SUSTAINABLE SOLID WASTE MANAGEMENT IN SPORT GAMES: A CASE STUDY OF FOOTBALL MATCHES IN THAILAND

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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาศิลปศาสตรดุษฎีบัณฑิต
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Field of Study	Environment Development and Sustainability
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กอปรทิพย์ อัจฉริยโสภณ : การจัดการขยะอย่างยั่งยืนในการแข่งขันกีฬา : กรณีศึกษาการแข่งขันฟุตบอลในประเทศไทย (SUSTAINABLE SOLID WASTE MANAGEMENT IN SPORT GAMES: A CASE STUDY OF FOOTBALL MATCHES IN THAILAND) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: อ.ดร. แสงจันทร์ ลิ้มจิรกาล, 140 หน้า.

กีฬาเป็นกิจกรรมที่มีความสำคัญในเกือบทุกวัฒนธรรม กีฬาไม่ได้มีเพียงแค่ประโยชน์ต่อร่างกายเท่านั้น หากแต่ยังเป็นเครื่องมือส่งเสริมความสำเร็จในเป้าหมายการพัฒนาของสหัสวรรษได้อย่างมีประสิทธิภาพตามรายงานของโครงการสิ่งแวดล้อมแห่งสหประชาชาติ กิจกรรมกีฬานั้นสร้างผลกระทบทางลบต่อสิ่งแวดล้อมเช่นเดียวกันกับกิจกรรมอื่นๆ ของมนุษย์ เช่น มลภาวะทางเสียง มลภาวะทางอากาศ และผลกระทบจากขยะมูลฝอย

คณะกรรมการโอลิมปิกสากลได้นำเอาหลักการของแผนปฏิบัติการ 21 มาปรับใช้เป็นแผนปฏิบัติการเพื่อลดผลกระทบทางสิ่งแวดล้อมจากการแข่งขันกีฬาขนาดใหญ่ แผนการนี้มีเนื้อหากล่าวถึงการจัดการขยะอันตราย อย่างไรก็ดีไม่มีการกล่าวถึงการจัดการขยะมูลฝอยโดยเฉพาะ

งานวิจัยนี้จึงจัดทำขึ้นเพื่อนำเสนอแบบจำลองสำหรับการจัดการขยะที่ยั่งยืนในสนามฟุตบอล โดยลงพื้นที่สังเกตและเก็บข้อมูลขยะที่เกิดขึ้นจากการแข่งขัน วิธีการจัดการขยะในปัจจุบันของสโมสรฟุตบอล 3 ทีม ที่อยู่ในไทยพรีเมียร์ลีก ขยะที่เกิดขึ้นในสนามฟุตบอลถูกศึกษาด้วยการเก็บและแยกประเภท รวมถึงมีการสำรวจความคิดเห็นของผู้ชมด้วยแบบสอบ ถามเพื่อศึกษาพฤติกรรมในการสร้าง ทิ้ง และแยกขยะ และสัมภาษณ์เชิงลึกกับผู้มีส่วนได้ส่วนเสียสำคัญในกระบวนการจัดการขยะที่เกิดขึ้นในสนามฟุตบอล นอกจากนั้นงานวิจัยนี้ยังได้ทบทวนนโยบายที่เกี่ยวข้องกับการจัดการขยะในการแข่งขันกีฬาทั้งในประเทศและต่างประเทศ

ผลการวิจัยพบว่าส่วนใหญ่ขยะเปียกและขยะแห้งถูกทิ้งปะปนกัน ทำให้ขยะที่เกิดขึ้นในสนามฟุตบอลถูกนำไปรีไซเคิลไม่ถึง 15% ขยะที่เหลือขาดการจัดการที่เหมาะสมนำไปสู่การปล่อยก๊าซเรือนกระจกสู่ชั้นบรรยากาศโดยไม่จำเป็น

ผลการศึกษาความคิดเห็นของผู้เข้าชมพบว่า ถึงแม้มีแนวโน้มว่าผู้เข้าชมมีความตระหนักรู้เกี่ยวกับผลกระทบที่เกิดจากการทิ้งขยะ แต่ผู้เข้าชมมีพฤติกรรมการคัดแยกขยะก่อนทิ้งน้อยมาก ทำให้ขยะที่เกิดขึ้นถูกนำไปรีไซเคิลน้อยกว่าที่ควรจะเป็น ผลจากการสัมภาษณ์ผู้มีส่วนได้เสียพบว่า ส่วนใหญ่ไม่มีมาตรการในการคัดแยกขยะก่อนทิ้ง ส่วนขยะที่เหลือจะถูกเก็บกองไว้รวมกัน รอให้รถเทศบาลมาเก็บต่อไป โดยไม่มีการคัดแยก

แม้ประเทศไทยจะมีกรอบกฎหมายและนโยบายที่เกี่ยวข้องกับการจัดการขยะ แต่ในวงการกีฬา โดยเฉพาะสมาคมฟุตบอลยังขาดแคลนแรงจูงใจ กฎเกณฑ์ นโยบาย และความตระหนักเกี่ยวกับการจัดการขยะอย่างเหมาะสม

ปัจจุบันการจัดการขยะของสโมสรฟุตบอลในการแข่งขันไทยพรีเมียร์ลีกยังขาดการจัดการที่เหมาะสม ดังนั้นการสร้างแบบจำลองที่ประกอบไปด้วยนโยบาย กฎหมาย วิธีการ องค์ความรู้และแรงจูงใจที่ส่งเสริมให้เกิดการจัดการขยะอย่างยั่งยืน สามารถนำไปปรับปรุงข้อบกพร่องของการจัดการขยะในปัจจุบัน ทั้งยังช่วยเพิ่มโอกาสในการนำขยะกลับมาใช้เป็นทรัพยากรในการแข่งขันกีฬา และยังสามารถนำไปปรับใช้กับการจัดการขยะในการแข่งขันกีฬาอื่นๆ ทั้งในประเทศไทยและต่างประเทศได้

สาขาวิชา สิ่งแวดล้อม การพัฒนา และความยั่งยืน ลายมือชื่อนิสิต .....

ปีการศึกษา 2558 ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

5387752320 : MAJOR ENVIRONMENT DEVELOPMENT AND SUSTAINABILITY
KEYWORDS: SUSTAINABLE SOLID WASTE MANAGEMENT / GHG EMISSIONS / FOOTBALL MATCHES IN THAILAND

KORBTIP ATCHARIYASOPHON: SUSTAINABLE SOLID WASTE MANAGEMENT IN SPORT GAMES: A CASE STUDY OF FOOTBALL MATCHES IN THAILAND. ADVISOR: SANGCHAN LIMJIRAKAN, D.Tech.Sc., 140 pp.

Sports are essential to humankind. They are undeniably the key to better living in most cultures. The benefits of sports extend beyond one's physical health to the whole society as a cost-effective tool to accelerate the achievement of the Millennium Development Goals according to the United Nations Environmental Programme. Similar to other intensifying human activities, sports would be considered as a cause of adverse impacts on nature and environment including noise, water, air pollution, and impact from solid waste.

As a countermeasure to the unsustainability of sport events, the International Olympic Committee has adopted The Agenda 21 as an action plan to lessen human impacts on environment. The conclusive plan of The Olympic Movement's Agenda 21 still nevertheless lacks a concrete solid waste management model. This research was conducted with a goal to obtain a sustainable solid waste management model for sport games.

In this research, field observations were utilized at 3 football clubs in Thai Premiere League to obtain information about their environmental impacts regarding solid waste. The solid waste generated at the study stadiums was collected and sorted. The structured questionnaires were applied to the spectators at the study stadiums to obtain information about solid waste generating, disposing and sorting behaviors. The semi-structured questionnaires were used to in-depth interview with the key stakeholders of solid waste management of each study clubs. In addition, the policy relevant was reviewed.

The research revealed that only less than 15% of the recyclable wastes proceed to the recycling process. The rest went to inappropriate treatment and generating unnecessary greenhouse gas emission.

Questionnaires for the football spectators have shown that despite a strong sign of awareness regarding environmental impacts caused by disposing waste, the spectators in the sport events paid very little attention to waste sorting. The lack of sorting behavior at every study stadium correlates to the very low recycling ratio found in the solid waste collection study. The in-depth interviews with the key stakeholders underlined that it was lack of prior sorting at the study clubs.

Despite Thailand's legal frameworks and policies related to solid waste management, in the field of sports, the current policies are still very lacking in terms of proper incentives, rules, regulations and environmental awareness of solid waste management among the related institutions especially in the Football Association of Thailand.

The current solid waste management by the football clubs in the Thai Premier League is still lacks proper management that can be developed by means of a modeling instrument. To achieve proper management, the proposed sustainable solid waste management model comprises of responsive policy, laws and acts formulated, techniques, knowledge, forceful incentives provided and public participation. The model would improve the deficiencies of the current solid waste management and increases the opportunity of resource recovery and recycling at the sport game. Besides, the model could be applied to any sport games in Thailand and other countries.

Field of Study: Environment Development and Sustainability Student's Signature .....
Academic Year: 2015 Advisor's Signature .....

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CONTENTS

Page

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Page

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Page

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

LIST OF TABLES

Page

Chapter II

Chapter III

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Page

Chapter IV

Page

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

LIST OF FIGURES

Page

Chapter II

Chapter III

Chapter IV

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Page

LIST OF ACRONYMS

3Rs	Reduce, Reuse and Recycle
ABS	Australian Bureau of Statistics
AFC	Asian Football Confederation
BGFC	Bangkok glass Football Club
CH_4	Methane
CO_2	Carbon dioxide
CO_{2e}	Carbon dioxide equivalent
CRUTD	Chiangrai United Football club
CT	Cleaner Technology
Division 1	Yamaha League 1
Division 2	Yamaha League 1
DOC	Fraction of degradable organic carbon
DOC_F	Fraction of DOC dissimilated
EQMP	Environmental Quality Management Plan
ERTC	Environmental Research and Training Center
F	Fraction of CH_4 in generated landfill gas
FAT	The Football Association of Thailand
FC	Football Club
FIFA	Federation International de Football Association
FOD	First Order Decay
FTI	Federation of Thai Industries
GDP	Australian Bureau of Statistics
G-ForSE	Global Forum for Sport and Environment
GHG	Greenhouse gas
GWP	Global Warming Potential
Ifs	International Federations
IOC	International Olympic Committee
IPCC	The Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
ISWM	Integrated solid waste management
k	Methane generation rate constant
LCA	Life cycle assessment

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

LDPE	low-density polyethylene
MCDA	Multi-criteria decision analysis
MCF	Methane Correction Factor
MSW	Municipal solid waste
MSWM	Municipal solid waste management
MTUTD	SCG Muangthong United Football club
NCPO	National Council for Peace and Order
NCV	Net Calorific values
NIDA	National Institute of Development Administration
NOCs	National Olympic Committees
OCOGs	Olympic Games Organizing Committees
ONEP	Office of Natural Resources and Environmental Policy and Planning
PCD	Pollution Control Department of Thailand
PET	Polyethylene terephthalate
PONRE	Provincial Office of the Natural Resources and Environment
RDF	Refuse Derived Fuel
REQMP	Regional Environmental Quality Management Plan
SNC	Thailand's Second National Communication
TIMPMSE	National Institute of Development Administration
TPL	Thailand Premier League
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNESCAP	United Nation Economic and Social Commission for Asia and the Pacific
UNFCCC	United Nations Framework Convention on Climate Change
USEPA	United States Environment Protection Agency
WWF	World Wide Fund for Nature

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

CHAPTER I
INTRODUCTION

1.1 Background and importance of the study

Solid waste is an inevitable rubbish, created by human activities (Moeller, 2005). The immense growth rate of human population, a growing of urbanization and soaring expansion in technology of production have contributed to an upsurge in the quantity and diversity of solid wastes (United Nations Environment Programme [UNEP], 1991).

Sport is one of human activities that generates solid waste. Amount of solid waste generation in sport games likely to increase due to a number of spectators participated. Hence, mega sporting events with a great number of spectators participated tend to generated a large amount of solid waste. Woods (1993) described that spectators generated 74.1 tons of solid waste during 5 days of the 27th Super Bowl in California in 1993 and around 50,000 spectators at the Skydome baseball stadium in Toronto in 1992 generated 212.67 tons of solid waste per month. Schmidt (2006) reported that solid waste was generated around 5-10 tons during the Football World Cup competition in 2006. While, 6,386 tons of solid waste and 40,000 tons of hazardous waste were generated at the Beijing Olympic Game in 2008 (UNEP, 2009a).

Solid waste create several effects on environment including environmental deprivation, impact on public health and greenhouse gas emission which is the main cause of climate change (United States Environment Protection Agency [USEPA], 2009). Although, the International Olympic Committee [IOC] concerned on environmental impact created by sport games, solid waste management was not mentioned precisely in the sustainable sport policy (International Olympic Committee [IOC], 1999).

Currently, football is becoming more popular in Thailand. Thai football competition is divided into 3 leagues, namely, Thai Premier League [TPL], Yamaha League one and AIS Regional Leagues. A number of spectators of Thailand's football league increased approximately 23% during the first 3 years (The Football Association of Thailand [FAT], 2013). The number of spectators participated in football match

reached to 24, 125 person in a match between the Buriram United and the Chiangrai United in 2011. The total spectators at every stadium were about 1.4 million persons per year. Due to the number of football matches, the number of spectators and their activities, a vast amount of solid waste was generated. Nevertheless, a proper solid waste management is still lacking in sport games.

To moving to sustainable solid waste management, solid waste management should attempt to change unsustainable patterns of production and consumption according to Agenda 21 (United Nation Conference on Environment and Development [UNCED], 1992). Besides, an average solid waste generated by Thai people from household activities was 1.15 kg/person/day (Pollution Control Department of Thailand [PCD], 2015) and would not be applied to solid waste generation rate from football match. The study on solid waste generated and managed of football matches are significant to obtain the solid waste generation rate from football match and understand the deficiencies of current solid waste management. In addition, national and international solid waste management relevant policy reviews are imperative to obtain sustainable solid waste management model in sport games.

1.2 Objectives of the study

The objectives of this study are:

1) to study current situation of solid waste and its management in the football games.

2) to propose possible sustainable solid waste management model for the football games.

1.3 Scope of the study

The study was conducted in the following scope.

1) The study focused on the three selected football clubs in Thailand.

2) Related data on current situation of solid waste management in the football games both local and international level were reviewed.

3) The national and international sport sustainability policies were studied.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

4) Primary data on solid waste generated and managed at the selected football clubs were collected using questionnaire to spectators and in-depth interview to key stakeholders of solid waste management at the football games.

5) All data collected were analyzed.

6) A sustainable solid waste management was proposed based on data obtained.

1.4 Expected outputs

1) Quantity and type of solid waste produced by football games.

2) Greenhouse gas emissions from solid waste generated in the study matches of the football games.

3) Policy relevant sustainable solid waste management in the football games.

4) A possible model of sustainable solid waste management for the football games in Thailand.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

CHAPTER II
LITERATURE REVIEWS

2.1 Sports and its advantage

Sports are human activities since an ancient time. Oak (2011) generally explained that physical exercises in sports can mitigate several other stress related disorders, lessen depression, anxiety and other psychological disorders, constructive expenditure of energy, strengthen the bones and muscles and tones and improve the math skills in children. The advantages of sports can separate into three groups as follows:

2.1.1 Advantages of sports on society

Sports can enhance people's spirit and ability for their social life. Beutler (2008) mentioned that even an international organization such as the United Nations Environmental Programme [UNEP], also place an importance on sports by using it as a cost-effective tool to accelerate the achievement of the Millennium Development Goals. Participation in sports can increase the quality of life of individuals and communities, endorse social inclusion, enhance health, abate anti-social behavior and boost individual self-esteem and confidence (Coalter, 2005).

In 2003, the United Nations Inter-Agency Task Force on Sport for Development and Peace underlined that the use of sport that can boost up public health, gender equality, education and environmental sustainability. Besides, sport also raises individual empowerment, combats discrimination and enhances cohesive and sustainable community development. It is a tool to help preventing HIV, AIDs and other diseases, peace-building and conflict resolution.

2.1.2 Advantages of sports on economy

In addition to the benefits for individual and society, sports can generate benefits to boost the economy. The New South Wales Government outlaid budget over US$380 million and the Commonwealth Government invested budget estimated US$72 million for the Sydney Olympic Games in 2000 (Australian Bureau of Statistics [ABS], 2002).

While the Super car event held in Canberra in 2001 received the government subsidy of A$5 million (Banks, 2002) and the Victorian Government subsidized the Melbourne Grand Prix motor race to the extent of A$19 million in 2003 (Dabkowski, 2012). In 2006, Oldenboom and Kleissner estimated the added value of sport in Austria which was between 0.46% and 3.65% of the Gross Domestic Product [GDP]. The sport sector has an enormous employment potential and could also be useful for regional development policies as it is labor-intensive.

Oldenboom and Kleissner (2006) also stated that the importance of sport events is an engine of regional development in political and promotional senses. They confirmed that the sport is a growing new service industry with a high potential for the future. The aging society, the raising purchasing power and the growing demand for organized leisure activities have made sport as a dynamic sector.

2.1.3 Advantages of sports on environment

Sports have potential benefits to the environment and its sustainability. Mulholland (2007) described that sport can promote environmental protection and provide a platform for society contributing to sustainability by means of creating sustainable sport facilities, raising environmental awareness and advocating a greater sustainability at all levels.

Conversely, sports would consider as a cause of adverse impacts on nature and environment. The scale and enormity of effect are subject to the kind of sport and the scale of the event. For examples, any sporting event can contribute noise, water, air pollution, soil deterioration, etc. (The International Olympic Committee [IOC], 2005).

2.2 Sustainable sport and management

The environmental impacts on sports were firstly recognized by the president of the International Olympic Committee (IOC) in 1986. He proposed the environment to be one of the third pillars of Olympism including sports and culture (Carmichael et al., 2009).

In 1992, it was the first time that the Olympic Games in Barcelona using a concept of “green design” to build the Olympic village (Gyarfas, 2012). Consistently, most of the world’s nations committed themselves to pursuit their economic development in ways that would protect the Earth’s environment and non-renewable

resources. The Agenda 21 was adopted as a global action plan at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro (UNCED, 1992).

2.2.1 Agenda 21

Due to current environmental problems and challenges, Agenda 21 is a comprehensive plan of action to minimize human impacts on the environment (UNCED, 1992).

Agenda 21 have addressed current problems and planned to prepare all countries for the forthcoming challenges. The program areas of Agenda 21 are described in terms of the basis for action, objectives, activities and means of implementation covering four sections as follow:

Section I: Social and economic dimensions. This section includes international collaboration to expedite sustainable development in developing countries, encountering poverty, altering consumption patterns, promoting sustainable human settlement development, demographic dynamics and sustainability, protecting and promoting human health conditions and integrating environment and development in decision-making.

Section II: Conservation and management of resources for development. This section includes protection of the atmosphere, planning and management of land resources, combating desertification and drought, combating deforestation, promoting sustainable agriculture and rural development, environmentally sound management of biotechnology, conservation of biological diversity, protection of the oceans and coastal areas, protection of the quality and supply of water resources, environmentally sound management of hazardous wastes, environmentally sound management of solid wastes and sewage-related issues and environmentally sound management of radioactive wastes.

Section III: Strengthening the role of major groups. This section includes global action for women towards sustainable and equitable development, children and youth in sustainable development, strengthening the role of indigenous people, their communities and non-governmental organizations, local authorities' initiatives in support of Agenda 21, strengthening the role of business and industry, scientific and technological community and strengthening the role of farmers.

Section IV: Means of implementation. This section includes financial resources and mechanisms, transfer of environmentally sound technology, cooperation and capacity-building, science for sustainable development, promoting education, public awareness and training.

Agenda 21 is also a programme which would be carried out by the various actors in full respect of all the principles contained in the Rio Declaration on Environment and Development. The programme areas are shown in Figure 2.1.

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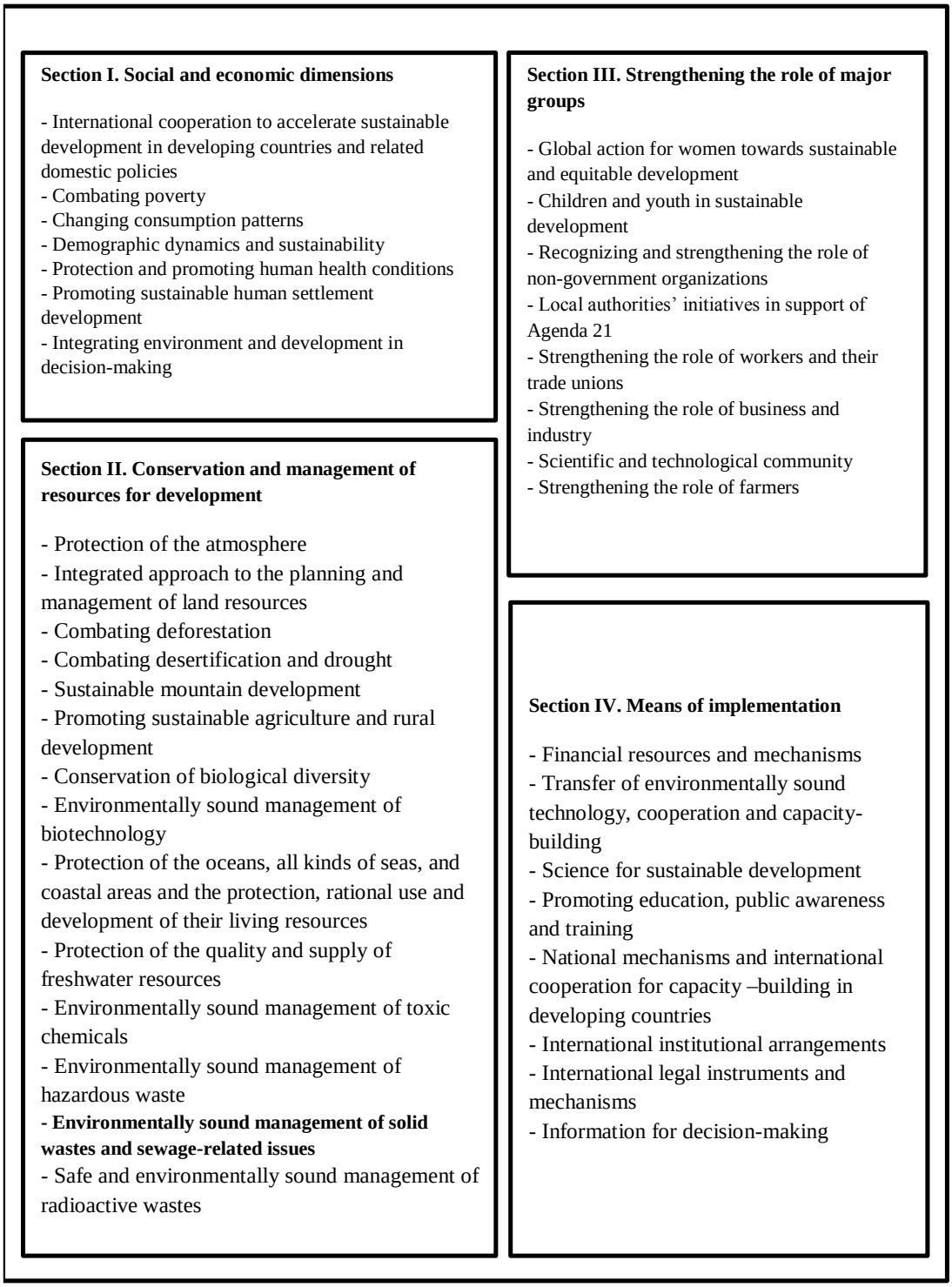

Figure 2.1 The content of Agenda 21.
Source: The United Nations Conference on Environment and Development (1992)

The importance of solid waste management stated in the section II Conservation and management of resources for development. It declared that "environmentally sound management of wastes are among the environmental issues of major concern in

maintaining the quality of the Earth's environment and especially in achieving environmentally sound and sustainable development in all countries".

2.2.2 Environmentally sound management of solid wastes and sewage-related issues

Solid wastes, as defined in chapter 21 of Agenda 21, comprise "all domestic refuse and non-hazardous wastes such as commercial and institutional wastes, street sweepings and construction debris" (UNCED, 1992). This chapter underlines that "environmentally sound waste management must go beyond the mere safe disposal or waste recovery and seek to address the root cause of the problem by attempting to change unsustainable patterns of production and consumption".

Consequently, the framework for necessary action should be established on objectives and emphasized on the 4 major programme areas related to waste as described as follows:

1) Minimizing wastes

Unsustainable patterns of production and consumption are growing the quantity and diversity of solid waste at excessive rates. The trend could considerably increase quantities 4-5 times by the year 2025 (UNCED, 1992). A preventive solid waste management approach that focused on shifts in production and consumption patterns proposes the best opportunity for reversing current trends.

The objectives in this area are:

- To stabilize or reduce the production of wastes for final disposal by setting goals based on waste weight, volume and composition and to encourage solid waste separation to facilitate waste recycling and reuse.

- To strengthen procedures for assessing waste quantity and composition changes to formulate solid waste minimization policies and utilizing economic or other instruments to induce changing of production and consumption patterns.

2) Maximizing environmentally sound waste reuse and recycling

The deficiency of stricter environmental controls and disposal sites of solid waste disposal and growing quantity of solid waste have all contributed to a rapid growth of waste disposal service cost. Some current disposal practices create an impact on the environment. Solid waste resource recovery and recycling are becoming gradually cost-effective (UNCED, 1992). Future solid waste management programmes should be resource-efficient approaches. Public education programmes are required to help and market for recycled material should be promoted.

The objectives in this area are:

To strengthen and increase national solid waste reuse and recycling systems.

To create a model solid waste reuse and recycling programme for waste streams, including paper, within the United Nations system;

To provide information, techniques and applicable policy instruments to encourage solid waste reuse and recycling schemes.

3) Promoting environmentally sound waste disposal and treatment

Although after treatment process, all wastes generate some impact on the environment. Thus, the improvement of waste treatment and disposal practices should be done. In developing countries, less than 10% of waste are treated and only a minor proportion of treatment is in compliance with quality standard (UNCED, 1992).

The objective is to encourage safely disposal and treatment. The governments should found criteria, standards and objectives of waste disposal and treatment quality based on the capacity of the environment.

4) Extending waste service coverage

According to the UNCED (1992), “over 2.0 billion people will be without access to basic sanitation, and an estimated half of the urban population in developing countries will be without adequate solid waste disposal services by the end of the century. As many as 5.2 million people, including 4 million children, die from waste-related diseases each year. The health and environmental impacts of inappropriate solid waste management result in water, land and air contamination over a wider area.

Extending and improving solid waste collection and safe disposal services are crucial in order to gaining control over the pollution".

The objective of the programme is to provide environmentally friendly waste disposal and collection services. The governments should develop technical, financial and human resource capacity that important to provide the services.

The activities and the means of implementation of four programme areas are shown in Table 2.1 and Table 2.7 respectively.

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Table 2.1 The Activities of the four programme areas on environmentally sound management of solid wastes of Agenda 21

Programme areas	Activities		
	Management-related activities	Data and information	International and regional cooperation and coordination
Minimizing wastes	- Develop and strengthen national capacities in research and design of environmentally sound technologies, as well as adopt measures to reduce wastes to a minimum - Provide for incentives to reduce unsustainable patterns of production and consumption - Develop, where necessary, national plans to minimize waste generation as part of overall national development plans - Emphasize waste minimization considerations in procurement within the United Nations system	- Develop and apply methodologies for country-level waste monitoring; - Undertake data gathering and analysis, establish national goals and monitor progress - Utilize data to assess environmental soundness of national waste policies - Input information into global information systems	- Identifying, developing and harmonizing methodologies for waste monitoring and transferring such methodologies to countries; - Identifying and further developing the activities of existing information networks on clean technologies and waste minimization - Undertaking periodic assessment, collating and analyzing country data and reporting systematically, in an appropriate United Nations forum - Reviewing the effectiveness of all waste minimization instruments and identifying potential new instruments that could be. Guidelines and codes of practice should be developed - Undertaking research on the social and economic impacts of waste minimization at the consumer level

Source: The United Nations Conference on Environment and Development [UNCED], 1992

Table 2. 2 The activities of the four programme areas on environmentally sound management of solid wastes of Agenda 21 (Continue)

Programme areas	Activities		
	Management-related activities	Data and information	International and regional cooperation and coordination
Maximizing environmentally sound waste reuse and recycling	- Develop and strengthen national capacity to reuse and recycle an increasing proportion of wastes; - Review and reform national waste policies to provide incentives for waste reuse and recycling; - Develop and implement national plans for waste management that take advantage of, and give priority to, waste reuse and recycling; - Modify existing standards or purchase specifications to avoid discrimination against recycled materials, taking into account the saving in energy and raw materials - Develop public education and awareness programmes to promote the use of recycled products.	- Undertaking an extensive review of options and techniques for reuse and recycling all forms of municipal solid wastes. Policies for reuse and recycling should be made an integral component of national and local waste management programmes; - Assessing the extent and practice of waste reuse and recycling operations currently undertaken and identifying ways by which these could be increased and supported - Increasing funding for research pilot programmes to test various options for reuse and recycling - Producing guidelines and best practices for waste reuse and recycling - Intensifying efforts, at collecting, analyzing and disseminating, to key target groups, relevant information on waste issues - Identifying potential markets for recycled products.	- Undertake a periodic review of the extent to which countries reuse and recycle their wastes - Review the effectiveness of techniques for and approaches to waste reuse and recycling and ways of enhancing their application in countries - Review and update international guidelines for the safe reuse of wastes - Establish appropriate programmes to support small communities' waste reuse and recycling industries in developing countries

Source: The United Nations Conference on Environment and Development [UNCED], 1992

Table 2. 3 The activities of the four programme areas on environmentally sound management of solid wastes of Agenda 21 (Continue)

Programme areas	Activities		
	Management-related activities	Data and information	International and regional cooperation and coordination
Promoting environmentally sound waste disposal and treatment	- Develop and strengthen national capacity to treat and safely dispose of wastes; - Review and reform national waste management policies to gain control over waste related pollution - Encourage countries to seek waste disposal solutions within their sovereign territory and as close as possible to the sources of origin that are compatible with environmentally sound and efficient management - Develop human wastes management plans, giving due attention to the development and application of appropriate technologies and the availability of resources for implementation	- Assembling and analyzing the scientific evidence and pollution impacts of wastes in the environment in order to formulate and disseminate recommended scientific criteria and guidelines for the environmentally sound management of solid wastes - Recommending national and, where relevant, local environmental quality standards based on scientific criteria and guidelines - Including within technical cooperation programmes and agreements the provision for monitoring equipment and for the requisite training in its use; - Establishing an information clearing-house with extensive networks at the regional, national and local levels to collect and disseminate information on all aspects of waste management, including safe disposal.	- Identify, develop and harmonize methodologies and environmental quality and health guidelines for safe waste discharge and disposal; - Review and keep abreast of developments and disseminate information on the effectiveness of techniques and approaches to safe waste disposal and ways of supporting their application in countries

Source: The United Nations Conference on Environment and Development [UNCED], 1992

Table 2. 4 The activities of the four programme areas on environmentally sound management of solid wastes of Agenda 21 (Continue)

Programme areas	Activities		
	Management-related activities	Data and information	International and regional cooperation and coordination
Extending waste service coverage	- Establish financing mechanisms for waste management service development in deprived areas, including appropriate modes of revenue generation; - Apply the "polluter pays" principle, where appropriate, by setting waste management charges at rates that reflect the costs of providing the service and ensure that those who generate the wastes pay the full cost of disposal in an environmentally safe way; - Encourage institutionalization of communities' participation in planning and implementation procedures for solid waste management.	- Developing and applying methodologies for waste monitoring; - Data gathering and analysis to establish goals and monitor progress; - Inputting information into a global information system building upon existing systems; - Strengthening the activities of existing information networks in order to disseminate focused information on the application of innovative and low-cost alternatives for waste disposal to targeted audiences.	- Launch a settlement infrastructure and environment programme following the United Nations Conference on Environment and Development to coordinate the activities of all organizations of the United Nations system involved in this area and include a clearinghouse for information dissemination on all waste management issues; - Undertake and systematically report on progress in providing waste services to those without such services; - Review the effectiveness of techniques for and approaches

Source: The United Nations Conference on Environment and Development [UNCED], 1992

Table 2. 5 The means of implementation of the four programme areas on environmentally sound management of solid wastes of Agenda 21

Programme areas	Means of implementation			
	Financing and cost evaluation	Scientific and technological means	Human resource development	Capacity-building
Maximize environmentally sound waste reuse and recycling	The conference secretariat has estimated that if the equivalent of 1 per cent of waste-related municipal expenditures was devoted to safe waste reuse schemes, worldwide expenditures for this purpose would amount to $8 billion. The secretariat estimates the total annual cost (1993-2000) of implementing the activities of this programme area in developing countries to be about $850 million on grant or concessional terms.	- The transfer of recycling technologies within bilateral and multilateral technical cooperation and aid programmes. - Developing and improving existing technologies. - Facilitating the transfer of waste reuse and recycling technology. - Offering incentives to local and municipal authorities that recycle the maximum proportion of their wastes. - Providing technical assistance to informal waste reuse and recycling operations. - Applying economic and regulatory instruments to support the principle that generators of wastes pay for their disposal. - Providing legal and economic conditions conducive to investments in waste reuse and recycling. - Implementing specific mechanisms such as deposit/refund systems as incentives for reuse and recycling. - Promoting the separate collection of recyclable parts of household wastes. - Providing incentives to improve the marketability of technically recyclable waste. - Encouraging the use of recyclable materials, particularly in packaging, where feasible. - Encouraging the development of markets for recycled goods by establishing programmes.	Governments should: -Including waste reuse and recycling in in-service training programmes as integral components of technical cooperation programmes on urban management and Infrastructure development. -Expanding training programmes on water supply and sanitation to incorporate techniques and policies for waste reuse and recycling. -Including the advantages and civic obligations associated with waste reuse and recycling in school curricula and relevant general educational courses. -Encouraging non-governmental organizations, community-based organizations and women's, youth and public interest group programmes, in collaboration with local municipal authorities, to mobilize community support for waste reuse and recycling through focused community-level campaigns.	-Making operational national policies and incentives for waste management. -Enabling local and municipal authorities to mobilize community support for waste reuse and recycling by involving and assisting informal sector waste reuse and recycling operations and undertaking waste management planning that incorporates resource recovery practices

Source: The United Nations Conference on Environment and Development [UNCED], 1992

Table 2. 6 The means of implementation of the four programme areas on environmentally sound management of solid wastes of Agenda 21(Continue)

Programme areas	Means of implementation			
	Financing and cost evaluation	Scientific and technological means	Human resource development	Capacity-building
Promoting environmentally sound waste disposal and treatment	In developed countries the focus is on improving facilities to meet higher environmental quality criteria, while in developing countries considerable investment is required to build new treatment facilities. The Conference secretariat has estimated the average total annual cost (1993-2000) of implementing the activities of this programme in developing countries to be about $15 billion, including about $3.4 billion from the international community on grant or concessional terms.	-Prepare guidelines and technical reports on subjects such as the integration of land-use planning in human settlements with waste disposal, environmental quality criteria and standards, waste treatment and safe disposal options, industrial waste treatment and landfill operations. -Undertake research on critical subjects such as low-cost, low-maintenance waste-water treatment systems; safe sludge disposal options; industrial waste treatment; and low technology, ecologically safe waste disposal options. Transfer technologies, in conformity with the terms as well as the provisions of chapter 34 (Transfer of environmentally sound technology, cooperation and capacity-building), on industrial waste treatment processes through bilateral and multilateral technical cooperation programmes and in cooperation with business and industry, including large and transnational corporations, as appropriate. -Focus on the rehabilitation, operation and maintenance of existing facilities and technical assistance on improved maintenance practices and techniques followed by the planning and construction of waste treatment facilities -Establish programmes to maximize the source segregation and safe disposal of the hazardous components of municipal solid waste. -Ensure the investment and provision of waste collection facilities with the concomitant provision of water services and with an equal and parallel investment and provision of waste treatment facilities.	-Providing both formal and in-service training, focused on pollution control, waste treatment and disposal technologies, and operating and maintaining waste-related infrastructure. Intercountry staff exchange programmes should also be established. -Undertaking the requisite training for waste-related pollution monitoring and control enforcement.	-Creating and strengthening independent environmental control bodies at the national and local levels. International organizations and donors should support needed upgrading of manpower skills and provision of equipment. -Empowering of pollution control agencies with the requisite legal mandate and financial capacities to carry out their duties effectively.

Source: The United Nations Conference on Environment and Development [UNCED], 1992

Table 2. 7 The means of implementation of the four programme areas on environmentally sound management of solid wastes of Agenda 21(Continue)

Programme areas	Means of implementation			
	Financing and cost evaluation	Scientific and technological means	Human resource development	Capacity-building
Extending waste service coverage	The Conference secretariat has estimated the average total annual cost (1993-2000) of implementing the activities of this programme to be about $7.5 billion, including about $2.6 billion from the international community on grant or concessional terms. Actual costs and financial terms, including any that are non-concessional, will depend upon, inter alia, the specific strategies and programmes Governments decide upon for implementation.	Governments and institutions should launch programmes to extend waste services to the unserved populations. These programmes should build upon and reorient existing or planned activities. Policy changes at the national and local levels could enhance the rate of waste service coverage extension. These changes should include the following: -Giving full recognition to and using the full range of low-cost options for waste management, including, where appropriate, their institutionalization and incorporation within codes of practice and regulation. -Assigning high priority to the extension of waste management services, as necessary and appropriate, to all settlements irrespective of their legal status, giving due emphasis to meeting the waste disposal needs of the unserved, especially the unserved urban poor. -Integrating the provision and maintenance of waste management services with other basic services such as water-supply and storm-water drainage. Research activities could be enhanced. -Find solutions and equipment for managing wastes in areas of concentrated populations and on small islands. In particular, there is a need for appropriate refuse storage and collection systems and cost-effective and hygienic human waste disposal options. -Prepare and disseminate guidelines, case-studies, policy reviews and technical reports on appropriate solutions and modes of service delivery to unserved low-income areas. -Launch campaigns to encourage active community participation involving women's and youth groups in the management of waste, particularly household waste. -Promote intercountry transfer of relevant technologies, especially technologies for high density settlements.	-International organizations and national and local Governments, in collaboration with nongovernmental organizations, should provide focused training on low-cost waste collection and disposal options, particularly techniques for their planning and delivery. Intercountry staff exchange programmes among developing countries could form part of such training. Particular attention should be given to upgrading the status and skills of management -level personnel in waste management agencies. -Improvements in management techniques are likely to yield the greatest returns in terms of improving waste management service efficiency. The United Nations, international organizations and financial institutions should, in collaboration with national and local Governments, develop and render operational management information systems for municipal record keeping and accounting and for efficiency and effectiveness assessment.	-Establishing a special unit within current institutional arrangements to plan and deliver services to the unserved poor communities, with their involvement and participation. -Making revisions to existing codes and regulations to permit the use of the full range of low-cost alternative technologies for waste disposal. -Building institutional capacity and developing procedures for undertaking service planning and delivery.

Source: The United Nations Conference on Environment and Development [UNCED], 1992

2.2.3 The Olympic Movement's Agenda 21

After the adoption of Agenda 21 under the United Nations Conference on Environment and Development [UNCED] in 1992, the International Olympic Committee [IOC] called for the Olympic Charter of a provision underlining the necessity of preserving the environment at the Centennial Olympic Congress held in Paris in 1994 (IOC, 2009). Consequently, the IOC established a sport and environment commission for promoting environmental sustainability and the Olympic Charter was amended in 1996.

The Olympic Movement's Agenda 21 was adopted by the IOC at its session and consequently endorsed by the members of the Olympic Movement at the Third World Conference on Sport and the Environment held in Rio de Janeiro in October 1999. A joint UNEP/IOC working group has been set up to implement this Agenda. The Olympic Movement's Agenda 21 aims to support members' role on sustainable development. It is a guide for members of the Olympic Movement and for sportsmen and sportswomen (IOC, 2009).

Regarding the International Olympic Committee (1999), the Olympic Movement's Agenda 21 consists of a programme of action that leads to better socio-economic conditions, preservation of the environment and natural resources, and a more significant role for its members in sustainable development in order to fulfill the general objectives of Agenda 21. This programme of action was generated in order to fulfill the following three objectives:

1) Improving socio-economic condition

This objective aim to reinforce projects for sustainable development, to decrease social exclusion, to encourage new consumer habits, to play an active role in supporting health protection, to promote sports infrastructure that adapted to social needs, and further to integrate concepts of development and environment into sports policies.

2) Conservation and management of resources

This Olympic Movements' Agenda 21 has placed the environmental defense policy in the wider context of sustainable development. The activities of the Olympic Movement are now geared to the conservation and natural resources management. In

general, all the actions undertaken by the Olympic Movement must respect to the environment and sustainable development, support education on environmental issue and initiate specific activities to encourage environmental preservation.

In the construction of facilities or the planning of large-scale sports events, those responsible have to ensure that a prior environmental impact study is carried out. The conservation areas, countryside, the cultural heritage and natural resources must be protected. The best use of sports facilities and reducing their environmental impact must be encouraged. The using of environmental-friendly sports equipment and the use of public transport must be supported. The use of new equipment, technologies, practices and facilities that encourage renewable energy using must be encouraged. The water conservation and processing the waste water must be supported and the importance of preserving the quality of the biosphere should be aware. The waste must be minimized by maximizing recycling of the products used, processing the waste that cannot be recycled, avoid using hazardous or toxic products, minimizing the quantity of wastes and minimizing all form of pollution.

3) Strengthening the role of major groups

In order to pursue this objective, the Olympic Movements' Agenda 21 would strengthen the role of two groups: women and youths. Furthermore, the Olympic Movement should pay attention to the indigenous communities who suffer from social exclusion.

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The three main objectives of the Olympic Movement's Agenda 21 are shown in Figure 2.2.

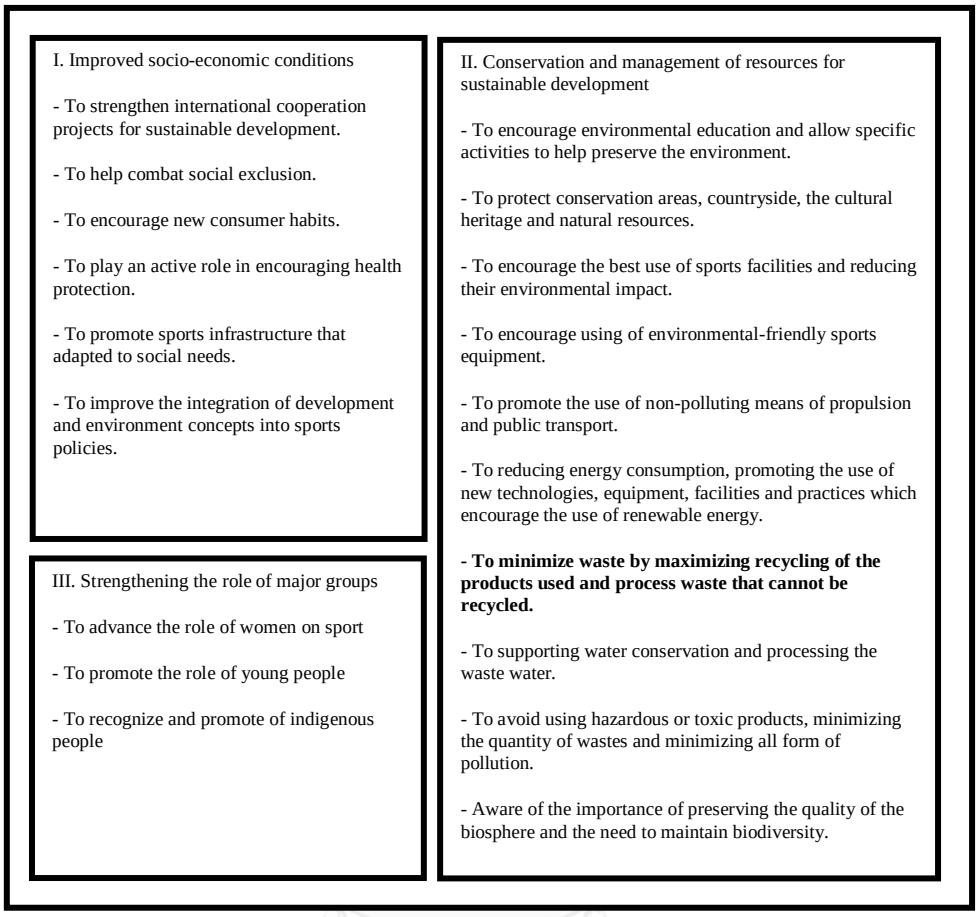

Figure 2.2 The Olympic Movement's Agenda 21.
Source: International Olympic Committee [IOC], (1999)

The Olympic movements' Agenda 21 has implemented in the Olympic Games. Meanwhile, the concept of sustainable sport was formulated. One of the most accepted definition of sustainable sport was developed based on the definition of sustainable development of Brundtland Commission in 1987 which described that sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (The United Nations [UN], 1987). Chernushenko et al. (2001) defined that sustainable sport is sport that meets the needs for today's sports community while contributing to the improvement of future sports opportunities for all and the integrity of the natural environment on which it depends.

Mackenzie (2006) stated that the Olympic host countries attempted to endorse the concept of sustainable sport in their games both conceptual and practical levels. The

range of environmental commitments in the Olympic Games in Athens 2004 was emphasized. The green legacy for the Olympic Games was created in Turin 2006 and the bar for green ambitions was raised in Beijing 2008 (Carmichael et al., 2009). The concept of "One Planet Olympics" which was developed by London mayoralty together with the World Wide Fund for Nature [WWF] and Bioregional, an award-winning sustainability charity, were promoted in London Games 2012.

Besides the movement of the IOC, more implementations at large of sporting events are put into practice also by major sport organizations such as the Federation International de Football Association [FIFA]. A greater environmental protection in sport was initiated. Schmied et al., (2007) reported that in the FIFA World Cup 2006, solid waste was generated almost 20% less, the majority of stadium visitors travelled by public transport and quantities of waste in stadiums were reduced. Stahl and Hochfeld (2003) stated that the FIFA tried to create climate neutrality and carbon offset of expected 100,000 tons of greenhouse gas emission by investment in renewable energy and energy-efficient technology. The FIFA also concerned about water usage, solid waste recycling, energy efficiency and traffic mitigation.

The implementation of the sustainable sport concept derived from the Olympic Movements' Agenda 21 has been handled to several nongovernmental organizations [NGOs], businesses, and environmental groups. Schmidt (2006) explained that the United Nations Environment Programme [UNEP] is an influential player in this area. In 1994, the UNEP set up a Sports and Environment Programme to boost environmental awareness through sports. In 1995, the first World Conference on Sport and the Environment held in Lausanne, Switzerland and hosted by the cooperation between the UNEP and the IOC. While, the 9th World Conference on Sport and the Environment held in Doha, Qatar, the sports world committed to the Doha Declaration that emphasized on the social, environmental and economic aspects of sustainable development in sport sustainability concept (IOC, 2011b). In addition, the UNEP has organized the Global Forum for Sport and Environment [G-ForSE] in 2001 that allow stakeholders in sport world to examine their contributions to sustainable development.

2.3 Impact of sport activities on the environment

The practice of sport includes activities at different level (IOC, 2005). It ranges from persons who occasionally engage in sports activities and physical education to elite athletes, from small club to international federations, from local competitions to championships and large scale events such as the Olympic Games. The practice of sport implies, to a varying degree, a structured organization, sports facilities and equipment, logistics and sponsors, media, and athletes.

Sports can generate several impacts on the environment ranging from minor to major impacts. The scale of impact depends on a kind of sport and a size of the sporting event. The International Olympic Committee [IOC] (2005) stated that the activities and needs created by sport events are mainly from people and material. In this context, people include sport organizers, media, sponsors, athletes and spectators. While, material covers sport equipment, infrastructures and sport facilities. People could generate impacts on the environment through the activities of sanitation, catering, providing accommodation, transportation, energy consumption, merchandising and waste generation. Similarly, building, construction and maintain the sport equipment, infrastructures and sport facilities also generate impacts on the environment.

The manual on sport and the environment issued by the International Olympic Committee [IOC] (2005) summarized the impacts of sports on environment as shown in Figure 2.3.

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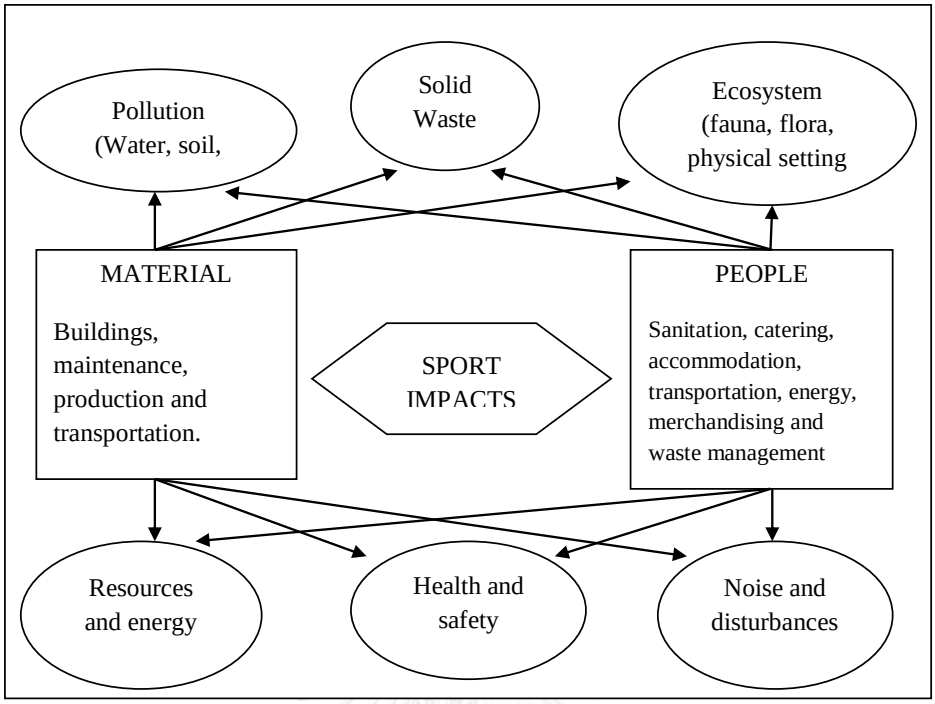

Figure 2.3 Potential impacts of sport events on the environment.
Source: International Olympic Committee, 2005

The impacts can be divided into short-term, long-term, direct and indirect impacts. The short-term impacts occur during the event such as noise, air pollution or solid waste. The long-term impacts exist after the end of an event such as soil deterioration and long-term pollution. The direct impacts are caused by facilities and people directly involved in the event and the indirect impacts are due to new infrastructures built for the event but not directly related to the sports activity such as new roads, and new sport village.

However, one of the most obvious impacts comes from inappropriate solid waste management which would cause a huge amount of waste to landfill. Schmied et al. (2007) reported that a total of approximately 3,000 tons of waste were generated during the 154 large sporting events in Germany in 2005. Each event had to discard nearly 19 tons of waste or 6 tons a day. A waste generation rate per capita was around 200 grams. Likewise, the World Cup 2006 produced 5-10 tons of trash (Schmidt, 2006). Both the public area such as stadium, roads and merchandising area and non-public area such as kitchens, kiosks and media facilities area were littered with rubbish. Such events are considered a magnet for millions of spectators. In a large sporting event, more than 10,000 spectators per day are frequently reported. Subsequently, larger effects on

environment are likely to be occurred. Meanwhile, there are other factors that determine the impacts such as the scale and duration of the sporting event, the infrastructure and the venue (Schmied et al., 2007). Therefore, without appropriate solid waste management, the larger sporting events and bigger number of spectators would generate more solid waste and impacts.

2.4 Solid waste management

2.4.1 Waste generation and management

Most of materials produced by human activities often turn to be waste. Waste is always generated along the entire supply chain of production to the consumption of goods. Though much of the material can be reused or recycled under appropriate management (Tchobanoglous, 2002), the rapid economic and population growth results in accelerating solid waste generation (Seo, 2006). Thus waste management becomes a major obstacle to the sustainable development of human and environment. As the result, our society is trying to adopt improved methods of waste management and ways to reduce waste that cannot be regenerated.

Franklin (2002) defined that the basic process of solid waste management include technologies related to the control of solid waste generation, storage, handling, collection, transportation, transfer, treatment and disposal. However, all the processes are needed to execute under the existing laws and social guidelines that protect the environment and public health. Thus, the elements of a solid waste management system can be described in Table 2.8.

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Table 2.8 Functional elements of a solid waste management system

Functional element	Description
Waste generation	Waste generation encompasses those activities in which materials are identified as no longer being of value and are either thrown away or gathered together for disposal. Waste generation is, at present, an activity that is not very controllable.
Separation	Waste handling and separation involve the activities associated with managing storage, and processing at the source wastes until they are placed in storage containers for collection. Separation of waste components is an important step in the handling and storage of solid waste at the source.
Collection	Collection includes both the gathering of solid wastes and recyclable materials and the transport of these materials, after collection, to the location where the collection vehicle is emptied, such as a materials-processing facility, a transfer station, or a landfill.
Transfer	The functional element of transfer and transport involves two steps: (1) the transfer of wastes from the smaller collection vehicle to the larger transport equipment, and (2) the subsequent transport of the wastes, usually over long distances, to a processing or disposal site.
Processing	Separation, processing, and transformation of solid waste: The means and facilities that are now used for the recovery of waste materials that have been separated at the source include curbside collection and dropoff and buyback centers. The separation and processing of wastes that have been separated at the source and the separation of commingled wastes usually occurs at materials recovery facilities, transfer stations, combustion facilities, and disposal sites. Transformation processes are used to reduce the volume and weight of waste requiring disposal and to recover conversion products and energy.
Disposal	Disposal by landfilling or land spreading is the ultimate fate of all solid wastes, whether they are residential wastes collected and transported directly to a landfill site, residual materials from material recovery facilities, residue from the combustion of solid waste, compost, or other substances from various solid waste processing facilities.

Source: Franklin, 2002

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Nevertheless, waste management planning needs reliable data regarding waste generation, influencing factors on waste generation and forecasts of waste quantities and characteristic based on facts (Mazzanti and Zoboli, 2008). Thus, these influencing factors require to be studied in details.

2.4.2 Characteristic and categories of solid waste

Waste is likely an unavoidable by-product of human activity. In spite of waste collection and disposal are crucial steps, waste minimization or recycling and reuse are the key elements in the improvement of waste management strategies. According to the

United Nation Economic and Social Commission for Asia and the Pacific [UNESCAP] (2000), types of wastes can be categorized into various types as listed in Table 2.9.

Table 2.9 Types of wastes

Types	**Examples**
Industrial Solid Waste	A wide range of materials of varying environmental toxicity such as paper, packaging materials, waste from food processing, oils, solvents, resins, paints and sludges, glass, ceramics, stones, metals, plastics, rubber, leather, wood, cloth, straw, abrasives, etc.
Agricultural Waste	Livestock waste, agricultural crop residues and agro-industrial by-products and etc.
Hazardous Waste	The by-product of a broad spectrum of industrial, agricultural and manufacturing processes, nuclear establishments, hospitals and health-care facilities.
Municipal Solid Waste	Major components are food waste, paper, plastic, rags, metal and glass, collected waste, electric light bulbs, batteries, automotive parts, discarded medicines and chemicals, etc.

Source: UNESCAP, 2000

The definition of municipal solid waste (MSW), that defined by the United states Environmental Protection Agency (USEPA) is that MSW includes wastes from residential, commercial, institutional, and some industrial sources (Franklin, 2002) as listed in Table 2.10.

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Table 2.10 Sources of municipal solid waste

Source	**Examples**
Residential	Single-family homes, duplexes, town houses, apartments
Commercial	Office buildings, shopping malls, warehouses, hotels, airports, restaurant
Institutional	Schools, medical facilities, prisons
Industrial	Packaging of components, office wastes, lunchroom and restroom wastes

Source: Franklin, 2002

In general, waste from sporting events has not categorized as a major category of solid waste yet. According to UNESCAP (2000), waste generated from sporting events mostly are food waste, paper, plastic and glass, would be similar to municipal solid waste. The wastes from these sources are categorized into durable goods, nondurable goods, containers and packaging, and other wastes. However, in the process

of general waste separation, the most recovery factors for source-separated recycled materials at the point of collection normally are mixed paper, cardboard, polyethylene terephthalate [PET], mixed plastics, glass, tin cans and aluminum cans (Tchobanoglous, 1993).

2.4.3 Development of solid waste management models

Solid waste management has been developed for several decades. Tanskanen (2000) indicated that the initial solid waste management models were optimization models. In the 1980s when computing technology was developed, the models were developed to be more sophisticated and mostly aim at minimizing the cost of waste management (Gottinger, 1988). Nevertheless, the concept of sustainable waste management has not been applied in any model yet up to the 1990s.

During the 1990s, a concept of recycle has been put more in most of the planning of municipal solid waste management [MSWM] (Morris, 1991). The environmental and economic issues have been considered for the development of MSWM more than ever. Afterwards, due to the aim of making an inclusive environmental impact assessment, a concept of life cycle assessment has been taken into account (Harrison et al., 2001; McDougall, et al., 2001). However, main objectives of the models are still based on environmental and economic considerations, while social considerations have been ignored.

McDougall and Nilsson-Djerf (2000) made a point that waste management would be sustainable if it was economically affordable, environmentally effective, and social acceptable. In addition, Petts (2000) asserted “that the most effective management of MSW has to relate to local environmental, economic and social priorities”. Thus, Morrissey and Browne (2004) concluded that “none of the models can be considered to be fully sustainable”. Meanwhile, Agenda 21 acknowledges that “environmentally sound waste management must go beyond the mere safe disposal or recovery of wastes that are generated and seek to address the root cause of the problem by attempting to change unsustainable patterns of production and consumption”. It would assume that the most likely sustainable solid waste management model is life cycle assessment model included with Agenda 21 proposes four waste-related programmes which aim at maximizing environmentally sound waste reuse and recycle,

minimizing wastes, extending waste service coverage and promoting environmentally sound waste disposal and treatment (UNESCAP, 2000).

2.4.4 Solid waste management models

The first solid waste management models were optimization models and dealt with specific problems such as vehicle routing or transfer station siting (Morrissey and Browne, 2004). The early models were affected from many limitations and recycling was not taken into account. The deficiencies lead to the unsuitable long-term planning (Sudhir et al., 1996). The development of technology in the late 1980s provided an chance to advance more complex waste management models. The models developed in the 1980s were mostly mixed waste management that can minimize the cost and some models emphasized on recycling (Gottinger, 1988). During the 1990s, recycling was taken into account for most of the models (Chang and Wei, 1999).

Current models also mirror a modification of waste management policy where waste planning has to shift from a reliance on landfill to other waste management that based on integrated solid waste management [ISWM] principle (Clift et al., 2000). Rogers (2001) reviewed that most of current waste management models can be categorized into one of three categories which one based on cost-benefit analysis, another one based on life cycle assessment and the last one based on the use of a multi-criteria technique.

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1) Cost-benefit analysis model

Rogers (2001) and Mutavchi (2012) describes that cost-benefit analysis models allow decision-maker to evaluate both positive and negative effects of waste management into a common measurement, usually monetary. The scenario with the greatest benefit and least cost is the preferred scenario. The results are presented and all impacts summed up into monetary term. It allows decision makers to see which managements are the most cost effective. Nevertheless, there is uncertainty in calculating social and environmental impacts into monetary terms. The procedures of the environmental-economic efficiency evaluation of a solid waste management scheme are shown in Figure 2.4.

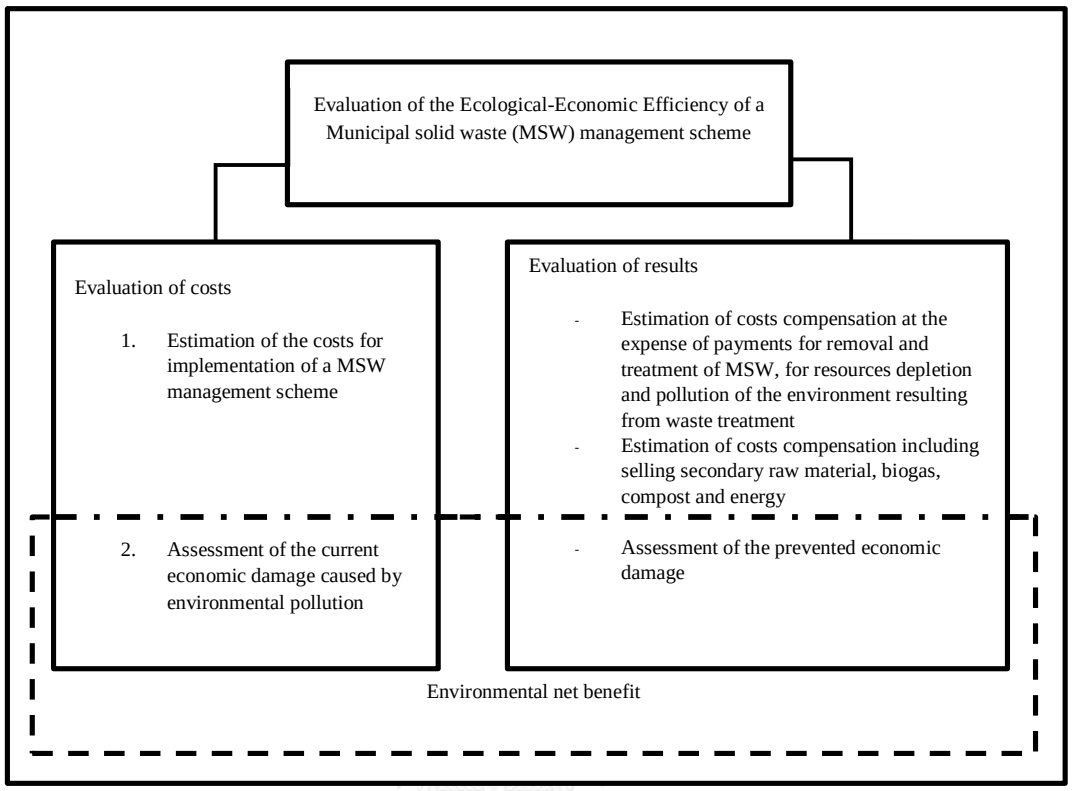

Figure 2.4 Procedures of the environmental-economic efficiency evaluation of a solid waste management scheme.
Source: Mutavchi, 2012

2) Life cycle assessment model

Life cycle assessment [LCA] is an analytical mechanism that identifies the environmental impacts all over product's life from raw material through resources procurement, production, transportation, utilization, waste disposal and waste recycling. The assessment has done by collecting an inventory of associated inputs and outputs of a system, appraising the impacts and interpreting the results (Finnveden, 1999). In the definition of LCA, the term "product" includes not only product systems but also service systems, for instance, waste management system (Clift et al., 2000). The LCA scheme is officially stipulated by the International Organization for Standardization [ISO], and the calculation method of LCA is prescribed by ISO 14040 and ISO 14044. The life cycle assessment model based on International Standard 14040 is shown in Figure 2.5.

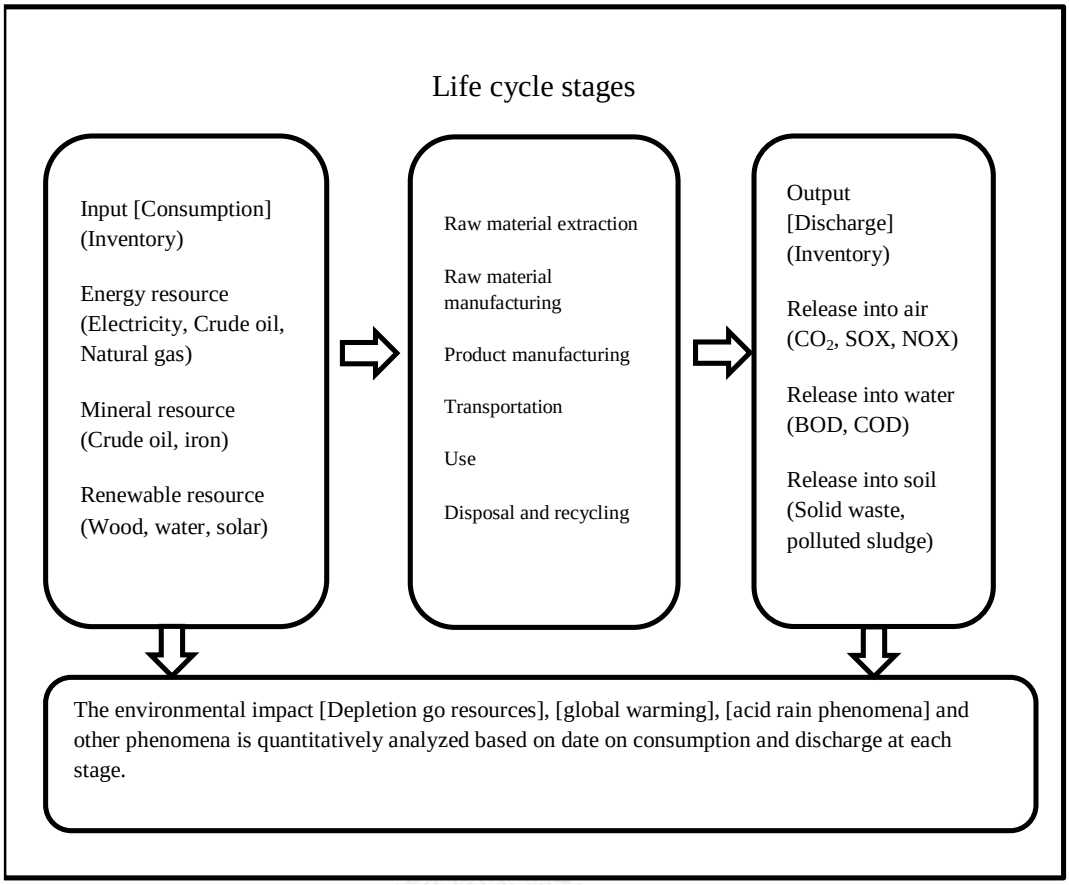

Figure 2.5 Life cycle assessment model based on ISO 14040
Source: The International Organization for Standardization, 2006a

Clift et al. (2000) explained that during the first phase, the alternatives of delivering will be studied and compared. In the second phase, the materials and emission will be identified and quantified. Then, inputs shall be traced back to primary materials. Moreover, in the processing operations, transportation is also studied. This is an important part of the economic cost and environmental impacts. In principle, manufacture and disposal of plant and equipment are also part of the life cycle. In the third phase, it aims at studying and evaluating the potential environmental impacts of a product system.

The part of public sector, decision-making will be outlined later. In the last phase, the results of both the inventory analysis and the impact evaluation are associated with the defined goal. The findings are used to reduce environmental impacts or put in decision process of policy making for integrated waste management.

3) Multi-criteria decision analysis model

Bana E Costa et al. (1997) found that over the past two decades, a multi-criteria decision analysis [MCDA] was developed into a discipline. A mutual characteristic of all MCDA approaches is many criterion are taken into account.

It leads to powerful decision making rather than optimizing a single criteria or dimension. This method allows decision makers to understand the problems and options from several perspectives. The criteria selected in these models indicated by the objectives of the model and could include environmental impact or risk assessment in the model.

The MCDA goes beyond the assessment of purely economic consequences. It allows other criterion to be assessed on an equal basis. The preferences of different group of stakeholder can take into account.

This method does not provide the best solution, but a set of preferred solutions. Thus, the decision-maker should have personal judgment and experience in making the decisions. The allocation of weights to each criterion is subjective and could lead to a different result.

Knoeri et al. (2011) stated that “analyzing the relevance of weighted criteria to agents’ decision-making is the field of multi criteria decision analysis [MCDA]. They found it allowed to structure complex decision-making process and to measure ratio scales on all hierarchical levels”. The phases of the analytical hierarchy process as a multi-criteria decision analysis approach is shown in Figure 2.6.

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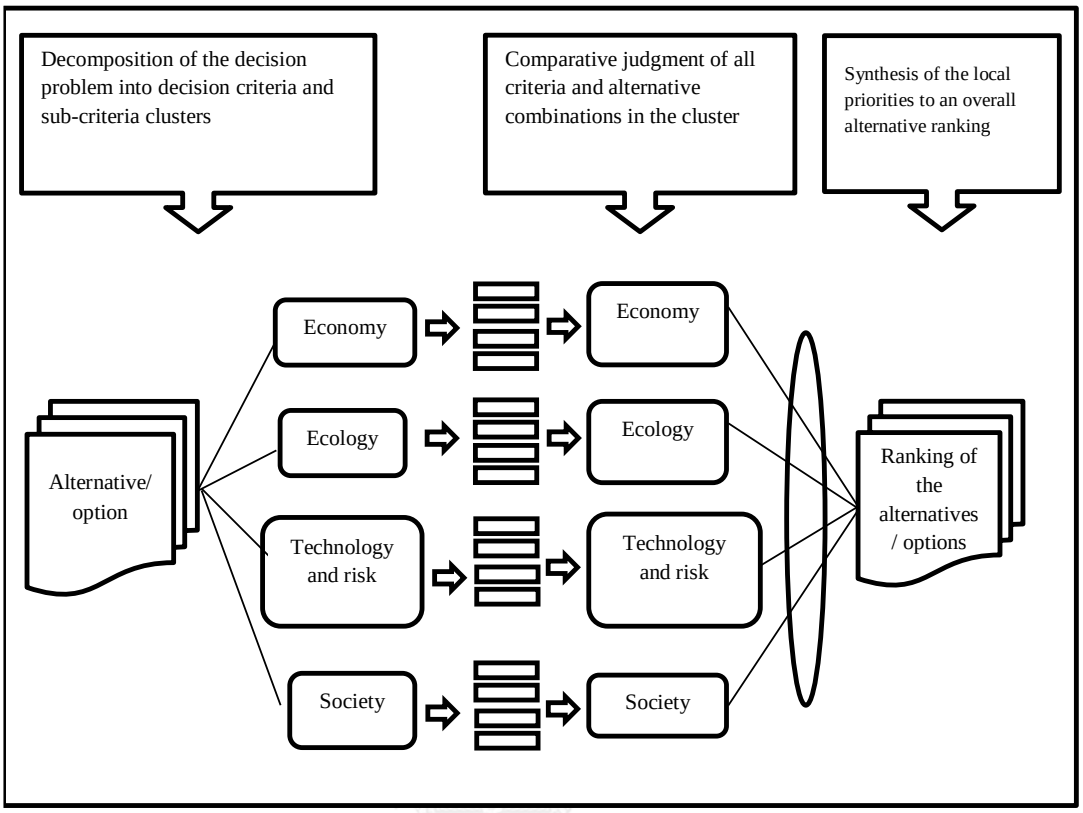

Figure 2.6 Phases of the analytical hierarchy process as a multi-criteria decision analysis approach.
Source: Knoeri et al., 2011

2.5 Sustainable solid waste management

Morrissey and Browne (2004) indicated that "for a solid waste management system to be sustainable, it needs to be environmentally effective, economically affordable and socially acceptable". McDougall and Nilsson-Djerf (2000) stated that "for a waste management system to be effective, it must be accepted by the population". In addition, Petts (2000) asserted that "the most effective management of municipal solid waste has to relate to local environmental, economic and social priorities". While, Agenda 21 chapter 21.4 (1992) stated that "environmentally sound waste management need to surpass the safe disposal or recovery of wastes that intend to address the cause of the problem by changing unsustainable patterns of production and consumption."

2.5.1 Concept of 3Rs

The waste hierarchy or the 3Rs referring to reduce, reuse and recycle is deemed the method of waste management to achieve the goal of minimization of waste

(USEPA, 2009). The 3Rs promote the sustainable consumption in the way of reducing materials and resource consumption. The 3Rs model applied in waste hierarchy is shown in Figure 2.7.

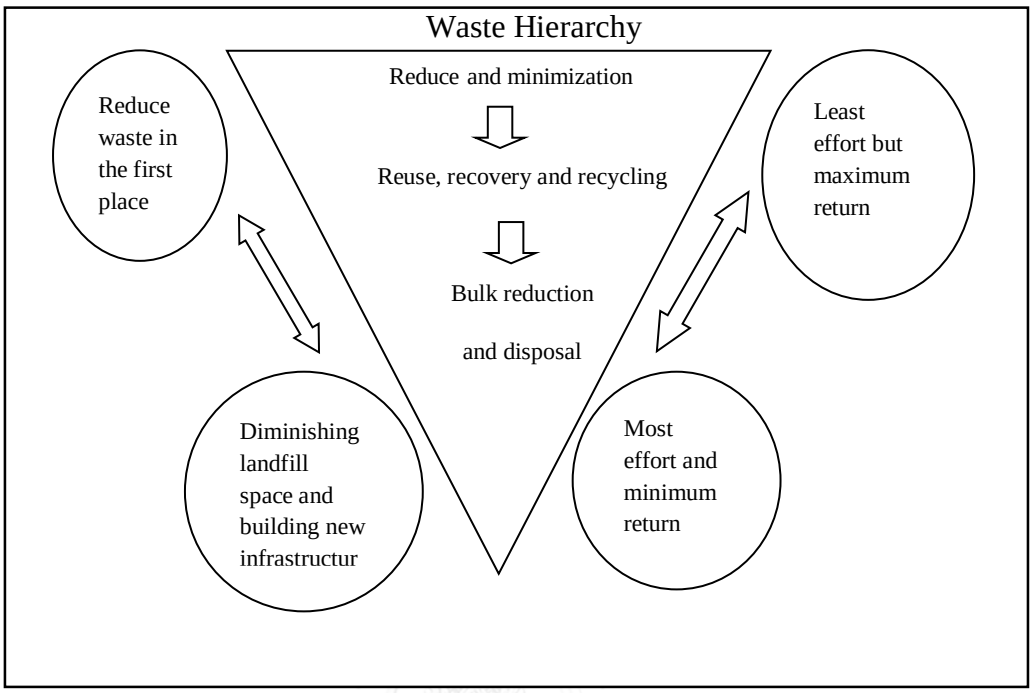

Figure 2.7 3Rs model applied in Waste Hierarchy.

Source: The Environment Protection Department [EPD], 2005

Reduce is to consume less to save the materials and resources in production. The US Environmental Protection Agency [USEPA], (2013) described that the most effective way to reduce waste is to means to conserve natural resources and environment. For instance, low-flow toilets that use very less water to flow the tube. It can considerably save a large amount of water and generate less waste water.

Reuse is the second priority on the solid waste management hierarchy and involves using item again in another way when their primary use is completed. The US Environmental Protection Agency [USEPA] (2013), described that reuse is the most effective ways to save natural resources, protect the environment and money. For example, an empty plastic bottle can be reused to contain water again to decrease the waste production.

Recycle is a process to change materials or waste into new products to avoid waste of possibly useful materials. Recycle helps reduce the consumption of new raw materials, decrease energy usage and pollution and lessen greenhouse gas emission.

Recyclable materials are several kinds such as plastic, glass, metal, aluminum, tin and paper. Additionally, there are some standard related to recycle practice such as International Organization for Standardization [ISO] 15370:2008 for plastic waste and ISO 14001:2004 for environmental management control of recycling practice (ISO, 2012).

In Thailand, approximately 70% of solid waste recycling activities and recovery operations were carried out by waste pickers and municipal collectors. The other 30% was managed by the formal sectors (Liamsanguan and Gheewala, 2008). Only small fraction of waste was managed in households by separation. Therefore recycling should be promoted as the way to reduce the amount of solid waste disposed at dumpsites. The income return from waste separation activity could be the incentive to drive the effort forward.

2.5.2 Concept of integrated solid waste management

The United Nations Environmental Programme [UNEP] (2009) described that integrated solid waste management (ISWM) is a comprehensive waste prevention, recycling, composting and disposal programme. An effective ISWM considers how to recycle, manage and prevent solid waste in ways that protect environment and human health effectively.

The ISWM includes local needs evaluation and the most suitable waste management was selected for fulfill the needs. The activities of ISWM consist of waste minimization, recycling, treatment, combustion and disposal in appropriate designed and sanitary landfills. The conceptual model of integrated solid waste management is shown in Figure 2.8.

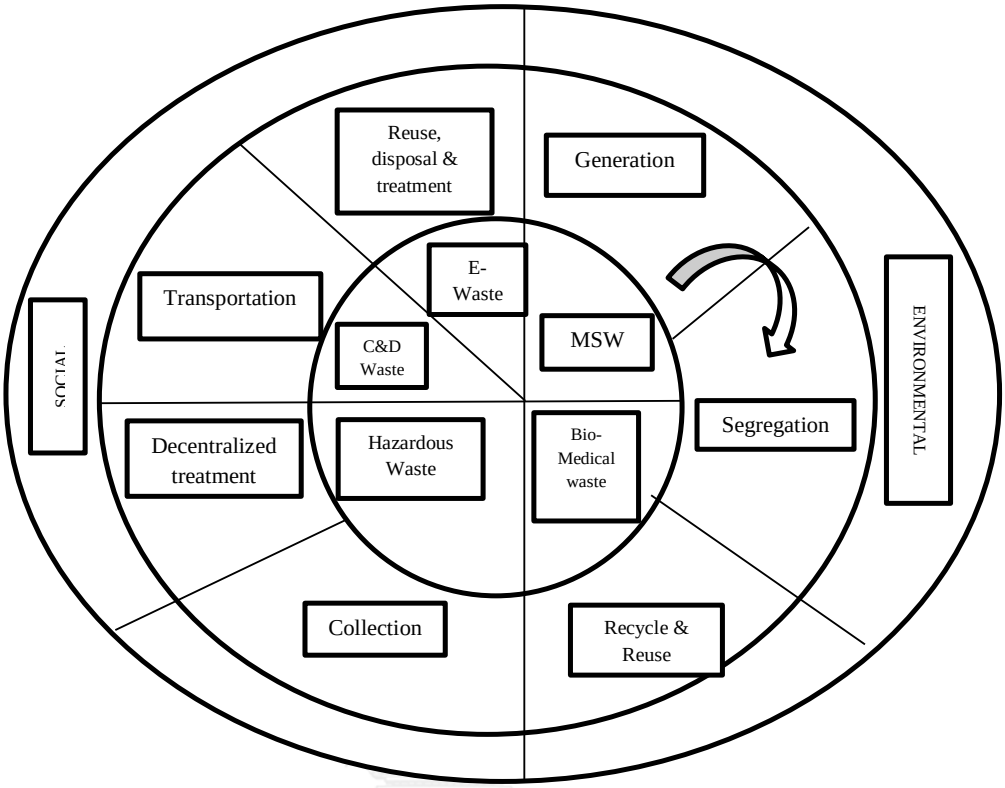

Figure 2.8 The conceptual model of integrated solid waste management.
Source: The United Nations Environmental Programme [UNEP], 2009

The US Environmental Protection Agency [USEPA] (2002) stated that the first step to design or improve a solid waste management system is planning. The significant factors which the planner should take into account are institutional, financial, economic, social, environmental and technical factors as details shown in Table 2.11.

Table 2.11 The significant factors for the integrated solid waste management planning process

Factors	Questions to consider	Steps to take
Institutional (Law and processes)	Are existing laws and policies adequate to allow the government to properly implement ISWM	- Establish a national policy and pass laws on solid waste management standards and practices. - Identify the roles and responsibilities of each level of government. - Ensure the local government has the authority and resources to implement an ISWM plan
Social	What types of waste does your community generate and how it is managed	- Encourage citizen participation in all phases of waste management planning to help gain community awareness, input, and acceptance
Financial (Funding)	Where will you go to get funds for creating a solid waste management system	- Identify sources that can provide funding for solid waste management, including general revenues or user fees, the private sector, and government or international agency grants and loans
Economic (costs and job creation)	What will it cost to implement various waste management activities	- Calculate the initial capital investment requirements and long-term operating and maintenance costs associated with the various waste management activities - Evaluate the public's ability and willingness to pay - Evaluate activities based on effectiveness in handling waste and potential for job creation
Technical (location and equipment)	Where will you build collection and disposal facilities and what equipment will you need	- Include geological factors, transport distances, and projected waste generation in siting and design considerations - Determine what equipment and training will be necessary to perform the waste management tasks.
Environmental (natural resources and human health)	Will solid waste management activities (e.g. landfilling or combustion) affect the environment	- Establish procedures to verify the protection of groundwater and drinking water - Monitor compliance with the national standards to ensure human health risks are minimized

Source: The United States Environmental Protection Agency [USEPA], 2002

According to the comprehensive integrated solid waste management planning process, some essential steps such as needs identification, existing system and regulation reviews, decision-making framework arrangement, short-term and long-term goals establishment, potential components identification, options comparing and the integrated solid waste management plan development are needed. This process is shown in Figure 2.9.

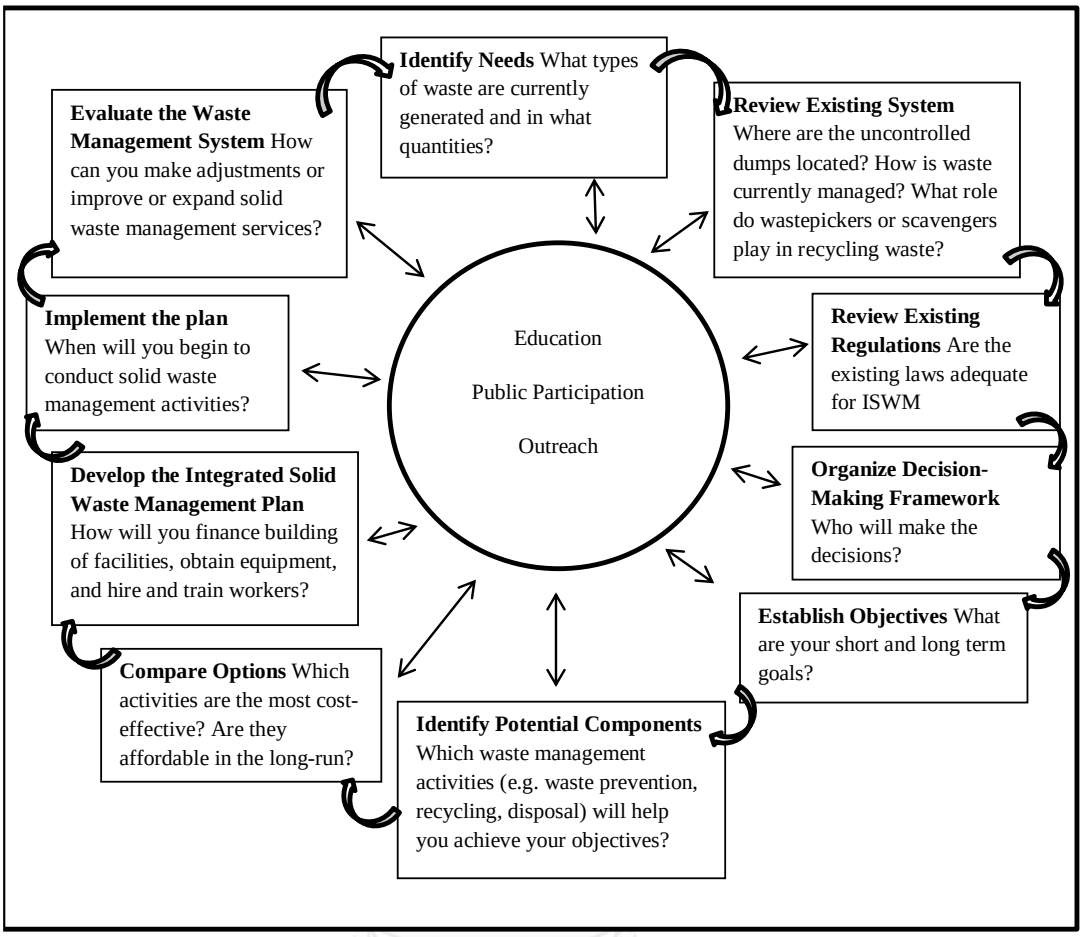

Figure 2.9 The comprehensive integrated solid waste management planning process. Source: The US Environmental Protection Agency [USEPA], 2002

The integrated solid waste management was initiated from the policy move away from landfilling in the 1990s (Van de Klundert and Anschutz, 2001). The concept of integrated solid waste management aims at balancing between three dimensions of waste management including environmental effectiveness, economic affordability and social acceptability (Morrissey and Browne, 2004) and emphasizes on the integration of the many related processes to diminish environmental impacts and decrease the cost of management. The integrated solid waste management paradigm developed by Marshall and Farahbakhsh (2013) is shown in Figure 2.10.

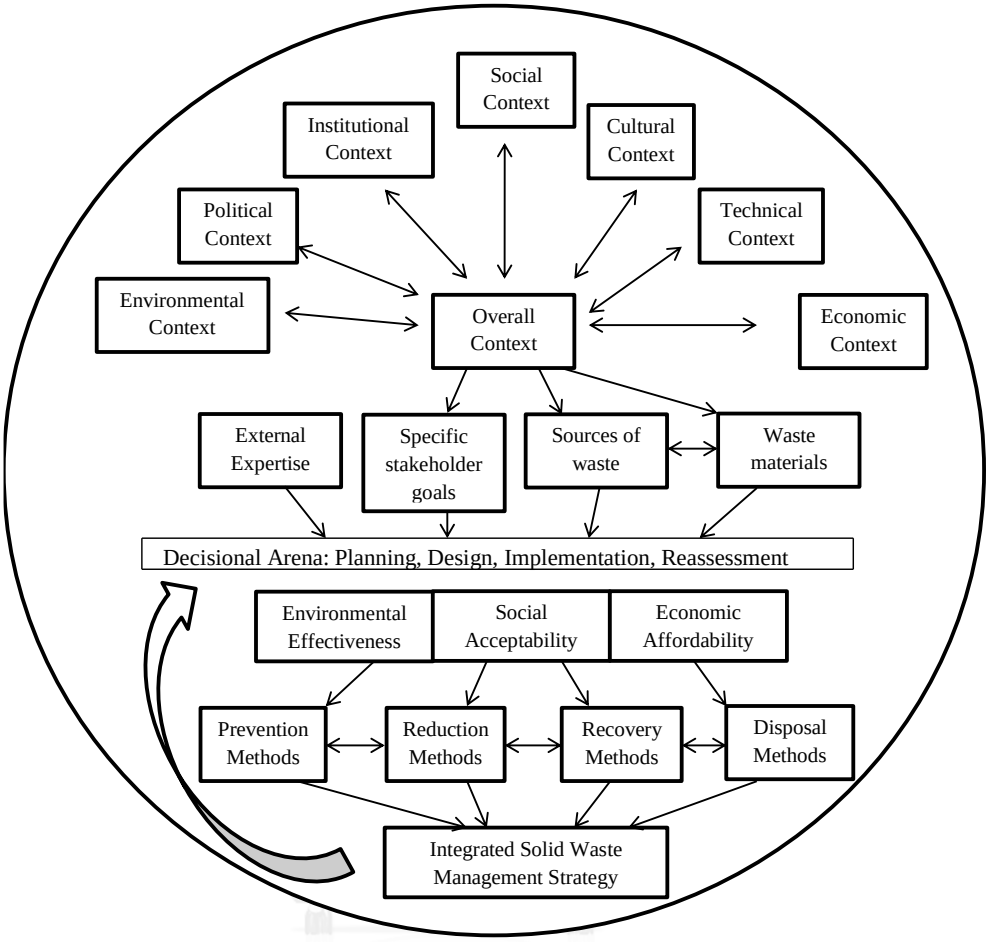

Figure 2.10 The integrate solid waste management paradigm.
Source: (Marshall and Farahbakhsh, 2013)

Integrated solid waste management systems should be designed to specific community objectives by combining stakeholders' perspectives and requirements regarding waste characteristics, political, environmental, institutional, cultural, economic and social contexts and the appropriate methods of prevention, reduction, separation, collection, recovery and disposal (Kollikkathara et al., 2009).

Solid waste management systems that disregard social elements and priorities tend to fail (Petts, 2000). Changing in value systems, consumer behavior, public acceptance, public participation in planning and implementation stage are significant as technical and economic aspects of solid waste management (Carabias et al., 1999). Optimal and effective solid waste management should be adopted by local authorities and participated by public sphere (Morrissey and Browne, 2004). The public

participation, capacity building, communication, changing in pattern of production and consumption and an accessibility of information are the key elements to the success of the integrated solid waste management (Carabias et al., 1999).

2.6 Greenhouse gas emission from waste generation

The Intergovernmental Panel on Climate Change [IPCC] reported that most of the warming observed during the last 50 years caused by greenhouse gases from human activities (McMichael, 2003). Mohareb et al. (2008) confirmed that climate change, by greenhouse gases [GHGs] increasing emission, is currently threatening the quality of life for humanity and ecosystem.

Since the greenhouse gas emission has exacerbated the impact of climate change, the United Nations Framework Convention on Climate Change [UNFCCC] adopted an ultimate objective aimed at stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system (Rogner et al., 2007). This led to the Kyoto protocol, an international treaty which set binding obligations on developed countries to reduce greenhouse gas emissions. One of the important commitment stated that each party included in Annex I, the developed countries, shall limit and/or reduce methane emission which is one of the greenhouse gases that most generates from solid waste disposal sites to achieve its quantified emission limitation and reduction commitments. The methane could be released during the decomposed process in solid waste disposal sites and recycle process (USEPA, 2013).

The assessment of the methane emissions from solid waste generation has several methods. The generally accepted one was developed by the Intergovernmental Panel on Climate Change [IPCC]. The IPCC methodology for estimating methane emissions is based on the First Order Decay [FOD] method and the decision tree for methane emissions from solid waste disposal sites as shown in Figure 2.11.

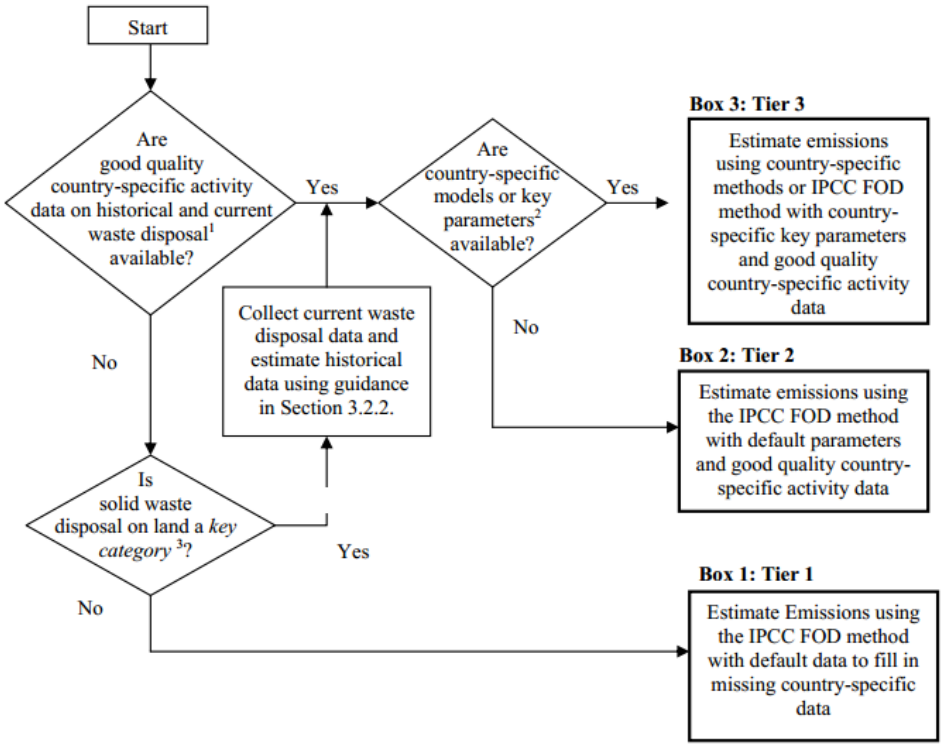

Figure 2.11 The decision tree for methane emissions from solid waste disposal sites
Source: The IPCC guidelines for National greenhouse gas inventories (2006)

In 2011, the Public Health and Environmental Technology Services Center, Public Health Faculty, Khonkaen University and the Environmental Research and Training Center [ERTC] introduced the methodology mentioned about production-based greenhouse gas emission calculating software to calculate greenhouse gas emission from solid waste generated (The Environmental Research and Training Center [ERTC], 2011a).

Another accepted module was developed by the Intergovernmental Panel on Climate Change [IPCC], namely the revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories Worksheet. The module provides methodologies for estimating emissions of methane [CH4] from solid waste disposal sites. In addition, the module could help solid waste planners and organizations to track and voluntarily report greenhouse gas emissions reductions from several waste management practices. Then, total greenhouse gas emissions baseline and alternative waste management practices-source reduction, recycling, combustion, composting and landfilling can be numbered (IPCC, 1996).

Barker et al., (2007) reported that recycling, re-use and waste minimization initiatives are indirectly decreasing greenhouse gas emissions by reducing the mass of waste requiring disposal. While, integrated solid waste management model was applied to help determine the best options for reducing greenhouse gas emissions from waste in the city of Ottawa (Haigh et al., 2004). Bogner et al., (2008) also affirmed that flexible strategies and financial incentives can enlarge waste management options to attain greenhouse gas mitigation goals.

2.7 Application of sustainable solid waste management on sporting event

Solid waste is a recurring problem everywhere around the world. Despite the difficulty, there have been many attempts to counter the problem. For instance, the FIS Nordic World Ski Championships 2005 in Oberstdorf, Germany set up 20 waste disposal points in the proximity of the stadiums. The locals were in charge for the waste collection, separation and treatments prior recycling and disposal. The feedback from the event's spectators was positive as they acknowledged the disposal system as a good idea (Schmidt, 2007).

Other than the system, the products themselves can contribute largely to the waste reduction. Multi-use products can dramatically reduce waste and cost over non-recyclable one. A promotion such as the interesting "Put it in a roll" programme where foods were distributed in edible containers such as a bread roll instead of plastic or paper plates. As much as it helps reducing non-recyclable waste, the programme draws a lot of attention from media.

Schmidt (2007) suggested that controlling waste-collection behaviors could benefit solid waste management in The Guide to Environmentally-Sound Large Sporting Event. A deposit money could be required from spectators in order to guarantee that they will return the containers for the money. And consequently clean their seats after the game. Limiting the number of flyers, giveaways and promotional articles in general during an event can also benefit waste reduction. Constantly emptying waste containers is also necessary to prevent overflowing of waste. Lastly, waste separation sites in utility rooms also need to be properly controlled.

2.8 Thailand Football

In Thailand, football competitions are divided into 3 major leagues. Thai premier league is the highest league of Thailand, Division 1 is the second league of Thailand and the smallest league is regional league Division 2. Both Thai premier league and Division 1 have 18 football clubs that play against each other. In the end of the season, 3 clubs in Division 1 who got the most points in the table will be promoted to Thai premier league. While, 3 clubs in Thai premier league that got the least points will be relegated to play in Division 1. By the same token, 3 clubs in Division 1 that got the least points will be relegated to play in Division 2.

The Football Association of Thailand (2012) reported that there were 3,880 matches conducted by three leagues each year. According to the Thai Premier League (2013), spectators have increased every season. The average spectators per match in 2010, 2011, 2012 and 2013 were 4,717, 4,572, 4,822 and 6,096, respectively.

In 2012, the Thai premier league consisted of 18 football clubs and Division 1 consisted of 18 football clubs. While, the regional league Division 2 separated into 5 regional namely, Bangkok Metropolitan, Northern region, Southern region, North-eastern region, Central and East region are shown in Table 2.12.

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Table 2.12 The Regional League Division 2 Football Clubs in 2012

No.	Bangkok	Northern	Southern	North Eastern	Central and East
1.	Thai-Honda	Chiangmai FC	Trang FC	Roiet Utd	Ayuthaya FC
2.	Samutsakorn FC	Paknampo NSRU FC	Pattani FC	Udonthani FC	Rayong FC
3.	Rayong Utd	Phitsanulok FC	Ranong FC	Srisaket Utd	Trad FC
4.	Rbac-BEC TERO	Utaradit- Mhorseng	Nakornsritham marat FC	Nakronpanom FC	Aangthong FC
5.	Kasetsart Univ	NakornsawanFC	Chumporn FC	Mahasarakam Utd	Prachuap FC
6.	North Bangkok	Phrae Utd	Nara United	Loei City	Sakaew FC
7.	Chamchuri Utd	Nan FC	Satun United	Nhongkai FC	Lopburi FC
8.	Kasembandit Univ	Kampangphet FC	Pang-nga FC	Amnatcharoen Town	Phetburi FC
9.	Globex FC	Payao FC	Had Yai FC	Yasothorn Utd	Pracheanburi Utd
10.	Assumption Thonburi FC	Lamphun warrior	Surathani FC	Nongbualampoo FC	Samitprakarn FC
11.	Loog Esan Thai Airways	Utaitanee Forest	Yala FC	Surin FC	Muangkarn FC
12.	Custom Utd	Tak FC		Chaiyapoom FC	Chacherngsao
13.	Krung Thonburi	Chiangrai FC		Kalasin FC	Kabin City
14.	Rangsit FC	Sukhothai FC		Mukdaharn City	Mabtaput Navy Rayong
15.	Samutprakan Utd	Phichit Fc		Ubonratchathani FC	Royal Thai fleet
16.	Central FC	Phetchaboon Fc		Sakonnakorn FC	Pathumtani FC
17.	Bkk Christian	Singburi FC			Nakornnayok
18.	Nonthaburi	Lampang FC			Thanyaburi Utd

Source: Thailand Premier League (2012)

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Football clubs can be categorized into 3 categories based on an annual financial investment of the clubs (Thai Premier League, 2013a). The annual financial investment of the football club which were over 150 million Baht, 149-100 million Baht and less than 100 million Baht annually were defined as large, medium and small football clubs respectively. The categories of football clubs are shown in Table 2.13.

Table 2.13 The categories of Football Clubs

No.	**Football Club**	**Categories**
1.	SCG Muangthong United	Large
2.	Chonburi FC	Large
3.	Buriram United	Large
4.	BEC Tero Sasana	Large
5.	TOT SC	Large
6.	Insee Police United FC	Large
7.	Army United	Medium
8.	Bangkok Glass	Medium
9.	Chainat FC	Medium
10.	Osotsapa M150 Saraburi	Medium
11.	Thaiport FC	Medium
12.	Wuachon United	Medium
13.	Esan United	Small
14.	Pattaya United	Small
15.	Chiangrai United FC	Small
16.	BBCU FC	Small
17.	Genufood Samutsongkhram	Small
18.	TTM Chiangmai FC	Small

In the three major leagues, 117 clubs are participated every season. Each club has to comply with the rules and regulations given by the Thai premier league Company Limited. Such rules and regulations are derived from the Asian Football Confederation [AFC] which mainly on the subject of stadium regulations, competition regulations and law of the game. However, there was no regulation related to solid waste management or environmental policy at all.

CHAPTER III
RESEARCH METHODOLOGY

3.1 Conceptual research Framework

The main purpose of this research is to study current situations of solid waste managed in football games and to propose a possible sustainable solid waste management model for the football games.

The study was conducted based generally on the objectives of the Olympic Movement's Agenda 21 and its action programme on conservation and management of resources for sustainable development. The conceptual research framework is shown in Figure 3.1.

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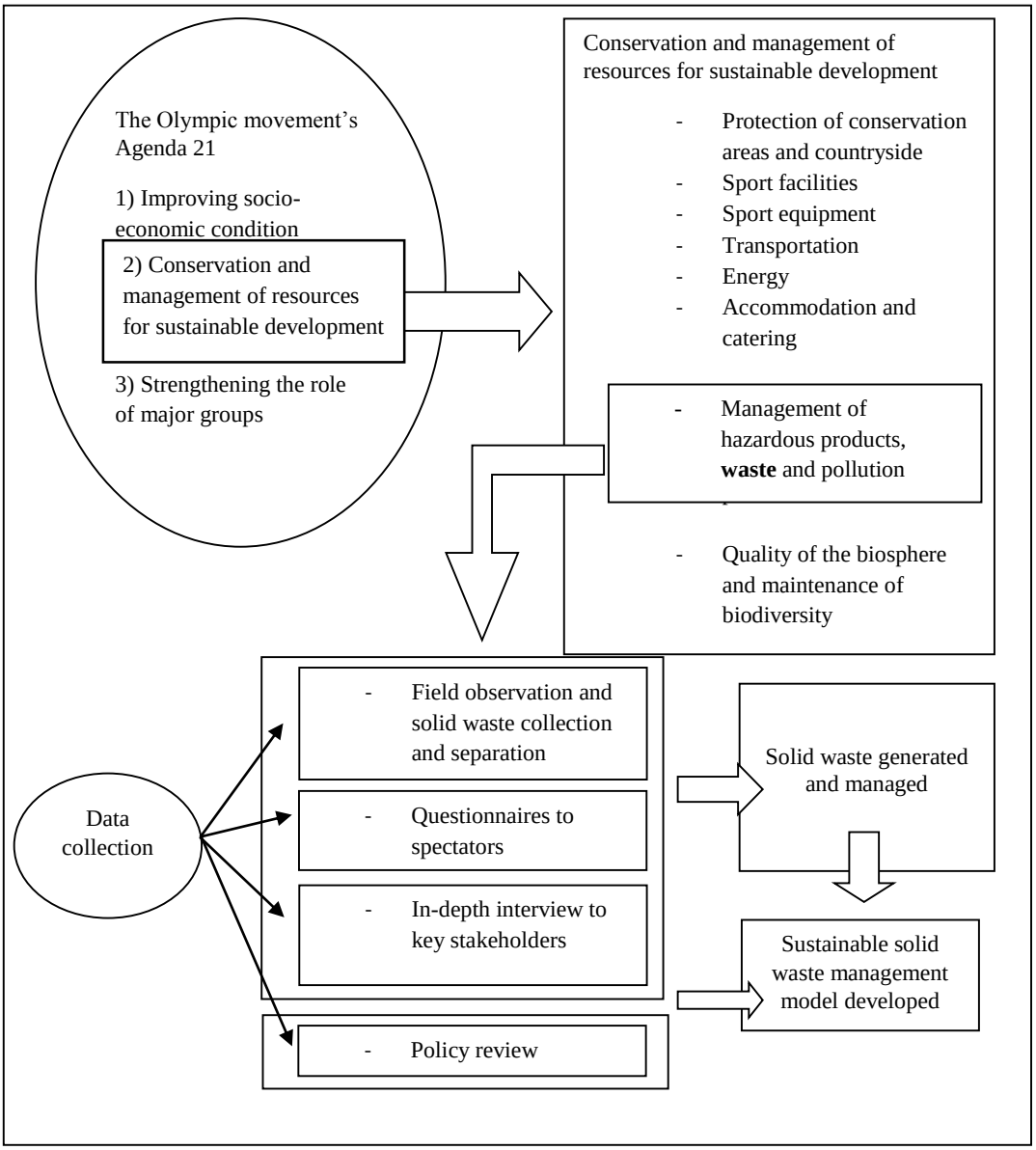

Figure 3.1 Conceptual research framework.

According to the Olympic movement's Agenda 21, the programme of action was built around the three objectives which are 1) improving socio-economic conditions, 2) conservation and management of resources for sustainable development and 3) strengthening the role of major groups. The management of hazardous products, waste and pollution is one of key environmental activities of the Olympic movement's Agenda 21 which do not mention about solid waste management in particular. Therefore, this research has to collect data of solid waste generated in some football matches in Thailand as a case study. The data collection including field observation, solid waste collection and separation, in-depth interview to key stakeholders, questionnaires to spectators and policy review was conducted to obtain the situation of solid waste managed and generated in the football matches. Eventually, all data collected were synthesized and analyzed to develop a sustainable solid waste management model.

3.2 The study areas

The study areas comprised of three football clubs in the Thai Premier League namely the SCG Muangthong United FC, the Bangkok Glass FC and the Chiangrai United FC. The criteria used in selecting the study areas are as follow:

1) Location: the study areas are located in three provinces of Thailand namely,

- Nonthaburi, the suburb of Bangkok which the SCG Muangthong United FC is located.
- Prathumthani, the suburb of Bangkok which the Bangkok glass FC is located.
- Chiangrai, the northern province which the Chiangrai United FC is located.

2) A number of spectators: an annual number of spectators were in the top five of Thai Premier League (TPL, 2013a).

3) An annual financial investment of the football club which were over 150 million Baht, 149-100 million Baht and less than 100 million Baht annually. In 2012, the SCG Muangthong United FC, the Bangkok glass FC and the Chiangrai United FC financially invested 160 million Baht, 120 million Baht and 60 million Baht, consecutively (TPL, 2013a).

The criteria for the selection of the study clubs are shown in Table 3.1. The locations are in different areas as shown in Figure 3.2.

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Table 3.1 The criteria used for the selection the study clubs.

Criteria	**SCG Muangthong United FC**	**Bangkok glass FC**	**Chiangrai United FC**
Location	Suburb of Bangkok	Suburb of Bangkok	Northern province
A number of spectators	Top 5	Top 5	Top 5
Financial investment	Over 150 Million Baht annually	149-100 million Baht annually	Less than 100 million Baht annually
Club category	Large	Medium	Small

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Figure 3.2 The study area.
Source: Modified from Ezilon maps [Online]. 2015. Available from: http://www.ezilon.com/maps/asia/thailand-maps.html [2015, May]

3.3 Respondents and their numbers

The respondents were classified into 2 groups as follows,

- Spectators from each study match.
- Key stakeholders involving in solid waste managed in the football match such as club's president or manager, head of solid waste managed, waste collectors and some spectators selected for in-depth interview.

The spectators in the study match were selected by the random sampling (Creswell, 2007). Due to the number of spectators were up to 10,000 according to the statistical record of the Thailand Premier League, Taro Yamane's formula was used for a number of sample size (Yamane, 1967). A sample size of 385 spectators in each study match was required at confidence interval of 95 percent as detail in the following formula and Table 3.2.

$$n = \frac{N}{1 + Ne^2}$$

where

n = sample size.

N = population size. (i.e. number of spectator in the football match)

e = precision of random sampling.

Table 3.2 Population size and precision of random sampling of Taro Yamane

Population Size	**Sample size**				
	1%	2%	3%	4%	5%
100	99	96	92	86	80
500	476	417	345	278	222
1000	909	714	526	385	286
6000	3750	1765	938	566	375
10000	5000	2000	1000	588	**385**
50000	8333	2381	1087	617	397

Source: Yamane (1967)

Additionally, 12 key stakeholders were selected using the purposive sampling method to in-depth interview (Bernard, 2012). In order to study the situation of solid waste managed in the football match, people who participate in activities related to

generation, source reduction, storage, handling, collection, and disposal of solid waste were selected as the respondents. The criterion for the purposive sampling was based on the role of selected respondents in solid waste managed activities (Joseph, 2006).

The 12 selected key stakeholders consisted of 3 club's presidents or managers, 3 heads of solid waste managed, 3 waste collectors, and 3 spectators from each study club. The club's presidents or managers are responsible for policies on solid waste managed and its budget. The heads of solid waste managed are responsible for source reduction, storage, handling, collection and disposal of solid waste based on given policies. The waste collectors work on collection and handling of solid waste while the spectators generate solid waste.

3.4 Questionnaires development

1) A structured questionnaire for spectators was developed to study their opinion and behavior on solid waste generated at the stadium. The questionnaire comprises of two parts. The first part was socio-demographic information and solid waste generating, disposing and sorting behaviors of the spectators. The second part was opinion of the spectators on solid waste managed at the study stadiums and awareness of its impacts. An example of this questionnaire is in Appendix A.

2) A semi-structured questionnaire for in-depth interview with the key stakeholders was developed based on the interview guide of the United Nations Environmental Programme [UNEP] (2009c). The questionnaire comprised of 3 parts. Part I was about opinion of the respondent on environmental, social, economic issues of solid waste. Part II was about opinion of the respondent on solid waste managed at the stadium. Part III was about opinion on sustainable solid waste management. An example of this questionnaire is in Appendix B.

3.5 Data collection

Data collection carried out in this study comprised of a field observation and a solid waste collection and separation at the stadiums, in-depth interview with the key stakeholders involving in solid waste managed activities in the football match, questionnaires to spectators on the opinion and behavior regarding solid waste generated at the stadiums and policy review on solid waste managed in sport games.

1) Field observation and solid waste collection and separation

The solid waste generated and managed was observed during the study matches at the selected stadiums. Solid waste generated was collected from area of the football club including stadium after the matches over. It was separated and sorted its types and amount between July and September 2012.

2) Questionnaire to spectators

The structured questionnaire was applied to 385 spectators by the random sampling method (Creswell, 2007) in each study match. The three study matches were held at each study stadiums during the Thailand Premiere League season 2012 between July and September 2012.

3) In-depth interview with key stakeholders

The key stakeholders involving in solid waste managed activities were selected by means of the purposive sampling (Bernard, 2012) due to their roles in the solid waste managed activities. The in-depth interviews were carried out between September and December 2012.

4) Policy review

The international and national sport policies related to sustainable sport, environmental management and solid waste management were studied from the International Olympic Committee [IOC], the United Nations environmental program [UNEP], the International Federation of Association Football [FIFA], the Asian Football Confederation [AFC], the Football Association of Thailand [FAT], and Ministry of tourism and sports of Thailand.

3.6 Data Analysis

1) Field observation and solid waste generated collection and separation

The solid waste generated in the study matches was collected from the study stadiums and sent to the separation site, namely Wongpanit. The solid waste was separated and sorted in compliance with the ISO 14001 standard which waste and hazardous waste were minimized and managed correctly and effectively. The wastes

were segregated into wastes requiring disposal and those for recycling. The amount of waste for off-site disposal and recycling was recorded (ISO 14001:2004). The types and amount of separated solid waste data from 3 study matches were also recorded and compared.

In addition, the greenhouse gas emissions from solid waste generated at the study stadiums were calculated using the production-based greenhouse gas emission calculating software developed by the Public Health and the Environmental Technology Services Center and the Environmental Research and Training Center [ERTC], Public Health Faculty, Khonkaen University and the revised 1996 Intergovernmental Panel on Climate Change [IPCC] Guidelines for National Greenhouse Gas Inventories Worksheet developed by the IPCC.

2) Questionnaires

The data from a structured questionnaire was analyzed using Likert scale. A frequency distribution table and the statistical mode were used to analyze the opinion and behavior of spectators regarding solid waste generated at the stadium.

3) In-depth interview

The data from in-depth interview was analyzed by using method developed by McCracken (1988) for long interviews. The data was coded based on in-depth interviews. The codes were grouped in the same categories for further analysis.

4) Policy review

The relevant international and national sport policies were studied and applied to propose the sustainable solid waste management model for sport games.

3.7 The sustainable solid waste management model

The data collected from the field and frameworks of integrated solid waste management planning of the USEPA (2002) was used in the study to develop sustainable solid waste management model for sport games.

CHAPTER IV
RESEARCH FINDINGS AND DISCUSSIONS

This chapter brings up research findings to fulfill objectives set of this research. Data collection was carried out through field observation of solid waste collection and separation. The in-depth interviews were conducted with key stakeholders using semi-structured questionnaires. The structured questionnaires were applied to spectators. The relevant policies on solid waste managed in sports were reviewed. All relevant data was then analyzed for a possible sustainable solid waste management model for sport game.

4.1 The study area

The study areas consist of three football clubs and their stadiums in the Thai Premier League. The study clubs consist of the SCG Muangthong United Football club (MTUTD), the Bangkok glass Football Club (BGFC) and the Chiangrai United Football club (CRUTD). The study areas were selected based on their location, a number of spectators and an annual financial investment of the football club (Thailand Premiere League [TPL], 2013a).

1) The SCG Muangthong United football club locates in Nonthaburi province, a suburb of Bangkok. Its home stadium namely SCG Muangthong stadium has the capacity of 17,500 seats. The average number of spectators in season 2012 was 13,427 (TPL, 2013a). The SCG stadium is shown in Figure 4.1.

2) The Bangkok glass football club locates in Prathumthani province, a suburb of Bangkok. Its home stadium namely Leo stadium has the capacity of 13,000 seats. The average number of spectators in season 2012 was 7,118 (TPL, 2013a). The Leo stadium is shown in Figure 4.2.

3) The Chiangrai United football club locates in Chiangrai province. Its home stadium, The United stadium has the capacity of 14,000 seats. The average number of spectators in season 2012 was 8,034 (TPL, 2013a). The United stadium is shown in Figure 4.3.

Figure 4.1 The SCG Muangthong Stadium.

Source: The SCG Muangthong United FC [Online]. 2012.

Available from: http://www.mtutd.tv [2012, December]

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Figure 4.2 The Leo Stadium.

Source: The Bangkok glass FC [Online]. 2013.
Available from: http://www.bangkokglassfc.com/club-info-04.html [2013, January]

Figure 4.3 The United Stadium.
Source: The Chiangrai United FC [Online]. 2012.
Available from: http://www.thailandsusu.com [2012, December]

As football has continually grown its popularity in Thailand, the number of spectators has also increased every season (The Thai Premiere League, 2013). It led to the growth of football club's revenue both from ticket sales and souvenir sales. The sales revenue from ticket and souvenir of the study clubs consequently shown in Table 4.1 has risen up as well.

Table 4.1 Number of spectators, sales revenue of ticket and souvenir of the study clubs in season 2010, 2011 and 2012.

Season	**Club**	**No. of Spectators**	**Sales revenue**	
			Ticket (Baht)	**Souvenir (Baht)**
2010	SCG Muangthong United FC	154,573	11,747,190	9,530,085
	Bangkok glass FC	75,856	5,019,640	3,246,880
	Chiangrai United FC	-	-	-
2011	SCG Muangthong United FC	182,610	16,408,740	13,849,901
	Bangkok glass FC	97,059	8,049,797	4,336,723
	Chiangrai United FC	63,447	4,778,760	1,442,680
2012	SCG Muangthong United FC	228,256	21,345,971	17,921,386
	Bangkok glass FC	121,003	9,608,716	4,885,699
	Chiangrai United FC	136,578	9,686,580	3,728,323

Source: The Thailand Premiere League, 2013a

The president of the Thai Premiere League disclosed that the number of spectators attended the football matches between season 2010 and 2013 was 5,274,962 persons and the sales revenue circulated in a football business was almost 10,000 million Baht between season 2010 and 2013.

4.2 Field observation and solid waste collection and separation

To study solid waste generated and current solid waste managed of the study clubs, they were observed at the study football matches of the clubs between July and September 2012. The solid waste generated was collected at the study stadiums after the 9 study matches were over and were separated in order to identify its type and amount. The study matches and a number of spectators are shown in Table 4.2.

Table 4.2 The study matches and a number of spectators.

Study matches No.	**Stadium**	**Home team**	**Number of spectators**
1	SCG Muang-thong Stadium	SCG Muang-thong United (MTUTD)	11,453
2			11,755
3			13,548
4	Leo Stadium	Bangkok glass FC (BGFC)	5,933
5			5,653
6			10,050
7	United Stadium	Chiangrai United FC (CRUTD)	7,108
8			11,000
9			14,320

Source: The Thailand Premiere League, 2013a

The solid waste generated at the study matches were collected right after the matches were over by the home club's solid waste managed staffs. The solid waste collected was stored at the storage of the stadium and was transported to the separation site, namely Wongpanit on the next day. The solid waste was basically separated into

solid waste for recycling and solid waste for disposal. The amount of solid waste for recycling and disposal was recorded (ISO 14001:2004) as shown in Table.4.3.

Table 4.3 The amount of solid waste generated in the study matches.

Study matches No.	**Club**	**Solid waste for recycling**		**Solid waste for disposal**		**Net solid waste (kg.)**
		(kg.)	**Percentage**	**(kg.)**	**Percentage**	
1	SCG Muang-thong United (MTUTD)	111.1	12.65	767.5	87.35	878.6
2		140.9	12.74	965.6	87.26	1106.5
3		209.1	15.50	1139.6	84.50	1348.7
Average		153.7	13.83	957.6	86.17	1111.3
4	Bangkok glass FC (BGFC)	70.9	9.94	642.7	90.06	713.6
5		103.1	11.22	815.9	88.78	919.0
6		162.6	12.94	1094.8	87.06	1257.4
Average		112.2	11.65	851.1	88.35	963.3
7	Chiangrai United FC (CRUTD)	54.6	7.36	687.0	92.64	741.6
8		65.9	9.38	636.9	90.62	702.8
9		121.4	9.97	1096.3	90.03	1217.7
Average		80.6	9.10	806.7	90.90	887.4

The average solid waste generated at the SCG Muangthong United's stadium, the Bangkok glass's stadium and the Chiangrai United's stadium were 1111.3, 963.3 and 887.4 kilograms respectively. From amounts of solid waste generated in 9 study matches and a number of spectators participated in those matches, solid waste generation rate can be calculated to be 0.097 kg per person.

It is noteworthy that some solid waste generated at the stadiums can be sorted including glass bottles, aluminum cans, plastic cup, LDPE, mixed plastic, tin cans, and

paper. Nevertheless, a large amount of commingled solid waste cannot be economically sorted due to its mixture with food remains and garbage in the bins.

After sorting, the solid waste for disposal at the SCG Muangthong United's stadium, the Bangkok glass's stadium and the Chiangrai United's stadium were 957.6 (86.17%), 851.1 (88.35%) and 806.7 (90.90%) respectively. While, the solid waste for recycling were 153.7 kg (13.83%), 112.2 kg (11.65%) and 80.6 kg (9.10%) respectively which mean that less than 15% of the total solid waste generated at the study matches were transported to recycling process. The commingled solid waste generated at the stadiums could be less if an appropriate prior-sorting was implemented. The amount and type of sorted solid waste generated in the study matches are shown in Table 4.4.

Table 4. 4 The amount and type of sorted solid waste generated in the study matches.

Study matches No.	**Club**	**Glass (kg)**	**PET (kg)**	**LDPE (kg)**	**Alumi-num can (kg)**	**Tin Can (kg)**	**Mixed plastic (kg)**	**Soft paper (kg)**
1	The SCG Muangthong United (MTUTD)	34.0	25.0	9.0	5.8	2.1	15.2	20.0
2		48.0	29.8	13.7	6.6	2.5	18.3	22.0
3		67.0	44.5	16.4	11.2	4.0	28.0	38.0
Average		49.7	33.1	13.0	7.9	2.9	20.5	26.7
4	The Bangkok glass FC (BGFC)	28.0	5.6	3.0	0.4	0.6	22.1	11.2
5		38.0	3.5	4.9	0.5	0.8	39.0	16.4
6		64.0	2.7	6.0	0.9	1.3	63.7	24.0
Average		43.3	3.9	4.6	0.6	0.9	41.6	17.2
7	The Chiangrai United FC (CRUTD)	31.0	4.0	2.0	0.6	1.0	6.0	10.0
8		18.0	6.0	1.1	0.3	0.5	21.0	19.0
9		57.0	8.0	3.1	1.0	1.3	25.0	26.0
Average		35.3	6.0	2.1	0.6	0.9	17.3	18.3

The proportion of each type of the sorted solid waste found at the study matches were comprised of glass bottles (35.3%), polyethylene terephthalate [PET] bottles (6.0%), low-density polyethylene [LDPE] bottles (2.1%), mixed plastic (17.3%), soft paper (18.3%), aluminum can (0.6%) and tin can (0.9%).

Stahl and Hochfeld (2003) reported types of solid waste generated in football matches are quite similar in almost every kind of sports. Solid waste generated mainly comprised of catering waste, packaging materials, promotional materials and merchandise provided to spectators which were glass, plastic, paper, can and food remain. While, most of the solid waste generated at the London Olympics games and the NFL Super Bowl XXVII 1992 were glass, plastic, food packaging (paper), mixed paper and can (Bardelline, 2012; Woods, 1993).

The types of solid waste generated at the study matches that can be sorted were relatively conform to the study of Stahl and Hochfeld (2003) and solid waste generated at the London Olympics Games 2012 and the NFL Super Bowl XXVII 1992. It shows that glass, plastic, paper and can were common types of solid waste generated at most of sport events.

Due to the similarity of solid waste types that generated at the study matches, the London Olympics games and the NFL Super Bowl XXVII, the solid waste management policy and practices of international mega sport events might be also effective to apply with the football matches in Thailand.

According to field observation, source reduction, separation and recycling was deficient in current solid waste management of football clubs. Current solid waste management of football clubs is shown in Figure 4.4.

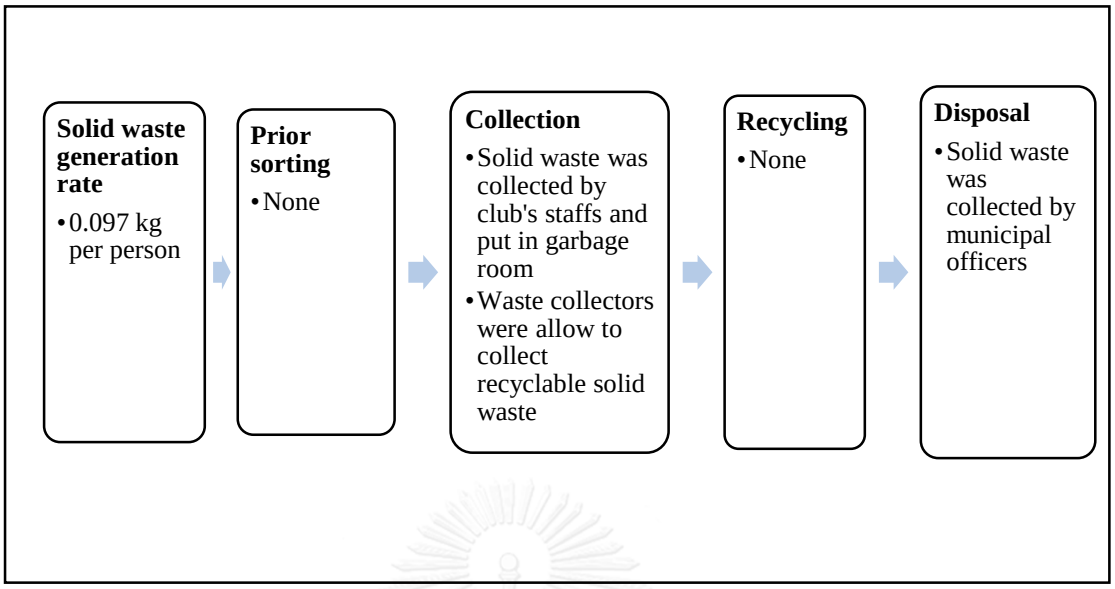

Figure 4. 4 Current solid waste management of football clubs.

This represented solid waste generation rate of the study football clubs and current solid waste management process at the SCG Muanthong United's stadium and the Chiangrai United's stadium that prior sorting was not found at any study stadiums. While, prior sorting practice was found only at the Bangkok glass's stadium. The solid waste generated at the stadium was collected from an area of the football club including its stadium by solid waste management staffs of the football clubs. The solid waste was put together at the garbage room for municipal officers to collect. For recycling process, only the Bangkok glass's stadium sold sorted solid waste to junk shop. In contrast, the waste collectors were allowed to collect solid waste at the SCG Muangthong United's stadium and the Chiangrai United's stadium. For disposal process, the commingled solid waste was collected and disposed at sanitary landfills by the municipality. This clarified current solid waste management process that was found from the study.

4.3 Data collection

4.3.1 Target respondents

1) Spectators: 385 of the spectators from each study match (included 1,155 persons from 3 matches) were selected by the random sampling (Creswell, 2007) to

study their solid waste generating, disposing and sorting behaviors at the stadium, opinion and awareness of impact from solid waste.

2) Key stakeholders: 9 key stakeholders who involving in solid waste managed in the football match such as president or manager of the football club, head of solid waste management and waste collectors of each club were selected for in-depth interview (Bernard, 2012) to study the current solid waste management of the study clubs and opinion about sustainable solid waste management. The criterion for the purposive sampling was based on the role of selected respondents in solid waste managed activities (Joseph, 2006).

4.3.2 Questionnaire development

1) A structured questionnaire for spectators was developed to study their opinion and solid waste generating, disposing and sorting behaviors at the stadium. The questionnaire consisted of 2 parts. Part I was about socio-demographic information and solid waste generating, disposing and sorting behaviors of the spectators. Part II was about opinion of the spectators at the study stadiums on solid waste managed at the study stadiums and awareness of impact from solid waste.

2) A semi-structured questionnaire for in-depth interview with the key stakeholders was developed based on the targets and issues of concern for integrated solid waste management of the United Nations Environmental Programme [UNEP] (2009c) to study current situation of solid waste managed at the study stadiums and the opinion on sustainable solid waste management. The semi-structured questionnaire consisted of 3 parts. Part I was about opinion of the respondent on environment, social, economic issues of solid waste. Part II was about opinion of the respondent on current solid waste managed at the stadium. Part III was about opinion on sustainable solid waste management.

4.3.3 Research findings

4.3.3.1 The spectators' behavior on solid waste generated at the stadium, opinion and awareness of impact from solid waste.

According to Schultz, Oskamp and Mainieri (1995), personal factors such as attitudes, knowledge, demographics or personality variables and situational factors

might determine one's behaviors. The structured questionnaire on solid waste generated at the football match was developed comprising of socio-demographic information, solid waste disposing and sorting behaviors, and opinions of the spectators on solid waste generated and managed at the stadiums. The structured questionnaires were applied to 385 spectators each match that make up to the number of 1,155 spectators in the 3 study matches, using the random sampling technique. The 3 study matches were held at the SCG Muangthong United stadium, the Bangkok glass's stadium and Chiangrai United stadium during Thailand Premiere League season 2012 between July and September 2012. The data obtained were analyzed using the Likert scale, percentage and the statistical mean.

1) Socio-demographic information

The socio-demographic information of respondents including sex, age, status, education, occupation, monthly income and frequency of match attendance were study and shown in Table 4.5 and Table 4.6.

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Table 4.5 Socio-demographic information of the spectators

Socio-demographic information		**The SCG Muangthong United**		**The Bangkok glass FC**		**The Chiangrai United**	
		Number (person)	**%**	**Number (person)**	**%**	**Number (person)**	**%**
Sex	Male	231	60	288	74.8	275	71.4
	Female	154	40	97	25.2	110	28.6
Age	Under 15 years old	10	2.6	33	8.6	27	7
	15-25 years old	159	41.3	147	38.2	204	53
	26-35 years old	141	36.6	122	31.7	58	15.1
	36-45 years old	52	13.5	67	17.4	40	10.4
	46-55 years old	21	5.5	13	3.4	33	8.6
	Over 56 years old	2	0.5	3	0.8	23	6
Education	Lower than Primary School	0	0	2	0.5	14	3.6
	Primary School	14	3.6	16	4.2	23	6
	High School	79	20.5	157	40.8	106	27.5
	High vocational Certificate	50	13	56	14.5	56	14.5
	Bachelor's degree	229	59.5	147	38.2	167	43.4
	Master degree	13	3.4	6	1.6	15	3.9
	Doctoral degree	0	0	1	0.3	4	1
	Government officer	92	23.9	68	17.7	70	18.2
Occupation	Farmers	5	1.3	2	0.5	14	3.6
	Trader	30	7.8	25	6.5	35	9.1
	Employee	95	24.7	125	32.5	50	13
	Student	110	28.6	125	32.5	208	54
	Other	53	13.8	40	10.4	8	2.1

The study found that in all study matches 60.0-74.8% of the spectators were men. In the range of 38.0-53.0% of the spectators were at the age of 15-25 years old. For the education, 38.0-59.5% of the spectators graduated at a bachelor's degree. In the range of 28.6-54.0% of the spectators were students.

Table 4.6 Monthly income and match attendance of the spectators

Socio-demographic information		The SCG Muangthong United		The Bangkok glass FC		The Chiangrai United	
		Number (person)	%	Number (person)	%	Number (person)	%
Monthly Income	Lower than 5,000 Baht	36	9.4	78	20.3	163	42.3
	5,000 – 10,000 Baht	95	24.7	89	23.1	119	30.9
	10,001 – 20,000 Baht	130	33.8	119	30.9	59	15.3
	20,001 – 30,000 Baht	78	20.3	59	15.3	25	6.5
	30,001 – 40,000 Baht	28	7.3	21	5.5	14	3.6
	More than 40,000 Baht	18	4.7	19	4.9	5	1.3
Frequency of match attending	First time	113	29.4	44	11.4	92	23.9
	2-3 times/season	74	19.2	30	7.8	100	26
	3-4 times/season	37	9.6	28	7.3	32	8.3
	Over 10 times/season	29	7.5	74	19.2	36	9.4
	Over 15 times/season	31	8.1	57	14.8	37	9.6
	Attend every time	101	26.2	152	39.5	88	22.9

In the range of 46.2-58.5% of the spectators had monthly income between 5,000-20,000 Baht and 11.4-29.4% of them stated that they attended the match for the first time while 22.9-39.5% of them attended every match.

2) Solid waste generating, disposing and sorting behaviors

The respondents' opinion on food, beverage and other products consumption and solid waste generated in the football matches are shown in Table 4.7.

Table 4.7 The respondents' opinion on food, beverage and other products consumption and solid waste generated in the football matches

Solid waste disposal and sorting behaviors		The SCG Muangthong United		The Bangkok glass FC		The Chiangrai United	
		Number (person)	%	Number (person)	%	Number (person)	%
Food, beverage and other products consumption at the match	Liqueur/Beer	91	11.2	103	12.7	86	11
	Water	242	29.9	255	31.5	257	32.9
	Fruit juice	59	7.3	14	1.7	44	5.6
	Soft drink	84	10.4	124	15.3	61	7.8
	Cheering equipment	37	4.6	29	3.6	54	6.9
	Food	94	11.6	119	14.7	106	13.6
	Snack	101	12.5	69	8.5	107	13.7
	Tea/Coffee	14	1.7	7	0.9	8	1
	Souvenir	47	5.8	73	9	46	5.9
	Booklet	38	4.7	11	1.4	7	0.9
	Other	2	0.2	6	0.7	6	0.8
Solid waste generated at the stadiums	Plastic bag	172	21.7	178	24.9	197	27.2
	Food package	68	8.6	129	18.1	112	15.5
	Glass bottles	61	7.7	40	5.6	50	6.9
	Plastic bottles	207	26.1	95	13.3	81	11.2
	Can	95	12	35	4.9	84	11.6
	Plastic cup	102	12.9	161	22.5	80	11.1
	Plastic box	18	2.3	29	4.1	46	6.4
	Paper	57	7.2	31	4.3	41	5.7
	Hazardous waste	5	0.6	7	1	13	1.8
	Other	7	0.9	9	1.3	19	2.6

The study found that in the range of 29.9-32.9% of the spectators' consumption was water and 24.4-29.7% of the spectators consumed beer, juice and soft drink. While 23.2-27.3% of the spectators consumed food and snack. Thus, the solid waste generated at the study stadiums should mostly consist of glass and plastic bottles, cans, plastic and paper packaging.

Regarding opinion on solid waste generated at the stadiums, the spectators mentioned that they generated plastic bag (21.7-27.2%), food package (8.6-18.1%), glass bottles (5.6-7.7%), plastic bottles (11.2-26.1%), can (4.9-12.0%), plastic cup (11.1-22.5%), plastic box (2.3-6.4%), paper (4.3-7.2%), hazardous waste (0.6-1.8%) and other waste (0.9-2.6%) respectively.

The solid waste sorting and disposing behaviors of the respondent at the study matches are shown in Table 4.8.

Table 4.8 Solid waste sorting and disposing behaviors of the spectators

Solid waste disposing and sorting behaviors		**The SCG Muangthong United**		**The Bangkok glass FC**		**The Chiangrai United**	
		Number (person)	**%**	**Number (person)**	**%**	**Number (person)**	**%**
Sorting behavior	Never sorted	176	45.7	91	23.6	166	43.1
	Sorted sometimes	180	46.8	206	53.5	153	39.7
	Sorted every time	29	7.5	88	22.9	66	17.1
Disposing behavior	Dispose at provided bins every time	189	49.1	283	73.5	235	61
	Dispose at provided bins sometimes	165	42.9	62	16.1	80	20.8
	Never disposed at provided bins	15	3.9	1	0.3	4	1
	Never disposed anything at the stadiums	16	4.2	39	10.1	66	17.1

Regarding sorting behavior of the spectators, the study found that in the range of 23.6-45.7% of the spectators stated that they never sorted the solid waste, 39.7-53.5% of the spectators sorted sometimes, and 7.5-22.9% of the spectators sorted every time.

For the disposing behavior of the spectators, the study found that in the range of 49.1-73.5% of the spectators stated that they disposed the solid waste at provided bins every time while 16.1-42.9% of them disposed the solid waste at provided bins sometimes. However, 0.3-3.9% of the spectators stated that they never disposed at provided bins and 4.2-17.1% of the spectators stated that they never disposed anything at the stadiums.

Though, the spectators stated that they disposed the solid waste at provided bins every time in the range of 49.1-73.5%, due to lack of prior-sorting behavior, the solid waste generated could not be properly separated to recycling process and was commingled with food remains and garbage. Consequently, the commingled waste was uneconomical to separate and it was disposed inefficiently.

3) Opinions of the spectators on solid waste management

The opinions of the spectators on solid waste managed at the study stadiums are shown in Table 4.9.

Table 4.9 Opinions of the spectators on solid waste managed at the study stadiums

Opinions of the spectators on solid waste managed at the stadiums		**The SCG Muangthong United**		**The Bangkok glass FC**		**The Chiangrai United**	
		Number (person)	**%**	**Number (person)**	**%**	**Number (person)**	**%**
Person in charge of solid waste management at the stadium	Football club	318	73.2	358	92.9	282	73.2
	Municipality office	66	17.1	23	6	92	23.9
	Waste collector	1	0.3	4	1	11	2.9
Current solid waste management	Land filling	24	6.2	44	11.4	73	19
	Burning	24	6.2	37	9.6	86	22.3
	Collected by waste collection vehicle without separation	137	35.6	91	23.6	95	24.7
	Separated and collected by waste collection vehicle	200	51.9	204	53	126	32.7
	Other	0	0	9	2.3	5	1.3
Awareness of impact of proper solid waste management	Yes	370	96.1	343	89.1	289	75.1
	No	15	3.9	42	10.9	96	24.9
Awareness of greenhouse gas emission	Yes	371	96.4	337	87.6	268	69.6
	No	14	3.6	48	12.5	117	30.4

In the range of 73.2-92.9% of the spectators agreed that the football clubs should take responsible for solid waste management at the stadiums. While 6.0-17.1% and 0.3-2.9% of the spectators mentioned that municipality office and waste collector should be on duty.

The opinion of the spectators on current solid waste management, 32.7-53% of the spectators viewed that the solid waste generated at the stadiums was separated and was collected by waste collection vehicle, 23.6-35.6% of the spectators viewed that was collected by waste collection vehicle without separation, 6.2-19.0% of the spectators viewed that was transported to landfill and 6.2-22.3% viewed that was burnt.

All study stadiums, 75.1-96.1% of the spectators mentioned that they were aware of positive impact of proper solid waste management and 69.6-96.4% of them were aware of the greenhouse gas emission.

In spectators' opinion, in the range of 73.2-92.9% viewed that the football clubs should be responsible mainly for solid waste management at the stadium. In addition, 32.7-53% of them viewed that the football club should managed solid waste by sorting it before disposal.

The opinion of the spectators at the study stadiums on solid waste managed at the study stadiums and awareness of impact from solid waste are shown in Table 4.10.

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Table 4.10 Opinion of the spectators at the study stadiums on solid waste managed at the study stadiums and awareness of impact of solid waste

ITEM	Rating of agreement					
	The SCG Muangthong United		The Bangkok glass FC		The Chiangrai United	
	Absolutely agree (5) (person)	Agree (4) (person)	Absolutely agree (5) (person)	Agree (4) (person)	Absolutely agree (5) (person)	Agree (4) (person)
Large amount of waste generated in each match	193 (50.1%)	121 (31.3%)	123 (31.9%)	155 (40.2%)	97 (25.3%)	180 (46.7%)
Solid waste has environmental impact at the stadium	106 (27.6%)	189 (49.0%)	96 (24.9%)	134 (34.7%)	83 (21.6%)	164 (42.7%)
The club should pay attention to the environmental impact created by the match	149 (38.7%)	185 (48.1%)	160 (41.5%)	141 (36.6%)	108 (28.0%)	161 (41.9%)
The club should mitigate impact from solid waste	173 (45.0%)	169 (44.0%)	145 (37.6%)	141 (36.6%)	100 (26.1%)	156 (40.5%)
The club should promote solutions to decrease an impact of solid waste at the stadium	186 (48.3%)	162 (42.0%)	163 (42.3%)	136 (35.2%)	97 (25.3%)	165 (42.9%)
I am aware of the impact from solid waste at the stadium	154 (39.9%)	171 (44.3%)	144 (37.3%)	151 (39.2%)	95 (24.8%)	172 (44.6%)
I satisfy the club's current solid waste management	114 (29.5%)	147 (38.2%)	97 (25.1%)	172 (44.6%)	60 (15.7%)	185 (48.0%)
I should reduce solid waste at the stadium	180 (46.8%)	152 (39.4%)	172 (44.6%)	135 (35.0%)	106 (27.5%)	150 (38.9%)
I will cooperate with sustainable solid waste management activities, if any.	172 (44.8%)	147 (38.2%)	174 (45.1%)	132 (34.2%)	106 (27.5%)	161 (41.8%)
Solid waste could generate income for the club, if it is managed properly.	117 (30.3%)	107 (27.7%)	157 (40.7%)	135 (35.0%)	112 (29.0%)	146 (37.9%)
Football Association of Thailand should have regulations on solid waste management	151 (39.3%)	184 (47.8%)	165 (42.8%)	138 (35.8%)	121 (31.5%)	163 (42.4%)
Solid waste reduction can mitigate impact of climate change	238 (61.8%)	72 (18.6%)	222 (57.7%)	99 (25.8%)	151 (39.2%)	137 (35.7%)

The level of solid waste generated and managed awareness indicated by agreement level of the statements that describe 1) a recognition of solid waste generated

at the stadiums and its impact, 2) an understanding related to solid waste management at the stadiums and 3) an encouragement of participation from the Football Association of Thailand [FAT], the clubs and the spectators to reduce and manage solid waste. The higher level of agreement reflected the more awareness on the issues.

Regarding a recognition of solid waste generated at the stadiums, 25.3-50.1% of the spectators absolutely agreed that a large amount of waste generated in each match, 21.6-27.6% of them absolutely agreed that solid waste has environmental impact at the stadium, 28.0-38.7% of them absolutely agreed that the club should pay attention to the environmental impact created by the match and 26.1-45.0% of them absolutely agreed that the club should mitigate impact from solid waste. In addition, in the range of 25.3-48.3% of the spectators absolutely agreed that the club should promote solutions to decrease an impact of solid waste at the stadium. While, 24.8-39.9% of them absolutely agreed that they are aware of the impact from solid waste at the stadium.

The spectators recognized that a large amount of waste generated in each match and agreed that it caused an environmental impact. In addition, they viewed that the football club should concentrate on mitigate the impact.

Regarding an understanding related to solid waste management at the stadiums, 15.7-29.5% of the spectators absolutely agreed that they satisfy the club's current solid waste management and 27.5-46.8% of them absolutely agreed that they should reduce solid waste at the stadium. While, 27.5-45.1% of the spectators absolutely agreed that they would cooperate with sustainable solid waste management activities, if any. In the range of 29.0-40.7% of the spectators absolutely agreed that solid waste could generate income for the club, if it is managed properly.

It reflects that around 70% of the spectators still did not absolutely satisfy with current solid waste management and 27.5-45.1% would cooperate with the sustainable solid waste management. In addition, they viewed that the sorted solid waste could generate income for the football clubs.

Regarding an encouragement of participation to reduce and manage solid waste, 31.5-42.8% of the spectators absolutely agreed that the Football Association of Thailand should have regulations on solid waste management and 39.2-61.8% of them absolutely agreed that solid waste reduction can mitigate impact of climate change.

The average rating of the spectators' opinion on solid waste managed at the study matches and awareness of impact from solid waste are shown in Figure 4.5.

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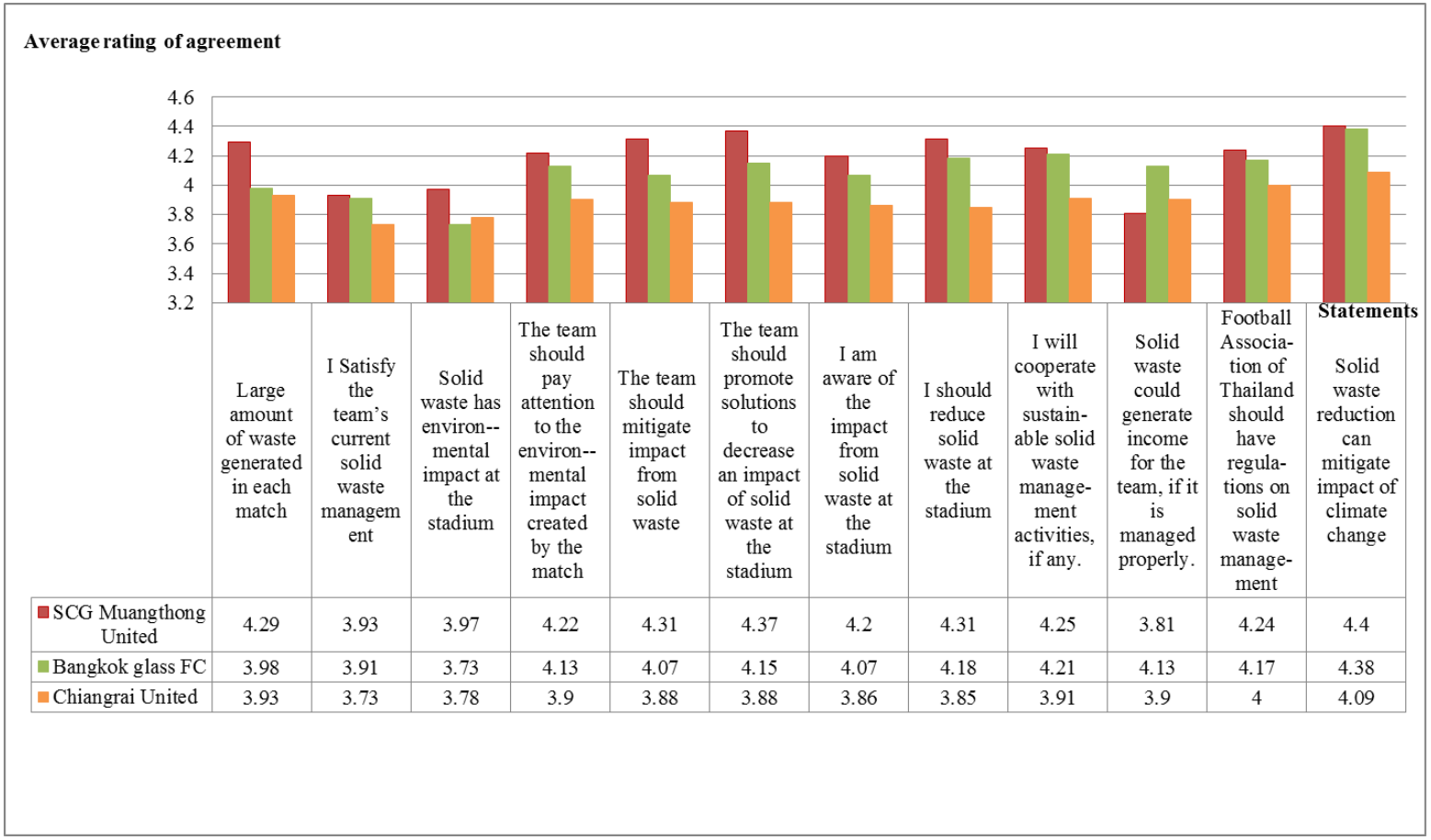

	Large amount of waste generated in each match	I Satisfy the team's current solid waste managem ent	Solid waste has environ-- mental impact at the stadium	The team should pay attention to the environ-- mental impact created by the match	The team should mitigate impact from solid waste	The team should promote solutions to decrease an impact of solid waste at the stadium	I am aware of the impact from solid waste at the stadium	I should reduce solid waste at the stadium	I will cooperate with sustain- able solid waste manage- ment activities, if any.	Solid waste could generate income for the team, if it is managed properly.	Football Associa- tion of Thailand should have regula- tions on solid waste manage- ment	Solid waste reduction can mitigate impact of climate change
SCG Muangthong United	4.29	3.93	3.97	4.22	4.31	4.37	4.2	4.31	4.25	3.81	4.24	4.4
Bangkok glass FC	3.98	3.91	3.73	4.13	4.07	4.15	4.07	4.18	4.21	4.13	4.17	4.38
Chiangrai United	3.93	3.73	3.78	3.9	3.88	3.88	3.86	3.85	3.91	3.9	4	4.09

Figure 4.5 The average rating of the spectators' opinions on solid waste managed at the study matches and awareness of impact from solid waste.

According to Figure 4.5, as the higher level of average rating reflects the higher level of awareness of each issues, the spectators at the SCG Muangthong United's stadium had the highest level of awareness on 11 out of 12 issues regarding solid waste generated and managed at the stadiums and its impacts, followed by the spectators at the Bangkok glass's stadium and the Chiangrai United's stadium respectively. While, the spectators at the Bangkok glass's stadium had the highest level of awareness on 1 issue, followed by the spectators at the Chiangrai United's stadium and the SCG Muangthong United's stadium respectively.

In addition, the awareness level of the spectators at the study stadiums corresponded to proportion of the actual average solid waste for recycling mentioned in Table 4.3. The actual percentage of solid waste for recycling at the SCG Muangthong United was the highest, followed by the Bangkok glass and the Chiangrai United at 13.83%, 11.65% and 9.10% respectively.

It could be discussed that the higher level of awareness may bring about the higher amount of recycled solid waste. This conformed to research of McCarty and Shrum (1994) which reported that the greater awareness and understanding would be extremely useful in order to promote recycling behaviors. It is applicable to upcoming design of public campaigns and educational programs which aim at raising awareness among spectators, increasing sorting behavior, minimizing solid waste generated at the stadiums. In addition, the Football Association of Thailand [FAT], the clubs and the spectators should play an important role in encouraging the more sustainable solid waste management.

4.3.3.2 In-depth interview with key stakeholders

To understand the situation of solid waste managed in the study matches, key stakeholders involving in solid waste managed activities were in-depth interviewed. The key stakeholders were selected by means of the purposive sampling (Bernard, 2012). Joseph (2006) stated that the key stakeholders are people who affect or be affected by the solid waste managed activities. Consequently, the study conducted the in-depth interview with 9 key stakeholders, namely the president or manager of the football club, head of solid waste managed of each club and waste collector of each club during September to December 2012 using two set of the semi-structured

questionnaires which were developed based on the target and issues of concern for integrated solid waste management [ISWM] (UNEP, 2009c) as shown in Appendix B. The first set is for the club's president or manager and heads of solid waste managed. The second set is for the waste collectors.

Both set of the questionnaires were divided into 3 parts. Part I is about an opinion on environment, social and economic issues of solid waste. Part II is about an opinion on solid waste managed at the stadium. Part III is about an opinion on sustainable solid waste management.

1) An opinion on relevant issues of solid waste

The opinion on environment, social and economic issues of solid waste of the respondents is shown in Table 4.11. The proportions of the respondents who mentioned each sub element are presented in terms of percentage.

Table 4.11 The opinion on environment, social and economic issues of solid waste of the respondents

Item	Element	Sub element	Percentage
Impacts of the football match	Environmental issue	Noise	16.67
		Traffic jam	16.67
		Land use change to be stadiums	8.33
		Solid waste	58.33
	Social issue	Unity	50.00
	Economic issue	Vendor	100.00
Impacts of solid waste generated at the stadiums	Yes	Scatteringly disposal	33.33
		No solid waste separation	50.00
		Sanitary	8.33
	No, if there is a proper management	Depends on the clubs	8.33
		Recycling	33.33
		Reducing	25.00
		Reuse	8.33

According to impacts of the football match on environmental issues, the respondents concerned on solid waste, noise, traffic jam and effect of land use change

from natural or agricultural land to be sport venues of about 58.33%, 16.67%, 16.67% and 8.33% respectively. This conforms to the study reported in the manual on sport and the environment issued by the International Olympic Committee (2005) stated that the short-term impacts occur during the event such as noise, soil deterioration and solid waste.

In addition, 50.00% of the respondents mentioned that the football matches could restore the unity among the spectators in terms of social aspect. While 100.00% of the respondents stated that the football matches could contribute to local economy via generating income for local vendors. It conforms to the information of the Thai Premiere League which disclosed that the sales revenue circulated of football business was almost 10,000 million Baht between season 2010 and 2013.

Regarding solid waste generated at the stadiums, 50.00%, 33.33% and 8.33% of the respondents indicated that solid waste was a problem due to the lack of sorting. The spectators do not dispose solid waste in the bins provided and unsanitary respectively. On the other hand, 33.33%, 25.00%, 8.33% and 8.33% of the respondents stated that the solid waste was not a problem if there was a proper management such as solid waste recycling, solid waste reduction, solid waste reusing and other practices depends on the club's strategy respectively.

2) An opinion on solid waste managed at the stadium

The opinion on solid waste managed at the stadium of the respondents is shown in Table 4.12.

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Table 4. 12 The opinion of respondents on solid waste managed at the stadium

Item	Element	Percentage
Types of solid waste generated at the stadium	Plastic bottles	91.67
	Can	33.33
	Plastic bag	83.33
	Paper	66.67
	Glass bottle	25.00
	Food remain	50.00
	Plastic cup	75.00
	Cheering equipment	16.67
Club's responsibility for solid waste management	Stadiums cleanliness	16.67
	Adequate number of bins	100.00
	Promoting prior sorting system	50.00
	Awareness raising for spectators	50.00

The respondents specified the types of solid waste generated at the stadium including plastic bottles 91.67%, plastic bags 83.33%, plastic cup 75.00%, paper 66.67%, food remains 50.00%, can 33.33%, glass bottle 25.00% and cheering equipment 16.67%. This conforms to the study of Stahl and Hochfeld (2003) and solid waste generated at the London Olympics games and the NFL Super Bowl XXVII 1992. It shows that glass, plastic, paper and can were common types of solid waste generated at most of sport events.

According to the club's responsibility on solid waste management, 100.00%, 50.00%, 50.00% and 16.67% of the respondents mentioned that the club was responsible for providing enough bins, encouraging prior sorting system, building awareness among the spectators and cleaning the stadiums respectively. Nevertheless, due to limited budget of the clubs, the prior sorting enhancement and awareness building are not found.

Regarding the respondents' opinion, 58.3% of the respondents viewed that solid waste generated an environmental impact. The impact caused by a lack of solid waste sorting and the spectators did not dispose the solid waste in the provided bins. Thus, knowledge regarding solid waste sorting should be disseminated.

2.1) Source reduction, source separation and reuse

The current source reduction/ source separation/ reuse of the study clubs are shown in Table 4.13.

Table 4.13 The current source reduction/ source separation/ reuse of the study clubs.

Item	Element	Percentage
Source reduction/ source separation/ reuse	Club responsible for the cost of source separation (e.g. cost of waste bins and bags)	100.00
	Waste collectors and club get the revenue from selling sorted solid waste	33.33
		66.67
	No fee system for the waste collectors	100.00
	No awareness raising for sorting and proper disposal	66.67
	Awareness raising for sorting and proper disposal	33.33
	An availability of different color of waste bins for recycling	100.00
	120 Litres waste bin	100.00
	240 Litres waste bin	100.00
	Waste bin at the entrance	100.00
	Waste bin at the vendors' area and shops	66.67
	Waste bin in front of toilets	100.00
	On the grandstands	16.67
	No environmental impacts on this stage	100.00

According to source reduction, source separation and reuse, 100.00% of the respondents mentioned that the club was responsible for the cost of waste bins and bags and 66.67% and 33.33% of the respondents stated that the benefit from selling sorted solid waste belonged to the club and the waste collectors respectively. 100.00% of the respondents reported that the clubs did not collect any fee from the waste collectors at their stadiums. In addition, 66.67% of the respondents reported that it lacked of awareness building for solid waste sorting and a proper disposal and 100.00% of the respondents mentioned that the clubs provided different colors of 120-240 litres waste bin for recycling and waste bags around the stadium. The bins were 100.00% found in front of the entrance and toilets, 66.67% found at the vendors' area or shops and 16.67%

found on the grandstands. Besides, 100.00% of the respondents reported that there was no environment impact on this stage.

According to the in-depth interview of the club's presidents and heads of solid waste management, the practice of source separation was not found at the rest of two stadiums. The source separation policy was implemented at only the Bangkok glass's stadium. At every entrance of the stadium, solid waste managed staffs were assigned to collect solid waste from spectators and separate the plastic bottles and cans from other solid waste before the spectator enter to the stadium. The sorted solid waste was later sold to the junk shop or the waste collectors as recyclable solid waste. While, other clubs did not execute prior sorting due to the limited budget on solid waste management and the shortage of the staffs. Thus solid waste was not utilized as much as possible.

2.2) Collection

The current solid waste collection of the study clubs is shown in Table 4.14.

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Table 4.14 The current solid waste collection of the study clubs

Item	Element	Percentage
Current solid waste collection	Scatteringly disposal	100.00
	A lack of staffs to collect solid waste or change the waste bags	50.00
	No prior sorting	83.33
	Collection held after the game finished	100.00
	Waste collectors allow to collect solid waste	66.67
	No waste collectors allowed at the stadium	33.33
Possible suggestions for the improvements	Encouraging the spectators to dispose solid waste in the bins provided	33.33
	After the game finished, the spectators help collecting the solid waste	50
	Building awareness on waste sorting to spectators	83.33
	Encouraging the implementation of 3Rs policy	50.00

According to Table 4.14, 100.00%, 83.33% and 50% of the respondents reported that the current problems of the solid waste collection were sometimes the spectators do not dispose the waste in the bins provided by the club, the spectators do not sort solid waste before disposal and a lack of staffs to collect solid waste respectively. The respondents added that usually full waste bags were not replaced during the game due to the lack of solid waste managed staffs. This make solid waste scatter outside the bins.

In addition, 100.00% of the respondents expressed that the stadium was cleaned after the game was over by the solid waste managed staffs. The 66.67% of the respondents stated that sometimes the club allowed waste collectors to collect the scattered solid waste such as plastic cup and plastic bottles on the grandstands.

All solid waste collected was put together in the temporary garbage room or storage after the game and transfer to the municipality's dumping site on the day after.

Regarding the possible suggestions for the improvement of the collection, 83.33% of the respondents suggested to build awareness on waste prior sorting among the spectators, 50% of the respondents suggested that the spectator should help collecting the solid waste after the game finished and the club should encouraging the implementation of 3Rs concept. While, 33.33% of the respondents stated that the club should encourage the spectators to dispose the solid waste in the bins provided.

Thus, knowledge and guideline regarding prior sorting and 3Rs concept should be provided for the spectators. In addition, an effective incentive should be created to encourage a proper disposal.

2.3) Recycling, composting and energy recovery

The current solid waste recycling, composting and energy recovery undertaken by the study clubs is shown in Table 4.15.

Table 4.15 The current solid waste recycling, composting and energy recovery undertaken by the study clubs

Item	Element	Percentage
Current solid waste recycling, composting and energy recovery	No recycling policy	66.67
	Some staffs collect plastic bottles in front of the entrance	33.33
	No ready market for resources generated from solid waste	100.00
	No problems on work safety in recycling process	100.00
	Not sure about an acceptance of the goods produced from recycled materials	100.00
	No environmental standards execution	100.00
Energy recovery	No technology and capacity to convert solid waste into a resource	100.00

According to recycling, composting and energy recovery, 66.67% of the respondents noted that many clubs do not have solid waste recycling policy. Thus, the commingled solid waste left in the garbage room was collected by the municipal officers without any process of recycling, composting or treatment. In addition, 100% of the respondents noted that there was no problem on work safety of individuals involved in the recycling and composting process. Besides, 100.00% of the respondents admitted that current solid waste treating method did not comply with the environmental standards.

In addition, 100.00% of the respondents stated that there was no technology and capacity to convert solid waste into a resource, they were not sure about market for resources generated from solid waste (compost, bio-gas) and they did not acknowledge that people accept the goods which produced from solid waste. As mentioned before, the Bangkok glass FC was the only club that implemented solid waste prior sorting policy and sold the sorted solid waste to the junk shop for recycling.

The respondents from the Bangkok glass added that price the sorted solid waste was determined daily by the junk shop. This sorted solid waste generated income around 1,000 to 3,000 Baht per match. As the club was fully responsible for all expenses of solid waste managed at their stadiums, the extra revenue from selling the sorted solid waste generated at the stadium could also alternatively subsidize the cost of solid waste management including the cost of waste bins, waste bags and solid waste transportation and solid waste managed staffs' payment.

2.4) Treatment and disposal

The current solid waste treatment and disposal of the study clubs is shown in Table 4.16.

Table 4. 16 The current solid waste treatment and disposal of the study clubs

Item	Element	Percentage
Treatment/ disposal	Costed about 3,000 Baht per match	33.33
	Costed about 4,000 Baht per match	66.67
	No environmental impacts in disposal process	100.00

According to the cost of solid waste management in each match, 33.33% of the respondents stated that they spent around 3,000 Baht per match to manage the solid waste while 66.67% noted that they spent around 4,000 Baht per match. The respondents added that the cost of solid waste management largely based on the staffs' payment, the cost of municipality's solid waste collection and the cost of waste bins and waste bags respectively. In addition, 100.00% of the respondents mentioned that there was no environmental impact on this stage.

The respondents described that the solid waste generated at the stadium was transferred to the municipal dumping site with all the solid waste generated in municipal area. The solid waste went to sanitary landfilling without the process of sorting, recycling or energy recovery. In addition, they added that the municipality did not have the technology that could convert solid waste into a resource. In their opinion, people still have negative attitude to use any goods that are produced from solid waste. Thus, the ready market for resources generated from solid waste was not well supported.

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Consequently, the current solid waste managed of the study clubs, challenges and issues are shown in Figure 4.6.

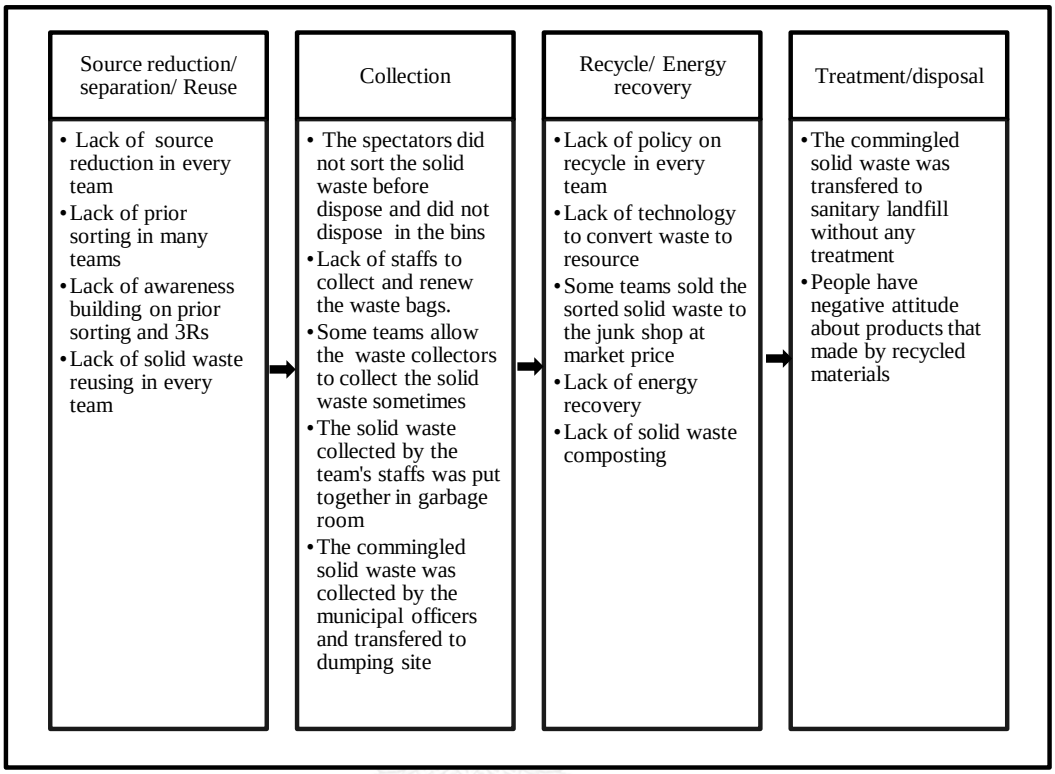

Figure 4.6 The current solid waste managed of the study clubs, challenges and issues.

3) An opinion on sustainable solid waste management.

The opinion on sustainable solid waste management of the respondents is shown in Table 4.17.

Table 4.17 The opinion of respondents on sustainable solid waste management

Item	Element	sub element	Percentage
Opinion on sustainable solid waste management	Awareness building on prior sorting		66.67
	Awareness building about disposing in the provided bins		33.33
	Awareness building on 3Rs concept		50.00
	Understanding of sustainable solid waste management	Recycling	50.00
		Sorting	41.67
		3Rs	33.33
	Income from selling of the sorted solid waste is an advantage from the sustainable solid waste management		100
A support of the sustainable solid waste management.	The spectator		50.00
	TPL/ government		16.67
	The club		100.00
	Media		0.00
	Willing to cooperate with the sustainable solid waste management policy		100
	Supporting 3Rs concept		91.67
	No cooperation on 3Rs concept		8.33
Effective incentives for implementing the sustainable solid waste policies	Point for the club		25.00
	Providing more bins for recycling		33.33
	Souvenirs/ tickets/ gifts		33.33
	Reputation of the clubs		16.67

In terms of improvement the solid waste managed process, 66.67%, 50.00% and 33.33 % of the respondents noted that they should build awareness on prior sorting, 3Rs concept and disposal the solid waste in the bins provided respectively.

The 100.00% of the respondents stated that they have heard about the sustainable solid waste management. The 50.00%, 41.67% and 33.33% of respondents indicated that the sustainable solid waste management was about solid waste recycling, solid waste sorting and 3Rs respectively.

In addition, 100.00% of the respondents agreed that the club could get positive advantages from the sustainable solid waste management via selling the sorted solid waste to the junk shop.

Besides, 100% of the respondents stated that the club should support the sustainable solid waste management. While 50.00% and 16.67% of the respondents thought that the spectators and the Thailand Premiere League or the government respectively should be the one who support the sustainable solid waste management.

Nevertheless, the respondents added that due to the club's limited annual budget, the clubs have less incentive to improve the solid waste management. The club would prioritize the development of youth players, stadium construction, and players' nutrition before solid waste management.

On the other hand, if the Football Association of Thailand [FAT] enacts the rules and regulations on the sustainable solid waste management, every club had to cooperate. In addition, 100.00% of the respondents indicated that they would cooperate with the sustainable solid waste management policy from the FAT and 91.67% of the respondents stated that they would cooperate if the Thailand Premiere League implements 3Rs concept.

Regarding effective incentives for the sustainable solid waste management, 33.33% of respondents mentioned about providing more bins and easier way to sort and recycle the solid waste. While, 33.33% mentioned about souvenirs, tickets or gifts as incentives. Besides, 25.00% of them mentioned that extra points from the Thai Premiere League would be effective incentives for the club to implement the sustainable solid waste management policy and 16.67% of them mentioned that the good reputation from implementing the sustainable solid waste management policy among other clubs would be forceful incentives.

Thus, the Thai Premiere League should launch the regulation and policy on the sustainable solid waste management. At the same time, it should encourage or provide some incentives and guidelines for the football clubs to enforce the sustainable solid waste policy. While, the club should build awareness regarding the sustainable solid waste management and 3Rs concept among the spectators. In addition, the clubs should engage the spectators to enhance the efficiency of solid waste management by providing persuasive incentives for them.

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4.4 Greenhouse gas emission generated.

The environment was respected as the third pillar of the Olympic movement by the IOC, along with sport and culture (Cantelon and Letters, 2000), and was conveyed to local Organising Committees for Olympic Games (OCOGs) which promised to consider the environmental consequences of their organizing activities. For examples, the Torino Winter Games in 2006 included measures to reduce greenhouse gas emissions, minimize water use in snow making and plan to offset carbon emissions linked to the event.

The Federation International de Football Association [FIFA]'s Green Goal programme aimed to make the World Cup the most environmentally friendly ever, by reduced use of water, refuse, energy and transport, and with plans to offset the 100,000 tons of carbon emissions expected to be generated by the event (Stahl and Hochfeld, 2006). In 2008, the Beijing Olympic Games also promoted to be "zero net emissions" games (Cheung, 2010).

Greenhouse gases are emitted from various sources of all sport game. In particular, a major sport event caused a large amount of waste left after the match inevitably. The organic waste decay resulting in various greenhouse gases. In order to calculate the greenhouse gas emissions from solid waste generated from the football matches, the revised 1996 IPCC guidelines for National Greenhouse Gas Inventories (Tier 2) was used for estimating emissions of methane [CH_4] from solid waste disposal sites.

The IPCC methodology for estimating methane [CH_4] emissions was based on the First Order Decay [FOD] method and some key emission factors such as Methane Correction Factor [MCF], Fraction of degradable organic carbon [DOC], Fraction of DOC dissimilated [DOC_F], Fraction of CH_4 in generated landfill gas [F] and Methane generation rate constant [k] with good quality of country-specific activity data. The First Order Decay [FOD] method can be expressed equivalently by equation as follows:

$$Q_{T,X} = kR_X L_0 e^{-k(T-X)}$$

Where

$Q_{T,X}$ = The amount of methane generated in year T by the waste R_X (Gg)

k = Methane generation rate constant (1/yr)

X = The year of waste input

R_X = The amount of waste disposed in year x (Gg)

L_0 = Methane generation potential (m^3/Gg of refuse)

= MCF x DOC x DOC_F x F x 16/12

(16/12 is molecular weight ratio CH_4/C)

T = Current year

The key emission factors used in inventory of waste sector of the Thailand's Second National Communication [SNC] submitted to the United Nations Framework Convention on Climate Change [UNFCCC] in 2010 are shown in Table 4.18.

Table 4.18 IPCC's default Emission factors used to estimating CH_4 emission from waste sector

Parameter	**Emission factors**
MCF	0.60
DOC	0.14
DOCF	0.77
F	0.53
K	0.03

Source: The Thailand's Second National Communication [SNC], Office of Natural Resources and Environmental Policy and Planning, 2010

This method assumes that the degradable organic component [degradable organic carbon, DOC] in waste decays gradually throughout a few decades, during which methane [CH_4] and carbon dioxide [CO_2] are formed. If conditions are constant, the rate of CH_4 generation relies on the amount of carbon remaining in the waste. As a result emissions of CH_4 from waste dumped in a disposal site are highest in the first

few years after deposition and slowly decline as the degradable carbon in the waste is consumed by the bacteria responsible for the decay (IPCC, 1996).

The emissions of CH_4 are converted to the emissions of carbon dioxide equivalent [CO_{2e}] which is a term for describing different greenhouse gases in a common unit. For any quantity and type of greenhouse gas, CO_{2e} signifies the amount of CO_2 that would have the equivalent global warming impact. The CO_{2e} allows comparing the greenhouse effect done by such degradation directly. Since carbon dioxide's effects are well-studied and used to indicate the atmospherical effect of various industries. Converting the methane produced by biodegradation to the CO_{2e} would provide the better perspective of the environmental effect done on the atmosphere. Thus, the result of greenhouse gas emission was usually presented in CO_{2e} per kilogram.

In order to convert greenhouse gases to CO_{2e}, the Global Warming Potential (GWP) index was used. GWP index shows the ability of a greenhouse gas to trap heat in the atmosphere relative to an equal amount of carbon dioxide. One kilogram of Carbon dioxide is equal to one kilogram of Carbon dioxide equivalent. Though the most prevalent, it is the least powerful greenhouse gas. Thus, one kilogram of CH_4 is equal to 21 kilograms of CO_{2e}. The CO_2 Equivalence factors of various substances are shown in Table 4.19.

Table 4.19 CO_2 Equivalence factors of various substances

Substance	**CO2 equivalence factor**
1 kg CO_2	1 kg CO_{2e}
1 kg CH_4	21 kg CO_{2e}
1 kg N_2O	310 kg CO_{2e}

Source: The Intergovernmental Panel on Climate Change [IPCC], 1996

The methane emissions from solid waste generated from the study matches were calculated by the aforementioned First Order Decay equation using some default emission factors and the country specific emission factors of waste sector from the Thailand's Second National Communication [SNC] submitted to the UNFCCC. The

methane emissions obtained from the IPCC method were converted to greenhouse gas emission in CO_2 equivalent unit. The average greenhouse gas emissions from solid waste generated from the study matches are shown in Table 4.20.

Table 4.20 The average greenhouse gas emissions from solid waste generated from the study matches

Club	**Average solid waste (kg.) per match**	**GHG emission ($kgCO_{2e}$) per match**
The SGC Muangthong United	370.4	10.96
The Bangkok glass	321.1	9.50
The Chiangrai United	295.8	8.75
Average	392.1	9.73

The SGC Muangthong United, the Bangkok glass and the Chiangrai United emitted 10.96, 9.50 and 8.75 $kgCo_{2e}$ respectively per match.

The data of solid waste generated from the study matches were also calculated into greenhouse gas emission using the production-based greenhouse gas emission calculating software developed by the Public Health and Environmental Technology Services Center which funded by the Environmental Research and Training Center [ERTC] (2011a). The software used country specific data obtained by production-based calculation of greenhouse gas emissions of each type of recycled material from a project research (phase I) of the ERTC (ERTC, 2011b). The production-based calculation is detailed as follow:

The production-based calculation of greenhouse gas emissions of each type of recycled material consisted of greenhouse gas emissions calculated by 1) production process and 2) energy used in production process of each type of recycled material.

1) The greenhouse gas emission calculated by production process used default emission factors from the revised 1996 IPCC guidelines for National Greenhouse Gas Inventories (ERTC, 2011b).

2) The greenhouse gas emission calculated by energy used in production process used the Net Calorific values [NCV] from the ministry of energy of Thailand and

default emission factors from the revised 1996 IPCC guidelines for National Greenhouse Gas Inventories (ERTC, 2011b). A set of parameter was from It is shown in Table 4.21.

Table 4.21 A set of parameter of greenhouse gas emissions from production process and energy used in production process of each type of recycled material

Type of sorted solid waste	**Greenhouse gas emission (kg CO_{2e}/kg of refuse)**
1. Soft paper	0.8049
2. Tin	0.4251
3. Glass bottle	0.4895
4. LDPE bottle	0.8722
5. PET bottle	0.6400
6. Aluminum	0.7851
7. Mixed plastic	0.0000

Source: The Environmental Research and Training Centre [ERTC], 2011b

The average greenhouse gas emissions from solid waste generated from the study matches calculated by the production-based greenhouse gas calculating software are shown in Table 4.22.

Table 4.22 Average greenhouse gas emissions from solid waste generation in each stadium

Club	**Average solid waste (kg.) per match**	**GHG emission ($kgCO_{2e}$) per match**
The SGC Muangthong United	370.4	28.60
Bangkok glass	321.1	14.13
Chiangrai United	295.8	12.84
Average	392.1	18.52

The SGC Muangthong United, the Bangkok glass and the Chiangrai United emitted 28.60, 14.13 and 12.84 $kgCo_{2e}$ respectively per match.

Due to the different estimating method, the average GHG emission per match calculated by the IPCC method was 9.73 $kgCo_{2e}$ while the one calculated by the ERTC method was 18.52 $kgCo_{2e}$.

The difference of greenhouse gas emission estimated using the IPCC method and the ERTC method was 62.23%. The difference would come from the emission factors used and method. While the IPCC method calculates the greenhouse gas emission using the default emission factors from the revised 1996 IPCC guidelines for National Greenhouse Gas Inventories which reported in The Thailand's Second National Communication, the production-based greenhouse gas calculating software utilized a set of country specific data from the ERTC's study of the greenhouse gas emissions from production-based recycled materials.

The greenhouse gas emission from solid waste generated at the stadium would mitigate if the solid waste is well managed. The implementation of the 3Rs concept [reduce, reuse and recycle] with solid waste prior sorting at the stadiums could improve the current solid waste management and help decreasing the greenhouse gas emission.

4.5 Policy review on solid waste management in Thailand

4.5.1 Solid waste management policy in Thailand

In Thailand, there are three fundamental laws regarding solid waste management which are detailed as follow:

4.5.1.1 The Enhancement and Conservation of National Environmental Quality Act B.E.2535

In the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (Ministry of Science, Technology and Environment, 1992), waste was defined in section 4 as "refuse, garbage, filth, dirt, wastewater, polluted air, polluting substances or any other hazardous substances which are discharged or originate from point sources of pollution, including residues, sediments, or the remainders of such matters, either in the state of solid, liquid or gas."

In Part 6, Section 78 and 79 stated about solid waste management that "the collection, transport, and other arrangements for the treatment and disposal of garbage and other solid wastes; shall be in accordance with the governing laws related thereto.

In case there is no specific law applicable thereto, the Minister shall, with the advice of the Pollution Control Committee, have the power to issue ministerial regulations specifying the types and categories of hazardous wastes generated from the production and usage of chemicals or hazardous substances in the production process of industry, agriculture, sanitation and other activities which shall be brought under control.

For this purpose, rules, regulations, measures and methods must also be prescribed for the control of collection, storage, safety measures, transportation, import into the Kingdom, export out of the Kingdom, and for proper and technically sound management, treatment and disposal of such hazardous wastes."

Since the Act was legislated in 1992, it was currently outmoded. It did not circumstantiate about a proper waste management and lack of awareness building and technology transfer regarding waste management for local government. In addition, it was deficient in public participation.

Nevertheless, the Act stipulated the National Environmental Board to create a policy and plan for enhancement and conservation of national environmental quality and submit to the cabinet for using as the long term National Framework in Section 13 (1).

1) The National Policy and Plan for Enhancement and Conservation of Environment Quality B.E. 2540- 2559 [1997-2016]

The National Policy and Plan for Enhancement and Conservation of Environment Quality (Office of the Natural Resources and Environmental Policy and Planning [ONEP], 1997) is a long term policy and has implemented for 20 years since 1997-2016. The main policy regarding waste management in the National Policy and Plan was about an encouragement of a systematic waste and hazardous waste management and its efficiency.

Furthermore, to develop an action plan that specify solid waste management, in Section 35 of the Enhancement and Conservation of National Environmental Quality Act mentioned that "The Minister shall, with the approval of National Environmental Board, formulate an action plan called "National Environmental Quality Management

Plan [EQMP]" for implement the National Policy and Plan for Enhancement and Conservation of Environment Quality determined by virtue of Section 13(1)."

2) The National Environment Quality Management Plan

The National Environment Quality Management Plan (ONEP, 2012) is a medium term policy that implemented for 5 years to achieve tangible environmental outcomes in improving environmental performance in the country. It stated that "shall be concerned by all government agencies to take actions within their powers and functions that are necessary for effective implementation of the plan. In addition, to ensure that actions are taken to achieve the objectives and goals as prescribed, it shall be the duty of the Ministry of Science, Technology and Environment to give advice to government agencies and state enterprises which are concerned with the formulation of work plans or the taking of any actions to implementing the Environmental Quality Management Plan".

The current version of the action plan is the National Environment Quality Management Plan for B.E. 2555-2559 [2012-2016] which corresponds to the 11th National Economic and Social Development Plan B.E. 2555-2559 [2012-2016].

The waste management was mentioned in the 4th strategy of the current National Environment Quality Management Plan regarding an environmental quality development for all level of the citizens. Key performance indicators of the 4th strategy regarding waste management were increase recycle rate to more than 30% of the waste generated in the country, increase percentage of waste that managed properly to more than 50% of the waste generated in the country.

The 4th strategy regarding solid waste emphasized on implementation 3Rs concept to waste management, empowerment of local governments to manage the waste efficiently with public participation.

In a short term action plan under the 4th strategy, the Enhancement and Conservation of National Environmental Quality Act B.E.2535 is required to reform in Section regarding decentralization and citizen engagement. In Section 4.1.5 stated that "creating economical instrument and mechanism of incentive to mitigate pollution emission at source by using deposit-refund system, developing packaging based on 3Rs [Reduce, Reuse and Recycle] concept and encouraging a concept of waste to energy."

In a medium tern action plan under the 4th strategy, a reinforcement of recycling business by supporting products that made by recycling materials and developing resource recovering technology were mentioned in Section 4.1.6. In addition, in Section 4.1.8 stated that the public-private partnership is supported for the private to invest in waste disposal center. In Section 4.1.12 stated about providing incentives for using polluting prevention technology or zero waste technology and incentives for using products that made from recycling materials or products that concerned Life Cycle Assessment [LCA] or Cleaner Technology [CT] such as investment incentives, tax incentives and special funding from financial institutions.

3) Regional Environmental Quality Management Plan

Besides the Environment Quality Management Plan, the regional Environmental Offices all over the country are mandated to formulate Regional Environmental Quality Management Plan [REQMP] (ONEP, 2013a) and carry out environmental planning activities that align to the National Framework formulated by the Office of the Natural Resources and Environmental Policy and Planning [ONEP] and on the basis of the Decentralization Policy of the government.

4) Provincial National Resources and Environment Plan

The REQMPs are expected to be adopted by respective Provincial Office of the Natural Resources and Environmental [PONRE] via the formulation of action plans, as contained in the respective Provincial National Resources and Environment Plans that implemented for 4 years [2013-2016] (ONEP, 2013b).

5) Provincial Environment Quality Management Action Plan

At the provincial level, the PONREs will formulate an annual Provincial Environment Quality Management Action Plan adopting the direction, plan and programmes of the REQMP which is an annual plan.

The linkages and relationships of the Environment Quality Management Plan with the other National Frameworks and plans are shown in Figure 4.7.

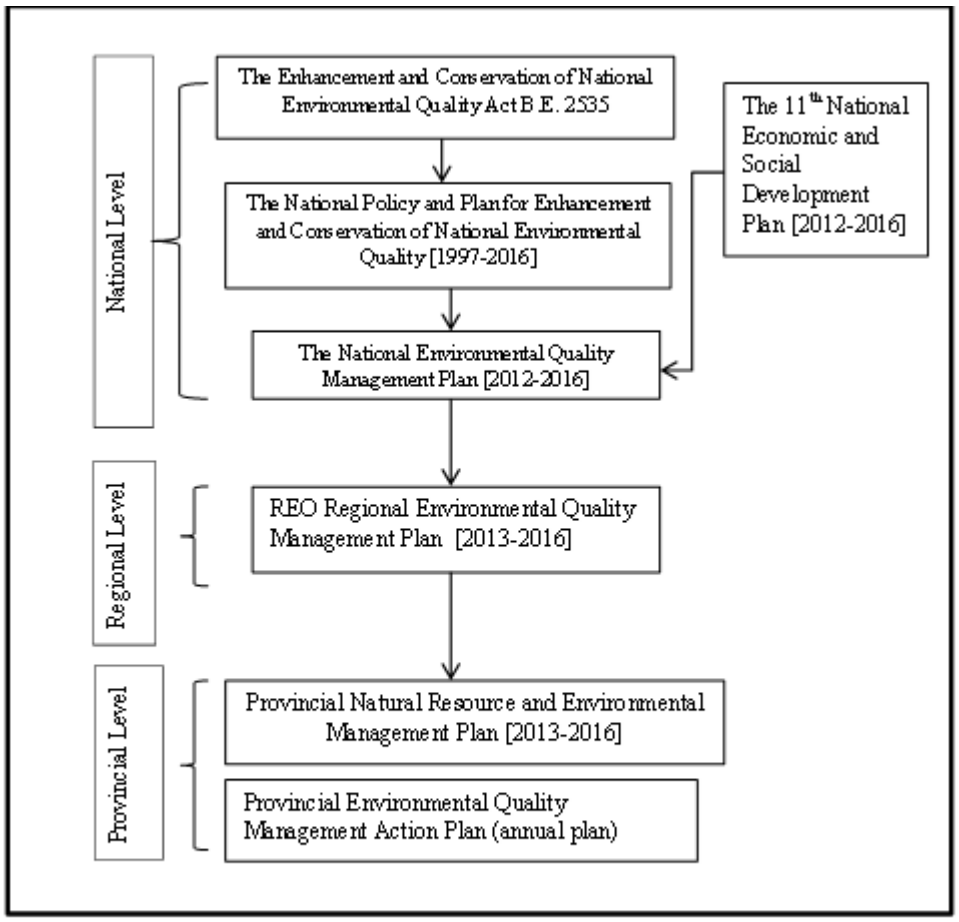

Figure 4.7 The linkages and relationships of the Environment Quality Management Plan with the other National Frameworks and plans.

Nevertheless, regarding the 4th strategy, it lacks of creating knowledge and understanding of a proper waste management and technology for local government before empowering them. In addition, the strategy did not set a standard for waste separation method. Some of local governments separated waste into burnable and unburnable waste while some of them separated waste into garbage, trash and hazardous waste. Therefore, the local governments disseminate and promote different separation methods to people. It eventually leads to a difficulty of management in waste management center.

Hence, if the strategy could provide the standard method of waste separation and determine waste collection period and frequency that applied in all districts, the strategy could be implemented more efficiently.

4.5.1.2 The City's Cleanness and Orderliness Act B.E. 2503

The City's Cleanness and Orderliness Act (Ministry of Interior, 1960) mentioned about solid waste management in Section 6. Regarding a responsibility to keep the areas clean, "owner of a building which located next to public footpath, was required to clean the footpath."

In Section 31 and 32 mentioned about a waste disposal that "waste disposal in public area was prohibited and an owner of property was not allowed to leave the land with waste and dirtiness."

Due to the City's Cleanness and Orderliness Act was legislated since 1960, it was lack of waste management framework. It was obsolete and needed to be reformed to use with other policy and plan effortlessly.

4.5.1.3 The Public Health Act B.E. 2535

The Public Health Act B.E. 2535 (Ministry of Public Health, 1992) mentioned about solid waste in Chapter 3: disposal of sewage and solid waste, section 18-20.

Section 18 stated that "Disposal of sewage and solid waste in the area of any local government shall be the power and duty of such local government. With reasonable cause, the local government may entrust any person with the task pursuant to paragraph one on its behalf under the control and supervision of the local government or may permit any person to operate the disposal of sewage or solid waste under section 19."

Section 19 stated that "Any person is forbidden to operate the business of collecting, transporting, or disposing of sewage or solid waste as a business or for payment of service charges, unless he has obtained a license from the local official."

Section 20 stated that "For the purpose of maintenance of cleanliness and establishment of orderliness in collecting, transporting, and disposing of sewage or solid waste the local government shall have powers to issue local provisions as follow:

1) Forbidding the discharging, emptying, leaving, or causing to exist in a public place or way of sewage or solid waste, except in the place provided by the local government for such purpose;

2) Prescribing that there be receptacles for sewage or solid waste available along public places or ways and private places;

3) Prescribing means of collecting, transporting disposing of sewage or solid waste or that owner or occupant of any building or place be required to practice correctly according to the hygiene and to the condition and nature of use of such building or place;

4) Prescribing rate of fees for services provide by the local government on collection and transportation of sewage of solid waste not exceeding that prescribed in the ministerial regulation;

5) Prescribing rule, procedure, and conditions on collecting, transporting, and disposing of sewage or solid waste, for observance by persons obtaining a license pursuant to section 19, and prescribing a rate of maximum charges collectable by the persons obtains a license pursuant to section according to the nature of services provided.

6) Prescribing any other requirements necessary for hygienic practice."

Although, the Public Health Act mentioned that waste management should be a duty of such local government, it did not mention that how the local government should manage the waste. Thus, without the Environment Quality Management Plan, the Public Health Act regarding waste management could not implement accordingly.

4.5.1.4 Other solid waste management policies

Besides the fundamental National Acts related to solid waste, there were the national strategic plan for municipal general and hazardous solid waste management (ONEP, 2005b) emphasized on promoting an environment-friendly waste disposal and enhanced waste disposal capacity of local administrative authorities.

Furthermore, the government also reinforced public-private sector participation on solid waste management and built public awareness to minimize waste and support the using of recyclable wastes and organic wastes. The policy aims at promoting the

private sectors to use clean technology for waste treatment and management, goods production and waste dispodal.

In addition, tax incentives are used as a tool for reducing wastes generated. The government also established and revised laws and regulations to make waste management more effective. Likewise, the research and development of suitable technology for creating environmental friendly products and products made from recycled materials and contents are supported (ONEP, 2005b).

Besides, the government also launched the national integrated waste management plan (ONEP, 2005b) which focused on application "cradle to cradle' concept that promote sustainable consumption such as managing waste generation at sources, increasing waste prior sorting and improving efficiency of waste utilization prior to disposal.

In addition, the government proposed the strategic plan on packaging and packaging waste management to minimize the volume of packaging waste generated each year. The proposed plan was based on the integrated waste management approach and life cycle approach which concern all relevant stakeholders from each stages of packaging life cycle. In this regard, the Federation of Thai Industries [FTI], the office of industrial economics, Chula Unisearch and the National Institute of Development Administration [NIDA] were assigned to study waste management that coped with recycled packaging. Thereafter, the Thailand Institute of Packaging management for Sustainable Environment (TIPMSE) was established (PCD, 2005).

To support the policies implementation, the Pollution Control Department developed solid waste reduction, separation and utilization guideline for people (PCD, 2008). The guideline underlined 3Rs concept and solid waste sorting method. In the guideline, solid waste was divided into 4 types as follow:

1) Compostable waste such as food remains, leaves, scraps of vegetable and fruit.
2) Recyclable waste such as glass, paper, plastic and can.
3) Hazardous waste such as pesticide container, chemical spray, battery and fluorescence.

4) General waste such as sullied plastic bag, foam, candy packaging and instant noodle packaging.

The guideline encouraged people to sort solid waste and dispose in different colors of waste bin regarding the types of solid waste. The green waste bin is for compostable waste, the yellow waste bin is for recyclable waste, the orange or waste bin is for hazardous waste and the blue waste bin is for general waste.

The latest policy regarding waste management was formulated by the Ministry of Natural Resource and Environment and adopted by the National Council for Peace and Order [NCPO] in 2015 namely Roadmap for waste and hazardous waste management. The Roadmap emphasized on waste reduction and separation at source, encouragement of integrated waste management center, enhancement of waste to energy implementation and public-private partnership, awareness building and participation creating in waste management, from source reduction to disposal, among youths and citizens.

According to cabinet resolution on 10th February 2015, the Roadmap implementation was detailed as follow:

1) Approximately, 30 million tons of accumulated remaining waste was eliminated by temporary landfill, a proper disposal and turn it to be Refuse Derived Fuel [RDF]. The waste elimination was expected to completely finish within 2017.

2) To eliminate the new waste, they plan to enhance waste reduction and separation at source, manage the waste at the integrated waste management center and turn the waste to energy with support of public-private partnership. In addition, they plan to increase awareness and public participation among youths and citizens.

3) To enhance waste disposal technology, they plan to build 53 waste-to-energy power plants.

4) While all provinces are developing their Provincial Environment Quality Management Action Plan, the Roadmap will implement in 6 provinces of Thailand.

5) The Ministry of Public Health and the Ministry of Industry are mandated to reform the relevant Acts and regulations to support the Roadmap.

Nevertheless, the plans in the Roadmap were prioritized backward. They emphasized on eliminating the accumulated remaining waste first. Thus, currently all

local governments are focusing on buying land and preparing for landfills and will collect fee from local people. The methods of waste elimination in the plans were not specified clearly such as a proper disposal. Besides, the temporary landfill is not a proper waste management.

The plans emphasized on enhancing waste reduction and separation at source before creating knowledge and understanding of waste reduction and separation for local governments, youths and citizens. Thus, the local governments, youths and citizens might not understand how to comply with the plans accurately.

4.5.2 Solid waste management policy and practices in sports

In sport filed, although several international sports organizations, mega sport events and sport clubs in many countries have implemented rules, regulations and practices regarding sustainable solid waste management. The Olympic movements' Agenda 21 implemented in the Olympic Games. It aims to encourage members' role on sustainable development and consists of a programme of action that leads to better socio-economic conditions, conservation and management of the environment and natural resources, and a more significant role for its members.

Solid waste management policy was in section of conservation and management of resources for sustainable development. It stated that the waste must be minimized by maximizing recycling of the products used, processing the waste that cannot be recycled, avoid using hazardous or toxic products, minimizing the quantity of wastes and minimizing all form of pollution. Nevertheless, the framework mentioned in the Olympic movement's Agenda 21 emphasized on hazardous waste and waste in general. It did not mention specifically about the solid waste management.

Besides the international Olympic Committee, the Federation International de Football Association [FIFA] which is a major football organization also encouraged the sustainable waste management practices even there was no waste management policy stated in the regulations. Schmied et al., (2007) reported that in the FIFA World Cup 2006, solid waste was generated almost 20% less, the majority of stadium visitors travelled by public transport and quantities of waste in stadiums were reduced.

On the other hand, the Football Association of Thailand [FAT] was lack of good practice of solid waste management. The Football Association of Thailand [FAT] is the

main actor who regulates and controls the professional football leagues in Thailand. The FAT executes under the roadmap of The Federation Internationale de Football Association [FIFA] and the Asian Football Confederation [AFC]. All of the main rules and regulations of Thailand's football leagues were legislated accordingly to the FIFA's. Other specific rules and regulations for the Asian countries were enacted by the AFC.

According to the rules and regulations of The Asian Football Confederation [AFC] and the Football Association of Thailand [FAT] (2013) the rules or regulations regarding solid waste management, recommended practices or an environmental concerning were not found. The AFC and the FAT have never launched any regulations and policy regarding a proper solid waste management, so does the Thai Premier League.

According to the Thai Premier League regulations 2015, it mentioned only that the club should clean the stadium and provide bins in toilets and around the stadium. The football clubs in Thailand managed solid waste by theirs own methods and policy depend on the management of the clubs, human resource and budget. Thus, the method regularly focused on economic affordability while environmental sustainability and social acceptability were overlooked.

Nevertheless, regarding to the solid waste managing laws, Acts, policy and plans initiated by the government would be able to support the concept of sustainable solid waste management and could be adopted to sport management well ahead.

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4.6 Sustainable solid waste management model

From the research results, the study found that the current solid waste management by the football clubs in the Thai Premier League is still lacks proper management, responsive laws, acts and policy, knowledge and techniques, public participation and effective incentives. The current management could not reduce the solid waste at source. Resource could not be efficiently recovered. Thus, the unnecessary amount of commingled recyclables went to the landfill without utilization. While, the rest of solid waste went to landfill without any treatment and create impact on an environment.

To achieve proper management, a sustainable solid waste management model for football matches is developed by means of a modeling instrument. The model is including the aspects of institution, policy, techniques, knowledge, economic, financing and public participation based on the significant factors for integrated solid waste management planning of the United Stated Environment Protection Agency [USEPA] (2002). The sustainable solid waste management model for football matches is shown in Figure 4.8.

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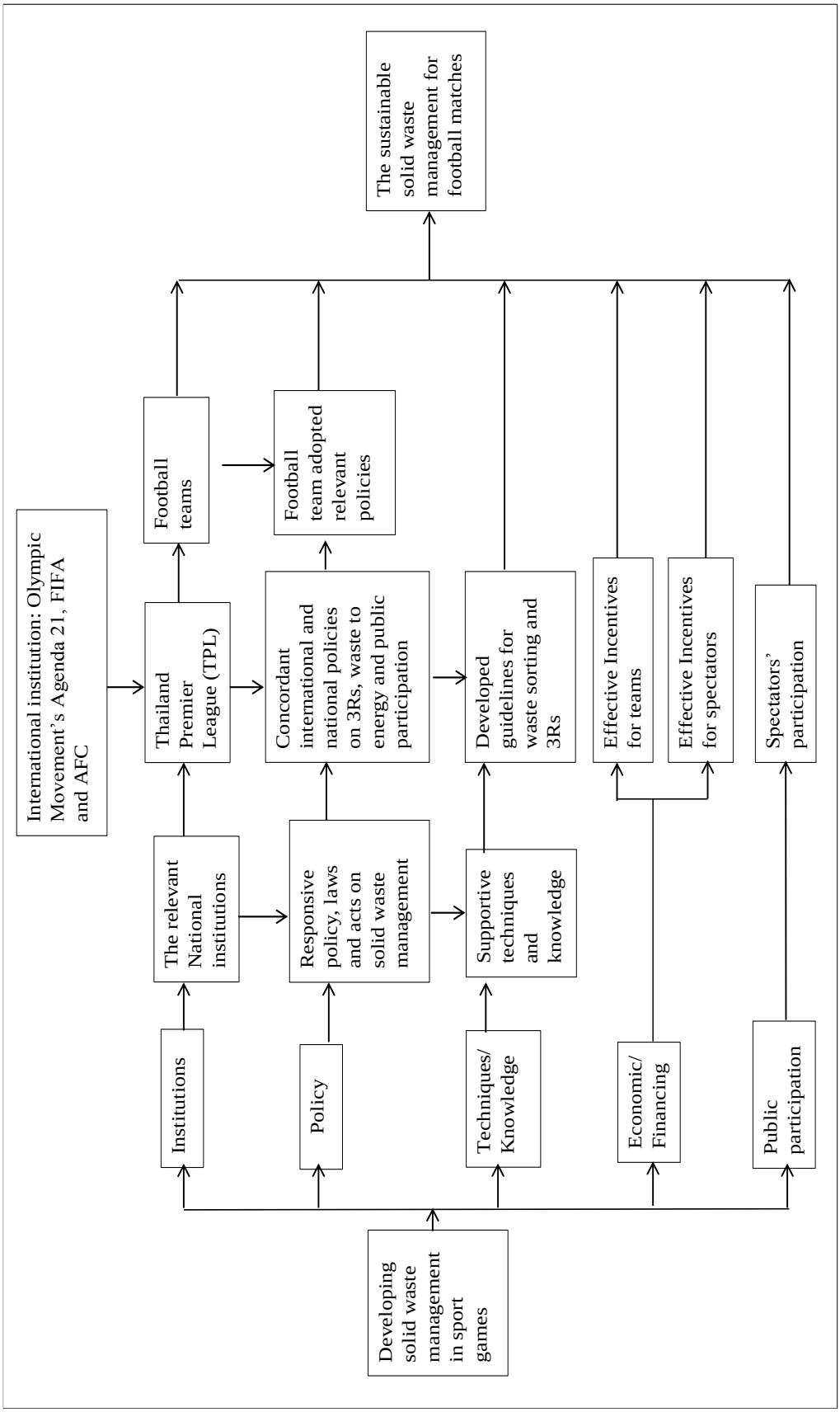

Figure 4.8 The sustainable solid waste management model for football matches.

In this model, the relevant national and international institutions have an important role to formulate and disseminate responsive policy, laws and acts on solid waste management. The Thailand Premier League [TPL] should adopt such policy, laws and acts, as well as international policy and guidance such as Olympic Movement's Agenda 21, to develop the concordant policies that emphasized on Supportive 3Rs concept, empowering SWM staffs, supporting spectator participation, creating incentives for 3Rs, developing packaging based on 3Rs, encouraging waste to energy concept, reinforcing of recycling business, developing resource recovery, supporting public-private partnership in SWM, developing public education and awareness program to promote prior sorting and 3Rs. Football clubs would be required by the TPL to implement the policy and adopt it to their solid waste management from source reduction/ separation/ reuse to disposal process to enhance 3Rs and resource recovery.

At source reduction/ separation/ reuse process, the shops and vendors are demanded to sell beverages with dispensers instead of sell as bottles or cans. They need to dispense or pour the beverages from bottles or cans to a recyclable plastic cup. The spectators are asked to deposit some money for the recyclable plastic cup. The shops will return the deposit money to the spectators if they return the recyclable plastic cup to the shops.

For security, the bottles and cans are not allowed in the stadium due to the regulation of the TPL. To this extent, the bottles and cans can be separated at source to avoid the commingled solid waste.

To reduce solid waste generated from plastic bag and other materials, the shops and vendors are mandated to use only paper packaging for food in the stadium. Thus, the possible solid waste generated at the stadium would be mainly plastic cup, plastic bag, paper packaging, food remains and less of other waste.

At collection process, the spectators are engaged in this step. The spectators could get points by collecting the solid waste generated at the stadium and could exchange the points with souvenirs, tickets or gifs. For the rest of solid waste, the solid waste managed staffs would collect, sorted and put in the garbage room. In addition, the staffs are required to renew the full waste bags to prevent scatteringly disposal.

At recycle/ energy recovery process, all sorted solid waste is sold to the junk shop for recycling. For the sorted paper packaging, the municipal officer would transfer to waste-to-energy power plant of the area, if any. For the rest of organic waste from food remainings, the solid waste managed staffs would compost and used as fertilizer.

Lastly at disposal process, the municipal officers would transfer the rest of solid waste to sanitary landfill.

The relevant national institutions should provide supportive techniques and knowledge regarding waste prior separation and 3Rs concept for the TPL to develop guidelines for football clubs. Thus, football clubs could use this guideline to raise awareness and encourage spectators' participation in club's sustainable solid waste management process.

To encourage football clubs to implement the policy effectively, the TPL should create effective incentives for football clubs. The incentives could be provided in terms of extra point, good reputation, tax return, rewards and sponsorship. In addition, the income from selling sorted solid waste could also be an incentive for football clubs to implement prior sorting policy. While, football clubs should create incentives for spectators to participate in sustainable solid waste management through the provision of items such as souvenirs, tickets or gifts.

The proposed sustainable solid waste management model would improve the deficiencies of the current management and increases the opportunity of resource recovery and recycling at the sport game. Besides, the model could be applied to any sport games in Thailand and other countries.

Further, the model should be tested and customized for each context to accommodate specific conditions. These conditions need to incorporate concern about environmental sustainability, economic affordability and social acceptability to achieve sustainable solid waste management.

CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

This research was carried out to study current situation of solid waste and its management and to propose possible sustainable solid waste management model for the football games. The study can be concluded and recommended as follows.

5.1 Solid waste generated at the stadium

The solid waste generation rate of the study stadiums was 0.097 kilogram per person. The types of solid waste generated at the stadiums consisted of glass bottles, aluminum cans, plastic cup, LDPE, mixed plastic, tin cans, and paper. Nevertheless, a large amount of commingled solid waste cannot be economically sorted due to its mixture with food remains and garbage in the bins. Less than 15% of the total solid waste generated was transported to recycling company. The commingled solid waste generated at the stadiums could be less if an appropriate prior-sorting was implemented.

5.2 Solid waste generating, disposing and sorting behaviors

Regarding opinion on solid waste generated at the stadiums, the spectators generated plastic bag, food package, glass bottles, plastic bottles, can, plastic cup, plastic box, paper, hazardous waste and other waste respectively. Due to lack of prior-sorting behavior, the solid waste generated could not be properly separated to recycling process and was commingled with food remains and garbage. Consequently, the commingled waste was uneconomical to separate and it was disposed inefficiently. The football clubs should be responsible mainly for solid waste management at the stadium. The football club should managed solid waste by sorting it before disposal. It reflects the spectators still did not satisfy with current solid waste management and would cooperate with the sustainable solid waste management. In addition, they viewed that the sorted solid waste could generate income for the football clubs.

5.3 Solid waste managed at the stadium

The current solid waste management in Thai Premier League is needed to improve in terms of source reduction and separation, collection, recycling, composting, energy recovery, treatment and disposal.

1) Source reduction, source separation and reuse

The practice of source separation was deficient. It lacked of awareness building for solid waste sorting and a proper disposal. The clubs provided different colors of waste bin for recycling and waste bags around the stadium. The source separation policy was implemented at only the Bangkok glass's stadium. While, other clubs did not execute prior sorting due to the limited budget on solid waste management and the shortage of the staffs. Thus solid waste was not utilized as much as possible.

2) Collection

The stadium was cleaned after the game finish by the solid waste managed staffs. Usually, the solid waste was scatteringly disposed and full waste bags were not replaced due to the lack of solid waste managed staffs. The recyclable solid waste was sold to the junk shop. The rest of commingled solid waste was put in the temporary garbage room or storage after the game and transfer to the municipality's dumping site.

3) Recycling, composting and energy recovery

The clubs do not have solid waste recycling policy. Thus, the commingled solid waste left in the garbage room was collected by the municipal officers without any process of recycling, composting or treatment.

4) Treatment and disposal

The solid waste generated was transferred to the municipal dumping site. The solid waste was disposed by sanitary landfilling without the process of sorting, recycling or energy recovery.

5.4 Greenhouse gas emission from solid waste generated at the stadium

Regarding the current solid waste management, GHG emission per match was 9.73 $kgCo_{2e}$. The greenhouse gas emission from solid waste generated at the stadium would mitigate if the solid waste is well managed. The implementation of the 3Rs

concept [reduce, reuse and recycle] with solid waste prior sorting at the stadiums could improve the current solid waste management and help decreasing the greenhouse gas emission.

5.4 Solid waste management policy

5.4.1 Solid waste management policy in Thailand

In Thailand, there are three fundamental Acts regarding solid waste management which were currently outmoded and lack of awareness building and public participation. Nevertheless, the Acts stipulated to create a policy and plan. Roadmap for waste and hazardous waste management is the latest policy and plan implemented currently.

5.4.2 Solid waste management policy and practices in sports

The laws or policy regarding solid waste management were not found at The AFC and the TPL. Nevertheless, the laws and policy formulated by the government could be adapted to sustainable solid waste management for football matches.

5.5 The sustainable solid waste management model

From the research results, the study found that the current solid waste management by the football clubs in the Thai Premier League is still lacks proper management that can be developed by means of a modeling instrument. To achieve proper management, a sustainable solid waste management model for football matches was developed including the aspects of institution, policy, techniques, knowledge, economic, financing and public participation from the USEPA's integrated solid waste management planning process.

For institutions and policy aspects, responsive policy, laws and acts on solid waste management from the relevant national and international institutions that are adopted by the Thailand Premier League [TPL]. In addition, the concordant policies from the TPL are adapted by football clubs. Besides, the relevant national institutions should provide supportive techniques and knowledge for the TPL to develop guidelines for football clubs to implement.

In addition, the TPL should create effective incentives for football clubs to comply with the policy and laws. The incentives could be provided in terms of tax return, rewards, sponsorship or revenue. While, football clubs should create incentives for spectators to participate in sustainable solid waste management through the provision of items such as souvenirs, tickets or gifts.

At source reduction/ separation/ reuse process, the shops and vendors are demanded to sell beverages with dispensers instead of sell as bottles or cans. They need to dispense or pour the beverages from bottles or cans to a recyclable plastic cup. The spectators are asked to deposit some money for the recyclable plastic cup. The shops will return the deposit money to the spectators if they return the recyclable plastic cup to the shops.

For security, the bottles and cans are not allowed in the stadium due to the regulation of the TPL. To this extent, the bottles and cans can be separated at source to avoid the commingled solid waste.

To reduce solid waste generated from plastic bag and other materials, the shops and vendors are mandated to use only paper packaging for food in the stadium. Thus, the possible solid waste generated at the stadium would be mainly plastic cup, plastic bag, paper packaging, food remains and less of other waste.

At collection process, the spectators are engaged in this step. The spectators could get points by collecting the solid waste generated at the stadium and could exchange the points with souvenirs, tickets or gifs. For the rest of solid waste, the solid waste managed staffs would collect, sorted and put in the garbage room. In addition, the staffs are required to renew the full waste bags to prevent scatteringly disposal.

At recycle/ energy recovery process, all sorted solid waste is sold to the junk shop for recycling. For the sorted paper packaging, the municipal officer would transfer to waste-to-energy power plant of the area, if any. For the rest of organic waste from food remainings, the solid waste managed staffs would compost and used as fertilizer. Lastly disposal process, the municipal officers would transfer the rest of solid waste to sanitary landfill.

The proposed sustainable solid waste management model comprised of responsive policy, laws and acts formulated, techniques, knowledge, forceful incentives

provided and public participation. The model would improve the deficiencies of the current management and increases the opportunity of resource recovery and recycling at the sport game. Besides, the model could be applied to any sport games in Thailand and other countries.

5.6 Recommendations

The current solid waste management lacks of responsive laws, acts and policy, knowledge and techniques, public participation and forceful incentives. Regarding the proposed model, it is further recommended that:

1) The responsive policy, laws and acts on solid waste management from the international and national institutions should be adopted by football clubs.

2) The supportive techniques and knowledge on 3Rs and solid waste sorting should be developed to be guidelines for football clubs and spectators.

3) The sustainable solid waste management model for the football match could be applied to any sport games in Thailand and the model should be studied further.

4) The consumption and waste generation behavior of spectators should be further studied to identify relevant conditions and drivers, including attitudes and preferences, demographic and socio-economic factors.

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REFERENCES

(1960). The city's cleanness and orderliness act B.E. 2503. Bangkok, Ministry of Public health.

(1992). The Enhancement and Conservation of the National Environmental Quality Act B.E. 2535 Bangkok, Ministry of Science, Technology and Environment.

(1992). The public health act B.E. 2535. Bangkok, Ministry of Interior.

(2015). Cabinet Resolution for Ministry of Natural Resources and Environment on 10th February 2015. Retrieved from http://bit.ly/1T2O0rf

AbouNajm, M., and El-Fadel, M. (2004).Computer-based interface for an integrated solid waste management optimization model.*Environmental Modelling and Software, 19*(12), 1151-1164.

Adams, K.T., Philips, P.S., and Morris, J.R.(2000). A radical new development for sustainable waste management in the UK: the introduction of local authority best value legislation.*Resources, Conservation and Recycling,* 30(3), 221-244.

Al-Khatib, I. A., Monou, M., Abu Zahra, A. S. F., Shaheen, H. Q., and Kassinos, D. (2010). Solid waste characterization, quantification and management practices in developing countries. A case study: Nablus district – Palestine. *Journal of Environmental Management, 91*(5), 1131-1138.

Alexander, D. L., Kern, W., and Neill, J. (2000). Valuing the Consumption Benefits from Professional Sports Franchises. *Journal of Urban Economics, 48*(2), 321-337.

Arena, U., Mastellone, M.L., and Perugini, F.(2003).The Environmental performance of alternative solid waste management options: a life cycle assessment study.*Chemical Engineering Journal*, 96(1-3),207-222.

Australian Bureau of Statistics [ABS]. (2002). *Sport and Recreation Funding by Government.* Canberra: Australia AGPS.

Bana E Costa, C.A., Stewart, T.J., and Vansnic, J.C. (1997). Multicriteria decision analysis: Some thoughts based on the tutorial and discussion sessions of the ESIGMA meetings.*European Journal of Operational Research, 99(1)*, 28-37.

Banks, G. (2002). Inter-state bidding wars: calling a truce.*speech to the committee for Economic Development of Australia.* Brisbane, November 6.

Bardelline, J. (Producer). (2012). London Olympics aims for a gold medal in waste recovery [Online]. Retrieved from http://www.greenbiz.com/news/2012/08/03/london-olympics-waste-recovery [2012, May]

Barlaz, B., Staley F. and Morton A. (2009). Composition of Municipal Solid Waste in the United States and Implications for Carbon Sequestration and Methane yield.*Journal of Environmental Engineering*, 901-909.

Barker, T., Bashmakov, I., Bernstein, L., and et al. (2007). *Technical summary in Climate change 2007: mitigation*. Contribution of working group III to the Fourth Assessment report of the IPCC, Cambridge University Press, Cambridge, United Kingdom [Online]. Retrieved from http://www.mnp.nl/ipcc/pages_media/FAR4docs/final_pdfs_ar4/TS.pdf [2012, May]

Berger, C., S.G., Wizere A. (1999). EUGENE: an optimisation model for integrated regional solid waste management planning.*Environment and Pollution, 12(2/3)*, 280-307.

Bernard, R.H. (2012). Social research methods: Qualitative and Quantitative Approaches. SAGE publication inc, 167-203.

Beutler, I. (2006). Sport for a better world: Report on the International year of sport and physical Education [Online].Retrieved from http://www.sportanddev.org/data/document/256.pdf [2011, July].

Beutler, I. (2008). Sport serving development and peace: Achieving the goals of the United Nations through sport.*Sport in Society: Cultures, Commerce, Media, Politics*, 359-369.

Bogner, J., Pipatti, R., Hashimoto, S., Diaz C., Mareckova K., Diaz L. (2008). *Mitigation of global greenhouse gas emissions from waste: conclusions and strategies from the Intergovernmental Panel on Climate Change (IPCC)Fourth Assessment Report.* Working Group III (Mitigation). *Waste Management & Research*, 26: 11–32.

Bovea, M. D., and Powell, J. C. (2006). Alternative scenarios to meet the demands of sustainable waste management. *Journal of Environmental Management, 79*(2), 115-132.

Broitman, D., O. Ayalon , I. Kan, and et al.(2012). One size fits all? An assessment tool for solid waste management at local and national levels.*Waste Management*, 1979-1988.

Caliskan, G.(2009). Criteria in Sport Management.*International Business Management, 3(2)* (Medwell), 22-31.

Cantelon and Letters. (2000). *The making of the IOC Environmental policy as the third demension of the Olympic movement*. International Review for the Sociology of Sport, 294-308

Carabias, W.J.V., Vinistoerfer, H., Stuecheli, A. (1999). Social aspects of public waste management in Switzerland. Waste Management 19 (6), 417-425.

Carmichael, G. R. and et al. (2009). *Independent Environmental Assessment: Beijing 2008 Olympic Games.* The United Nations Environment Programme [UNEP].

Chang, N.-B., Wei, Y.L., (1999). Strategic planning of recycling dropoff stations and collection network by multiobjective programming. *Environmental Management,24 (2),* 247–263.

Chaya, W., and Gheewala, S. H. (2007). Life cycle assessment of MSW-to-energy schemes in Thailand. *Journal of Cleaner Production, 15*(15), 1463-1468.

Chen, Chang-Chih , So-De shyu, and Yen-Chun Wu. (2011). A Waste management model for optimal recycling-landfilling policies under macroecnomic conditions.*Economic Modelling*, 852-858.

Cheng, S., Chan, C.W. and Huang, G.H. (2003). An integrated multi-criteria decision analysis and inexact mixed integer linear programming approach for solid waste management.*Engineering Application of Artificial Intelligence, 16(5-6),* 543-554.

Chernushenko, D., Van der Kamp, A. and Stubb, D. (2001). *Sustainable sport management: Running an environmentally, socially and economically responsible organization.* United Nations Envrionment Programme.

Cheung, K.Y. (2010). Economic Analysis of the Beijing Green Olympics: Implications on Environmental Protection in China.*International Journal of Economics and Finance, 2(3),* 104-113.

Chiemchaisri, C., Juanga, J.P., and Visvanathan, C.(2006). Municipal solid waste management in Thailand and disposal emission inventory.*Environment Monitoring Assessment*.

Clarke, M. J., Read, A. D., and Phillips, P. S. (1999). Integrated waste management planning and decision-making in New York City. *Resources, Conservation and Recycling, 26*(2), 125-141.

Clift, R., Doig, A., and Finnveden, G. (2000). The Application of Life Cycle Assessment to Integrated Solid Waste Management: Part 1—Methodology. *Process Safety and Environmental Protection, 78*(4), 279-287.

Coalter, F. (2005). *The Social Benefits of Sport.* Scotland: Sportscotland Research.

Collins, A., Jones, C., and Munday, M. (2009). Assessing the environmental impacts of mega sporting events: Two options? *Tourism Management, 30*(6), 828-837.

Collins, A., Flynn, A., Munday, A. and Roberts, A.(2007). Assessing the environmental consequences of major sporting events: the 2003-04 FA Cup Final.*Urban Studies*, 457-476.

Commission for a sustainable London 2012 (CSLondon). (2012). *London 2012: From vision to reality.* London: The Commission for a sustainable London 2012, November 2012.

Consonni, S., and Viganò, F. (2011). Material and energy recovery in integrated waste management systems: The potential for energy recovery. *Waste Management, 31*(9–10), 2074-2084.

Costi, P., Minciardi, R., Robba, M., Rovatti, M., and Sacile, R. (2004). An environmentally sustainable decision model for urban solid waste management. *Waste Management, 24*(3), 277-295.

Creswell, J.W. (2007). *Qualitative inquiry and research design: choosing among five approaches*. The United States of America: SAGE.

Dabkowski, S. (2012). Olympic Size Crowds Swamp the Sporting Capital Every year.*The Age*, 8 November.

Danteravanich, S., and C. Siriwong. (1998). Solid waste management in southern Thailand.*Journal of Solid waste Technology and Management, 25*, 21-26.

Daskalopoulos, E., Badr, O. and Probert, S.D. (1998). An integrated approach to municipal solid waste management.*Resources, Conservation and Recycling*, 33-50.

Diaz, R., and Warith, M. (2006). Life-cycle assessment of municipal solid wastes: Development of the WASTED model. *Waste Management, 26*(8), 886-901.

Dorvil, L. (2007). *Private sector participation in integrated sustainable solid waste management in low- and middle income countries.* HSG.

El-Fadel, M., Findikakis, A. N., and Leckie, J. O. (1997). Environmental Impacts of Solid Waste Landfilling. *Journal of Environmental Management, 50*(1), 1-25.

Emery, P. (2009). Past, present, future major sport event management practice: The practioner perspective.*Sport Management Review*, 158-170.

Environment Protection Department [EPD]. (2005). *3Rs model applied in Waste Hierarchy*.

Environmental Research and Training Centre [ERTC]. (2011a). *A Production-based greenhouse gas emission calculating software.*

Environmental Research and Training Centre [ERTC]. (2011b). *Project research of greenhouse gasemission generated by each type of recycled municipal solid waste(phase I).*

Eriksson, O., and Bisaillon, M. (2011). Multiple system modelling of waste management. *Waste Management, 31*(12), 2620-2630.

Ezilon maps. (2015). Map of Thailand [Online]. Retrieved from http://www.ezilon.com/maps/asia/thailand-maps.html [2015, May]

Finnveden, G. (1999). Methodological aspects of life cycle assessment of integrated solid waste management systems. *Resources, Conservation and Recycling, 26*(3–4), 173-187.

Football Association of Thailand [FAT]. (2013). *Statistic of Thailand Premier League 2010/11 and 2011/12.* Football Association of Thailand [FAT].

Franklin, M. A. (2002). Solid waste stream Characteristics. In *Handbook of solid waste management*, by George Tchobanoglous, 5.1. McGraw Hill.

Furrer, P. (2002). Sustainable Olympic Games: A dream or a reality.*Bollettino della Societa Geografica Italiana*, 2002: Serie XII, Volume VII, 4.

Geng, Y., Zhu, Q. and Haight, M. (2007). Planning for integrated solid waste management at the industrial Park level: A case of Tianjin, China.*Waste Management*, 141-150.

Gheewala, Liamsanguan C. and Shabbir H. (2004). Environmental Evaluation of Municipal Solid Waste Management in Phuket: A Life Cycle Perspective.*The Joint International Conference on Sustainable Energy and Environment.* Hua Hin, Thailand: King Mongkut's University of Technology Thonburi.

Gibson, F. (2008). Green Design and sustainability in sport and recreation facilities.*The Smart Journal*, 26-33.

Gidarakos, E., Havas, G., and Ntzamilis, P. (2006). Municipal solid waste composition determination supporting the integrated solid waste management system in the island of Crete. *Waste Management, 26*(6), 668-679.

Gottinger, H. W. (1988). A computational model for solid waste management with application. *European Journal of Operational Research, 35*(3), 350-364.

Greyson, J. (2007). An economic instrument for zero waste, economic growth and sustainability. *Journal of Cleaner Production, 15*(13–14), 1382-1390.

Gyarfas, A. (2012). 8 ways the Olympic Games have gone green. Econewsnetwork. Retrieved from http://econewsnetwork.org/2012/07/eight-ways-the-olympic-games-have-gone-green/. [June, 2015]

Haan, H., Adrian C., and Inge, L. (1998). *Involving micro- and small enterprises: Guidelines for municipal managers* ITC/ILO, SKAT, WASTE.

Haigh M. et al. (2006). EPIC/CSR Integrated Waste Management Tool: Environmental Analysis Model, Environment and Plastics Industry Council and CSR: Corporations Supporting Recycling, Version: Release 2.0.6.

Harrison, K., Dumas, R.D., Solano, E. and et al.(2001). Decision support for life cycle based solik waste management.*Journal of Computing in Civil Engineering*, 44-58.

He, L., Huang, G.H., and Lu, H. (2011). Greenhouse gas emissions control in integrated municipal solid waste management through mixed integer bilevel decision-making.*Journal of Hazardous Materials*, 112-119.

Hone, P. (2011). *Assessing the Contribution of sport to the Economy.* Deaking University: School of Accounting Economics and Finance.

Intergovernmental Panel on Climate Change [IPCC]. (1996). *The revised IPCC 1996 Guidelines for National Greenhouse Gas Inventories*. Intergovernmental Panel on Climate Change.10 September 1996 [Online]. Retrieved from http://www.ipcc-nggip.iges.or.jp/public/gl/invs2.html. [2014, June]

Intergovernmental Panel on Climate Change [IPCC]. (2006). *2006 IPCC Guildelines for National Greenhouse Gas Inventories: Volume 5 Waste*. Institution for Global Environmental Strategies (IGES), Hayama, Japan on behalf of the IPCC.

Intergovernmental Panel on Climate Change [IPCC]. (2007). *IPCC Fourth Assessment Report: Climate Change 2007*. Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge.

International Academy of Sports Science and Technology [Academie Internationale des Sciences et Techniques du Sport: AISTS]. (2010). *Sustainable Sport and Event toolkit (SSET).* Vancouver: The Vancouver Organizing Committee for the 2010 Olympic and Paralympic Winter Games [VANOC].

International Olympic Committee [IOC]. (1999). Sport and Environment Commission. *Olympic Movement's Agenda 21: Sport for sustainable development.* Shell International.

International Olympic Committee [IOC]. (2005). *Manual on Sport and the Enviroment.* Lausarne, Switzerland: International Olympic Committee.

International Olympic Committee [IOC]. (2006). *IOC Guide on Sport, Environment and Sustainable Development.* International Olympic Committee.

International Olympic Committee [IOC]. (2009). *Factsheet the environment and sustainable development.* International Olympic Committee (IOC).

International Olympic Committee [IOC]. (2009). *Progress report: Sport, Environment and Sustainable Development.* Vancouver: 8th IOC World Conference on Sport and Environment.

International Olympic Committee [IOC]. (2011a). *Sport and Enviornment Commission.* April 2, 2011 [Online]. Available from : http://www.olympic.org/news/9th-world-conference-on-sport-and-the-environment-comes-to-a-close-in-doha/126983 [2011,August]

International Olympic Committee [IOC]. (2011b). *Sustainability Through Sport: Implementing the Olympic movement's Agenda 21.* International Olympic Committee [IOC].

International Organization for Standardization [ISO]. (2004). Environmental management systems- Requirement with guidance for use. ISO14001:2004. Swithzerland: ISO.

International Organization for Standardization [ISO]. (2006a). *Environment management-Life cycle assessment: Principles and framework: ISO14040.* Switzerland: ISO.

International Organization for Standardization [ISO]. (2006b). *Environment management-Life cycle assessment: Requirements and guidelines: ISO14044.* Switzerland: ISO.

International Organization for Standardization [ISO].(2012). *Sustainable Event: ISO20121.* Switzerland: ISO.

Ittiravivongs, A. (2012). Household Waste Recycling Behavior in Thailand: The Role of Responsibility.*2012 International Conference on Future Environment and Energy.* Singapore: IACSIT Press.

Jones, C. (2001). Mega events and the host economy: determining the true worth of the 1999 Rugby World Cup International.*Journal of Tourism Research*, 241-251.

Joos, W., Carabias, V., Winistoerfer, H., and Stuecheli, A. (1999). Social aspects of public waste management in Switzerland. *Waste Management, 19*(6), 417-425.

Joseph, K. (2006). Stakeholder participation for sustainable waste management. *Habitat International, 30*(4), 863-871.

Karamouz, M., Zahraie, B., Kerachian, R., Jaafarzadeh, N., and Mahjouri, N. (2007). Developing a master plan for hospital solid waste management: A case study. *Waste Management, 27*(5), 626-638.

Kaseva, M. E., and Gupta, S. K. (1996). Recycling — an environmentally friendly and income generating activity towards sustainable solid waste management. Case study — Dar es Salaam City, Tanzania. *Resources, Conservation and Recycling, 17*(4), 299-309.

Knoeri, C., Binder, C. R., and Althaus, H.-J. (2011). Decisions on recycling: Construction stakeholders' decisions regarding recycled mineral construction materials. *Resources, Conservation and Recycling, 55*(11), 1039-1050.

Kollikkathara, N., Feng, H., and Stern, E. (2009). A purview of waste management evolution: Special emphasis on USA. *Waste Management, 29*(2), 974-985.

Koroneos, C. J., and Nanaki, E. A. (2012). Integrated solid waste management and energy production - a life cycle assessment approach: the case study of the city of Thessaloniki. *Journal of Cleaner Production, 27*, 141-150.

Kuniyal, J.C., Jain, A.P., and Shannigrahi, A.S. (1998). Public involement in solid waste management in Himalayan trail in and around the Valley of Flowers, India.*Resources, Conservation and Recycling*, 299-322.

Liamsanguan, C., andGheewala, S. H. (2008). The holistic impact of integrated solid waste management on greenhouse gas emissions in Phuket. *Journal of Cleaner Production, 16*(17), 1865-1871.

MacDonald, M. (1996a). Solid Waste Management models: a state of the art review. *Journal of solid waste technology and management23 (2)*, 73–83.

MacDonald, M. (1996b). A Multi-attribute spatial decision support system for solid waste planning. Computer, Environment, and Urban Systems 20(1), 1–17.

MacKenzie, J.D. (2006). *Moving towards sustainability in the Olympic Games planning process.* University of British Columbia.

Manga, V.E., Forton, O.T. , and et al. (2008).Waste management in Cameroon: A new policy perspective?*Resouces, Conservation and Recycling 52*, 592-600.

Marco F., Iraldo, F., and Melis, M. (2008). *The Impact of Wide-Scale Sport Events on Local development: and Assessment of the XXth Torino Olympics through the sustainability Report.* Universita Commerciale Luigi Bocconi.

Marshall, R. E., and Farahbakhsh, K. (2013). Systems approaches to integrated solid waste management in developing countries. *Waste Management, 33*(4), 988-1003.

Mazzanti, M., and Zoboli, R. (2008). Waste generation, waste disposal and policy effectiveness: Evidence on decoupling from the European Union. *Resources, Conservation and Recycling, 52*(10), 1221-1234.

McDougall, F., White, P., Franke, M. and Hindle, P. (2001). *Integrated solid waste management: A life cycle inventory.* London: Blackwell Science.

McCarty, J. A., and Shrum, L. J. (1994). The recycling of solid wastes: Personal values, value orientations, and attitudes about recycling as antecedents of recycling behavior. *Journal of Business Research, 30*(1), 53-62.

McCracken, G. (1988). *The long interview*. Newbury Park, CA: Sage Publication.

McDougall, F., and Nilsson-Djerf, J. (2000). Social factors in sustainable waste management.*Warmer Bulletin 73*, 18-20.

McMichael, A.J. (2003). *Global climate change and health: An old story Writ Large.* World Heahlth Organization. 2003, Retrieved by 15 December 2013.

Medina, M. (2002).*Globalization, Development, and Municipal Solid Waste Management in Third World Cities.* Tijuana, Mexico: El Colegio de la Frontera Norte, 2002.

Mitchell, J.(2007). Sustainable Soccer: How green Projects at International Sporting Events Benefit the fans, the global climate, and local populations.*Sustainable Development Law and policy,* Article 19.

Moeller, D. W. (2005). *Environmental Health.* Havard University Press.The United States of America

Mohareb, A.K., Warith, M.A., and Diaz, R. (2008). Modelling greenhouse gas emissions for municipal solid waste management strategies in Ottawa, Ontario, Canada.*Resources, Conservation and Recycling*,*52 (11)*, 1241-1251.

Montibeller, A., and Franco, G. (2010). *Handbook of Multicriteria Analysis: Multi-Criteria Decision Analysis for Strategic Decision Making.* Berlin: Springer-Verlag, 2010.

Morris, E., George, L., and Van Houtven, L. (1999). Household Behavior Under Alternative Pay-As-You-Throw Systems for solid waste disposal.*Land Economics, 75(4)*, 515-537.

Morris, J. (1991). Source separation vs Centralised processing: An avoided cost optimisation model provides some intriguing answers.*Jornal of Resource Management and Technology*, 133-140.

Morrissey, A. J., and Browne, J. (2004). Waste management models and their application to sustainable waste management. *Waste Management*, *24*(3), 297-308.

Mulholland, E. (2007).*What sport can do.* The True Sport Report. Ottawa, Ontario: The Canadian Centre for Ethics in Sport.

Muller, M., and Hoffman, L. (2001). *Community partnerships in integrated sustainable waste management*, WASTE, CW Gouda, TheNetherlands, 2001 [Online].Retrived from http:// www.waste.nl [2013, January]

Mutavchi, V. (2012). *Solid waste management based on cost-benefit analysis using the WAMED model*, Linnaeus University. No 76/2012. ISBN: 978-91-86983-30-7.

Nitivattananon, S. and Suttibak, V. (2005). Enhancing solid waste management capacity of local government aothorities: Review of current status in Thailand.*International Conference on Integrated solid waste management in Southeast Asian Cities.* Siem Reap, Cambodia: Asian Institute of Technology, 5-7 July 2005.

Oak, M. (2011). *Benefits of Playing sports*[Online]. Retrieved fromhttp://www.buzzle.com/articles/benefits-of-playing-sports.html [2011,July]

Office of Natural Resources and Environmental Policy and Planning [ONEP]. (1997). *The National Policy and Plan for Enhancement and Conservation of Environment Quality B.E. 2540-2559*, the office of Natural Resources and environmental Policy and Planning.

Office of Natural Resources and Environmental Policy and Planning [ONEP]. (2005a). *Executive Summary: National Strategic plan for municipal general and hazardous solid waste management*, the office of Natural Resources and environmental Policy and Planning (PDF file created in 2005).

Office of Natural Resources and Environmental Policy and Planning [ONEP]. (2005b). *Background and justification, National Strategic Plan for municipal general and hazardous solid waste management*. the office of Natural Resources and environmental Policy and Planning (PDF file created in 2005).

Office of Natural Resources and Environmental Policy and Planning [ONEP]. (2010). *Thailand's Second National Communication under the United Nations Framework Convention on Climate Change*. Ministry of Natural Resources and Environment. Bangkok, Thailand. 102 p.

Office of Natural Resources and Environmental Policy and Planning [ONEP]. (2012). *The National Environment Quality Management Plan,* Ministry of Natural Resources and Environment. Bangkok, Thailand.

Office of Natural Resources and Environmental Policy and Planning [ONEP]. (2013a). *Regional Environment Quality Management Plan,* Ministry of Natural Resources and Environment. Bangkok, Thailand.

Office of Natural Resources and Environmental Policy and Planning [ONEP]. (2013b). *Provincial National Resources and Environment Plan,* Ministry of Natural Resources and Environment. Bangkok, Thailand.

Oldenboom E. and Kleissner, A.(2006). The Economic Impact of Sport.*The EU and Sport Matching expectations.* Brussels, 2006.

Othman, S. N., Zainon Noor, Z., Abba, A. H., Yusuf, R. O., and Abu Hassan, M. A. (2013). Review on life cycle assessment of integrated solid waste management in some Asian countries. *Journal of Cleaner Production, 41,* 251-262.

Özeler, D., Yetiş, Ü., and Demirer, G. N. (2006). Life cycle assesment of municipal solid waste management methods: Ankara case study. *Environment International, 32*(3), 405-411.

Palanivelu, K., and Thanasekaran, K. et al. (2003). *In Proceedings of workshop on sustainable landfill management,* Centre for Environmental Studies, Anna University, Chennai [Online]. Retrieved from : http://www.annauniv.edu/landfill [2013, March]

Petts, J. (2000). Municipal waste management: inequities and the role of deliberation.*Risk Analysis 20(6),* 821-832.

Pinheiro, G., Rendeiro, G., Pinho, J., and Macedo, E. (2012). Sustainable management model for rural electrification: Case study based on biomass solid waste considering the Brazilian regulation policy. *Renewable Energy, 37*(1), 379-386.

Pires, A., Martinho, G., and Chang, N.B. (2011). Solid waste management in European countries: A review of systems analysis techniques.*Journal of Environmental Management*, 92(4), 1033-1050.

Phillips, P. S., Tudor, T., Bird, H., and Bates, M. (2011). A critical review of a key Waste Strategy Initiative in England: Zero Waste Places Projects 2008–2009. *Resources, Conservation and Recycling, 55*(3), 335-343.

Pollution Control Department [PCD]. (1992a). The National environmental quality support and conservation act [Online]. Retrieved from http://www.pcd.go.th/info_serv/reg_envi.html, [June, 2015]

Pollution Control Department [PCD]. (1992b). The city's cleanness and neatness act [Online]. Retrieved from http://www.thailawtoday.com/index.php?option=com_content&view=article&id=649&format=pdf, [June, 2015]

Pollution Control Department [PCD]. (1992c). The public health act [Online]. Retrieved from http://www.anamai.moph.go.th/download/download/publichealthact.htm, [June, 2015]

Pollution Control Department [PCD]. (2003). *Final Report: Waste Composition Survey and Analysis for local Administrative Office all over the Country*[Online]. Retrieved from http://infofile.pcd.go.th/waste/Reportwaste.pdf?CFID=6073453&CFTOKEN=56977045. (in Thai) [2011,September]

Pollution Control Department [PCD]. (2008). *Solid waste reduction, separation and utilization guideline for people* [Online]. Retrieved from http://infofile.pcd.go.th/waste/waste_reduce_people.pdf?CFID=3776736&CFTOKEN=57912159 [2015, October]

Pollution Control Department [PCD]. (2009). *Thailand State of Environment 2008*. PCD. 252p. (in Thai) PCD [Pollution Control Department] (2011) Draft of National 3Rs Strategy. PCD. (Unpublished: in Thai)

Pollution Control Department [PCD]. (2009). *Final Report the Exploration and Analysis Municipal Solid waste Composition.* Bangkok: Ministry of Natural Resources and Environment.

Pollution Control Department [PCD]. (2012). *Thailand's Pollution Situation Report 2011*. Pollution Control Department [PCD].

Pollution Control Department [PCD]. (2015). *Waste and hazardous waste management guidelines proposed to the National Council for Peace and Order* . Pollution Control Department [PCD]. Retrieved from http://www.pcd.go.th/data/16-6-2014.pdf

Rogers, M. (2001). *Engineering Project Apprasisal: The Evaluation of Alternative Development Schemes.*London: Blackwell Science. Wiley, 304.

Rogner, H.-H., D. Zhou, R. Bradley. P. Crabbé, O. Edenhofer, B.Hare, L. Kuijpers, M. Yamaguchi. (2007). Introduction. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Rydin, Y., Seymour, R.,Lorimer, S. (2011). *Sustainability in the Sports Sector.* London: UCL Environment Institure.

Saaty, T.L. (1980). The Analytic Hierarchy Process. McGraw-Hill, New York.

Schmidt, C.W. (2006). Putting the Earth in Play: Environmental Awareness and sports.*Environment and Health Perspective,* A286-A295.

Schmied, M., Hochfeld, C. andStahl, H. (2007). *Green Champions in Sport and Environment.* Berlin: German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

Schultz P.W., Oskamp S. and Mainieri T. (1995). Who recycles and when? A Review of personal and situational factors. Journal of Environmental Psychology. 15, 106-121.

Seadon, J.K.(2006). Integrated waste management - Looking beyond the solid waste horizon.*Waste Management*, 1327-1336.

Seadon, J.K. (2010). Sustainable waste management systems.*Journal of Cleaner Production*, 1639-1651.

Seo, S. (2006). Environment impact of solid waste treatment methods in Korea.*Journal of Environmental Engineering Division, 130(1)*, 81-89.

Sharma, P., and Sharma, J. (2013). A Confirmatory Factor Analysis of Dutch Work Addiction Scale (DUWAS).*Global Business Review*, 211-223.

Shekdar, A.V. (2009). Sustainable solid waste management: An integrated approach for Asian Countries.*Waste management 29*, 1438-1448.

Silva da Rosa, F., Ensslin, S.R, Ensslin, L. and Lunkes, R.J.. (2012). Environmental disclosure management: a constructivist case.*Environmental disclosure management*, 1117-1136.

Singh, R. P., Singh, P., Araujo, A. S. F., Hakimi Ibrahim, M., and Sulaiman, O. (2011). Management of urban solid waste: Vermicomposting a sustainable option. *Resources, Conservation and Recycling*, *55*(7), 719-729.

Skordilis, A. (2004). Modelling of integrated solid waste management systems in an island.*Resources, Conservation and Recycling*, 243-254.

Smith, D.G., and Baetz, B.W., (1991). A comprehensive costing methodology for the assessment of solid waste management alternatives. *Journal of Resource Management and Technology, 19 (4),* 140–147.

Solid Waste and Emergency Response [SWER]. (2002). *What is integrated solid waste management.* United States Environmental Protection Agency.

Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M. and Miller, H.L. (2007). *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*,Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Stahl, H. and Hochfeld, C. (2003). *Green Goal: Environmental goals for the 2006 FIFA World Cup.* Berlin: Oko-Institut.

Steiner, A. (2006). Quoted in *London 2012's one planet Olympics Policy approval*. United Nations Environmental Programme, News Centre.

Stubbs, D. and Chernushenko . (2005). Guidelines for greening sports events [Online].Retrieved from http://www.committedtogreen.org [August, 2011].

Su, J.-P., Chiueh, P.-T., Hung, M.-L., and Ma, H.-W. (2007). Analyzing policy impact potential for municipal solid waste management decision-making: A case study of Taiwan. *Resources, Conservation and Recycling*, *51*(2), 418-434.

Sudhir, V., Muraleedharan, V.R., Srinivasan, G., (1996). Integrated solid waste management in urban India: a critical operational research framework. *Socio-Econ. Plann. Sci*.,*30(3),* 163–181.

Sudhir, V., G. Srinivasan, and V.R. Muraleedharan. (1997). Planning for sustainable solid waste management in urban India.*System Dynamics Review,13*, 223-246.

Tanskanen, J.H. (2000). Strategic planning of municipal solid waste management.*Resources, Conservation and Recycling 30*, 111-133.

Tchobanoglous, George. (2002).Waste generation and management in a technological society. In *Handbook of solid waste management,* 1.1. McGraw-Hill.

Tchobanoglous, George. (2009). *Environmental engineering: Environmental health and safety for municipal Infrastructure, Land use and planning, and Industry.* United States of America.

—. *Integrated Solid waste management.* New York: McGraw-Hill, 1993.

The Asian Football Confederation [AFC]. (2013). Rules and regulations [Online]. Retrieved fromhttp://www.the-afc.com/en/ [2013, April]

The Bangkok glass FC [BGFC]. (2013). The Leo stadium [Online]. Retrieved from http://www.bangkokglassfc.com/club-info-04.html [2013, January]

The Chiangrai United FC [CRUTD]. (2012). The United stadium [Online]. Retrieved from http://www.thailandsusu.com [2012, December]

The London Organising Committee of the Olympic Games and Paralympic Games. (2009). Towards a one planet 2012. Retrieved from*www.london2012.com.* December

The London Organising Commitee of the Olympic Games and Paralympic Games. (2012).*London 2012 Post-Games sustainability Report: A legacy of change.* London: The London Organising Commitee of the Olympic Games and Paralympic Games.

The SCG Muangthong United FC [MTUTD]. (2012). The SCG Muangthong stadium [Online]. Retrieved from http://www.mtutd.tv [2012, December]

The Siam sport. (2014). Sales revenue circulated in a football business in Thailand [Online]. Retrieved from http://www.siamsport.co.th/tablet/views.php?code=130116214924 [2014, September]

The Thailand Premier League [TPL]. (2013a). Number of spectators, sales revenue of ticket and souvenir in season 2010, 2011 and 2012.

The Thailand Premier League [TPL]. (2013b). Regulations [Online]. Retrieved from http://www.thailandpremierleague.co.th [2013, April]

The Thailand Premier League [TPL]. (2015). Regulations [Online]. Retrieved from http://www.thailandpremierleague.co.th [2015, August]

The United Nations [UN] (1992). Framework Convention on Climate Change,*International Legal Materials, 31,* 849-873.

Chulalongkorn University

The United Nations Inter-Agency Task Force on Sport for Development and Peace. (2003). *Sport for Development and Peace: Toward Achieving the Millennium Development Goals.* United Nations.

The United Nations [UN]. (1987). *Our Common Future: Report of the World Commission on Environment and Development.* United Nations [UN], 1987.

The United Nations [UN]. (1987). *Sport as a means to promote education, health, development and peace*. 2003. Retrieved from http://www.un.org/Depts/dht/resguide/r58.htm.

The United Nations Conference on Environment and Development [UNCED]. (1992). United Nations Sustainable Development: Agenda 21. Rio de Janerio, Brazil, June 1992.

The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). (2000). *Solid Waste.* United Nations Economic and Social Commission for Asia and the Pacific [UNESCAP].

The United Nations Environment Programme [UNEP]. (1991). *Environmental Data Report 1991/92.* United Nations Environment Programme [UNEP].

The United Nations Environment Programme [UNEP]. (2005). *Integrated waste management scoreboard: A tool to measure performance in municipal solid waste management.* United Nations Environment Programme [UNEP].

The United Nations Environment Programme [UNEP]. (2005). *Solid waste management Volume 1.* United Nations Environment Programme [UNEP].

The United Nations Environment Programme [UNEP]. (2006). *Sustainability Report 2006: XX Olympic Winter Games.* Torino: The Environment Department of the Organising Committee.

The United Nations Environment Programme [UNEP]. (2007). *Beijing Olympics 2008: An Environmental Review.* Nairobi, Kenya: United Nations Environment Programme [UNEP], 2007.

The United Nations Environment Programme [UNEP]. (2009a). *Developing integrated solid waste management plan: Volume 1 Waste characterization and quantification with projections for future.* United Nations Environment Programme [UNEP].

The United Nations Environment Programme [UNEP]. (2009b). *Developing integrated solid waste management plan: Training manual Volume 2: Assessment of current waste management system and gaps therein.* United Nations Environment Programme [UNEP].

The United Nations Environment Programme [UNEP]. (2009c). *Developing integrated solid waste management plan: Volume 3 Targets and issues of concern for ISWM.* United Nations Environment Programme [UNEP].

The United Nations Environment Programme [UNEP]. (2009d). *Developing integrated solid waste management plan: Volume 4 ISWM Plan.* United Nations Environment Programme [UNEP].

The United States Environmental Protection Agency [USEPA]. (2002). *Solid Waste and Emergency Response.* USEPA.

The United States Environment Protection Agency [USEPA]. (2009). *Proposed Revision to Definition of solid waste frequent Questions*[Online].Retrieved from http://www.epa.gov/osw/nonhaz/municipal/index.htm [2013, July]

The United States Environment Protection Agency [USEPA]. (2013). *High global warming potential [GWP] Gases Web site-Science*[Online]. [August,2013]

The Vancouver Organizing Committee for the 2010 Olympic and Paralypic Winter Games [VANOC]. (2010). *Vancouver 2010 Sustainability Report 2009-2010.* Vancouver: VANOC

Van de Klundert, A. and Anschutz, J. (2001). Integrated sustainable waste management-the concept: tools for decision-makers. *Experiences from the Urban waste expertise programme*.

Visvanathan, Chiemchaisri, C and Chettiyappan. (2012).Greenhouse gas emission potential of the Municipal Solid Waste Disposal sites in Thailand.*Journal of the Air and Waste Management Association*, 629-635.

Wagner, J. (2011). Incentivizing sustainable waste management.*Ecological Economics*, 585-594.

Wagner, J. (1995). The 3R's of solid waste and the Population Factor for a sustainable planet.*The American Biology Teacher,57*, 88-91.

Woods, R. (1993). Waste from Stadiums.*Waste Age*. Washington.

Yamane, T. (1967).*Statistics, An Introductory Analysis*, 2nd Ed., New York: Harper and Row.

Zotos, G., Karagiannidis, A., Zampetoglou, S., Malamakis, A., Antonopoulos, I. S., Kontogianni, S., and Tchobanoglous, G. (2009). Developing a holistic strategy for integrated waste management within municipal planning: Challenges, policies, solutions and perspectives for Hellenic municipalities in the zero-waste, low-cost direction. *Waste Management, 29*(5), 1686-1692.

Zurbrügg, C., Gfrerer, M., Ashadi, H., Brenner, W., and Küper, D. (2012). Determinants of sustainability in solid waste management – The Gianyar Waste Recovery Project in Indonesia. *Waste Management, 32*(11), 2126-2133.

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APPENDICES

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APPENDIX A

THE STRUCTURED QUESTIONNAIRE

Sustainable solid waste management in sport games:

A case study on football matches in Thailand

Explanation for participants

1. This research aims to study Thailand's current waste management situation in Football matches to evaluate a quantity of Greenhouse gas emission that generated by waste in the match. In addition, sustainable waste management model will be developed according to the data collected.

2. Questionnaire has 3 pages and divided into 2 parts as follow:

Part I: Socio-demographic information and solid waste generating, disposing and sorting behaviors of the spectators.

Part II: Opinion of the spectators at the study stadiums on solid waste managed at the study stadiums and awareness of its impacts.

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Thank you for your cooperation

If you have any questions or comments please contact

Miss Korbtip Atchariyasopon

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Part I: Socio-demographic information and solid waste generating, disposing and sorting behaviors of the spectators.

Please check off ✓ at your right answer.

Socio demographic information

1. Sex ❍ Male ❍ Female

2. Age ❍ Lower than 15 Years old ❍ 15-25 Years old ❍ 26-35 Years old

❍ 36-45 Years old ❍ 46-55 Years old ❍ More than 56 Years old

3. Education

❍ Lower than Primary School ❍ Primary School ❍ High School

❍ High vocational Certificate ❍ Bachelor's degree ❍ Master Degree

❍ Doctoral degree

4. Occupation

❍ Government officer ❍ Farmer ❍ Trader

❍ Employee ❍ Student ❍ Other (Please specify.....)

5. Monthly Income

❍ Lower than 5,000 Baht ❍ 5,000 – 10,000 Baht ❍ 10,001 – 20,000 Baht

❍ 20,001 – 30,000 Baht ❍ 30,001 – 40,000 Baht ❍ More than 40,000 Baht

6. Frequency of match attending

❍ First time ❍ 2-3 times/season ❍ 3-4 times/season

❍ More than 10 times/season ❍ More than 15 times/season ❍ Attend every time

Solid waste generating, disposing and sorting behaviors

7. Do you buy anything before enter the stadium

❍ Food ❍ Water ❍ Fruit juice ❍ Soft drink ❍ Tea/Coffee

❍Liqueur/Beer ❍ Snack ❍ Cheering equipment ❍ Booklet

❍ Souvenir ❍ Other (Please specify.....)

8. Do you dispose the waste in provided bin around the stadium?

❍Every time ❍Sometimes

❍Never dispose in the bins ❍Never dispose anything

9. What kind of waste that you normally dispose around the stadium?

❍ Plastic bag ❍ Food package ❍Glass bottles ❍ Plastic bottles ❍ Can

❍ Plastic cup ❍ Plastic box ❍ Paper ❍ Hazardous waste

❍ Other (Please specify.....)

10. Have you ever sorted the waste into category before discard it?

❍ Never ❍ Sometimes ❍ Every time

11. Who do you think that currently responsible for waste management in the stadium?

❍ Football club ❍ Municipality officer ❍ Waste picker

12. What do you think is the current waste management method in each match?

❍ Land filling ❍ Burning❍ Collected by refuse collection vehicle without separation

❍ Collected by refuse collection vehicle with separation

❍ Other (Please specify.....)

13. Do you know that waste separation and recycling can help increasing income and mitigating environmental problems from waste?

❍Yes ❍ No

14. Have you ever heard about Greenhouse gas emission?

❍ Yes ❍ No

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Part II: Opinion of the spectators at the study stadiums on solid waste managed at the study stadiums and awareness of its impacts.

Please check off ✓ at your closest answer

5 = absolutely agree 4 = agree 3 = not sure 2 = disagree 1 = strongly disagree

ITEM	Opinion level				
	5	4	3	2	1
1. There is a large amount of waste generated in each match					
2. I satisfy the club's current solid waste management					
3. Waste is one of the environmental problems occurring in the stadium					
4. The club should pay attention to the environmental impact created by the match					
5. The club should mitigate impact from solid waste					
6. The club should promote solutions to decrease an impact of solid waste at the stadium					
7. I am aware of the impact from solid waste at the stadium					
8. I should reduce solid waste at the stadium					
9. I will cooperate with sustainable solid waste management activities, if any.					
10. Solid waste could generate income for the club, if it is managed properly					
11. The Football Association of Thailand [FAT] should have regulations on solid waste management					
12. Solid waste reduction can mitigating impact of climate change					

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APPENDIX B

Interview guide for the key stakeholders
In-depth interview guide applied from UNEP (2009) Volume 3: Targets and issues of concern for ISWM

Set I : In-depth interview guide for the club's presidents and head of solid waste managed of each club

Part I: Opinion on environmental, social, economic issues of solid waste

1.1 Do you think that the football match has any environmental, social, economic issues? How?

1.2 Do you think solid waste is a problem? How?

Part II: Opinion on solid waste managed at the stadium

1.1 What are the types of solid waste generated at the stadium?

1.2 How should the club manage solid waste from the match?

1.3 How does the club manage solid waste generated at the stadium?

- 1.3.1 Source reduction/ source separation/ reuse
  - 1.3.1.1 Who would bear the cost for buying bins and bags for source segregation (if any)?
  - 1.3.1.2 Who would get the benefit of earnings from the sale of source-separated recyclables?
  - 1.3.1.3 How is the current fee system (if any)?
  - 1.3.1.4 Is there any awareness raising for segregation of solid waste and proper primary disposal?
  - 1.3.1.5 Is there an availability of different types of waste collection bags?
  - 1.3.1.6 How are the size and shape of bins/ where are the locations of bins?
  - 1.3.1.7 Are there any environmental impacts on this stage?
- 1.3.2 Collection

1.3.2.1 What are the current problems in the solid waste collection?

1.3.2.2 What would be 1-2 possible suggestions for the improvements?

1.3.2.3 Do you allow waste collectors to come to the stadium?

1.3.2.4 How are the frequency and timing of collection?

1.3.3 Recycling/ composting

1.3.3.1 What are the methods for recycling solid waste at source?

1.3.3.2 Is there a ready market for resources generated from solid waste (compost, bio-gas)?

1.3.3.3 Are there any problems on work safety of individuals involved in the recycling and composting business?

1.3.3.4 Do people accept the goods that produced from solid waste (compost, bio-gas)?

1.3.3.5 Does the current solid waste treating method comply with the environmental standards?

1.3.4 Energy recovery

1.3.4.1 Are there any technology and capacity to convert solid waste into a resource?

1.3.5 Treatment/ disposal

1.3.5.1 Are there any environmental impacts on this stage?

1.4 How does it cost to manage the solid waste?

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Part III: Opinion on sustainable solid waste management

1.1 What is the solid waste management policy or any improvement in the future?

1.2 Are there any environmental issues that important for sport society? What are those?

1.3 Have you ever heard about sustainable solid waste management? Do you think what is it? Are you interested in this issue?

1.4 Do you think the club will get any advantages from sustainable solid waste management?

1.5 In your opinion, who should play an important role in order to support sustainable solid waste management? How?

- 1.5.1 The spectator
- 1.5.2 TPL/ government
- 1.5.3 The football club
- 1.5.4 Media

1.6 If the Thailand Premiere League launch 3Rs policy, would the club implement it? Why? Any suggestions?

1.7 What kind of incentive structure do you want in order to implement the sustainable solid waste policy?

1.8 Have you ever heard about greenhouse gas emissions? If yes, what is that?

1.9 If there is the sustainable solid waste management policy, will your club be willing to comply?

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Set II : In-depth interview guide for the waste collectors of each club

Part I: Opinion on environmental, social, economic issues of solid waste

1.1 Do you think that the football match has any environmental, social, economic issues? How?

1.2 Do you think solid waste is a problem? How?

Part II: Opinion on solid waste managed at the stadium

2.1 What are the types of solid waste generated at the stadium?

2.2 In your opinion, who should play an important role in order to support sustainable solid waste management? How?

2.1.1 The spectator

2.1.2 TPL/ government

2.1.3 The club

2.1.4 Media

Part III: Opinion on sustainable solid waste management

3.1 What do you think is the sustainable solid waste management? Is it possible to do at the stadium?

3.2 If the TPL launch 3Rs policy, would you cooperate? Why? Any suggestions?

3.3 What kind of incentive structure do you want in order to support the sustainable solid waste policy?

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VITA

Miss Korbtip Atchariyasopon was born in Chiangrai on 24th August 1985. In 2008, she obtained her Bachelor's Degree in Economics with Second class honors from Thammasat University. During studying, she started to work as a research assistant for some developmental economics related research projects. She has never been straying too far from the idea of making change in the society.

After graduating, with a research assistant experience and having ran a few extracurricular activities, she started off with public-relations projects for the Chiangrai United Football Club. As the Marketing Director of the team, she initiated numbers of campaigns and sustainable projects to raise brand awareness and shared value. Moreover, as she became committed to the sustainable development, she started her PhD in Environment, Development and Sustainability (EDS) at Chulalongkorn University. Her main research interest includes sustainability solid waste management in sport games. She also did a short-term student exchange program in Osaka University, Japan.

In 2012, she was selected to be a committee secretary in the standing committee on Economics Development of the House of Representatives, Parliament House of Thailand and rewarded the member (Fifth Class) of the Most Noble Order of the Crown of Thailand. In 2013, she qualified for an internship program at the United Nations Development Programme (UNDP). After the internship program finished, she started to work as marketing and customer relations associate at Sal Forest Co., Ltd. Which is Thailand's first "sustainable business accelerator that aim to jumpstart and sustain a public discourse on sustainable business via events, online media and conducting research on important sustainability issues in Thailand.

During the study, she received research fellowships from the Graduate School, Chulalongkorn University and tuition scholarships from the Environment, Development and Sustainability (EDS) program.