

Improvement of Rice Production Through Water Treatment and Integrated Rice-Fish Farming

--Team Japan--

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After the rice is harvested, it is hung on wooden poles to dry. This farm is typical of Japan's rice farms.

Executive Summary:

This pilot project is intended to assist the average rice farmer in rural Japan by: 1) enhancing water quality used on crops; 2) introducing integrated farming techniques (introduction of aquaculture production to rice field); and 3) through steps 1 and 2, increase overall rice production. The term of the project is three years at a cost of \$ 89,135.26. According to our research we expect after three years to have paid back the grant monies of \$ 100,000 and have a profit from fish production of \$ 4,480. It would take about three years to see profits from the fish production.

Background:

Due to the industrial production, Japan has a problem with acid rain. The problem with acid rain is that the acidification of lakes, streams, and rivers occurs and pollutes the major water sources for crops. A common practices liming cancels out the acidity in the soil and water. This can be expensive so we used the more economic Grander filtration system.

Water in the Uonuma, Niigata area comes from mountain snow runoff and is considered very good drinking quality. It is used by several industries in the area for Sake production, food processing, and other manufacture companies as well as bottled and sold as drinking water.

Water from the Shinano River, Japan's largest, is noted for its troubled past with contamination challenges. Environmental quality standards for organic pollution are still not being met at about thirty percent of Japan's total water area. There has been little improvement in urban rivers and enclosed water areas such as inland seas, inlets, lakes, and reservoirs. Potable water standards were last updated in 2004.

In December 2007 the World Trade Organization (WTO) was to meet in Japan to discuss free trade agreements and Japan's agriculture dilemma. Japan is very dependent on imports; about 60 percent of its calorie intake comes from other countries. This makes it difficult for local farmers to compete against imports. Only one percent of Japan's Agriculture is exported, mostly apples, peaches and a small amount of rice to niche markets around the world. Without the government support, the local farmers will not be able to compete with rice imports. The Japan Agriculture Association (JJA) is looking for ways to expand Japan's agriculture (rice production) and strengthen its competition in the world market. The local government controls the domestic price of rice production and many farmers (about three million) have to find a second job to support their families.

Tilapia has already been introduced to Japan and is quickly becoming a choice of substitution for Red Snapper sushi. Introduction of tilapia production as a second crop will reduce some pressure on the salt water fishing industry which has to travel farther away from home to harvest for Japan's demand of fish. Our project also plans to stock grass carp (White Armor) along with the tilapia. Some farmers currently raise carp in the rice fields. Both species coexist well with each other and offer different benefits to the rice plant. Tilapia is good for insect control and carp root around the roots and aerate the rice plants. Both species are selective weed consumers and the by products from the fish naturally fertilize the rice plant.

The Problem:

Due to industrialization in Japan there is a serious water pollution situation affecting potable water and water used in crop production. Even with recent measures to correct the causes of acid

rain, the acidification of water sources and heavy metal pollution to water sources, water quality is not yet at healthy standards.

Second, recent trade agreements (2007) in Japan have placed the average small farmer at risk. Imports of rice make it difficult to compete domestically against the large rice producers even with price adjustments intended to protect the smaller farmer. Many of the small farmers are seeking work elsewhere to support their families.

Objectives:

The first step of this project is to enhance the quality of water taken from the Shinano River and used for rice production;

- 1) Construct a water filtering system:
 - a. Design an inline artificial wetland between the river and field using existing canal system.
 - b. Design an intake reservoir for the rice field.
 - c. Install a Grander Immersion Unit filtration devise in the reservoir.
- 2) Introduce tilapia and carp to rice production:
 - a. Construct fish holding ponds for reproduction and grow out.
 - b. Construct channels around the field for fish collection when field is drained.
 - c. Construct a weir system and cannel to control effluent from rice field back to wetland.
- 3) Assist in production and marketing of fish.
- 4) Collect data for evaluation purposes:
 - a. Water quality change from river, wetland, reservoir, and exit of rice field.

- b. Rice production—to compare with farm history and surrounding farms.
- c. Fish production
- d. Economic benefits/disadvantages.

Scope:

The short term goal of this project is to improve water quality supplied to rice farmers. In the process, or long term goal, we hope to increase the productivity of the rice field. In addition, due to recent economic barriers to free trade of rice in Japan, we intend to assist the farm in becoming an integrated farming system by converting the farm into a rice-fish farm. This will allow the farmer to use the same resources to produce two or more crops for profit. To achieve this goal we will require grant money totaling \$ 100,000 for the pilot project, and partnerships with two or more agencies in the area that can aid with research assistance (these groups may also be the source of our grant money). We expect the pilot project will take approximately three years: Year one for set up and operate as a trial. Year two consisting of production to make sure the project is working as planned. Year three will provide time for training of the farmer to take over operation of fish production techniques and water filtering methods. Our partners may wish to monitor the project longer for data on increased production and economic benefits of being an integrated farm. We hope the project will be successful enough that further integration of rice farms will expand.

The project includes the necessary construction, stocking, production, employment and assistance with marketing pertaining to water quality improvement and fish production. The farmer is responsible for the rice production of his farm. Changes in rice production are recorded to aid in assign the success of the project.

Partners:

Japan International Research Center for Agriculture Sciences (JIRCAS):

<http://www.jircas.affrc.go.jp/>

JIRCAS was established in October 1993 through the restructuring of the Tropical Agriculture Research Center (TARC). It has since (2001) become incorporated under the Ministry of Agriculture, Forestry and Fisheries (MAFF) in Japan. The goal of JIRCAS is to undertake “comprehensive research on agriculture, forestry and fisheries technology in developing areas of tropical and subtropical regions, as well as domestic research on agriculture, forestry and fisheries, aimed at providing solutions to international food supply and environmental problems through technology development; and collects, analyzes and publishes information to grasp trends relevant to international agriculture, forestry and fisheries as well as farming systems, through international collaboration and cooperation.” (JIRCAS web site)

Niigata University, Field Centre For Sustainable Agriculture and Forestry:

http://www.agr.niigata-u.ac.jp/index_eng.html

“The goals of the education and research in the Faculty of Agriculture, Niigata University are as follows: Active and flexible system of education and research in accordance with current social requirements, toward sustainable agriculture and forestry in the sound natural environment. Development of productive agriculture and stable local societies including mountain villages. Education from an international point of view by means of basic sciences and new technologies. Promotion of interdisciplinary research and regional collaboration projects.” (Niigata University web site)

Methods:

We will be monitoring and filtering secondary used water from the Shinano River with the flow through method in an average, 1.2 hectare, rice production farm near Uonuma. The water from the Shinano River will be channeled into an artificial wetland. Using the artificial wetland and the effluent from the rice field, we believe that water quality will meet the standards of the Ministry of Environment water and waste water regulations. The artificial wetland water will be channeled to an intake collection reservoir that will flow into the rice production farm. The intake reservoir will contain a large double, Grander Immersion Unit filtration system.

The water will leave the reservoir and enter the rice production farm via a canal system that is dug below the embankments of the field that circle the rice field. Water enters the canal and overflows to fill the field, allowing the fish released into the canal access to the field. The flooding of the production field is controlled by a concrete weir with adjustable wood dam boards. Effluent water leaving the rice field will be directed back to the wetland for reuse. The canal surrounding the rice field becomes a collection area for the tilapia and grass carp in the harvesting phase of fish production. Tilapia and grass carp will be released into the field approximately ten days after the rice has been planted. When the water is drained from the field for weeding (twice a season) the fish will congregate in the canal for easy harvest and restocking. Three days before the rice is harvested the field will be drained, and all fish collected in to the canals for harvesting.

Fish stocking is based on growth rate: Fingerlings, ten days after rice is transplanted, at 4,000/ha. First weeding of rice will entail a fish harvest and restocked at 1,500/ha. And, the second weeding fish will be harvested and restocked at 500/ha. Fish in the rice field during rice farming will require supplemental feed only if growth needs to increase to meet harvesting

requirements. Fish that are not market size will be held over in the wintering/reproduction ponds and restocked the next season along with juvenile fry.

Fish in the wintering/restocking ponds will require feed and light maintenance over winter.

Winter in this region is severe enough that fish should not winter in field canals. Draining the canals will allow for winter and early spring maintenance.

Evaluation of the success of this pilot program will be based on this farm’s prior rice production history and a comparison to the rice production on similar size monorice and integrated rice farms in the region.

Time Line:

The project begins in March (Month 1).

Year One:	Month:	1	2	3	4	5	6	7	8	9	10	11	12
Objective 1:													
Construction:		X	X										
Wetland Development			X	X									
Intake Reservoir					X								
Grander Immersion Unit						X							
Effluent Emissions Weir							X						
Diversion Canal to Wetlands		X											
Objective 2:													
Construction:		X	X										
Fish Holding Ponds				X	X								
Fish Cannels in Rice Field						X							
Winter Maintenance									X	X			
Objective 3:													
Stocking Fish		X											
Monitor Fish			X		X		X						
Harvest Fish				X		X		X					
Marketing Fish				X		X		X					
Restocking Fish				X		X		X					
Wintering/breeding Fish									X	X	X	X	X
Objective 4:													
Data Collection:			X		X		X						
Water Quality			X		X		X						
Rice Production									X				
Fish Production				X		X		X					

Time Line:

Year two begins in March (Month 1)

Year Two:	Month:	1	2	3	4	5	6	7	8	9	10	11	12
Objective 2:													
Spring Maintenance		X	X										
Objective 3:													
Stocking Fish		X											
Monitor Fish			X		X		X						
Harvest Fish				X		X		X					
Market Fish				X		X		X					
Restocking Fish				X		X		X					
Wintering/breeding Fish									X	X	X		
Objective 4:													
Data Collection:			X		X		X						
Water Quality			X		X		X						
Rice Production									X				
Fish Production				X		X		X					

Time Line:

Year three begins in March (Month 1)

Year Three:	Month:	1	2	3	4	5	6	7	8	9	10	11	12
Objective 2:													
Spring Maintenance		X	X										
Objective 3:													
Stocking Fish		X											
Monitor Fish			X		X		X						
Harvest Fish				X		X		X					
Market Fish				X		X		X					
Restocking Fish				X		X		X					
Wintering/breeding Fish									X	X	X		
Objective 4:													
Data Collection:			X		X		X						
Water Quality			X		X		X						
Rice Production									X				
Fish Production									X				
Final Data Collection										X	X	X	X
Project Paper										X	X	X	X

Location/Facilities:

The site we chose for our pilot operation is an existing small farm near Uonuma, Niigata in the Chubu region of Japan. Uonuma is located midway along Japan's longest river, the Shinano.

There is also a man-made reservoir, Lake Okutadami which is Japan’s largest reservoir in the area. Four cruise ships operate on the lake regularly connecting several ports along three different routs around the lake. Niigata Prefecture is noted for its specialty rice production and processing, sake, cut flowers (tulips) and Ornamental Koi. Near by in Uonuma is the Katokichi Company LTD. which is noted for its meet processing, including frozen fish. We feel area this will offer adequate transportation, processing and a market outlet for our productions.

Please check out the Map of Uonuma, Niigata, Japan-Live Star (Map site allows you to “zoom in/out” for location details.)

<http://maps.live.com/?q=Uonuma%20japan%20web%20cams&mkt=en-US&FORM=BYIX#JndoZXJIMT1Vb251bWEIMmMrKytqYXBhbiZiYj0zNy43MDU1NTM0ODcyMTU4JTdlMTM5Ljc1MTU4NjxNDA2MyU3ZTM2Ljc2OTY5MjMzMjE0NTUIN2UxMzguMTgwNTQxOTkyMTg4>

Budget:

Grant Money for Project/Three Years: \$ 100,000

Predicted Fish Sales/Three Years: \$ 104,480

Table: Probable Cost of the Project/Three Years (in U. S. dollars):

Employees				Project Expenses	
Name	Title	Pay Rate	Hours		
Kurisutiina Ayako	Foreman	12.00	2340		\$ 28,080.00
Tairaa Monika	Laborer	9.54	1560		\$ 14,882.40
Maaku Takkaa	Laborer	9.54	1560	\$ 14,882.40	
Equipment/Supplies					
Item	Cost	Item	Cost		
Grandar Unit	\$ 3,000.00	Tools	\$ 500.00		
Cement	\$ 150.00	Wire Mesh	\$ 45.00		
Lumber	\$ 100.00	Netting	\$ 300.00		
				\$ 4,095.00	
Services					
Type	Cost	Type	Cost		
NA					

Transportation				
Where	Cost	Miles		
Ship to Processing	\$ 4.00	15	\$ 60.00	
Ship to Processing	\$ 4.00	15	\$ 60.00	
Ship to Processing	\$ 4.00	15	\$ 60.00	
				\$ 180.00
Fish Production				
Description	Cost per Kg	Weight (kg)	Cost	
Talpia Stock	\$ 0.03	96	\$ 2.88	
Carp Stock	\$ 0.03	96	\$ 2.88	
Fish Feed	\$ 2.03	1970	\$ 3,999.10	
				\$ 4,004.86
Construction				
Item	Cost			
Holding/Wintering Pond Construction	\$ 333.90			
Cannel Construction	\$ 333.90			
Wetland Construction	\$ 667.80			
				\$ 1,335.60
Indirect				
Item	Cost			
Permits	\$ 75.00			
Living Expenses	\$21,600.00			
				\$ 21,675.00
Total				\$ 89,135.26

Fish Sales for Three Years

Species	Price Per KG	KG Production	Total Sales
Carp	\$ 16.52	4,000	\$ 66,080
Tilapia	\$ 2.40	16,000	\$ 38,400
Total		20,000	\$ 104,480

Sales Grants Profit for Three Years
\$ 104,480 – \$ 100,000 = \$ 4,480

Personal/Credentials:

Our team is qualified for this project as we have the necessary education background and related experience in science, technology, agriculture, aquaculture, logistics, and business management needed to complete this project.

Expected Results:

We expect that the water quality, by passing through the artificial wetland and the intake reservoir with the Grander filtration system, will increase rice production. The effluent from the rice field will be free of pesticides, herbicides and other chemical agents commonly used to raise rice production. The effluent, also treated with the Grander filtration system should also be healthier for natural organisms benefiting the environment. For the tilapia production we expect to coordinate harvests with the weeding and harvest schedule of the rice, thus, three harvest of tilapia. Tilapia will be delivered to the Katokichi processing plant in Uonuma. Previous studies have shown that rice-fish production has reduced chemical additives such as pesticide and herbicides. After three years, the farmer is expected to earn \$8,000 per year.

Sources:

Text/Articles:

Avault, James W., Jr. Ph.D. Fundamentals of Aquaculture, A step-By-Step Guide to Commercial Aquaculture, 1996

Lightfoot, Roger, Cagauan, Cruz. A Fish Crop May Improve Rice Yields and Ricefields, Naga, The ICLARM Quarterly September 1991.

Web Sites:

Info please--Japan

<http://www.infoplease.com/ipa/A0107666.html>

Japan Geography

<http://www.kidport.com/RefLib/WorldGeography/Japan/Japan.htm>

Japan Maps

http://search.live.com/images/results.aspx?q=japan+maps&mkt=en-us#focal=0645870141151ae16a7e2970013921db&furl=http%3A%2F%2Fjin.jcic.or.jp%2Fimg%2Fjapan_map.gif

CIA-The World Fact book-Japan

<https://www.cia.gov/library/publications/the-world-factbook/geos/ja.html#Intro>

Country Studies—Japan Industry

<http://countrystudies.us/japan/106.htm>

Effects of Acid Rain on Surface Water

http://www.epa.gov/acidrain/effects/surface_water.html

Ministry of the Environment—Stat of Japan’s Environment At a Glance: Japanese Lake Environment (996)

<http://www.env.go.jp/en/water/wq/lakes/index.html>

FAO Corporate Document Repository—Originated by: Fisheries and Aquaculture Department—An outline of water pollution in Japan

<http://www.fao.org/docrep/005/AC861E/AC861E01.htm>

Lake Net—Lake Profile

<http://www.worldlakes.org/lakedetails.asp?lakeid=8366>

Measuring Water Quality at Water Purification Plants

<http://www.yokogawa.com/iab/appnotes/iab-app-measuringwater-en.htm>

World Health Organization—Water Sanitation and Health

http://www.who.int/water_sanitation_health/industrypollution/en/index1.html

Ministry of the Environment—Stat of Japan’s Environment At a Glance: Water Pollution
<http://www.env.go.jp/en/water/wq/pollution/index.html>

Food and Agriculture Organization of the United Nations-Fisheries and Aquaculture
Department--Japan
http://www.fao.org/fishery/legalframework/nalo_japan

Japan for Sustainability (JFS)--Industry
<http://www.japanfs.org/en/japan/industry.html>

Living Water by Grahame Whitehead
http://www.harmonikireland.com/living_water.htm

Grander--Agriculture
<http://www.granderwater.com/agriculture.htm>

Sushi Foods Co.--Tilapia
http://www.sushifoods.com/Merchant2/merchant.mv?Screen=PROD&Product_Code=11901&Category_Code=seafood&Product_Count=45

The Case of Rice-fish Farmer Mang Isko from Dasmarinas, Cavite, Philippines
<http://www.fao.org/DOCREP/005/Y1187E/y1187e25.htm>

Water Harvesting and Aquaculture for Rural Development
<http://www.ag.auburn.edu/fish/international/introwaterharv.htm>

Rice-fish farming potential to help achieve food
<http://nation.ittefaq.com/issues/2008/04/26/news0229.htm>