CHAPTER I
INTRODUCTION

1.1 Background

The snack food industry is one of the Micro, Small, and Medium Enterprises (MSMEs) sectors that continues to experience rapid growth in Indonesia. According to data from the Ministry of Cooperatives and SMEs, the number of MSMEs in 2021 reached 64.19 million, accounting for 61.07% of the Gross Domestic Product (GDP), or IDR 8,573.89 trillion (Limanseto, 2021). The food and beverage subsector accounted for 38.38% of the non-oil and gas processing industry's GDP in 2023, making it the largest contributor to the national economy (Sayekti, 2022). A typical product from West Sumatra is *balado* cassava chips, widely recognized both locally and nationally (Arham et al., 2023). Kripik Balado Christine Hakim, the pioneer of *balado* chips in Padang, represents this locally rooted snack industry (Gusvita et al., 2023).

Established in 1990, Kripik Balado Christine Hakim Business has become one of the main production centers of *balado* chips in Padang City (Gusvita et al., 2023). The chip production process includes several stages, ranging from processing cassava as raw material, frying, mixing *balado* spices, and packaging the product. Along with the times, the production technology at Kripik Balado Christine Hakim has also improved, from manual frying techniques to the use of modern industrial machinery to increase efficiency and production capacity (Ayesha et al., 2020).

The *balado* chips business, like other snack industries, has potential environmental impacts from production and distribution activities. For cassava based products, these include concerns such as the high thermal energy required for frying and cassava peel waste that may contribute to eutrophication or acidification if improperly managed (Nandar et al., 2025). With rising market demand and export efforts, assessing the full production process is crucial for sustainable practices (Gusvita et al., 2023). For example, Nandar et al. (2025) conducted an environmental assessment of *Sanjai* chips production in Payakumbuh, West Sumatra, using the Life Cycle Assessment (LCA) with gate-to-gate approach. Their study found that producing 1 kg of Sanjai chips generated a Global Warming

Potential (GWP) of 1.36 kg CO_2-eq, Acidification Potential (AP) of 0.0132500 g SO_2-eq, Eutrophication Potential (EP) of 0.074 kg PO_4-eq, and Ozone Depletion Potential (ODP) of 8.09×10^{-7} kg CFC-11-eq**,** with the frying stage contributing the highest share (78.7%) of total emissions due to cooking oil use. Thus, applying methods such as LCA is essential to evaluate product impacts throughout life cycle.

LCA is a compilation and evaluation of the inputs, outputs, and potential environmental impacts of a product system throughout its life cycle (ISO 14040, 2016). It is a tool for measuring a product's environmental performance across its entire life cycle, from raw material production to final disposal, including material recycling when needed (Pre Sustainable, 2014). LCA consists of four main stages: goal and scope determination, life cycle inventory, environmental impact assessment, and result interpretation. By applying this method, companies can identify the extent of their production impacts on the environment and make necessary improvements to support sustainability (Akbar & Gusnita, 2020).

This study uses SimaPro 9.5 software with CML-IA Baseline approach method to analyze the environmental impact of the production of balado cassava chips. SimaPro is an application used in LCA analysis to evaluate environmental impact. According to CML-IE (2016), CML-IA baseline is a method for calculating the value of environmental damage from the life cycle of a product. In LCA, two systems are analyzed, i.e., the foreground system includes all processes in production and background systems such as material supply, energy use, and waste disposal (Guinée et al., 2001).

Previous studies have primarily employed a gate-to-gate approach in various cassava chip businesses and locations, resulting in varying potential impacts. This study therefore, introduces novelty by being the first to apply a cradle-to-grave LCA approach, covering raw material transport, production, packaging, and waste management. The findings are expected to illustrate the environmental impact, guide preventive actions, and strengthen sustainability practices in the cassava chips industry. Furthermore, the implementation of LCA can improve environmental management performance and support product sustainability in Indonesia's snack industry.

1.2 Purpose and Objectives

The purpose of this study is to analyze the environmental impact of the balado cassava chips production process at the Kripik Balado Christine Hakim with the LCA approach.

The objectives of this research are as follows:

1. Identifying the stages of the product system of *balado* cassava chips from raw materials cultivation to the end of life at the Kripik Balado Christine Hakim business;
2. Compile a life cycle inventory of raw materials, energy, and emissions used and produced throughout whole production and end of life process;
3. Analyzing the potential environmental impacts generated from the product system of the Kripik Balado Christine Hakim business using SimaPro 9.5 software and CML-IA baseline method;
4. Providing recommendations for improving the production process of *balado* cassava chips to improve environmental sustainability.

1.3 Benefits

The benefits of this research include:

1 As a source of information about the life cycle of product system of *balado* cassava chips so that it is useful to increase production efficiency and reduce negative impacts on the environment;

2 Provide added value to the Kripik Balado Christine Hakim business by assessing environmental impacts using the LCA approach, which can attract consumer interest and enhance marketing reach;

3 As a recommendation to industry, government, and related institutions regarding the benefits of implementing LCA in the evaluation of food services and production.

1.4 Scope

The scope of this study is as follows:

1. This research was conducted at the production site of Kripik Balado Christine Hakim business on Jl. Adinegoro no. 11 A, Padang Sarai, Koto Tangah District, Padang City, West Sumatra;
2. The system approach used is cradle-to-grave, covering the production of raw materials, transportation of raw materials, peeling, slicing, frying, packaging, transportation to consumers, and packaging waste management;
3. The functional unit used is 1 pack of cassava chips weighing 250 g;
4. The inventory data consist of primary data obtained directly from the Kripik Balado Christine Hakim business and secondary data from literature and software databases;
5. This study used SimaPro 9.5 software with the CML-IA Baseline as impact assessment method.
6. The environmental impact categories evaluated in this study include GWP, EP, and AP.

1.5 Writing Systematics

The systematics of writing in this final project are as follows:

CHAPTER I INTRODUCTION

The introduction contains the background, purpose and objectives of the research, benefits of the research, scope of the research and the writing systematics.

CHAPTER II LITERATURE REVIEW

This chapter contains fundamental theories, literature review, and prior research related to the cassava chips industry, LCA, and environmental impact assessment methods.

CHAPTER III METHODOLOGY

This chapter describes the research location and period, the stages of the study including data collection, scenario development, analysis, and the LCA approach applied to the production system of the Keripik Balado Christine Hakim business

CHAPTER IV RESULT AND DISCUSSION

This chapter contains data presentation, analysis results, and interpretation of environmental impacts based on the LCA method.

CHAPTER V CONCLUSION AND SUGGESTION

This chapter contains the conclusions derived from this research along with recommendations that can be proposed for future studies.