

## **CAUSE AND EFFECT DIAGRAM OF FOOD SAFETY STANDARDS: AEC PREPARATION**

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### **Abstract**

Food safety standard is crucial for the food companies to ensure that the food is safe when it is prepared and consumed according to its intended use. To achieve competitive advantage and be able to compete with other Asean Economic Community (AEC) countries, Thailand needs to focus on food safety implementation. This paper utilizes the cause and effect diagram to capture key food safety factors, including Man, Material, Method, Machine, Management, and Environment factors, in order to plan for food safety implementation. A total of 28 associated items are listed based on a number of food safety-related literature. It is expected that the cause and effect diagram assists in better understanding of food safety implementation in Thai food companies.

**Keywords:** AEC, Cassava, Cause and Effect Diagram, Food Safety Standard

## **1. INTRODUCTION**

Food safety is defined as the assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use (WHO 2013). Recently, there is an increase in customer demand for safe food; this leads the food industry in conducting a number of food safety researches and building up its food safety standard.

In Thailand, there is a need to meet the requirements on food safety to enhance the country's standard, and be able to compete with other countries. For example, there are approximately a million cases of acute diarrhea reported in Thailand each year, and the reported cases of food poisoning are more than 120,000 per year (Food and Agriculture Organization of United Nations 2004). The food safety standard should be built upon customer focus, continuous improvement, and process approach. Moreover, Thailand will be a part of the Asean Economic Community (AEC) in 2015. This will open the trade boarder to many businesses. Food industry will be more competitive, and that the adaptation to meet the requirement for food safety standard is needed to gain the competitive advantage.

This paper, therefore, aims at examining key factors influencing food safety implementation to achieve higher safety standard using one of the most widely used quality tools, which is the cause and effect diagram. It is expected that the key factors guide the industry plan its food safety implementation, so that the country will be able to compete with the AEC neighbors in the future.

## 2. FOOD SAFETY STANDARD IN AEC COUNTRIES

Based on a number of food safety related literature, the food safety standards currently implemented in the AEC countries are as shown in Table 1.

**Table 1:** Food safety standards in AEC countries.

Countries	HACCP	GMP	GMO	GHP	GAP	TQM	BRC	HALAL	ISO9000	ISO9001	ISO22000	Total
Thailand			✓			✓					✓	3
Singapore	✓	✓					✓	✓			✓	5
Malaysia	✓	✓		✓				✓	✓			6
Vietnam	✓	✓										2
Brunei	✓	✓									✓	3
Indonesia	✓	✓						✓		✓		4
Philippines	✓	✓										2
Laos	✓	✓		✓	✓							4
Myanmar	✓	✓										2
Cambodia	✓	✓										2

**Note:** Derived from Ramos and Oblepias (2002), Food and Agriculture Organization of the United Nations (2004), Ministry of Health (2009), Thailand Board of Investment (2010), Dao et al. (2011), Chia (2012), Sphere Exhibits Malaysia (2013)

Based on Table1, it is found that the two common food safety standards implemented in the AEC countries are the HACCP and GMP standards. Details of each of these standards are explained below.

### 2.1 Hazard Analysis and Critical Control Point (HACCP)

Hazard Analysis and Critical Control Point (HACCP) is a systematic preventive approach to food safety and biological, chemical, and physical hazards in production processes that can cause the finished product to be unsafe, and designs measurements to reduce these risks to a safe level (NM Public Education Department 2013). In this manner, HACCP is referred as the prevention of hazards rather than finished product inspection (NM Public Education Department 2013). The HACCP system can be used at all stages of a food chain, from food production to preparation processes, including packaging and distribution (NM Public Education Department 2013).

According to NM Public Education Department (2013), there are seven steps of a HACCP program, as follows.

- Identifying hazards;
- Identifying critical control points;
- Setting up procedures and standards;
- Monitoring critical control points;
- Taking corrective action;
- Developing HACCP record-keeping systems; and
- Verifying that the HACCP program is working

## **2.2 Good Manufacturing Practice (GMP)**

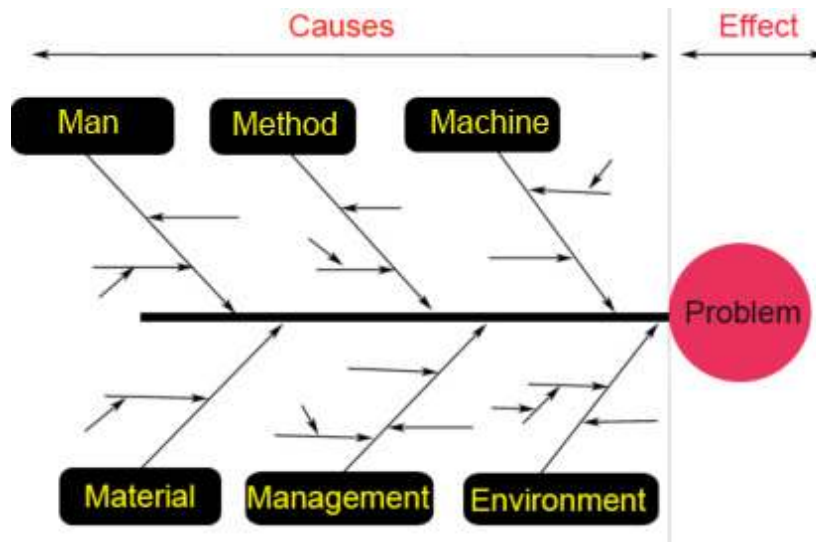
Good Manufacturing Practice (GMP) is a system to ensure that products meet food safety, quality, and legal requirements (Kakkoo 2011). It contains ten principles that introduce employees to critical behaviors, and industry leaders to maintain good manufacturing practices in plants, as followings.

- Writing procedures;
- Following written procedures;
- Documenting for traceability;
- Designing facilities and equipment;
- Maintaining facilities and equipment;
- Validating work;
- Job competence;
- Cleanliness;
- Component control; and
- Auditing for compliance

The above two standards are used in the development of the cause and effect diagram of food safety in Thailand.

## **3. CAUSE AND EFFECT DIAGRAM OF FOOD SAFETY STANDARD**

To better understand the food safety standard, and plan for food safety implementation, this paper utilizes a cause and effect diagram to capture key factors influencing food safety implementation in Thailand. The cause and effect diagram, also known as the fishbone or Ishikawa diagram, is an effective tool to be used as a guideline to improve food safety standard, see Figure 1 (Siliconfareast 2013). It is a tool for analyzing the business process and its effectiveness. It evaluates the causes and sub-causes of one particular problem, and therefore assists to uncover all the symptoms of any business problem. The main problem, which is required to be resolved, has been put on the head of the diagram, and the causes are put as the bones. The smaller bones are created as the resemblances of the sub-causes. Ultimately, after completion of the diagram, it is a comprehensive evaluation of the causes of the main problems, and reveals all possible root causes.



**Figure 1:** An example of a cause and effect diagram.

Generally, the cause and effect diagram consist of four major bones, including Man, Material, Method, and Machine Pandey (2006), however, added two more bones in the diagram, which are Management and Environment. He commented that these two bones are crucial in the supply chain management in the service industry.

Based on the above information, this paper considers six major bones (5Ms+1E) in food safety implementation in Thailand. Details are as below.

### 3.1 Man

Based on a number of food safety-related literature, the Man factor consists of four items, as followings.

- Proper safety training: Personnel should be trained to make them aware of their roles and responsibilities in protecting high quality cassava flour from contamination or deterioration. The training program should be reviewed regularly to meet individual personnel's level of knowledge and understanding (AVA 2013).
- Safety communication among employees: To ensure that the sufficient information on issues concerning food safety is available throughout the food chain, the organization shall establish, implement, and maintain effective arrangements for communicating with personnel on issues having an impact on food safety (Thai Industrial Standard Institute 2005)
- Proper dress: Personnel should wear clean working clothes, working shoes, and must not wear any loose items, such as jewelry and watches, to avoid food contamination (Bonne et al. 2005).
- Employee healthy: Employees, whose injures and diseases are likely to be transmitted to the food, must be excluded from the workplace (Bonne et al. 2005).

### 3.2 Material

Based on a number of food safety-related literature, the Material factor consists of four items, as followings.

- Freshness: Cassava should be processed within 8 – 12 hours of harvesting to ensure its freshness (Dziedzoave et al. 2006).
- Age of raw material: Cassava should normally be 10 – 12 months old at harvest. In few cases, some varieties mature in 15 – 18 months (Dziedzoave et al. 2006).
- Certified document of raw cassava: The raw cassava farm should get certified document, such as Good Agricultural Practices (NM Public Education Department 2013).
- Contract farming: Contract farming directly effects the cassava industry to encourage the competitive advantages and guarantee quality of raw cassava. (Parthanadee et al. 2010).

### 3.3 Method

Based on a number of food safety-related literature, the Method factor consists of seven items, as followings.

- Utilization of first in first out approach: The company should utilize the first in first out system to ensure the freshness of raw materials (AVA 2013).
- Supplier evaluation: The company should have the procedures for the evaluation, selection, and maintenance of approved suppliers (Food Safety Auditor 2006).
- Document control: Document control is crucial in ensuring that the information used throughout the organization is correct (Thai Industrial Standard Institute 2006).
- Package selection: Different types of food require different packaging to ensure food safety (Bonne et al. 2005).
- Clear separation of related of non-relate zones: Production area should be clearly separated from non-production areas (CEPI 2010).
- Clear separation of entrance and exit : The plant should have separate entrance and exit to avoid the contamination (CEPI 2010).
- No production line criss-cross: Each production line should be assigned for only one production at a time (CEPI 2010).

### 3.4 Machine

Based on a number of food safety-related literature, the Machine factor consists of four items, as followings.

- Proper maintenance: Machine must be maintained on a regular basis (Easdani et al. 2012).
- Proper location: Machine should be placed in the location that allows proper cleaning and inspection (Bonne et al. 2005).
- Use of clean machine: Machine should be cleaned prior to use to ensure good hygiene and product quality (Bonne et al. 2005).
- Adequate number of machines: There should be adequate number of machines to avoid work pressure that leads to poor quality products (Thai Industrial Standard Institute 2005).

### **3.5 Management**

Based on a number of food safety-related literature, the Management factor consists of five items, as followings.

- Food safety policy: Top management should consider food safety policy as one of the core policies to improve product quality (Thai Industrial Standard Institute 2005).
- Commitment to food safety development: Top management should provide evidence of its commitment to the development and implementation of the food safety management system, and to continually improving its effectiveness (Thai Industrial Standard Institute 2005).
- Food safety team: Top management should appoint a food safety team to ensure that the food safety management system is established, implemented, maintained (Thai Industrial Standard Institute 2005).
- Supplying in necessary resources: Top management should provide necessary resources to ensure food safety standard (Thai Industrial Standard Institute 2005).
- Consultation: Top management should provide food safety-related consultation to the employees to enhance food safety standard (Thai Industrial Standard Institute 2005).

### **3.6 Environment**

Based on a number of food safety-related literature, the Environment factor consists of five items, as followings.

- Pest control: To ensure high quality product, the company must control its production area not to have any unwanted animals (Bonne et al. 2005).
- Light control: The plant should control the brightness of the production zone to ensure good working environment (Bonne et al. 2005).
- Temperature control: Zones where hot foodstuffs are treated should be clearly differentiated from those where cold one are treated to avoid their thermal pollution. (Bonne et al. 2005).
- Ventilation control: There should be proper ventilating system to ensure good working environment (Pandey 2006).
- Dust control: Dust explosion is one of the key factors in the cassava industry, and that it must be closely controlled (Pandey 2006).

The above 28 items, within six major bones, are then used to develop the cause and effect diagram, as shown in Figure 2.



**Figure 2:** The cause and effect diagram of food safety standards.

#### 4. CONTINUING STUDY

The cause and effect diagram is later used in developing a questionnaire survey to gather data for the exploratory factor analysis to further confirm the six key safety factors (5Ms + 1E) with their associated items. The causal relationship between the six key factors will also be examined using the structural equation modeling technique.

#### 5. CONCLUSION

Thailand now focuses on improve food safety standard to be able to compete with other AEC countries. The development of the cause and effect diagram of food safety assists the organization in planning for food safety implementation. The six key food safety factors, including Man, Material, Method, Machine, Management, and Environment, together with their 28 associated items, are considered vital in improving food safety standards in Thailand.

#### ACKNOWLEDGEMENT

The authors would like to thank the Thammasat University Research Fund for the support of this research study.

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