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Some Initial Results on Research and Modeling of Organic Rice Production in the Mekong Delta, Vietnam

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Abstract: The rice-shrimp crop rotation system in the coastal provinces of Mekong Delta (MD) is a special farming system and has become the cultivation practices for decades. Currently, seven provinces in the Mekong Delta applied rice-shrimp farming systems are Soc Trang, Tra Vinh, Bac Lieu, Ca Mau, Ben Tre, Kien Giang and Long An. In this farming system in the dry season when the saltwater intrusion into the field usually begins in February and lasts about 8 months, up to September yearly, farmers raising shrimps, crab and some fishes. After harvesting shrimps, farmers use raining and fresh water to make desalination the field and grow rice in the late August or early September. The study aim is to build the procedure for this kind of initial organic production following the international standards and to demonstrate the organic rice production model for farmers to practice. The methods apply in this research includes experiments on organic fertilizers, high quality rice varieties comparision and seed sowing methods through experiment split-plot design, randomised complete block design along with farmer survey. The initial results showed that in the rice-shrimp system, the sowing density can reduce as compared to recent farmer practice (80-100 kg/ha) with around 60-70 kg/ha. From the experimental results can encourage farmers to apply a row seeding method (using row seeder) with many advantages, and can save seed (seed density below 60 kg/ha). In case of broadcasting seed by hand the seed density use about 70kg/ha. For study on the suitable rice varieties, VTN 19 varieties gave highest yield (4.72 t/ha), followed by ST 5 (4.52 t/ha-check), then OM 4900 (4.37 t/ha); OM 6162 (4.19 t/ha); and OM 5451 (4.09 t/ha). On the effective modeling of farmers producing organic rice, the real profit in the year 2015 was 24,023,000 VND and planning profit in the year 2016, 2017 were 26,511,200 VND and 31,487,600 VND per ha respectively. The highest capital efficiency third year of organic production is 2.4; then the second year (2.0) and first-year (1.8). While in case of inorganic rice production, the capital efficiency is only 1.4. Rice product produced from this organic rice project has received international organic rice certificates from EU (Europe), USDA (United States) and JAS (Japan). With the initial good results this model can encourage to multiply larger areas in the MD.

Keywords: Organic Rice, Chau Thanh District, Tra Vinh Province, Rice - Shrimp System, ST 5 Rice Variety, Row Seeding, Broadcasting Seeding

1. Introduction

The model of shrimp - rice crop rotation in coastal provinces in Mekong Delta (MD), Vietnam is a special farming systems and has become the cultivation practices for decades. Currently, seven provinces in the Mekong Delta are applied shrimp-rice farming systems, those are Soc Trang, Tra Vinh, Bac Lieu, Ca Mau, Ben Tre, Kien Giang and Long An. In it, there are some provinces not only produce prawn but also other aquatic species such as white leg shrimp, prawn, crab, fish of all kinds... with a total area of about 140,000 hectares, which is the largest area with 60,000 hectares in Kien Giang and lowest area is 500 hectares in Long An provinces [1]. Tra Vinh province has many conditional districts cultivating rice – aquaculure, especially with 02 communes in Chau Thanh district isle shrimp-rice growing area of nearly 2000 hectares (900 ha in Hoa Minh commune and 1040 ha in Long Hoa commune).

According to Thanh *et al* [2], their summary reported in

the Proceedings of the IAS in 2016 for scientific research to practical production, shrimp-rice farming systems in the Mekong Delta in general and in particular in Tra Vinh is a model of environmentally sustainable farming, in line with climate change and high economic efficiency. With the requirement that the system to maintain rotational cultivation of rice-shrimp/aquaculture, rice monoculture is not suitable and can not give up the rice-shrimp system to chase for mono shrimp cultivation (due to the high profits of shrimp, but failed). The system has the characteristics of mutual benefits as follows:

- Taking advantage of residual organic matter after the shrimp cultivation season to supplement the nutrition for the rice crops;
- Shrimp/aquaculture raising after rice was used artificial and natural feeds from the food chain, from plankton in the wetland environment and developed well due to the decomposition of roots;
- A rice-shrimp farming creates ecological balance and environmental safety have mutual benefits for crops and livestock (aquaculture);
- Limiting pests for both rice and livestock thanks to the rotation to cut pests' chain and the advantages of the farming style creates a special ecosystem of mutual benefit;
- Increased resolution and leaching toxic elements by rotating modes of ecosystems (saltwater, freshwater and crop with root activity and the movement of livestock in the field);
- Reduce production costs by limiting the use of fertilizers because of persistent organic material residues in the soil; limited or no use of pesticides by cutting off sources of pests by rotation, no tillage, no weeding or do very little because no weeds in the flooded fields before planting rice, thus reducing environmental pollution;
- As a basis condition for the creation of delicious, organic cleaning products to serve for human health, creating important commodities for export, increasing income for farmers and businesses have been participating in the linkage from production to consumption.

Also, in the rice fields there are many species of bacteria capable of nitrogen fixation. In the growth of cyanobacteria secreted ambient environtment significant amounts containing nitrogen- compounds and other bioactive substances. The fertility in paddy rice field in the presence of nitrogen fixation of cyanobacteria is increased from 15 to 50 kg N/ha/year, can sometimes be up to 80kg N/ha [3].

According to Dr. Nguyen Cong Thanh, Institute of Agricultural Sciences for Southern Vietnam quoted by Le Huy Hai, [4] rice cultivation in rice-shrimp farming practices help to improve the environment conditions very well, rice and aquaculture interactions for each other. Planting rice after shrimp, especially rice varieties resistant to alkaline, salty, not only take advantage of nourishing soil, creating a natural food source abundance for shrimp, but also for the quality of commercial rice, safe, so do not use chemical pesticides in the cultivation cycle. Shrimp farming in rice fields have sufficient food resources, rapid weight gain and potentially disease-free. Then, guarantee to create a source of good quality supply for processing and export.

Author Nguyen Cong Thanh [5], argues that organic rice production started from the use of high-quality rice varieties and pure seeds, do not use genetically modified seeds (GMO). Next is committed to continuous compliance improves soil quality by applying organic fertilizers which are allowed to use and apply a variety of natural remedies and biological products to reduce the impact of pests and weeds without need herbicides and chemical pesticides.

On the demand of organic products, in Vietnam, Nguyen Cong Thanh [6] has quoted from Vietnamnews.vn (08/4/2014), organic rice production also increased due to the needs of many consumers in the country despite higher prices. Organic rice became popular because of so many meanings including certified brand and clearly sourced organic standards. Some companies invested heavily in organic rice and organic vegetables as Vien Phu organic Company that has been certified organic products from the US and EU. The company has plans to export their rice product but currently, domestic demand has exceeded export orders.

Vien Phu Company provides organic white rice, red rice, purple rice, black organic rices... These types of rice have high nutrition and minerals than ordinary rice. Prices range from 45-75 thousand VND/kg, equivalent to 2.1 to 3.5 USD/kg.

Comay Company in Dong Thap was marketed with 3 branded rice Nosavina. The company said that consumers care much about quality and safety. Since then, the company has invested $ 5 million for the establishment of regional infrastructure, production and processing standard HACCP. Organic rice products of the company contain more nutrients and high other vital minerals which are necessary for human health. They are sold as functional foods in the market with relatively high prices.

There is also the An Giang Plant Protection Joint Stock Company (now known as the Loc Troi Group) also marketed branded germ rice Vibigaba (Vibigaba sprouted rice), rice is said to help stabilize blood sugar of people with diabetes.

So, we see the potential of the demand for growing organic rice. The study's objective is to build organic rice production procedure and to organize farmers into cooperative groups to produce organic rice in large scale with hundreds of hectares for protection of the environment and public health, improving income of rice farmers in the project area of Chau Thanh district, Tra Vinh province, belong to MD. One of the research objectives are to increase farmers' income by 30-50% through organic rice production for first, second and third year respectively compared to the market price; producing delicious, nutritious and clean products for society, with sustainable production methods should be encouraged and replicated.

In addition, the organization of organic rice production

linked to export markets also aim to help the restructuring of agriculture in the district. In rice exports and agricultural products in general are unstable and depend heavily on the Chinese market, for instance, rice exports in this market account for 40-50%, but in the first 6 months of 2015 due to Yuan value decline led to only 38.1% market share [7]. Also fruits like litchi, dragon... exported to Chinese markets accounted for 80%. Therefore, the search for other adding markets is significant jobs that organic rice products exported is a typical example.

However, organic production in Vietnam is still very new and only the first step in practice, so it should be invested in research and implement uniformity from research to applications; from production associated with the inspection, certification and links from production to consumption through tight organization and consistency to be effective for the investor to implement the project and provide higher income for farmers.

The study aim is to buid the procedure for this kind of initial organic production following the international standards and to demonstrate the organic rice production model for farmers to practice because this model is completely new one in the MD. The expected results from the study would be applied in the larger areas in the MD and contributed significant work in the protection of farmers and consumers' health, environmental protection and sustainable production in new stage of agriculture.

2. Materials and Methodology

2.1. Research

Experiment 1: Research on sowing methods and sowing density suitable for rice – shrimp cultivation system

The experiment was split plot designed with 2 sub factors and 3 main factors and with three replications in the farmers' field representing producing regions. The sub factors are 2 sowing methods (row seeding and scatter seeding) are arranged in the main-plot and the main factors is the sowing density (60-80-100 kg /ha) are located in sub-plots.

- The area of each plot is 50 m^2, the total area of experiments is 900 m^2.
- Experimental materials: choosing a special rice varieties adapted for the production (ST5) and high quality for export.
- Time & place of experiment: The experiment was conducted in September 2015, the first year of project at Long Hoa and Hoa Minh communes.
- Tracking indicators:
  - Agronomic indicators: plant height, growth duration, number of effective branches/hill, flowering time, ripening time, the percentage of lodging...
  - Major pests: the rate of major diseases, and pests density (if any).
  - Yield and yield components: 1000 grain weight, number of panicle/m^2, number of grains/panicle, theoretical yield and actual yield at 14% moisture.

Figure 1. *Organic rice field monitoring and sample taking for analysis.*

Experiment 2: Evaluation of rice varieties suitable for rice-shrimp cultivation areas

- Curently, ST 5 is the request of company for export. This rice variety grows about 110 days, and salt tolerant variety. The rice quality is quite good, and high value.
- To diversify products to meet the need of exporters and businesses ordering, the experiment was implemented in order to determine additional 1-2 varieties suitable for the production, with tolerant to certain salinity, yield and quality equivalent to or rather than current ST5 control variety. (Do not use GMO varieties).
- The experiment was arranged in randomized complete block design (RCBD), one factor with 3 replications in farmers' fields representing the production area.
- The area of each plot is 50 m^2, the total experiment area is 750 m^2
- Materials: select 5 high quality rice seeds, capable of adapting to the production areas such as: OM 4900, OM 6162, OM 5451, VTN 19 and ST5 is control variety which currently are cultivated locally and popularly.
- Time & place: The experiment was conducted in September 2015 in Hoa Minh commune.
- The amount of seeding as recommended by local agricultural sector (80 kg/ha) and apply scattering seeding, cultivation technology and irrigation farming was uniformly applied to the experiment. Fertilizer application are organic fertilizers which are currently applied in the production area. Bio-pesticides are

applied for the experiment as bio pest control when needed.

- Tracking indicators:
  - Water and soil test: analysis of physical and chemical properties of soil and water collected from the field for testing (1 sample of soil and 1 samples of water, soil sampling method taking on a 5-point sampling diagonally and mixing), measuring for pH, EC on the folowing stages: before sowing, 30 days after sowing (tillering), when rice made panicle initiation, flowering, maturity stage, after harvest and before the phase of stocking shrimp into experimental fields.
  - Agronomic indicators: plant height, growth duration, leaf color at extremely critical stages, effective number of branches/hill, flowering time, ripening time, the percentage of lodging...
  - Major pests indicator: rate of major diseases, main pest populations.
  - Yield and yield components: 1000 grain weight, number of panicle/m^2, number of grains/panicle, theoretical yield and actual yield at 14% moisture.
  - Qualities of rice: rice recovery rate (%), the proportion of unbroken rice (%), Amylose (%), and aroma.

There are also research on kinds of fertilizers, rate of fertilizer applied and plant protection products for organic/bio-controls are underway.

2.2. Building Organic Rice Production Model in Large Scale

Building organic rice produtcion model is based on:

- Principles for organic production: According to IFOAM (The International Federation of Organic Agriculture Movement) has 04 principles of organic agriculture (OA) which was approved by IFOAM from 25 September, 2005 [8], were:
  - Principles of health: OA maintains and increases the health of soil, plants, animals and people as a whole and can not be separated.
  - Ecological principle: OA based on living ecological systems and cycles, the impact on them, simulate and support them.
  - The principle of fairness: OA builds on relationships that ensure fairness concerning common environment and life opportunities for all people, creatures and plants.
  - The principle of preserving the environment: OA needs to manage in a prudent and responsible to protect the health and welfare of the current generation, and environmental future.
- Standards of organic farming: According to the USDA [9], OA produces products using the methods of conservation of the environment and avoids the use of synthetic inputs such as chemical fertilizer and pesticides, and antibiotic. The USDA organic standards will specify the inputs used for crop and OA for pets. USDA defined organic standards in particular. These standards include products from farm to eating table and even the quality of soil, water, pest management, agricultural practices, animal husbandry and processing.

Organic standards are:

- Conservation of natural resources and biodiversity.
- Improving animal health and welfare of all creatures.
- Facilitate access of animal nature can make them work according to their natural behavior.
- Only allowed the use of inputs such as fertilizers, pesticides, seeds have been approved (without the use of fertilizers and chemical pesticides, synthetic).
  - Producers, technicians should have records on organic farm and field management. Fully record the inputs, outputs and impact measures, treatment during cultivation. This information shows that the transparency of the organic production, helps prevent the use of chemicals or mixed goods from outside. The entire process will be inspected annually by a third party (Control Union) is specialized agency authorized testing and certification.
  - As the request of the research project: organic rice product to be certified organic branded by organizations such as the USDA, EU and JAS.

3. Results and Discussion

3.1. Research Experiments

Experiment 1: Research on cultivation methods and sowing density suitable for rice – shrimp system.

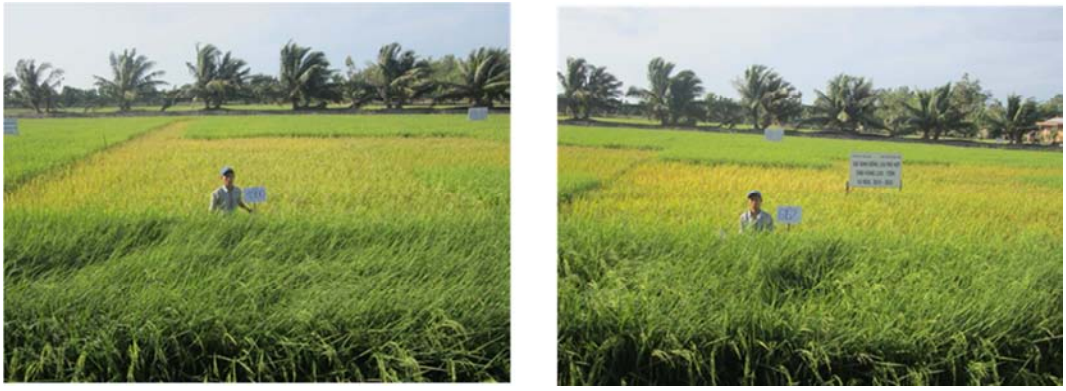

Figure 2. *Experimental field on comparision of rice varieties for organic production.*

Table 1. *Effect of sowing methods and sowing density on yield (Quintal/ha).*

Sowing methods (K)	Sowing density (Kg/ha) (M)			Mean of Sowing methods
	60	80	100	
Scatter seeding	46.3 ab	47.8 a	42.6 b	45.6 A
Row seeding	43.4 b	46.0 ab	44.2 ab	44.6 A
Mean of Sowing density	44.9 AB	46.9 A	43.4 B	

Note: The average numbers with the same characters was not difference statistically significant at p <0.05 for the elements M(LSD_M=1,82), factor K (LSD_K=2,23), not interaction D*M; CV=3,72%.

- Seeding density of 80 kg/ha given the number of grains/panicle higher than other densities; sowing densities and sowing methods are not much difference in the number of grains/panicle
- Different sowing densities (60, 80, 100 kg/ha) was not visible changes in 1000 grain weight; sowing densities and sowing methods are also not different in 1000 grain weight.
- Sowing less seed rate tends to increase the number of panicles/m^2 but with appropriate seeding density is 80kg/ha; type of scatter seeding given the number of panicles/m^2 more than sowing in rows but not much difference in the number of panicles/m^2.
- Sowing with less density tends to increase in yield and highest yield at sowing density of 80kg/ha;
- Row seeding method tends to give higher rice yields and reduced production cost due to less seed rate.

Experiment 2: Evaluation of rice varieties suitable for rice-shrimp cultivation areas

Table 2. *Effect of experimental rice varieties on the yield indicators and yield components.*

Treatments (rice varieties)	Number of filled grains/panicle (grains)	Number of panicles/m^2 (panicles)	1000 grain weight (gram)	Yield/ha (Kg/ha)
1. OM 4900	148.67 ba	317.00 b	24.33 b	4370.67 bc
2. OM 6162	135.67 b	319.67 b	23.67 b	4190.67 dc
3. OM 5451	131.00 b	315.33 b	23.33 b	4090.67 d
4. VTN 19	159.00 a	305.67 b	26.33 a	4717.33 a
5. ST 5 (ĐC)	142.67 ba	337.33 a	25.66 a	4519.67 ba
LSD 0.05	21.80	15.01	1.03	206.30
CV%	8.08	2.50	2.22	2.50

Note: The average numbers with the same characters was not difference statistically significant at p <0.05.

- The yield of VTN 19 variety was highest (4.72 T/ha), followed by the control variety ST 5 (4.52 T/ha); OM 4900 (4.37 T/ha); OM 6162 (4.19 T/ha); and OM 5451 (4.09 T/ha).
- The yield of OM 4900 rice variety is significantly higher than both OM 6162 and OM 5451.
- The yield of VTN 19 rice variety is higher than ST 5 variety but no statistical significance; while it is higher than all the rest varieties and with statistical significance.

ST5 rice variety is suitable for the project area for long time with high yield and good quality for export. In the production of organic rice, high-quality varieties occupy a very important position, as the author Guo Jingqi [12] said that in organic rice system, rice variety was also a crucial factor that can influence rice production (e.g. yield and yield components), in either as a single source of variation or interact with environment condition and nutrient managements. And also, in organic production, do not use chemical inputs rice varieties should have the ability to adapt to organic fertilizers and pest tolerant. So, in the long term we need for special rice varieties that adapted to organic production. The author Vanaja, T. *et al* [13] stated that developing crop varieties that are less dependent on the heavy application of synthetic fertilizers is essential for the sustainability of agriculture. He has reported the development of a new rice cultivar, the first of its kind possessing the general criteria for an organic rice variety, at the same time suitable for chemical agriculture as well, and with favourable cooking and nutritive qualities.

3.2. Production Models

Model of organic rice production increase the profit and income of farmers

- Organic rice production model in the first year almost 50 hectares, producing around 200 tons reached organic standards and nearly 20 tons not reached organic standards. This rice was consumed by companies for processing and export.
- Calculate the efficiency of organic rice: In terms of organic certified rice, the company has to buy rice of farmers involved (year 1, (2015) increased by 25%, 35% by year 2 and from year 3 onwards increase 55% comparing to the purchase price of the market.

Production cost for inorganic rice has increased compared to organic production such as spraying pesticides, herbicides. These cost are not involved in organic production. Cost for organic fertilizer is 5.5 million VND/ha. Since then, the total cost of organic production was 13.3 million VND/ha; while inorganic production is 14.4 million VND/ha. The difference cost or the cost for organic production is lower than cost of inorganic production is 1.1 million VND/ha (Table 3).

Figure 3. *Monitoring shrimps, fishes in the organic rice production farming.*

Table 3. *Production cost of organic rice compared to inorganic rice.*

Type of rice production	Cost of production per ha (Million VND)				Total cost (Mill. VND)
	Labours' cost	Cost of inputs	Rice seeds	Havesting cost	
Organic rice	4.0	5.5	1.6	2.2	13.3
Inorganic rice	4.2	6.3	1.7	2.2	14.4
Difference	0.2	0.8	0.1	0	1.1

- The average yield in 2015 of organic rice was 4,29 T/ha (households reached the highest yield of 6 T/ha; the lowest is 3.5 T/ha).
- In case of inorganic rice yield in average according to the Long Hoa Commune People's Committee was 5.40 T/ha (highest household was 6.2 T/ha; the lowest was 5.5 T/ha). This figure is taken as a basis for comparison; and assuming the cost and purchase price stability over the years.
- Floor price of fresh organic rice procurement season 2015 is 5,800 VND/kg, the actual purchasing dry rice price for organic rice is 8,700 VND/kg.
- Floor price of fresh inorganic rice at the same time is 5,400 VND/kg, equivalent to dry rice price is 6,480 VND/kg (20%).

Table 4. *Income and benefit of organic rice compared to inorganic rice (VND/ha).*

Nr	Items	Organic rice	Inorganic rice
1	Rice yield (T/ha)	4.29	5.40
2	Total cost/ha	13,300,000	14,400,000
3	Rice price (VND/kg)	8,700*	6,480
4	Total income/ha	37,323,000	34,992,000
5	Benefit/ha	24,023,000	20,592,000
6	BCR	1.8	1.4
7	Additional benefit/ha	+ 3,431,000	

Note: * Rice price is dry grain rice = 7,250 + 1,450 (25% of fresh grain price as 5,800 VND)

Figure 4. *Monitoring shrimps, crabs rotation with rice in organic farming.*

Thus, with 1 ha, farmers produce organic rice in the model they got the income of 37,323,000 VND compared to inorganic rice with 34,992,000 VND. The profit/ha of organic rice production in year 1 is: 24,023,000 VND; 2nd year is estimated at VND 26,511,200 and third year is 31,487,600 VND. While income in inorganic rice is 20,592,000 VND. The additional benefit from organic rice is 3,431,000 VND/ha as compared to inorganic rice. The BCR (benefit cost ratio) in the first year is 1.8 for organic rice, while it is only 1.4 in inorganic rice.

The total area was done in 2015 with 50 hectares, the total profit was 1.20115 billion VND and 2016 of plan year is 3.97668 billion VND for 150 ha and 2017 plan year is 7.8719 billion VND for 250 ha.

Effectiveness of fisheries: rice-shrimp (prawn)/crab farming rotations: Given income of about 70 million VND/ha, excluding cost, the benefit was about 40 million VND. In case of aquatic (crayfish) intercroping farming with rice, farmers can lure fish with many species (shrimp, goby, mullet...) from the large rivers fishing on such land and at the end of the rice harvesting, farmers caught fishes like catfish, snakehead, perch... to increase revenue from 15-20 million /season/ha. This benefit can not be gained in case of inorganic rice due to pollution.

While the efficiency for environmental safety, for the health of humans, animals and plants in long term are very valuable.

The economic efficiency achieved not only for farmers but also for the "4 partners", those are the managers, scientists, farmers and enterprises. Especially the participation of enterprises in the contract associated with farmers. In Laos, they also have the same result as the author namely Gustaf Erikson recently wrote that, one possible way to increase the profits and income for smallholder farmers may be to convert in to organic rice production for the export market, since the international market for organic rice is growing, consumers are prepared to pay a premium prise for organic products and conditions for organic rice production are favourable in Laos. [10]. Or consolidate by other research by Sa Kennvidy [11], the author wrote that majority of farmers converted their farms into organic farms because of premium prices on organic products and 15% increase from their farm incomes compared to conventional farms. Adapting organic rice farming is able to increase rice yields by 5% accounting from 2.46 to 2.59 tons per hectare. The increased amounts of rice production were equivalent to 21%. Furthermore, organic farming systems could be more stable since the analysis of its economic efficiency was higher than conventional farming system.

4. Conclusion and Suggestion

4.1. Conclusion

- Experiment on sowing methods found that no difference in yield, but row seeding method can help to reduce seed rate. Less seeding density tends to increase in yield and reached higher yield at 80kg/ha; row sowing seeding tends to give higher yields compared to scatter seeding.
- From the experimental results can encourage farmers to apply row seeding method which has many advantages, can save seed sowing with 60 kg/ha by row seeding and 70-80 kg/ha by scatter seeding.
- VTN 19 variety gave the highest yield (4.72 T/ha), followed by control variety ST 5 (4.52 T/ha); then by OM 4900 (4.37 T/ha); OM 6162 (4.19 T/ha); and OM 5451 (4.09 T/ha).
- The profit/ha of organic rice production in year 1 is: 24,023,000 VND, while profit in inorganic rice is 20,592,000 VND. The additional benefit from organic rice is 3,431,000 VND/ha as compared to inorganic rice. The BCR in the first year is 1.8 for organic rice, while it is only 1.4 in inorganic rice.
- Effectiveness of fisheries: rice-shrimp/crab farming rotations: Given income of about 70 million VND/ha, excluding cost, the benefit was about 40 million VND. In case of aquatic farming intercropped with rice, farmers can increase revenue from 15-20 million /season/ha.
- There are also effective in environmental safety, human and animals health.
- Rice products from the research project has achieved organic certificates from international organizations such as EU (Europe), USDA (United States) and JAS (Japan).

4.2. Suggestion

- Due to climate change and saltwater intrusion in an unusually way, we need to research and apply transplanting rice instead of sowing rice in traditional cultivation in the project area in order to prevent rice seedling die due to salinity in the early season and shorten the duration to avoid loss due to late season salinity, to reduce seed costs, and will allow shrimps to move in the rice field for intercropping shrimp/fish and many other benefits.
- Even though the highest seed yield of VTN 19 like shorter growing period of about 10 days and other advantages but needs wider testing before recommending for large scale production.
- Other varieties like OM 4900, OM 6162, OM 5451 are equally productive, good-quality rice; have short growth period (96 days) and especially grown in some farmers' fields in the region from a few year ago so they can apply for production in organic rice model.

Figure 5. *Organic rice certificates from EU (Europe), USDA (United States) and JAS (Japan).*

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