

Reuse of Drainage Water for Water Saving and Pollution Control by Cyclic Irrigation

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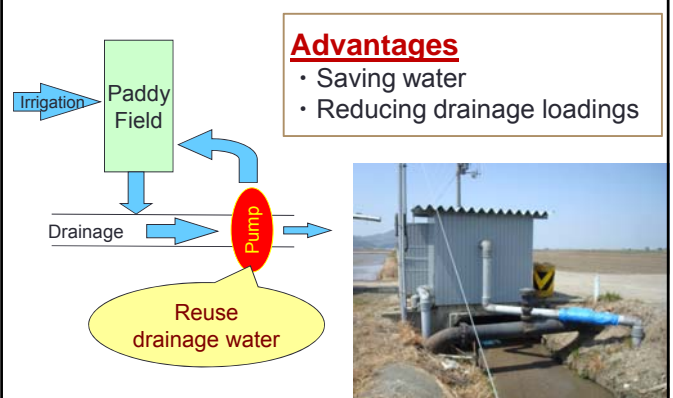
Biwa Lake



- The biggest lake in Japan
- Important water resource for 14 million people

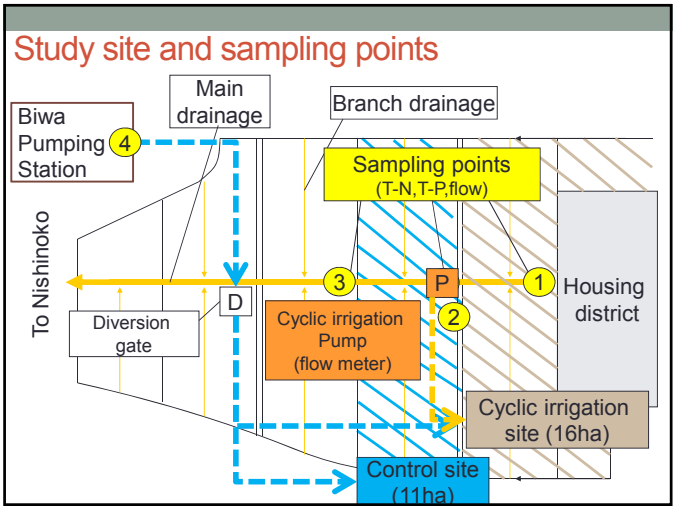
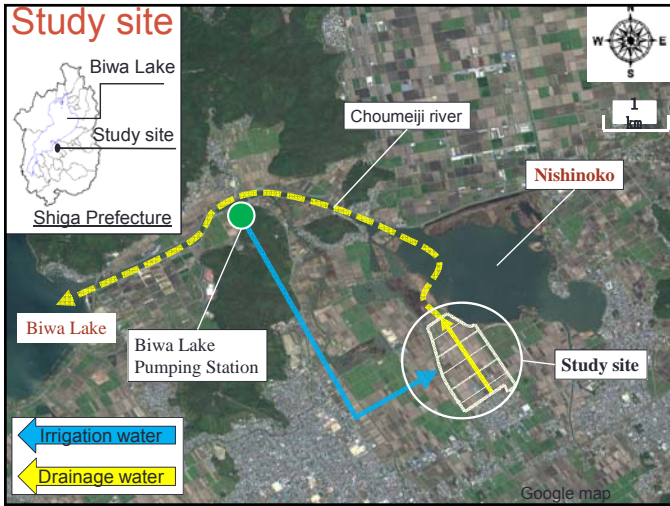
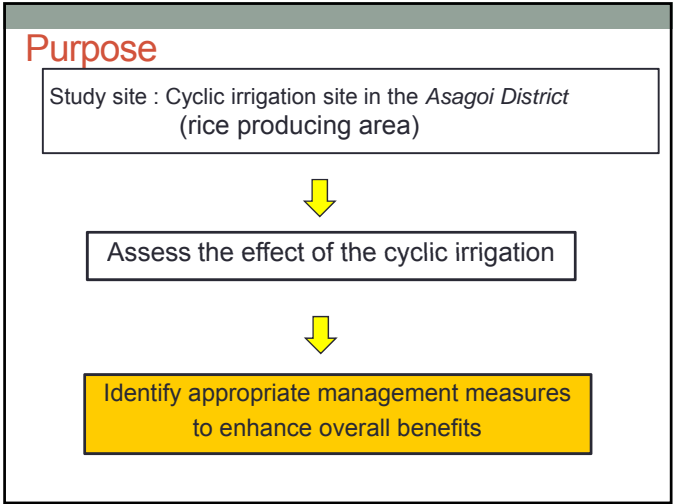
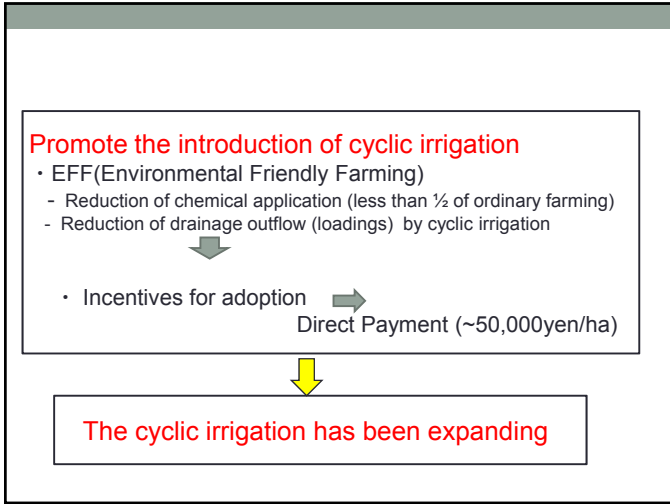
In the late 1960s,
 • water pollution
 • eutrophication

Cyclic Irrigation



Advantages

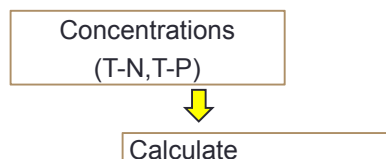
- Saving water
- Reducing drainage loadings



Methods

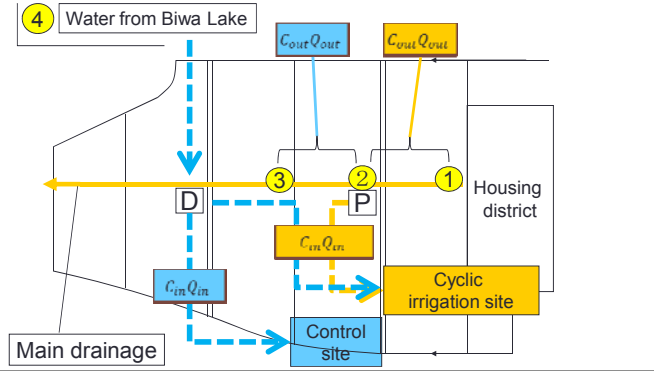
Sampling and measurement	Normal Irrigation Period (May 6~Sep.23) Once every two week Land Preparation Period (Apr.28~May 5) Every day
Irrigation volume	Records of the diversion gate Flow meter
Agronomic information	Green Omi Agricultural Cooperative
Weather data	Hikone meteorological station

Analysis



Calculating methods of net loadings

$$B = C_{out}Q_{out} - C_{in}Q_{in}$$

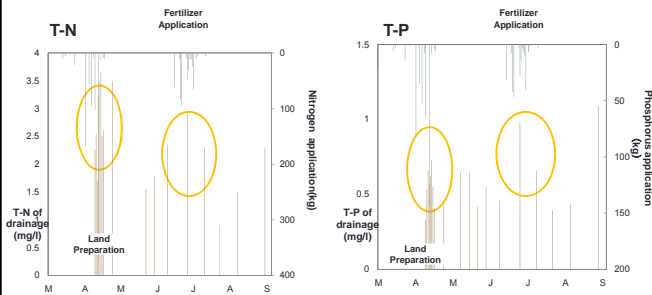


Irrigation and rainfall (mm month⁻¹)

	April*	May	June	July	August	September**	Total(year)
No cyclic irrigation (2004-07,2009)	158	697	481	434	602	89	2,461
(STD)	(68)	(259)	(101)	(177)	(133)	(43)	(503)
Rainfall	14	153	131	229	122	82	731
Cyclic irrigation (2008,2010-11)	70	350	267	452	461	23	1,622
(STD)	(36)	(105)	(81)	(218)	(170)	(4)	(410)
Rainfall	14	146	271	175	76	89	620

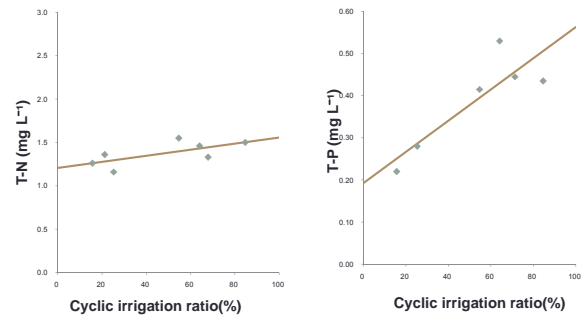
*April: (4/22-4/30)
**September: (9/1-9/25)

Concentration of T-N and T-P and Fertilizer Applications



High T-N and T-P concentrations : during land preparation and after fertilizer applications periods

CIR and T-N / T-P concentrations



T-N and T-P concentrations increased with higher CIR.

Average net loadings of T-N

	Net loadings of T-N (kg day ⁻¹ ha ⁻¹)					
	Cyclic irrigation site			Control site		
	2010	2011	Total	2010	2011	Total
Land preparation period	-1.38	-	-1.38	0.72	0.29	0.49
(STD)	(0.41)	-	(0.41)	(0.60)	(0.20)	(0.49)
Normal irrigation period	-0.74	-0.40	-0.54	0.49	0.02	0.12
(STD)	(0.29)	(0.23)	(0.31)	(0.50)	(0.14)	(0.33)

Net loadings: Cyclic irrigation: **negative** ↔ Control: **positive**

Land preparation period > Normal Irrigation period

Average net loadings of T-P

	Net loadings of T-P (kg day ⁻¹ ha ⁻¹)					
	Cyclic irrigation site			Control site		
	2010	2011	Total	2010	2011	Total
Land preparation period	-0.30	-	-0.30	0.28	0.20	0.24
(STD)	(0.11)	-	(0.11)	(0.24)	(0.20)	(0.17)
Normal irrigation period	-0.18	-0.07	-0.13	0.14	0.02	0.06
(STD)	(0.19)	(0.04)	(0.15)	(0.28)	(0.04)	(0.19)

Net loadings: Cyclic irrigation: **negative** ↔ Control: **positive**

Land preparation period > Normal Irrigation period

Conclusions

- Water saving
- Cyclic irrigation ratio
- Net loadings



Cyclic irrigation:

- Save irrigation water as much as 35%
- Net loadings were negative

➡ suggesting more adsorption/denitrification

Recommendation

To enhance the benefits of the cyclic irrigation without losing agricultural productivity



Reduce fertilizer application

➡ Reduction of outflow loadings/ saving fertilizer cost

{ Current level of fertilizer application [Cyclic irrigation site] = [Control site] }



Further research and analysis

Mechanism of nutrient absorption, denitrification & leaching

