached the target (Eurostat, 2015a; 2015c; Naturvårdsverket, 2014). The recycling rate of all packaging waste in Sweden was the same year also 79 %. For plastic packaging waste the recycle rate was in 2013 about 45.6 % (FTI, 2015a; Eurostat, 2016; Naturvårdsverket, 2014).

The Analysis framework, which is a development of the Legislation framework (Figure 6), shows how the recycling rates relate to the legislation scale presented in Legislation framework. The framework in figure 8 presents the prescribed and implemented recycling rates. The Analysis framework will be presented further in chapter 5.

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
75 - 100 %	EU, Sweden, (EU), (Sweden), (Sweden)				
50 - 74 %	(EU)				
25 - 49 %	Sweden, EU, (EU), (Sweden)				
0 - 24 %	Sweden, EU				

Green = Total paper waste
Blue = Total plastic waste
Black = Total MSW
() = Paper packaging waste
() = Plastic packaging waste
() = Total packaging waste

Figure 8. Analysis framework - Recycle rates in relation to the legislation scale of waste management.

5 Methods

This chapter presents the methodology used to reach the aim and answer the research questions of the study. First is the study's method process described in overall steps and then is the data gathering process presented, followed by a description of how the results was analysed and interpreted. The chapter ends with an overview model of the study method.

The aim and research questions were formulated in collaboration with BillerudKorsnäs, to get better information about their new sales markets' (the selected countries') recycling and separation systems. The recycling and separation systems of BillerudKorsnäs' home market (EU and Sweden), was used as a benchmark in the analysis of the selected countries. Official data of the selected countries' legislation on waste management were gathered and complemented with results from previous research. The selected countries' legislations on waste management were analysed in the Legislation framework. The framework presents a scale of how strict the waste management legislation is and the selected countries were compared to EU & Sweden in the framework. Data was then gathered of how the recycling and separation systems actually work in reality, since legislations may not be implemented, which affects the study. Data on the waste quantities generated, collected and recycled concluded the overview. All gathered data, including the information about the legislation on waste management, was then examined in the Analysis framework. The result of the overview was analysed in relation to BillerudKorsnäs' sustainability strategy. Conclusions were drawn to sum up the study and to suggest future research studies within the study area and recommendations to BillerudKorsnäs were presented.

5.1 Data gathering

The study is based on secondary data. Secondary data is data that has been collected for other purpose than this study and the study researcher has not been involved in the collection of data (Saunders, Lewis & Thornhill, 2012). The data in this study has been collected from official documents distributed from governments working on these questions from the selected countries. The data has been gathered from official sources as governments', ministries' departments' and World Bank's official webpages. Where official sources did not provide the requested data, studies by researcher and consultant were used. All data used from researcher has been found by using searching tools as Primo, the Uppsala University Library search service, ScienceDirect, Google Scholar etc. Key terms as; waste management, recycling, MSW, packaging materials, Asia, etc. was used. The data from other researchers are all published as studies in authorised and peer-reviewed journals or as articles.

5.1.1 Secondary data

A secondary analysis was conducted meaning that sources were examined for data that can contribute to new interpretations, different knowledge and conclusions (Bryman, 2004). This process was guided by the Analytical framework. Official documents of legislation about recycling and separation systems contributed valuable information that was used to create the overview of the selected countries recycling and separation systems. Official statistics about how much paper and plastic that are generated, collected and recycled within the selected countries were also valuable to the secondary analysis to investigate the study's aim. Secondary data provided by government, researcher and consultants can usually contribute with higher-quality data than if a student collected data by itself. Secondary analysis also creates good opportunities for cross-cultural analysis since the research can contain international data without the researcher need to visit the investigated countries. Research barrier as language barrier may be less, since no local contact is needed (Bryman, 2004). In

this study language barrier did occur anyway since some of the official documents and local studies only were available in local languages. The study may be biased since it is based on the secondary data available in English. However, most of the globally recognized studies are made in English. The secondary analysis of data in English made it possible to investigate and compare all five selected countries.

The study would have benefited from primary data, which would have given the study a deeper understanding of the secondary data, but this expansion was not possible for time reasons. An advantage with secondary data is that there are no travels needed, but the evaluating and analysis of the secondary data can need more time, since the data is not collected for the study specially (Saunders et al. 2012). The selected countries governments and some researchers were contacted by email and phone to collect primary data, but without success.

5.1.2 Reliability, validity and ethical issues

The limitation of a secondary analysis is that the researcher cannot control the data used in the study (Bryman, 2004). This can partly be compensated, by using sources with high reliability. In this study information has been used that the governments and ministries of the selected countries publish themselves. For India a legal consultant, PSA, was used as a compliment to the data presented of the government.

For the figures of generated, collected waste and recycled waste materials, different sources were used, depending on what was available. Some data come from official government documents, others from researchers' results. Some countries had no official data of MSW, but credible estimated figures could be provided, which have been used in this study. It can be questioned if some government would provide fictional figures, to make the country look good. But since the governments are the highest official source, the data provided by them are handled as trustworthy in the study.

To collect as trustworthy and comparable data as possible official statistics and researches published in authorised journals has been used as main sources. To give the study result more credibility, data from different sources were compared and verified. When no official statistics was available, data was gathered from research papers and other technical reports. The most recent available data has always been chosen from the available sources.

A high reliability is created if the study could be made of another researcher or on another occasion and the result would be the same (Saunders et al. 2012). By only using secondary data available on Internet, another researcher probably would get the same result. The reliability of this study can therefore be seen as high.

Because the study only is made out of secondary data, the study consists of interpretation of the collected data (Saunders et al. 2012). To avoid miss interpretation of the data, it is presented as close as possible to the original presentation. By doing this the reader can by itself follow how the data fit in this study.

When primary data is used the researcher could affects the result just by being there (Saunders et al. 2012). In for example an interview the researcher could affect the result by acting in a certain way. By using only secondary data this issue should not appear in the study, but it is important to understand that the issue most likely have appeared when the original researcher collected the data, but that the issue do not affect this study's reliability.

To find data about how much packaging waste materials that were generated, collected and recycled in the selected countries were difficult and the sources were limited. Not many of the selected countries' governments distributed all the requested data and in many of the countries were not the requested data distributed by anyone. To be able to make a reliable comparison between the countries, should the gathered data be from the same time period. The best alternative would be if all data were newly gathered. In the study have the latest data published of an authorised source been used in the extent it is possible.

Some sources have provided information about several of the selected countries with information gathered by the same method, which makes the comparison more exact. Sources that provide information about several countries create a higher credibility to the comparison. An example of such a source used in the study is the World Bank's (2012) study *What a waste*.

Since some government could not provide the requested data about packaging waste materials of paper and plastic from households. For this reason the study was expended to investigate the total generation of MSW. With this expended focus makes it harder to generalized conclusions, about packaging waste materials. Since packaging waste materials of paper and plastic are part of the total generated MSW, the study result could give a hint on how the packaging waste materials are divided and handled. Because the results are generated from MSW and not only packaging waste materials, the result could also be used for analysing other parts of MSW as recycling of metal such as aluminium. The study's validity is therefore of MSW materials and not only packaging materials of paper and plastic (Bryman, 2011).

Ethical aspects must be taken in account in all academic studies. According to Bryman (2011) there are four ethical principles that should be worked with throughout the study process. The principles are suited for studies that involve people and the four principles are:

- *Information requirements* – all involved people must be informed about the studies aim and why they are requested to be involved in the study.
- *Consent requirements* – all involved people must have the right to accept or pass on the involvement in the study.
- *Confidentiality requirements* – all personal information used in the study was handled so no unauthorized person could take part of the information. After the study, the materials will be destroyed if no further studies are planned.
- *User requirements* – all personal information that appear in the study can only be used for what the involved people have given consents to.

The information and data used in this study has only been gathered by documents. The only contact involving people have not given any useful information and it is therefore not part of the study result. All the ethical principals were considered when the involved people were contacted, but since no useful information came out of it have no materials been saved. No personal information has been used in the study and only general information about the selected countries and the benchmark has been used.

5.2 Result and data analysis

Information about the European and especially Swedish recycling and separation systems are used as a benchmark. This makes it also easier to analyse if the selected countries' recycling and separation systems are compatible with BillerudKorsnäs' sustainability strategy. The result is presented together with the analysis in chapter 6. The analysis is a comparison

between the selected countries' result and the benchmark. The Result and analysis chapter is divided in four parts, where each of the parts tries to answer one research question.

- The first part of the chapter sums up in the Legislation framework (Figure 9), which is a scale of legislation on waste management made by the author. The Legislation framework is cumulative and fills up after each of the selected countries are presented. The framework is presented closely in part 5.2.1.
- The second part of the Result and analysis chapter presents the actual waste management system. The selected countries' different waste flow are described and a comparison between them are made in the summary part 6.2.6.
- The third part of the Result and analysis chapter presents the waste management data and put them in relation to the legislation on waste management described in part one of the chapter. This is made in the Analysis framework (Figure 10), which gives an overview of the selected countries' recycling systems. The Analysis framework is also cumulative and fills up as the information is presented in the Result and analysis chapter. The framework is more detailed presented in part 5.2.2.
- In the last part of the Result and analysis chapter the results from the previous parts are put in relations to BillerudKorsnäs' sustainability strategy. BillerudKorsnäs' model presented in chapter 2 (figure 4) is used as framework for the analysis to investigate if BillerudKorsnäs' sustainability strategy is compatible with the selected countries recycling and separation systems.

5.2.1 Legislation framework

The Legislation framework is created of the author to create an analytical framework and an overview of the answer of the first research question. The framework is used to show how strict the legislation on waste management is in the selected countries and the benchmark. The data in the framework is built up cumulative along with the presentations of each country. The scale of strictness of the legislation is divided in five levels, which was chosen as reasonable and possible levels. The highest level is based on the benchmark's (EU and Sweden) strictness on legislation on waste management with an EPR for collection and recycling (SFS 1994:1235; EU, 2008; EU, 2016c). This level was chosen as highest since recycling rates in EU and Sweden are seen as high. The figures and legislation for EU and Sweden is presented in chapter 4. An EPR puts pressure on the producer (EU, 2008; EU, 2016c). The second level in the Legislation framework is demanding recycling and separation of waste of those who are generating the waste. This level was chosen since demanding laws or regulations are strict towards the population. The third level in the framework is encouraging recycling and separation of waste of those who are generating the waste. This level was chosen since encouraging is softer than demanding. The fourth level of legislation on waste management is encouraging waste handling for protection of the environment. The fourth level was chosen since it is still encouraging like the third level, but the method for the waste handling is not specified. The fifth and lowest level in the framework is of no legislations for waste handling at all. The built up of the Legislation framework is presented in Figure 9.

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
EU					
Sweden					
India					
Indonesia					
China					Plastic = Special legislation for plastic waste
Malaysia					Packaging = Special legislation for packaging waste
Thailand					MSW = Legislation for all MSW

Figure 9. Legislation framework.

5.2.2 Analysis framework

To reach the aim to create an overview of the selected countries' legislation on waste management and their waste management data, the result were mapped in the Analysis framework. The framework was created to make it easier to compare the result of the selected countries with each other and with the benchmark, Sweden and EU. The benchmark is presented in chapter 4. By showing the legislation on waste management in a scale in comparison to the recycling rate of waste materials, the Analysis framework gives an overview of how the waste management is officially managed (from part 6.1) and how the recycling system looks in figures (6.3). The Analysis framework does not include the informal and private system and how the waste flow goes. This is shown and analysed separately in part 6.3.

The Analysis framework is, as stated before, a development of the Legislation framework (Figure 9). The Legislation framework is placed on the Analysis framework's X axis and the scale of levels is described in part 5.5.1. On the Analysis framework's Y axis is a scale of recycling rates from 0-100 %. The selected countries name is placed in relation to the actually recycling rate and strictness of the legislation on waste management. When information is available the selected countries are placed after total MSW, paper waste, plastic waste, total packaging waste, paper packaging waste, plastic packaging waste. Different colours in the Analysis framework mark the different waste types.

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
75 - 100 %					
50 - 74 %					
25 - 49 %					
0 - 24 %					

Green = Total paper waste
 Blue = Total plastic waste
 Black = Total MSW
 () = Paper packaging waste
 () = Plastic packaging waste
 () = Total packaging waste

Figure 10. Analysis framework - Recycle rates in relation to the legislation scale of waste management.

5.2.3 Analyse of “the fit” with BillerudKorsnäs sustainability strategy

To reach the second part of the aim, to investigate if the systems are compatible with BillerudKorsnäs’ sustainability strategy, was the company’s model for sustainability work used as a framework for an analysis of the results from the chapter parts 6.1 - 6.3. The model is presented in chapter 2 and consists of three focus areas, which have each two commitments. A comparison is made between the commitments and the result of the existing recycling and separation systems in the selected countries. The model has previously been shown in Figure 4.

5.3 Summary of the study method

To reach the aim and answer the research question the study was made in seven steps. The seven steps were; 1. Collect information about recycling and separation systems in EU and Sweden, 2. Collect official documents of legislation about waste management of the selected countries, 3. Collect official waste management data from the selected countries, 4. Map the selected countries in the Analysis framework, 5. Analyse the selected countries according to BillerudKorsnäs’ sustainability strategy and the benchmark, 6. Synthesise conclusions and recommendations. The research approach is illustrated in Figure 11.

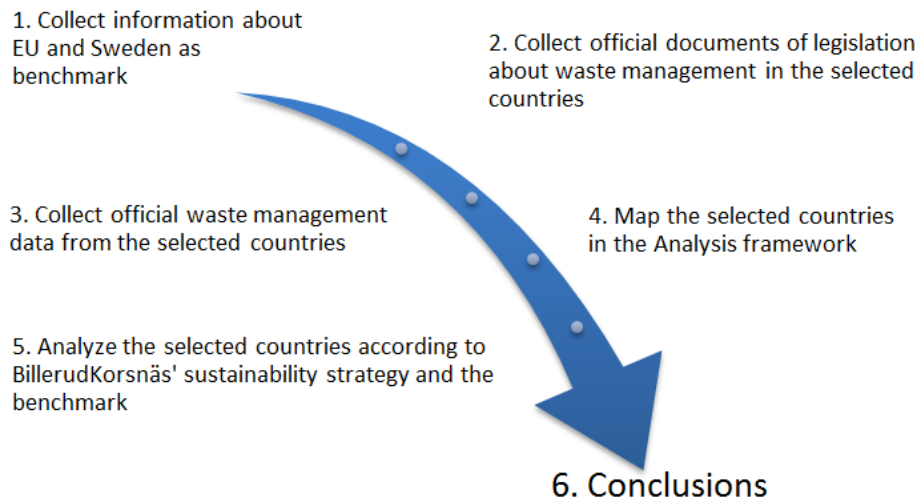


Figure 11. An illustration of the approach to reach the study's aim and answer the research questions.

6 Results and analysis

This chapter presents the result of the study in four parts. The first part presents the selected countries legislation about waste management. In the second part is the existing waste management system of the selected countries presented. The third part shows the statistic of the countries' waste management and the last part is an analysis of how the results for the first three parts are compatible to BillerudKorsnäs' sustainability strategy.

6.1 Legislation on waste management

The legislation on waste management is effecting how the waste management system gets structured in a country. This first part of the results and analysis chapter tries to answer the first research question:

- *What are the legislation (laws, regulations and policies) on recycling and material handling for packaging waste of paper and plastic?*

This by creating an overview of the selected countries' legislation on waste management in the Legislation framework. Some of the selected countries, for example Indonesia, do not have their legislations authorised translated to English, which have made the task difficult. In those cases information about the legislation on waste management has been taken from research studies.

6.1.1 India

The Indian waste management is based on three principals; *Sustainable development*, *Precaution* and *Polluters pay*. *Sustainable development* includes both development of the society, the environment and the organization. *Precaution* is about avoiding environmental degradation and *Polluters pay* states that the polluter must pay for the environmental damage caused by the polluter. These principals have a fundamental part of the Indian environmental law system (PSA, 2015).

The waste management in India is governed, in the different stats, by the Ministry of Environment, Forests and Climate Change (MoEF) and the State Pollution Control Boards (SPCB), together with some other sub-oriented legislation authorities. The umbrella law, *Environment Protection Act, 1986* grants MoEF the right to empower rules and regulations about managing disposal and dealing with the generation of waste (PSA, 2015). The SWM services are locally provided of Urban Local Bodies (ULB) on behalf of the Municipal Authority. The expenses for the SWM services are usually paid by the Property tax from the residents in the area (MoEF, 2009; 2015a; Joseph, 2002).

Implementation of functional SWM services is lacking in India, which led to that a national policy of MSW was notified by MoEF in year 2000, *Municipal Solid Waste (Management and Handling) Rules, 2000*. This policy made it mandatory for the Municipal Authorities and the Urban Local Bodies, to improve the SWM services and work towards goals that had target dates for December 2003. The rules that should be implemented included (MoEF, 2000; 2009; 2010; 2015a; Joseph, 2002):

- Prohibiting throwing waste on streets
- Organizing door-to-door waste collections
- Creating an awareness program to spreading information to the public
- Providing adequate community storage facilities
- Promoting waste separation with use of colour waste bins

The tasks that citizens are responsible for:

- Separation of waste at source
- Avoiding throwing waste on streets
- Delivery of waste in accordance to the delivery system made by the Urban Local Bodies.

Even though the policy has instructions and targets, many Municipal Authorities and ULB have problem implementing the rules and the targets were not reached (MoEF, 2000; 2009; 2010; 2015a; Joseph, 2002). Because of the lacking implementation MoEF (2015a) wanted to amend the rules to make clearer instructions. This lead to a draft for an updated version of the rules, published in 2013 for the public to comment upon. This draft focus on management of waste through a sustainable business model, including strict demands for separation of MSW at source, door-to-door waste collection and processing of separated waste into useful products. After the draft from 2013 was presented, a newer draft was presented in 2015. The new draft was a development of the previous draft and it was also published for the public to comment upon (MoEF, 2015a; 2015b).

In April 2016 MoEF notified a new version of the waste management rules - *Solid Waste Management Rules, 2016*. These rules have clear directions on which duties each stakeholder are responsible of. Every waste generator should separate and store the generated waste in three categories (MoEF, 2015b; PIB, 2016a);

1. *Wet waste* (biodegradable)
2. *Dry waste* (non-biodegradable as plastic, paper, metal, wood etc.)
3. *Domestic hazardous waste* (as diapers, napkins, empty containers of cleaning agents etc.)

Non-biodegradable waste is defined as waste that cannot be degraded by microorganisms into simpler stable compounds and it should be sorted into the *dry waste* (MoEF, 2015b). The definition of *dry waste* can be questioned, since both paper and wood is biodegradable. It may be that the translation is wrong and it should have been non-compostable instead. Compostable materials are also degraded by microorganisms, but have a timeframe of the degradable period, which usually is stated by a standard, nationally or global (Davis & Song, 2006).

A day-to-day collection of the sorted waste should be arranged by the ULB. The collection can be made of the ULB itself or with public private partnership. The ULB are responsible for the whole development of infrastructure for collection, storage, separation, transportation, processing and disposal of MSW in India. To finance the system all waste generators should pay a “User fee” as may be prescribed of ULB, this fee can vary in different provinces. Generators that do not separate the waste needs to pay a “Spot Fine” fee, also this fee can vary in different part of the country (MoEF, 2015b; PIB, 2016a).

Manufactures and brand-owners that introduce disposable products as plastic packaging or glass, to the Indian market need to finance the ULB for establishing a sustainable waste system. All brand-owners that sell or market their products in packaging materials that are non-bio-degradable, need to develop a collect back system for the packaging waste generated by their products (MoEF, 2015b; PIB, 2016a).

India has a special legislation for handling plastic waste, but the general *Solid Waste Management Rules* needs to be followed by all generators of plastic as separation and safe

storage. The rules for plastic waste have also been amended within the last years and the last version was notified in March 2016 - *Plastic Waste Management Rules, 2016*. The aim of the rules is to introduce the responsibility of the producer and generator. All producer, importer and brand-owners which introduce plastic carry bags, multi-layered plastic sachet, or pouches, or packaging to the Indian market need to establish a system for collecting back the plastic waste generated by their products. The producers, importers and brand-owners have an EPR for the plastic within their products. The collection can be done collectively or individually, through own distribution or in corporation with the ULB. All parts with an EPR need to get a collecting-back-plan approved by the SPCB, to operate in India. The rule also states that production and use of non-recyclable multilayers plastic should be phased out in two years (PIB, 2016b).

Since 2011 there are regulations about packaging and labelling of food in India. The regulation is called *Food Safety and Standards (Packaging and labelling) Regulations, 2011*, which The Ministry of Health and Family Welfare with the Food Safety and Standards Authority of India (FSSAI) notified in 2011. The regulation controls how food should be packed and labelled. The regulation states that container made of plastic packaging materials that store food, must follow the Indian Standard Specification, which specifies standards for different plastic types (FSSAI, 2011).

India - Legislation on waste management, summary

India's legislation on waste management has developed fast during recent years. In the spring 2016 two new rules about solid waste and plastic waste were presented. The new rule about solid waste has clear instructions how waste should be collected and separated. It states that paper and plastic materials should be sorted as *dry waste* (non-biodegradable waste). The definition of biodegradable waste in the new rule could be questioned, since paper is usually defined as biodegradable (Davis & Song, 2006).

Figure 12 tries to summarize India's legislation on waste management compared with EU and Sweden. The general legislation about MSW in India is placed at the second highest level of the Legislation framework in Figure 12, since the new rule involves clear demanding of separation and recycling of waste materials. The new solid waste rule also includes parts about how producers and brand owners need to create collecting back systems if their packaging materials are non-biodegradable. This can be defined as an EPR, but by producing biodegradable packages the producers and brand-owners could avoid the EPR. In Figure 12 the legislation for packaging waste placed on the highest level as an EPR. The new rule about plastic waste states a clear EPR for the producer, importer and brand-owners, which introduce plastic in India. No special legislation about waste handling of paper has been found in the study.

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
EU	MSW				
Sweden	MSW				Plastic = Special legislation for plastic waste
India	Plastic, Packaging	MSW			Packaging = Special legislation for packaging waste MSW = Legislation for all MSW

Figure 12. Legislation Framework.

6.1.2 Indonesia

The legal base of the Indonesian solid waste management is *Act no. 18/2008* notified of the Republic of Indonesia in 2008. The act was the first national comprehensive waste management act in Indonesia. The objective of the act was to improve the public health and environmental quality, but also utilize waste as an energy source (RoI, 2008; Landon, 2013). Since year 1999 have a decentralisation system applied in Indonesia, making the province the highest tier of the local government. The local government in the province has the right to establish its own policies and manage its local resources, including the waste. Some provinces therefore already had waste management policies before 2008, when the first national regulation was notified (Meidiana & Games, 2011). The central government set the standards, norms, criteria, policies, procedures etc. of how to handle the solid waste, but it is the provincial and local government that implement it and follow-up locally (RoI, 2008).

According to *Act no. 18/2008*, everyone in Indonesia has right to good and environmentally sound services in waste management, organized by the central and local government. But everybody involved with household waste also have the obligation to *reduce* and *handle the waste*, based on environmental sound management. With *reduce waste* means: decreasing the generation of waste, recycling of waste and/or re-using of waste materials. To make this possible the government and the regional government are responsible for creating activities for reusing and recycling, but also to facilitate a market for recycled products. The obligation to *handle the waste* means: separation, collection, transportation, processing, and final processing. To make this possible, the management of settlement area, commercial area, industrial area, public facility, etc. are obliged to provide waste separation facilities (RoI, 2008; Landon, 2013).

Act no. 18/2008 is made in line with the country's 3Rs policy: (*reduce, reuse, recycle*). The act promotes cooperation between all parties – industry, community, business and government that share the responsibility, to create a good waste management. The act also bans waste management that cause environmental pollution, illegal dumping and open burning in the country. The central government also had a target to close all open dumps before the year 2013, but it was still a long way to go in 2015 (Landon, 2013; GBG, 2014; Dhokhikah, Trihadiningrum & Sunaryo, 2015).

The act states that business actors should utilize their product's materials so that only a minimum of waste is created. Business actors also need to make their products reusable and recyclable and/or easy to be decomposed by natural processes. All producer of waste should put a label on the product or package, related to the reduction and handling of the waste. The

producer is also obliged to handle the package of the product and the used product, if it cannot or is difficult to be decomposed (RoI, 2008). This is a sort of EPR, but if the product and package can be decomposed the producer have no obligation to handle the waste. The central government of Indonesia has not made any regulation of technical guidance for the producers' obligation, or stated an official definition of EPR in the country (Chaerul, Fahrurroji & Fujiwara, 2014). It can be questioned what the RoI (2008) mean by "*cannot or is difficult to de decomposed*". All biodegradable materials as paper are degradable but over a longer time than decomposable materials as food waste. Since the producer can skip the EPR by making the product and packages easy to decompose, this rule is not classified as complete EPR in this study.

In 2012 *Act no. 18/2008* was followed up by the *Government Regulation No. 81/2012*. This regulation confirms the importance of *Act no. 18/2008*'s work with the 3Rs, but the new regulation has focus on implementation of the 3R's on household solid waste with instructions on collection, treatment and disposal. The regulation states that all waste materials must be separated in at least five categorize (Kamis, 2012; Landon, 2013; Dhokhikah et al, 2015):

1. *Hazardous and poisonous materials*
2. *Degradable materials*
3. *Reusable materials*
4. *Recyclable materials*
5. *Other materials*

The regulation has no mention of sanctions for violators, but that should be covered by local bylaws (Kamis, 2012; Landon, 2013; Dhokhikah et al, 2015). Paper and plastic waste are assumes to be placed in the category of *recyclable materials*.

In 2012 another regulation was notified, the *Regulation of MoE of the Republic of Indonesia No. 13/2012*. This regulation declares its support for development of Waste Banks. Waste Banks are banks where citizens can sell household waste for recycling and get money in return. The Waste Bank sets a price on each waste type per weight. The money can be put on an account at the Waste Bank as a savings account a normal bank or the person can get the money in cash. The Waste Bank is developed to increase the incentive for the citizens to sort recyclable materials from their MSW, but also to create a platform where the citizens can get information about reusable and recyclable materials. Since the regulation was notified many Waste Banks has started their businesses (Dhokhikah et al. 2015).

Indonesia - Legislation on waste management, summary

Indonesia legislation on waste management focus on getting everyone involved with waste handling system. The *Act no. 18/2008* clarifies that all involved are obligated to *reduce* and *handle waste*, which includes re-using, recycling, collecting, separation, etc. The act also points out that all business actors must make their products reusable, recyclable and/or easy to decompose. If a product or package is difficult to decompose, the producer is obliged to handle the waste. This is a sort of EPR for the producer, but if the product or package is decomposable it is not subject to EPR. Since there is no English translation of the act, only a describing article about it, it is difficult to place the legislation of Indonesia's MSW on the legislation scale. It is can also be questioned if the act really means that the product or package should be easy to decompose or it should be biodegradable? With decomposable materials the degradable process have a timeframe after a standard (Davis & Song, 2006). Since the act points out that business actors must make their products reusable, recyclable and/or easy to be

decomposed, in this study the producer is seen to have no EPR. If the producers follow the act it will not be included in the part of EPR, because of this is it not seen as an EPR in this study.

After studying the *Act no. 18/2008* and the *Government Regulation No. 81/2012* with a demand about sorting household waste for recycling, the legislation of the MSW for Indonesia is placed at the second level in the Legislation framework (Figure 13). By supporting the development of Waste Bank in *Regulation of MoE of the Republic of Indonesia No. 13/2012* shows that Indonesia put the responsibility of recycling on the user of the product instead of the producer. This distinguishes from the MSW system in Sweden where both the producer and the user has a responsibility to recycle the waste. No laws or regulation specially focusing on paper or plastic waste materials were found in the study.

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
EU	MSW				
Sweden	MSW				
India	Plastic, Packaging	MSW			Plastic = Special legislation for plastic waste Packaging = Special legislation for packaging waste
Indonesia		MSW			MSW = Legislation for all MSW

Figure 13. Legislation framework.

6.1.3 China

The Ministry of Construction of the People's Republic of China (P.R.C) and the Ministry of Environmental Protection of P.R.C has divided the Chinese directions of the SWM in three levels; Regulations, laws and documents issued by the State Administration, regulations and documents issued by related ministries of the Central Government and local laws and regulations issued by the Local Governments State level (Bouanini, 2013).

In 1995 the law of P.R.C on *Prevention and Control of Solid Waste Pollution* was issued, which is the base of the Chinese national solid waste management. The law has been revised, and the latest version was issued in 2005. It states that all units or individuals that generate solid waste should take measures to prevent pollution of the environment by solid waste. It also states that every unit or individual has an obligation to protect the environment and has the right to report or bring charges against those units or individuals that are responsible for environmental pollution caused by solid waste. The law presents basic requirements about collecting, dumping, cleaning up, transportation, recycling, treatment and disposal. For example it states that; Thee relevant departments under the urban People's governments shall make comprehensive plans to reasonably arrange a purchasing network and promote the recycling of waste (Bouanini, 2013; Ministry of Construction of P.R.C, 1995; Ministry of Construction of P.R.C, 2013).

For packaging materials the law on *Prevention and Control of Solid Waste Pollution* state, "products shall use packing materials which are easily recycled, disposed of, or assimilated by

the environment”. It also states “the product manufacturer, retailer, or consumer shall recycle those product packages and containers that can be recycled in accordance with the relative regulations of the state”. The central government work on spreading the information about the law and in year 2011 266 cities had released the information and in 2012 the number was raised by further 12 cities (Bouanini, 2013; Ministry of Construction of P.R.C, 1995; Ministry of Construction of P.R.C, 2013).

Another important law that relates to waste management is *the Environmental Protection Law* from 1989. This law has been revised and the latest version is from 2014. It encourages the public to observe environmental protection laws and make efforts in this regard, including sorting their waste for recyclable materials (Ministry of Construction of P.R.C, 2014).

There are many recyclers in China that import waste from other countries. The growing recycling business in China has created opportunities for Westerns enterprises to develop their businesses in China. A German waste management and recycling company, Alba, has exported recyclable materials to China since 20 years. To manage the imported flow of waste the Chinese government notified a new policy in 2013 that made limitations on what type of waste and how much waste that was allowed to import, it is called *The Green Fence Policy*. Since the policy was notified the quality of the imported waste has become much better (Ministry of Construction of P.R.C, 2015).

In China’s *Twelfth Five-Year Plan (2011-2015)* the government is focusing on developing the SWM system, with a budget on 280 million Yuan (about 37,8 million Euros). The Chinese government knows that the country is behind other developing countries and it wants to put focus on the MSW situation (Bouanini, 2013).

China, – Legislation on waste management, summary

The *Prevention and Control of Solid Waste Pollution* contains of basic requirements that encourage the citizens to recycle the MSW, which is similar to the encouragement made in *The Environmental Protection Law*. In the study’s framework the legislation for MSW in China is placed at the fourth highest level (Figure 14). The law *Prevention and Control of Solid Waste Pollution* prescribes that packaging materials should be easily recycled, disposed of, or assimilated by the environment. The same law also states “the product manufacturer, retailer, or consumer shall recycle those product packages and containers that can be recycled in accordance with the relative regulations of the state”. This indicates that recycling and separation is being implemented. The legislation for packaging waste is therefore placed at the second highest level on the scale in the Legislation framework (Figure 14). Compared to India and Indonesia, the legislation for MSW in China is not as strict. The legislation for MSW in China is placed on the third level of encouraging recycling and separation, while the legislation for packaging materials is seen as strict as the legislation for MSW in India and Indonesia (Figure 14).

No special legislation about paper or plastic waste materials has been found in the study, but the government of China has stated a target to recycle 50 % of all paper waste in 2030. This can be compared with the Swedish target to recycle 65 % of all paper and cartonboard at year 2020 (Bouanini, 2013; SFS 2014:1073).

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
EU	MSW				
Sweden	MSW				
India	Plastic, Packaging	MSW			Plastic = Special legislation for plastic waste Packaging = Special legislation for packaging waste MSW = Legislation for all MSW
Indonesia		MSW			
China		Packaging	MSW		

Figure 14. Legislation framework.

6.1.4 Malaysia

Before the 1970s the waste management in Malaysia only included local street cleaning and removal of household wastes to disposal sites. Since then Malaysia's waste is divided in to two categories: scheduled waste (hazardous waste) and MSW. *Environmental Quality Act 1974* was the first waste management legislation in Malaysia and it still controls the scheduled waste with the last amendment in 2001 (GoM, 2001; Agamuthu & Victor, 2011). In 1988 the *Action Plan for a Beautiful and Clean Malaysia (ABC Plan)* was notified by the Ministry of Housing and Local Government (MHLG). The aim of the plan was to create a national uniformed MSW system that was productive, environmental sound and socially accepted by 2020. The *ABC Plan* introduced the 3Rs and it is part of Malaysia's *Vision 2020*, which aims for Malaysia to be a fully developed country by year 2020. The implementation of the *ABC Plan* has not been successful and several recycling programs have been introduced since 1993 to instruct the citizens how to manage their waste. For example in 2001 the 3Rs were re-launched by the MHLG to enlightened the citizen of Malaysia of the focus on waste handling, but because of lack of participation the recycling rates has remained low (Sreenivasan, Govindan, Chinnasami and Kadiresu, 2012; Moh & Manaf, 2014).

In 2007 the *Solid Waste and Public Cleansing Management Act 2007 (Act 672)* was notified, which controls the handling of MSW (Moh & Manaf, 2014). A department of National Solid Waste Management (JPSPN) was created with the purpose to form plans, policies and strategies to enforce the act and regulations towards making Malaysia a clean country. The SWM has before been placed on the local authorities, but with this act the federal government takes over the responsibility. At the same time the federal government decided to privatise the collection of MSW and due to that the act stated that the federal government could make collaboration with any part, person or private company that manage solid waste services. By making that statement, the federal government open up for collaboration with companies and individuals already working in the informal sector with waste management. The federal government of Malaysia also placed a new staff of 900 employees nationwide with the purpose to raise the public awareness of recycling and SWM around the country (Sreenivasan et al. 2012; Dato', 2012).

The first of September 2011 the *Solid Waste and Public Cleansing Management Act 2007* was enforced in eight Malaysian states and federal territories. At the same time the implementation started for a 2 + 1 collecting system that should be carried out of private companies in collaboration with the federal government. The new 2 + 1 collecting system includes three collecting times a week, two times for residual waste and one for recyclable waste (Dato', 2012).

Since the first of September 2015 it is mandatory for all households to sort their solid waste in the eight Malaysian states (Kuala Lumpur, Putrajaya, Johor, Melaka, Negeri Sembilan, Pahang, Kedah and Perlis). The new rule includes a mandatory waste separation for all households. The separated waste is being handled by the 2 + 1 collecting system that should be implemented in the states. The household must take the recyclable waste to a collecting site, which should be put up close to living areas. The separation of household waste should be sorted in six categories (Palansamy, 2016; MUWHLG, 2015):

Non-recyclable waste:

1. *Residual waste*

Recyclable waste:

2. *Paper waste*
3. *Plastic waste*
4. *Garden waste*
5. *Bulk waste* (sofas, big electronic applications, etc.)
6. *Others* (glass, ceramic, metal, electronic waste, leather, rubber, fabric, hazardous waste, etc.)

To help the implementation of sorting at source, the federal government has introduced a fine of maximum RM1000 (about 230 EURO), for household that do not separate their waste. The fine was implemented in 1 June of 2016 (Palansamy, 2016; MUWHLG, 2015).

Malaysia - Legislation on waste management, summary

The waste management legislation in Malaysia is under construction. The federal government has since the *ABC Plan* was presented in 1988, tried to engage the citizens in a sustainable waste handling process with the 3Rs. The *Solid Waste and Public Cleansing Management Act 2007* shows that the federal government sees the existing waste managing work that is made by the informal sector and they tries to work *with*, instead of *against* it. With the new mandatory separation system for recycling, Malaysia is placed on the second highest level on the scale on the Legislation framework for MSW (Figure 15), on the same level as India and Indonesia. Compared to Sweden and EU is Malaysia placed on a lower level, but compared to China, one level higher. No information about special legislations for plastic, paper or packaging materials could be found.

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
EU	MSW				
Sweden	MSW				
India	Plastic, Packaging	MSW			
Indonesia		MSW			
China		Packaging	MSW		
Malaysia		MSW			

Plastic = Special legislation for plastic waste
Packaging = Special legislation for packaging waste
MSW = Legislation for all MSW

Figure 15. Legislation framework.

6.1.5 Thailand

The *Enhancement and Conservation of National Environmental Quality Act, 1992* is one of important acts of the environmental legislation in Thailand. In a section about pollution it is stated that measures to prevent and reduce the pollution of the environment should be taken (MoNRE, 2004). In the same year as the *Enhancement and Conservation of National Environmental Quality Act, 1992* was notified, two more acts were notified which are part of the legislation of the SWM system in Thailand; The *Public Cleanliness and Orderliness Act, 1992* and the *Public Health Act, 1992*. The *Public Cleanliness and Orderliness Act, 1992* forbid all activities that could cause dirtiness on public places. The *Public Health Act, 1992* is promoting sanitation and disposal of solid waste. The *Public Health Act* also includes directives that the local authorities have the highest responsibility for the handling of the SWM (Muttamara, Leong, Somboonjaroensri, Wongpradit, 2004; Valin & Chotthong, 2001).

In 1998 the *Regulation and guideline of municipal solid waste management* was notified to create a structure of how the MSW should be managed. The regulation was a guideline that the citizen and industries were encouraged to follow and it contains for example instruction about how waste handling facilities should be managed and encouragement of recycling and sorting programs. The guideline promotes private investments in recycling business and it declared that laws and regulations about MSW should be revised and focused on waste reduction and recycling (MoSTE, 1998).

In 2007 a national plan was notified which presented targets for the waste management, The *National Environmental Quality Management Plan (2007-2011)*. The targets were to (Towprayoon & Wangyao, 2012):

- Reduce the generation of solid waste to not more than 1 kg per person and day.
- Utilize at least 30 % of the total MSW by using recycling, compost and biogas or incineration for heat and energy.
- Increase the coverage of sanitary disposal to at least 40 % of the total MSW.
- Establish a centre for municipal hazardous waste management in each region.
- Separate municipal hazardous waste and safely dispose at least 30 % of it.

A *National Integrated Waste Management Policy* was developed with strategies for reaching the targets in the *National Environmental Quality Management Plan (2007-2011)*. The policy consisted of four different strategies. The first was to apply the 3Rs (*reduce, reuse, recycle*) to decrease the waste generation and increase the utilization of waste. The second strategy was to promote an integrated waste management system to reduce the landfill areas and increase the generation of renewable energy. The third strategy was to create cooperation between adjacent local governments to establish functional waste management facilities. The last strategy to achieve the targets in the *National Environmental Quality Management Plan (2007-2011)* was to endorse both the public and the private sectors to participate in the waste management project (Towprayoon & Wangyao, 2012).

Thailand – Legislation on waste management, summary

Information about Thailand's legislation on waste management has been limited to fine in English. There is therefore a risk that information has been missed. However, based on the result that was found Thailand is placed in the third level of legislation on waste management. The reason for this is that the country is trying to implement the 3Rs and the *Regulation and guideline of municipal solid waste management* encourage recycling and separation. Thailand does not have any specific legislation of how the recycling process should be managed. Compared to the other selected countries is Thailand together with China placed the lowest in the Analysis framework (Figure 16).

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
EU	MSW				
Sweden	MSW				
India	Plastic, Packaging	MSW			
Indonesia		MSW			
China		Packaging	MSW		
Malaysia		MSW			
Thailand			MSW		

Plastic = Special legislation for plastic waste
Packaging = Special legislation for packaging waste
MSW = Legislation for all MSW

Figure 16. Legislation framework.

6.1.6 Summary - Legislation on waste management

This first part of the chapter shows that the selected countries' legislations on waste management are not as developed as the legislations in Sweden and EU. India has during the last year developed their legislation on waste management, so plastic waste and packaging waste the companies involved in the producing and selling process has an EPR of the waste materials. Malaysia has also developed its legislation on waste management during the last two years, with stricter legislation about how the sorting and collection processes should be handled. The first part of the chapter also shows that India, Indonesia and Malaysia are demanding sorting and recycling of the produced MSW. This differs from China and Thailand, where the citizen only is encourage to sort and recycle their MSW waste. The difference can be seen in the Legislation framework (Figure 17), where the result of this first part of the chapter is shown.

Even though China is only encouraging sorting and recycling for MSW, does their legislation contain a clearer legislation on packaging materials. Legislation for packaging waste in China is therefore placed on the level of demanding recycling and separation in the Legislation framework (Figure 17). The result shows that EU and Sweden have a stricter legislation on waste management with EPR for MSW and that India since spring 2016 has developed a similar legislation regarding plastic waste and packaging waste. The result shows also that Thailand's and China's legislation on MSW is not that developed, but because of 3Rs (*reduce, reuse, recycle*) policies have the countries started to engaging and encourage the citizen in the recycling and separation processes.

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
EU	MSW				
Sweden	MSW				
India	Plastic, Packaging	MSW			
Indonesia		MSW			
China		Packaging	MSW		
Malaysia		MSW			
Thailand			MSW		

Plastic = Special legislation for plastic waste
Packaging = Special legislation for packaging waste
MSW = Legislation for all MSW

Figure 17. Legislation framework.

6.2 Municipal solid waste management system

This part of the chapter tries to answer the second research question:

- *How does the waste management system actually work and how does the flow of recycling materials goes? Is there a separation system for laminated paper and if so, how is the separation system involved in the recycling process?*

This by creating flow charts of how the MSW systems of the selected countries actually look like. Since the systems are not only formed by the official sector, is most of the information from previous studies of other researchers. No special separation systems for laminated paper have been found in any of the selected countries.

6.2.1 India

According to Gupta et al. (2015) the waste collection in India is unorganized. In the urban areas there is a shortage of MSW storage and separation at source. The collection bins that do exist in some of the Indian cities, are not properly maintained or designed correctly for the use. The collection bins are usually used for both decomposable and non-decomposable waste, so no organised separation is made at source. The waste in the collection bins is then disposed at a municipal disposal centre. The average official collection efficiency of MSW in an Indian city or state is estimated to be 70 % (Gupta et al., 2015). The waste that is not collected by ULB or waste collectors is usually dumped at streets, at unauthorised landfills, in rivers, self burnt or buried close to living areas (Joseph, 2002; MoEF, 2009).

The existing separation and recycling system in India is built on informal systems created of waste collectors that collect valuable waste and sell it to recycling companies. These waste collectors may collect packaging materials as paper and plastic, but what type of waste materials the waste collectors focus on gathering, depends on the recyclers the waste collectors sell to. The waste collectors focus on the waste that is most valuable for the recyclers (Paney & Shah, 2015). Figure 18 shows a flow chart for the managing of MSW in a typical Indian city. The part marked in the middle of the figure is the formal system built by the ULB. The parts around the middle consist of unauthorised landfills and different type of waste collectors collecting valuable waste for recyclers. This part is built on the informal sector (Joseph, 2002; Gupta et al., 2015).

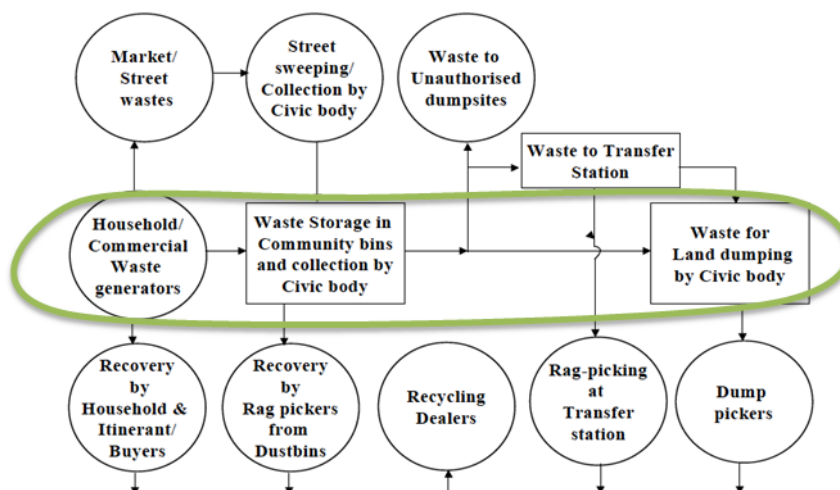


Figure 18. Typical MSW management process in India. (Adapted from Joseph, 2002)

The management for MSW do vary in different Indian cities. For example in Mumbai has the Municipal Corporation together with the citizen have developed a program (Advanced Locality Management – ALM) that encourage the municipal corporation's employees and the citizen to work together with the improvement of the SWM services. By involving the citizens in the ALM program have the level of cleanliness improved and the separation of household waste have increased in the city (MoEF, 2009).

The new rules presented in 2016 have not been applied in the country yet. With the new EPR on plastic materials and stricter demand on sorting the MSW, India's MSW system probably will make a big development in the nearest future. The biggest challenge will be to create a system where sorted recyclable waste materials can go through an official system and not only the informal waste collectors to reach the recyclers.

6.2.2 Indonesia

The waste management system in Indonesia is built on an informal operation that goes back many generations, especially in rural parts of the country. This informal system has foremost been developed where the people does not have access to the governments waste collection/management. It is estimated that only 56 % of the Indonesian people have access to the official waste collection and disposal system (SMoE, 2008; Landon, 2013). The government has since year 2008 tried to establish an official infrastructure of recycling, which the informal sector have practise for many years (Chaerul et al. 2014).

According to a study of Landon (2013), Indonesia has a well-established private sector recycling industry consisting of individuals and small and medium-sized enterprises (SMEs). Backlund (2014) concludes that the existing recycling system in Indonesia mostly consists of informal companies and individuals. The enterprises that are working with recycling, are not usually formal registered and may therefore not always follow all rules and regulations on the subject. The waste recycled by the informal sector includes plastic, paper, cardboard, fabric metal, glass and organics for compost and animal feed (Chaerul et al. 2014; Landon, 2013).

A flow chart of the MSW system in Indonesia is presented in Figure 19. The majority of the waste collected is transported to a temporary collection site (TPS) or an integrated waste processing site. The TPS is the site before the waste is being transported for processing, recycling or to an integrated waste processing site. At an integrated waste processing site the waste is collected, sorted, recycled, handled and final waste processed. Valuable waste at TPSs are manually sorted out and sold to material buyers. These material buyers then sell the waste to recyclers using the waste materials as raw materials. The waste that is not valuable for the recyclers is send to a final disposal/processing site (TPA). TPA is where the waste is processed and returned to the nature environment. The standard of the TPAs are of different levels in the country (SMoE, 2008; Backlund, 2014).

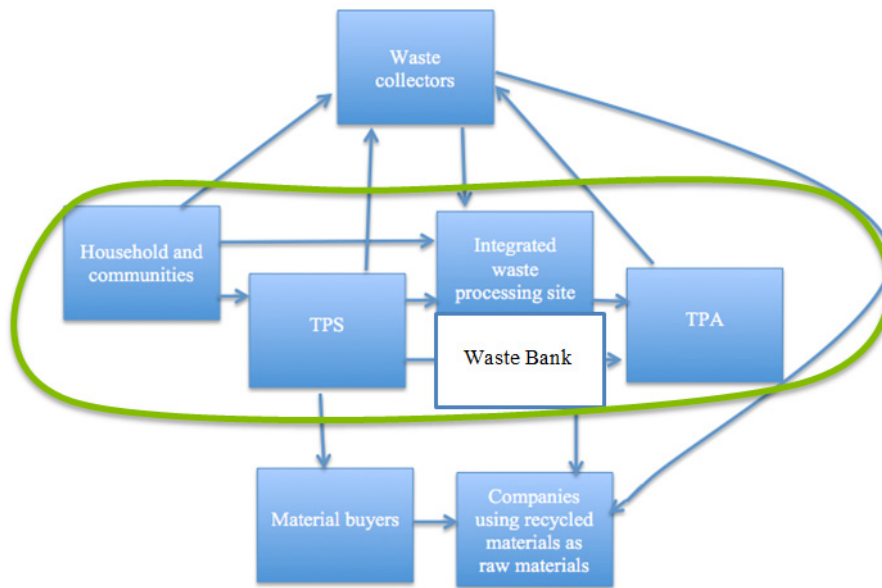


Figure 19. MSW management system in Indonesia. (Adapted from Backlund, 2014)

Private persons or waste collectors collect a large part of the household's wastes in Indonesia, which are dumped at streets or at public places. These waste collectors gather waste that is valuable and brings it to the integrated waste-processing site, where it is sorted manually and the valuable materials are sold to companies using recycled materials as raw materials. The people working as waste collectors or at the integrated sites gets only compensation from the sold materials, no authorities are responsible for their salary. Waste that is not valuable for recycling is send to a TPA (SMoE, 2008; Backlund, 2014).

According to the *Government Regulation No. 81/2012*, all waste generators should separate MSW in five categories (*Hazardous and poisonous materials, Degradable materials, Reusable materials, Recyclable materials and Other materials*). No special system for collecting these different wastes categorizes has been found in the study. The sorted waste or unsorted waste is supposed to be transported to a TPS or Integrated waste processing site.

Since the *Regulation of MoE of the Republic of Indonesia No. 13/2012* stated its support for Waste Banks, an increasing amount of households have started to sell their recyclable materials direct to the Waste Banks. In Figure 19 has the Waste Banks been placed at the same place as the integrated waste processing site, this since both household themselves and waste collectors use the Waste Banks to sell their recyclable waste and the Waste Banks are selling the recyclable waste materials further to recycling companies (Dhokhikah et al., 2015).

6.2.3 China

The informal and private sector drives the recycling of MSW in China (Bouanini, 2013; Zou, 2011). In a Master's thesis by Zou (2011) it is stated that China does not have a complete MSW system with separation at source. The existing separation at source is created of informal or private waste collectors. These waste collectors go door-to-door and buy recyclable waste materials from the households' MSW. The household waste that is not valuable for the waste collectors is all mixed up and put in the neighbourhood's collective bins.

The municipal authorities are responsible for transporting the waste in the collective bins to collective sites where it is sorted and transported further to landfills, sites for incineration or

composted. Some of the waste may be transported to illegal landfills, so called wild dumpies. Officially, no waste materials from the collective sites are being sorted for recycling. The only separation at source is managed by the waste collectors. The recyclable waste materials the waste collectors are buying from the households are for example waste material consisting of paper and plastic. After buying the recyclable waste materials from the household the waste collectors sell the waste materials to recyclers, manufactures that are using it as raw materials. Figure 20 shows a flow chart of the general national treatment of MSW in China (Zou, 2011).

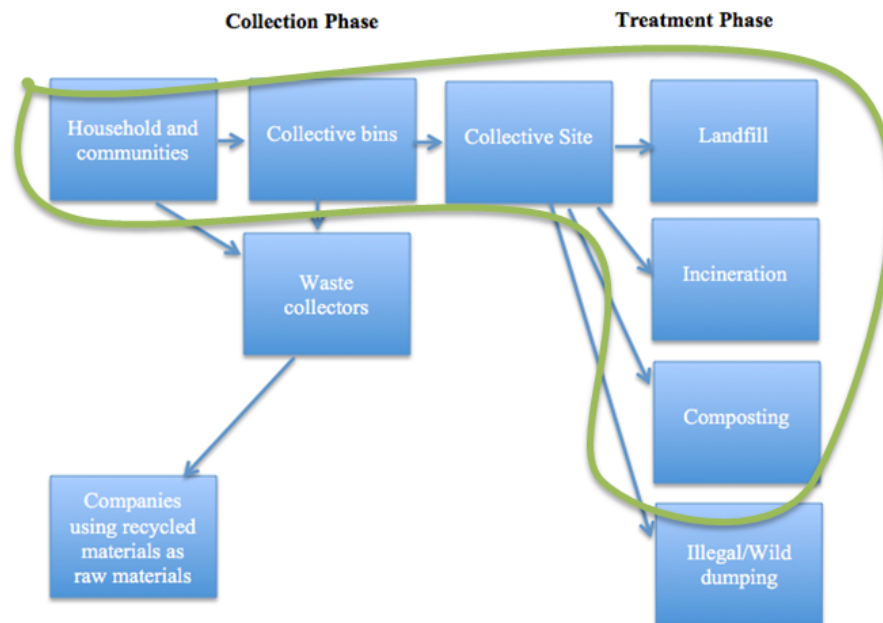


Figure 20. MSW Treatment, General Mechanism in China. (Adapted from Zou, 2011)

The development of the MSW system in China has been slow. Some provinces have created local sorting system for increasing the recycling of waste materials, which in some places have worked well. On national level no result has been reported, since the *Twelfth Five-Year Plan (2011-2015)* declared a focus on the development of a functional SWM system (Bouanini, 2013). Even though China has an undeveloped legislation about waste management compared to India and Indonesia, the country's official system has a formal structure to use incineration and composting, which is not presented formally in India and Indonesia. It is difficult to understand how the *Prevention and Control of Solid Waste Pollution's* part about how packaging materials should be recyclable could be used, since no national official system of recycling is available in the country.

6.2.4 Malaysia

Information about Malaysia's existing MSW system has been limited and difficult to get access to, mostly because of language barriers. No flow chart of the MSW system is therefore presented in the study.

According to Dato' (2012)., the late General Director of the JPSPN, the privatisation of the waste collection was implemented in 2011 when the federal government acknowledge the already established recycling network made by the informal sector. The informal sector consists of waste collectors and intermediaries gathering recyclable waste, which they sell to recyclers. Waste collectors and intermediaries are affected by the market price of the supply of recyclable waste, which has a high seasonal nature. The seasonal nature of the selling price can lead to feedstock issues for the recyclers, if the waste collectors and intermediaries

“hoard“ recyclable waste until the selling price is at a desirable level. Dato’ (2012) points out that since the recycling activities take place in the informal sector the data about these activities is unreliable.

Even though the federal government of Malaysia have started to collaborate with the informal sector, there was no official system for recycling in Malaysia in 2012 and the standard of the existing SWM system was poor (Sreenivasan et al. 2012). The SWM system consisted of inefficient storage and collecting sites where the people that managed the systems had no education in sorting recyclable materials.

The federal government of Malaysia has made attempts to increase the recycling of recyclable waste materials in the country since the 1980s. But the implementation has always faced obstacles to reach out to the citizens. The country has a tradition of using landfilling as disposal of waste materials and even though the federal government has created several national programs to inform the citizen of sorting and recycling, no major improvement can be seen in the country (Moh & Manaf, 2014).

No information has been found on how the implementation of the new mandatory sorting system has been functioning since its implementation in September 2015 in eight states. The goal with the new 2 + 1 collecting system was to reduce the solid waste placed at landfills, which in 2012 where almost 95 % of all solid waste generated in Malaysia (Dato, 2012).

Because of the limited information available about Malaysia’s MSW system it is difficult to create a clear picture of the MSW system. The federal government has been trying to increase the country’s recycling rates for some time, but since 2015 it has forced eight states to make sorting of recyclable waste mandatory. The federal government has also committed to establish the new 2 + 1 collecting system. The result of this has not yet been investigated.

6.2.5 Thailand

Most of the official information about Thailand is only presented in Thai and no authorised translation has been available. Language barriers has therefore caused problem in the study of Thailand’s MSW system. The limited data that were found about Thailand’s MSW shows that the existing recycling activities in the country are driven by the informal sector, which helps reducing the burden of the official waste disposal (Chiemchaisri, Juanga & Visvanathan, 2007).

Chiemchaisri et al. (2009) declare that data about waste in Thailand is limited and in a study of the Bang Maenang area in Nonthaburi Province, adjoining Bangkok, they have investigated how the official waste management system actually works. This area is a typical urban-rural fringe area, which is an area with a land-use mixture of agricultural fields and residential areas. This type of area has developed on many places in Thailand close by cities. The study result shows that the waste flow structure is complex and also that not all households are served with waste collection.

Figure 21 show a flow chart of the MSW system in the Nonthaburi Province in Thailand. The green marked area shows the official system. As can be seen in the data, all separation of waste is made by the private sector. Some households use illegal dumping to get rid of their waste and organic waste can be used as feed to animals. Where public waste bins are available unsorted waste is placed and collected of the official waste collectors. The waste in the public waste bins is transported directly to landfills. Informal waste collectors and private companies

may sort the official waste collection for recyclable waste, which they sell to recycling companies or washing and repacking companies for reusing. The waste that gets recycled is gathered at streets, bought of household or picked at landfills of different types of informal waste collectors or private collecting companies. The waste-related jobs in the informal and private sector give a high income in Thailand because of the current economic situation. This have led to that some people have quit jobs such as farmers and employees at factories to work as waste collectors, especially on landfills (Chiemchaisri et al. 2009).

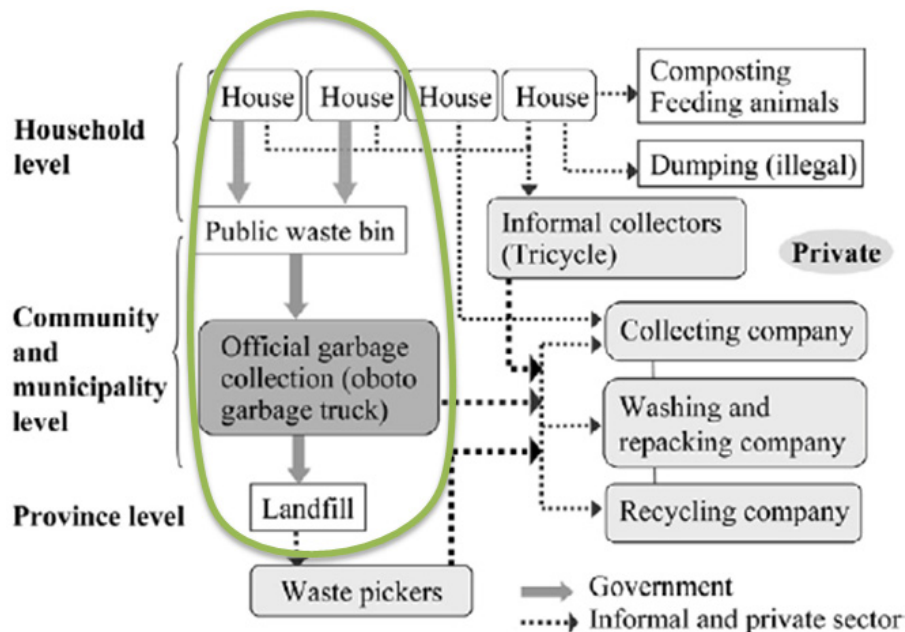


Figure 21. MSW flow in Nonthaburi Province. (Adapted from Chiemchaisri et al. 2009)

According to Muttamara et al. (2004) the MSW system in Bangkok look similar to the one in Nonthaburi Province. The only difference is that in some parts of Bangkok does the official system have small separation sites for recyclable waste materials. But still are most of the recycling activities done by the informal sector.

No information has shown that the government of Thailand is working on improving the official system. According to the *National Integrated Waste Management Policy* should the country apply the 3R policy, but no official system of reducing, reusing or recycling is found in the study.

6.2.6 Summary - Municipal solid waste management system

All selected countries have an official MSW system. However, none of the selected countries has a national official recycling system. This differs from the MSW system in Sweden. All recycling processes in the selected countries are run by the informal and private sector. Because of this the waste management system is difficult to regulate or monitor. The informal and private sector is driven by the value of the recyclable waste materials. Many of the workers in the informal sector live on the money they get from the recyclable waste materials they can sell to recyclers or intermediaries. This type of recycling system differs from the recycling system in Sweden, where the producers of the recyclable waste materials together, manage the official recycling system. None of the selected countries have a similar system built on an EPR according to the result in this part of the chapter. India is trying to create an EPR with their new legislation on plastic waste but no information about the development has been found. The result shows that no separation system for laminated paper is found in any of

the selected countries. The result in the second part of this chapter also shows that without the informal and private sector no recycling would be done in the selected countries.

6.3 Waste management data

In this third part of the chapter the study tries to answer the third research question:

- *How much paper and plastic packaging waste is generated, collected and recycled?*

This by gathering and presenting data from official sources as governments or data calculated of other researcher's studies. It is challenging to monitor the world's MSW. Several of the countries in this study present limited official numbers and descriptions of quantities and waste handling system. There is also a large growing problem with illegal global trade of solid waste (Moses, 2013), which is even harder to monitor and will not be part of the study.

In 1999 the World Bank presented a study called *What a Waste*, focusing on solid waste management in Asia. According to the research Asia would generate 1.8 million tonnes MSW per day in year 2025. In year 2012 the World Bank presented a new updated study of *What a Waste*, spreading to a global focus. This second version concluded that the estimated numbers from the first edition were still accurate. Table 2 show the total MSW generation tonnes per day of each of the selected country, estimated total MSW generation per year and how much of the total waste that are paper and plastic in percentage presented in the World Bank's study (World Bank, 2012)

Table 2. MSW generation (Adopted from World Bank, 2012)

	Total MSW generation (tonnes/day)	Estimated total MSW generation (million tonnes/year)	Paper (%)	Plastic (%)	Other (%)
India	109 589	40	3	2	95
Indonesia	61 644	22.5	6	10	83
Malaysia	21 918	8	7	12	81
China	520 548	190	N/A	N/A	N/A
Thailand	39 452	14.4	15	14	71

The World Bank data differs from other studies, which demonstrate the difficulties involved with these estimations. Table 2 point out that many of the sources are presenting different data and that even the reliable sources have difficulties to present reliable data on the subject. In the rest of this part of the chapter (6.3) the data will be given of official statistics or other researchers' studies as a comparison to the data presented in Table 2 of the World Bank.

Present recycling rates of paper waste and plastic waste is not easy to find for the selected countries. Many studies show numbers of how much waste is produced, collected and treated. "Treated" usually includes landfill and incinerate. The recyclable materials are usually not included in the treated materials, but in some cases it is. In some cases recyclable materials is not even included in the collected waste. Because of this it is difficult to make a correct comparison of the data collected. In this third part (6.3) of the chapter are the data presented that is most credible or simply the only data available.

6.3.1 India

The solid waste has increased rapidly in India, because of the fast population growth and the urbanization. According to MoEF (2009) there is no total quantity amount of solid waste reported for the country, only estimated data. Gupta et al. (2015) state that the solid waste generation in India in 2009 was about 90 million tonnes. According to a study of World Bank

(2012), India generated a total of 109.589 MSW tonnes/day in 2012, which is about 40 million tonnes waste per year. The MoEF presented in 2016 an estimated annual waste generation in India of 62 million tonnes (PIB, 2016a). The data presented by the MoEF is the official one and will therefore be used further in the study.

According to the data presented by MoEF in 2016 about 43 million tonnes of waste was collected, out of which 11.9 tonnes was treated and processed. The rest of the collected waste (about 31 million tonnes waste) was dumped at a landfill. This shows that about 70 % of the total generated MSW (62 millions) is collected and about 70 % of the collected waste is transported to a landfill (PIB, 2016a).

No official total recycling rate of MSW is presented about India. Since the informal waste collectors are gathering recycling materials at all stages in the Indian MSW system it is difficult to get clear recycling rates. There is no stage where the recyclable waste is collected and counted. This shows that the recyclable waste is probably found in both categories of collected and uncollected waste. Because of the limited data total MSW from India is not mapped in the Analysis framework (Figure 23).

An estimated composition of the MSW in a typical Indian city is presented of the MoEF in Figure 22 (MoEF, 2009). According to the Minister of State for Environmental and Forest the generation of plastic waste was estimated to 5.6 million tonnes annually in 2016 (PIB, 2016b). About 80 % of the plastic waste was Thermoplastics, which can be recycled. The rest (20 %) was Thermoset plastic, which cannot be recycled in India. Thermoset plastic can for example consist of metalized and multilayer plastic. About 60 % of the plastic waste was collected and treated of the 5.6 million generated (PIB, 2016b).

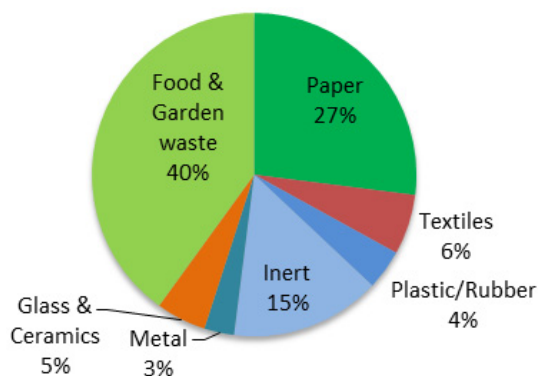


Figure 22. Composition of MSW in a typical Indian city. (MoEF, 2009)

According to the MoEF (2009) the recycling rate of plastic waste in India in year 2009 was officially estimated to 70 %. As can be seen in the Analysis framework (Figure 23) this rate is higher than the recycling rates in Sweden and EU, but Nandy et al. (2015) present a recycling rate for plastic waste between 50 – 70 %. Even though the reliability of the data can be questioned, it is included in the study because of the two sources and since no other data are found.

In the study of Nandy et al. (2015) estimates the generation of paper and cardboard waste to 10.5 million tonnes waste per year. The same study estimates the recycling rate of the paper and cardboard waste to be 30-65 %. The range between 30 % and 65 % is large, so to use the figures in the study the average (47.5 %) was used in the comparison to Sweden and EU. As

can be shown in the Analysis framework (Figure 23) the recycling rate of paper and cardboard for Sweden and EU are higher, than the recycling rate in India.

India – Waste management data, summary

Packaging materials is managed along with the rest of the MSW and because of that there is no data available about recycling rates of packaging materials. Packaging materials may be recycled if waste collectors gather it and sell it to recycling companies, but most of the packaging materials in India is burned or buried in pile of waste by the citizens, to get it out of their way (Paney & Shah, 2015). Since no recycling rates of total MSW or packaging materials waste are found, the Analysis framework (Figure 23) presents the recycling rates of plastic waste and paper and cardboard waste in relation to the legislation presented in chapter 6.1.1. As can be seen in the framework the recycling rate for paper waste in India is much lower than compared to EU and Sweden. The recycling rate of plastic waste in India is questioned, but since the data is conducted of the MoEF (2009) itself and another research study (Nandy et al. 2015) the data is seen as official and therefore used in the study. The plastic waste in India is placed on the first legislation level since the country during 2016 have formed new rules with EPR of plastic waste, meanwhile legislation of paper waste are demanding recycling and separation.

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
75 - 100 %	EU, Sweden				
50 - 74 %	India				
25 - 49 %	Sweden, EU	India			
0 - 24 %					

Green = Total paper waste
Blue = Total plastic waste

Figure 23. Analysis framework - Recycle rates in relation to the legislation scale of waste management.

6.3.2 Indonesia

New official statistics about the waste collection and recycle rates of Indonesia are limited. The last official statistics of waste handling was presented of the RoI in 2008 and it is based on a survey of 465 cities and 33 provinces throughout Indonesia with data from 2006. According to the official survey the estimated total MSW generation per year was 38.5 million tonnes and about 56 % (130 million people) of the population had access to an official waste management system (SMoE, 2008). These official numbers differs from the MSW generation reported by World Bank' (2012) study, which reported a total generation of 61 644 tonnes MSW/day, about 22.5 million tonnes MSW per year (World Bank, 2012). This also differs from numbers presented of UNCRD in 2010, which states that about 176 000 tons MSW are generated each day. That gives a total MSW generation of about 64.2 million tonnes per year (UNCRD, 2010). The UNCRD's data is in line with the data from an article of Antara News in 2016. In that article the Indonesian director of Waste Management of the RoI's MoEF stated that the national garbage production in a year has reached 64 million tonnes (Minggu, 2016). The data presented of the director of Waste Management in the article is the data that

will be used further in the study, since it is the latest presented data and it is stated of an official source.

In Figure 24 the official estimated waste generation by composition is presented. What is included in the category “Garbage” is not presented in the official data (SMoE, 2008). A study of IndII’s (2012) indicates that “Garbage” from the official composition, probably consists of mainly organic waste. The composition from IndII’s (2012) is shown in Figure 25.

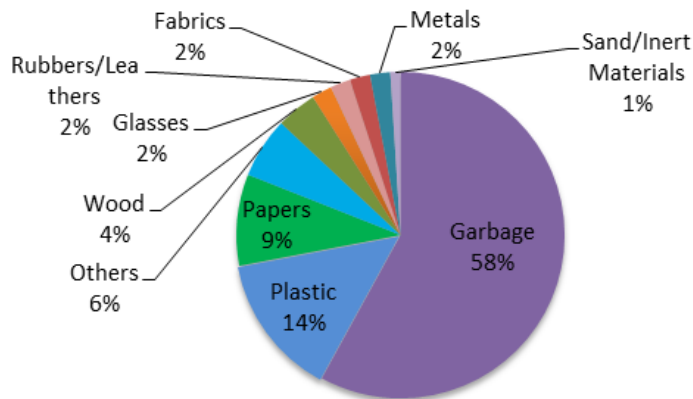


Figure 24. Estimated Waste generation by Composition. (SMoE, 2008)

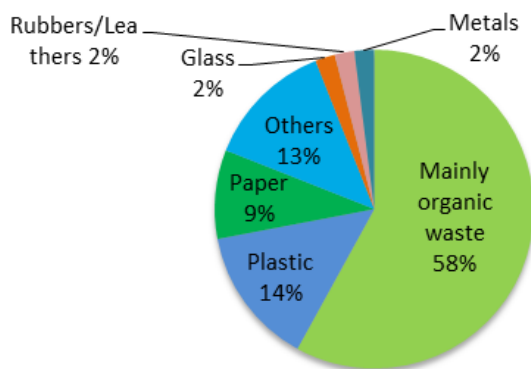


Figure 25. Estimated Waste generation by Composition. (IndII, 2012; Modified by the author)

The official statistics from RoI (2008) shows that 57 % of the total waste is part of 3R activities (*reduce, reuse, recycle*). The data do not include waste collectors that are not part of an official program and there is no instruction of how must of the waste that is part of 3R activities that is recycled. Of the total amount waste in 3R activities, 44 % of the activities are conducted at source, 26 % conducted at a temporary disposal site and 29 % conducted at a final disposal site (SMoE, 2008).

According to Meidiana & Gamse (2010) the total collecting rate of waste in Indonesia was about 69.5% in 2006. The community usually treats the waste that is not collected by the official authority individually. This leads to much waste getting improper treatment such as open burning, buried waste and disposal in rivers. The estimated treatment of MSW in Indonesia in 2001 is presented in Figure 26. The World Bank (2012) presents a collection rate of 83 % of MSW in Indonesia capital Jakarta in 2004.

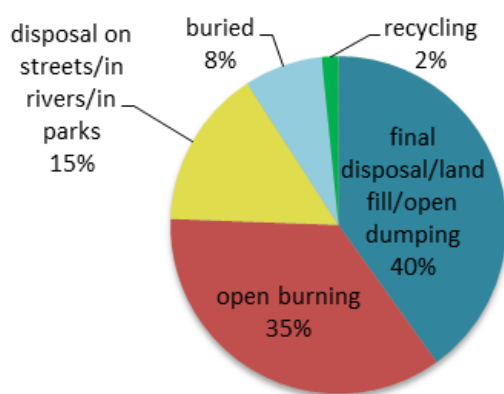


Figure 26. Treatment of municipal waste in Indonesia in 2001. (Meidiana & Gamse, 2010)

The study of Meidiana & Gamse (2010) shows that the recycling rate of total MSW in Indonesia in 2001 was less than 2 %.. Indonesia's recycling rates are estimated to 10-20 % of all waste including the recycling by the informal sector (Landon 2013). This recycling rate in relation to the legislation of the county is presented in the Analysis framework (Figure 27). The recycling rate for MSW is lower than in Sweden and EU.

According to Chaerul et al. (2014) most of the plastic packaging waste in Indonesia is not collected properly nor disposed in appropriate manner by the municipality. Plastic packaging waste is usually seen as valuable waste and it is therefore mostly collected by the informal sector and sold to recycling companies. Chaerul et al. (2014) estimate that recycled rates of plastic packaging waste, mostly made by the informal sector, are 27.5 tonnes per day, which is about 65% of the total generated plastic packaging waste per day. Compared to Sweden and EU the estimated recycling rate for plastic packaging in Indonesia is much higher. Since the recycling rate is an estimated number from only one study and it is more than 20 percentages higher than the data in Sweden and the recycling rate for MSW is much lower, can its reliability be questioned. Since no other data of recycling rate on plastic packaging waste can be found is it still presented in the study.

Indonesia – Waste management data, summary

Indonesia has low numbers of recycling of MSW, but according to Chaerul et al. (2014) high recycling rates on plastic packaging waste. The waste materials that become recycled is the valuable waste materials that waste collectors can sell to recycling companies. No data about paper waste, total plastic waste or total packaging waste were found. The Analysis framework (Figure 27) presents the recycling rates of Indonesia in relation to the legislation of waste management and in comparison with Sweden and EU. The recycle rate for packaging paper can be question since it is much higher than in Sweden and EU, which has strict laws with EPR, and only one source can confirm the data. But since no other data are found this is presented in the Analysis framework (Figure 27). The recycling rate of MSW is lower and is therefore placed on the lowest level on the recycling rate scale, even though Indonesia has regulations demanding recycling and separations.

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
75 - 100 %	EU, Sweden				
50 - 74 %	India	(Indonesia)			
25 - 49 %	Sweden, EU, (Sweden), (EU), Sweden, EU	India			
0 - 24 %		Indonesia			

Green = Total paper waste
Blue = Total plastic waste
Black = Total MSW
() = Plastic packaging waste

Figure 27. Analysis framework - Recycle rates in relation to the legislation scale of waste management.

6.3.3 China

The World Bank (2012) has estimated the generation of MSW per day in China to 520 548 tonnes, which in a year is about 190 million tonnes. According to the China Statistical Yearbook 2015, the total consumption of waste collected and transported in China year 2014 were about 178.6 million tonnes. The treatment rate of that was 91.8 %, which is about 163.9 million tonnes treated waste. The treated waste was divided in three categories; Landfill, Incinerate and Others. It is estimated that about 65.5 % of the treated waste was placed at landfills, about 32.5 % was incinerated and 1.9 % treated in other ways (China Statistical Yearbook, 2015). Since no official data for generation of MSW is presented is the data used further in the study the World Bank's 190 million tonnes MSW per year.

The amount solid waste generated in China, which is not treated, is increasing per year. According to Bouanini (2013) and Haiyun (2008) it is due to that more waste are being recycled, which is not include in treated waste. The recycling material is not included in the treated waste category, since it does not get collected in the official system. The recyclable waste is collected by waste collectors, mostly before the waste is transported to a collective site. The researchers refer to the treated waste category as "waste handling after recycling activities". With an increasing recycling rate the treatment rate will decrease, but the generation of solid waste keep on increasing. Since the recyclable waste usually is gathered of waste collectors before it gets to the collective site is it difficult to find data of exact recycling rates. In a study of Moh & Manaf (2014) was China's recycling rate of total MSW estimated to 13 % in 2011.

Figure 28 shows the estimated typical composition of the MSW in China (Zhang, Tan and Gersberg, 2010). Compared with the other selected countries is China different, because of high rates of ash and wood in its MSW. A reason to this can be that ash and wood, especially ash, is not categorised as waste in the other selected countries and does therefore not show in the composition data. According to Velis (2014) 15 million tonnes of the domestic plastic waste was recovered in China in 2011. Less than 50 % of that has been estimated to be recycled waste. This shows that less than 13.7 % (7.5 million tonnes) plastic waste was recycled in China during 2011 (Velis, 2014).

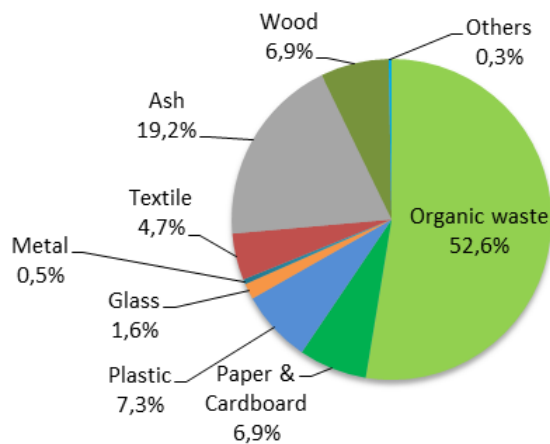


Figure 28. Typical composition of the MSW in China. (Zhang et al. 2010)

Information about paper waste has been limited but a study of the World Bank (2005) estimated that China had a recovery rate of 30 % of their waste paper in 1999. Recovery rates often included both recycling and incineration (Haiyun, 2008; World Bank, 2005), which make the data difficult to interpret. It is also difficult to investigate how the country is doing on its target to recycle 50 % of all paper waste at year 2030 (World Bank, 2005; Bouanini, 2013; SSCC, 2015). A challenge with the domestic paper waste in China is that the domestic paper often is non-wood based, which is not that good for recycling (Ministry of Construction of P.R.C, 2015; Velis, 2014; Moses, 2013). During the last years many western companies have started selling their products on the Chinese market, which will generate more wood based paper and so also more wood based paper waste.

The waste of packaging materials is increasing in China. It is estimated that the country has an annual generation of about 16 million tonnes packaging waste, with an increment of more than 1.05 million tonnes per year. The recycling rates for packaging waste are estimates to be below 20 % (World Bank, 2005; Bouanini, 2013; SSCC, 2015).

China is the top importer of waste in the world. More than 80 % of all plastic waste and 50 % of the paper waste collected in the UK are sent to China for recycling. The imports have a big part in providing the country's growing recycle industry. One of the reasons why recyclers import waste is because of the poor quality of their domestic recycling waste. Both domestic plastic and paper products do not have as good quality as products made in for example Europe, where most of the imported waste comes from. The domestic paper in China is often non-wood based and plastic products manufactured in China have often poor quality. Recycling waste materials with poor quality creates recycled products with even poorer quality, which only gives the recyclers new products they cannot sell. In 2010 China imported about 28 million tonnes waste paper and 7.4 million tonnes used plastic materials. These figures are not included in the recycling rates of China, since the waste is directly sent to the recycling industry (Ministry of Construction of P.R.C, 2015; Velis, 2014; Moses, 2013). Since the *Green Fence Policy* was notified, has the imported waste gain better quality. No study has been found about the limitations of the imported waste. Maybe could the *Green Fence Policy* create an incentive for the recyclers work to with the domestic waste and focus on creating a formal recycling system?

China - Waste management data, summary

There is not much exact data about the waste management and recycling rates in China. According to Bouanini (2013) and Haiyun (2008) this is because recycling materials get collected by waste collected before it arrives to a collective site, where the official data is collective. The data presented for comparison in the Analysis framework (Figure 29) are the estimated recycling rate for total MSW, plastic waste and packaging waste. All of the recycling rates are lower than 20 % and placed on the lowest level on the recycling rate scale. Compared to the other presented countries only Indonesia's recycling rate of the total MSW is on the same level, this even though Indonesia demands recycling and separation meanwhile it only is encourage in China. Comparing the recycling rate of plastic waste, China is far below India, EU and Sweden (but the reliability of India's data can be questioned). No clear data of recycling rate for paper waste in China was found and paper waste is therefore not presented in the Analysis framework (Figure 29) for China.

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
75 - 100 %	EU, Sweden, (Sweden)				
50 - 74 %	India, (EU)	(Indonesia)			
25 - 49 %	Sweden, EU, (Sweden), (EU), Sweden, EU	India			
0 - 24 %		Indonesia, (China)	China, China		

Green = Total paper waste
Blue = Total plastic waste
Black = Total MSW
() = Plastic packaging waste
() = Total packaging waste

Figure 29. Analysis framework - Recycle rates in relation to the legislation scale of waste management.

6.3.4 Malaysia

Malaysia has during the last years had an increasing population and urbanisation, which has created an increasing solid waste problem in the cities but also in the countryside. It is assumed that Malaysia has increased its MSW generation with 91 % during the years of 1990-2000. In year 2013 the total waste generation of Malaysia was recorded to be approximate 33 000 tonnes solid waste per day, which is about 12 million solid waste in a year (JPSPN, 2015; Moh & Manaf, 2014). According to the World Bank's study has Malaysia a MSW generation of 21 918 tonnes per day, which is about 8 million tonnes per year (World Bank, 2012). This data can be questioned since it is much lower than the other countries, but since no other data is found of MSW generation in Malaysia is 8 million tonnes per year the data that will be used further in the study.

The average composition of household waste in Malaysia based on a study of JPSPN (2013) is presented in Figure 30. The category Paper contains mixed paper, newspaper and cardboard, but Tetra Pak is placed in an own category. This shows that the country is aware of a difference of cardboard and liquid board (Tetra Pak) and may have special managing routines for handling Tetra Pak. No further information about recycling rates of Tetra Pak or liquid board has been found.

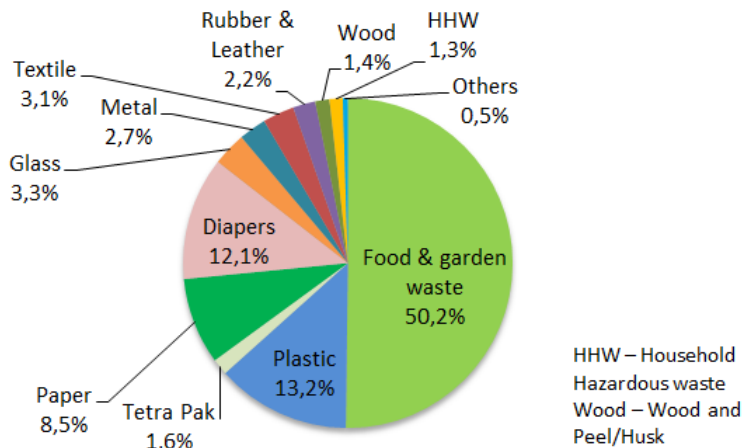


Figure 30. Malaysian household waste composition (as generated). (JPSPN, 2013; Modified by the author)

No study has been made of the collection or recycling rates after the mandatory sorting was notified in 2015. The federal government of Malaysia is with their new regulations during the last years making efforts to improve the waste management system. The question is if it will work and if the citizens will accept the new 2 + 1 collection system, even though they have a history of placing MSW on landfills.

There is limited information about how much waste is collected in Malaysia (Dato', 2012). According to the report of JPSPN (2013) the household recycling rate of solid waste was 9.7%. In other studies researchers have shown total recycling rates of MSW between 5-15% from the years of 2011 to 2015. Malaysia's official recycling rate target of solid waste is on a recycling rate on 22 % in 2020 (Moh & Manaf, 2014, Palansamy, 2016).

Malaysia - Waste management data, summary

The information about Malaysia's waste management is limited and no study has been made since the new 2 + 1 collecting system was implemented. In comparison with the other countries is Malaysia's waste management placed on the lowest recycling rate level together with Indonesia and China in the Analysis framework (Figure 31) This is even though Malaysia's legislation are demanding recycling and separation, but China's is only encouraging it. No recycling rates for paper, plastic or packaging waste could be found.

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
75 - 100 %	EU, Sweden, (Sweden)				
50 - 74 %	India, (EU)	(Indonesia)			
25 - 49 %	Sweden, EU, (Sweden), (EU), Sweden, EU	India			
0 - 24 %		Indonesia, (China), Malaysia	China, China		

Green = Total paper waste
Blue = Total plastic waste
Black = Total MSW
() = Plastic packaging waste
() = Total packaging waste

Figure 31. Analysis framework - Recycle rates in relation to the legislation scale of waste management.

6.3.5 Thailand

Information about Thailand's MSW system has been limited and most of the data is estimated. Thailand's population has grown fast the last couple of years, which have caused an increase of the MSW and the need of a functional MSW system. In a study of the World Bank from 2012, it was estimated that Thailand had a total MSW generation of 39 452 tonnes/day, which is about 14.4 million tonnes MSW annually (World Bank, 2012). According to Towprayoon & Wangyao (2012) did Thailand generate 15.03 million ton MSW in 2008. Because of the limited regulation of waste in Thailand the numbers could have been calculated differently.

Figure 32 show the estimated waste composition in Thailand's capital Bangkok in year 2012 (Challcharoenwattana & Pharino, 2015). As in the other selected countries organic and food waste is the main part of the composition, followed by plastic and paper waste.

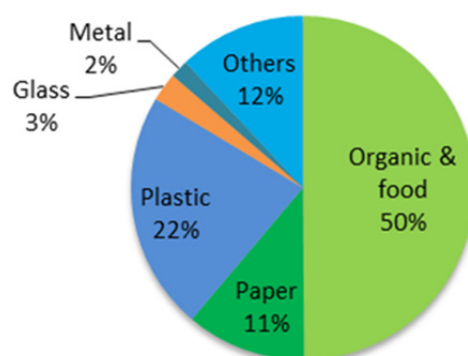


Figure 32. Estimated waste composition in Bangkok, Thailand 2012. (Challcharoenwattana & Pharino, 2015)

The official waste collection rate in the Nonthaburi Province is 90 %, but according to Chiemchaisri et al. (2009) do several numbers of household not get served by the waste collection. The result of Chiemchaisri's et al. (2009) study shows that the collection rate is lower than 90 %. According to Towprayoon & Wangyao (2012) was 12.62 million ton MSW

collected in 2008, which gives a collection rate at about 84 %. In the capital Bangkok in 2012 about 3.6 million ton solid waste was collected (BMA, 2013). According to both World Bank's (2012) and Moh & Manaf's (2014) studies Thailand's recycling rate of MSW was estimated to 14 % in 2011.

Thailand - Waste management data, summary

In the Analysis framework (Figure 33) is Thailand placed on the lowest level of recycling rates of total MSW. Compared to the other selected countries Thailand placed on the same level as the other countries, with the exception of India which do not have any the recycling rate for total MSW presented in the study. Thailand's legislation on waste management encourages recycling and separation, which gives the country the same rank as China for total MSW. No data of recycling rates of paper, plastic or packing waste has been found in the study.

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
75 - 100 %	EU, Sweden, (Sweden)				
50 - 74 %	India, (EU)	(Indonesia)			
25 - 49 %	Sweden, EU, (Sweden), (EU), Sweden, EU	India			Green = Total paper waste Blue = Total plastic waste Black = Total MSW () = Plastic packaging waste () = Total packaging waste
0 - 24 %		Indonesia, Malaysia, (China)	China, China, Thailand		

Figure 33. Analysis framework - Recycle rates in relation to the legislation scale of waste management.

6.3.6 Summary – Waste management data

Since the MSW management in the selected countries are handled by the official, informal and private sector, no actor has full control of the MSW systems. Data were therefore limited and most of the data presented in the study are estimated data.

It has been especially difficult to find specific information about paper and plastic packaging waste. Since these waste types are recyclable waste materials, they are often sorted out from the official waste stream and can therefore not be detected in the official data. Due to lack of reliable data the study could not fully answer the third research question, about paper and plastic packaging materials (*How much waste is generated, collected and recycled of paper and plastic packaging materials?*). But since paper and plastic packaging is part of MSW, the study presents almost a full answer of the question, related to total MSW. A summary of the data of MSW is presented in Table 3.

Table 3. Summary of the data from the third part of the chapter Result and analysis

	How much MSW is generated? (million ton)	How much MSW is collected? (million ton)	What is the recycle rate of MSW? (%)	
India	62	43	N/A	
Indonesia	64	(44.5)	10-20	
China	190	178.6	13	() = Estimated with the collection rate
Malaysia	8	N/A	5-15	N/A = No available figures
Thailand	15	12.6	14	

In this third part of the chapter the recycling rates of all selected countries are presented in the Analysis framework (Figure 34) in relation to the legislation scale of waste management. The result in the Analysis framework (Figure 34) shows that countries with stricter legislation on waste management generally have a higher recycling rate, with the exception of plastic packaging waste from Indonesia. No reason can be found how Indonesia could have a higher recycling rate for plastic packaging waste than all other investigated countries (including Sweden and EU) and since it also only appear in one research the data is questioned, but it presented in the study since no other data was available.

	Strict laws about EPR to collect & recycle	Laws and/or regulation demanding recycling & separation	Laws and/or regulation encouraging recycling & separation	Laws and/or regulation encouraging protection of environment	No laws or regulation about waste handling
75 - 100 %	EU, Sweden, (Sweden)				
50 - 74 %	India, (EU)	(Indonesia)			
25 - 49 %	Sweden, EU, (Sweden), (EU), Sweden, EU	India			Green = Total paper waste Blue = Total plastic waste Black = Total MSW () = Plastic packaging waste () = Total packaging waste
0 - 24 %		Indonesia, Malaysia, (China)	China, China, Thailand		

Figure 34. Analysis framework - Recycle rates in relation to the legislation scale of waste management.

All selected countries except India have available recycle rates of MSW, and they are all lower than 20 % and lower than those of Sweden and EU. No data of India's recycling rate for MSW is presented in the study, since the data is not stated officially or found in any other research. The reason for this is assumed to be that the recycling activities in India are mostly made by the informal sector.

6.4 The selected countries' recycling and separation systems fit with BillerudKorsnäs' sustainability strategy

In this fourth part of the chapter the study tries to answer the fourth research question:

- *How do the recycling and separation systems in Asia fit with BillerudKorsnäs' sustainability strategy?*

BillerudKorsnäs' sustainability strategy contains of three different focus area, all presented in chapter 2 (BillerudKorsnäs, 2015d). BillerudKorsnäs' focus areas are presented again in Figure 4 and all focus areas are analysed in this fourth part of the chapter.

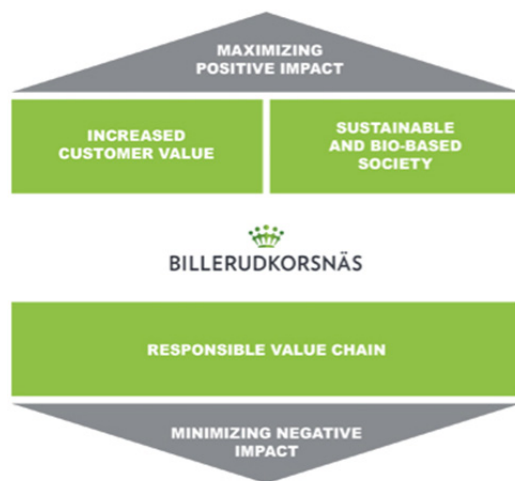


Figure 4. BillerudKorsnäs' sustainability focus areas 2015. (BillerudKorsnäs, 2015d)

6.4.1 Responsible value chain

In BillerudKorsnäs' sustainability strategy the most relevant focus area for the study is the *Responsible value chain*. In this focus area one of the two commitments is more relevant for the study. The most relevant commitment is;

- *Promote responsibility from raw material supply and production to recycling* (BillerudKorsnäs, 2015d).

This commitment shows that BillerudKorsnäs wants to take responsibility for the products they produce. It shows that the company is interested in their products, from the raw materials through the production chain, all the way to the waste materials recycling process. BillerudKorsnäs make their products recyclable and the company is promoting recycling by being member or part financier of collecting organisations, as FTI in Sweden (BillerudKorsnäs, 2014a). The company is also member in industrial organisations, which are engaged in recycling questions and development of recycling processes. By having this commitment BillerudKorsnäs' sustainability strategy can fit (/be compatible) with all countries' recycling systems which promote recycling.

As is shown in the final version of the Analysis framework (Figure 34), all the selected countries have a legislation that encourages recycling and separation or stricter legislations targets of recycling and separation activities. Looking only at the legislation on waste management in the selected countries, BillerudKorsnäs' sustainability strategy, is compatible with the selected countries' recycling and separation systems.

The existing recycling and separation systems in the selected countries have low recycling rates. Even though the legislations in the selected countries are encouraging recycling, the recycling and separation systems are not functional at a good level. According to the result in

6.2 and 6.3, the high value waste materials get recycled. By trying to create a higher second hand value of their products BillerudKorsnäs could increase the chances for their product to become recycled. But since BillerudKorsnäs use the word *Promote* in the commitment, which is a promise to encourage, can the selected countries' recycling and separation systems be seen as compatible with BillerudKorsnäs' sustainability strategy, as long as they work to encourage recycling activities.

A recycling and separation system that especially encourages recycling of paper packaging material, would be even more compatible with BillerudKorsnäs' sustainability strategy than the countries' existing recycling and separation systems. This BillerudKorsnäs' products are made of paper materials. The new mandatory sorting system in Malaysia demanding separation of paper waste materials at source, is therefore even more in line with BillerudKorsnäs' sustainability strategy. Also the legislation in Indonesia that demands the household to separate the recyclable materials is in direct line with BillerudKorsnäs' sustainable strategy if BillerudKorsnäs' products are sorted in the category for recyclable materials. Because of this the recycling and separation systems in Malaysia and Indonesia can be seen as more compatible to BillerudKorsnäs' sustainability strategy than the other selected countries' systems. But as been stated before, all recycling and separation systems in the selected countries are compatible with BillerudKorsnäs' sustainable strategy, due to of the first commitment.

The second commitment in the *Responsible value chain* focus area is to;

- *Provide engaging workplaces where safety, diversity and human rights are a priority* (BillerudKorsnäs, 2015d).

This commitment is about BillerudKorsnäs own operations. Since it only is focus on BillerudKorsnäs' own operation it does not apply on the selected countries' recycling and separation systems.

6.4.2 Increased customer value

The second focus area is; *Increased customer value*. The first commitment in this focus area is to;

- *Improve our customers' business using knowledge on sustainable packaging solutions* (BillerudKorsnäs).

By using the knowledge of their sustainable packaging materials BillerudKorsnäs transforms the sustainability of the product into a valuable component. To be able to use knowledge of sustainability to increase the customer value, it is important that there is a system available where the product can be taken care of in a sustainable way after use. Recycling and separation systems that can use the product in a sustainable way are therefore more compatible with BillerudKorsnäs' sustainability strategy than, system that cannot. In none of the selected countries the official recycling and separation systems will take care of packaging materials in a sustainable way, but the informal sectors in the selected countries make sure that valuable waste materials get recycled. Since limited data are presented from the informal sectors no statement can be made if the recycling and separation systems in the selected countries fit with this commitment or not.

The second commitment in the focus area is;

- *Through innovation expand the markets of renewable packaging materials* (BillerudKorsnäs).

BillerudKorsnäs wants to expand their market through innovations, but the expansions needs to be within all local and global restrictions. BillerudKorsnäs believes that a challenge for

their different expansions is to operate within all restriction and legislations that exists on the sales markets (BillerudKorsnäs). Many of these restrictions are changing and developing. To monitor the change the company has started to work on a model, which controls and do follow-ups on changes in the regulations worldwide. This type of model would be useful in the selected countries, especially if the model would control both legislations on development of packaging materials and the waste management. It is only China that has a restriction of how the packaging materials should be created (“product should use packaging materials which are easily recycled, disposed of, or assimilated by the environment”) (Ministry of Construction of PRC, 2013). It is of great importance for BillerudKorsnäs to know how the legislation is formed, when they are developing innovations, because without that information of regulation and legislations BillerudKorsnäs could make costly. Just because some special packaging materials or solutions are allowed in one country, it does not say if it is allowed in the country next to it. If BillerudKorsnäs model for monitoring the legislation are functional the company has a great advantage. No statement can be made if the commitment fit with the selected countries’ recycling and separation system or not. This since the study does not investigate *how* BillerudKorsnäs is expanding on the new markets.

6.4.3 Sustainable bio-based society

The last focus area in BillerudKorsnäs’ sustainability strategy is to create a *Sustainable bio-based society*. The first commitment in this focus area is to;

- *Combat climate change throughout the value chain* (BillerudKorsnäs, 2015d).

This commitment is important for this study since it proves that the company wants to have a limited negative effect on the climate as possible. By using renewable and recyclable materials BillerudKorsnäs produce sustainable products that are sends to a functional recycling and separating system after use. Because of the lack of functional official recycling systems and limited information about the informal system is it difficult to judge if the selected countries’ recycling and separation systems are compatible with this commitment in BillerudKorsnäs’ sustainable strategy.

The last commitment in BillerudKorsnäs’ sustainability strategy is;

- *Generate value for the society though collaboration, both locally and globally* (BillerudKorsnäs).

BillerudKorsnäs have not worked with this commitment in the selected countries, but the company has good possibilities to collaborate both locally and globally to increase the market for renewable packaging materials in the selected countries and at the same time generate value for the society.

6.4.4 Summary – Fit with BillerudKorsnäs’ sustainability strategy

To sum up the answer of the fourth research question;

- *How do the recycling and separation systems in Asia fit with BillerudKorsnäs’ sustainability strategy?*

The study can only show result related to the first and most relevant commitment in BillerudKorsnäs’ sustainability strategy. According to the result all the selected countries’ recycling and separation systems are compatible with BillerudKorsnäs’ first commitment in their sustainability strategy. This is due the fact that all countries have legislations on waste management that promote or are stricter on recycling of recyclable materials.

7 Discussion

This chapter starts with a discussion about the result and method followed by a discussion about BillerudKorsnäs' sustainability strategy in relation to the result. The chapter ends with a discussion about BillerudKorsnäs future in the selected countries.

7.1 Result and method discussion

The study result shows that countries with a stricter legislation on recycling and separation, especially with an EPR, have higher recycling rates. But it can be questioned if the result gives the correct picture on the subject. Most of the data presented are estimates, which shows that this is a difficult subject to study using only secondary sources. Official data are limited and shows that even though legislation on the subject is available, the governments do not know exactly how the system works to day.

This study used information about EU and Sweden as a benchmark, since they are BillerudKorsnäs' main market, but also since the recycling rates are higher there. It can be questioned if the only way to reach a higher recycling rate is to do it in the same way as EU and Sweden. Is a stricter legislation the only way to a higher recycling rate? Can a country create a high recycling rate without a strict legislation, for example by involving the informal sector? According to this study none of the selected countries have managed to create a high recycling rate without a strict legislation on waste management. But it would be interesting to make further studies of other countries with limited legislation on waste management to see if any of them have developed high recycling rates. According to a study by Innventia (2013) can a too strict legislation about packaging materials work against product development and innovations? No signs of that have been shown in this study. But this study has not focused on developments and innovations on the products that create waste materials.

According to Finnveden et al. (2013) policy instruments are needed to help countries to work towards a more sustainable society. The best policy to decrease the environmental impact is to create compulsory recycling of recyclable materials. According to the result of the legislation study (part (6.1)), the legislation in the selected countries have not been powerful enough. But the effect of the latest stricter legislation in some of the countries cannot yet be seen. Finnveden et al. point out that in developing countries it is more efficient to create policy instrument and legislations that are stimulating the demand of recycling materials. With the right policy instruments and legislation the governments could help establish a market for recycling materials. The selected countries are all developing countries and according to the result of the study, it could be a good alternative for the governments to work on creating a demand for recyclable materials, instead of pushing the producers that generates the waste. None of the selected countries have a functional recycling system and all countries have focused their legislation on the waste generators, instead of making it easier for recycling companies to start operating.

The aim of the study was to focus on the official recycling and separation systems in the study result, but since most of the recycling activities in the selected countries were operated by the informal or private sector this part was also taken in account and presented. Since the study was focusing on the official systems, it can be questioned if all information available for the informal and private systems has been found. It can therefore be interesting to make a deeper study focusing on the informal systems, to learn more about how they are formed and operating.

According to Olsmats & Kaivo-oja (2014) and Shekdar (2009), the unemployment is growing in developing countries and the informal waste collectors are increasing in numbers. Since the informal waste collectors are not in an official system they are not controlled. Unemployed people can start picking and buying waste, to sell it further to recyclers and intermediaries. This is a possibility for unemployed people to earn money in an uncontrolled environment. Malaysia is the only country of the selected countries, where the federal government tries to implement a system, where the informal waste collectors is a part of the official system. By allowing the informal system, the federal government hope to involve the waste collectors in the official system and getting more control.

Since little information was available about paper or plastic packaging materials, total MSW was studied. If information had been available, the result has had another outcome. The materials could also be placed against each other and the result could point out which of the two materials that have a highest recycling focus in the countries. This would have been interesting since plastic packaging materials are competitors to BillerudKorsnäs' products. Since this information only was found concerning India no comparison could be done, except in India where plastic have a higher recycling rate. One reason to why no information about paper and plastic packaging materials was found, can be because the two materials are treated the same way, another reason can be that the materials sold directly to the recyclers is not found in the official system.

7.2 BillerudKorsnäs' sustainability strategy

BillerudKorsnäs has followed the global megatrend of the increasing demand of sustainable products, by producing sustainable products. According to Grant (2013) companies work with sustainability and CSR because of three arguments; 1. *The sustainability* argument 2. *The reputation* argument 3. *The license-to-operate* argument. This study result shows that all three of the arguments are important for BillerudKorsnäs. Since the company's mission is to *challenge conventional packaging for a sustainable future* (BillerudKorsnäs, 2015d) the *sustainability* argument could be seen as the most important. With their sustainability strategy with three focus areas the company shows how they intended to work towards a sustainable future. The result of the study of the selected countries shows that all countries have legislations that encourage recycling. This is in line with the *sustainability* argument, since the countries and BillerudKorsnäs' are working for a sustainable future.

BillerudKorsnäs market itself as a sustainable company (BillerudKorsnäs), due to that the *reputation* argument is also significant for the company. The *license-to-operate* argument is also important since CSR and sustainability work is standard practice in the industry. If BillerudKorsnäs would not work at all with sustainability, the company would probably not be able to continue its operation.

Even though it can be concluded that BillerudKorsnäs has arguments for working with sustainability, a question raised in the study is how important it is for BillerudKorsnäs that their products are recycled? With the commitment to *Promote responsibility from raw material supply and production to recycling* the company makes a stand for responsible value chains, but the commitment does not presented any special actions to promote recycling activities. A reason for this may be that BillerudKorsnäs only use virgin fibres in their production and have therefore only the sustainability argument as reason for why the company should work with recycling activities. In BillerudKorsnäs' Sustainability report 2015 actions are outlined on how the company will work with the commitment to promote responsibility among their suppliers and in their production (BillerudKorsnäs, 2015). According to the

World Bank (2005) only 5 % of the environmental impact comes from the treatment of solid waste. The rest (95 %) of the environmental impact is created during the production, processing and using of a product. This can be a reason why BillerudKorsnäs focus their actions to promote responsibility in their production and with their suppliers. But since BillerudKorsnäs' products often are components in a consumer product, it could be questioned why BillerudKorsnäs do not have an action plan to control the value chain all the way to the end consumer, for example by forming recycling targets together with their customers.

7.3 The future for BillerudKorsnäs in the selected countries

Another question that has come up during the study is why BillerudKorsnäs are expanding in countries without developed recycling and separation systems? If recycling of their product is important for the company, why expand in countries where they have low recycling rates? The answer is probably that, the packaging markets are expanding in these countries and BillerudKorsnäs wants to take a part of that expanding market. By expanding on markets where the recycling and separation systems are not developed BillerudKorsnäs could be part of the development in these countries. The company could do this by working with lobbying and collaboration with industrial organisations, local recyclers and other actors in the area. Together with them BillerudKorsnäs can inform and instruct how their products should be taken care of in other markets as for example Sweden, and try to get a similar system implemented on the new markets. For example paper waste in India can according to their new legislation be sorted as *dry waste* (non-biodegradable waste) together with metal and plastic waste. By informing the government about paper waste's ability to be biodegraded BillerudKorsnäs could establish local and global collaborations. In countries like China and Thailand, where no instruction on sorting and recycling are defined, BillerudKorsnäs could affect recycling rates even more, if they could inform the governments and recyclers of the paper waste abilities.

When BillerudKorsnäs decided to enter the selected countries they had no information about the recycling and separation systems. According to Shekdar (2009) the scale of sustainability should be in the focus in the SWM systems, depending on the economic status of the country. Shekdar states that developing countries, as all the selected countries, the ability to work with sustainability in the SWM system is not as high as in developed countries. When BillerudKorsnäs decided to enter the selected countries they should have known that the sustainability in the SWM systems maybe lacking. The company could therefore have foreseen that the recycling and separation systems would not have the same level as in Sweden. To raise the level of sustainability focus in the SWM systems in the selected countries, actions to improve the economic status in the country could be a way to work towards in local and global collaborations.

The study result shows that the existing recycling activities in the selected countries are driven by the informal and private sector. To raise the recycling rates of BillerudKorsnäs' product in the selected countries without developing a new system, BillerudKorsnäs will need to relay on the informal and private sector. To do this the company need to create a higher value for their products. This may be achieved if BillerudKorsnäs collaborate with local recyclers and help them develop the right recycling methods for their products.

This study is made on behalf of BillerudKorsnäs to create overview information of the recycling and separation systems in the selected countries. The study can therefore be seen as a first step towards promoting responsibility all the way to recycling and hopefully will the study result help the company to create special actions on how to promote recycling activates at new markets.

8 Conclusions and recommendations

This chapter sums up the study by presenting the conclusions, giving proposals for futures research studies and recommendations to BillerudKorsnäs.

Global megatrends are affecting the packaging industry. If existing companies within the industry use the knowledge of the megatrend right, they could create a competitive advantage. Three of the global megatrends affecting the packaging industry are: the world's growing population, the urbanization and the growing requests for sustainable products. The two first of this megatrends are making a big impact on the Asian markets. BillerudKorsnäs is working to meet the third megatrend by producing sustainable products. During the last year BillerudKorsnäs has expanded their sales market to Asia, to take part of the growing packaging markets created of the first two megatrends.

8.1 Aim and research questions

8.1.1 Aim

The aim of the study is to give an overview of the recycling and separation systems for packaging materials of paper and plastic in some key Asian countries.

- The results show that there is not enough information available through secondary studies, about packaging materials of paper and plastic to present a correct overview. The study area has therefore been expanded to; *give an overview of the recycling and separation systems for MSW, together with paper, plastic and packaging materials in the extent information are found, in some key Asian countries.*
- The created overview of the recycling and separation system is presented in the final Analysis framework (Figure 34). It shows that among the selected countries those with stricter legislation on waste management, especially with an EPR, have higher recycling rates.
- India and Malaysia have, during the last years, developed their legislation on waste management to become stricter and similarities to Swedish legislation on waste management can be noticed. The data of generated, collected and recycle rates of MSW shows that the implementation of the new legislation is still lacking.
- Most of the recycling activities in the selected countries are carried out by the informal and private sector. The waste materials that are recycled are the valuable waste materials that can be sold to recyclers or intermediaries.

The aim is also to investigate if the systems are compatible with BillerudKorsnäs' sustainability strategy.

- The result shows that the selected countries are compatible with BillerudKorsnäs' sustainability strategy, since they are at least encouraging recycling and separation of recyclable materials, which is in line with BillerudKorsnäs' first commitment in their sustainability strategy to *promote responsibility from raw material supply and production to recycling.*

8.1.2 Research questions

1. What are the legislations (laws, regulations and policies) on recycling and material handling for packaging waste of paper and plastic?

- Due to lack of data of paper and plastic packaging waste, the research question was expended to investigate MSW.

- All the selected countries have legislations that encourage recycling of MSW, but at different levels. The countries scale of legislation is found in the final version of the Legislation framework (Figure 17).

2. How does the waste management system actually work and how does the flow of recycling materials go? Is there a separation system for laminated paper and if so, how is the separation system involved in the recycling process?

- In none of the selected countries is there a national official recycling system. The study result indicates that the informal and private sectors are the ones driving the existing recycling activities.
- It is foremost the valuable waste materials that gets recycled by the informal and private sector.
- No information of a special separation system for laminated paper was found in any of the selected countries.

3. How much paper and plastic packaging waste is generated, collected and recycled?

- Due to lack of data of paper and plastic packaging waste, the research question where expended to investigate MSW.
- The MSW management is handled of the official, informal and private sector, but none of the actor has full control. The study result is shown in Table 3. It shows that none of the selected countries have a recycling rate over 20 % of MSW.

4. How do the recycling and separation systems in Asia fit with BillerudKorsnäs' sustainability strategy?

- BillerudKorsnäs' sustainability strategy fits with the recycling and separation systems in the selected countries in Asia, since all countries have legislation that encourage recycling, which is in line with BillerudKorsnäs' first commitment in their sustainability strategy.

8.2 Future research studies

This study has a focus on presenting an overview on the recycling and separation system in Asia. The result shows that not that many studies of legislation on waste management have been produced in the selected countries and data is therefore limited. It would therefore be interesting to conduct further studies that analyse the legislations more in depth. A study made of primary and secondary data would give more depth. To make such a study it would probably be better to focus on one individual country's recycling and separation system.

Another continued study to follow up on this study's results is to investigate how the informal systems operate in the different countries and the factors, what makes a waste material valuable in this sector.

Since the study result shows that none of the selected countries has created a high recycling rate without a strict legislation on waste management, it would be interesting to study if there exists any country in other regions that have a limited legislation on waste management, but anyway have developed independent recycling systems.

8.3 Recommendations to BillerudKorsnäs

The most important conclusion of this study for BillerudKorsnäs is that there is no special legislation about paper waste in any of the selected countries. This brings a possibility for BillerudKorsnäs to affect the outcome of a future legislation in the paper waste area. By

lobbying and collaborations with industrial organisations, local companies and other actors BillerudKorsnäs could help form a legislation in the selected countries, which favours recycling of their sustainable paper packaging products.

The study states that the legislation on waste management is under development in many countries. It is therefore important for BillerudKorsnäs to be updated on the subject and if possible support the development of appropriate recycling policies.

Since the result shows that the informal and private sectors are foremost recycling valuable materials, it would be interesting for BillerudKorsnäs to work in collaboration with local recycling companies to bring up the value of packaging paper waste materials.

Another recommendation to BillerudKorsnäs is to support their customers to work with action plans for recycling, since they are closer to the end consumer. By only selling to customers who follow this sort of action plans, this could be one part of BillerudKorsnäs way of promoting a *Responsible value chain*.

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Wohrne, L. Sustainability Developer, BillerudKorsnäs. 2016-03-21. BillerudKorsnäs' headquarters in Solna.

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Distribution
Sveriges lantbruksuniversitet
Institutionen för skogens produkter
Department of Forest Products
Box 7008
SE-750 07 Uppsala, Sweden
Tfn. +46 (0) 18 67 10 00
Fax: +46 (0) 18 67 34 90
E-mail: sprod@slu.se