



## ECONOMIC EVALUATION ANALYSIS FOR SUSTAINABLE AGRO-SUPPLY CHAIN IN EXPORT GREEN BEANS

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**Abstract :** This research focuses on economics evaluation for export green beans farmers. It aims to explore sustainable of agro-supply chain. Survey data are collected from Magelang Regency, Central Java Province, where the main source and high producers of export green beans. There are three major farming groups (Merapi Asri, Melati Sari, and Ngudi Roso), which are 100 selected farmers. The used criteria for evaluation is Net Present Value (NPV) and Benefit per Cost (B/C) Ratio as measurement farming business feasibility. Demographics and economics data of respondents is presented to depict farmer level condition. Statistical data analysis is performed to identify significant factors affecting NPV and B/C Ratio. It is found that demographics and economics status has effect to NPV and B/C Ratio. The results show implementing intercropping farming method can increase NPV and B/C Ratio for all farming groups. Applying second seeding as farming activities especially in Ngudi Roso and Merapi Asri farming group is recommended to gain high B/C Ratio. But, Melati Asri farming group is not recommended. So, all stakeholders shall cooperate and develop some programmes to sustain export green beans supply chain especially encouraging and accompanying farmers as producers to be more professional comparing with nowadays condition.

**Key words :** Sustainable supply chain, Export green beans, Economic evaluation, NPV, B/C.

### 1. Introduction

Green beans is one of featured agricultural product from Indonesia. It is not only for domestic consumption but also for being export commodity. Country that imports green beans from Indonesia is Singapore. Many places in Indonesia plant green beans. But, green beans from Central Java Province that is selected to be exported to Singapore because of the quality and quantity. Those green beans are from Temanggung Regency, Magelang Regency, and Wonosobo Regency. Statistics Indonesia (2016) states that based on those three places, Magelang Regency has the biggest production. Districts where have the big proportion for the export in Magelang Regency are Sukun District, Kaliangkrik District, Sawangan District and Pakis District.

Exporting green beans is a part of Agroindustry activities. Dania *et al.* (2016) study that Agroindustry is one of the sectors that can support economic benefits in developing countries and Winters *et al.* (1997)

investigate that for countries that want to industrialize, agriculture is commonly the main source of resources that can be captured for investment in the emerging activities. Lestari (2017) adds that in Indonesia, the agricultural sector is the second sector that has the largest contribution to GDP below the manufacturing industry having contribution to GDP is 13.6%. Meijerink and Roza (2007) mentions that the liberalization of agricultural trade can provide benefits to exporters. Major exporters will profit from increased access to markets in developed countries, where they will receive relatively higher prices.

Adityowati (2017) states that the share of Indonesia's agricultural sector has declined in the last 25 years from 22% of GDP in 1991 to 13% in 2016. Rusono *et al.* (2014) mention that one of the major challenge facing Indonesia in maintaining and improving national food production including horticulture is the dominance of small producers with an average size of the narrow farmland. Kaur and Dharmi (2013) claim that a huge number of entrepreneurs in agricultural

sector are small farmers in terms of their production and operations and most of them concentrated in the unorganized segment.

The phenomenon is also happening in Indonesia's green beans export market to Singapore. Indonesia has exported agricultural product to Singapore since 1980. However, the percentage of exported agricultural decreased to be less than 10% at last five years. It is quite ironic considering geographical location between Indonesia and Singapore. So, by shipping product from Indonesia, Singapore will receive many benefits such as minimizing logistics cost and keeping the products stay fresh [Romadlon *et al.* (2015)].

Dharshini and Abirami (2017) study for farming attitude towards exporting agriculture product. They focus on reason why farmers are lack of exporting support facilities as lack of storage facilities, lack of proper price fixation policy, rapid growth of urbanization and migration of farmers. If farmers change their attitude, farmers will have produced more to gain market surplus for exports and to have sustainable growth in agriculture sector and better margins also. Yet, exchange rate will be effect to agriculture export performance [Sertoglu and Dogan (2016), Oremadu and Onyele (2016), Mousavi and Leelavathi (2013)].

Moreover, vegetable exports require routine and sustainable availability of goods. If the farmers, who become suppliers for the Singaporean export business stopped, then the sustainability of export business will also be threatened. Sustainable supply chain management is an important innovation that can be applied in agri-food industry in order to sustain their competitive advantage [Mohezar and Nor (2014)].

Tilman *et al.* (2002) add that the goal of sustainable agriculture is to maximize the net benefits that society receives from agricultural production of food. All stakeholders on this supply chain have important responsibility but, farmers who plant green beans has to be concerned also. In Indonesia, farmers usually run their business personally with small size of land and investment.

This research focuses on economic evaluation analysis of green beans farming to support the supply chain sustainability. Economic evaluation analysis usually is used for analyzing and marking enterprises before starting the business. However, this study is done to support and evaluate farming business process for

sustainability of the supply chain.

Empirically, economic dimensions are critical drivers in food business processes [Shokri *et al.* (2014)] and sustainable economic is becoming a strategic issue in the competitive market [Myung *et al.* (2012)]. To evaluate the business process in supply side, NPV and B/C Ratio has been used as a method that aims at assessing the sustainability of the farmers's businesses. According to NPV method, agricultural farm can be considered as an investment option, which provides future revenue given the required investment [Ustaglu *et al.* (2016)].

In addition, there have been several studies that examine the factors affecting the economic dimensions, especially in cost efficiency, of small holder farmers. Some influential factors are farm size [Tchale (2009), Fernandez *et al.* (2009), Niringiye *et al.* (2010)] purchased seed [Tchale (2009)] ethnic cohesion and group membership [Binam *et al.* (2003)].

## 2. Materials and Methods

The study is conducted on 100 green beans farmers in Magelang, Central Java. The data are collected by using survey method. Fig. 1 shows the data used to conduct economic evaluation analysis. The economic evaluation analysis is carried out by counting NPV and B/C Ratio for each farmer. The calculation of NPV and B/C Ratio is done for five years period starting from 2017 until 2021. The result from NPV and B/C Ratio then analyzed using ANOVA to identify significant factors affecting NPV and B/C on farmer level.

Projected value is a total income earned from harvest for a year multiplied with its selling price. Different green beans quality caused different selling price based on its quality. Green beans grade A sold at IDR 11000 (USD 0.8), grade B IDR 8000 (USD 0.58), and grade C IDR 2000 (USD 0.15). Proportion between grade A:B:C is 20%:70%:10%. Assume the annual increase of harvest is 1.46%, which is derived from the average increase in green beans demand. The value of the projected value is calculated by the Equation (1)

$$B_t = H_t \times [(11000 \times 0.2) + (8000 \times 0.7) + (2000 \times 0.1)] \quad (1)$$

where,

$B_t$  = Benefit cost in year t

$H_t$  = Amount of harvest in year t

Investment cost is a initial cost that is spent before operational activities done. Investment cost is obtained

from the total cost of initial asset purchased by farmer (hoe, scissor, big and small bucket, *panjo* (long stick for planting), manual sprayer, automatic sprayer, and motor cycle). Straight line's method used to calculate depreciation cost. Selling price for each equipment divided into five years. The salvage value entered into last year's cash flow.

Operational cost consists of production cost, labor cost, transportation cost, and communication cost. Operational cost computed with the Equation (2).

$$O_t = P_t + L_t + T_t + C_t \quad (2)$$

where,

$P_t$  = Production cost in year t

$L_t$  = Labor cost in year t

$T_t$  = Transportation cost in year t

$C_t$  = Communication cost in year t

Production cost included all costs used to produced green beans (seed, fertilizer, mulch and pesticide). Assumed there is no increase in production cost based on price policy trend set by the government 5 years back [Ministry of Agriculture (2016)].

There are ten activities in green beans farming which required workers that is cultivating, making beds, first fertilizing, mulch setting, planting, stitching, second fertilizing, spraying pesticide, and harvesting. The cost of labour is calculated in work day unit. In one day there are eight hours of work with wages per day ranged from USD 1.82 to USD 2.92. The number of working work per day divided by 8 then multiplied by the number of workers and wages per day.

There are two kinds of transportation systems that has performed used by farmers, on foot and use motorcycle. Transportation cost for motorcycle consists of administration cost, fuel cost, and maintenance cost. While communication cost is total cost used to communicate to collector.

Net cash flow is a flow of company's cash in certain period. The value of net cash flow is obtained from the difference between cash inflow and cash outflow. Cash inflow consists of benefit cost or projected value while cash outflow consists of operational cost and land tax. Net cash flow can be calculated by Equation (3).

$$C_t = B_t - O_t - Tax \quad (3)$$

NPV is commonly used to make agriculture decisions, especially when making first-time investment

decisions. A discount rate of 13% (based on bank lending rate of commercial banks in Indonesia) is used in this study to discount NPV and B/C Ratio. The best value for projects are those with the highest NPV. The equation to count NPV shows on Equation (4) [Adusumilli *et al.* (2016)].

$$NPV = -K_0 + \sum_{t=1}^T \frac{C_t}{(1+r)^t} \quad (4)$$

where,

$K_0$  = Investment cost

$C_t$  = Cash flow in year t

$r$  = Discount rate

$t$  = Time period, in years

NPV = Net Present Value

B/C Ratio is a method of bringing economic efficiency. To pass this economic analysis, the value of B/C Ratio must be higher than one. The higher the B/C Ratio the better the investment. The equation to count B/C Ratio can be specified as Equation (5).

$$\frac{B}{C} \text{ ratio} = \frac{\sum_{t=1}^T \frac{B_t}{(1+r)^t}}{K_0 + \sum_{t=1}^T \frac{K_t}{(1+r)^t}} \quad (5)$$

where,

$K_0$  = Investment cost

$B_t$  = Benefit in year t

$K_t$  = Cost in year t

$r$  = Discount rate

$t$  = Time period, in years

The result of NPV and B/C Ratio then is analyzed with ANOVA to identify factors affecting the value of NPV and B/C Ratio.

### 3. Results and Discussion

#### 3.1 Respondent Demographics

The respondents of green beans farmers are shown in Table 1. Proportion of male and female is almost same 51% and 49%. There are two types of farming type, monoculture and intercropping. Monoculture is farming method that plant one type of crop in a single land and intercropping is multi crop on single land. Moreover, intercropping that has greatest estimated

**Table 1** : Demographic and economic data of respondents.

	Variables	Percentage
Gender	Male	51
	Female	49
District in Magelang	Kaliangkrik	33
	Dukun	32
	Pakis	35
Farming type	Monoculture	22
	Intercropping	78
Intercropping with	Chili	67.95
	Cabbage	1.28
	Scallion	1.28
	Super green beans	2.56
	Chili and Cucumber	1.28
	Chili and Super green beans	2.56
	Chili and Onion	1.28
	Chili and Scallion	3.85
	Chili and Cauliflower	1.28
	Chili and Celery	2.56
	Chili and Corn	1.28
	Chili and Eggplant	1.28
Chili and Cabbage	11.54	
Applying seeding two times/cultivation	Yes	69
	No	21
Farm size (m <sup>2</sup> )	<500	17
	500-1000	55
	1001-1500	18
	1501-2000	6
	>2001	4
Yield per harvest cycle per year	Four times	14
	Three times	86
Harvesting amount per year	<500	34
	501-1000	24
	1001-2000	23
	2001-4000	17
	4001-6000	2

percentage around 78% that has been planted dominated with chili.

Every single farmer has different wide of landfill area. Majority or 55% of farmer's land is ranged on 500-1000 m<sup>2</sup>. Most of the farmers here have their own land. So, they don't need to pay for land renting cost.

Every land where is planted green beans has different time of harvesting time. 86% of them harvests green beans three times a year and the rest are four times a year. It depends on planting period and planting age, so it will implicate with estimate yield per year every farmer.

### 3.2 Green beans supply chain

Tracking and mapping green beans supply chain is compulsory to map whole supply chain condition. The map is started from input supply until consumption phase (Fig. 2). Input supply is farmer and farming group activity to obtain seed and fertilizer and perform farming activity process from production until harvesting. Production is begun from land preparation and plant treatment. Land preparation has some activities from land cultivating, making soil mound and fertilizing, mulches soil covering and irrigation. After finishing land preparation, farmer will plant green beans seed and then doing treatment (fertilizing, spraying pesticide, and stitching for ungrown seed).

During farming activity, farmer purchase seed and fertilizer from farming group. Farming group is a group or organization that is established by farmers in each district to support agricultural activities from land preparation until harvesting process to come up with farmer's goals.

After harvesting, farmers sell their green beans to farming group at packing house. Packing house is place to collect, sort out, and pack green beans before picking by the collector. If green beans specification is under required quality, farming group will reverse green beans to farmers. Then, farmers will distribute it to domestic collector, who will sell to local wholesaler. Local wholesaler will distribute to traditional markets and then end with domestic customer.

Farmers get green beans seed and fertilizer from farming group. In addition, farming group also has duties for collecting and packing green beans before sending to exporter. The name of exporter is Bina Sari Lestari Limited. At Bina Sari Lestari Limited, sorting and packaging are also done. After being packed, green beans will be preserved freshly using refrigerator room and will be sent to Singapore by flight from Yogyakarta airport. Moreover, Bina Sari Lestari Limited has responsibility to educate and manage green beans from farmers. The goal of is to keep green beans supply chain sustainable and continues to fulfill Singaporean

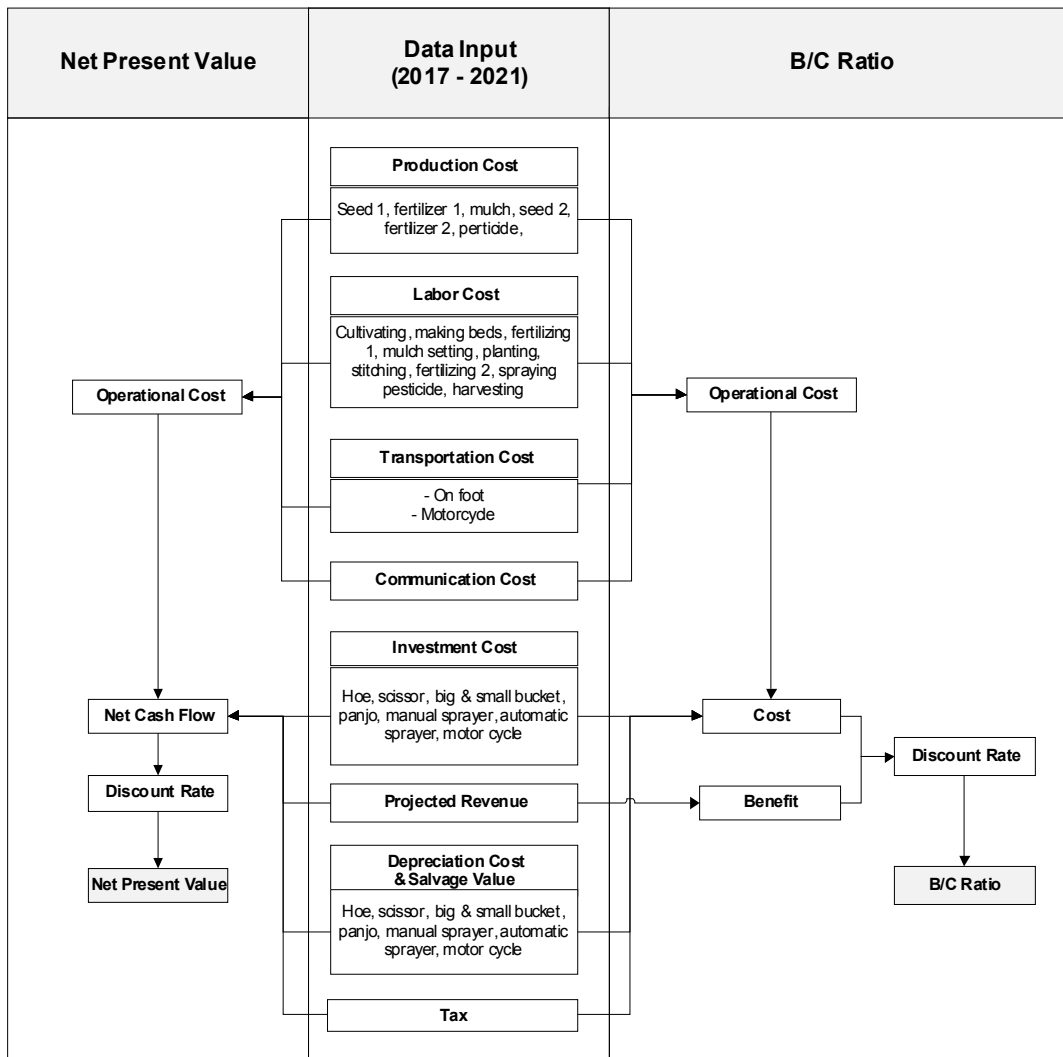


Fig. 1 : Data used to count Net Present Value and B/C Ratio.

demand.

By educating and managing green beans supply, Bina Sari Lestari Limited has obligation to control farming activity from seed preparation until harvesting time. They give guidance farmers through farmer community how to obtain desired quality of green beans and how to treat green beans plant to be more productive. So, Bina Sari Lestari Limited will intensively communicate with Farming group by hold some activity such as agricultural extension or meeting and agricultural expo.

### 3.3 Impact of demographics and economics status affecting NPV and B/C value for economic evaluation

The data are analysed by ANOVA to discuss the implication of demographics and economic status toward NPV and B/C Ratio. The hypothesis testing is conducted to test whether farming group, performing

seeding 2 times or not, and farming type has significant impact to NPV and B/C value. In Table 2, there is strong evidence that farming type and two-way interaction farming group and performing second seeding has significant effect to NPV because  $p$ -value is less than 0.05. Farming type has  $p$ -value = 0.000 and two-way interaction farming group and performing second seeding has  $p$ -value = 0.003. Further analysis using Tukey comparisons which figure out two significant interactions can be shown in Tables 3 and 4.

According to Table 3, implementing second seeding at Ngudi Roso Farming group has higher NPV than not implementing second seeding. It also has significantly different NPV for Merapi Asri farming group. Farmer at Merapi Asri who implement second seeding achieves higher NPV than farmers who do not apply second seeding. Yet, at Melati sari has no significant different for farmer who perform and do not perform second

**Table 2** : Anova result for NPV on fifth year.

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Farming Type	1	5.84696E+15	6.88851E+15	6.88851E+15	18.28	0.000
Farming Group	2	7.83357E+14	2.43520E+15	1.21760E+15	3.23	0.044
2nd Seed	1	2.66309E+14	3.84120E+12	3.84120E+12	0.01	0.916
Farming Type*Farming Group	2	2.20509E+15	1.70130E+15	8.50650E+14	2.46	0.091
Farming Type*2nd Seed	1	2.26198E+11	5.52867E+13	5.52867E+13	0.16	0.690
Farming Group*2nd Seed	2	3.22136E+15	4.26750E+15	2.13375E+15	6.17	0.003
Farming Type*Farming Group*2nd Seed	2	1.57859E+15	1.57859E+15	7.89294E+14	2.28	0.108
Error	88	3.04267E+16	3.04267E+16	3.45758E+14		
Total	99	4.43286E+16				

**Table 3** : Multiple comparisons of NPV vs. significant interaction terms.

Interaction term		N	Mean	Grouping
Farming Group	Seeding 2 times			
Ngudi Roso	Yes	32	2132682.9	A
Melati Sari	Yes	20	2050197.1	A B
Merapi Asri	Yes	15	1632101.1	A B
Melati Sari	No	13	(7176847.0)	A B
Ngudi Roso	No	3	(14681990.2)	A B
Merapi Asri	No	17	(35175200.3)	B

**Table 4** : Grouping Information using tukey method in NPV.

Farming Type	N	Mean	Grouping
Intercropping	78	-705329.1	A
Monoculture	22	-20494794.3	B

seeding. So, it is better for Ngudi Roso and Merapi Asri farmers shall perform second seeding because it will effect for NPV value. But, Melati Sari performs or not performs second seeding will not effect to NPV. Table 4 states that different farming type has different effect of NPV. It is shown at grouping column that has different letter. Letter "A" means that intercropping has statistically different with monoculture and giving significantly effect to NPV value.

Table 4 interprets farming type that has significant difference for B/C value only. P-value of farming type is 0.003 and it is less than 0.05. In addition, farmers group and performing second seeding have not strong evidence to B/C value. It happens also for two-way interaction between farming type \*farming group, farming type \*performing second seeding, farmer group \*second seeding. Those things have not significant different with B/C value because p-value is higher than 0.05.

By using Tukey method, Table 5 represents

implementing intercropping or monoculture farming type has different B/C value. It is figured out from different letter from "Grouping" column. Letter A indicates that strongly different with higher value than letter B. The mean of intercropping farming type is 1.3 point and monoculture is at 0.6 point. Implementing monoculture or performing intercropping will effect to B/C of farmer business.

According to Newman (1990), if B/C value is greater than 1.00 means farmers business is profitable. But, if B/C value is less than 1.00 means that the business is not profitable. In one hand, farmer who implements monoculture, his business will be non-profitable and in other hand, farmer who applies intercropping, business will be profitable. Implementing monoculture or performing intercropping will effect to B/C of farmer business.

### 3.4 Implication for farmers businesses and green beans supply chain sustainability

The survey result shows that in Magelang Regency different demographics and economics status in each farmer group. Most of them perform intercropping during planting the green beans with chili. Chili is chosen because it has high value in domestic market. In addition, chili can be planted on dry land and survived on summer season also. Sharing land space with green beans is beneficial with farmers. Green beans and chili have almost identical characteristics. The plants have similar fertilizer and less consuming water.

Actually green beans export has grades. The highest grade or grade A will be exported to Singapore. Grade B and C will be sold in traditional market. The estimated proportion of grade A, B and C is following 20%, 70%, and 10%. The price is also different. Grades are determined by length, withered, and defect condition of green beans. By getting best grade of green beans

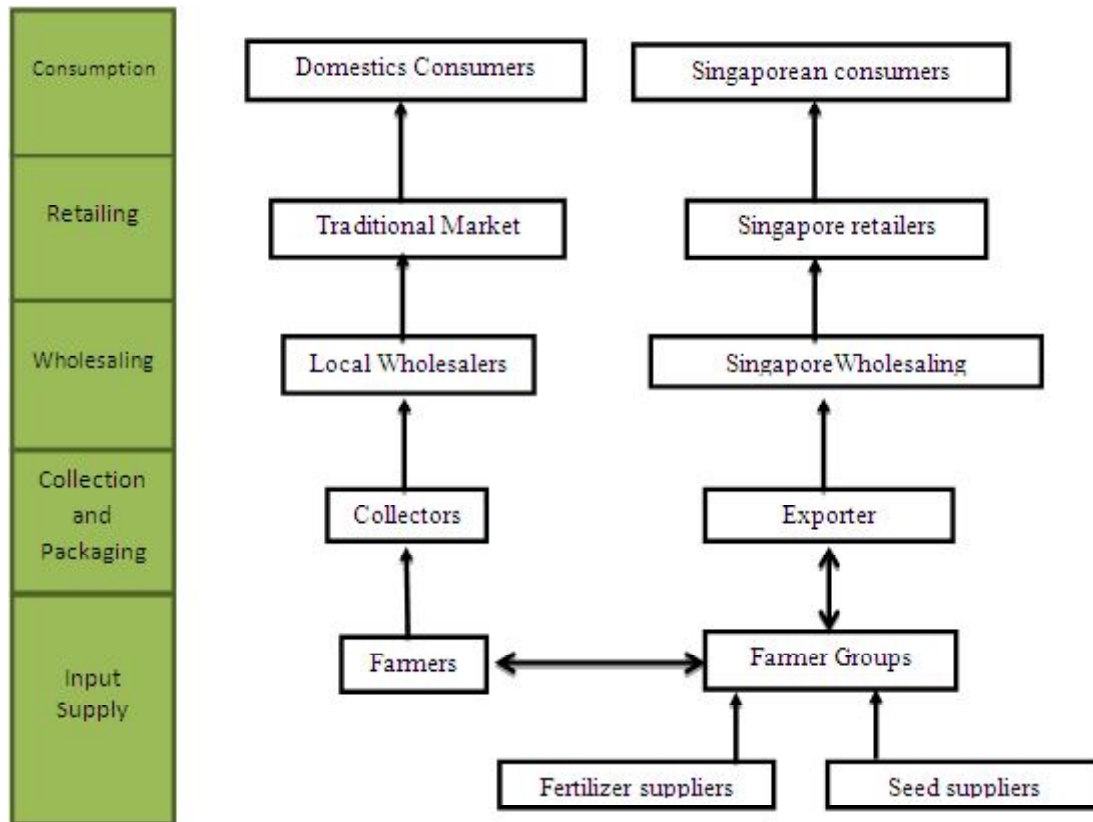


Fig. 2 : Domestic and Export green beans supply chain map.

to maintain the quality, sorting process is done two times. First at packing house and second is in Bina Sari Lestari Limited warehouse. Green beans grade is also one of the criteria for farmers profit.

Traditional farmers in Magelang Regency mostly has landfill that less than 1000 m<sup>2</sup>. It means that they rely on small farm with small investing. Most of them have used family members to be labors. Profit from harvesting will be used for completing daily need and prepare next planting such as land cultivating and buying seed, fertilizer and pesticide. Even though, there is no exact payment to labor, traditional farmer never calculate whether they will get profit or not, because after getting payment for harvesting yield, farmer will use the money to buy or pay their debts.

Romadlon *et al.* (2015) mentioned that green beans export supply chain, harvesting cost has highest logistics portion. Harvesting has biggest portion because it is done every day and if green beans are late to be harvested, grade will be down. No ergonomics tools or machines makes harvesting process is expensive. Farmers need to bend over for picking green beans, so it is not good for farmer health. Farmer will get tired fast and amount of harvested green beans will be

decreased.

Almost every agricultural area has farming group. Farming group is established and developed by farmers to ease communicate with government and collector intensively. Farming group has to convey government information in order to solve agricultural issue. Sometimes, government gives subsidiary and soft loan for farmers to continue their farming activities. Farming group is a bridge for farmers and government. Farmers group also give some information for doing intercropping and what kind of crop that shall farmer taken.

For exporting, farmer group cooperates with Bina Sari Lestari Limited to control farmer yield. It can be done by serving fresh green beans to Singapore daily. It aims to minimizing green beansiste or withered green beans and preventing green beans lack out.

After setting some assumption, we conduct to calculate NPV and B/C. NPV and B/C is one of economic aspect to determine new business is profitable or not. In this research, we use NPV and B/C calculation as economics evaluation. NPV and B/C is used for checking whether a business is feasible to be run or not. We analyzed used NPV and B/C to measure supply chain sustainability. Supply chain sustainability

**Table 5 :** ANOVA result for B/C.

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Farming Type	1	7.2440	4.3554	4.3554	9.14	0.003
Farming Group	2	0.8617	0.3195	0.1598	0.34	0.716
2nd Seed	1	1.0983	0.0096	0.0096	0.02	0.888
Farming Type*Farming Group	2	2.7591	1.1843	0.5922	1.24	0.294
Farming Type*2nd Seed	1	0.6356	0.1486	0.1486	0.31	0.578
Farming Group*2nd Seed	2	1.1452	1.3986	0.6993	1.47	0.236
Farming Type*Farming Group*2nd Seed	2	0.3489	0.3489	0.1745	0.37	0.694
Error	88	41.9385	41.9385	0.4766		
Total	99	56.0312				

**Table 6 :** Grouping Information using Tukey Method for B/C.

Farming Type	N	Mean	Grouping
Intercropping	78	1.3	A
Monoculture	22	0.6	B

is divided by three aspects, economics, social, and environment. This study concentrate on economic aspect.

After collecting some information in order to set up NPV and B/C, we get the result that 46% of green beans farming's NPV is minus or less than zero for five years and 42% of B/C are less than 1.00. If NPV is minus, it means within next five years the business is not profitable or feasible. The business shall not be run or they shall find another business. Moreover, almost half of respondent has B/C is less than 1.00.

In farmer level, regarding NPV and B/C, farmers shall perform intercropping method. Intercropping method will lead farmer to get benefit from their farming business process. Farmers shall plant at least two kinds of crops within one land. However, farmers can do monoculture if they can guarantee that they harvest green beans with export quality. Green beans with export quality will lead them to get higher revenue than selling to domestics. But, the reality is most of farmer fail to gain high proportion of green beans grade. So, they get only less revenue from small proportion of green beans best quality.

By evaluating NPV, farmers shall perform second seeding activities. Second seeding is done to get inexpensive raw material for green beans. Farmers pick and let some green beans crop to be next seed. They shall not need to buy from supplier because the quality of green that comes from supplier and second seeding are same. Yet, collector sometimes is worried for the quality if green beans seed is not from them.

In farming group level, regarding NPV and B/C ratio, they shall educate farmers for implementing intercropping and not applying second seeding. Farming group shall map what kind of crop that more profitable planting with green beans. Moreover, they shall educate and control farmers how to get high quality so, farmers can increase proportion of getting high grade of green beans. Furthermore, by minimizing high value of investment, such as hand tractor and pesticide sprayer, they can provide for farmers.

Consequently, Thanh *et al.* (2017) show that when agriculture is managed in the production value chain, the value of agricultural products will raise also. So, all of supply chain channel should be coherent from raw material production to marketing products. Thus, shall be a policy mechanism to support businesses, investment in post-harvest technology, preservation and processing to limit loss and enhance agricultural products value. Dinh and Nguyen (2017) define commodity value chain from production until consumption is important way to enhance supply chain performance and sustainability.

Boansi (2014) depicts that by maximizing diversification of agricultural product, it will give impact on export performance from existing addressed market. So, farmers and stake holder should start to grab new opportunity for another export products. It will ascertain farmers production activities. Bala and Sudhakar (2017) note that Total Factor Production (TFP) will be a potential to determine ability to generate exportable surplus, export growth and comparative advantage. Sato (2012) applies production management system is a better way for improving export performance.

By preventing lack of green beans supply, collector level shall find more sources in Magelang area. More sources will prevent green beans shortage and keep



customer satisfaction. Collector or Bina Sari Lestari Limited can cooperate with Ministry of Agriculture to nurture new green beans farmer to prioritize their land for planting green beans. In addition, Ministry of Agriculture can do some subsidiary program for existing and new farmer to support and sustain green beans export.

#### 4. Conclusion

This study investigates farming activities that occurred in the exporting green beans from Indonesia to Singapore. The green beans is planted in Magelang Regency. The supply chain is done with domestic and international supply chain. The supply chain has many levels including input supply, collection and packaging, wholesaling, retailing, and consumption. Criteria is used for economic evaluation is NPV and B/C. From statistical analysis, to gain high NPV farmers shall perform intercropping farming method and some of farming groups (Merapi Asri and Ngudi Roso) shall implement second seeding. In addition, gaining higher B/C farmers shall perform intercropping instead of monoculture method. Maintaining green beans supply chain with focusing farmers condition as producers, all stakeholders shall cooperate and develop some program to sustain green beans supply chain especially for export purposes.

#### Acknowledgment

Authors would like to thanks all respondents who gave us valuable information and participation. Thanks to Agricultural Engineering and Biosystem Department, Universitas Gadjah Mada for opening the network among stakeholders, Pustral UGM, Institut Teknologi Telkom Purwokerto, and Sirindhorn International Institute of Technology Thammasat University for scholarship.

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