A Modelling Framework of Sustainable Supply Chain Management for Organic Vegetables in Rural Area with Narrow Land: An Action Research in Indonesia

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***Abstract*— As a developing country, food security is still an important issue in Indonesia. The increase in demand for organic vegetables products over the last couple of decades has created one of the fastest growing sectors within the fresh produce industry. The low productivity of housewives in villages and their lax spare time are well positioned to take advantage of existing sustainable and profitable opportunities, specifically in organic vegetables production even they only have narrow land. This study aims: (1) to demonstrate the hidden potency of rural housewives community to apply modern technology in cultivating organic vegetables for narrow land, and (2) to develop supply chain management modelling tools of organic vegetables for supporting food security system in rural area. The subjects of this study are housewives in rural area of Semarang City in Province Central Java, Indonesia. By employing an exploratory sequential mixed methods research design, this study's results show that the proposed supply chain management model is proven as an appropriate model to secure supply chain of organic vegetables in rural area. Using this model, organic vegetables cultivation sustainably maintains the family's food self-sufficiency and lead to semi-commercial needs of the surrounding communities.**

***Keywords*—** *organic vegetables, supply chain management, rural, housewives productivity, narrow land*

1. Introduction

Over recent decades, trends in food production per capita have been generally positive across most regions. Growth rates in Indonesia have been higher for the last 20 years [1]. One of the popular varieties which have high demand today is organic vegetables. Organic farming is a form of agriculture which avoids the use of synthetic fertilizers and pesticides, plant growth regulators, and livestock feed additives. Organic farmers rely on crop rotation, integrated pest management, crop residues, animal manures and mechanical cultivation to maintain soil productivity and till to supply plant nutrients, and to control weeds, insects and other pests. For animals, it means that they were reared without the routine use of antibiotics and without the use of growth hormones.

The demand for organic products in developed countries keeps growing year by year [2, 3], [4]. Take organic vegetables as examples. The growing population of middle class is taking the lead in purchasing them. They are even willing to offer more money as long as they obtain goods which are not only healthier but also environmentally-friendly. Increased awareness of a better place to live, a healthy lifestyle, supports from government policies, food industries, and markets taking up 50% of organic products, high prices among consumers, "organic" labeling, and adamant national campaigns on organic farming are the main factors in driving the demand for organic vegetables.

In Indonesia, organic farming has been developing for about five years which is expected to gain more profitable outcomes. However, they turn out to be not fulfilling, especially for those who do not own adequate farming land, because of unpredictable all year round rainfall levels (2016-2017) resulting in damaged crops. Therefore, this problem has to be solved immediately. There should be some improvement in production processes, be it in

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working method, personnel capacity, and equipment used in the production process [5].

Table 1. The Production of Vegetables in Indonesia in 2012-2016

No.	Vegetable	Amount of Production (tons)			
		2012	2013	2014	2016
1.	Leek	596.824	579.973	584.631	537.931
2.	Mustard	594.934	635.728	602.478	601.204
3.	Long bean	455.615	450.859	450.727	388.071
4.	Chili	954.363	1.012.879	1.074.611	1.045.601
5.	Tomato	893.504	992.780	916.001	883.242
6.	Eggplant	518.827	545.646	557.053	509.749
7.	Kale	320.144	308.477	319.618	297.130

(Source: BPS, 2017)

Table 1 describes a decreasing amount of production from 2014 to 2016 for the vegetable varieties listed for both organic and artificial vegetables. This declining production is caused by many constraints. In developing countries, the constraints faced by farmers are almost similar. Constraints in cultivating apple in Chitral, Pakistan: (1) trigger constraints, consist of natural disasters and socio-cultural factors; (2) productivity/value creation, consist of quality production, lack of awareness, and financial constraints; (3) transactional/value capture, consist of market access, market power, market security, and technological constraints [6].

In Malaysia, the challenges in rice production included changes in climate, dependent on the economic rule, high production cost, lack of land availability, dependency on subsidy and inadequacy in technology and infrastructure [7]. While India faces constraints in terms of infrastructure particularly irrigation, transportation and electricity, and financial and marketing constraints for higher output and income realization [8]. In Indonesia case, the current condition that could be found in the Indonesian company now is because the available product is not replenished based on the daily requirement [9].

The same problem occurs in organic vegetables market in Indonesia. The increasing demand of organic vegetables and, in other side, the "stuck" supplies of them creating a big opportunity to whoever who wants to produce organic vegetables. An additional of supplies are really needed to secure the supply chain of organic vegetables in Indonesia. Government might find out the easier way to secure this supply chain by importing the organics vegetables from other countries. But, instead of doing import practice, there are many domestic resources which are able to be empowered to increase the supply of organic vegetables.

Supply chain is defined as a group of inter-connected participating companies that add value to a stream of transformed inputs from their source of origin to the end products or services that are demanded by the designated end-consumers [10]. This study will examine a model of supply chain management for organics vegetables in Indonesia by empowering women community in rural area of Indonesia. This model tries to catch the economics opportunity for women in rural area who are less productive (because almost all of them are housewives) to become more productive by maximizing the potency of their house yards. This model reforms their house yards become "little garden" for planting organic vegetables to be consumed by themselves and to be sold in order to gain profit.

2. Organic Vegetables Cultivation Potency in Central Java, Indonesia

Semarang City as the capital City of Central Java faces a problem of increasing critical land in the upper area of it. This critical land exacerbates the problem of flooding in the lower Semarang area. Critical land is land that is currently unproductive due to the management and use of that land no or less attention to soil and water conservation requirements, resulting in erosion, chemical, physical, watering and environmental damage [11]. One of the recommendations to minimize the increase of land criticality is with empowering the land of sleep (moor, vacant land) according to the rules of soil conservation [12]. Empowerment of this sleeping land will be able to increase the value of the land itself mainly from aspects of productivity and the necessity of a sustainability effort through soil conservation meet the rules of conservation of soil and water.

Cultivating organic vegetables in upper area of Semarang can be the best way in empowering sleeping land to reduce critical land level in Semarang. This idea is supported by the fact that the production of vegetables in Central Java is high comparing to other province in Indonesia. For the example, production of leek in

Central Java itself can cover 21, 69% production of Leek in Indonesia. Therefore this study chose Central Java as a role model of organic vegetables cultivation based on the proposed model.

Table 2. The Production of Vegetables in Central Java in 2016

No.	Vegetables	Total Production (tons) in 2016		
		Central Java	Indonesia	Ratio (%)
1.	Leek	116.700	537.931	21.69
2.	Mustard	84.698	601.204	14,09
3.	Long bean	25.108	388.071	6,47
4.	Chili	164.980	1.045.601	15,78
5.	Tomato	61.587	883.242	6,97
6.	Eggplant	28.982	509.749	5,68
7.	Kale	27.924	297.130	9,39

(Source: BPS, 2017)

One of the potential area in Indonesia to produce organic vegetable is Central Java. District Gunungpati, Semarang, Central Java, is one of regions famous for producing fresh tropical fruits (durians and rambutans). The growth and development in District Gunungpati as the *green belt* of Semarang is closely related to the aspect of social economy of the people who earn their living from growing fruit and laboring as their side jobs. The latter is necessary for them to meet their daily needs as growing fruit is seasonal. Most of them are not intensive farmers. They grow fruit for their own consumption and sell the rest of it. Besides, they own limited size of farming land. Cultivating organic vegetables in narrow land around their houses can be an alternative way that should be taken into consideration, for it can not only fulfill their needs on hygienic food but also preserve the nature.

Unfortunately, filed based observation indicates that there are some issues which are likely to be obstacles to the people of District Gunungpati's real income when starting a business of organic vegetables cultivation, namely: (2) a small number of people who are into cultivating them; (2) inadequate farming land; (3) insufficient technology to function narrow land; and (4) the people's lack of knowledge on the cultivation of organic vegetables.

The state is not only the responsibility of the government but also all social elements. A harmonized cooperation among the government, farmers, and intellectuals must occur in order to enhance the productivity of farming products, especially the organic ones which are not only environmentally-friendly but also safe for daily consumption. Thus, a model of efficient and effective supply chain management for organic vegetables is required for this to happen.

3. Related Works

If the producer developed a product innovation follow the rapidly changing world, it makes the consumer give more interest in to the local product [13]. That indication could build an engagement between local producers and consumers. Nevertheless, creating business innovation in the form of organic vegetable farming is not the only solution in empowering the community for economic strengthening. Innovation does not mean anything without the competence to manage the business. Entrepreneurial quality and business success depend heavily on personal characteristics of business people (in this study are women), not on any formal education system or training [14]. The study also found that many women were able to develop a strategy of anticipating a strong business failure.

Conventional farming refers to a farming system making use of synthetic chemical fertilizers and pesticides and other materials to manage weeds and pests leading to potential risk to humans and other life forms and unwanted side effects to the environment, such as pollution, residual pesticides on food, health issues, loss of useful wildlife, growing resistance of insects and pathogens, and pest resurgence [15]. This farming method can be developed further provided that farmers are in possession of a large amount of capital and able to predict the weather and prices to cover production cost. Agribusiness as a commercial farming invasion may grow as what occurs in Zimbabwe [16]. On the other hand, the use of synthetic fertilizers poses a likely threat to soil fertility. In fact, they can enhance the production of nutrients needed for soil fertility, yet they may also disrupt absorption and balance of other nutrients in the soil and reduce the growth of soil microbes causing the production of humus to suppress [17]. To lessen these hazards, an alternative technology-based organic farming in the form of recycling soil nutrients by utilizing organic residues as fertilizers and nitrogen fixation, employing natural enemies

and cutting down chemical substances needs to be developed.

Organic vegetables farming is an organic agriculture which is supposed to be managed well and intensively in the form of a firm with a complete structure organization and transparent job descriptions in order that its fixed and variable costs function effectively and optimally and guarantee products with good quality, quantity, and continuity. The seeds in organic vegetables farming are not derived from genetic engineering or *genetically modified organism (GMO),* but they are gained from organic farming plantation and do not apply synthetic fertilizers and *phytohormones*. Soil fertility security is practiced through providing organic and natural fertilizers, plant residues, and legume rotation and avoiding the use of synthetic and chemical pesticides while weeds and pests are controlled manually with natural pesticides and agents and plant rotation. Synthetic *phytohormones* and additive substances w fodder and manure are also prevented from use. Post-harvest and food preservation are handled in natural manners.

Nutrient control technology on organic farming is practiced though recycling plant nutrients naturally to enhance biological, physical, and chemical soil fertility. Macro and micro nutrients taken away during harvest are brought back by adding organic fertilizers and plant residues periodically into the soil in the form of either green manure or compost. It is highly recommended that organic fertilizers are obtained from organic substances, such as composted manure, legume residues, and hedgerow cuts organic waste, as well as Tithonian diver's folia as a green manure. The applied manure should not be taken from live stocks managed in factory farming. The existing issue of narrow land in fact occurs due to planting patterns with soil as its direct media. Potting system and polybag nursery can be silver bullets to overcome this issue so that farming activities continue to thrive.

4. Data Collection and Modelling Framework

The research is conducted in District Gunungpati consisting of 12 villages with 89 hamlets (RW) and 418 neighborhoods (RT). The people who have already cultivated organic vegetables on a daily basis for more than two years and founded a community, Female Farmers Organization (KWT), called Sri Rejeki, are those from RW 3 with 24 housewives as the members.

This research is specific, meaning that the subject is family groups, and holistic, implying that it covers the aspects of both agricultural technology and agricultural economics. Both the researcher and the subject are interactively involved at a particular time and context. Regarding the distinctiveness of the subjects, the objects, and the characteristics of the research, it employs *exploratory sequential mixed methods,* a mixed research method pertaining to a sequence of activities experienced by the researcher to gather both quantitative and qualitative data [18].

In this research, qualitative data collection is gathered prior to the quantitative ones. It is essential to do so, for the purpose of the research is, at first, to explore the issues being examined, and then proceed with quantitative data which can be utilized to analyze larger samples, so the results of the research can be commended to a population [18]. More specifically, the goal of the use of qualitative and naturalistic research method is to observe a natural phenomenon without any manipulation in a context of entity [19], [20]. With this approach, the researcher is required to apply inductive procedures to describe the phenomenon with a person as the main instrument. Quantitative method, on the other hand, is intended to expose nutrient content of a medium and a plant and to calculate the degree of technical, price, and economic efficiency, and the cost and benefit of cultivating organic vegetables.

Based on theoretical analysis, the model of sustainable supply chain for organic vegetables in narrow land is formulated in Figure 1.

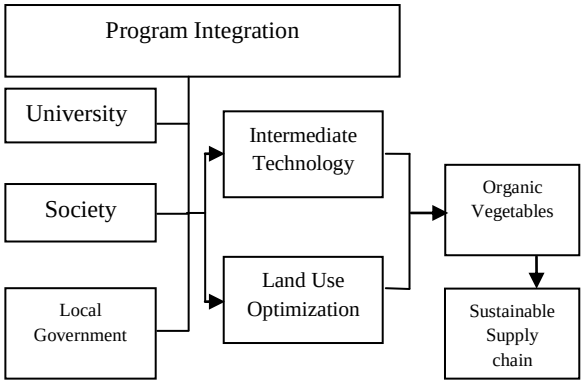

Figure 1. Theoretical Model of Sustainable Supply Chain for Organic Vegetables in Narrow Land

This model is tested in the field to be further evaluated and perfected with some inputs and revisions from experts.

5. Results and Discussion

5.1 Cultivation of Organic Vegetables in Narrow Land

Farming organic vegetables in narrow land in the area of the research makes use of the courtyard and the yard of a house, and the roadsides which certainly do not hinder traffic. The cultivation also exploits domestic waste, such as plastic packaging of mineral water, frying oil, and detergent, paint cans, used buckets and gutters, and other used materials. Tiny size ones are functioned as the substitute of polybags for seedlings. More than one liter/kg size of used materials is used to cultivate organic vegetables and are placed in every vacant nook and cranny of the yard.

The vegetables are planted one by one in the media, such as used paint cans, buckets, and plastic packaging of frying oil holed at the bottom part for water absorption. Approximately two meter long gutters are used to plant vegetables placed in a row. Used plastic is to be recycled, but it can also benefit farmers with an issue of narrow land.

The members of KWT Sri Rejeki also belong to Family Welfare Movement (PKK) of small groups of ten families (*Dasa Wisma*), RT, and RW. Their effort to undergo family food security through cultivating organic vegetables in narrow land is supported by their husbands, children, and parents. Besides, they also provide treatment of the plants, control pests naturally by taking advantage of local potentials, and market the products after harvest if some are left after meeting their family's daily consumption. Husbands play roles in preparing the media and plants' sitting places, and making bamboo hydroponic kit to show their supports whereas children and parents deal with the treatment and harvest. Postharvest handling includes sorting and grouping based on size and standard to ease the process of marketing the products.

5.2 Production Modelling Framework to Secure Supply Chain of Organic Vegetables

Food security, at the individual, household, national, regional and global levels is achieved when all people, at all times, when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life [21]. Based on the definition, a country is not considered having sustainable food security if its citizens happen to be in famine and lack of nutrition. Thus, food security is any country's mission, for access to food is human's right and must be guaranteed by the country. One of many efforts a country can implement is to provide access to food for the poor in order that they can lead productive life to raise the state of their economic status. Food security is also required for the purpose of growing healthy and quality human resources to increase productivity and national competitiveness and security.

Table 3. The Flow of Marketing of Organic Vegetables in District Gunungpati

No	Marketing Pattern	Total	Percentage
1.	Farmers → Consumers	23	95.83 %
2.	Farmers→Sellers → Consumers	1	4.17 %
3.	Farmers→Wholesale sellers→Sellers→ Consumers	0	0
Total:		24	100 %

Farming production of vegetables is seasonal and requires particular location. The products are distributed through marketing to consumers. The flow of marketing used by the farmers of organic vegetables in District Gunungpati, Semarang, is through direct marketing system, from the farmers to consumers (95.83%). Marketing efficiency is accomplished by analyzing the marketing flow. There are two patterns in marketing organic vegetables in District Gunungpati. In general, the pattern is where the farmers market the products to consumers first hand. It is a definitely efficient way of marketing, for the farmers can savor all marketing profit margin for themselves. It is in accord with the argument that percentage of price margin paid by consumers and producers are not too high [22]. The efficiency supports food security in District Gunungpati in particular. Similarly, in South Africa, farming contribution is subsistent to food

security [23]. In addition, aquaculture handled domestically improves food security in Asia [24].

Organic vegetables in narrow land produced in District Gunungpati are subsistent, which means that the farmers cultivate them to meet their daily needs, and market the rest if any. If one seeks for polybag plants, they will trade them. Thus, they contribute a great deal in providing nutritious, healthy, and safe vegetables for their family. Moreover, the subsistent characteristic also raises family's income [25].

The result of discussion by the research team, experts, and farmers concludes that family-based food security model and the use of narrow land generated based on empirical study in District Gunungpati is further developed to be gradually disseminated to other villages or larger society. The model of family-based food security through cultivation of organic vegetables in narrow land which has been developed and gains inputs from experts can is presented in this following figure.

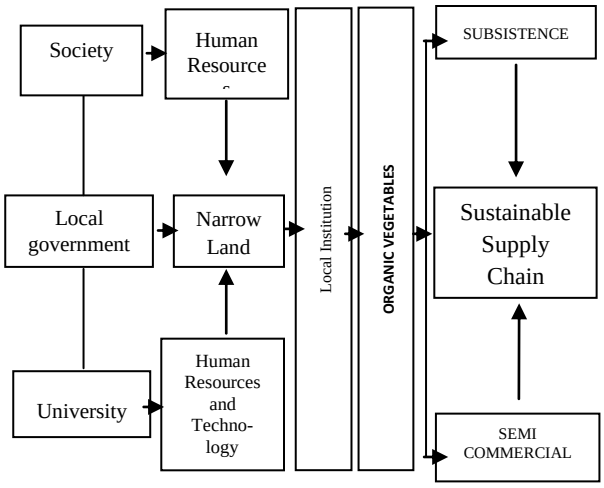

Figure 2. Empirical Model of Sustainable Supply Chain for Organic Vegetables in Narrow Land

This improvement model will be applied to conduct dissemination of the implementation of family-based food security through cultivation of organic vegetables in narrow land in defined loci in all villages in District Gunungpati, Semarang. In this model, society, local government, and university synergize in setting up a whole framework to increase production of organic vegetables. Society are responsible to prepare human resources, in this case is housewives in rural area who are going to be the main producers of organic vegetables. Local government is served for setting up the narrow land in rural area, they are responsible for campaigning house yards as a farming land of organic vegetables. University supplies human resources (experts) and technology for supporting production of organic vegetables in rural area. All of those housewife whom produce organic vegetables has to be organized by local institution, in this case is KWT Sri Rejeki. This local institution will organize everything in producing organic vegetables, including financial and technical matters.

The application of this model has increased production of organic vegetables in District Gunungpati. In three months farmers are able to harvest several organic vegetables, such as: bokchoy, leek, water spinach, celery, and many others worth more than one million rupiahs. This production can be used for fulfilling their family's daily needs (subsistence) and they also can sell them in market (semi commercial).

Although the female farmers in District Gunungpati have been able to grow their own organic vegetables, this is still a long way to go for them to improve and strengthen their supplies if they want to sell their products in supermarket. Their ability to supply supermarkets is related to the combination of functions they make available to their members, especially with regard to promoting and controlling quality for which they receive public support [26]. Their participation in flexible contracts with supermarkets, shops and schools is also a key issue.

5.3 Cost and Benefit Analysis of Sustainable Supply Chain Management for Organic Vegetables in Narrow Land

Cost Benefit Analysis is a technique of analyzing cost and benefit involving estimation and evaluating benefit associated with alternative acts which will be performed [27]. *Cost Benefit Analysis* is employed to predict loss and profit of a program. It calculates cost and benefit obtained from carrying out the program. Furthermore, it can be used to detect how good and hazardous a program is. By including profit and social cost, it can function as a firm basis to determine decision making or funding and assure investors as donators of a program, in this case the farmers of organic vegetables, to come to a decision whether to run the business or not.

Data in the field indicate that *fixed cost* and *variable cost* needed by the farmers to cultivate organic vegetables are relatively low. They will only bear fixed cost if they provide hydroponic kits for creeping plants on their own. Based on information from the farmers of organic vegetables in District Gunungpati, Semarang, the fixed cost of the kit is IDR 150.000 to IDR 200.000 depending on the width, and there are only four farmers using them. As mentioned before, the kit will come in handy for certain vegetables requiring media for them to creep, such as chayote, Chinese okra, and bitter melon. Variable cost, on the other hand, covers the purchase of seeds and planting media. However, not all farmers buy planting media. Most of them take the advantage of used can and common soil as planting media. Land, manure, pesticides, and irrigation practically do not require a lot of money since the land used is privately-owned, the pesticides are self-made, and the irrigation is from their own well.

Table 4. The Cost of Production of Organic Vegetables

No	Kinds of Farming Means	Farmers	Quan-tity	Price	Total Cost
	Fixed Cost				
1.	Hydroponic Kit	4	1	IDR 150.000	IDR 600.000
	Variable Cost				
1.	Seeds	24	4	IDR 3.000	IDR 288.000
2.	Manure	24	0	IDR 0	IDR 0
3.	Husk	12	1	IDR 5.000	IDR 60.000
4.	Polybags	12	40	IDR 250	IDR 120.000
	Total Cost	IDR 1,068,000.-			

Source: Analyzed data

Benefits in *Cost Benefit Analysis* are both tangible and non-tangible. The former is income gained by the farmers from selling organic vegetables while the latter is a way for them who mostly are housewives and teenagers to spend their spare or non-productive time doing something useful, in this case farming, so, even without cost, they benefit from what they do such as producing organic vegetables on a daily basis.

Basically, a business is worth running provided that the average return compared to the total cost is bigger than 1 as the higher a ratio of a business is, the higher the profit will be. According to cost and tangible benefit, the ratio of benefit and cost in cultivating organic vegetables is IDR 1.381.000: IDR 1.068.000. Thus, the ratio is 1.29 (> 1) indicating that this business is indeed worth running.

Table 5. Income of Organic Vegetables in District Gunungpati

No	Kinds of Vegeta-bles	Farmers	Harvest (kg)/month	Price/kg	Income
1.	Bok choy	24	24 x 5 kg = 120 kg	IDR 5.000	IDR 600.000
2.	Leek	22	22 x 0.5 = 11 kg	IDR 6.000	IDR 66.000
3.	Water spinach	8	8 x 1 kg = 8 kg	IDR 3.000	IDR 24.000
4.	Choy sum	8	8 x 0.5 = 4 kg	IDR 5.000	IDR 20.000
5.	Spinach	10	10 x 1 kg = 10 kg	IDR 3.000	IDR 30.000
6.	Cosmos	6	6 x 1 kg = 6 kg	IDR 2.500	IDR 15.000
7.	Lemon basil	5	5 x 0.2 kg = 1 kg	IDR 7.000	IDR 7.000
8.	Celery	5	5 x 0.2 kg = 1 kg	IDR 6.000	IDR 6.000
9.	Garlic chives	20	20 x 1 kg = 20 kg	IDR 4.000	IDR 4.000
10.	Lettuce	2	2 x 1 kg = 2 kg	IDR 10.000	IDR 20.000
11.	Cauliflo wer	1	0	IDR 10.000	0
12.	Chili	22	22 x 0.1 kg = 2.2 kg	IDR 20.00	IDR 44.000
13.	Broad beans	2	2 x 5 kg = 10 kg	IDR 5.000	IDR 50.000
14.	Peas	0	0	IDR 20.000	IDR 0
15.	Winged bean	2	2 x 2 kg = 4 kg	IDR 5.000	IDR 20.000
16.	Tomato	20	20 x 0.5 kg = 10 kg	IDR 7.500	IDR 75.000
17.	Long beans	0	0	IDR 6.000	IDR 0
18.	Eggplant	20	20 x 1 kg = 20 kg	IDR 5.000	IDR 100.000
19.	Bitter melon	4	4 x 10 kg = 40 kg	IDR 5.000	IDR 200.000
20.	Cucumb er	2	2 x 10 kg = 20 kg	IDR 5.000	IDR 100.000
21.	Rhizome	18	0	IDR 0	IDR 0
Total:			289.2 kg		IDR 1.381.000

Source: Analyzed data

Even the results of cost and benefits analysis shows that the production of organic vegetables by female farmers in District Gunungpati is worth running, there are many things to improve if they want to expand their business. Organic micro farms can be made economically viable in some cases but that the risks of not reaching viability in micro farms are not to be neglected [28]. For micro farms, system redesign based on low mechanization, higher cropping

density, more cropping cycles per year, low-input practices, lower fixed costs, and lower initial investment (manual and bio-intensive system with tiller cultivation) was more favorable (meaning a higher modeled viability) than input substitution (classic system) at a small scale.

Empirical model of sustainable supply chain for organic vegetables in narrow land needs to be developed further. However, an important point about synergizing society, local government, and university in improving productivity of organic vegetables can be highlighted from this model. By incorporating vegetable yield patterns as a function of environmental and resource variables, the decision maker can explore harvesting cycles of complementary regions matching market price behavior through a supply chain planning perspective [29]. Collaboration among stakeholders in the vegetable production system might help address the problems and make the vegetable production sector more efficient [30].

6. Conclusions

Cultivation of organic vegetables in narrow land intended to accomplish sustainable supply chain of organic vegetables as well as to provide productive activities for housewives in rural area and to accommodate local wisdom of the people in District Gunungpati. The model of sustainable supply chain for organic vegetables in narrow land is still required to be analyzed further. Donation from 24 organic vegetable farmer families in District Gunungpati as many as 2892.2 kilograms of organic vegetables by making use of narrow land in the yard of their houses is proven to be able to meet FAO recommendation standard in consuming vegetables in big families as many as 144.6 kg/capita/year. Technology of cultivation of organic vegetables in narrow land which is environmentally-friendly supports conservation movement by reusing waste for planting media and refraining from employing chemical substances during production process. According to the ratio of cost and benefit which is higher than 1, it can be concluded that economically, cultivation of organic vegetables is worth running as a potential business to raise the income of organic vegetable farmers in District Gunungpati. The implication in this research is that the dissemination of innovation cannot be done with one-time socialization activity, but must be done continuously to the community, to internalize the productive and innovative mindset in running the business. The recommended follow-up study to complement and refine the results of this study is research related to the utilization of waste for organic vegetable planting medium.

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