



## Comparing Farmers Capacity in Dealing with Huanglongbing Disease (A Case Study in Jember Regency)

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### ABSTRACT

Jember Regency is included among top three regencies in Province of East Java with the largest amount of Siamese citrus production, with a total of 116.473,5 tons showing a decrease from 171.322,3 tons in 2021. There are two main Siamese citrus centers in Jember Regency, namely Semboro and Umbulsari Subdistricts. Despite the smaller land area, Semboro Subdistrict has more productivity of 28 tons/ha. The variation in productivity can be due to the intensity of Huanglongbing (HLB) disease and mitigating strategies by farmers. HLB is an infectious disease caused by *Liberibacter asiaticus* and transmitted through citrus psyllid vector insects. Currently, there is no specific best treatment has been found for citrus crops affected by HLB disease. Therefore, this research aimed to measure and compare farmers capacity level in overcoming HLB disease using Andragogy Theory. After conducting a proportional random sampling, data of 30 farmers from Semboro Subdistrict and 32 from Umbulsari Subdistrict were analyzed by independent sample t-test. The result showed that there was no significant difference between farmers capacity level in Umbulsari and Semboro Subdistricts. Capacity level of farmers in Umbulsari Subdistrict was 62.33%, while Semboro Subdistrict had 63.27%.

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### INTRODUCTION

Siamese citrus is a superior variety with big potential to be cultivated by community due to broad market, high consumer interest, and stable price (Rp9,000-Rp10,000 per kilogram in Jember, based on farmers experiences). As explained by Hariyadi et al (2020), Siamese citrus in Indonesia has a broad market due to

the highest production among other types. Siamese citrus is popular because of sweetness and big size. This variety comprised approximately 80% of total citrus in Indonesia due to easy cultivation in lowland and highland (Kristiandi et al., 2021). Jember Regency started citrus in the 1980s and became one of the top three regencies in Province of East

Java with larger productivity reaching 116,473.5 tons (BPS-Statistics of Jember Regency, 2022). However, this amount shows a decrease from the previous year, which is 171,232.3 tons in 2021. The decrease is assumed to be caused by disease called Huanglongbing (HLB). Previous research showed that HLB in Indonesia caused a 6095% reduction citrus productionDwiastuti et al., 2023). HLB is an infectious disease caused by bacteria, namely *Liberibacter asiaticus*, and transmitted through citrus psyllid vector insect (Zuhran et al., 2021). This disease has infected a lot of Siamese citrus crops in Jember Regency since 2012 (Puspito et al., 2018). HLB has become the most challenging disease in Siamese citrus farming business, as there is no available cure or exact treatment for infected crops (da Costa et al., 2021).

Regarding the intensity of HLB disease, several Siamese citrus crops have been significantly infected, requiring a high level of farmers capacity. However there is no research that focuses on measuring the existing condition of citrus farmers capacity in Jember Regency. Capacity of farmers includes the knowledge and skill to carry out the best Siamese citrus cultivation system and overcome HLB disease. As defined in Webster's Dictionary in Anantanyu (2011), capacity is a skill to do something or an ability and an eligible condition. Ardiniasari (2017) explained further that individual capacity is formed from education process, training, and experience.

According to Ruhimat (2017), capacity of farmers has three indicators, namely 1) technical, 2) managerial, and 3) social. Technical capacity is a set of abilities and knowledge of farmers to run the farming business appropriately. It is related to technical principles of activity that need to be performed successfully. Technical capacity is shown by the ability and knowledge of farmers to develop the agricultural system, starting from the early stage as seedling to post-harvesting. Managerial capacity is more related to managerial principles, such as planning, organizing, controlling, and evaluating for achieving the goal of farming business. Social capacity shows the ability to build interpersonal relationship with other farmers and any level of stakeholders including the farming business.

Capacity is a temporary condition (Morgan, 2006). Therefore, it is necessary to build individual capacity from existing conditions to the target level of capacity in order to complete responsibilities effectively and efficiently. Capacity building method suggests individuals and community to control their challenges (Boelk & Retrum, 2014). One of the strategies to enhance individual capacity is creating support network. Boelk an Retrum (2014) stated that support network could be the facilitator of community with insider perspectives. Related to the agricultural community, extension agent and fellow farmers are the most appropriate facilitators who have the possibility to help others increase

their knowledge and skills. This process is in line with Andragogy Theory.

Andragogy Theory is a term for adult learning process usually used as an overview of farmers learning process (Purwati et al., 2022). The theory was popularized by Malcolm Knowles in the 1960s with a concept consisting of four assumptions (Sunhaji, 2013). These assumptions include adult being self-directing and independent, considered mature based on previous experiences in life, the readiness to learn is forced by their needs, and possessing a learning tendency to solve problems. In the agricultural sector, farmers are the main adult actors responsible for their lives in the farming business. Therefore, farmers tend to learn something new to support the success of farming business. Although the learning process is self-directed, there is a need for a facilitator (extension agent) to guide and help in accepting innovation.

This research aims to measure and show capacity of citrus farmers in dealing with HLB disease in Jember Regency using a comparative method to compare capacity level of Siamese citrus farmers between Semboro and Umbulsari subdistrict. These locations were selected based on the significant difference in production. Farmers in Umbulsari Subdistrict implemented intercropping system between citrus and guava. Meanwhile, farmers in Semboro Subdistrict used chili intercropped with citrus. Both

extension agents gave the data that Semboro Subdistrict had narrower Siamese citrus land area (825 ha) than Umbulsari Subdistrict (2.286 ha). Semboro Subdistrict has a larger amount of Siamese citrus production (28 tons/ha) than Umbulsari Subdistrict (22 tons/ha). Therefore the hypothesis states that there is a significant difference in capacity level of Siamese citrus farmers in Jember Regency. The use of comparative method is the first novelty of this research with independent sample t-test for the data analysis. The second novelty is the use of Andragogy theory to gain a deeper understanding of the importance of measuring capacity level of farmers.

## METHODS

The research was conducted in two subdistricts that became the main Siamese citrus production centers in Jember Regency, namely Semboro and Umbulsari subdistrict with quantitative method. The primary data of this research was collected from 30 Siamese citrus farmers in Semboro Subdistrict and 32 in Umbulsari. Farmers were selected randomly after conducting proportion random sampling. This selection method was used to determine the number of samples from sub-population (Hatmoko, 2015). To conduct proportional random sampling, the total sample from total population was determined using Slovin equation (Engkus, 2019). The population in this research was 80 farmers, comprising 40 each from Semboro and Umbulsari Subdistrict.

$$n = \frac{N}{1 + N (e)^2}$$

$$n = \frac{80}{1 + 80 (0.05)^2}$$

$$n = \frac{80}{1 + 0,2}$$

$$n = \frac{80}{1,2}$$

$$n = 66,67 \rightarrow 67$$

From the result of Slovin equation, the total sample needed for this research was 67 farmers. Subsequently, proportional random sampling was carried out to determine the total sample from each subdistrict as sub-population.

#### 1. Semboro Subdistrict

Population of Siamese citrus farmers in Semboro Subdistrict is 40 farmers ( $N_i$ ). N is the total population of the research, that is 80 and n is the total sample needed based on Slovin equation (67).

$$n_i = \frac{N_i}{N} \times n$$

$$n_i = \frac{40}{80} \times 67$$

$$n_i = 34$$

#### 2. Umbulsari Subdistrict

Population of Siamese citrus farmers in Semboro Subdistrict is 40 farmers ( $N_i$ ). N is total population of the research, that is 80 and n is the total sample needed based on Slovin equation (67).

$$n_i = \frac{N_i}{N} \times n$$

$$n_i = \frac{40}{80} \times 67$$

$$n_i = 34$$

From the proportional random sampling in each subdistrict, 34 farmers are needed. During the data collection process, the total sample received was 32 farmers from Umbulsari Subdistrict and 30 from Semboro Subdistrict. This was because there were some people who could not be interviewed, due to unavailable time. Since this research was a part of a big project of ACIAR which had a specific timeline, the interview was conducted with available farmers.

Farmers were interviewed per person by the research team with a structured-questionnaire. The answers provided were placed on Likert scale and automatically processed by Microsoft Excel with add-ins Method of Successive Interval (MSI). Since this research used Likert scale data, validity and reliability tests were required. Validity and reliability tests were conducted by IBM SPSS version 23. IBM SPSS version 23 was also used to run an independent sample t-test to compare capacity of farmers between Semboro and Umbulsari Subdistricts. This method was used because of two sample groups that have no relationship (Pradana, et al., 2022). The research used a significant alpha of 10% or 0.1 rather than 5% to obtain a more specific result with a larger possibility.

## RESULTS AND DISCUSSION

### Validity and Reliability Test

Capacity of farmers is measured using 24 question items, divided into 3 categories. These included 9 items in technical, 8 in managerial, and 7 in social capacity. Validity test is conducted with Pearson correlation or by calculating Pearson correlation or by calculating

**Table 1.** Result of Validity Test

Item of Question	Pearson Correlation	R table (R count)
Technical 1	0.720	
Technical 2	0.370	
Technical 3	0.546	
Technical 4	0.679	
Technical 5	0.564	
Technical 6	0.615	
Technical 7	0.713	
Technical 8	0.623	
Technical 9	0.724	
Managerial 1	0.453	
Managerial 2	0.671	
Managerial 3	0.739	
Managerial 4	0.585	0.211
Managerial 5	0.639	
Managerial 6	0.710	
Managerial 7	0.718	
Managerial 8	0.668	
Social 1	0.590	
Social 2	0.550	
Social 3	0.652	
Social 4	0.761	
Social 5	0.572	
Social 6	0.666	
Social 7	0.651	

Source: Primary Data Analysis, 2024

**Table 2.** Result of Reliability Test

Cronbach's Alpha	N of Items
0.934	24

Source: Primary Data Analysis, 2024

coefficient of product-moment Pearson. Items are decided as valid when correlation coefficient (R count) is more than R table (Sugiarta et al., 2023). The result of validity test shows that all of question items are valid, as presented in Table 1.

Reliability test shows how far the research instrument is believable due to its consistency. It is conducted by calculating Cronbach's Alpha coefficient. The research instrument is acceptable when the Cronbach's Alpha coefficient is more than 0.60 (Ursachi et al., 2015). The Cronbach's Alpha coefficient for this research is 0.934, which means that the instrument is reliable (Table 2).

### Capacity of Siamese Citrus Farmers in Umbulsari Subdistrict

Based on observation, Umbulsari Subdistrict has less Siamese citrus productivity than Semboro Subdistrict with 22 tons/ha. This research assumed that capacity of Siamese citrus farmers in Umbulsari Subdistrict is low because of the inability to manage their farming business with a large land area (2,286 ha). Furthermore, there is a lack of knowledge and ability of farmers to overcome HLB disease, causing a significant loss to infected crops. Farmers were not aware of the specific pest responsible for HLB disease, namely Asian Citrus Psyllid (ACP) transmitting the bacteria (*Candidatus*

*Liberibacter* spp.) (Dwiastuti et al., 2023). This was due to irregular participation in extension activity to learn more about pest in citrus farming. Therefore, capacity of Siamese citrus farmers becomes important to be measured for capacity-building to achieve success in overcoming HLB disease.

Capacity of Siamese citrus farmers is measured by three indicators, according to Ruhimat (2017), namely technical, managerial, and social. Capacity level is categorized as very low (0-20%), low (21-40%), moderate (41-60%), high (61-80%) and very high (81-100%).

Based on Table 3, the technical capacity of farmers had the highest level at 63.83%. The result showed farmers did not know about intercropping system implementation as one way to control HLB disease. However, the majority have implemented intercropping system in their Siamese citrus farming business for a long period of time to gain more income. Islam et al (2020) reported citrus and guava as the best intercropping system.

From the Likert scale of farmers' answers, there are only

**Table 3.** Capacity of Siamese citrus farmers in Umbulsari Subdistrict

Indicator of Capacity	Level (%)	Category
Technical capacity	63.83	High
Managerial capacity	63.15	High
Social capacity	59.10	Moderate
Average	62.33	High

Source: Primary Data Analysis, 2024

44.25% responses in the moderate category. The result shows that farmers did not get enough answers to the main question "why" before learning and implementing the intercropping system. This is not in line with andragogy theory, where adults (farmers) will learn and accept something new according to three main questions, namely "why", "what", and "how" (Bullington et al., 2021). From the interview, intercropping system has been implemented only to gain more income, specifically in the first three years of Siamese citrus when there is no produced fruit yet. Farmers also stated that their limited awareness regarding the benefit of intercropping system was due to the lack of information from extension agent.

The highest score of managerial capacity of Siamese citrus farmers in Umbulsari Subdistrict is shown by an indicator that farmers are able to plan the appropriate time to fertilize the crop. This indicator shows the ability and knowledge of farmers to fulfill the nutritional needs of Siamese citrus crops. Most farmers in Umbulsari Subdistrict use a mixture of organic and inorganic fertilizers. From the interview, farmers understand the need for fertilizer, specifically the best time to prevent HLB disease.

According to Zuhran et al (2021), larger application of potassium fertilizer to citrus increases resistance to ACP.

Social capacity in Umbulsari Subdistrict shows 59.10% of responses in the moderate category. According to the interview farmers do not

know all members of the same group. This shows the lack of social relations among farmers within the group. Furthermore, there is no regular group meeting due to lack of initiative. Extension agent does not give enough attention, only visiting when there is a special invitation from farmers. From the discussion, farmers stated infrequent participation in social activities outside the village. Elvira et al. (2024) stated the need for social capacity of farmers to enhance direct observation and identify more potential in developing the farming business from others, specifically with different domiciles and cultures.

#### **Capacity of Siamese Citrus Farmers in Semboro Subdistrict**

Based on observation, Umbulsari Subdistrict has more Siamese citrus productivity reaching 28 tons/ha. Although with a smaller land area (825 ha), it is assumed that capacity of Siamese citrus farmers in Semboro Subdistrict is high enough for managing farming business and productivity. Capacity of Siamese citrus farmers is measured by three indicators (technical, managerial, and social) (Ruhimat, 2017) and will be categorized as very low (0-20%), low (21-40%), moderate (41-60%), high (61-80%), and very high (81-100%). As shown in Table 4, capacity of Siamese citrus farmers in Semboro Subdistrict is categorized into high category with 63.7% level of responses. The highest indicator is technical capacity with 65.56% followed by social 63.03% and

**Table 4.** Capacity of siamese citrus farmers in Semboro Subdistrict

Indicator of Capacity	Level (%)	Category
Technical capacity	65. 56	High
Managerial capacity	60. 86	High
Social capacity	63. 03	High
Average	63. 27	High

Source: Primary Data Analysis, 2024

managerial 60.86%. Regarding the technical indicator is shown by the ability and knowledge of farmers to spray pesticides in the appropriate manner and dose. Farmers in Semboro Subdistrict understand the importance of exact dose of pesticide. These farmers have succeeded in using a specific insecticide called Avidor with an active ingredient named Imidacloprid. As described in previous research by Iqbal et al (2020), imidacloprid proved to be an effective insecticide that could control the attack of ACP.

The managerial capacity of Siamese citrus farmers in Semboro Subdistrict is the lowest. This is due to the lack of knowledge about cost planning of farming business in each year. The cost planning is usually made in the first year, leading to difficulties in purchasing fertilizers, pesticides, and others with the most efficient cost and appropriate quantity. Previous research by Iakodivis et al (2023) showed that cost planning was important to guide farmers in deciding about farming business in each year's production period.

Siamese citrus farmers' social capacity is included as high category. According to the interview and discussion, farmers are often going outside their domicile to attend social activities and visit others from different villages. The social activity often participated in is farmers group regular meeting. In Semboro Subdistrict, farmers feel the impact of regular participation in group meeting. This helps in engaging and communicating with other farmers to exchange, share, and increase knowledge. Previous research of Aruna et al (2023) stated that farmers group had a primary function as a learning class, where participation allowed sharing of information and experiences. Therefore, the social capacity is high and can lead to searching for more sources of Information.

#### Comparison of Capacity of Siamese Citrus Farmers in Jember Regency

To compare capacity of Siamese citrus farmers in Jember Regency, this research uses independent sample t-test analysis by IBM SPSS 23. The hypothesis is that there is a significant difference in capacity of Siamese citrus farmers between Umbulsari and Semboro

**Table 5.** Result of Independent Samples Test

Capacity	Equal Variances Assumed	Levene's Test for Equality of Variances		Sig.
		F	Sig.	
		0.006	0.94	

Source: Primary Data Analysis, 2024

Subdistrict.

The result of independent sample t-test in Table 5 shows a significance of 0.94. Since this value is more than the significant alpha of 0.1, the hypothesis is denied. The result shows that there is no significant difference between capacity of Siamese citrus farmers in Semboro and Umbulsari Subdistrict. This is shown by the fact that interviews and discussions with farmers from both subdistricts have the same level of capacity due to the long-term citrus farming business of 15-20 years, as presented in Table 6.

From the summary of the comparison in the Table 6, there is no significant difference in the average capacity of Siamese citrus farmers from Umbulsari and Semboro Subdistricts. Capacity of Siamese citrus farmers in Umbulsari Subdistrict is 62.33%, while in Semboro Subdistrict is 63.27%. These results show that although there are differences in the types of farmers in learning according to the conditions of regencies, farmers generally have a similar level of capacity.

**Table 6.** Comparison of capacity of siamese citrus farmers in Jember Regency

Indicator of Capacity	Level (%)	
	Umbulsari Subdistrict	Semboro Subdistrict
Technical capacity	63. 83	65. 56
Managerial capacity	63. 15	60. 86
Social capacity	59. 10	63. 03
Average	62. 33	63. 27

Source: Primary Data Analysis, 2024

An interesting result of this research is related to the social capacity, where Siamese citrus farmers in Umbulsari Subdistrict are categorized as moderate with 59.10%, and Semboro Subdistrict in high category with 63.03%. Based on interviews and discussions from both subdistrict, Semboro farmers are more often engaging and communicating with those in the same and other groups. Siamese citrus farmers in Semboro Subdistrict realized that social activities or openness with outside villages were needed to increase their knowledge. Based on the discussion, majority made time to visit different villages to search for more information. The result is in line with the characteristic of Andragogy Theory. This theory explains that adults (farmers) are self-directed in selecting how to learn and suitable sources of information (Bullington et al, 2021).

Based on the characteristics, Siamese citrus farmers in Jember Regency have a low education level, as majority are only educated to junior high school. The low level of education contributes to the difficulty of accepting information and technologies (Arvianti et al., 2019). Therefore, social capacity is needed for farmers to engage with others who have higher education level. The phase of knowledge exchanging can be conducted in regular meeting of farmers group. This is also related to a process of capacity building of an individual which is supported by social learning and a part of Andragogy Theory. It is explained in

the previous research by Azizah & Tohani (2019), where an individual has to be focused on independent learning process with intrinsic motivation, self reflection, and learning from others' experiences.

The technical capacity of Siamese citrus farmers in Jember Regency is the highest indicator of capacity. This is indicated by the learning process, based on experiences as well as formal and informal education. Farmers in Umbulsari Subdistrict stated that informal education, including extension and training activities, successfully increased their interest a willingness to learn something new, specifically related to Siamese citrus farming business and HLB disease. Meanwhile, farmers in Semboro Subdistrict select a specific role model (successful farmers) to be observed and followed. The two different methods show the importance of knowing the existing condition of farmers ("why") to decide the best *roadmap* for their learning process ("how"), with a specific topic to be learned ("what"). This is in line with the first characteristic of Andragogy, where Knowles underscores that adults (farmers) will decide when to learn after obtaining answers from three main questions, namely "why", "what", and "how". The questions will help farmers to understand the benefits and consequences of something (Purwati et al., 2022).

## CONCLUSION AND SUGGESTION

In conclusion, this research showed no significant difference

between capacity level of Siamese citrus farmers in Umbulsari and Semboro Subdistricts. Farmers in Umbulsari Subdistrict were included in high capacity level with 62.33% and Semboro had 63.27%. The significant difference was the social capacity because Umbulsari Subdistrict farmers were categorized into moderate level. Meanwhile, Semboro farmers were categorized into high level. The comparison of capacity level in Jember Regency followed Andragogy Theory in the agricultural sector. This showed that farmers learning process was in line with the characteristics of Andragogy Theory.

The recommendation given to farmers in Umbulsari Subdistrict was to increase the frequency of participating in group meeting (once every month). This would allow farmers to be more connected with each other and increase the chance for easy learning. Moreover, future research in this field should use another method of data analysis to determine the determinant factors of farmers capacity level.

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