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## The Utilization of Rice Straw for Increase Orange Productivity and Reducing Environmental Pollution

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### ABSTRACT

Siam Banjar oranges was one of the leading commodities in South Kalimantan with an area 2,594 ha. The development of Siam Banjar oranges in South Kalimantan was overflow in Barito Kuala and Banjar District. The level of responsiveness plants for fertilization encourages farmers to apply high inorganic fertilizers. If it is applied continuously and without return organic matter into the soil, it will produce the reduced soil fertility in terms of chemical, physical, and biological soil. This research showed the effect of the use of straw in increasing the production of Siam Banjar oranges. First, they completely decomposed so that increasing soil fertility. Second, reduce environmental pollution because it did not leave residues as inorganic fertilizers. Third, prevent soil erosion so that nutrients needed by oranges for grow properly could be fulfilled optimally. So, oranges did not easily attacked by pests and diseases then provide abundant harvest. The results of the differences between two values could be concluded that, the benefits of orange farming was produced with straw was greater than farming without straw. Revenue Cost Ratio (RCR) value of orange farming with straw was 3.56 and the Revenue Cost Ratio (RCR) value of orange farming without straw was 3.26. Based on the RCR value, orange farming with straw was more feasible than orange farming without a straw.

**Keywords:** different test, feasibility of farming, oranges, utilization of rice straw.

### 1. Introduction

The potential fruit production in Indonesia is very large. Diversity of varieties that supported by climate is very suitable for tropical fruits, producing a variety of fruits. In addition, quite large area can produce fruits that are quite potential with other commodities. Siam Banjar oranges was one of the leading commodities in South Kalimantan. The high level of responsiveness to fertilization was encourages farmers to apply high inorganic fertilizers. If it is applied continuously and without any organic matter (OM), soil fertility will be degraded. One of organic materials that available in large quantities in the fields is rice straw. Rice fields produce rice straws about 75-80 million t/year widely used for industrial purposes (paper, cardboard, media) (Pirngadi, 2009). Most farmers were burning all rice straw in order to clear the land for the next planting period.

The utilization of rice straw can maintain the content of organic matter in soil. According to (Arafat and Sirappa, 2003), incorporating straw into the soil accompanied of organic fertilizer will reduce the use of NPK fertilizer, without reducing rice production. (Setiobudi et al. 2008) added several research results showed that rice straw has the potential to replace inorganic fertilizer. Utilization of rice straw with the application of organic fertilizers and biological fertilizers is an alternative to reduce the use of NPK fertilizer and increase crop yields. The difference treatment of siam Banjar in South Kalimantan

produce high-quality with different characteristics and qualities. Based on the description above it is necessary to conduct study of the characteristics and quality of Siam Banjar oranges by utilizing rice straw waste as organic and biological fertilizer to reduce the use of inorganic NPK fertilizers and to increase orange yield.

## 2. Material and Method

This research used qualitative (descriptive) and quantitative methods. The qualitative method was applied to describe business activities of orange plantations in the research location by using straw as organic fertilizer.

Quantitative analysis is to analyze the effect of rice straw that use for increasing orange yields and differences in yields between farmers using straw and without rice straw and the feasibility of orange planting by utilizing rice straw waste as organic fertilizer and biological fertilizer in Banjar District.

## 3. Results and Discussion

### *Siam Orange Farming*

Implementation of siam orange farming in Astambul Subdistrict used surjan system, at above planted with oranges and below planted with rice. The stages of farming activities, first was land clearing and land management, consisting of making of shipyards and others. Second was stage of caring for and planting seedlings, third was stage of maintenance and harvesting of yields which was include weeding, storing and controlling HPT and harvesting. At the time of research, the cultivation of conjoined orange plants in Astambul Subdistrict was at the third stage with the age of conjoined orange plants, which was between 5-6 years.

#### a. Land Making and Processing

Good tillage for optimal growth in plants was carried out through three stages, the first stage of tillage was plowed soils 40 cm deep, the second stage was grafting of large lumps of soil and the third stage was soil rejuvenated with ground 30 cm deep and making dams at the same time.

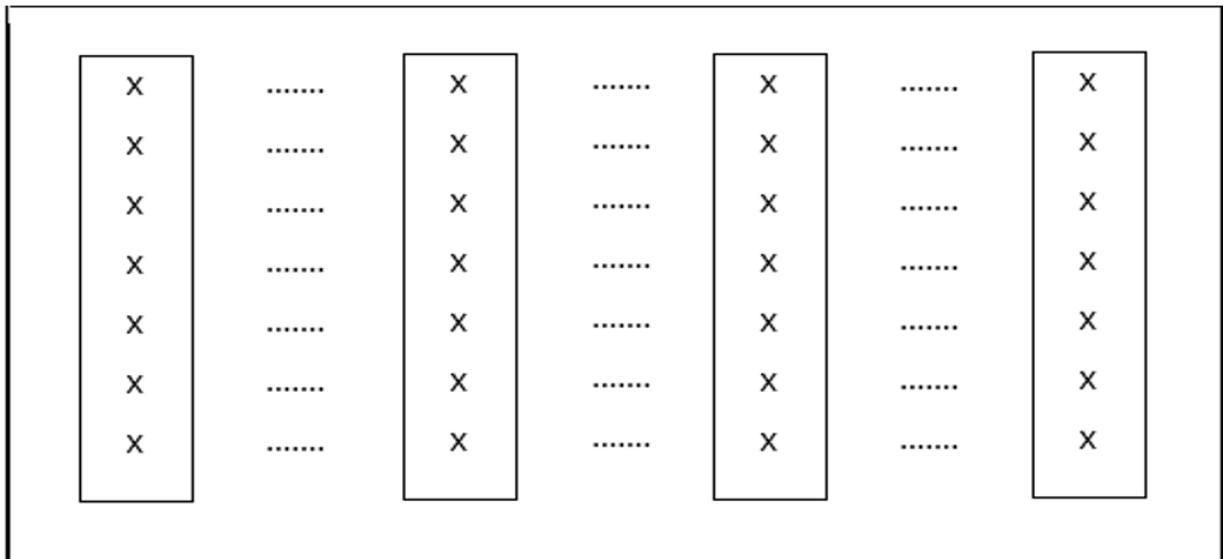
#### b. Making a raised bed

Lifting and hoarding the soil to make a long mound. They were generally made between 2 to 3 m, the length was adjusted to the shape of land owned by farmers and the height of 2 m.

The distance between beds ranges from 3 to 3.5 m. Shipyards was used for rice cultivation. After making the shipyard, the next activity was making support on the shipyard as place for planting conjoined oranges.

#### c. Planting Seeds

According to (Pracaya, 2003), planting should be done at the beginning of the rainy season so there was no difficulty in watering. At the beginning of planting, a lot of water was needed. Seedlings were used derived from grafting, with shallow roots and spreads, this species can grow well above the shipyard whose height was only a few centimeters from the surface of the water. Siamese seeds that ready to be planted were generally available at seed nurseries which sometimes far from the location of the planting plan. In such conditions, the transportation process from the nursery to the planting area was required and good handling was needed so the plant was not damaged. Seedlings should not be planted immediately but treated first so that the seeds can adapt to the new environment. The next treatment was watering plants regularly and done twice a day. If the seedlings have begun to grow fresh and good growth, it means that plants can be adapted in advance by placing it in a hotter place. Then the seedlings can be moved to the planting area. Before planting the seeds, remove the seeds from the polybag needs to be done carefully so that the root system was not damaged. Seedlings were planted by grafting buds about 10 cm above the soil surface, after planting they were given mulch, straw or disease-free leaves. The following pattern of planting orange and rice seeds with surjan system in Astambul District can be seen in Figure 1.



Description:

The "x" = orange plant

The sign "....." = rice plants

Figure 1. Patterns of planting orange and rice seeds with a surjan system in Belawang District

#### d. Maintenance

Maintenance of siam orange at Astambul Subdistrict as follows:

##### 1. Replacing

If there was a rotten orange, then the plant was replaced. Replanting is done when the plants were less than 10 months after planting and at the age of 10-11 months after planting.

##### 2. Weeding and Vetting

Weeding was intended for orange tree to grow without disturbance which means both weed/shrub, parasite, and other wild plants. Weeding is done to clean weeds by the frequency of growth. Weeding was carried out in growing season 1-3 times. In addition to weeds, farmers also usually put rice straw around the orange plant so that the soil remains moist and the growth of the orange root is not disturbed.

Implementation of weeding or cleaning the shipyard to see the condition of weeds that grow above the shipyard, the remnants of weeds that have died were left on the dock as a ground cover which also functions as organic fertilizer. Channeling was an activity to raise grass or weeds and mud in the wetlands to the yard of the conjoined orange plantation. This activity has shown to increase the shipyard.

##### 3. Pruning

Pruning aims to regulate plant height, facilitate maintenance, form branches (1,3,9) so that plants are sturdy and balanced, facilitate sunlight to enter the entire surface of the leaf, so that normal growth, improve fruit quality such as size, color, and quantity. Branching system 1,3,9 was technological engineering by regulating the growth of branches, the main trunk was only 1 trunk, the second main branch was only 3 branches, and each branch only develops 3 branches, so it becomes 9 branches. It has multiply new shoots that gave rise to flowers, fruit and reduce tree cover to prevent mold and disease.

Pruning time is done periodically when plants grow healthy for the formation of the first mining, after fertilizing, during and after harvest. When the main stem of the plant has grown about 70 cm (4-6 months old) all branches that grow on it must be trimmed. After growing branches on the main stem, select only 3 branches that are developed. The selection of branches is seen based on the distance that is symmetrical, its mean that not too close to one branch to another, another branch that is not maintained to be cut.

##### 4. Fertilizing

To obtain high production required correct fertilization. Fertilizers were given in a balanced way to increase soil fertility, encourage plant growth, maintain plant resistance from pests and diseases. Giving fertilizer to orange plants is usually done in the rainy season. The fertilizer was

sown around the orange plants and then covered with straw around the orange plants from harvesting rice. The fertilizing dose for orange plants given by farmers is usually according to the age of the plant, soil conditions, and climate.

#### 5. Pest and Disease Control

Pest and disease control is carried out regularly by farmers. When controlling weeds that grow on orange farms, farmers usually spray using chemical pesticides and local farmers never control biologically that pays attention to and utilizes natural enemies (predators, parasites and pathogens).

#### 6. Harvest

In Astambul Subdistrict, 3-year-old conjoined orange plants have begun to bear fruit, but by local farmers, the first fruit is usually discarded to provide opportunities for the stems to grow strongly.

The quality of conjoined oranges was determined by various factors starting from the various demands of the plant to be treated properly since the maintenance of the plant at various stages up to the manner and time of harvest. At the harvest stage, good treatment was needed in several ways including the fulfillment of the right harvest of mature fruit requirements.

In general, tangerines can be harvested at 6 months to 8 months after flowering, but physically indicators of ripe tangerines harvest include:

- a) a yellowish-colored rind (orange)
- b) the fruit is not too hard when held
- c) the underside of the fruit is rather soft and when pinned with a finger the sound is no longer loud.

In addition, to the requirements above, how to harvest orange fruit must be considered and carried out with carefully. The method that often used by farmers is use their hands directly by turning the fruit slightly then pulling it away from the stem. However, this method can cause fruit defects, especially near the stem. The recommended harvest method and also applied by farmers in Astambul Subdistrict is picking ripe fruit using pruning shears to avoid damage to the fruit. Some things to consider in harvesting Siam orange were:

- a) Picking the fruit should be done when the sun is already shining and there is no more dew residue, which is between 9 a.m. until the afternoon.
- b) Stalk the fruit tightened with pruning shears about 1 to 2 cm from the fruit. Stems that are too long can damage the other fruit when putting in a basket.
- c) Every picking the fruit should bring a bag that can be hung on the neck or shoulder so that fruit goes directly into the bag and does not need to be dropped to the ground so that the fruit is not damaged.

#### *The Effect of Utilization Straw in Increasing Production of Siam Oranges*

Straw is the most potential organic material possessed by rice farmers. Giving straw as a source of soil organic matter can be given in the form of dry stover, ash, or straw compost. Straw compost has a high C-organic content and can increase soil organic matter content. Consistent use of straw compost, in the long run, will increase soil organic matter content and restore soil fertility in the fields.

Banjar District is one of the area that has abundant straw waste potential. According to data from the Central Statistics Agency of Banjar District, in 2017 the production of dry unhusked the rice (GKG) reached 218,855 tons. Based on Agricultural Research and Development data, for 1 ton of unhusked the rice (GKG) from rice cultivation can produce 1.5 tons of straw. With the total production of unhusked rice (GKG) in Banjar Regency reaching 218,855 tons, the potential of available rice straw is around 328,282.5 tons. However, the abundant amount of straw has not been used optimally by farmers to add value to rice straw.

Based on the farmer's habits in Astambul Subdistrict, straw from the rest of the rice harvest is mostly burned directly on the land to speed up land preparation for the next planting period. Continuous burning of straw on agricultural land can cause an increase in air temperature at the surface of the soil and cause air pollution so that it can destroy microorganisms that are useful in soil biological processes, such as soil organic material removers that have an impact on decreasing levels of organic matter in the soil. Indeed, the ash produced from burning rice straw can add potassium nutrients in the soil. However, this straw burning activity produces carbon dioxide gas residue which

is released into the atmosphere, although the amount is not so large, it still causes air pollution / environmental pollution.

Some orange farmers in Astambul Subdistrict have used rice straw as mulch when orange or rice straw is placed around the orange plant so that the soil remains moist and the growth of the orange root is not disturbed and left on the dock as soil cover which also functions as organic fertilizer. Land that left open and not covered by any material will more easily lose moisture because it undergoes evaporation, which is the evaporation of water from the soil surface. This can adversely affect the growth of orange plants. Because water is the main ingredient that needed by plants throughout their lives. Likewise, organisms that live in the soil, they prefer moist and warm soil conditions. The organism actively breaks down nutrients and organic matter into nutrients that are readily absorbed by plants. For this reason, the use of rice straw mulch can significantly increase the productivity of orange plants. Also, rice straw mulch provides dark soil conditions. So that weeds cannot grow, because the sunlight needed by the seeds to germinate is blocked by rice straw mulch.

Therefore, the solution that can be done is to use rice straw to be processed into compost. Rice straw composting aims to increase soil nutrients and reduce farmers' production costs in purchasing fertilizer. The maximum processing of rice straw into compost can produce yield of approximately 60% of the initial weight of straw so that with straw available at 328,282.5 tons, resulting compost can reach 196,969.5 tons. With the use of rice straw into compost can be used as an alternative to minimize the use of inorganic fertilizers that are increasingly massive in use today. Besides, the reduction of environmental pollution, in this case, is the health of agricultural land can continue to be maintained from the adverse effects of excessive use of inorganic fertilizers.

Dry rice straw is an organic material with high carbon. When the remnants of these plants were returned to the land, then we have carried out carbon storage activities in the soil. The more crop residues are returned to the land, the greater the carbon stored. In terms of agriculture itself, the use of rice straw provides many benefits. First, rice straw can decompose, thereby increasing soil fertility, and secondly, environmentally friendly, because it does not leave residues such as inorganic fertilizer. Third, it prevents soil erosion.

The fall in rainwater can harm the soil. Which is the splash of water on the ground surface without mulch can cause erosion. Soil particles will be carried along with rainwater to the river, as well as nutrients stored in them.

#### *The Difference between Using Straw and Without Straw*

Production is a physical result of cultivated oranges. The production of oranges is based on yield per kilogram of oranges. Revenue is the production of oranges valued in cash (rupiah) based on a certain selling price range. Income is a farm receipts that have been reduced by explicit costs of farming. Farming profits are farm receipts that have been reduced by total farming costs (explicit and implicit costs). The production, revenues, and profits of orange farming can be seen in Table 1 below.

Based on the data presented in Table 1, it shows that produced by orange farmers with straw (5,740 kg) are greater than that of orange farmers without straw (5,165 kg), so that the revenue generated by orange farmers with straw (Rp.57,395). 556, - / ha/year) is greater than orange farmers without straw (Rp.51,648,000 / ha/year). In terms of income and profits generated by citrus farmers with straw is also greater than the citrus farmers without straw. The income and profits generated by orange farmers with straw are IDR 51,744,113 / ha/year and IDR 43,377,844 / ha/year, respectively. While the income and profits generated by orange farmers without straw are Rp.41,295,066 / ha/year and Rp.35,818,428 / ha/year, respectively.

Table 1. Production, revenues, income, profits and feasibility of orange farming per hectare per year

No	Description	Unit	With Straw	Without Straw
1	Production	kg	5.740	5.165
2	income	Rp	57.395.556	51.648.000
3	Total cost	Rp	16.100.490	15.829.572
	a. Explicit cost	Rp	5.651.442	5.812.270
	b. Implicit cost	Rp	10.449.048	10.017.302
4	Revenues	Rp	51.744.113	45.835.730
5	Profit	Rp	41.295.066	35.818.428
6	Feasibility		3,56	3,26

### *Difference Test of Two Middle Values*

The analysis of differences two middle values that see the extent to difference in profits of orange farming carried out by orange farmers with straw and orange farmers without straw. The sample of farmers were used two parts; orange farmers with straw and orange farmers without straw.

Based on the results calculation analysis of the middle value obtained t-count value of 5.296 with sig. (2-tailed) of 0,000. The number of tables with significant level  $\alpha = 5\%$  or 0.05 with degree of freedom (df) 39 is 1,645. It means that the value of t is greater than t-table (t-count>t-table) or sig value. (2-tailed) is smaller than the 5% confidence level. So it can be decided that H1 is accepted or H0 is rejected. Then it can be concluded that the profitability of orange farming produced by citrus farmers with straw is greater than the profits generated by orange farmers without straw.

### *Feasibility of Farming Siam Orange*

Based on Table 1, revenue generated by orange farmers with straw is IDR 57,395,556/ha/year and orange farmers without straw is IDR 51,648,000/ha/year, while the total cost of farming orange with straw is IDR 16,100.490/ha/year and the total cost of orange farming without straw is Rp.15,829,572/ha/year, the Revenue Cost Ratio (RCR) value of orange farming with straw is 3.56, which means that every Rp.1, - the costs incurred will result in receiving citrus farming with straw as much as Rp.3.56 or profit of Rp.2.56 while the Revenue Cost Ratio (RCR) value of orange farming without a straw is 3.26, meaning that every Rp.1, - the costs incurred will result in receipt of citrus farming without straw by Rp.3,26 or a profit of Rp.2.26. Based on the RCR value, orange farming with straw is more feasible than orange farming without straw.

## **4. Conclusions**

Based on the results of the study it can be concluded that the influence of the use of straw in increasing the production of conjoined oranges, first, rice straw can decompose thereby increasing soil fertility, and second, reducing environmental pollution (environmentally friendly) because it does not leave residues such as inorganic fertilizer, and third, prevents soil erosion, the nutrients needed by orange plants to grow properly can be fulfilled optimally. So, the orange plants were not easily attacked by pests and diseases then provide an abundant harvest. The results of the calculation of the analysis of the difference in the two middle values can be concluded that the benefits of orange farming produced by orange farmers with straw are greater than the benefits generated by orange farmers without straw. Revenue Cost Ratio (RCR) value of orange farming with straw is 3.56 while the Revenue Cost Ratio (RCR) value of orange farming without a straw is 3.26. Based on the RCR value, orange farming with straw is more feasible than orange farming without straw. Based on the results and discussion, some things can be used as suggestions to reduce environmental pollution on agricultural land and increase the production of tangerine orange. It is hoped that Siam Banjar farmers optimize the utilization of rice straw by processing straw as organic fertilizer.

## **References**

- Abu Bakar Tawali. (2004). Effect of Storage Temperature on the Quality of Imported Fruits Marketed in South Sulawesi. Department of Agricultural Technology. UNHAS.
- Alkasuma, Suparto. Samdan CD and Jaelani. (2001). Final Report. Identification of Lebak Swamp Land Potential for Food Crop Development in the framework of Anticipating El-Nino Impacts. Center for Research and Development. Bogor.
- Arafat and M. P. Sirappa. (2003). Study of the use of straw and N, P and K fertilizer on irrigated paddy fields. *Soil and Environmental Science* 4 (1): 15-24.
- Indonesian Center for Agricultural Resources Research and Development. (2006). Characteristics and Management of Swamp Land. Monograph Balittra. Banjarbaru.
- Eagle, A.J., J.A. Bird, W.A. : ingust, S.M. Brouder, J.E. Hill, and C. Van Kessel. (2000). Nitrogen Dynamics and Fertilizer Nitrogen Use Efficiency in Rice Following Straw Incorporation and Winter Flooding. In: IAEA TECDOC. management of Crop Residues for Sustainable Crop Production. Australia. 81-97p.
- Izzuddin Noor, SS. Antarlina, W. Annisa, E. Maftuah, and A. Fahmi. (2006). Relationship of Ca Ca and Ma Nutrition with Citrus Fruit Quality in Tidal Land. Balitra Research Report. Banjarbaru.

- Noor, M. (2004). *Swamp Land. Nature and Management of Problematic Soil Sulfate*. PT. RadjaGrafindoPersada. Jakarta.
- Pracaya. (2003). *Sweet Orange. Varieties, Cultivation and Postharvest*. Swayer spreader. Jakarta.
- Pirngadi K. (2009). The role of organic matter in increasing sustainable rice production supports national food security. *Indonesian Center for Rice Research* 2 (1): 48-64.
- Center for Land and Agro-climate Research and Development, Bogor. Dudal, R. (1980). An evolution of conservation needs p. 5-12. In R.P.C. Morgan (Ed). *Soil Conservation, Problems and Aspects*. John Wiley & Sons, USA
- Setyadjit and R. Tahir. (2004). *Results of Citrus Postharvest Research*. Proceedings of the National Siam Orange Seminar. Horticultural Research and Development Center. Jakarta.
- Sunarmani and Soedibyo, 1989. *Analysis of the Quality of Siem Oranges (Citrus nobilis L) Fresh and Processed*. Horticultural Research Institute. Jakarta.
- Simanungkalit R.D.M., D.A. Suriadikarta, R. Saraswati, D. Setyorini, and W. Hartatik. (2006). *Organic and Biofertilizers*. Center for Agricultural Land Resources and Development. Bogor. 14 things.
- Sutanto R. (2002). *Application of Organic Agriculture*. Kanesus. Yogyakarta. 219 things.
- Winarno. (2004). *Strengths and Weaknesses of Siam Oranges in Indonesia*. Proceedings of the National Siam Orange Seminar. Citrus and Subtropic Horticultural Research Workshop. Poor