Strategies to implement total quality management in small scale rural agroindustry to enhance Indonesian pepper competitiveness

S Wulandari
Indonesian Center for Estate Crops Research and Development
E-mail: suciwulandari@hotmail.com

Abstract. The competitiveness of Indonesian pepper in the global market shows a decreasing trend. It is indicated by the decrease in the market and low product quality. Additionally, the consumer countries’ standard requirements are also stricter, especially quality, sanitary, and safety. Microorganism contamination is one issue of pepper product safety. This condition is due to improper implementation of Total Quality Management (TQM) as a strategic resource that can generate competitiveness by achieving the required quality and providing the agroindustry with sustainable competitive advantages. This study aims to map quality management practice and formulate strategies to implement the TQM in the pepper agroindustry. The analysis used Quality Management Mapping and Interpretative Structural Modeling (ISM). Quality Management Mapping was used in analyzing constraints, and ISM was used to analyze the internal and external elements. The pepper agroindustry’s quality management is traditional management, which has not to support the TQM implementation. Implementation of TQM in pepper agroindustry faces constraints related to training and preparation; understanding of TQM; TQM adoption within the organization; resistance to learn and change; learning organization; resources available; measurement of quality improvement; access to data and results; and attention to customers. Internal and external factors construct strategies to implement TQM. Internal-based strategies include training on the methods and concepts of quality, adopting technology, and using appropriate methodology and tools. The main strategy as external support is creating incentives linked to quality goods to support farmers shifting mindset and improving product quality.

1. Introduction
Pepper is taking a leading role in the total value of spice production traded in the world. The demand is increasing and creating a more dynamic pepper market. Pepper consumption tends to increase in line with the food industry’s development and the absence of synthetic pepper products. The growing cosmetics industry is also positively impacting the pepper market as the antibacterial and antioxidant properties in pepper used in the manufacturing of skincare products.

Pepper plantations area in Indonesia is 180,176 haand involves 289,354 farmer households. The national pepper commodity system’s performance shows low production, productivity, quality, and
added value. In 1990, Indonesian pepper production was 36,626 tons and in Vietnam was 556 tons, but in 2018 Indonesian production only reached 88,715 tons, while Vietnam produced 262,658 tons[1].

On the other hand, Indonesian pepper also faces various issues. Microorganism contamination is one of the problems in product safety and contamination of aflatoxins and pesticide residues due to traditional methods still being used in pepper processing[2]. In 2018, the volume of Indonesian pepper exports reached 47,616 tons with a value of US$152.471 million, with the majority of exports in the form of unprocessed granulated pepper.

Meanwhile, there is an increasingly global competition in the agroindustry characterized by introducing technology and expanding business scales. This competition is in line with the shifting structure of the market competition for agricultural products, emphasizing agroindustry, retail, product services, and global supply chain development [3]. Pepper agroindustry continues to develop competing countries. Innovation and production orientation is to create products following sanitary and food safety standards.

Product quality contributes to the strengthening of share in the global agricultural trade market. The quality of agricultural products can essentially be developed by implementing Total Quality Management (TQM). TQM is considered a strategic resource to obtain competitiveness by improving the quality and provides the agroindustry with sustainable competitive advantages. TQM improves the economic performance: increases market share, price competitiveness, competitive advantage, total sales, the introduction of new products, profitability, input use efficiency, exports, and employee and consumer satisfaction [4]. This study aims to map quality management practice and formulate strategies to implement the TQM in the small-scale pepper agroindustry.

2. Materials and Methods

2.1. Types and sources of data
The data consist of primary and secondary data. Primary data were used in conducting context analysis, namely a description of the conditions and problems of pepper processing and its environment in quality management. Secondary data consist of data on area, production, productivity, and distribution of pepper plantations. The data sources are the Central Bureau on Statistics and the Directorate General of Estate Crops.

2.2. Location and time of research
Observations of the pepper agroindustry were carried out in Bangka Regency (2010 and 2015), Kutai Kertanegara Regency (2016), East Luwu Regency (2018), which are some of the national white pepper development areas.

2.3. Method of collecting data
The unit of analysis of this research was the smallholder white pepper agroindustry. Data were collected through field observations, in-depth interviews, and FGD. In-depth interviews and field observation was carried out in Bangka Regency (4 units), Kutai Kertanegara Regency (2 units), East Luwu Regency (2 units). Data taken from Focus Group Discussion held in Bangka Regency involved researchers, local government, exporters association, and farmers groups.

2.4. Analysis method
The analysis used Quality Management Mapping and Interpretative Structural Modeling (ISM). Quality Management Mapping was done by analyzing quality management conditions based on quality definition, decision approach, customer focus, problem-solving, errors, and improvements emphasis. The results of the observations were matched according to traditional management or TQM.

The steps involved in ISM modeling are as follows: (1) identifying the elements, (2) establishing a contextual relationship between elements, (3) developing a Structural Self-Interaction Matrix (SSIM), (4) developing a reachability matrix from the SSIM, (5) separating the reachability matrix into
different levels, (6) converting the reachability matrix into conical form, (7) drawing digraph based on the relationship given in reachability matrix and removing transitive links, and (8) converting the resulting digraph into an ISM based model, and (9) reviewing the model to check for conceptual inconsistencies and making the necessary modifications [5]. The element classification is based on the Structural Self Matrix (SSM) which is made based on the VAXO system, namely: “\( V \)” if \( e_{ij} = 1 \) and \( e_{ii} = 0 \); “A” if \( e_{ij} = 0 \) and \( e_{ii} = 1 \); “X” if \( e_{ij} = 1 \) and \( e_{ii} = 1 \); and “O” if \( e_{ij} = 0 \) and \( e_{ii} = 0 \) [6].

3. Results and Discussion

3.1. Indonesian pepper performance

Pepper producing areas in 2008-2017 tended to fall globally with an average decline of 0.68% per year. In 2008, pepper-producing areas in the world were around 571 thousand ha and decreased to 568 thousand ha in 2017. World pepper production in 2008 amounted to 510 thousand tons and increased to 690 thousand tons in 2017, an average productivity increase of 3.97% per year during 2007-2018.

The countries with the largest pepper area are Indonesia (33.22%), followed by India (24.52%), Vietnam (13.53%), Sri Lanka (7.83%), and Brazil (4.38%). The five countries in total contributed 83.49% to the total area of pepper production globally. The world’s main pepper producing countries in the 2013-2017 period are Vietnam, Indonesia, Bulgaria, India, and Brazil. Vietnam ranks first as the largest pepper producing country in the world with an average production of 185 thousand tons or a contribution of 31.63%. Although Indonesia is the largest pepper producing area, the production ranks second to Vietnam with 14.58% of total global pepper production.

Vietnam’s pepper output has been growing with an estimated 12.1% from 2012 through 2018, accounted for 40% of total global pepper production, of which black pepper covered a significant proportion with 89% of total production. Besides, to increase production, Vietnam puts a priority on quality improvement in pepper development. Various quality improvement programs have been implemented. Vietnam’s pepper industry benefits from the quality improvement program and gets appreciation for achieving quality requirements for increasingly stringent key markets.

Agroindustry provides added value to agricultural commodities through processing before the product reaches the consumer [6]. Pepper processing can be done traditionally and mechanically. White pepper is pepper produced through peeling or separating the skin and drying, whereas black pepper is pepper produced directly through the drying process without peeling or separating the skin.

The value of Indonesian pepper exports during 2015-2018 tended to decline with an average decline of 34.02%. In 2018, pepper export value reached USD 152.47 million or decreased by 36% from 2017. In 2018, the largest pepper export was the export of pepper with HS code 09041110 or the pepper export in the form of white pepper or the formation of granules with a value of USD 95.30 million and a volume of 28.05 thousand tons [6].

The development of pepper agroindustry is characterized by the dominance and a large number of smallholder plantations, dispersed plantation locations, and individual processing with low linkage to related industries. Pepper products commonly traded in world markets are black pepper, white pepper, green pepper, and ground pepper. Indonesian pepper exported is primarily white pepper, black pepper, and other pepper, both as granulated and powder.

3.2. Indonesian pepper agroindustry profile

The main pepper development areas covered provinces: Bangka Belitung Island, Lampung, South Sulawesi, South East Sulawesi, South Sumatera, West Kalimantan, East Kalimantan, and East Java Provinces. Bangka Belitung Island and Lampung Provinces are the most considerable areas, covering 51,404 ha and 45,883 ha, respectfully [1]. Pepper production in Kutai Kartanegara Regency was the largest with a value of 3.587 tonnes or 51% of the East Kalimantan total pepper production. The entire area was 4,535 ha or 47% of the total area in East Kalimantan Province. The pepper commodity was one of the leading sectors in East Luwu Regency that making South Sulawesi the third-largest pepper producer after Bangka Belitung Island and Lampung Provinces. East Luwu Regency contributed 58%
of pepper production in South Sulawesi. The pepper plantations in East Luwu Regency were 5,871 ha and produced 4,323.92 tons of pepper.

Pepper processing in Bangka, Kutai Kertanegara, and East Luwu Regencies is relatively similar. Most of the pepper is processed into white pepper, but many farmers produced black pepper from fallen or young pepper. White pepper processing is held at the farmers’ level, which involves soaking, washing, and separating the skin, drying, sorting, and packaging. The processing in the three areas still used the traditional method. White pepper processing in Indonesia is generally less hygienic thus highly susceptible to microorganism contamination.

Harvesting occurs 8-9 months after flowering, indicated by reddish-yellow berries at the bunches’ base. The pepper berries were put into sacks for soaking. The soaking duration depends on the pepper varieties, growing environment, the berries’ ripeness, and the environmental conditions in which it is soaked, such as water hardness, light intensity, etc. After soaking, the skin is peeled then the pepper is washed and dried. The peeled and washed pepper were then spread on a clean surface for drying.

Soaking is a critical point in white pepper processing. In this phase, the outer skin is being decomposed by bacteria to separate the seeds’ skin. Generally, soaking in Kutai Kertanegara and East Luwu Regency is done in rivers or ponds. Soaking in the river is relatively better because of the flowing water, but it has a high risk of loss hence not a safe option for farmers. In Bangka pepper, aside from river and pond, it is also soaked in a former tin mining excavation site with stagnant and unclean water.

Traditional soaking may result in foul odor and *E.coli* and *Salmonella* contamination. Excessive soaking also may cause foul and muddy odor (off-flavor) and a decrease in its aroma due to the loss of essential oil contain. Soaking may take 12 to 14 days at the farmer level and is done in stagnant water; hence, the foul odor in white pepper.

Mechanical white pepper processing uses pepper thresher, peeler, dryer, and sorting equipment. Whereas black pepper processing mechanically uses only pepper thresher, dryer, and blaster. Mechanical processing is also known as semi-mechanical processing to distinguish between non-soaking machine-assisted processing. Improvement of mechanical processing aims to improve processing efficiency and quality, and hygiene [7]. However, mechanical processing of white pepper has not been implemented massively at the farmer level as it requires a large investment and solid group organization. The white pepper processing machinery is a government aid for use among farmer groups.

3.3. Quality management in the pepper agroindustry

Quality is one of the strategies to increase competitiveness. Competitiveness at the industry level can be analyzed with the competitiveness of indicators and drivers [7]. The level of competitiveness is determined by the operation of two sets of variables, namely the creation of competitiveness and the process of creating competitiveness. Assets for creating competitiveness include technology, funding, infrastructure and transportation, and human resources. The method of creating competitiveness can be pursued by improving quality, cost efficiency, and reliability.

Pepper development in Indonesia faces numerous challenges related to the ability to meet quality requirements. Consumer countries propose increasingly stringent requirements, especially in quality assurance, sanitary, and safety[8]. Aside from microorganism contamination, aflatoxins and pesticide residues also pose a severe defect due to traditional processing methods [2,9]. The processing technology generally does not meet the SOP and neglects the sanitary requirements [10]. In terms of costs, small-scale agribusiness is mostly inefficient users of agricultural inputs, so the production cost per unit is relatively high [8], which affects the financial capability to improve product processing.

TQM is a management approach that is focused on sustainable process improvement through universal participation [11]. In TQM, quality is defined by the enterprise’s subjective expectations and requirements of the internal and external stakeholders. TQM is implemented in many organizations to improve product quality and increase customer satisfaction [12]. It is divided into six elements: top
management commitment, customer focus, supplier quality management, human resource management, continuous improvement, and process management [13].

Implementation of TQM in agroindustry varies from one region to another and among different commodities. Still, it has certain essential principles, which can be applied to achieve a more significant market share, increase profits, and reduce costs. The TQM factors revealed by this study are the quality definition, decision approach, customer focus, problem-solving, errors, and improvement emphasis. Based on these factors’ characteristics, it can be identified as an agroindustry system in quality management, whether it is based on traditional management or TQM (Table 1).

### Table 1. Comparison of traditional approach and TQM.

| No | Aspect            | Traditional management                        | TQM                                           |
|----|-------------------|-----------------------------------------------|-----------------------------------------------|
| 1  | Quality definition| Products meet specifications                  | Products fit for customers                    |
|    |                   | Focus on post-inspection                      | Focus on building quality into the work process|
| 2  | Customer focus    | Ambiguous understanding of customer requirements| A systematic approach to seek, understand, and satisfy both internal and external customers. |
| 3  | Problem-solving   | Unstructured problem solving and decision making by individual specialist | Participative and decision making based on hard data |
| 4  | Errors            | A certain margin of error, waste, and reworks is tolerable | No tolerance for errors |
| 5  | Improvement emphasis | Technological breakthrough such as automation | Gradual but continuous improvements of each function |

Analysis of quality management in the pepper agroindustry at the smallholder level has the following characteristics:

1. **Quality definition**
   Pepper quality standards in the local market are based on agreements between farmers and buyers. Formally, the quality factors for pepper are determined by the physical and chemical characteristics: bulk density, foreign matter, broken berries, moldy berries, defiled insect berries, moisture content, total ash, nonvolatile ether extract, volatile oil, and piperine content. In addition to these parameters, international standards also set light peppers, insects, mammal droppings, *Escherichia coli*, and *Salmonella*. The standardization of quality in smallholder plantations is not following ISO 9000, ISO 14000, Hazard Analysis Critical Control Point (HACCP), and Sanitary and Phytosanitary (SPS) Quality Standards, so that they are not able to compete in the international market. The quality analysis showed white pepper produced by farmers is generally under the standards because it still contains black pepper and has higher microorganism contamination [2].

2. **Customers focus**
   Most Indonesian pepper is produced for the export market, but farmers have a vague understanding of customer requirements. Farmers focus on sales made only with collectors at relatively low prices due to inconsistent pepper qualities. The trader then separates the pepper-based on its quality. At the exporter level, farmers’ pepper is usually reprocessed to meet the quality set by Fair Average Quality (FAQ) or American Spice Trade Association (ASTA). The process carried out by machine consists of sifting and blowing to separate the pithy pepper from mild pepper, groats, and dust, then proceed by washing and drying.

3. **Decisions approach**
   Problems in pepper processing are usually solved based on farmers’ knowledge, skills, and instincts. They rarely solve problems and make decisions based on substantive data. Extension
workers should ideally provide assistance and technical guidance, but extension workers in the field have a multi-commodity role and focus on staple crops.

4. Problem-solving
Farmers mostly use unstructured problem solving and decision making. Issues related to harvest and post-harvest techniques are usually associated with climatic and safety risks that affect production and quality management. Farmers’ knowledge is based only on their experience.

5. Errors
In the pepper agroindustry, inadequate products that do not meet the quality standards are often found. The pepper enters the market without a sorting and grading process. Selection and separation are executed at the exporter level.

6. Improvement emphasis
Traditional quality management emphasizes achieving short-term objectives, such as the number of products or profits earned. It does not seek long-term improvements in production and sustainably maintaining customer satisfaction.

Based on the analysis of TQM factors, it can be concluded that quality management in the pepper agroindustry is traditional management, which does not advocate TQM implementation. Traditional and TQM differ in philosophy, implementation, and measurement. The fundamental differences between TQM and traditional management are related to the scope. TQM has a broad spectrum and extends to reduce defects, eliminate waste, and improve quality throughout the organization’s processes for long-term benefits.

3.4. Strategy to implement TQM in pepper agroindustry
TQM practices affect business performance [12]. Its successful implementation leads to better results: improvement in both financial and non-financial indicators [13]. However, there are constraints at the farmer level in implementing quality management. TQM assists in achieving productivity and process efficiency by identifying and eliminating problems in work processes and systems.

Implementation of TQM in pepper agroindustry faces constraints related to training and preparation; understanding of TQM; TQM adoption within the organization; resistance to learn and change; learning organization; resources available; measurement of quality improvement; access to data and results; and attention to customers. As a consequence, strategies to implement TQM are directed at handling these weaknesses.

The strategies consist of overcoming weaknesses in the internal aspect and building opportunities from the external aspect. The strategies that related to the internal aspect include training on the methods and concepts of quality (E1), technology adoption (E2), development of effective measurement of quality improvement (E3), use of appropriate methodology and tools (E4), recording data and results (E5), and paying attention to internal and external customers (E6).

TQM implementation supports streamlining processes and ensures a proactive work system to counter deviations from the ideal state. The main strategies constructed by internal factors are training on the methods and concepts of quality (E1), adopting technology (E2), and use of appropriate methodology and tools (E4) (Figure 1 and 2). TQM is positively related to innovation performance because TQM’s application encourages actors to continue making breakthroughs for performance improvement [14].
TQM is positively related to innovation performance because TQM’s application encourages actors to continue to make breakthroughs for performance improvement. Technologies and developed instruments are crucial for strategic management, forecasting, optimization, and improving agricultural enterprises’ resource use[15]. Market benefits are derived from customer satisfaction and internal quality improvement [16]. Farmers groups, as the driving force of pepper agroindustry at the subdistrict level, need support from the stakeholders in implementing the TQM. It is due to the numerous limitations to overcome weaknesses and take advantage of current opportunities.

The driving strategies from the external aspect consist of: building a learning system (E1), creating knowledge transfer and process management practices (E2), developing effective programs of product and service quality (E3), creating incentives linked to quality goods (E4), promoting a zero-defect philosophy (E5), and developing a feedback mechanism to ensure continuous improvement (E6).

The successful implementation of TQM is also influenced by supporting factors from the external environment. Support will be directed towards identifying and communicating quality goals, understanding the production system, and defining the process for achieving quality goals. The main strategy in external support is creating incentives linked to quality goods (E4). It is important to support farmers’ shifting mindset and improving product quality (Figure 3-4).
Figure 3. Matrix graph of external supports to implement TQM in pepper agroindustry.

Figure 4. Hierarchy graph of external supports to implement TQM in pepper agroindustry.

TQM enables to focus on time and effort in increasing production, extending the range of products, and improving the existing outcomes. In the end, the TQM application will encourage the development of the competitiveness of the pepper agroindustry.

4. Conclusions

Quality management of pepper agroindustry at the farmer level is still using traditional management in terms of quality, decision approach, customer focus, problem-solving, errors, and emphasis on repairs that are still technical, partial, and short term. Implementation of TQM in pepper agroindustry faces constraints related to training and preparation; understanding of TQM; TQM adoption within the organization; resistance to learn and change; learning organization; resources available; measurement of quality improvement; access to data and results; and attention to customers. Consequently, strategies to implement TQM are directed at handling these weaknesses. The main strategies established on internal factors are training on the methods and concepts of quality, technology adoption, and appropriate methodology and tools as the driving factors. The successful implementation of TQM is also influenced by supporting aspects from the external environment, which is accomplished by creating incentives to reinforce farmers’ mindset to improve product quality.
References

[1] Ditjenbun 2020 Statistik Perkebunan Indonesia 2018 - 2020 Lada (Indonesian Plantation Statistics 2018 - 2020 Pepper) [In Indonesian].

[2] Nurdjannah N 2006 Perbaikan Mutu Lada Dalam Rangka Meningkatkan Daya Saing di Pasar Dunia Perspektif (Improvement of Pepper Quality in Order to Increase Competitiveness in the World Market Perspective) Perspektif. 5 1 13–25 [In Indonesian].

[3] Jaffee S, Siegel P, Andrews C 2008 Rapid Agricultural Supply Chain Risk Assessment: A Conceptual Framework. Agriculture and Rural Development. Washington, DC.

[4] Kristiđ J 2016 The application of quality management (TQM) to enhance the competitiveness of agricultural entities Poljoprivreda 222 70-70.

[5] Attri R, Dev N, Sharma V 2013 Interpretive structural modeling (ISM) approach: an overview Res. J. Manag. Sci. 223-8.

[6] Kholil, Eriyatno, Sutjahyo S H, Soekarto S H 2008 Pengembangan Model Kelembagaan Pengelola Sampah Kota dengan Metode ISM (Interpretative Structural Modeling) Studi Kasus di Jakarta Selatan (Development of an Institutional Model for City Waste Management with the ISM (Interpretative Structural Modeling) Method Case Study in South Jakarta) Sodality. 21 31–48 [In Indonesian].

[7] Ketels DC 2016 Review of competitiveness frameworks National Competitiveness Council (Dublin: National Competitiveness Council). p 7-37.

[8] Wulandari S, Eriyanto, Rusli M S and Kusmuljono B S 2011 Model Proses Adopsi Teknologi di Agroindustri Lada dengan Fuzzy Inference System (Technology Adoption Process Model in Pepper Agroindustry with Fuzzy Inference System)J. Optim. Sist. Ind. 10 1145–153 [In Indonesian].

[9] Hidayat T, Nurdjannah N and Usmiati S 2009 Analisis Teknis dan Finansial Paket Teknologi Pengolahan Lada Putih (White Pepper) Semi Mekanis (Technical and Financial Analysis of Semi-Mechanical White Pepper Processing Technology Package) Bul Littr. 20 1 77–91 [In Indonesian].

[10] Karmawati E, Ardana I K, Siswanto and Soetopo D 2020 Factors effecting pepper production and quality in several production center. 1st International Conference on Sustainable Plantation IOP Conf. Ser. Earth Environ. Sci. 418 P10.

[11] Cumagun C J R and Dagaas C T Integration of Total Quality Management (TQM) into the UPLB College of Agriculture Instruction / Academic Programme 57–64

[12] Mambanda J, Maibvisira G and Murangwa S I 2017 Effects of Total Quality Management on the Performance of the Food and Beverages Industry in Zimbabwe Int. J. Bus. Manag. Invent. 6 6 26–36.

[13] Jancikova A and Brychta K 2009 TQM and organizational culture as significant factors in ensuring competitive advantage: A theoretical perspective Econ. Social. 21 80–95

[14] Gharakhani D, Rahmati H, Farrokhi M R and Farahmandian A 2013 Total Quality Management and Organizational Performance Am. J. Ind. Eng. 13 46–50

[15] Mizanbekova S, Umbetaliev N, Aitzhanova A and Bogomolov A 2017 The quality management system improvement for the enhancement of production competitiveness Espacios. 38 42 29-41.

[16] Psomas E, Vouzas F and Kafetzopoulos D 2014 Quality management benefits through the “soft” and “hard” aspect of TQM in food companies TQM J. 26 431–44.