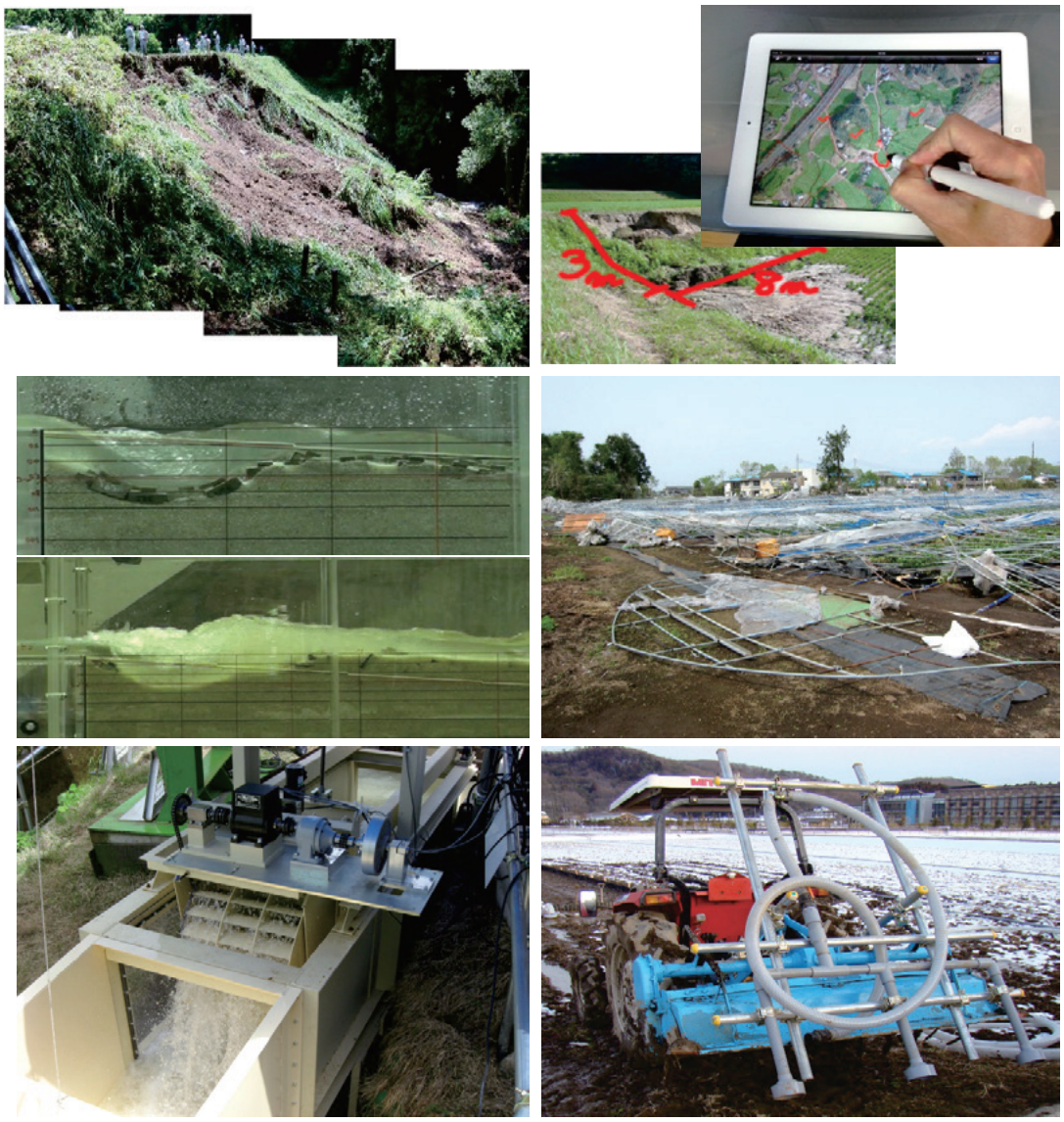
Research Topics 2012



January 2014

National Agriculture and Food Research Organization
National Institute for Rural Engineering（NIRE）

Preface

The National Institute for Rural Engineering (NIRE) is one of several institutes belonging to the National Agriculture and Food Research Organization, an incorporated administrative agency. Scientists at NIRE perform engineering research to support measures to promote rural areas from the technical side, and have developed technology that meets the demands of the times.

Our recent research focuses on the development of technology that contributes to strategic renewal and management of agricultural irrigation facilities, disaster prevention and reduction in rural areas, preservation of regional resources for agricultural production, advanced paddy field management, biomass utilization, measures against the effects of climate change on farmland and water resources, and sophisticated environmental control of agricultural structures as well as many other areas.

This pamphlet outlines the main results of NIRE research in 2012. We greatly hope this pamphlet will be used by engineers of rural engineering.

Takeshi Koizumi
Director General
National Institute for Rural Engineering
January 2014

Research Topics 2012

1. System for monitoring fluctuations in freshwater lens thickness using electric conductivity meters

[Keywords]
Fresh water lens, groundwater, saltwater-freshwater boundary depth, EC meter, continuous measurement

[Abstract]
We established a system for monitoring fluctuations in freshwater lens thickness using EC meters that are set up at two or more depths in an observation hole. EC in the observation hole fluctuates by the influence of the tide. The influence of tides can almost be excluded by averaging the data of 25 hours. The thickness of the freshwater lens of the Tarama Island increased by 1.6 m when Typhoon No. 17 passed in 2012. Influences that extreme phenomena such as a typhoon and localized torrential rain exert on fresh water lens can be clarified by using this system.

[Reference]
Ishida S. et al. (2013) Investigation of fluctuation of freshwater lens using continuous monitoring of electric conductivity in some depths (In Japanese with English Summary), Technical Report of NIRE, 214, 163-174

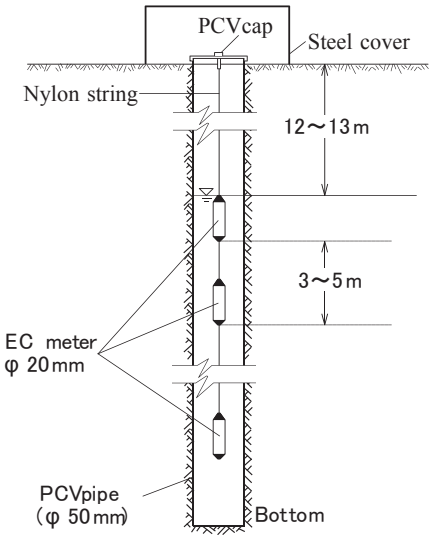


Fig. Outline of monitoring system.

2. Numerical model for predicting the impacts of climate change on groundwater storage and nitrate concentrations in reservoir areas of subsurface dams

[Keywords]
Global warming, Subsurface dam, Groundwater, Nitrate, Tank model, Predictive model

[Abstract]
A numerical model was developed to predict the impacts of future changes in precipitation and temperature on water resources of subsurface dams. The model is composed of a water balance sub-model and a nitrogen balance submodel; the water balance sub-model is built from tank models that express water transport in the catchment area, and the nitrogen balance sub-model represents changes in nitrogen forms and movement of nitrogen in the soil and aquifer zones. The model is also applicable to estimating the influences of changes in land use as well as climate.

[Reference]
Yoshimoto S. et al. (2011) *Paddy Water Environ.* **9**(4):367–384; Yoshimoto S. et al. (2011) *Environ Earth Sci*. doi:10.1007/s12665-011-1356-6

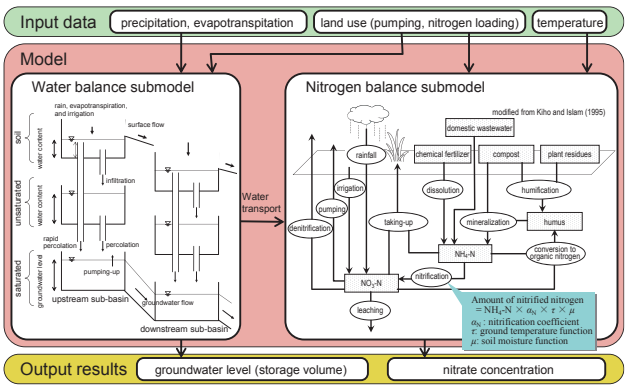


Fig. Outline of the model.

3. Development of Spatial Distribution Index for Droughts : Effects of integrated irrigation management on reduction of drought damage

[Keywords]
Water resources management, Draught, Paddy irrigation, Distribution function

[Abstract]
Many irrigation facilities have been constructed in Japan to stabilize the supply of irrigation water. To maintain a sustainable water supply system, it is important to perform integrated water management of irrigation facilities. A method for assessing integrated irrigation management to reduce drought frequency was proposed and a spatial distribution index for rainfall was developed to show the effect of integrated irrigation management. Values of the spatial distribution index were calculated. Drought return period for two irrigation facilities planned to stand a 1/10 drought frequency was prolonged by integrated irrigation management. The effects of drought damage reduction depend on the distance of two irrigation facilities (Fig.).

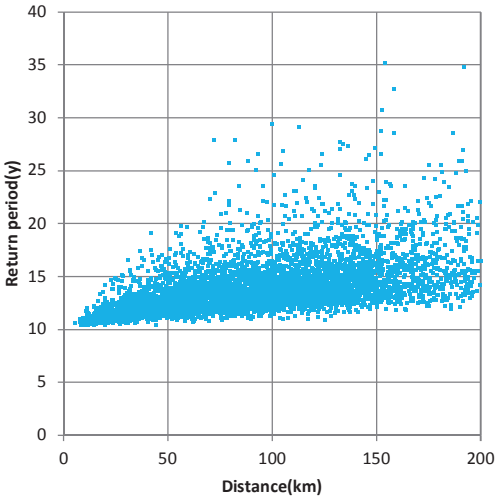


Fig. Spatial distribution index of total effective rainfall during an irrigation season.

4. Influence of the introduction of irrigation projects with large scale cyclic irrigation on stream flow

[Keywords]
large scale cyclic irrigation, E-flow, discharge data, irrigation project, multi-functionality

[Abstract]
The influence of irrigation on stream flow is appreciable with the virtual stream flow in which the influence of irrigation is not received. The effect of the river flow stability function was confirmed to cause a remarkable decrease in stream flow during the irrigation period that was seen before the irrigation project with large scale cyclic irrigation.

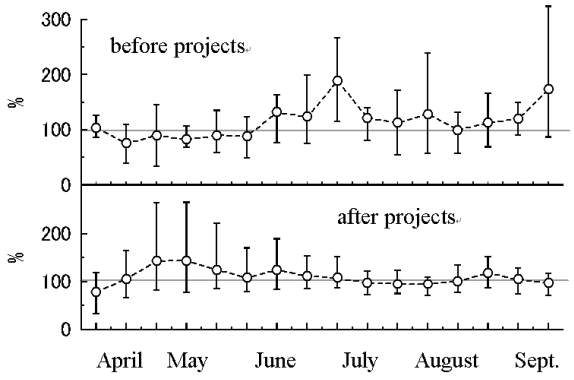


Fig. Changes in streamflow before and after irrigation projects. Clicking will enlarge the photograph.

5. Effect of flexural resistance on the loss of a canal cross-section

[Keywords]
Reinforced concrete, channel, ablation, flexural resistance

[Abstract]
In order to evaluate a decrease in flexural resistance of a canal wall losing cross-section due to wear, we conduct bending tests on reinforced concrete beams (approximate 1.1% reinforcement ratio) losing a portion of the cross-section. As a result, the strength of the beam is decreased in proportion to the cross-sectional loss with compression side loss, but the strength of the beam does not decrease significantly with tension side loss.

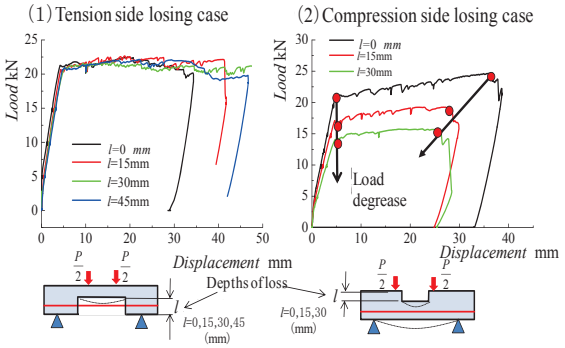


Fig. Relationship between the loss of cross-section and flexure resistance of reinforced concrete beams.

6. Method for evaluation of stability and renovation costs for small scale irrigation and drainage facilities based on a simple functional diagnostic

[Keywords]
Small scale irrigation and drainage facilities, functional diagnostic, prediction of renovation year, renovation

[Abstract]
This evaluation technique is for the purpose of promoting the formations of agreements among residents.

We developed a method to predict the renovation year of irrigation and drainage facilities, estimate stability and measure renovation costs of facilities based on simple functional diagnostics.

In addition to the above method, a degradation curve and external database were used for prediction of renovation year and a radar chart was used for visualization of the stability of facilities.

By applying this method, quantitative evaluation of “Nouchi and Mizu maintenance and reservation activities” is possible.

施設状態評価表（U字溝・鉄筋コンクリート開水路）

地区名						評価年月日			
施設名						評価者			
定点調査番号						調査地点（測点等）			
規格・延長	B=		H=		L(m)=				
造成年度	40年未満:		40年以降:おおよその造成年						
施設の状態	S-5：変状なし S-4：変状兆候（要観察） S-3：変状あり（補修） S-2：顕著な変状あり（補強） S-1：重大な変状あり（改築）								
評価項目			評価区分（該当箇所に○を付ける）					評価の流れ→ 変状別評価（各項目最低値）	主要因別評価（各項目平均値）
健全度ランク			S-5	S-4	S-3	S-2	S-1		
内部要因	構造物自体の変状	ひび割れ、側壁	ひび割れの程度	ほとんどない	横断方向のひび割れが、部分的にあり	横断方向のひび割れが、全体の半分程度あるいは縦断方向のひび割れが部分的にあり	S-3に該当するものが全体的	左記以外	
		漏水	ひび割れからの漏水	無		滲出し、漏水跡、滴水	流水、噴水	左記以外	
		水路表面	剥離・剥落、錆汁、鉄筋露出	無	部分的	全体的		左記以外	
			摩耗・すりへり	細骨材露出	粗骨材露出	粗骨材剥落	―	左記以外	
外部要因	基礎部分	変形・歪み	変形・歪みの有無	無		局所的	全体的	左記以外	
		欠損・損傷	欠損・損傷の有無	無		局所的	全体的	左記以外	
		通水阻害	草繁茂・土砂の堆積等による通水阻害	無		局所的	全体的	左記以外	
		地盤変形	構造物の沈下、蛇行	無		局所的	全体的	左記以外	
			背面土の空洞化	無	局所的	全体的		左記以外	
			周辺地盤の陥没・ひび割れ	無	局所的	全体的		左記以外	
その他の要因	構造物の変状	目地の変状	目地の開き	無	局所的	全体的		左記以外	
			段差	無	局所的	全体的		左記以外	
			止水板の破断	無		有		左記以外	
			周縁コンクリートの欠損等	無	局所的	全体的		左記以外	

Fig. Example of functional diagnostic sheet for concrete canal.

[Reference]
Kunimitsu, Y. and Nakata, S. Abstract for Annual Meeting of Japanese Society of Irrigation, Drainage and Rural Engineering

7. Diagnosis of hydraulic functions in division works for updating canal systems

[Keywords]
Diagnosis of hydraulic and water serviceability functions, Updating enterprise, Division works, Symbolization of performance index

[Abstract]
In updating canal systems, designers are required to grasp the user performance requirements, and to provide the hydraulic and water serviceability functions of the former canal system. However, unexpected faults have arisen after institutional completion in designs based on the view of the specification design. Many of the causes of these faults are in the gap of the problem recognition between designers and users. Therefore, it is necessary to introduce a view of performance-based design to resolve these problems. In this study, we showed that a diagnosis method of hydraulic functions based on symbolization of performance indexes is effective for problem discovery, etc, when updating canal systems.

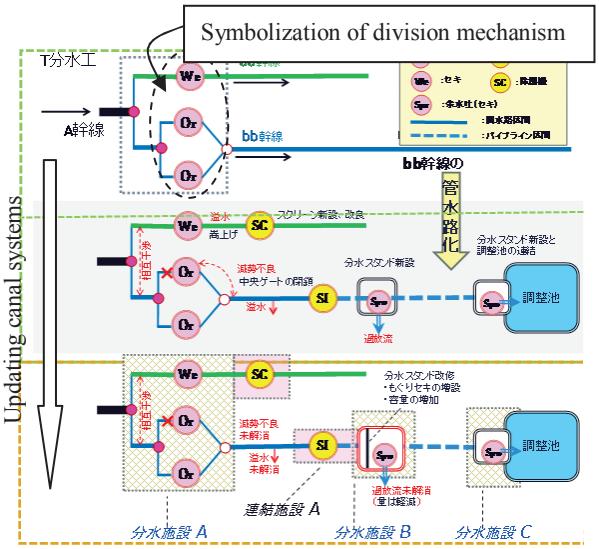


Fig. Changes in hydraulic functions of a canal (comparison by symbolization of division mechanisms) .

8. Mechanisms of riprap destruction downstream of irrigation barrages during downstream riverbed excavation

[Keywords]
Riprap, Barrage, Headwork, Scouring

[Abstract]
Management actions are required to extend the life-span of irrigation barrages for downstream excavation to protect downstream city areas from large floods. Therefore, we examined the mechanisms of downstream riprap destruction for barrages by progressing downstream riverbed fall to develop efficient repair methods for barrages. Results show that destruction mechanisms are classified into two types; scouring type and slope type. In the scouring type, destruction progresses rapidly during a large flood. In the slope type, destruction progresses slowly during small floods with piping.

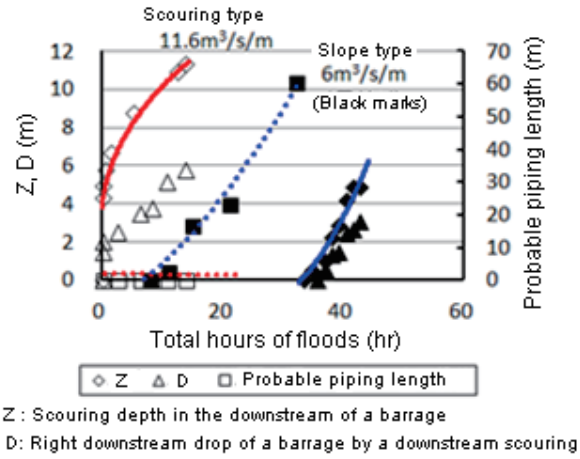
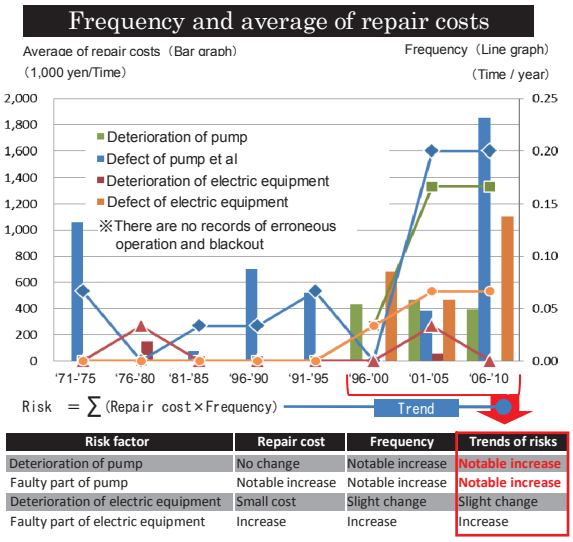


Fig. Example of damage by riprap destruction.

9. Reduction of risks based on maintenance repair records for irrigation and drainage pump stations

[Keywords]
Irrigation and drainage pump station, Maintenance repair records, Risk, Fault tree

[Abstract]
The purpose of this study was to analyze factors for failures of irrigation drainage pump stations and to improve the efficiency of maintenance management. Analytical data were based on the maintenance repair records kept by the managers of the pump stations. A shutdown failure of a pump is recognized as a risk, and the frequency of failures was determined based on a fault tree.



Risk factor	Repair cost	Frequency	Trends of risks
Deterioration of pump	No change	Notable increase	Notable increase
Faulty part of pump	Notable increase	Notable increase	Notable increase
Deterioration of electric equipment	Small cost	Slight change	Slight change
Faulty part of electric equipment	Increase	Increase	Increase

Fig. Analysis of risk factors.

10. Method to support planning and design of regulating ponds that allows resilience in irrigation water distributions

[Keywords]
Regulating pond, facilities planning, water distribution system, demand-driven, supply-demand balance

[Abstract]
In the planning and updating of irrigation canals, water distribution systems are required to determine how to ensure economic and efficient water use. By using numerical hydraulic analysis and optimization techniques, this technique can support the planning and design of pump characteristics, operating time, position and capacity of regulating ponds in response to demand changes in the end irrigation facilities.

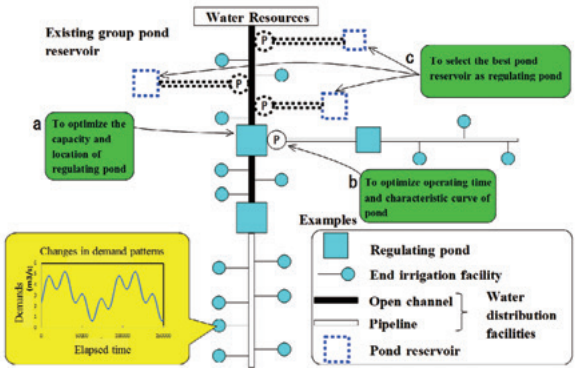


Fig. Conceptual diagram of the output of this method used to update or plan regulating ponds.

11. Pipe-Framed Greenhouses destroyed by Tornadoes on May 6th, 2012

[Keywords]
pipe-framed greenhouse, tornado, direction of wind, wind velocity, wind pressure

[Abstract]
We surveyed damaged pipe-framed greenhouses (pipe houses here after) along the tracks of two tornadoes, and determined the relationship between the failure of pipe houses and wind direction. Pipe houses were destroyed by wind in a horizontal direction around the circumference, rather than by upward flow near the center of the tornado. There was not enough time for the covering film to fail, because the wind velocity increased within an exceedingly short period.

[Reference]
Moriyama *et al.* (2012), J. SASJ, 43(4) : 152-159.

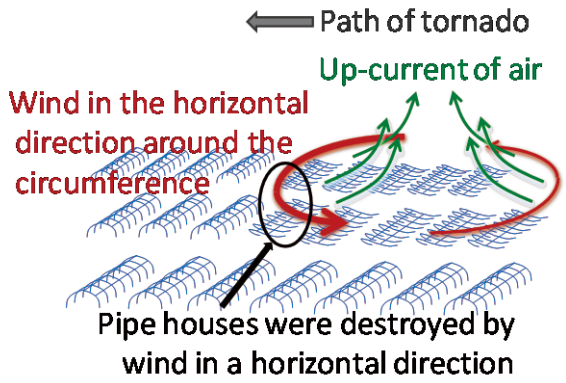


Fig. Relationship between the failure of pipe houses and wind direction.

12. Capacities of heat pump heating systems for greenhouses in Japan

[Keywords]
heat pump, water source, air source, greenhouses, heat demands, heat storage water tank, heat exchanger

[Abstract]
Greenhouse heating systems with three types of heat pumps: air source-air supply, water source-air supply and water source-water supply, were evaluated by hourly calculations based on a simple heat balance model. Cases were considered for the current 4 most typical greenhouses at 4 locations in Japan and for three common night heating set points. Based on the results, the water source heat pump reduced the heat pump size by 30% compared to the air source heat pump. The W-W heat pump reduced the required heat pump size by 40-50% compared to the air source.

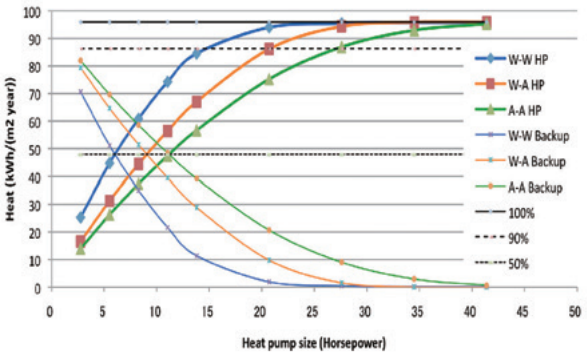


Fig. Annual heat supplied by the heat pumps (HP) and annual heat deficits in a 1200 m^2 greenhouse with a night set air temperature of 15 °C in Tokyo.
(Percentages were 50, 90 and 100% of the total heat requirement. W-W: water source-water supply, W-A: water source-air supply, A-A: air source-air supply) .

13. Remediation of cadmium-contaminated soils by *Arabidopsis halleri* ssp. *gemmifera*

[Keywords]
Cadmium, Phytoremediation, *Arabidopsis halleri* ssp. *gemmifera*, Remediation duration

[Abstract]
Fifty to seventy percent of total cadmium (Cd) was removed with cultivation of *Arabidopsis halleri* ssp. *gemmifera* in Cd-contaminated soils for 4 years. In addition, a calculation method, composed of a balance equation for Cd in the field and a relational expression between soil Cd concentrations and Cd concentrations in the plants (above-ground part) obtained from pots and field experiments, made it possible to predict the time required for *Arabidopsis halleri* ssp. *gemmifera* to remediate Cd-contaminated soils.

[Reference]
Kameyama et al. (2013) Method to predict Soil Cd Concentration Changes by Phytoextraction with *Arabidopsis halleri* ssp. *gemmifera* in a Cd-contaminated Andisol Field, Irrigation, Drainage and Rural Engineering, 282, 79-84.

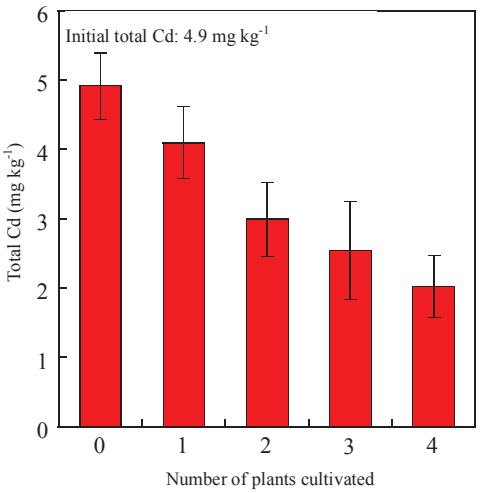


Fig. Total Cd with the number of *Arabidopsis halleri* ssp. *gemmifera* cultivated in a Cd-contaminated Andisol.

14. Evaluating the subsurface drainage properties of upland fields converted from paddies with cylinders

[Keywords]
Cylinder intake rate test, Upland fields converted from paddies, Subsurface drainage properties, Clack

[Abstract]
Single cylinders of 45 cm diameters are driven into the soil until they reach the subsoil. Then, the soil surface confined in the cylinder is flooded for 65 min, and the intake rate after 60 min of flooding (*I*60) measured. Water is then removed from the soil surface, tensiometers are installed at a depth of 10 cm, and the cylinders are covered with a plastic bag. After 24 h, the soil moisture suction of the plowed soil (*S*24) is measured using the tensiometers. The soil hydraulic properties can be evaluated using the *I*60 and *S*24 measured values.

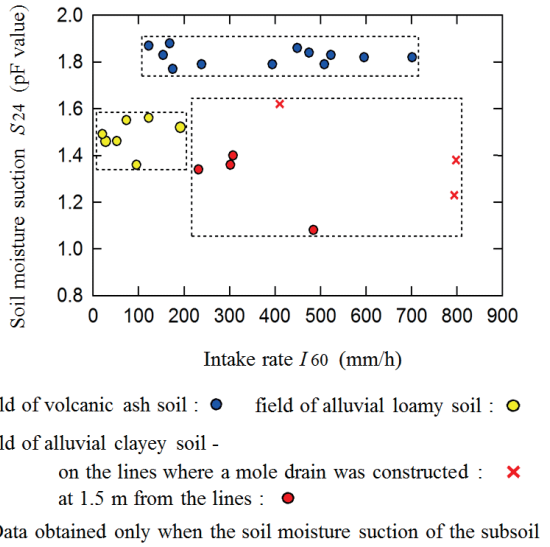


Fig. Combination of the intake rate after 60 min of flooding and the soil moisture suction of the plowed soil after 24 h with the cylinder intake rate test.

15. Effects of a New Groundwater Level Control System the Farm Oriented Enhancing Aquatic System

[Keywords]
Groundwater Level Control System, FOEAS, Questionnaire, Drain Performance

[Abstract]

The functions of the new groundwater level control system FOEAS (Farm Oriented Enhancing Aquatic System) were evaluated according to questionnaires to FOEAS users. The drain performance was improved remarkably, and the kind of crops was diversified in paddy fields equipped with the system.

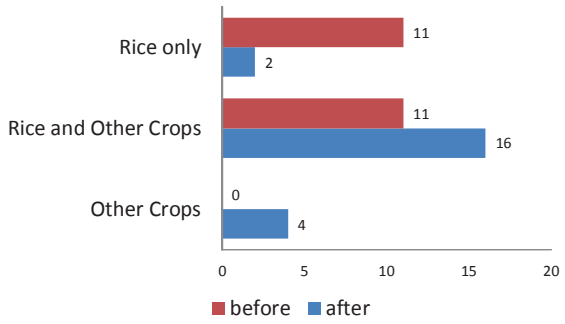


Fig. Changes in Crops of Paddy Fields Caused by FOEAS Equipment.

16. A factor that promotes business diversification in farm management of consolidated farm land

[Keywords]
Developing agriculture into sixth-order industries, Farmland consolidation, Business diversification of farm

[Abstract]

In areas where farmland consolidation has been carried out, efforts to promote business diversification of farm management have developed more than in unconsolidated areas. Improvement in agricultural infrastructure by a farmland consolidation project brings opportunity to improve farm management and will be a factor that promotes business diversification in farm management of Tottori Prefecture.

Efforts to promote business diversification of farm management in Tottori Prefecture (2004-2012)[a]

		Basic Grid Squares		
		Present	Absent	Total
Farm land consolidation (1963-2010)[b]	Executed	145	697	842
		17.2%	82.8%	100%
	Unexecuted	94	1267	1361
		6.9%	93.1%	100%
	Total	239	1964	2203[c]

a. Plans were made by farmers and certificated by Tottori Prefectural Goverment.
b. Executed by Tottori Prefecural Goverment.
c. These basic grid squares contein the agricultural land zone (Agriculture Promotion Area Act) in Tottori Pref.

Table Differences in efforts to promote business diversification of farmland management through farmland consolidation (Basic Grid Square (Third Area Partition)) .

17. Flood simulation model for adapting to coastal farmlands with drainage channels and farming-roads

[Keywords]
storm surges, disaster prevention plans, coastal farmlands, flood simulation model

[Abstract]
This is a model that can faithfully reproduce the flood process in coastal farmlands with a network of drainage channels and farming-roads. The model divides channels from the flood region, and separately simulates flows in the flood region and channels. Simulating flows in channels by a one-dimensional model makes analyses including thin channels easy. Also, simulations are carried out for each block in a flood region that is surrounded by roads or channels. Simulation of each block can express an interruption of floods by roads, etc.

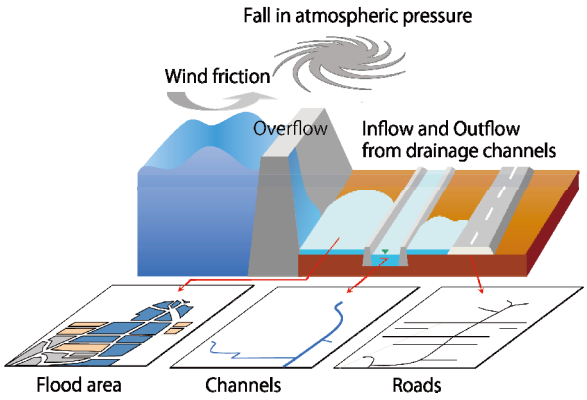


Fig. Concept of the flood simulation model.

18. Digital communication GIS with AR function for sharing disaster information

[Keywords]
Augmented Reality, GIS, Digital Communication, Disaster Information, Mobile Device

[Abstract]
For the purpose of correspondence about a disaster and management of facilities, a GIS that can share the information by digital communications was developed.
Data of a place under investigation is carried to an iPad(Mobile Device) from VIMS, and an increase in the efficiency of work can be attained by performing renewal of the data directly on the iPad in the field.
The characteristic functions include, as shown in Fig. 1, a memo written in the photograph data of a disaster area updated by e-mail. Moreover, as shown in Fig. 2, the camera can be turned in the search direction, and the layer information from the viewpoint position of an actual image and GIS can be overlaid and visualized. Undergrounding facilities and moved facilities can also be investigated. This is called an AR function.

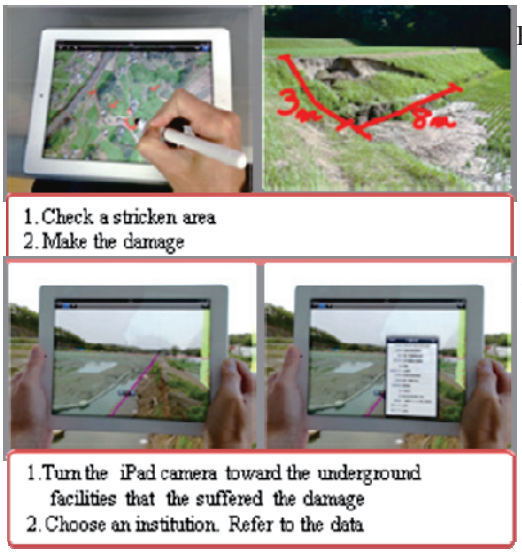


Fig.1
Fig.2

Fig.1 Renewal of data to a map by the memo function
Fig.2 Data reference by AR function.

19. Eneergy dissiparation by an elevation gap between farmland and secondary bank located in hinter farmland

[Keywords]
Tsunami, secondary bank, energy dissipation, land level gap

[Abstract]

To decrease damage by a huge tsunami the size of the tsunami caused by the Great Tohoku Earthquake in 2011, energy dissipation facilities located in hinter farmland was evaluated by a hydraulic model test. The results indicate a 40% decrease in the running speed of a tsunami with construction of an elevation gap between the secondary bank and farmlands.

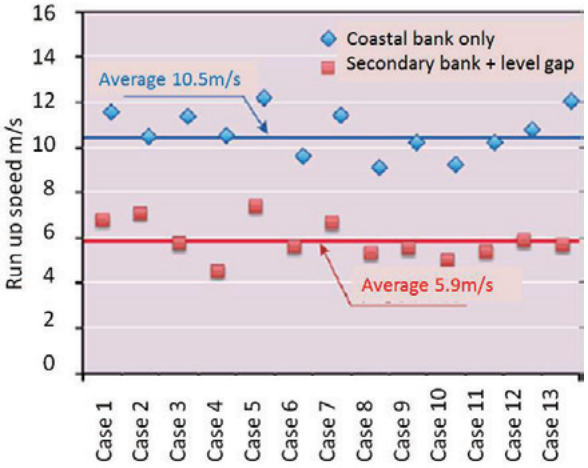


Fig. Comparison of run speeds of tsunamis.

[Reference]
Kiri et al. (2012) Journal of JSCE, B2 (Coastal Engineering), 68(2): I_1311-I_1315

20. Actual conditions and measures against the persistence of salinity damage by the 2011 TOHOKU earthquake and tsunami as related to damages of farmlands and drainage facilities

[Keywords]
Tsunami, Salt damage, Desalinization, Seawater intrusion, Pump station, Block drainage

[Abstract]

We investigated salt damage persistence in the coastal areas of the Miyagi Sendai Plain that were extensively inundated by the March 11, 2011 tsunami.

The salinity concentrations in water of the drainage canals near the sea were high because of sea water intrusion and drainage pump stations near the sea could not be operated.

To prevent saltwater intrusion from the sea, an effective strategy is to force drainage for each possible parcel of farmland even if the drainage function of a wide area is not restored.

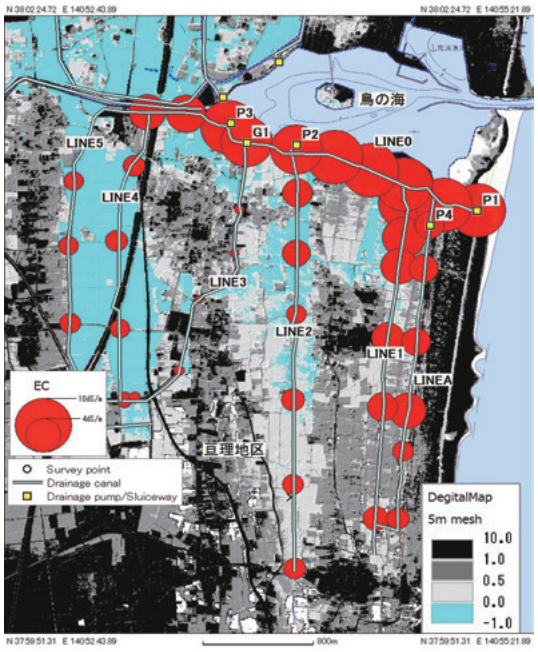


Fig. Distribution of electrical conductivity in drainage canals.

21. Developing residents' awareness of disaster risks based on their everyday knowledge

[Keywords]
Own concern, disaster risk awareness, knowledge based on everyday lives and experiences (frames-of-reference), handmade disaster prevention map

[Abstract]
By creating in four steps a handmade disaster prevention map—in which residents' perspectives of disaster risk awareness based on knowledge rooted in their everyday lives and experiences are used as evaluation standpoints—it is possible to develop disaster risk awareness to enhance the effectiveness of disaster prevention plans that consider residents' "own concern" perspectives.

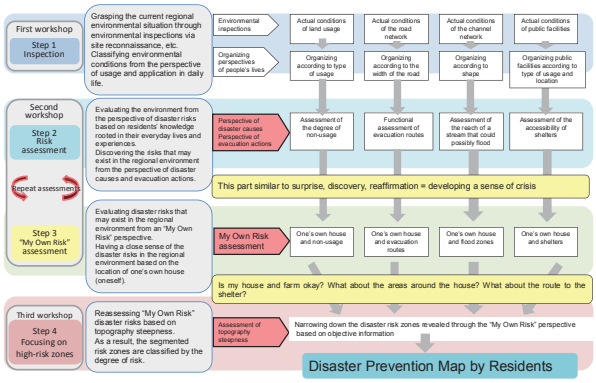


Fig. Model for the creation of handmade disaster prevention map.

22. Risk evaluation system for small embankment dam breaches during heavy rainfall

[Keywords]
Small embankment dam, Heavy rainfall, Breach, Sliding, Overflow failure

[Abstract]
In recent years, increases in the number of heavy rainfall occurrences such as through unpredictable cloudbursts have resulted in the need to improve the safety of the embankments of small earth dams. Use of a risk evaluation system based on a combination of runoff analysis, saturated and unsaturated seepage analysis, and slope stability analysis enables the limit for rainfall intensity and the probability of a dam breach with the risks of heavy rainfall taken into account to be calculated. The system requires data from the properties of the embankment (dam height, slope gradient, water capacity and etc.), properties of the dam material (shear strength and seepage coefficient) and the maximum depth for duration.

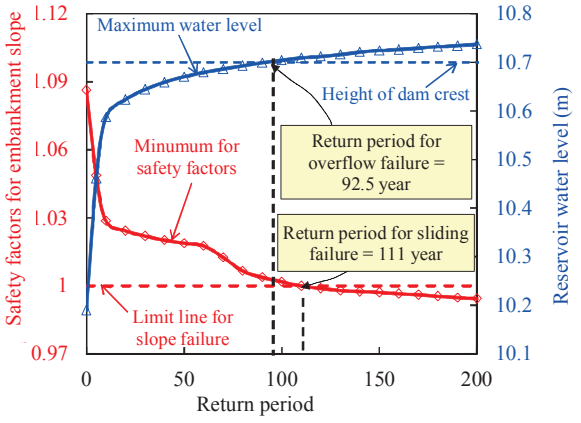


Fig. Risk evaluation of a small embankment dam breach during heavy rainfall.

23. Bend strain estimation method to verify the structural safety of buried pipelines

[Keywords]
Pipeline, Maintenance, Measurement of curvature, Performance verification, Failure strain

[Abstract]
Recently agricultural pipelines used longer than their durable years are increasing. Appropriate evaluations for the structural safety of buried pipelines are required for effective preservation of aging pipelines to prevent failures due to deterioration. However, it is difficult to quantitatively evaluate the structural safety by a conventional method that measures pipe deflections denoting simple cross-sectional deformations. Therefore, a new method that estimates the circumferential bending strains by measuring the curvature of a deformed pipeline was developed. The structural safety of pipelines can be quantitatively evaluated by comparing the estimated strain with the failure strain of pipe material.

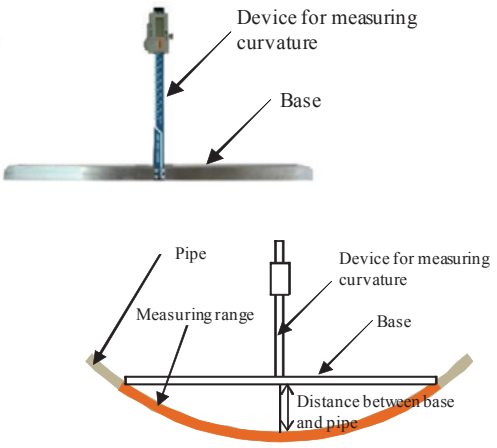


Fig. Method for measurement of the curvature radius of a pipe.

24. Seismic behavior characteristics of raised fill dams

[Keywords]
Raised fill dam, Seismic behavior characteristics, Earthquake resistance performance evaluation

[Abstract]
Raised fill dams have composite sections consisting of the existing dam body and a raised new dam body different in density and stiffness. They show distinctive seismic behaviors, such as changes in response acceleration at the boundary between the two dam bodies or at the transition zone located between the two dam bodies and settlements of the raised new dam body caused by deformations in the existing dam body.

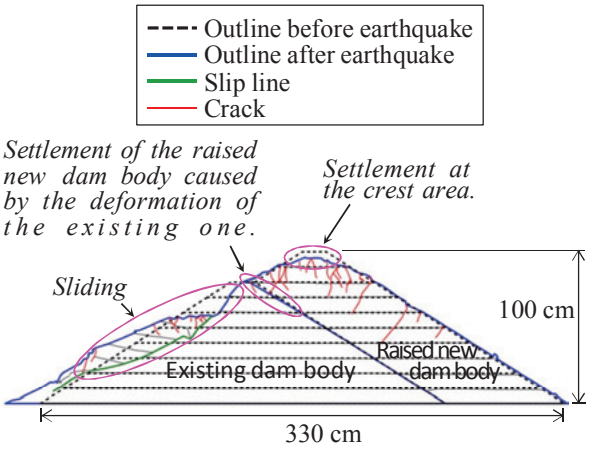


Fig. Vibrational damages in a raised fill dam model by a shaking table test.

25. Seismic risk assessment methods for irrigation and drainage facilities

[Keywords]
Irrigation and drainage facilities, seismic risk, earthquake losses, priority measures

[Abstract]
Seismic risk assessment is a method for calculating the loss of irrigation and drainage facilities caused by an earthquake. Through monetary value the risk is presented in an easy-to-understand way based on the magnitude of the earthquake risk to the facilities of the local residents. In addition, it is possible to do decision-making for mitigation measures, such as carrying out seismic measures on a priority basis from the largest facility at risk.

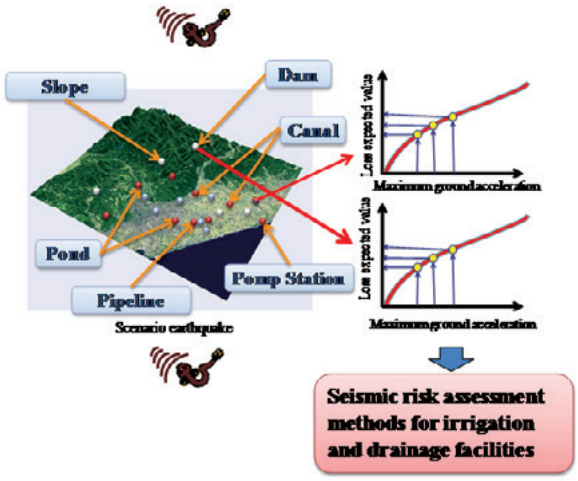


Fig. Seismic risk assessment methods for irrigation and drainage facilities.

26. Scheme for coupling inundation processes into a basin-wide water circulation model for low-lying rivers

[Keywords]
Low-lying paddies, Inundation, Distributed water circulation model, Remote sensing, Topographic data

[Abstract]
We describe the development of an inundation process model integrated with a basin-scale distributed water circulation model. By incorporating the inundation process, the performance of the model was improved in terms of peak discharges and their timing of occurrence. In addition, we rigorously validated the model by comparing the calculated inundation areas with those extracted from the ALOS/PALSAR images. The comparison revealed that the large-scale inundation processes in the lower reaches of the basin were precisely represented by the model, but also revealed that additional analyses are required to improve the accuracy in the middle reaches and branches.

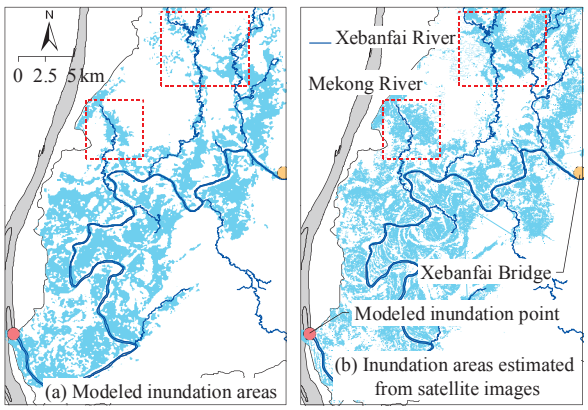


Fig. Comparison of (a) calculated and (b) satellite-based inundation areas on 12 Aug. 2008.

27. Method to assess the invasion of agricultural ditches by the loach Kara-dojo

[Keywords]
Multivariate analysis, Agricultural irrigation facility, Biodiversity

[Abstract]
Method to assess the invasion of agricultural ditches by the loach Kara-dojo, *Paramisgurnus dabryanus* was developed based on the ratio of individuals of the Kara-dojo compared with the domestic loach Dojo, *Misgurnus anguillicaudatus*. The simple discriminant function between both loaches allowed for correct identification 95.4% of the time, even though the two species have similar body shapes. An illustrated pamphlet was created so even beginners can easily use this method.

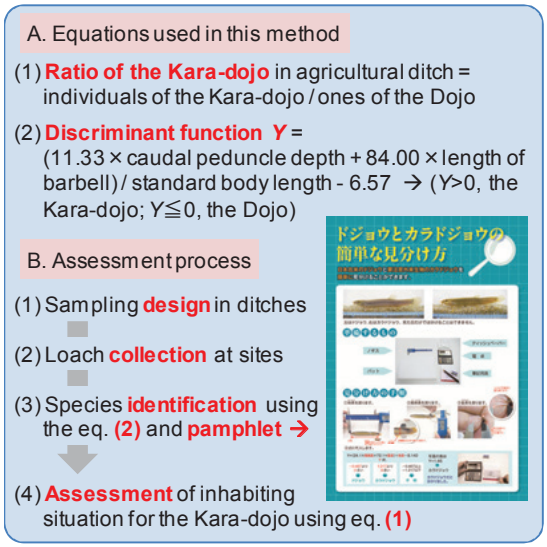


Fig. Method for assessment of invasion by the Kara-dojo.

28. Simulation model for estimating reproductive processes of the field gudgeon, *Gnathopogon elongatus elongatus*, populations in a re-networking fragmented

[Keywords]
Fish population, Population dynamics, Field gudgeon, Simulation, Agricultural canals

[Abstract]
The model estimates reproductive processes of the fish populations in a re-networking of fragmented habitats. A canal system as fish habitats is depicted on the computer by using numerous meshes. Difficulty levels of movement over each boundary between adjacent meshes are given by attribute values for each mesh. Hence, these values can be used to depict breakpoints that fragment a habitat or the degree of re-networking with construction of a fish-way. Utilization of the model based on various scenarios can be contributed to quantitatively compare with each scenario.

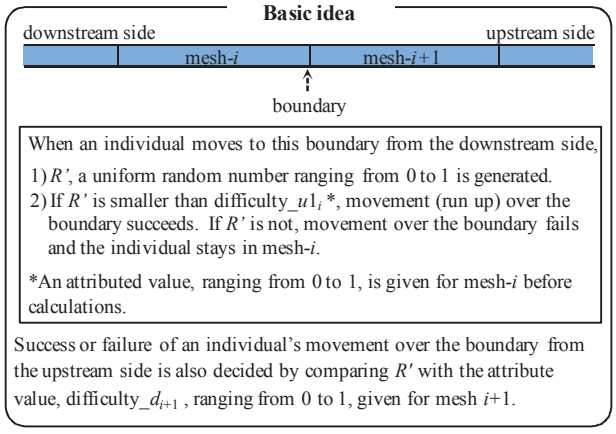


Fig. How to determine whether an individual's movement over a boundary between meshes does succeed or not.

[Reference]
Takemura et al. (2012): Simulation model for estimating reproductive processes of fish populations in networked habitats, E-book,
ISBN: 978-3-200-02862-3

29. Development of an effective, simple and inexpensive structure to help frogs escape from agricultural canals

[Keywords]

eco-friendly, agricultural infrastructure improvement and rural development, frogs

[Abstract]

We developed a revolutionary structure to help frogs that have fallen into agricultural canals to escape. The structure is shaped like a wall bar that is used for human training, consisting of tight strings and a weir. The structure provides frogs the ability to effectively get out of canals and is easy and inexpensive to attach to exiting canals.

[Reference]

Development of Wall Bars with Weir Type Escape Equipment for Preservation of Frogs, Water, Land and Environmental Engineering, 80(10), 823-526

Fig. Structure to give frogs the ability to escape from an agricultural canal.

30. Changes in the fractional zinc concentrations of ponded water in a paddy field

[Keywords]

Circular reuse of farmland drainage, Heavy metals, Fractionation method, Environmental standard

[Abstract]

For the purpose of environmental conservation in circular reuse systems of farmland drainage, zinc is classified as a heavy metal and plays an important role. Zinc mainly exists as a suspended particle in ponded water of a paddy field. Zinc concentrations in the ponded water during the early stages of an irrigation period rise remarkably in a short time through puddling and transplanting. In other periods, the concentrations are lower than the environmental standard (0.03 mg/L) in contrast.

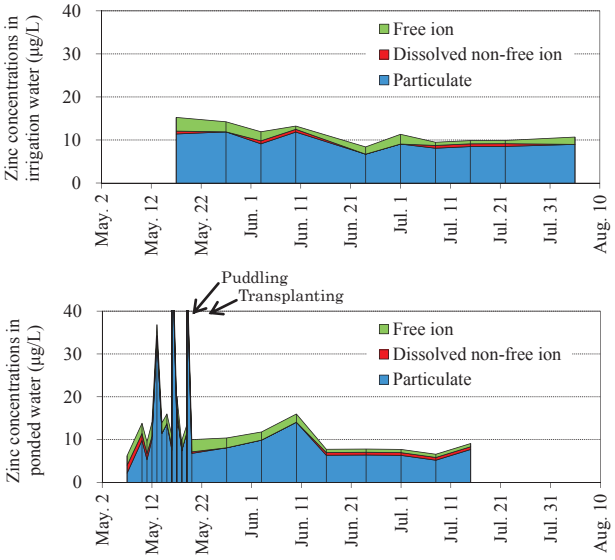


Fig. Changes in concentrations of zinc fractionations in irrigation and ponded water.

31. Method for selecting factors to promote non-farmers participation in activities to maintain irrigation/drainage canals

[Keywords]
Irrigation/Drainage canal, Maintenance, Non-farmer, Participation in maintenance activity, Selecting factors

[Abstract]
A method for selecting factors to promote non-farmers participation in activities to maintain irrigation/drainage canals was developed. In this method, the data of questionnaires given to non-farmers must be entered into the model to determine the relationships between participation in maintenance activities and influencing factors. The model was composed of a Structure Equation Model with Latent Variables. Using this method, appropriate factors can be selected to increase the level of non-farmer participation in activities to maintain irrigation/drainage canals by external approaches.

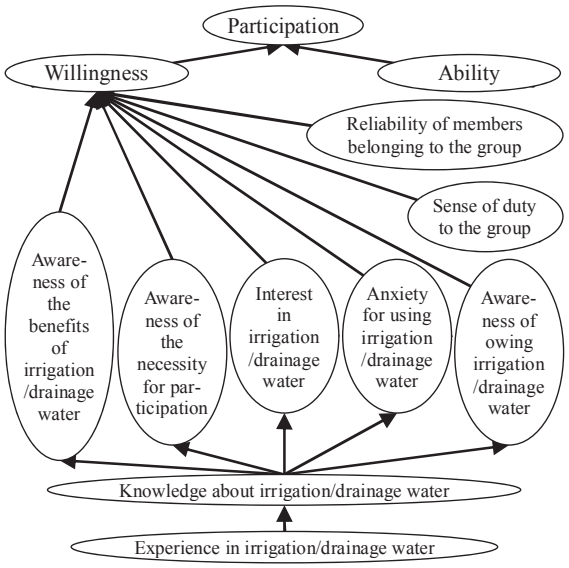


Fig. Model of the relationships between participation in maintenance activities and influencing factors.

32. Characteristics of abandoned irrigation reservoirs in depopulated aging regions

[Keywords]
Map information, Regional resource, Questionnaire for reservoirs user, Abandoned farmland, Small reservoirs less than 100 m^2

[Abstract]
Agricultural ponds that have been developed for irrigation use are important as regional resources even if their frequency of use is reduced.
Therefore, to understand a reservoir as a regional resource in depopulated aging regions in particular, detailed actual usage and distribution data need to be clarified. We extracted all reservoir information distributed in Ishikawa Prefecture Suzu City from scale maps and estimated reservoir sizes by GIS. In addition, from a survey of reservoir users, we determined the irrigational usage for agricultural settlement units, and analyzed the characteristics of abandoned reservoirs.

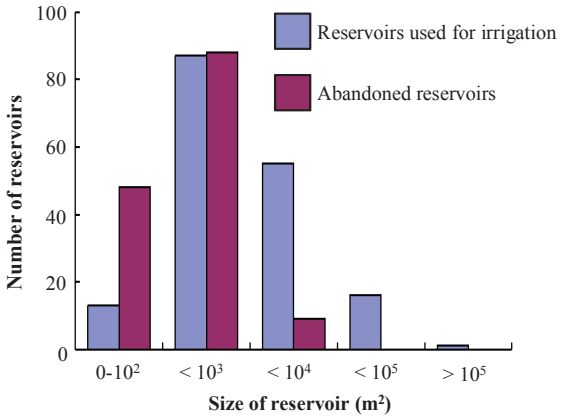


Fig. Distribution of abandoned reservoirs and irrigation use reservoirs.

33. Method to distinguish land cover of paddy fields from high resolution satellite data

[Keywords]
Remote sensing, High resolution satellite, Land cover, Image classification, Visual interpretation

[Abstract]
The proposed method is a method to distinguish the land cover (rice plants, weeds, etc.) of paddy fields by a combination of image classifications and visual interpretations with high resolution satellite data and parcel boundary data for paddy fields. The land cover of paddy fields can be distinguished with high accuracy even when distinction is difficult by only visual interpretation of the satellite image.

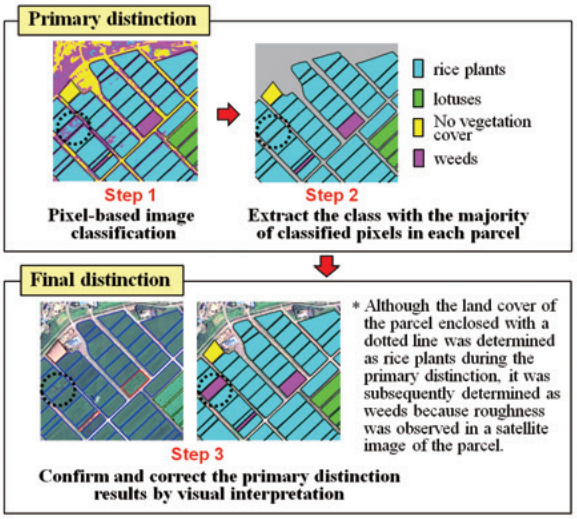


Fig. Procedure for distinction of the land cover of paddy fields.

34. Evaluation of Technologies for Sequestering Carbon in Agricultural Land by Using Organic Filter Underdrains

[Keywords]
Organic filter underdrains, Subsoil, Carbon sequestration, Wood chip, Rice husk

[Abstract]
Technology for storing carbon in the subsoil of agricultural lands by using organic filter materials in underdrains was evaluated as an activity for sequestering CO_2. First, the quantity of carbon remaining in wood chips in underdrains was determined for 15 years after construction. Moreover, the quantity of CO_2 emissions from the construction of the underdrain was calculated. Then, a survey was conducted to investigate the effect on greenhouse gas emissions of the filter material. The quantity of carbon stored in the wood chip filter material of underdrains during the 15 year service life was estimated to be 0.45 $tCO_2eq\ ha^{-1}\ y^{-1}$.

[Reference]
Iwao Kitagawa (2011), MARCO Workshop on Technology Development for Mitigating GHG Emissions from Agriculture, http://www.niaes.affrc.go.jp/marco/2011workshop/.

Item	Wood chip underdrain	Rice husk underdrain	Difference in quantity of carbon storage due to change in filter material
a. Quantity of residual carbon 15 years after burying filter material ($tCO_{2eq}\ ha^{-1}$)	11.41	0.59	–
b. Quantity of CO_2 emissions due to basic construction (for one-time construction, $tCO_{2eq}\ ha^{-1}$)	4.65	4.36	–
c. Quantity of greenhouse gas emissions increased due to installation of filter material underdrains ($tCO_{2eq}\ ha^{-1}$)	0	0	–
a-b-c. Carbon sequestered in to organic filter material ($tCO_{2eq}\ ha^{-1}\ 15\ y^{-1}$)	6.76	-3.77	10.53
Carbon sequestered per year ($tCO_{2eq}\ ha^{-1}\ y^{-1}$)	0.45	-0.25	0.7

Table Evaluation of carbon sequestration in organic filter underdrains.

35. Characteristics of digested slurry from methane fermentation as a liquid fertilizer and environmental impacts when used in upland fields

[Keywords]
Ammonia volatilization, Design for fertilizer application, Groundwater pollution, Nitrogen cycle, Andosol

[Abstract]
Characteristics of digested slurry from methane fermentation as a liquid fertilizer when used in upland field are shown. The results indicate that ammonia volatilization is a key factor for fertilizer design because more ammonia is emitted from soil treated with digested slurry than soil treated with chemical fertilizers. Nitrogen derived from digested slurry can be effectively utilized and increase in negative environmental impacts prevented when appropriate fertilizer design is conducted considering the amount of emitted ammonia (Fig. 1).

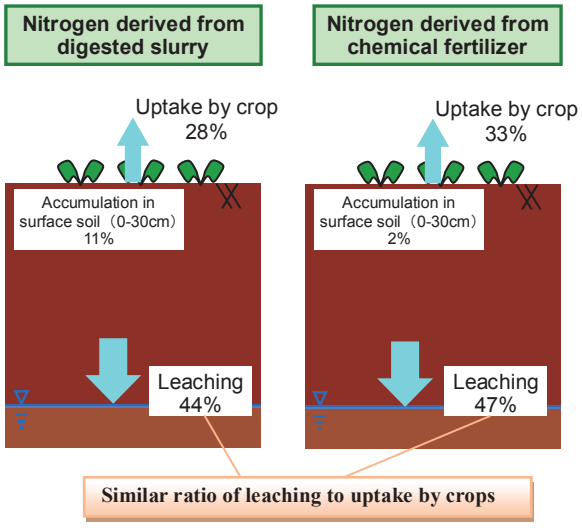


Fig. 1 Fate of nitrogen derived from digested slurry or ammonium sulfate in Andosol upland field after four years continuous cultivation.

36. Technique for estimation of economic ripple effects and green house gas emissions for life cycle assessment (LCA) of bio-ethanol production technologies

[Keywords]
Input-Output analysis, greenhouse gas (GHG) emission, life cycle assessment (LCA), bio-ethanol production

[Abstract]

This technique was developed to estimate the economic ripple effects and amount of GHG emissions from bio-ethanol production plants during the construction period of production facilities, operation period and scrapping stage by using an input-output model.

This method can be used for life cycle assessment of bio-ethanol production plants.

The input-output model was built from the GTAP (global trade analysis project) database in 129 countries, so this technique can be used for LCA of the bio-ethanol production in many countries in the world.

項目	投入 ①	生産誘発額		付加価値誘発額	
		ライフサイクル全体 ②	誘発係数 ②/①	ライフサイクル全体 ③	誘発係数 ③/①
現状技術	21,933	11,674	0.53	−288	−0.01
先進技術	10,219	8,581	0.84	4,651	0.46
革新的技術	6,581	7,836	1.19	6,429	0.98

項目	バイオエタノール生産技術のGHG排出量				代替可能ガソリン消費 ②	LCA ①−②	GHG排出係数 ①/投入 (kg/$)
	生産施設建設段階	製造段階	プラント廃棄段階	ライフサイクル全体 ①			
現状技術	4.4	32.0	0.6	37.0	27.1	9.9	1.69
先進技術	2.1	21.8	0.3	24.2	27.1	−2.9	2.37
革新的技術	1.4	15.0	0.2	16.6	27.1	−10.5	2.52

Fig. Outline of this technique

Table Example of application of bio-ethanol production from rice straw in Vietnam. .

[Reference]
Kunimitsu Y et al. (2013) PWE、11：411-421
Kunimitsu Y et al. (2012) Studies in Regional Science, 42(3)：56-70

37. Water delivery performance and usage of a new powerless pump attached to existing direct outlets

[Keywords]
Small hydraulic power, Coaxial mechanical pump, Powerless, Direct outlet

[Abstract]
Powerless pumps are disadvantageous for pumping under conditions of large discharge and high pump head. However, powerless pumps have features, such as a simple pumping principle and fossil fuels are unnecessary. In this study, we showed that a newly developed powerless pump (coaxial mechanical pump) can pump a discharge of 100-350 L/min to a height of approximately 1.0 m under conditions of 1) a direct outlet with a diameter of approximately 200 mm and 2) a water level difference inside and outside a canal of approximately 0.5-0.9 m.

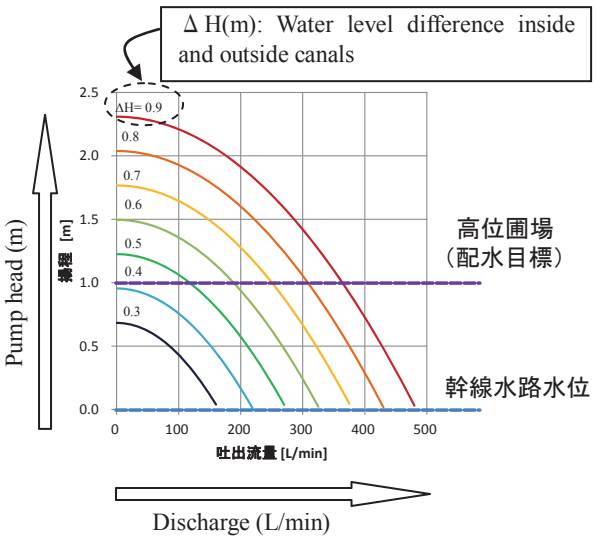


Fig. Performance curve of the newly developed powerless pump (coaxial mechanical pump) .

38. Open type cross flow turbine for micro-scale hydropower generation in a mild slope open channel

[Keywords]
micro-scale hydropower generation, turbine, open channel, mild slope, back water

[Abstract]
Open type cross flow turbines can carry out micro-scale hydropower generation with high efficiency. Backwater occurs upstream of the turbine without spilling from a channel, because the turbine has a water level adjustment cover and the open angle can be controlled. The runner of a turbine is devised so supercritical flow may occur downstream of the turbine. As a result, the water level differences between the upstream side of the turbine and downstream side are raised in comparison to conditions in which a turbine does not exist.

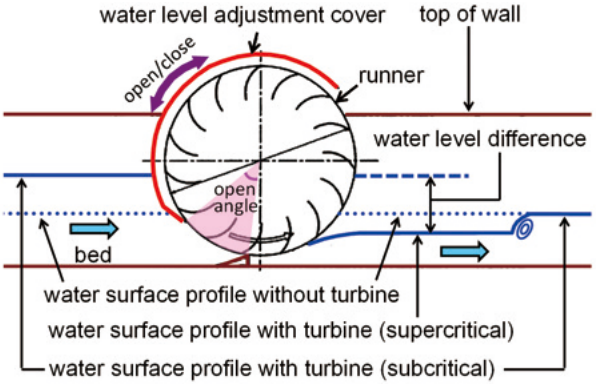


Fig. Conceptual diagram of open type cross flow turbine.

39. Economic costs and greenhouse gas emissions from individually-operated micro hydropower generation

[Keywords]
Small hydropower, Renewable energy, Economic evaluation, Life cycle assessment

[Abstract]
Economic costs and greenhouse gas (GHG) emissions were evaluated for individually-operated micro hydropower generation using an open crossflow (CF) waterwheel developed by NIRE. The cost analyses revealed that a CF waterwheel is cheaper than an engine (gasoline powered) dynamo but more costly than grid power in supplying electricity. The life cycle assessment suggested that a CF waterwheel is superior to both these substitutes in terms of GHG emission reduction potentials. We therefore conclude that a CF waterwheel is particularly suitable for use in remote locations beyond the reach of the grid power.

[Reference]
Ueda, T., et al. (2013): Perspectives of Small-scale Hydropower Generation Using Irrigation Water in Japan. Japan Agricultural Research Quarterly, 47(2), 1-6

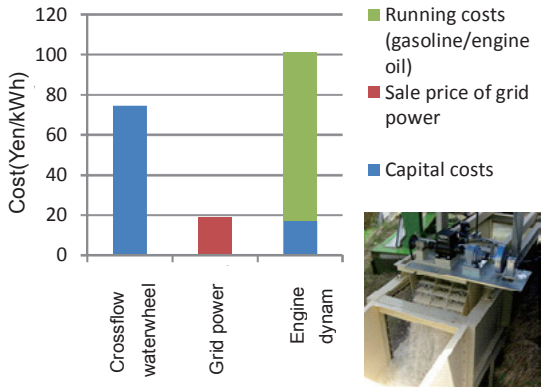


Fig. Unit costs for electricity (picture: experimental apparatus for a crossflow waterwheel).

40. Radioactive cesium reduction system for plowed paddy field using the soil stir method

[Keywords]
Paddy field soil contaminated with radioactive substance, Radioactive cesium, Plowed paddy field, Decontamination, Puddling

[Abstract]
The system sucks muddy water with a vacuum attached to the puddling rotary in a puddled paddy field, and removes fine grained soil that combines with radioactive cesium. This system enables decontamination of plowed paddy fields.

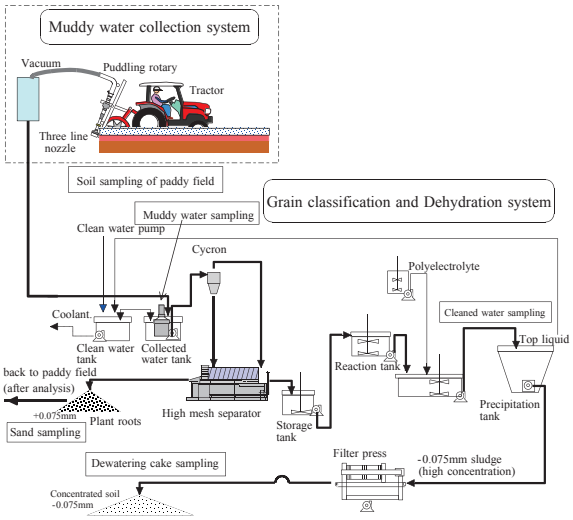


Fig. Outline of the radioactive cesium reduction system.

41. Removal of radioactive Cs from irrigation water at the inlet of a paddy field using chaff or other materials

[Keywords]
radioactive Cs, decontamination, irrigation water, rice husk, zeolite, Prussian blue coated nonwoven textile, Fukushima Daiichi Nuclear Power Plant

[Abstract]
Contamination of irrigation water by radioactive substances including Cs-134 and Cs-137 became an agricultural concern after the Fukushima Daiichi Nuclear Power Plant accident on March 11, 2011. Results of experiments to remove radioactive substances from irrigation water were as follows. High absorption ratios of dissolved Cs were obtained using zeolite and Prussian blue coated nonwoven textile, and the absorption function was also confirmed for rice husk and carbonized rice husk in a simple batch test. The removal of radioactive Cs was most effective in the order of zeolite, rice husk, and carbonized rice husk in the field tests.

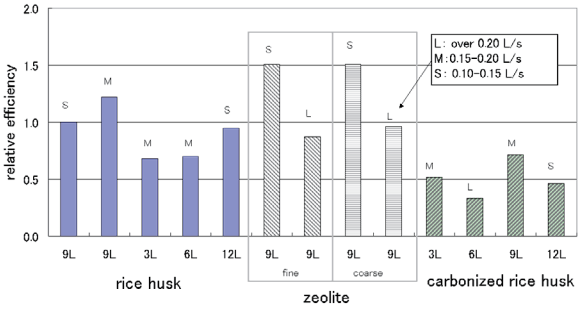


Fig. Comparison of efficiencies of adsorption and filtration for removal of radioactive materials. Clicking will enlarge the photograph.

Edited and Published

National Institute for Rural Engineering (NIRE)

2-1-6, Kannondai, Tsukuba City, Ibaraki Prefecture 305-8609 JAPAN

Please contact us directly by e-mail with the contact information below.

Information and Public Relations Section

National Institute for Rural Engineering (NIRE)

e-mail: nkk-web@ml.affrc.go.jp