

The activity of modern agricultural technique, mina paddy, on salt water and the income of farmers in west matang raya-north aceh regency

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Abstract. This is a study of activity in agricultural modern technique, mina paddy, on salt water and the income of Kena group farmer in West Matang Raya, North Aceh district. This study focuses on identifying the activity of modern agricultural technique on salt water and the income of farmers in Kena group. The major objective of this research is to find out the activity of modern agricultural technique on salt water and the income of Kena group. This study was conducted on February, 2017 with 20 members of Kena group. The data were obtained through library studies, documentations, observation, questionnaires and interviews. The data were analyzed descriptively. Based on the result of this study, the proper activity of modern agricultural technique, mina paddy, can increase the productivity of agricultural products and also increase the farmers' income compared to the agricultural activities in general. It is suggested that the government can encourage the farmers to do the mina paddy technique on the proper land and help them by providing the fertilizer, seed, pesticide and feed. Therefore, the farmers will have no difficulties and get the motivation to do the mina paddy technique which can improve their prosperity and ensure their food security for the future, especially for the farmers in Kena group, West Matang Raya.

1. Introduction

Mina paddy is one of the methods implemented by farmers from the monoculture system to the agricultural diversification system. The minapaddy cultivation business is an integrated business that can increase the productivity of paddy fields, gain more income for farmers' prosperity and keep the existence of food security [1]. The implementation of the modern technique of minapaddy is one of the foundations of food, many efforts and breakthroughs have been made to increase the agricultural productivity. One of them is integrated farming, known as the minapaddy system, which is a method of fish and paddy farming in one site of paddy field.

In agricultural land, the weeds will automatically become the food for Vannamei Shrimp and Milkfish. Consequently, it becomes fertile because the presence of fish' feces which is containing various nutrients. Therefore, farmers can save the fertilizer because the land that has been mixed with dirt and fish food can already be an organic fertilizer that minimizes the use of chemicals. Fish can also limit the growth of other plants that are competent to rice in the utilization of nutrients, as well as to reduce the cost of weeding wild plants. The minapaddy technique has long been developed. Besides providing food sources of carbohydrates, this technique also provides protein, hence it is good enough



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to improve the food quality for the population. The proper minapaddy technique can also increase the income if compared to the usual techniques that are often applied by farmers over the years. The benefits obtained from the minapaddy farming business are rice and fish production. Vannamei Milkfish and Shrimp chosen by the Kena group for the mina paddy system because they are not susceptible to disease and its market price tend to rise and stable.

The difficulty in managing the minapaddy system happens when there is a large number of birds that eat rice in the period leading up to harvest, when ensuring the irrigation runs well and also when feeding the fish regularly. However, with the various advantages such as saving fertilizers, minimizing weeding and also the benefits of milkfish and vannamei shrimp, all of the disadvantages are not a big deal. The application of this minapaddy technique is good enough in increasing agricultural products as well as improving community's productivity. For that reason, the researcher was interested in conducting a study entitled "The Activity of Modern Agricultural Technique, Mina Paddy, on Salt Water and The Income of Farmers (Kena Group) in West Matang Raya—North Aceh Regency".

Based on the background of the problem, this study focused on identifying the activity of modern agricultural technique on salt water and the income of farmers in Kena group. The aim of this research was to find out the activity of modern agricultural technique, mina paddy, on salt water and the income of Kena group farmer in West Matang Raya.

2. Methodology and Location

The study was conducted on February, 2017 in the West Matang Raya Village in North Aceh regency, especially for farmers in Kena group who implement the mina paddy technique. The data were obtained through library studies, documentations, observation, questionnaires and interviews. The data were analyzed descriptively.

The astronomical location of the West Matang Raya Village is 5010'20" LU-509'20" LU and 970220" BT-97022'50" BT. It is located in a low land, with an area of 275 Ha and a distance to the district capital as far as 7 km. As a lowland area and located near the coastal sea, it is very suitable for planting rice, ponds and coconuts. The geographical conditions are very supportive. However, the facilities and infrastructure are inadequate so the natural potential cannot be managed maximally.

3. Result and Discussion

3.1. *The Activity of Modern Agricultural Technique Mini Paddy*

According to Rahim [2] agriculture is an activity to develop (reproduce) plants and animals to grow better due to fulfill human needs, such as farming, breeding, and sailing. Agriculture is also a type of business or economic activity in the form of planting crops or farming (food, horticulture, plantations, and forestry), breeding (livestock) and fisheries (aquaculture). The mina paddy cultivation system is a method of maintaining fish on the sidelines of rice plants in order to make the alternation between two seasons of rice plants and/or to replace the crops in rice fields by breeding the fish. The presence of fish to this integrated farming business can enrich the planting media, because it develops organic fertilizers and produces plankton, which is the source of fish feed.

Montazeri [3] explained that mina paddy is one of the agricultural technologies for improving environmental quality as the anticipation of climate anomalies. Due to its' integrated cultivation system, it can increase the productivity of paddy fields as well as increasing farmers' income through rice production up to 10%; increasing the diversity of agricultural products because it produces fish; increasing soil and water fertility (reducing fertilizer up to 30%); and also reducing the pests that caused disease in rice plants. The mina paddy farming system is classified into [1,4]:

a. *Aquaculture as Alternation of Rice Plant*

Growing fish as an alternation is done while the farmers work on the field where the paddy will be planted. The duration of farming usually takes 20-30 days until the seeds are ready to be planted. In this system, the seeds dispersal is only done with 1-3 cm size seeds for the purpose that after 20-30 days, the seeds will turn into fish that are ready to be spread in the pond (3-5 cm size or seedlings).

b. Aquaculture with Plants

Aquaculture with plants means that the farmers are farming fish in the paddy fields. The length of farming is from the time the rice seeds are planted, continued to the first weeding, the second weeding, and until the rice flowering, even until drying. The harvest result can be a fish amounting to 100 grams/tail.

c. Aquaculture as Substitute for Crops

This aquaculture is carried out as a substitute for secondary crops in the pattern of rotation of rice crops. The purpose of this method is to restore the fertility of the rice fields. In general, fish farming as secondary crops is carried out after two consecutive rice planting periods.

The purpose of growing fish with rice is to increase farmers' income, in addition to the results of rice cultivation, the fish production also brings many profits. Moreover, families' nutritional value can be fulfilled and the risk of crop failure can be reduced.

3.1.1 The Process of Managing Mina Paddy Technique

The mina paddy technique done by Kena group [5] is the cultivation of fish in the paddy fields. The length of farming is from the time the rice seeds are planted, continued to the first weeding, the second weeding, and until the rice flowering, approximately when the paddy aged 50 days. The length of the farming is adjusted to the rice planting plan, usually takes 30-40 days. After the soil has been processed, then it is fertilized and irrigated to a 5-10 cm surface height. Next, after being left alone for 4-7 days, then the fish seeds are ready to be spread. The seeds are 1-3 cm (aged 20 days-1 month) with density levels ranging from 100-120 thousand tails/hectare. The farmers can also spread the fish seeds that have reached a size of 5-7 cm with a density ranging from 50-60 thousand tails per hectare. The harvest is done after the fish seeds have been kept for a month reaching a length of between 8-12 cm. The height of the water level in the plot of rice fields should not be too low. For the 1-3 cm fish seeds, 5 cm of water level is already enough. While the spreading of fish seeds which having 5-7 cm in size, the height of the water surface is set between 5-10 cm. The activity of maintaining fish with rice should be adjusted to the growth of rice plants. In one rice planting several types of fish can be carried out, according to the purpose of maintenance, whether for seed size only or for the size of consumption fish. The cultivation of fish with plants should be adjusted to the growth of rice plants. In one planting several kinds of fish farming can be carried out based on the farming purpose, whether for seed size only or for the size of fish to be consumed.

3.1.2 Land Preparation -The Making of Rice Field Dike

The paddy fields owned by farmers in Kena group are made to be high enough and strong enough to hold the water. The height of the dike should be between 25-40 cm, depending on the height of the water surface. The width of the base dike is not less than 50 cm, while the width of the top dike is only 25 cm. The making of dike does not use the materials derived from plants, because this material is rotten as a result, it caused leaks in the dike. The dike is made from soil that is compacted by stepping on it until it forms the expected result. The holes along the dikes are patched with soil to avoid seepage from the fields. If the hole is too large, the dike around the hole should be dismantled first and then rebuilt.

3.1.3 Land Preparation -The Making of Canal

The making of canal is intended to protect fish from pest attacks, such as birds, snakes or weasels. The dangers of drought are often caused by high seawater evaporation and increased water temperatures due to the heat of the sun. This canal is made across or parallel to the dike. Its width is around 50 cm with a depth of not less than 30 cm. During the farming, the water in the canal should be controlled.

3.1.4 Land Preparation -The Making of Drainage

The drainage is made with the aim of regulating the water level in the rice fields so that it is not too deficient or too excessive. Drainages for the water-entry and water-exit are made from bamboo or pipes that are planted in rice fields. There are two drainages made by the farmers, one serves to drain water contained in the canal hence it will facilitate fishing at the time of harvest. While the other one functions to regulate the desired water level. Farmers only need one water-entry-drainage and it must be located

higher than the water-exit-drainage, so that the water that has been flowed does not flow back. To prevent the entry of wild fish or rubbish to the farming fish, it is better to install a filter made from bamboo or wire netting on the drainages.

3.1.5 Land Preparation -The Making of Reservoir

The reservoir is useful for accommodating fish during the harvesting so that fish can be easily caught. This shelter is made around the drainage channel. The size of the shelter depends on the available rice fields so that it can accommodate all the fish that are farmed. The reservoir is deeper than the canal, so when the canal is dry the reservoir is still filled with water to hold the fish.

3.1.6 Land Cultivation

The cultivation on the Kena's group mina paddy land provides a good medium for supporting the growth of rice plants and fish food organisms. First, the land is hijacked 20 cm deep. Second, the water is drained so the soil becomes slightly muddy. Third, the urea fertilizer is sprinkled evenly across the ground with a dose of 100-200 kilograms for each hectare. After the seeds are planted, then the water is poured back until the surface of the water reaches 20 cm in height, and left it alone for 4-7 days to provide an opportunity for fish food organisms to grow. Finally, fish seeds are ready to be spread based on a certain density.

3.1.7 Fish Seeds' Density

To get the satisfactory results, the fish seeds that are going to be spread should meet the following requirements:

- Fish seeds do not have body striking-colors, because they can attract the attention of predatory animals
- Omnivorous fish
- Seeds come from superior, healthy and preferred types of fish
- Able to live in shallow water and heat-resistant

Seeds density at the time of spreading the size 1-3 cm is 40-60 thousand tails/hectare, with the total 4 weeks of farming. To get a larger fish seeds, farming is carried out until the second weeding. The spreading density reaches 30-50 thousand tails/hectare. The spreading of fish to be consumed: (a) For 3-5 cm size, the density is 2000 tails/hectare with 60 days of farming and 40 grams/fish will be obtained; (b) For sizes of 5-8 cm, the density is 1000-2000 tails/hectare with 50 days farming, 40 grams/fish will be obtained; (c) For sizes 8-11 cm, the density is 1,000-1500 tails/hectare with a farming period takes 50 days and 60 grams /fish will be obtained.

3.1.8 How to Farm Fish with Plants: Fish Farming as the Alternation of Rice Plants

Growing fish as an alternation is done while the farmers work on the field where the paddy will be planted. The length of the farming is adjusted to the rice planting plan, usually takes 30-40 days. After the soil has been processed, then it is fertilized and irrigated to a 5-10 cm surface height. Next, after being left alone for 4-7 days, then the fish seeds are ready to be spread. The seeds are 1-3 cm (aged 20 days-1 month) with density levels ranging from 100-120 thousand tails/hectare. The farmers can also spread the fish seeds that have reached a size of 5-7 cm with a density ranging from 50-60 thousand tails per hectare. The harvest is done after the fish seeds have been kept for a month reaching a length of between 8-12 cm. The height of the water level in the plot of rice fields should not be too low. For the 1-3 cm fish seeds, 5 cm of water level is already enough.

3.1.9 Fish farming with Plants

The cultivation of fish with plants should be adjusted to the growth of rice plants. In one planting several kinds of fish farming can be carried out based on the farming purpose, whether for seed size only or for the size of fish to be consumed. There are two forms of seed farming, namely: 1) the dispersal of 1-3 cm fish seeds, carried out 5 days after the rice is planted and harvested during the first weeding of rice. The spreading density is 40-60 thousand tails/ hectare. The length of farming for 24 days, will producing

3-5 cm fish seeds; 2) the spreading of 1 cm size of fish seeds is carried out 5 days after the rice is planted and harvested during the second weeding. The spreading density is 10-15 thousand tails/hectare. At the time of the first weeding, the farmers tried to keep the troughs at the bottom of ponds or rice fields with water, so that the fish continued to be cultivated until the second weeding. On this second weeding, the 5-8 cm fish seeds will be obtained.

The farming of fish for the purpose consumption starts by spreading as much as 3000 fish seeds (2-3 cm in size)/hectare. The dispersal is done 5 to 7 days after the rice is planted. For fish seeds that are 5-8 cm in size, they are spread around 1000-1500 fish/hectare. The spreading is done after the first weeding. For fish seeds that have size from 8-12 cm, they are spread around 1000 fish/hectare. The spreading is carried out after the second weeding and harvested during the rice harvest with a farming period up to 50 days.

3.1.10 Rice Harvest Period and How to Harvest Fish

The farmers in Kena group state that the length of the rice harvest period is 3 months whereas the length of the fish harvest period is 4 to 5 months. How to harvest the fish by using mina paddy technique are mentioned below:

- The filter is installed on the drainages. The water-entry-drainage is closed and the water-exit-drainage is opened, so that the water level drops.
- The fish are collected in the canals and then the water is lowered again until the water stays in the ditch.
- The fish in the canals are taken to the reservoir and ready to be caught by using scoop-net and placed in the clean water.

3.1.11 Advantages and Disadvantages of Mina Paddy Technique

Minapaddy has several advantages [6-9]:

- Increasing the income of paddy farmers who experience the crop failure because the attack from planthopper pests due to climate change. The presence of fish in this field will help the farmer because the fish will consume planthopper pests that fall into the water.
- Increasing the rice production about 10-20% and at the same time also increasing fish production at least 1 ton/ha for each planting season.
- Helping to accelerate environmental improvement because the minapaddysystem will reduce methane gas which is discarded from the remaining fertilization.
- Saving the government's budget on fertilizer subsidies because with mina paddy technique the fertilizer can be reduced up to 30%.
- Increasing fish consumption in order to improve family nutrition. It can be seen that the data of fish consumption in the main-rice-producing province has the lowest per capita fish consumption (18-23 kg/capita while the national average is 30 kg/capita).
- Developing the growth of rural fish industries as well as rice industries.
- Increasing the family income due to two types of production at once.
- Monitoring field becomes one of the most important things to do because the farmers are required to check the flow of water that irrigate their fields every day and check the filters that exist so that the fish in the fields are not easily released.
- Improving soil structure because fish often eat by flicking through the mud.
- Fish will help eat small animals that act as the pests of paddy.
- Reducing the dependency on the imported-meat because the farmers can produce fish with a cheaper price than meat.
- Food security that has been supported by rice will be reduced and at the same time the excess rice produced will be able to fill the world's food needs.
- Increasing the potential of existing paddy fields.
- Increasing the diversity of agricultural products, besides being able to produce organic rice, it can also produce fish.
- Increasing income due to both rice and fish businesses.

- Harvesting the good quality of organic rice, because the use of chemicals already replaced by the fish dirt which acted as organic fertilizer.
- Harvesting fish by saving the feed, because fish can eat Azolla and moss in the fields as an extra feed.
- Increasing fish production with pond size and water level.
- Helping to reduce pest and penile attacks.
- Breeding fish can be done based on the age of paddy plant, when the rice is ready to be harvested, the fish also ready to be consumed.

According to Anwar (2012), the disadvantage of the minapaddy system is because of the excessive pesticides are given to paddy itself. It affects the fish life in the pond and pests such as snakes, frogs, and birds can be easily entered the rice fields.

3.1.12 Mina Paddy on Salt Water by Kena Group

Saltwater intrusion is the movement of salt water into freshwater that can contaminate groundwater sources. On the paddy field of farmers in Kena group, the salt water intrusion can occur naturally because the location of the field is not too far from the coastal sea, thus it is a certain degree on most coastal aquifers due to the hydraulic connection between groundwater and sea water. Since salt water has a higher mineral content than freshwater, seawater has a higher density and greater water pressure. Therefore, salt water moves towards freshwater. The activity of mina paddy farmers, especially in pumping the groundwater from coastal aquifers can improve sea water intrusion because groundwater pressure decreases and becomes relatively smaller than the pressure from sea water. Another cause of saltwater intrusion is the navigation and drainage canal which creates a gap for sea water to move ashore across the surface and through tides. Sea water intrusion can also occur in extreme weather conditions such as storms and big waves.

Agriculture done by farmers in Kena group is located close to the shore; the groundwater flows from deeper field meets with salty-groundwater from the sea. Freshwater flows due to high differences. Since salt water has a higher level of dissolved minerals, seawater is denser than fresh water, thus it has a higher hydraulic height than fresh water. The hydraulic height refers to the pressure of the liquid shown in the water column; columns that have a higher hydraulic height will move to the water column which has a lower hydraulic height if both columns are connected.

3.2. *The Activity of Modern Agricultural Technique Mini Paddy*

Income can be interpreted as wages obtained by a person for the business or activity he/she does. The size of the income depends on the type of activities and capabilities of each individual, education also can be one of the factors between one's income and others. In general, income is the output from business. According to Skousen and Stice (2010: 161) "Revenue is an inflow or settlement (or a combination of both) from delivering or producing goods, providing services or carrying out other activities which are activities it self".

3.2.1 Venture Capital and Farmers' Expenditure in Using Mina Paddy

The venture capital and other expenses for mina paddy technique is commonly range from Rp. 2.000.000, - Rp. 4.000.000, -. It means that it is the capital spent by farmers in working on the agricultural sector after being summed up for both of rice and fish. The expenditures of Kena group are slightly different compared to other groups. It happens because the size of lands cultivated by each farmer are different. From the explanation above, it is known that in the activity of Mina paddy, the venture capital is higher than the expenditure.

3.2.2 Venture Capital and Farmers' Expenditure in Using Mina Paddy

Based on the data from this study, the total sales of rice production in one harvest range from Rp. 13.000.000, - to Rp. Rp. 15.000.000, - with 3 months of harvest period. For fish production, most of the respondents answered that the total of fish production in one harvest (4-5 months) up to Rp. 4.000.000, - Rp. 5.000.000.

3.3 Activity of Mina Paddy and Income of Farmers “Kena” Group

The study of mina paddy technique on salt water used by a group of farmers, called Kena, has been implemented since 2013 in West Matang Raya, Baktiya subdistrict. The ownership status of the land where mina paddy agricultural activity implemented is not the farmers' own, as a consequence, they use a profit-sharing system.

The capital donation such as the availability of water sources that flow through agricultural land from the irrigation, the pumping equipment and other expenditure costs in implementing the mina paddy activity are obtained from the farmers themselves. This technique requires up to 6 workers. Unfortunately, the farmers' problems in applying mina paddy technique are that the agriculture in their village does not use electricity, they also never get help in getting seeds, fertilizers, pesticides and fish feed—they use their own money to provide all of the equipment needed. However, they often get counseling about mina paddy agriculture from government agencies and several private institutions as well as the support from the agricultural service, the fisheries services, the irrigation services and the Development Planning Agency at Sub-National Level (BAPPEDA) of North Aceh.

Kena group explains that by using this technique, the rice-harvest period was 3 months, while the fish-harvest period took 4 to 5 months. The total of rice production in one harvest is 1.750 kg up to 2.750 kg, while for fish production is 150kg - 200 kg. The average income from the sale of rice production in one harvest amounting to Rp. 14.000.000, - whereas the income for fish production in one harvest amounting to Rp. 4.950.000, -. If both of the income is added, then the productivity of rice and fish once harvested within 4 months is Rp. 18.950.000, - then it can be said that the income of the farmers' family reaches an average of Rp. 4.737.500, - per month. Moreover, the mina paddy technique used by this Kena group is also supported by the fisheries services, the irrigation services and the Development Planning Agency at Sub-National Level (BAPPEDA) of North Aceh.

3.4 Discussion

Modern agricultural technique, mina paddy, on salt water is an activity done by a group of farmers, named Kena, in West Matang Raya, Baktiya subdistrict, North Aceh regency. This activity turned into a business that has been running since 2013 until today. Mina paddy is one of the techniques where the rice planting and fish farming carried out simultaneously in one land. The purpose of this business is to increase the productivity of agricultural products so that farmers' income will increase. Besides planting the rice, the products from fish farming are also very useful to fulfill the food needs and nutritional value of the community who live there as well as can reduce the risk of harvest-failure in an agricultural business. Farmers who apply the mina paddy technique show that this is a breakthrough to increase the productivity in agricultural. Through this technique, the process of fertilizing and farming fish in salt water can be harvested after 3 months 5 days. As a result, the farmers in West Matang Raya village receive an average income from rice production in a single harvest as much as IDR 14.000.000, - while the average sale of fish production in one harvest is IDR 4.950.000, -.

Mina paddy agriculture is one of the new strategies implemented by the farmers from the monoculture system to the agricultural diversification system. The mina paddy cultivation business is an integrated business that can increase the productivity of paddy fields, gain more income for farmers' prosperity and keep the existence of food security for the future.

4. Conclusion and Suggestion

Based on the results of the study that have been conducted, it can be concluded:

1. The people in West Matang Raya village are mostly works as farmers. Mina paddy farmers get higher profits/income compared to ordinary farmers. The income from the sale of rice production in one harvest amounting to Rp. 14.000.000, - whereas the income for fish production in one harvest amounting to Rp. 4.950.000, -. If both of the income is added, then the productivity of rice and fish

once harvested within 4 months is Rp. 18.950.000, - then it can be said that the income of the farmers' family reaches an average of Rp. 4.737.500, - per month.

2. The products from mina paddy's technique in the West Matang Raya indeed brings the improvement for the farmer in Kena group, it can be seen from the higher incomes obtained from both rice and fish business, which are mutually beneficial. Caterpillars in rice roots that usually hold up the growth of rice now becomes the fish food. The farmers do not bother with the fish feeds and the paddy can grow better without the interfere from caterpillars. The integrated-mina paddy technique can reduce the costs that farmers have to spend and do not require many workers because it can be managed simultaneously.

As a breakthrough in developing the agricultural technique, it is suggested that the government can encourage the farmers to do the mina paddy business and help them by providing the fertilizer, seed, pesticide and feed. Therefore, the farmers will have no difficulties and get the motivation to do the mina paddy business which can improve their prosperity and ensure their food security for the future, especially for the farmers in Kena group, West Matang Raya.

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