Why Should We Use Winter-flooded Rice Farming?

Migratory birds leave their feces in rice paddies. Rice straw and stubble are decomposed by fungi and tubificidae in winter to form a natural compost and nutrient source for algae, such as filamentous green algae, in the spring.

Projects have started to make the most of these natural organisms, as a means of replacing conventional farming dependency on pesticides, herbicides and chemical fertilizers.

Rice from winter-flooded paddies is also in high demand for the table.

Winter-flooded rice paddies also contributes to the natural restoration of *satoyama* by enhancing biodiversity, water purification and recharging ground water.

▲Winter-flooded Rice Paddy in Tajiri, Osaki

Expected Benefits of Winter-flooded Rice Farming

◆Environment (multi-function of the rice paddy = external economy)

環境

- Recovering wetlands rich in organisms
- Enhancing biodiversity (including birds, insects, and aquatic organisms)
- Feeding and/or roosting sites for geese, ducks, swans, shorebirds and other fowls.
- Groundwater re-charging
- Water purification
- Oxygen from algae

◆Agriculture

農業

- Restoration and conservation of the natural environment
- Raising consumer's awareness of agriculture
- Production of high value rice
- Maintenance of traditional village society
- Agriculture independent of pesticides, and with the help of increased populations of natural enemies including spiders, frogs, and swallows
- Use of natural fertilizer (bird feces and aquatic organisms decomposed by microbes)
- Weed control (due to formation of *Toro-toro*: a moist, upper soil layer with microbes and excreta of organisms including tubificidae worms.

• City Government Support of Winter-flooded Rice Farming in Tajiri, Osaki (Miyagi Prefecture)

Farmers and others in Tajiri, Osaki, discussed the promotion of rice paddies that provide additional resting sites for more than a hundred thousand of White-fronted Geese overwintering in the Kabukuri-numa wetland. This wetland supports various organisms including fish, frogs and worms. In 2004 the city government, and later the national government, began financial supports for environmentally friendly farming based on winter-flooded rice paddies that do not use pesticides, herbicides and chemical fertilizers.

Winter-flooded Rice Paddies Enrich Soil and Nurture Organisms

Fuyumizu-Tambo, rice paddy cultivation in harmony with nature

Winter-flooded Rice Paddy

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Winter-flooded Rice Paddy - Rice Paddy Filled with Water during Winter

Winter-flooded rice farming has been practiced in Japan since the Edo period (1603-1868)

Winter-flooded rice farming is both a traditional and innovative agricultural technique. The word *Tafuyumizu* first appears in an agricultural manual, *Aizu Nousho*, published in 1684.

This is an agricultural method that the author, Yojiemon Sase, tried himself. In the manual he explains that it is a good idea to flood a rice paddy during winter whether it be located in the mountains or the plain.

The advice suggests that he was aware that winter flooding increased productivity by encouraging growth of organisms including fungi, tubificidae worms and chironomidae.

Winter-flooded rice farming has now been re-introduced as a way to promote harmony between farming and nature.

冬水をかけよ岡田へこみたまり 土もくさりて能事すかし

Flood rice paddies in winter
Organics accumulated on the dry ground
Ferment to make good soil
(Yojiemon Sase)

雪花の散りぬる風のなごりには 稲なき水面（みなも）穂並みたらける

Snow blown like petals of a flower
Behind the wind
Waves occur on a pool of rice ears
Like the water surface
(Shigeki Iwabuchi)

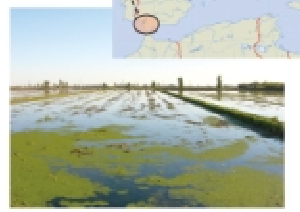
Winter-flooded rice paddies at home and abroad

SPAIN

What's *Perellona*?

Along the Mediterranean in Spain, farmers flood their rice paddies with water after harvesting rice from November to January.

This agricultural method, known as *Perellona*, has been in use for 200 years, and takes its name from the village of Perello where it was first practiced. The areas of *Perellona*, around Lake Albufera and Ebro Delta are all registered under the Ramsar Convention on wetlands.



Winter-flooded Rice Paddies at Ebro Delta in Catalonia

JAPAN

Wild Geese, Swans, Cranes, Ibises and Storks, and Their Connection to Winter-flooded Rice Paddies

Besides being an innovative agricultural method, winter-flooded rice paddies are also important for many wintering water birds, including migratory geese, swans and cranes, that use them for roosting and feeding. Ibises and storks also use them as feeding sites. There are now many projects to restore endangered or extinct species such as the Japanese Crested Ibis, the Oriental White Stork and other species depending on rice paddies.

▶Japanese Crested Ibis (Sado City, Niigata Prefecture)

▲Oriental White Stork (Toyooka City, Hyogo Prefecture)

▲White-fronted Geese and Whooper Swans (Tajiri, Osaki City , Miyagi Prefecture)

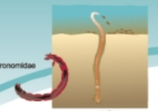
◀White-naped Cranes (Imari City, Saga Prefecture)

Winter-flooded Rice Paddies Nurture Biodiversity and Restore the Natural Environment of *Satoyama*

ふゆみずたんぼ 絵こよみ

Illustrated Calendar of Winter-flooded Rice Farming

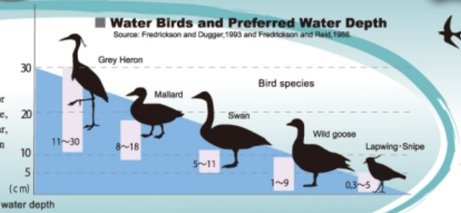
Late Autumn 晩秋 | Winter 冬 | Spring 春 | Summer 夏 | Autumn 秋



Filling rice paddies with water creates "oases" for many organisms such as small fungi, chironomidae, tubificidae worms, and waterbirds. In particular, bird feces make good fertilizer. Algal blooms in spring, also turn into a natural fertilizer.

Water Birds and Preferred Water Depth

Source: Fredrickson and Dugger,1993 and Fredrickson and Reid,1986



Fertilizing Effects

●Dead fish and tadpoles turn into natural fertilizer.

Water Management during winter

●Increase of microbial biodiversity/activity.

◀ Decomposed rice straw

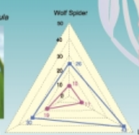
●Japanese red frog spawning season from late February to March.
No spawning is possible without water in the rice paddy.

Rice planting

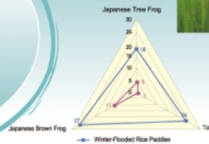
Integrated Biodiversity Management (IBM)

Frogs and Spiders Eat Insect Pests

What's the role of frogs and spiders in rice paddies? Previous studies indicate that spiders and frogs feed on insect pests. Surveys show that number of spiders and frogs were higher in winter-flooded rice paddies than in conventional rice paddies. The Integrated Biodiversity Management (IBM) recommendations received much attention recently, by suggesting natural control of pests as part of ecosystem management (Kiritani, 2004).



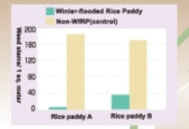
Abundance of Spiders in Winter-Flooded and Conventional Rice Paddies (Individuals/100 rootstocks)
(Survey of Organisms in Rice Paddies in Sasakami, Niigata, 29th July, 2006)



Abundance of Frogs in Winter-Flooded and Conventional Rice Paddies (Individuals/100m ridge)
(JA Midori Frog Survey: 21st June, 2008)

▲ Japanese Tree Frog

Effect on Weed Control



▲ Chart: weed control in winter-flooding (modified from a report on goose habitats in Miyagi prefecture in 2000)

▲ *Branchiura sowerbyi* (tubificidae worm) about 80 mm long

Tubificidae and Other Worms Overlay the Fine Soil-like *Toro-Toro* Layer

Winter-flooded Rice Paddies promote growth of tubificidae worms. When the density of the worms reaches 2/cm², weed seeds sink into the fine soil-like layer of their feces (Kurikahra 1983). The fine soil particles that pass through the body of worms mix with fungi forming the *toro-toro* layer. This depresses weed seeds ~ 10cm/ year and thus prevents their germination.

Rice reaping

Control of Cadmium Absorption

Heavy metals such as Cadmium in the soil are absorbed least to rice crops under low oxygen, a state of reduction by keeping water in rice paddy. A combination of the following measures is considered effective to prevent their absorption:

- No drainage for three weeks before and after heading
- Delay the timing of drainage
- Winter-flooding

▲Chart : The Amount of Cadmium in Brown Rice
(Data : Motoyoshi-Hibiki High School , Miyagi Prefecture).
(Japan Grain Inspection Association: 18th October, 2004)

Control of Cadmium Absorption

No Agricultural Chemicals, No Chemical Fertilizers Preparing Rice Seedlings for Winter-flooded Rice Paddies

二月 February			三月 March			四月 April		
early	middle	late	early	middle	late	early	middle	late

Selecting seeds with salt water

浸種開始 Seed soaking starts

40日程度 About 40 days

浸種終了 Seed soaking ends

プール育苗の準備 Preparation for seedling pool

播種 Sowing seeds

田植え Planting

Hot water sterilization

●Selecting Seeds in Salt Water
Selecting large and heavy seeds with less space between chaff and seed in salt water.

●Hot Water Sterilization
Sterilize seeds with hot water to prevent rice blast, brown spot, and bakanae, (foolish seedling) disease.

●Sowing
The number of seeds sown should be a half or less than that of conventional farming. Pot-cultures are easy to prepare and suitable for organic farming.

Give-and-Take Relationships between Rice Paddies and Migratory Birds

White-fronted Goose: a flagship species

The white-fronted Goose is a typical winter migratory bird that breeds in tundra of arctic Russia in summer. In autumn, they travel about 4,000 km south to Miyagi Prefecture, Japan. It is a large bird with a wingspan of about 160 cm.
It used to be found all over Japan, but its number and habitats have decreased due to over-hunting and land development.
Since legal protection took effect in 1971, the number has increased to over 100,000.
Suitable habitats, however, remain few. It needs a wide, safe area of water and rice paddies for overwintering. It is thus a symbol of rich biodiversity. Most of the population now overwinter in northern Miyagi, where such habitats still exist.

▲White-fronted Geese in rice paddies

Relationship between the White-fronted Goose (a flagship species) and Rice Paddy

The White-fronted Goose was threatened with extinction and designated a protected species in 1971. Although its number has been increasing, its major habitats are still limited to the northern part of Miyagi Prefecture.
It requires a wide, shallow body of water for roosting at night and rice paddies as feeding sites. Feeding sites are usually located within a radius of about 10 km from the roosting site. If this species uses winter-flooded rice paddies as new roosting sites, the rice paddies around there become new habitats for the geese to spread their distribution.
Rice paddies are classified as one type of important wetlands under the Ramsar Convention. Rice Paddy Resolution X.31, proposed by Japan and Korea at Ramsar COP10, 2008, recognized the biodiversity of rice paddies. At CBD COP10, 2010, a similar decision (X.34) was also adopted.

Winter-flooded Rice Paddies Q & A

Q: How to secure a water source during winter?
A: Use diverted river water, shallow wells, mountain streams, or irrigation. Use an electric pump or gravity to channel the water. Plug under drainage and repair ridges between paddies to prevent leakage.

Q: Will winter flooding the paddy cause inconvenience in the spring?
A: It depends on soil quality and farming method: however, our research shows that soil returns to normal about one month after drainage.
It should cause no major problems if the drainage timing is set according to soil type. When paddies get too swampy, they can be temporarily dried while continuing winter-flooding long term.