Improving Local Food Systems through the Coordination of Agriculture Supply Chain Actors

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Abstract: A local food system is an alternative food network that shortens and more effectively structures the supply chain system. An intermediary actor functioning as an aggregator is needed in the local food system. The food hub is one such intermediary actor with an essential role in strengthening the local food system and increasing the competence of small farmers to compete with large-scale food distribution. Many studies have been conducted on the effectiveness and efficiency of food hubs; however, changing the supply chain system to one that is based on a local food system is challenging. This study aims to build a conceptual model that describes the activities and coordination of the actors involved in a food hub to achieve a local food system. In this study, a soft system methodology and case study approach are used to answer the research question. The results show that two transformations are needed to achieve a local food system: changing the supply chain system to one that is shorter and more structured and increasing quality consistency. Recommendations are presented in the form of a series of human activity systems to achieve transformations. Human activities to achieve a shorter and structured supply chain involve building cooperation, operating operational activities to add value, product identification, promotion, and developing fair-trade contracts. Human activities required to achieve transformation of increasing quality consistency include identifying high-demand customer requirements, forecasting, scheduling planting, and harvesting, improving training, cooperating with research institutions, farmer assistance, and quality inspection.

Keywords: local food system; food hub; soft system methodology; case study

1. Introduction

Agricultural commodities are highly perishable food commodities with a short lifetime [1], whose distribution requires proper handling. The handling of agricultural commodities in the supply chain is different from the management of other commodities with a longer lifetime due to continuous and significant quality changes, from producers to end consumers [2]. As delays in distribution to consumers can reduce quality, increase the risk of food loss, and reduce profits, the agricultural food supply chain should focus on minimizing the shipment time [1]. The shipment time can be reduced by shortening the supply chain. Therefore, a strategy to create an alternative network that aims to shorten the supply chain is needed.

A local food system is an alternative food network (AFN) that aims to shorten the supply chain of food commodities, including agricultural commodities. The local food system supplies food locally based on regional characteristics [3,4], and involves small farmers as producers [5,6]. It affects certain social or supply chain characteristics in producing food [7,8] and creates new economic opportunities [9].

The local food system has a mission for social, economic, and environmental sustainability [10,11]; it is expected to build relationships between farmers and customers, provide fair-trade opportunities for small–medium farmers to sell their products, and shorten the supply chain in the distribution process. To achieve these goals, the most effective...
marketing strategy for commodities in the local food system is direct sales from farmers to customers [5,12]. However, direct selling can only operate efficiently if the customers are individual, not institutional customers. The supply of several small farmers can meet the demands of customers of one institution. With a direct selling system, institutional customer demand is not efficiently met, and the environmental sustainability of the local food system cannot be secured. Therefore, an intermediary local food system that can perform aggregation is needed to meet institutional customer demand and achieve the missions of the local food system.

The fastest-growing intermediary local food system is the regional food hub (RFH) [13]. RFHs function as an intermediary [14] to shorten the food supply chain [15,16] and increase sustainability [17,18]. RFHs play crucial roles in the local food supply chain system: providing operational services, producer services, and community/environmental services [19,20]. The differences between a regional food hub and a food distributor lie in the RFH paying more attention to economic viability, social justice, and ecological sustainability [21–23]. Furthermore, RFHs have social and coordination activities [16,24].

Koch and Hamm [24] categorize food hubs into three stages: planning, development, and operation. The food hub is still in the planning stage if it does not have physical facilities, paid employees, or a legal entity to support its operational activities, but has already developed operational ideas. A food hub is in the development stage if the food hub has physical space, funding, business plans, and staff or volunteers. A food hub is classified as operational if it has been sourcing and distributing food.

Among studies of food hubs in the planning stage, Mejia and colleagues [25], Perdana and colleagues [26], and Ge and colleagues [27] constructed a mathematical model to determine the location of a food hub that maximizes farmers' coverage and minimizes logistics and operational costs. Cleary and colleagues [28] sought to determine the optimal number of food hubs in a county by estimating breakeven market sizes and identifying factors that affect the profitability of food hubs. Their mathematical model found that the factors that need to be considered before building a food hub are the capacity of the food hub and the population to be covered. Martinez [29] explored the barriers to local food expansion and types of policies that can best encourage future growth, arguing that the obstacles that can hinder the development of a local food system through a food hub are inconsistent availability and quality, difficulty identifying reliable local suppliers, difficulty in making purchases due to farmers’ ordering procedures, and dealing with multiple suppliers.

In the planning stage, knowing the exact location and number of food hubs and the barriers that hinder the development of food hubs are not enough. The critical success factor in supply chain management in the local food system is coordination, which serves to increase profits and customer service performance [30]. As intermediaries of local food systems, many food hubs fail to fulfill their functions due to unsystematic coordination-related supply chain management [31]. The concept of a food hub as an intermediary for local food systems is complex because it involves many actors and has dense interactions [32]. The food hub involves many actors, such as farmers, customers, government, and local communities, with different and contradictory goals. Farmers seek a higher selling price than when they sell to middlemen, whose prices reflect customers' goals of obtaining fresh high-quality products at low purchase prices. In building a food hub, the government aims for the local food system to run effectively and efficiently so as to support the smooth functioning of the economy in their region. Research on food hubs to support the sustainability of the local food system cannot be approached only by focusing on one aspect. The goals of each actor are different but have the same level of importance, and thus solving problems based on only one factor can be detrimental to other actors. A holistic problem-solving approach needs to be applied to achieve the objectives of each actor in the food hub. Building a food hub requires significant funding on the financial side because it requires adequate infrastructure and equipment [33]. The success of a food hub is measured not only in profitability but also in the achievement of food security, a stronger local food
system, and increased regional economic activities. It is thus essential to design effective food hub coordination at the planning stage.

Among studies of coordination in the agriculture supply chain, Nguyen and colleagues [34] argued that the trust level of the participants, partner capacity, geographical distance between participants, collaborative culture, participation strategy, and specific government policies are significant factors that make the supply chain system more effective. Yan and colleagues [35] argued that consumer behavior is an essential factor for an efficient agriculture supply chain. Therefore, in coordinating strategies, it is necessary to increase the utility function of consumers via coordination contracts based on revenue sharing and wholesale prices. Ma and colleagues [36] investigated coordination problems influenced by the retail price, arguing that coordination contracts based on revenue sharing constitute a strategy that can solve the problem of coordination in the agriculture supply chain. Mishra [37] argued that collaboration, coordination, information and communication technology (ICT), and ground-level inputs can increase resilience in the agriculture supply chain. With the concept of a food hub as an intermediary in the local food system, the parameters of success cannot only be based on aspects of resilience and profitability. In carrying out its functions, food hubs must ensure these three elements of sustainability to secure the mission of the local food system. In carrying out commodity trading and marketing activities from farmers to customers, food hubs focus not only on profitability but also on social and environmental impacts. In addition, food hubs must be able to create new jobs and increase the knowledge and skills of the farmers who are members of the food hub. It is essential to study the supply chain coordination that considers social, economic, and environmental sustainability factors.

This study aims to build a conceptual model that describes the activities and coordination of the actors involved in a food hub to achieve a local food system. Coordination and activities are developed so that farmers and high-demand customers are willing to achieve a local food system. The research question we have sought to answer is: How do supply chain actors coordinate so that the food hub and local food system can be successful? The originality of this research lies in developing activities and coordination to transform an unstructured and long supply chain into one that is short and structured to achieve a local food system that considers economic, environment, and social sustainability factors. The transformation system employed here is the food hub as an intermediary, as well as the food hub being at the planning stage.

In this study, a soft system methodology (SSM) and case study approach are employed to answer the research question. Compared to the previous research method on local food systems with a food hub as an intermediary, the SSM approach is more suitable for answering the research question of this study. Mejia and colleagues [26], Perdana and colleagues [27], and Ge and colleagues [28] used a mathematical model to optimize the location selection food hub to achieve a local food system. Canal Vieira and colleagues [38], Nicol and Taherzad [39], and Avetisyan and Brent Ross [17] conducted a case study approach to describe how food hub activities meet local food demands. Mittal and Krejci [40] used agent-based modeling to simulate commodity delivery scheduling strategies from local farmers to food hubs. These approaches cannot be used to design activities and coordination to achieve a complex local food system that includes several different perceptions.

SSM is an appropriate approach to finding solutions in the form of multi-objective system problems that are equally important and complex, and involve human activities [41–43]. A soft system approach is appropriate for coordinating the design of a local food system and food hub because SSM accommodates systems that involve complexity and different perceptions without reductionism. SSM is suitable for solving problems related to improvement and coordination. SSM articulates the learning process from the system situation under study and compares the real world and systems thinking [43].

The case study in this research is the supply chain of agricultural commodities in Bandung Regency. Bandung Regency is an area that has two different regional characteristics, rural and urban. Rural areas are farming areas that produce many agricultural
commodities. These agricultural commodities are distributed within the Bandung Regency and outside the region. Currently, the flow of commodity distribution is still unstructured.

2. Literature Review

2.1. Local Food System

A local food system is defined as a supply chain system that distributes food from local producers for consumption by local customers. The local producer produces the product on a small or middle scale [5,12], and the local customers are the customers in the same area with producers who buy food from the local producer directly. This system can resolve social problems such as instability in supply, unavailability of healthy food, and inequality in economic growth between rural and urban areas.

Lyson and Guptill [3] called the local food system “civic agriculture”. Trauger, [44] argued that the local food system is part of the sustainable food system. Beckie and colleagues [9] argued that the local food system is a key factor in re-socializing and re-spatializing food, thereby opening new opportunities or strengthening relationships between supply chain actors. The local food system helps farmers, especially small-scale farmers, increase their competitiveness in selling their products to customers [15,45–47]. The local food system will also benefit customers by affording them greater access to fresh and healthy food products from local farmers [45–47]. Customers of the local food system consist of individual and institutional or commercial customers [48]. Institutional customers, including supermarkets, hotels, restaurants, catering firms, hospitals, school canteens, institutional canteens, exporters, e-commerce firms, and the home industry, have a considerable demand for food products.

Strengthening regional or local food systems will increase food consumption from local producers and enhance access to healthy and fresh food [45–47,49]. A regional food system is an alternative food system that can reduce the environmental and social sustainability problems of a conventional food system [22]. However, there are obstacles to localizing the food system, such as a lack of economic, organizational, and physical structures of the appropriate scale for moving locally grown food to local eaters.

The local food system concept prioritizes direct sales from producers to customers [12], enabling communication and the establishment of bonds between the two parties [18,50]. From this communication, customers know the characteristics or features of the product. Product differentiation is the unique attribute contained in the product, consisting of farmer identity, the story of the product, and the planting process. This product differentiation causes customers to buy local products at higher prices.

2.2. Food Hubs

The United States Department of Agriculture (USDA) defines a regional food hub as a business or organization that actively manages the aggregation, distribution, and marketing of source-identified food products, primarily from local and regional producers, to strengthen their ability to satisfy institutional demands [21]. A food hub plays a crucial role in the local food supply chain system by providing operational services, producer services, and community/environmental services [14,20]. Food hubs shorten the food supply chain system [21] and increase sustainability [17,18]. Community sustainability can be achieved by creating a market for small and medium-scale producers. The market is created through aggregation and distribution activities in the food hub [24,51,52]. With a short supply chain system, the expected food supply chain will be more efficient, and the amount of CO$_2$ emissions generated from distribution activities will be reduced. From a social perspective, a food hub tends to expand local producers’ markets [50,53] by creating new value chains that strengthen local and regional food systems [13], increase access to healthy food for low-income and urban communities [54], and create new jobs [50].

The food hub is an alternative market channel for producers and buyers that serves a social mission to improve the local and regional food systems. Food hubs must provide the main components needed and desired to encourage producers and buyers to collaborate...
with them. The main components producers need are food pick-ups, space facilities, storage, lighting, packing, pelleting, and labeling [19]. On the other hand, the main components that buyers need are aggregation, permanent facilities for storage and processing, and active coordination [19].

Food hubs are classified as part of the value-based value chain [55] because they have the same characteristics, which are transparent and collaborative decision making, differentiated products, and participants (producers and buyers) as strategic partners [24]. In its distribution activities, the food hub applies the partnership-based principle. It can help farmers perform branding and product differentiation while conducting marketing and cooperation with institutional customers. With this cooperation, small- and medium-scale producers can sell their products to institutional customers, which they cannot do when operating independently. The cooperation between food hubs and buyers will also stabilize the demand. Fischer and colleagues [16] classified food hub services into three services: producer, operational, and community services. Producer services aim to increase farmers’ competitiveness and facilitate farmers to sell their products. Operational services relate to activities in food hubs, such as aggregation, distribution, branding, marketing, packaging, storage, handling, and information changes. Community services are related to the food hub’s contribution to providing healthy and fresh food to the community and deprived areas.

3. Methodological Approach

The context of this research is the supply chain of agricultural commodities focusing on fruits and vegetables. This research employed SSM in combination with a case study approach.

3.1. Soft System Methodology (SSM)

SSM is used to model a system with many interests and perceptions. It is an appropriate approach to finding solutions in the form of multi-objective system problems that are equally important and complex and involve human activities [41,42]. A soft system approach is an appropriate approach for coordinating the design of the agriculture supply chain through a methodology that accommodates complex systems with differing perceptions without reductionism. Compared to other soft approaches, such as Strategic Options Development Analysis (SODA), and the participation approach, SSM is more suitable because it combines actual conditions with related theoretical concepts.

SSM is described in seven stages of the analysis process using human activities to understand the situation and determine the actions that need to be taken to improve the existing situation: identifying the problem situation, expressing the problem situation, generating the root definition using CATWOE analysis, building a conceptual model, comparing the conceptual model with the real world, offering recommendations, and implementation [42]. In SSM, there are two perspectives: the real-world perspective and systems thinking [56]. When identifying problem situations, the real-world perspective is applied, comparing conceptual models with the real world and providing recommendations [42]. Conversely, the systems thinking perspective on the real world is applied when building the root definition and conceptual model [41].

At the problem identification stage, SSM will define the problem non-reductively from a real-world point of view. SSM starts with the essential first step of identifying the problem situation in the agriculture supply chains. Many researchers fail to identify the problematic situation when conducting research using the SSM approach [57]. To avoid that obstacle, a case study approach is used. A case study approach describes the problem situation comprehensively by investigating recent phenomena in a real-world context [58–60]. The case study approach facilitates studying a complex issue in-depth and in an integrated fashion to identify the causal links and gaps in a system [61], thereby allowing researchers to adopt an appropriate design and carry out data collection to answer research questions [59]. The results of the case study are then described in a rich picture used to identify the required
system transformation [62]. Therefore, a rich picture must represent the actors involved, how powerful they are, and the socio-context of a situation [62].

The third step of SSM is root definition. The root definition is a statement that describes the activity of the system model under ideal, not actual conditions. In identifying the root definition, CATWOE analysis is conducted. CATWOE analysis identifies various perspectives on the problem situation and questions assumptions [63]. Transformation is the core of any root definition [64] that represents the purposeful activity to be modeled [63]. In conducting a CATWOE analysis, the steps that must be taken consist of defining the transformations, followed by identifying the weltanschauung/worldview, and then determining the other CATWOE elements.

After the root definition has been built, the next step is to create a conceptual model. The conceptual model in this study was developed based on food hub and local food supply chain theories and validated by confirming with the authority holders that the conceptual model developed is relevant to the real system of the food supply chain. The outputs of this study are recommendations of possible actions and coordination between actors of the agricultural supply chain system to achieve a local food system through a food hub. The research framework of this study is shown in Figure 1.

![Image of research framework](image)

**Figure 1.** Research framework of the research: SSM combined with a case study approach.

### 3.2. Case Study Approach

A case study is a qualitative approach in which the investigator analyzes a real-life contemporary bounded system (a case) over time through detailed, in-depth data collection involving multiple sources of information and reports a case description and case themes [65]. Compared with other qualitative approaches such as grounded theory and ethnographic studies, case studies allow researchers to apply specific theories when analyzing data, unlike other qualitative methods such as grounded theory or ethnographic theory frameworks, which are obtained from data processing. When processing data, researchers use supply chain theory so that the identified problematic situations only focus on the supply chain system activities.

The case study approach in this study is intended to identify the problem situation in the agricultural commodity supply chain. The results of this case study description will support the first and second steps of the SSM approach, namely identifying the problematic situation and expressing the problematic situation in the form of a rich picture. The purpose of this case study approach is to describe the interactions of agricultural commodity supply chain actors in coordinating the distribution of commodities from producers to customers. The results of the description of this case study must be able to describe the actors involved, the power of each actor, the socio-political context of the situation, and the gaps in the system.
The case study in this research is the supply chain of agricultural commodities in the Bandung Regency, which was chosen as the research setting because it is an area with both urban and rural regional characteristics. The commodities that are the object of the study are vegetables and fruits, which are the primary agricultural commodities in the Bandung Regency. The rural area of the Bandung Regency has fertile and extensive agricultural and plantation land, and most of the residents’ work as farmers. On the other hand, urban areas have more varied modern economic activities with potentially more high-demand customers. Farmers, who are actors that become commodity producers, have various characteristics in terms of age, types of plants grown, openness to technological changes, and ability to reach markets. Bandung Regency has several potential high-demand customers such as industry, traditional markets, restaurants, hotels, and exporters.

Primary and secondary data were collected to provide an overview of the agriculture commodity supply chain activities. Primary data collection was carried out through interviews and observation. Semi-structured interviews were conducted face-to-face and by telephone. Each interview was conducted for 1 h, and additional interviews were performed if further clarification and information were needed. As the selected informants were directly involved in the agricultural commodity supply chain activities in Bandung Regency, the information obtained can accurately describe the supply chain activities of agricultural commodities. The informants interviewed in this study comprised 11 heads of farmer groups, two middlemen, two small wholesalers, two big wholesalers, two exporters, and one head of procurement of industrial raw materials. The heads of farmer groups interviewed were farmers in seven primary areas producing fruit and vegetable commodities. The area of the farmers interviewed is shown in Figure 2. Heads of farmer groups were the leaders of 20–270 farmers in the same area. The roles of the head of farmer groups were coordinator of the training program, coordinator of the recipients of government assistance, and holder of the aspirations of the members. Information collected from the head of each farmer group represented information from his members. The interview covered several topics, including commodity transaction procedures, commodity pricing, commodity logistics systems, operating systems to increase the added value of commodities, and communication procedures in commodity supply chain activities.

For data triangulation, interviews with government officials of the Bandung Regency were conducted. Gray papers were also reviewed, such as food plans, food area action plans, and food logistics system documents. These data were used to confirm interview results and collect additional data that could not be obtained by interviews.

This case study is descriptive, aiming to explain a case clearly and its real-world context in detail [58]. This type of case study was chosen because it is intended to describe the problem situation of the agricultural commodity supply chain system as input in building a rich picture in the SSM. The interview results were coded inductively. Inductive coding is a data interpretation process based on raw data to build a concept or process. The data analysis technique used was pattern matching. Pattern matching is a data analysis technique in which the patterns that emerge from observations are compared with the patterns described in theory [58]. The theory used as a reference in pattern matching is the theory of supply chains, local food systems, and food hubs. The analysis carried out in this study involved:

- Identifying the parties directly involved in the supply chain activities of agriculture commodities;
- Identifying the character of each actor directly involved in the supply chain of agricultural commodities in Bandung Regency;
- Determining how farmers decide to whom they will sell their commodities, and what their considerations are;
- Determining how customers decide from whom they buy commodities, and what their considerations are.
4. Results and Discussion

4.1. The Real-World Situation in the Agriculture Supply Chain in Bandung Regency

The object agriculture commodities in this study are vegetables and fruits. Vegetables and fruits grown in Bandung Regency are highland horticultural crops, such as strawberries, cabbage, shallots, beans, carrots, and potatoes. Based on data from the Central Bureau of Statistics, in 2019, the number of farmers in Bandung Regency that cultivate fruits and vegetables is 72,614 farmers, producing 882,748,8 tons per year. The main actors directly involved in the agriculture supply chain in Bandung Regency are farmers, intermediaries (i.e., middlemen, small wholesalers, big wholesalers, and farmer groups), and high-demand customers (i.e., hotels, restaurants, traditional market, exporters, and industry).

Farmers are producers and suppliers of fruit and vegetable commodities. Farmers in Bandung Regency are classified into two groups: ordinary farmers and millennial farmers. Ordinary farmers are farmers who are over 39 years of age, a group that used to choose to become farmers because they lived in agricultural areas. This type of farmer chooses their profession to continue their parents’ lifestyle as well as for environmental reasons. Their cultivation follows the traditional habits and practices of their parents or of the farmers around them. Conversely, millennial farmers are farmers who are aged 19–39 years old. Millennial farmers are recruited by government programs intended to regenerate farming and to create a group of competent farmers capable of entrepreneurship and sustainable agricultural activities. However, the number of millennial farmers remains minimal, and this program has yet to reach success. This is because millennial farmers have not been able to achieve the government’s targets due to crop failure.

There are training and assistance programs facilitated by the government, universities, and industry. However, training has not been fully implemented because technical problems in the field are often different from what their training covers. In interviews, all farmers reported that they would be happy with a greater frequency of assistance to farmers in the field to prevent confusion due to technical problems, such as certain pests that attack their plants. Farmers report that optimal assistance is currently provided by industry. However, not all farmers receive service from the industry; only appointed farmers who cooperate with the industry receive such assistance.
Based on the interviews with heads of farmers groups, farmers have several strategies to sell their crops. Farmers sell their crops to middlemen, farmer groups, small wholesalers, traditional markets, or industries. The channel selected by farmers to sell their crops based on interviews can be seen in Table 1.

Table 1. Farmers channels in selling harvests.

| Area       | Farmer Group Name | Number of Farmer Members | Channel in Selling Harvest | Middlemen | Small Wholesaler | Farmers Group | Traditional Market | Industry |
|------------|-------------------|--------------------------|---------------------------|-----------|------------------|---------------|--------------------|----------|
| Ciwidey    | A                 | 35                       | -                         |  ✓        | ✓                | ✓             | ✓                  | -        |
|            | B                 | 40                       | -                         |  ✓        | ✓                | ✓             | ✓                  | ✓        |
|            | C                 | 270                      | -                         |  ✓        | ✓                | ✓             | ✓                  | ✓        |
| Pasirjambu | D                 | 20                       | -                         |  ✓        | -                | -             | -                  | -        |
|            | E                 | 170                      | -                         | -        |  ✓                | ✓             | ✓                  | -        |
| Pangalengan| F                 | 25                       | ✓                         | ✓        | ✓                | -             | -                  | -        |
| Arjasari   | G                 | 70                       | -                         |  ✓        | -                | -             | -                  | -        |
| Paseh      | H                 | 30                       | ✓                         | ✓        | -                | -             | -                  | -        |
| Cikancung  | I                 | 60                       | ✓                         | ✓        | ✓                | -             | -                  | -        |
| Cimenyan   | J                 | 30                       | ✓                         | ✓        | -                | -             | -                  | -        |
|            | K                 | 77                       | ✓                         | ✓        | -                | -             | -                  | -        |

Currently, individual farmers in Bandung Regency only sell their crops directly to two types of high-demand customers: the traditional market and industry. Farmers will sell to traditional markets if they already have traditional market trader partners willing to accommodate their harvested commodities at a price according to the agreement. Farmers then receive money on the same day as the sale without needing to carry out sorting and grading.

Several farmers cooperate with industry to sell their crops directly to them. Farmers who can sell commodities to industry receive special training from the government. For farmers’ harvests to meet the specifications and criteria, the industry will assign a quality control (QC) specialist to assist farmers from pre-planting to post-harvest. A QC specialist will help solve problems the farmers face during plantings, such as pests and diseases. The industry also provides interest-free capital loan assistance of 60% of the total costs.

Farmers who partner with specific customers follow outcropping patterns according to customer agreements and instructions. Meanwhile, farmers without customer partners will plant commodities according to the season. The income of farmers with customer partners is more stable than that of farmers without partners, as they already have a sale price agreement following the agreement. They cultivate the commodity type based on the agreement. Conversely, farmers without customer partners see inconsistent harvest sales results. Sale proceeds depend on fluctuating market prices as most of these farmers practice seasonal cropping patterns and do not cultivate based on market demand forecasts. Consequently, they frequently see very cheap selling prices due to the abundance of commodities in the market.

Currently, intermediaries for agricultural commodities in Bandung Regency are middlemen, small wholesalers, big wholesalers, and farmer groups. Most of the agricultural commodity farmers in Bandung Regency sell their commodities to small wholesalers either without or through middlemen. Farmers sell through middlemen if farmers cannot sell directly to small wholesalers. Middlemen receive a commission if the transaction between the farmer and small wholesaler is successful.

A small wholesaler is an intermediary who collects commodities directly from farmers to sell to big wholesalers or high-demand customers. When farmers sell their harvested commodities to small wholesaler, they do not need to sort and grade them. The payment system is also quick and straightforward. Small wholesalers offer two payment systems to farmers, namely direct cash payments and payments after commodities are sold successfully. If the payment is made directly, then the selling price received by farmers is below the
market price. If the payment is made after the small wholesaler has succeeded in selling the commodity, the selling price received by the farmer reflects the market price minus a commission of 10% of the selling price. Farmers are also dependent on the small wholesaler because the small wholesaler provides capital loans to farmers at 0% interest. Farmers prefer to borrow capital from the wholesaler than the government because the process is easy and without appeal. Before being sold, small wholesalers sort and grade commodities into four types from grade A for the highest grade and grade D for the lowest and sell them to the buyers.

Big wholesalers collect commodities from small wholesalers and aggregate them by quality level. These commodities are resold to another big wholesaler and high-demand customers, including supermarkets, restaurants, and exporters. High-demand customers have unique specifications, such as buying commodities from big wholesalers because of the ease of transactions, guaranteed availability of goods, consistency of quality, and continuity of supply. In addition, as big wholesalers have more capital than farmers, they are willing to conduct sales based on a contract system and are willing to be paid at the end of the month.

In Bandung Regency, several farmers form a farmer group in a certain area. The government distributes assistance and fosters agricultural activities through farmer groups, such as subsidized fertilizers, seeds, and training. Several farmer groups in Bandung Regency have introduced innovations into their operational activities by acting as aggregators of agricultural commodities. Members of these farmer groups perform sorting, grading, and packing themselves, and each commodity package is assigned a farmer’s identity to facilitate the control and payment process. These commodities are then collected at the homes of the head of the farmer group for sale to big wholesalers, industries, and exporters that have partnered with the farmer group. Under this system, farmers receive a higher selling price than if they sold it individually, either through middlemen or small wholesalers. However, not all farmer groups perform such commodity aggregation.

Based on interviews with the heads of farmer groups, all of them confirmed that none of the farmers in their area sold their harvests directly to restaurants, hotels, or exporters. One farmer alone cannot meet one such customer’s demand. Farmers also dislike selling their commodities to high-demand customers. However, when selling to high-demand customers, the sales system is contractually agreed upon, and the farmer will receive money from the sale for a certain period following the agreement. The ease and speed of obtaining capital for the following planting process are crucial for farmers.

The disparity in agricultural commodity prices between regions is still high. When commodity prices in another area are very high, the big wholesaler in Bandung Regency will sell the commodity to the big wholesaler in that region. In another region, big wholesalers will provide higher prices than those offered by high-demand customers in Bandung Regency. The supply of commodities for Bandung Regency will then decrease so that the external supply will enter the Bandung area through big wholesalers. As a result, commodity prices in the Bandung Regency will also increase.

High-demand customers consist of traditional markets, supermarkets, exporters, restaurants, and the industry. High-demand customers buy commodities from farmers or wholesalers and resell them with or without a production process. They buy commodities according to the prices prevailing in the market. If the farmer sells the commodity to high-demand customers, the harvest income will be greater than when selling to the wholesaler or middlemen.

Based on the interview with exporters, wholesalers who act as aggregators can easily supply commodities with consistent quality. The same information was obtained when conducting interviews with small and big wholesalers. Exporters, restaurants, supermarkets, and industries make purchases with specific quality and quantity on a contract-based period. High-demand customers that have the highest criteria are supermarkets, exporters, and industry. Wholesalers will supply grade A commodities to supermarkets, exporters, and industry. In addition, when selling commodities to exporters, supermarkets, and
industry, certification related to the cultivation system of the resulting commodity is required. For restaurants, the wholesalers will supply commodities of grades B and C. For exporters and industry, payment will be received directly when the buyer gets the commodities. As for supermarkets and restaurants, payments are made every two weeks or once a month.

Unlike other high-demand customers, traditional markets do not have specific criteria of quality or quantity. The wholesalers will generally supply the traditional markets with commodities with the lowest grades, namely grades C and D. Payment is made when the traditional market trader receives the commodity. The selling price of each commodity does not depend on the quality. Data on requirements for high-demand customers obtained from interviews with exporters, heads of procurement for industrial raw materials, big wholesalers, and small wholesalers is shown in Table 2.

Table 2. High-demand customers’ requirements.

| High Demand Customer | Requirements |
|----------------------|--------------|
|                      | Grade        | Certification | Contract Base |
| Traditional Markets  | no specific grade | no            | no           |
| Supermarkets         | A            | yes           | yes          |
| Restaurants          | B, C         | no            | yes          |
| Industry             | A            | yes           | yes          |
| Exporters            | A            | yes           | yes          |

A rich picture of the problematic situation of the agriculture supply chain in Bandung Regency can be seen in Figure 3.
4.2. Root Definition

The rich picture in Figure 3 shows that the supply chain of agricultural commodities is long and unstructured; the commodities harvested from the Bandung Regency are distributed outside Bandung, and consumer needs in the Regency are supplied from outside the Bandung Regency area. Not infrequently, commodities distributed outside the Bandung area will be re-distributed to the Bandung Regency. The existing agriculture supply chain in Bandung Regency has three intermediaries: middlemen, small wholesalers, and big wholesalers, resulting in farmers receiving a selling price much lower than the prevailing market price. The wholesaler sells the purchased commodity to the buyer with the highest bid price, and not infrequently, one outside the Bandung area. Meanwhile, commodity demand within the Bandung area is also met from outside the Bandung Regency. This supply chain system makes the supply chain of agricultural commodities inefficient as agricultural commodities are perishable commodities with a short product lifetime. Long, unstructured supply chains reduce the quality and freshness of commodities, harming the end consumers of agricultural commodities. From the farmer’s perspective, this supply chain will reduce their income because commodities pass through many intermediaries. The irregularity and length of the existing supply chain result in high logistics costs, which also have a negative impact on the environment. Moreover, the more transportation needed in distributing commodities, the more emissions generated from the supply chain system. Therefore, a transformation is needed to shorten and structure the supply chain of agricultural commodities. CATWOE analysis to achieve a short and structured supply chain can be achieved as seen in Figure 4, subsystem 1.

The current long supply chain is also due to the inability of individual farmers to meet the needs of high-demand customers. Though several farmers can meet the needs of one high-demand customer, purchasing commodities directly from farmers requires many transactions, and the transportation costs are higher. Therefore, high-demand customers prefer to buy from the wholesaler because the wholesaler offers easy transactions. In addition, most farmers cannot supply commodities consistently, and the quality of their
commodities is also inconsistent, as most farmers do not perform grading. Farmers’ planting patterns are still seasonal and based on the traditions of their parents. In order for high-demand customers to be willing to engage in purchases in the new supply chain system, the competence of farmers must be increased. This competency improvement is carried out by conducting training and mentoring farmers in the field. CATWOE analysis to improve farmer capacity can be seen in Figure 4, subsystem 2.

Farmers and high-demand customers are the deciding actors in determining the success of the local food system. Subsystem 1 has a role in making the supply chain system for agricultural commodities shorter. A shorter supply chain system will give farmers an advantage in selling prices. As it does not involve many intermediaries, the selling price received by farmers will be higher, as is the price prevailing in the market. With the achievement of subsystem 1, farmers will be interested in achieving the local food system.

In contrast to high-demand customers, the short supply chain is not directly profitable, primarily in finance. High-demand customers will continue to buy commodities according to the prices prevailing in the market. One of the reasons high-demand markets are not willing to buy goods from farmers directly is the uncertainty of quality. So, to attract high-demand customers, it is necessary to achieve subsystem 2, namely, the achievement of quality consistency at the farmer level.

4.3. Conceptual Model

Based on the CATWOE analysis highlighted in the previous subchapter, two transformation processes need to be carried out to achieve local food systems that prioritize local farmers and customers. The first is to structure and shorten the agriculture supply chain system, which requires the participation of farmers as producers and high-demand customers as end buyers. The participation of farmers in switching to selling their crops and high-demand customers to purchase commodities in the new system is crucial. Not only that, loyalty from producers and consumers is also needed so that the transformation system can be sustainable [19]. Therefore, a structured and shortened food supply chain system must accommodate the interests of the farmer and high-demand customers. In the problematic situation discussed in Section 4.1, the main goal of farmers participating in the agriculture supply chain system is to increase their income. Meanwhile, high-demand customers aim to secure commodities of suitable quality at low prices.

The ultimate goal of this structured and shortened agriculture supply chain system is to achieve a local food system. The parameters of success of the local food system are not based only on the economic aspects but also on the environmental and social aspects [17–19]. Intermediaries are still needed in designing a shorter and more structured supply chain because farmers in Bandung Regency are small and medium farmers. One high-demand customer must be supplied by several farmers through an intermediary that functions as an aggregator to make the transaction process more accessible. However, the developed intermediary must have a different principle from existing intermediaries and must support the achievement of a local food system. This new intermediary must also provide benefits for farmers and high-demand customers. An intermediary that fits this concept is a food hub [21], which not only prioritizes profit but also promotes social and coordination activities between farmers and customers [23].

Figure 5 subsystem 1 is carried out at the food hub. Farmer participation is the first thing that needs to be achieved in developing a new supply chain system because farmers are the primary producers who produce products sold to customers. Therefore, the first activity to be carried out is to build farmers’ cooperation for collaboration in selling commodities together to reach high-demand customers (1). Another actor no less important in achieving a local food system is the participation of high-demand customers. Marketing to high-demand customers (6) is carried out after operational activities at the food hub have been clearly defined.
Based on the elaboration in Section 4.1, farmers currently rely on capital loans provided by intermediaries, such as wholesalers. This dependence forces farmers to sell their commodities to the wholesaler at a lower price. To compete with wholesalers, food hubs must facilitate farmers to provide assistance services in seeking capital loans from government programs (2). Food hubs can cooperate with banks in distributing capital assistance loans, facilitating more accessible and more targeted assistance.

According to Barham and colleagues [21], a food hub must perform sorting, grading, aggregating, and product profiling to better support the local food system. Farmers in Bandung are small and medium farmers who have a small harvest. If the new aggregation is carried out at the food hub, the activity of delivering commodities from farmers to the food hub will be congested. These activities will lead to high transportation costs and CO₂ gas emissions. In Bandung Regency, every farmer becomes a member of the farmer group. Empowering farmer groups as the first aggregators to be sent to food hubs will make commodity delivery activities more efficient. Sorting, grading, and product profiling will also be more efficient if the farmers perform it before distributing commodities to food hubs. It is also necessary to ensure the identifiability of farmers to facilitate payment when sorted and graded commodities are sent to the food hub in aggregate. Shipping in aggregate is more efficient by saving transportation costs and reducing queues when loading and unloading commodities at the food hub. At the food hub, aggregation is carried out by grade and commodity type, as well as product profiling to inform prospective buyers of the characteristics and specifications of the products purchased (3,4,5).

To increase local people’s access to healthy and fresh food, it is necessary to maintain the availability of agricultural commodities. Therefore, the participation of farmers in the first transformation is highly needed in order to structure and shorten the agriculture
supply chain. Nguyen and colleagues [34] argued that the trust level of the participants and collaborative culture are significant factors that impact farmers’ joining the supply chain system. Based on the problematic situation in Section 4.1, it is known that farmers who have the most stable income are farmers who work together with the industry. The farmer receives a fair and definite price. Therefore, to achieve the first transformation, partnerships need to be built with farmers through an appropriate partnership strategy of fair-trade contracts (7). Fairtrade ensures that the farmers’ price is the prevailing market price.

In addition to establishing partnerships with farmers, food hubs must also establish partnerships with high-demand customers. Food hubs must carry out promotions to potential high-demand customers as much as when establishing partnerships with farmers. Food hubs also need to know possible customers’ preferences in agricultural commodities. The data from Table 2 revealed that the factors that influence high-demand customers’ purchases of agriculture commodities are the ease of transactions and consistency of quantity and quality. These three factors can be met if the operational activities at the food hub are well established. The success of operational activities at the food hub will increase customers’ trust.

Disclosure of information can build resilience in the supply chain [37]. With detailed information about the commodities being sold, trust will be formed between farmers and customers. Therefore, in the local food system, information is not only about basic information of commodity (e.g., variety, quantity, and quality) but also about commodity profiles, such as farmer identity and planting process. Commodity profiling allows customers to know the final quality of the commodity and the history of the product. Commodity profiling also makes customers more familiar with farmers to open broader collaboration between farmers and customers. Openness and ease of information about commodities will ease high-demand customers’ purchasing decisions. This information is also helpful in making contract decisions with farmers and customers.

Through partnerships with farmers and customers, supply and demand uncertainty can be minimized. The partnership strategy will facilitate the scheduling process of member farmers’ cropping patterns according to the needs of high-demand customers. With this certainty, commodity prices will be stable, and the availability of healthy and fresh food is guaranteed. The partnership strategy will also make it easier to synchronize the commodity logistics of producers, farmers’ communities, and food hubs with respect to high-demand customers, introducing greater certainty for producers and customers through a scheduling process that facilitates commodity handling at the food hub. The partnership strategy will reduce logistics costs, lower inventory requirements, and minimize food loss. The linkage of system activities to achieve a structured and short transformation of the agriculture supply chain can be seen in Figure 5, subsystem 1.

The second transformation needed to achieve a local food system is to increase the quality consistency of agricultural commodities. Activities to support this transformation are shown in Figure 5, subsystem 2. The first activity is mapping the potential of the high-demand customers (a). This mapping aims to identify high-demand customers who have the potential to purchase commodities from structured and short supply chain alternatives, from identifying potential high-demand customers to understanding what requirements must be met when selling commodities. These requirements then socialize to farmers (b). In addition, data requirements can also be the basis for potential forecasting demand (c). Forecasting can ensure the selling price of farmers does not drop due to the large availability of supply in the market. Forecasting data are used as a reference for scheduling planting (d). Scheduling planting needs to be carried out not only to maintain the availability of supply but also to stabilize the price. Scheduling harvest time (h) needs to be carried out to obtain optimal quality yields. By scheduling harvest time, the commodity will have optimal nutritional levels. A quality inspection (i) is carried out to ensure that the commodities comply with the desired requirements. The quality inspection activities include sorting and grading commodities so that the commodities distributed to food hubs are commodities of decent quality.
Activities that are no less important to improve quality consistency are increasing the competence of farmers. Increasing the competence of farmers is carried out by expanding the training program (e). The training program refers to the requirements desired by potential high-demand customers. This training program must also involve universities and living innovation laboratories (f). Living innovation laboratories and universities currently conduct training programs for farmers separately; this lack of integration causes the competence of farmers to vary across regions. With cooperation between food hubs, universities, and living innovation laboratories, training and assistance can be carried out in an integrated manner. Assisting farmers during the planting process (g) needs to be carried out so that farmers can solve problems in the field that are based on the most current science. The assistance is also so that farmers know the best harvest time to produce quality commodities.

The design of activities and coordination, as shown in Figure 5, aims to make the supply chain system shorter and more structured. In the existing agriculture supply chain, buying and selling activities are carried out in an unstructured manner, and the relationship between actors is transactional. Big and small wholesalers carry out operational activities, such as aggregation, sorting, and grading to meet high-demand customer requirements. These operations only provide profit for the wholesaler. These wholesalers buy commodities from farmers at lower prices for all qualities but resell them at a higher price according to the quality of the commodity-grade. The proposed supply chain system only requires one intermediary, the food hub, which will facilitate fair trade contracts between farmers and high-demand customers that benefit both parties. This partnership strategy of contracts between farmers and high-demand customers will stabilize demand, as well as make it easier to schedule cropping patterns to maintain supply stability. The balance of supply and demand will stabilize the price and supply of commodities while reducing food loss and insecurity. This strategy also reduces logistics activity by reducing transportation activities, thereby also reducing emissions from agricultural commodity supply chain activities.

To achieve a local food system, coordination activities are needed that not only help farmers produce commodities that meet the needs of high-demand customers but also provide science-based training tailored to the needs of farmers and the standard requirements of the high-demand customers, through collaboration with universities and living innovation laboratories. Such training, carried out in an integrated manner through a food hub, increases the ability and knowledge of farmers. The farmer competency improvement program does not stop at training; assistance in the field is also needed. The mentoring and training process will minimize crop failures and supply uncertainty regarding both quality and quantity.

The proposed alternative supply chain system has aims to increase economic, social, and environmental advantages. However, changing an agriculture supply chain is not easy. According to Mejia and colleagues [25], the middleman, small wholesaler, and big wholesaler will not give up on letting the supply chain system change. They argue that the strategy that can be implemented is to create intermediary memberships in the food hub. In the context of Bandung Regency, intermediary (i.e., middlemen, small wholesalers, and big wholesalers) membership can be applied. Middlemen and small wholesalers can act as coordinators in farmer groups that do not have the human resources to carry out aggregation, and the sorting and grading of operations. Small wholesalers and big wholesalers can still conduct their business but are limited to particular commodities. These wholesalers cannot do business in strategic commodities that are only sufficient to meet the needs of Bandung Regency. In this way, a local food system will be achieved without losing the livelihood of the intermediary.

5. Conclusions

This study recommends activities and coordination to achieve a local food system. Two transformations are needed: the shortening and structuring of supply chains and increasing the competence of farmers to produce crops with consistent quality to meet
demand. An intermediary is needed in the recommended supply chain system in the form of a food hub, whose activities agree with the economic, social, and environmental aspects of the system. The recommendations provided do not eliminate intermediaries, such as wholesalers, who are recommended to form partnerships with actors in the new supply chain system to not disrupt the intermediary’s livelihood.

The practical implication of this study is to provide coordination strategies and system activities that can attract high-demand customers and farmers to switch from a long and unstructured agriculture supply chain to a shorter and structured supply chain to achieve a local food system. The transformation to this new system does not eliminate middlemen and wholesalers. A membership strategy is carried out to accomplish the local system without the loss of livelihood for middlemen and wholesalers.

The social implication of this research is to provide recommendations for activities and coordination to create a local food system through a food hub. The recommendations make the supply chain shorter and more structured through the implementation of these activities and coordination; increase the level of welfare and competitiveness of local farmers; increase access to healthy and fresh food at more affordable prices; reduce food loss from supply chain activities.

A conceptual model for achieving a local food system is an important outcome of this study. Future research is recommended on the criteria in order to determine which process should measure and to carry out model simulation studies to establish whether the model meets the desired functions.

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