

Research Topics 2013



January 2015



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 2013. We greatly hope this pamphlet will be used by engineers of rural engineering.

Takeshi Koizumi

Director General

National Institute for Rural Engineering

January 2015

Research Topics 2013

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1. Estimation of evaporation loss and groundwater discharge ratios in closed lakes using environmental isotopes

[Keywords]

Environmental isotope, lake, evaporation, groundwater discharge, groundwater inflow

[Abstract]

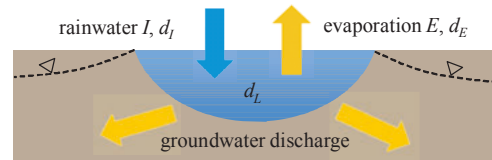
An environmental isotope-based method for estimating evaporation loss and groundwater discharge ratios in closed lakes without groundwater inflow was developed. Groundwater inflow into a lake is detected using the radioisotope radon, and the ratios of evaporation loss and groundwater discharge from the lake to rainwater input are estimated by water balance and mass balance equations of isotopic composition of oxygen and deuterium. Continuous monitoring of these isotopes can be used for estimating fluctuations in evaporation losses and groundwater discharges of different closed lakes, and for assessing environmental impacts of anthropogenic changes such as infrastructural development of farmlands adjacent to lakes.

[Reference]

Tsuchihara, T. et al. (2011) *TRANSACTIONS of the JSIDRE*, 79(5), 339-348 (in Japanese with English abstract)

1) Investigation of presence of groundwater inflow into a lake using the radioisotope radon

Closed lake without groundwater inflow



2) Estimation of evaporation loss and groundwater discharge ratios to rainwater input using stable isotope compositions of hydrogen and oxygen

$$\text{Evaporation loss ratio } r = \frac{E}{I} = \frac{(\delta_I - \delta_L)}{(\delta_E - \delta_L)}$$

$$\text{Groundwater discharge ratio } 1 - r$$

[I : inflow into lake, E : evaporation, d : stable isotopic compositions of hydrogen and oxygen. Stable isotopic compositions of discharge from lake is equivalent to d_L .]

Fig. Estimation procedures for evaporation loss and groundwater discharge ratios to inflow into a lake.

2. Salt concentration monitoring of irrigation water to avoid in the ground subsidence area by earthquake

[Keywords]

earthquake, ground subsidence, irrigation water, salt concentration monitoring, electric conductivity, rice

[Abstract]

In a disaster-struck area, salt concentration monitoring should be continued more than 1 year during the recovery process. Real-time monitoring by an EC data-mail sending system is useful for irrigation management in areas where the EC of water is not certain after the resumption of farming.

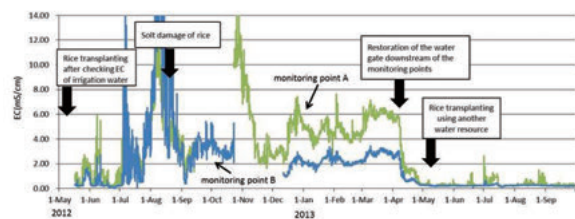


Fig. Trends in EC from May.2012-Sep.2013.

3. A portable device measures the degree of deterioration in lubricants of pump facilities

[Keywords]

lubricating oil, grease, deterioration, portable measuring device, pump facilities

[Abstract]

Lubricating oil and grease are used in the rotary machinery of pump facilities for irrigation and drainage. The deterioration of lubricants (e.g., oxidation and ascent of water into the lubricants) reduces the performance of pumps. A portable device can easily measure the degree of deterioration in the lubricant by taking samples of oil from machines and applying them to the detector of the device. Because the device is small and light, it is easy to handle and easy to utilize without technical knowledge. The portable device can be used for machinery of many types including agricultural pump facilities.



Fig. 1. A prototype of the portable measuring device.

4. Diagnostic method for delamination generated in the surface coating of agricultural canals using infrared thermography

[Keywords]

Infrared thermography, Cementitious surface coating method, Agricultural canals, Diagnostic method for delamination

[Abstract]

Figure shows a diagnostic method of infrared thermography to detect areas of delamination in the surface of agricultural canals repaired by the cementitious coating method. During the daytime, the temperature of the canal surface increases due to solar radiation, the temperature of the delamination area is higher than the peripheral portion. On the other hand, the temperature of the canal surface drops from sunset and later, so the temperature of the delamination area is lower than the peripheral portion. By using infrared thermography to determine the peripheral temperatures of the different parts, the position of the delamination can be specified.

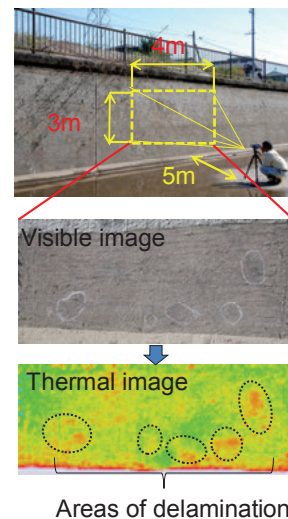


Fig. Overview of measurements and results.

5. Factors Limiting the long term measuring performance of buried transducers for underground communication technology and a control method

[Keywords]

monitoring, fill dam, wireless pore water transducer, long term measurement, underground communication technology

[Abstract]

We developed a wireless pore water transducer to apply to underground communication technology and measure pore water pressure for a long time in an actual dam. The inner resistance of the battery increased with elapsed time and caused a decrease in the voltage. If voltage decreases, transducers cannot perform properly. Then we set the batteries in parallel to moderate the effect of a decrease in voltage. Improved transducers can reduce the increase in inner resistance values during the elapsed time when compared with test models.

[Reference]

Y. Hayashida et al. : MEASUREMENT OF PORE WATER PRESSURES IN ROCKFILL DAMS BY WIRELESS TRANSDUCERS, ICOLD 2013 International Symposium, 2389-2398 ,2013

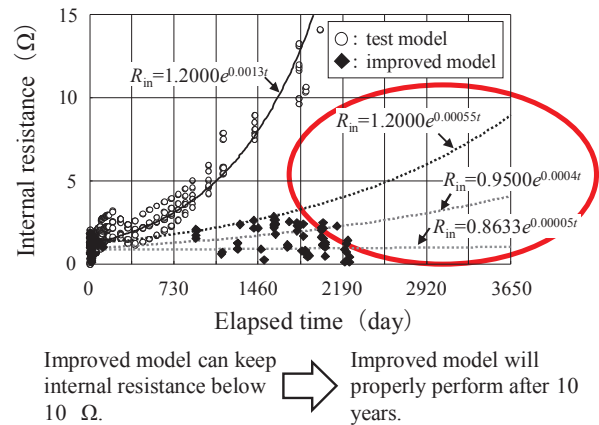


Fig. Comparison of internal resistance between the test model and improved model.

6. Erosion monitoring system with laser displacement meter for agricultural canals repaired by the cementitious surface coating method

[Keywords]

Cementitious surface coating method, agricultural canals, Erosion monitoring system, laser displacement meter

[Abstract]

Figure shows an erosion monitoring system with a laser displacement meter for agricultural canals repaired by the cementitious surface coating method. The average depth of the surface coating of the canals can be measured simply and quantitatively. The measurement accuracy is approximately measurement value ± 0.1 mm.

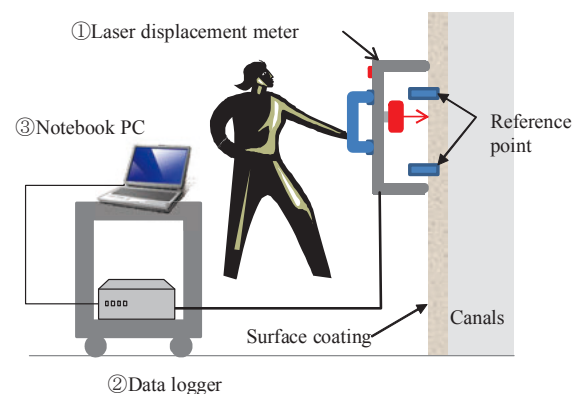


Fig. Outline of an erosion monitoring system.

7. Maintenance easy hydraulic performance verification software to ensure the safety of pipeline facilities

[Keywords]

irrigational pipeline, safety of hydraulics, water hammer pressure, object-oriented program

[Abstract]

A performance verification technique for hydraulic functions is an important technique to effectively utilize and extend the life of existing pipeline facilities.

Computational analysis software for a water hammer is a safe verification technique for hydraulic functions in pipeline facilities. The software is expected to provide a verified code for many engineers and can be maintained for long periods.

Therefore, we developed software with the "code maintenance management technique" and "data management technique" to support engineers, so they can easily reuse used analysis data to improve a design plan for pipeline facilities.

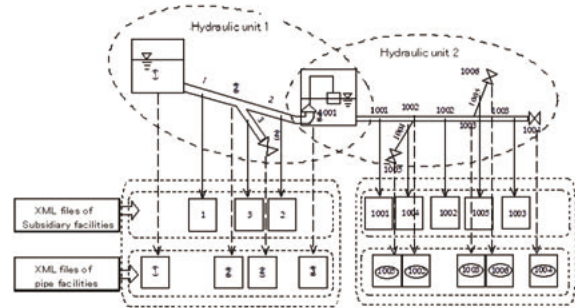


Fig. Example of the reuse of used data for hydraulic units to evaluate the hydraulic performance.

[Reference]

Yoshikazu TANAKA(2013):Transactions of JSIDRE,284,1-11

8. Procedures for upgrading a canal system based on networking methods

[Keywords]

Updating of irrigation canal system, canal network, plural-tracking, bypassing

[Abstract]

In this study, we propose a method for upgrading irrigation canal systems that have problems with equality of water delivery. The ability of irrigation canal systems can be evaluated by hydraulic characteristics of flow sections and reaches. Table 1 shows methods for upgrading existing irrigation canal sections by divisional and additional processing. Plural-tracking or bypassing methods are effective especially for existing canal systems suffering from delivery problems. Engineers concerned with hydraulic diagnostics of existing canal systems can create regional agreement and propose a plan for upgrading by this procedure.

Combinations of flow Processing of section	Open channel flows	Open channel flow and pipe flow	Pipe flows
	Division of an existing section (Plural tracking)	① 	②
Addition to an existing section (Bypassing)	④ 	⑤ 	⑥

Table 1. Classification of methods for upgrading existing irrigation canal sections by divisional and additional processing.

9. Effects of natural ventilation rate on temperature and relative humidity in a naturally ventilated greenhouse with a high pressure fogging system

[Keywords]

Greenhouse, Natural ventilation, Fog cooling, Temperature and relative humidity

[Abstract]

Effects of a high pressure fogging system on the inside dry-bulb temperature, relative humidity and ventilation rate as functions of vent configuration in a naturally ventilated greenhouse were studied experimentally during the summer. The inside dry-bulb temperatures decreased with increasing ventilation rate. During the experiment, the differences between inside and outside dry-bulb temperatures, inside relative humidity and ventilation rates were 2.9°C, 55.2% and 3.6 m³ m⁻² min⁻¹ in natural ventilation (NV), and -2.9°C, 88.2% and 2.3 m³ m⁻² min⁻¹ in fogging combined with natural ventilation (FNV). The high pressure fogging system is the most effective cooling methods in naturally ventilated greenhouses during the summer in Japan.

[Reference]

M. Ishii et al. 2014. Effects of natural ventilation rate on temperature and relative humidity in a naturally ventilated greenhouse with high pressure fogging system. *Acta Hortic.* 1037:1127-1132.

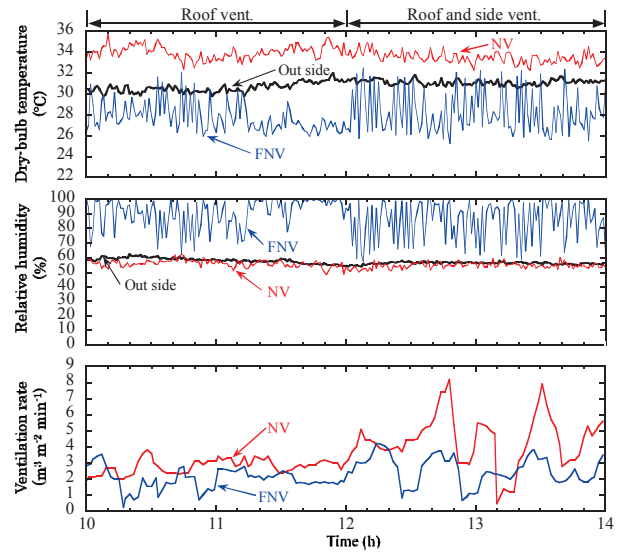


Fig. 1 Diurnal variations in NV, FNV and outside dry-bulb temperature, relative humidity, and ventilation rates of an experimental greenhouse on a clear day.

10. Effect of supplemental LED lighting at night on the fresh weight of lettuce or shungiku

[Keywords]

LED, Supplemental lighting, lettuce, shungiku, chlorogenic acid

[Abstract]

Fresh weight increases in leaf vegetables were significant under red LED lights. Influence on morphology and spindly growth revealed lower growth-promoting effects of red LED lighting. Both lettuce and shungiku showed higher yields with red LED supplemental lighting during the nighttime. Lettuce yield with red LED (300 μmol m⁻² s⁻¹) from 17:00 to 7:00 increased 30-50% in May-June, July-August and September, and three to four times in October-November and December. In the case of shungiku, the yields increased four to six times except during the summer season.

[Reference]

Sase S. et al. (2012) *Acta Hortic.* 956: 327-333

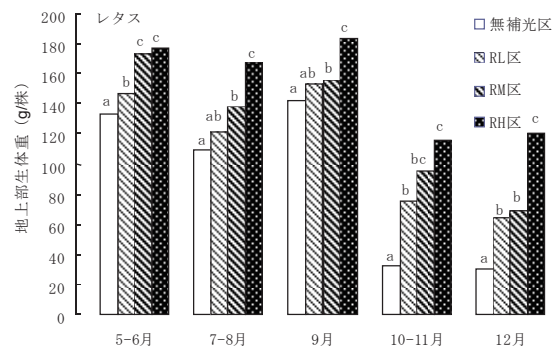


Fig. Fresh weights of lettuce with red LED supplemental lighting (RL, RM, RH: 50, 150, 300 μmol m⁻² s⁻¹) .

11. A new mole drainage implement “Cut-drain” for a farm tractor

[Keywords]

Mole drainage, Non-material, Cut drain, Farmers, Implement for tractor

[Abstract]

We develop a new mole drainage implement “Cut-drain” for a farm tractor. This drainage implement can construct the cavity of the 10-15cm corner square and the deeps of 40-70cm. The construction speed is the same as a sub soil breaker without the use of materials. However, soil conditions must be carefully selected for the type of mole drain. This mole drainage technique works well as an underdrain for the outlet of an open channel or supplementary underdrain.

This drainage improvement for agricultural fields should be examined by considering simple low-cost drainage solutions that have a similar drainage capacity as underdrains

[Reference]

• Kitagawa et al., Japanese patent application 2013-135684.

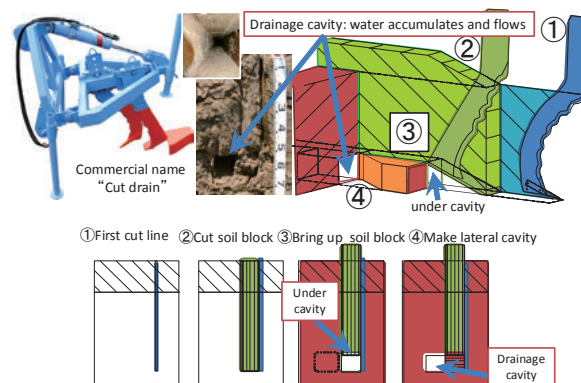


Fig. Outline for excavating a “Cut-drain” type mole drain

12. Water requirements for paddy fields equipped with a groundwater level control system

[Keywords]

A groundwater level control system, Water requirement for paddy fields, Subsurface irrigation, Controlling surface and subsurface water levels

[Abstract]

A groundwater level control system automatically supplies water and drains excess water through underdrains to a preset water level. The manner of water management in this system is different from a traditional system, but water requirements for paddies with the new system are not clear. Thus, a field study was conducted to evaluate the water requirements for rice and soybean cultivation in such paddies for five years. We found that the amount of water for a paddy with the system in rice cultivation was 100-400 mm/season less than compared to a paddy without the system (Table 1). We also found that the amount of water sub-irrigated in soybean cultivation ranged from 110 to 220 mm/season.

	2008	2009	2010	2011	2012
Amount of irrigated water in th paddy with the system* (mm/season)	460 (455)	542 (468)	408 (370)	587 (534)	451 (239)
Amount of irrigated water in th paddy without the system (mm/season)	766	925	162	826	547
Amount of irrigated water saved (mm/season)	306	383	—	239	96
*Figures in brackets indicate amount of subirrigated water					

Table. Amounts of irrigated water for rice cultivation in paddies with and without a groundwater level control system.

13. Chronological and regional differences in the comprehensive productivity (total factor productivity) of rice production.

[Keywords]

Comprehensive productivity, total factor productivity, Törnqvist index, Malmquist index

[Abstract]

The comprehensive productivity of rice production was measured by the Törnqvist index and the Malmquist index. The present level and the growth rate of both indexes are high in Hokkaido, Tohoku and Hokuriku. However, each index shows differences in Kyushu. Therefore, both indexes should be used for the factor analysis of rice productivity.

Regions		Hokkaido	Tohoku	Hokuriku	Kanto	Tokai
Törnqvist index	level in 2010	3.07	2.60	2.69	2.16	1.87
	ave. growth rate	2.01%	1.88%	1.77%	1.46%	1.35%
Malmquist index	level in 2010	3.26	3.08	2.39	2.19	2.16
	ave. growth rate	2.39%	2.52%	1.14%	0.69%	0.51%
Regions		Kinki	Chugoku	Sikoku	Kyushu	
Törnqvist index	level in 2010	1.94	2.00	1.98	2.24	
	ave. growth rate	1.89%	1.67%	1.61%	1.56%	
Malmquist index	level in 2010	2.40	2.15	1.93	3.13	
	ave. growth rate	1.16%	0.94%	0.92%	2.39%	

[Reference]

Kunimitsu, Y. (2013), Journal of Rural Economics Special Issue 2013, 107-112

Fig. Comprehensive productivity by regions and their average growth rate.

14. Effects of controlled drainage on nitrogen losses in a clayey agricultural field with cracks

[Keywords]

Subsurface drainage, Nitrate–nitrogen, Denitrification, Water quality

[Abstract]

Controlled drainage has been identified as a potential management method to reduce NO₃-N leaching into subsurface drainage systems. A field experiment was conducted on clayey soil to assess the effects of controlled drainage on NO₃-N leaching. Controlled drainage makes it possible to conveniently vary the water table levels by attaching a riser to the drain pipe. By raising the water table, more soil will be in a saturated state, producing anaerobic conditions which promotes denitrification. In addition, evaporation from the soil surface will increase and outflow volume will decrease. These results show that there are significant environmental benefits with controlled drainage.

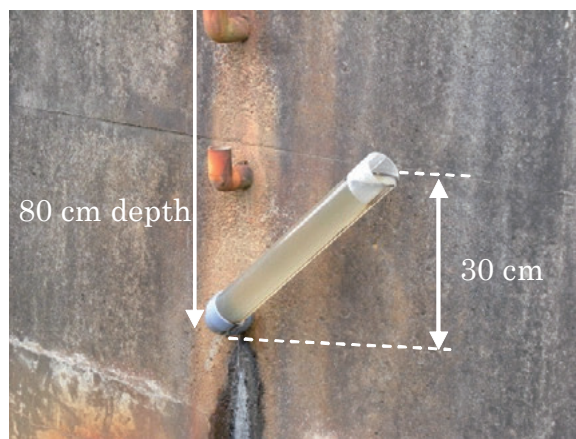


Fig. Controlled drainage by attaching a riser to the drain pipe.

15. Field Evaluation of a Capacitance Soil Moisture Sensor to Obtain Irrigation Scheduling Parameters

[Keywords]

Soil moisture, Irrigation, Field measurement, Irrigation scheduling, Electromagnetic wave

[Abstract]

To evaluate the performance of a capacitance soil moisture sensor (EC-5, Decagon device), two side-by-side soil moisture profile measurements using the EC-5 and tensiometers were compared. Soil moisture readings by the EC-5 coincided with those by tensiometers in the moisture range below 78 kPa. Tensiometers could not measure moisture levels above 78 kPa. However, the EC-5 was capable of measuring moisture levels above 78 kPa. Parameters for irrigation scheduling coincided well with each other, except during the dry period. Therefore, we conclude that the EC-5 can accurately measure soil moisture in the field and provide useful parameters for irrigation scheduling.

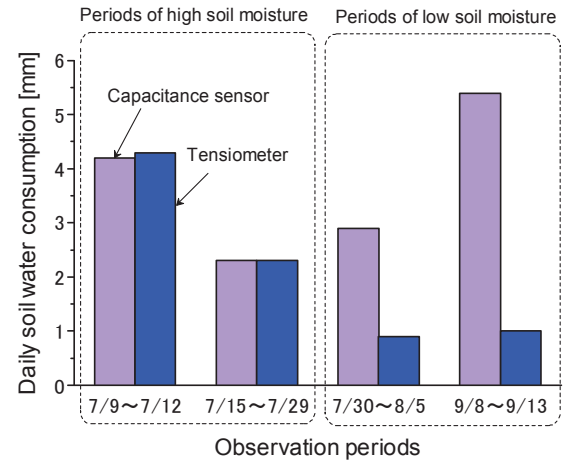


Fig. Comparison of daily soil water consumption estimated by capacitance sensor and tensiometer.

16. Design of a pseudo-flooding experiment to evaluate flood damages on rice yields due to heavy rainfall

[Keywords]

Yield-reduction scales for rice, Pseudo-flooding experiment, Flood damages in paddy, Reduction ratio of rice yields, Estimation of flood risks

[Abstract]

The experimental arena developed in this study can reproduce conditions similar to a real flood disaster. It has a clean and a turbid water plots, and each plot has three zones with different water depths. The combination of these plots allows us to reproduce a variety of flooding conditions. Yield-reduction scales for rice are formulated from results of the experiment. By using the scales, flood damage on rice is easily quantified in each paddy according to flooding conditions.

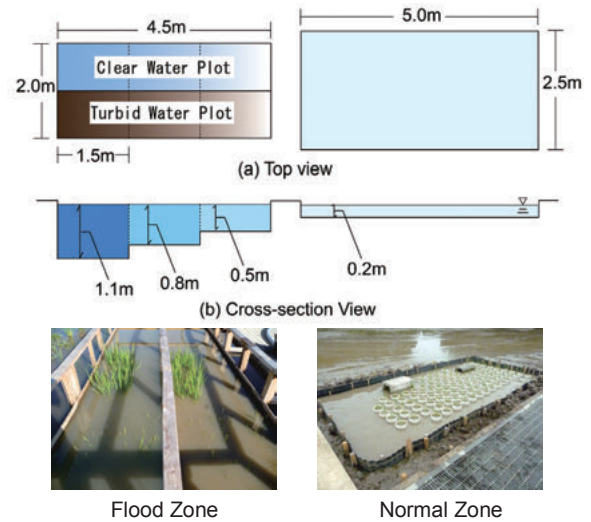


Fig. Design of the experimental arena and outcome of a flooding experiment.

17. A simple flood analysis method using detailed topographic data for small earth dam failure

[Keywords]

irrigation pond database, simple flood analysis, hazard map, numerical altitude model

[Abstract]

In creating hazard maps, it is possible to conduct a simple flood analysis with high prediction accuracy by using detailed numerical altitude data (Fundamental Geospatial Data of the Geographical Survey Institute) expressing microtopographic features that affect inundation flows and appropriately selecting break points for small earth dams and a coefficient of roughness for the flood area.

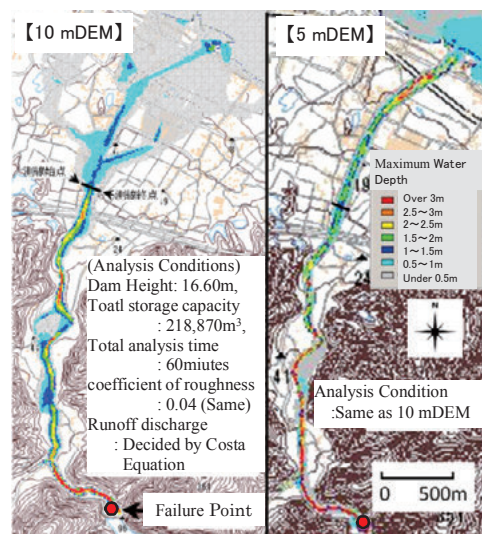


Fig. Improvements in the results of flood analyses.

18. Simple Rainfall Observation View System on a Smartphone for Rural Community Independent Disaster Prevention

[Keywords]

local disaster prevention, rainfall, smartphone,

[Abstract]

Developing hardware disaster prevention measures to endure a disaster is not enough in rural areas. It is very important to try to improve disaster prevention awareness of local communities with software disaster prevention measures.

Therefore, we developed an observation/viewing system so residents can observe local precipitation and voluntarily evacuate early at the time of heavy rain. This system is simple to operate and inexpensive because observations of the precipitation are delivered to a smartphone.

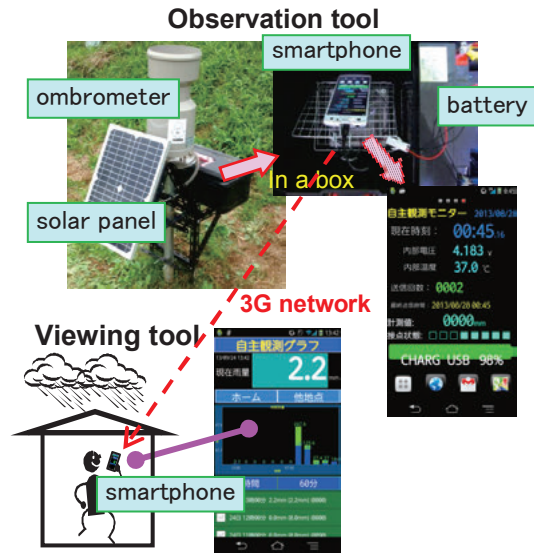


Fig. Observation tool and view tool for the system.

19. Characteristics of drainage channels to alleviate tsunami flood disasters in coastal farmlands

[Keywords]

Tsunamis, Hydraulic model test, flood disasters, drainage channels

[Abstract]

The effect of reducing the flow velocity of tsunamis that flood coastal farmlands by a drainage channel arranged parallel with the coastline is evaluated by the hydraulic model test.

Under conditions of this experiment with a tsunami wave height of 9 m, the flow velocity is reduced approximately 16% and the effect is heightened by reducing the flow velocity another 4 to 10% with a side wall on the land side.

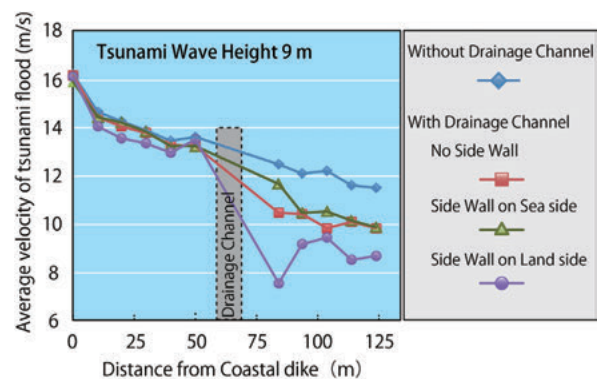


Fig. Velocity distributions in coastal farmlands.

20. Evaluation of Measures Against Saltwater Intrusion in Subsided, Tsunami-Inundated Farmlands

[Keywords]

2011 Tohoku earthquake, tsunami, salt damage, land subsidence, seawater intrusion

[Abstract]

We investigated saltwater intrusion in coastal farmlands in Japan near a river mouth that underwent subsidence after the 11 March 2011 earthquake and extensive inundation by the ensuing tsunami. Our measurements of electrical conductivity using a Geonics EM38 instrument showed that salt concentrations in the lower soil layers were higher than at the surface, and suggested continuing intrusion of seawater. Groundwater storage and the force drainage technique are proposed as measures against saltwater intrusion in subsided coastal farmlands. Our numerical analysis showed that it is possible to drain crop fields by these methods without shoaling the freshwater-saltwater interface.

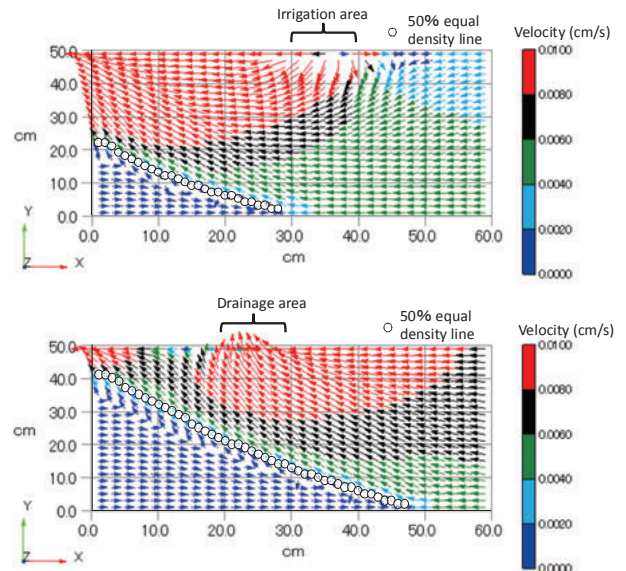


Fig. 1. Changes in the saltwater-freshwater interface depth by a difference in the water supply and drainage position

21. Wireless multi sensors for landslide monitoring not obstructed by shallow landslides

[Keywords]

large-scale landslide, multi slip surfaces, long term monitoring, multi item measurement

[Abstract]

We developed a sensor composed of an extensometer and strain gauges that can be installed into one borehole. Measured data are transmitted from the sensor by a wireless device, and can be received on the ground. In a large-scale landslide that has multi slip surfaces, the position, the direction of slide, and the displacement of the deep layer slip surface can be observed long term using these systems.

[Reference]

Nakazato et al. (2012) Abstracts of the 52nd Annual Meeting of the Japan Landslide Society, 175-176 (in Japanese).

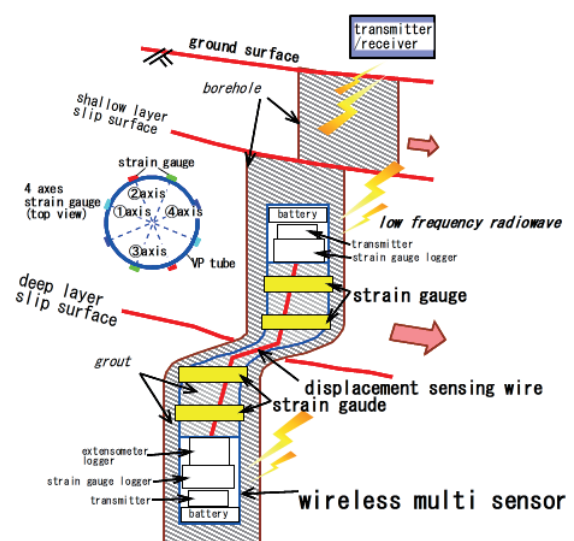


Fig. Schematic diagram of wireless multi sensor.

22. Evaluation of the benefits for consolidation of lifeline facilities and social capital for the national resilience plan

[Keywords]

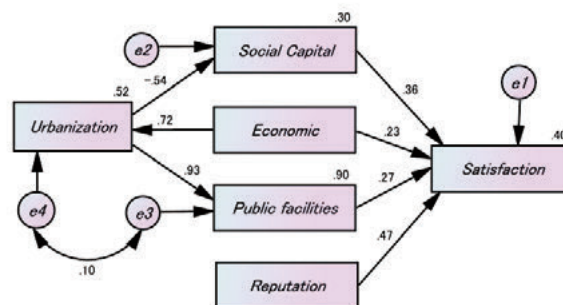
Satisfaction degree of residents, lifeline facilities, social capital, national resilience plan

[Abstract]

Consolidation of lifeline facilities (life base) and an increase in social capital improve the degree of satisfaction of residents in rural regions. This study provides a technique to divide such effects from the individual level into the regional level and to quantitatively evaluate the effects. Hardware and software policy measures in the national resilience plan can also be evaluated by this technique.

[Reference]

Kunimitsu (2014) Journal of Economic Policy Studies



GFI=.962 RMSEA=.011
 $\chi^2=7.050(df=7)$ p-value=.424

Fig. Causative factors for the degree of satisfaction of residents.

23. Flood control for downstream rivers using a group of valley-type irrigation ponds

[Keywords]

irrigation pond, flood control, percentage of storage, regional flood runoff model

[Abstract]

A group of valley-type irrigation ponds can be used for flood control in downstream rivers. Vacating half of the storage space of the ponds before rainfall results in a reduction of approximately 10% in the peak flow rate. It is possible to prevent the downstream rivers from flooding by discharging water preliminarily from the ponds to create a sufficient storage space based on rainstorm forecasts.

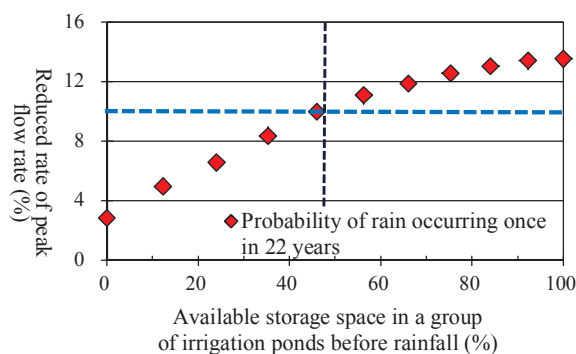


Fig. Reduction in peak flow rate using a group of irrigation ponds (reference point)

24. Changes in rainfall-runoff characteristics due to the cultivation conditions of hilly paddies

[Keywords]

Hilly paddies, Abandoned paddies, Runoff characteristics, Physically-based hydrological model

[Abstract]

To assess the interactions between hydrological characteristics and paddy conditions, two experimental watersheds were set, each of which is dominated by either cultivated paddies or abandoned paddies: namely cultivated paddy-dominant watershed (CPW), and abandoned paddy-dominant watershed (APW). The analysis revealed that the runoff ratios of APW were significantly higher than those of CPW under wet conditions. We then performed short-term runoff calculations. The discharge calculations revealed higher flow peaks for APW than for CPW in wet conditions. The model experiments showed that differences in groundwater storage may affect the short-term runoff characteristics of small watersheds.

[Reference]

- 1) Yoshida et al. (2013), JSIDRE, 285, 31-40
- 2) Yoshida et al. (2012), JSIDRE, 278, 39-46

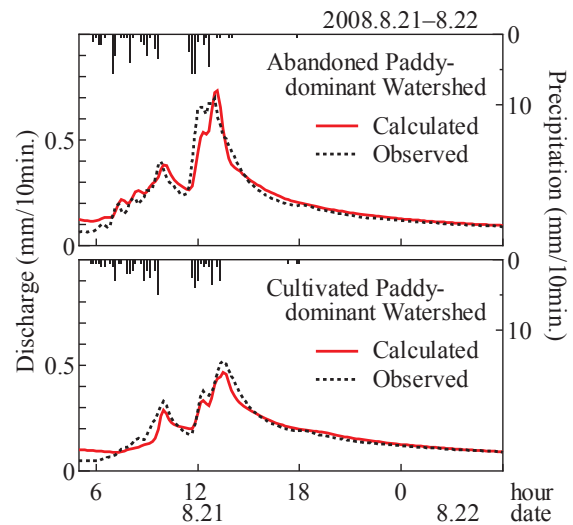


Fig. Comparison of observed and calculated runoff discharges in CPW and APW

25. New Dike Structure Integrating Three Surfaces and Materials

[Keywords]

Dike, Disaster, Mitigation, Tsunami, Earthquake

[Abstract]

A new dike structure was developed to create a persistent reinforced seawall for preventing block floatation and soil erosion triggered by tsunami waves and earthquakes.

The developed dike structure consists of three kinds of materials (block/ improved cement soil/ geotextile) and three surfaces (crest/front & back slopes).

All materials and surfaces are rigidly jointed with each other by geotextile, steel jointing and improved cement soil. For the meantime, we call this new seawall a "Dike structure integrating three surfaces and materials".

[Reference]

Press release 5th June, 2014

http://www.naro.affrc.go.jp/publicity_report/press/laboratory/nkk/052569.html

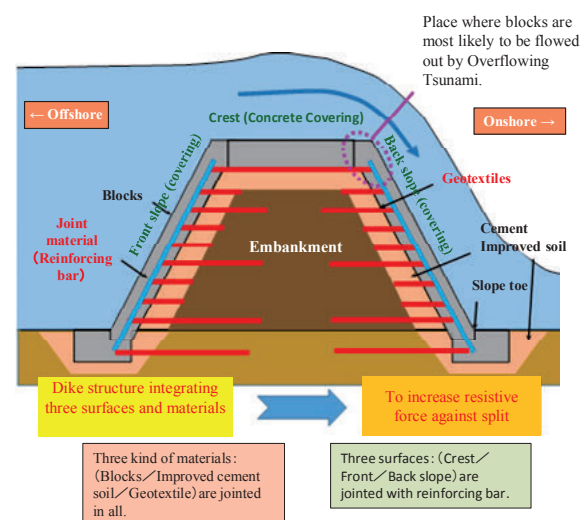


Fig. Typical Features of the New Dike Structure

26. Evaluation of swimming stress in fish by measuring lactate concentrations with a portable device

[Keywords]

Lactate, Swim experiment, Velocity measured in body lengths second⁻¹, Cruising speed, Anesthesia

[Abstract]

Preliminary application of a lactate test meter for evaluation of swimming stress in fish was foretasted. The fish species examined was the amur minnow *Rhynchocypris lagowskii*. Groups measured after swimming showed no significant differences in lactate, even though different times of swimming were tested. Alternatively, an influence of anesthesia by the FA100 was not detected either. These experiments suggest a positive correlation between lactate concentrations and swimming velocity measured in body lengths second⁻¹.

[Reference]

Beecham et al. (2006) Using portable lactate and glucose meters for catfish research, *North Am. J. Aquacult.*, 68, 291-295.

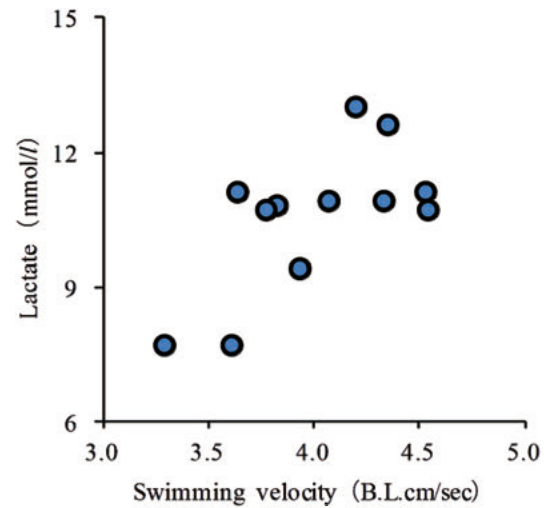


Fig. Swimming velocity measured in body lengths second⁻¹ and lactate concentrations

27. An indicator to evaluate the sustainability of non-farmer participation in activities to maintain irrigation/drainage canals

[Keywords]

Irrigation/Drainage canal, Maintenance, Participation in maintenance activity, Sustainability, Evaluation

[Abstract]

First, the data of a questionnaire about participation in activities to maintain irrigation/drainage canals given to a group of non-farmers should enter the model of the relationships between participation and influencing factors. The model is expressed by structure equation modeling with a mean structure. Based on the above, if we designate the ratio of “influenced level of knowledge about irrigation/drainage water” with “level of participation” as a new indicator, then the group of non-farmers having the lowest indicator should be the group that has the lowest sustainability and needs to be addressed for maintaining activities.

[Reference]

Onimaru, T. (2013) JDRE Journal, No.284, pp.89-90 [in Japanese].

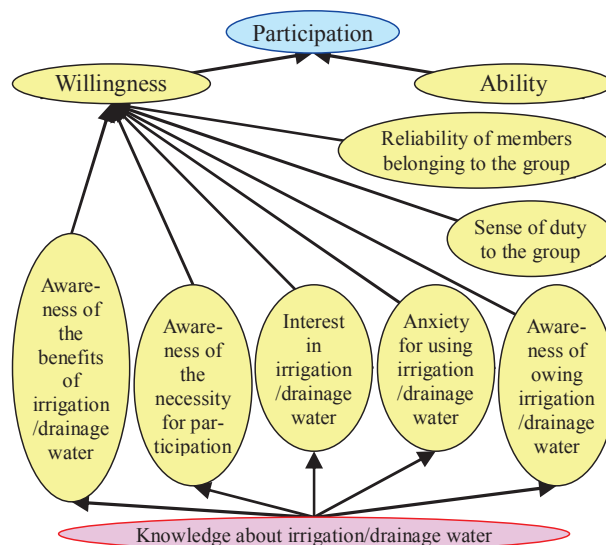


Fig. Model of the relationships between participation in maintenance activities and influencing factors.

28. Reuse of abandoned farmlands by planting buckwheat or barley

[Keywords]

abandoned farmland, land productivity, labor productivity

[Abstract]

When we plan reuse of abandoned farmlands, we must decide both which land to reuse and who should cultivate the reused farmland. We can make the selections by evaluating labor productivity and productivity of land planted with buckwheat or barley, abandoned farmlands with high land productivity should be reused and cultivated by large scale farmers. We can reuse abandoned farmland with low land productivity by simple land improvements or adding value to the product, for example, processing and selling the product ourselves.

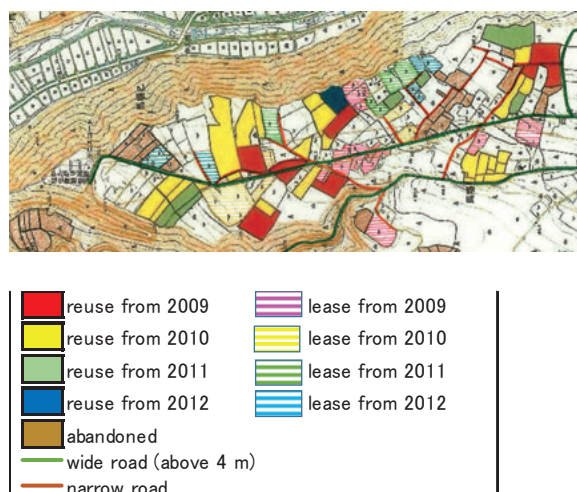


Fig. Reuse of abandoned farmlands by planting buckwheat (Niigata Prefecture).

29. Promotion of CSA by cooperation between farmers and consumers

[Keywords]

CSA (Community Supported Agriculture), Interchange with consumers, Organic products, Support organizations

[Abstract]

Cooperation among farmers through joint shipping and interchange with consumers are effective for starting CSA in Japan. In addition, CSA can be promoted by creation of support organizations that perform the following functions; 1) provision of information, 2) mediation between farmers and consumers, acknowledgements.

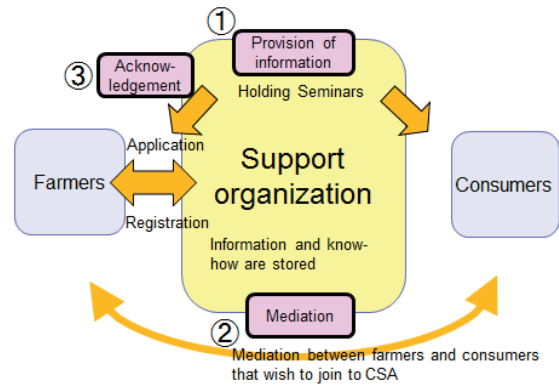


Fig. Functions required for support organizations of CSA

30. Potential to mitigate global warming with carbon sequestering technology by underdrainage construction in Japan

[Keywords]

Organic filter material, Subsoil, Carbon sequestration, Potential to mitigate global warming in Japan

[Abstract]

The service life of an underdrain is approximately 15 years, so we estimated the carbon retention at that point. Residual carbon within the organic filter of an underdrain after 15 years includes rice husk < bark compost < wood chip < charcoal. Local differences between the north and south areas of Japan are large in terms of carbon retention rates for organic filter materials. We calculated the carbon sequestration potential of underdrainage using organic filter materials. For wood chips, carbon sequestration in Japan is equivalent to 220,000 tons CO₂ per ha over a 15 year period. For rice husk, it is 4,000 tons.

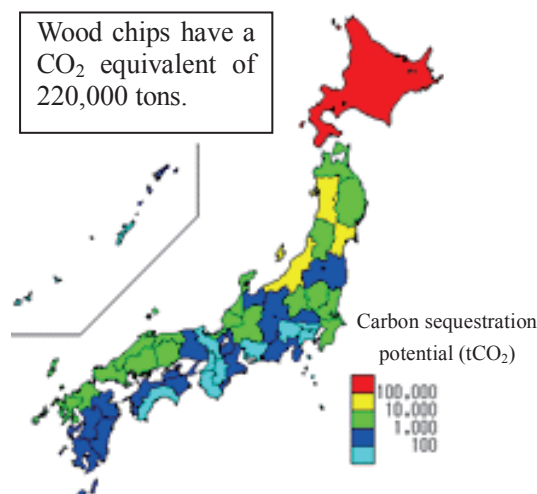


Fig. Example of the potential to mitigate global warming with carbon sequestering technology by underdrainage using organic filter materials

[Reference]

• Kitagawa I, Tsukamoto Y (2013), PWE, DOI 10.1007/s10333-013-0410-2

31. Projection model for the effects of future climate change on regional rice production profits

[Keywords]

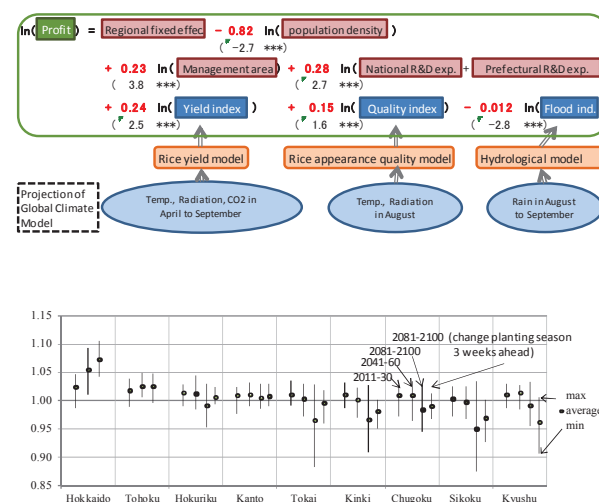
Comprehensive productivity of rice farming, rice yield index, rice quality index, flood index, climate change

[Abstract]

Climate changes in temperature and rainfall influence rice yield, rice appearance quality and flood damage.

This study estimated projection model that showed influences of climate factors as well as socio-economic factors on rice profit by econometric method. Rice profit for the targeted variable was measured by the total factor productivity, comprehensive productivity, which was calculated from the amount of production and the costs.

By using this model, this study evaluated future climate impacts on rice profit in accordance with the results of A1B scenario from the global climate model.



[Reference]

Kunimitsu et al. (2014) PWE, 12

Figs.1 and 2. Model and Future projections

32. Characteristics of materials accumulated in a digester tank for methane fermentation after operation for a long period

[Keywords]

Methane fermentation, sedimentation, crystallization, magnesium ammonium phosphate (MAP), Cattle manure, Maintenance of facility, Sand

[Abstract]

This study examined compositions and amounts of materials accumulated in a digester tank for methane fermentation after 7.5 years of operation. Approximately 20 m³ of sediments including large amounts of inorganic materials such as sand were found at the bottom of the tank. The accumulation of sand is unavoidable because feedstock materials such as dairy manure contain sand. Therefore, a tank should be designed considering the possibility of deposition of sand. Crystals of magnesium ammonium phosphate (MAP) were observed around the liquid mixer of the tank. These findings can contribute to stable operation of methane fermentation plants.

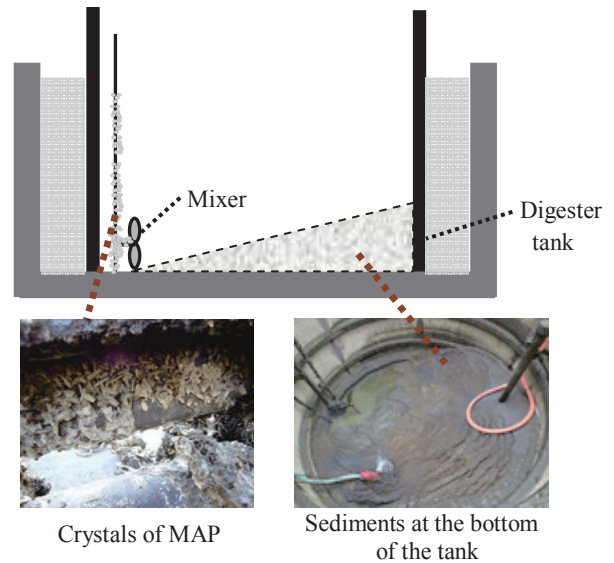


Fig. Cross-section diagram of digester tank and distribution of accumulated materials in the tank.

33. An alternative water management scheme for irrigation dams that enables efficient hydropower generation during a non-irrigation season

[Keywords]

Irrigation dam, irrigation water, renewable energy, small hydropower, water management

[Abstract]

We propose an alternative water management scheme for irrigation dam planning to annex a small hydropower plant. In order to conduct hydropower generation efficiently, the scheme aims to smooth out discharges during a non-irrigation season as far as possible, while trying to secure sufficient water for the next irrigation season. In comparison to the current water management scheme, the alternative is expected to improve the capacity factor (plant utilization factor) and reduce unit construction costs.

[Reference]

Ueda, T. et al. (2014) Water management strategies for hydropower annexation at existing irrigation dams in Japan. *Paddy and Water Environment*, Online First.

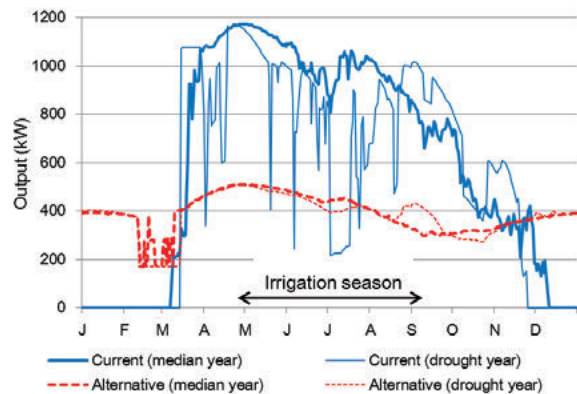


Fig. Variations in electricity output with the current and alternative water management schemes.

34. Pumping performance and conditions for introduction of Irrigation Water Wheel (IWW) installation for irrigation channels.

[Keywords]

Pumping irrigation, Hydro-energy, Traditional water use facility

[Abstract]

Pumping performance of IWW can be estimated from a) installation angle of bucket, b) channel conditions (ex; velocity) and c) submerged depth of the plate. There is no risk of an overflow stream because of minor backwater if an IWW with a width equal to the irrigation channel is installed.

[Reference]

HIROSE Yuichi (2014): Bulletin of the National Institute for Rural Engineering, 53, 1-61.

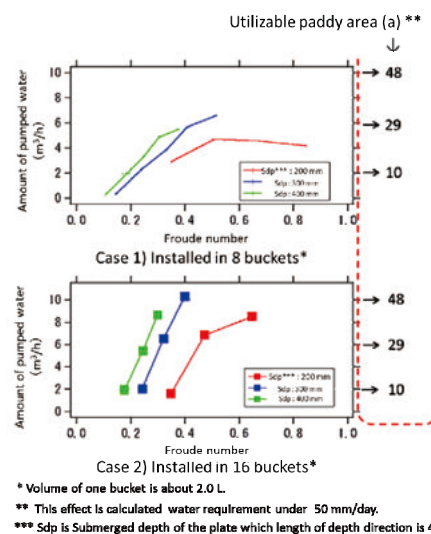


Fig. Relationships between pumping discharge and number of buckets.

35. Back-water forecast using the MPS method for design of a current water wheel

[Keywords]

open channel, current water wheel, back water, MPS method, un-uniform particle diameter model

[Abstract]

It is necessary to assess flow regimes around a water wheel in open channel flow, in order to introduce small hydroelectric generation in the irrigation channel. The MPS method with a modified model for non-uniform particle diameter in order to express the thin runner of a water wheel is effective for forecasting back-water that occurs with installation of a current water wheel.

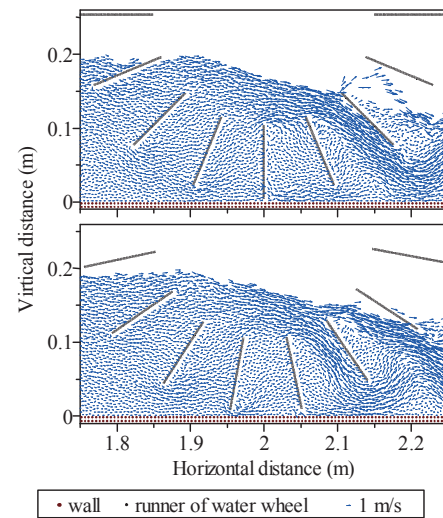


Fig. Simulated flow regimes around a current water wheel.

36. Measurements of a Gamma-ray spectrum to estimate distributions of radioactivity in farmland soils

[Keywords]

Farmland, Radiocesium, Monitoring, Radioactive decontaminant

[Abstract]

It is a new gamma-ray measurement technology intended for farmland soil using a NaI(Tl) scintillation detector, spectrum analyzer, altimeter, and GPS receiver. It can measure the strength of gamma rays bidimensionally emitted from each isotope in the soil for a short time.

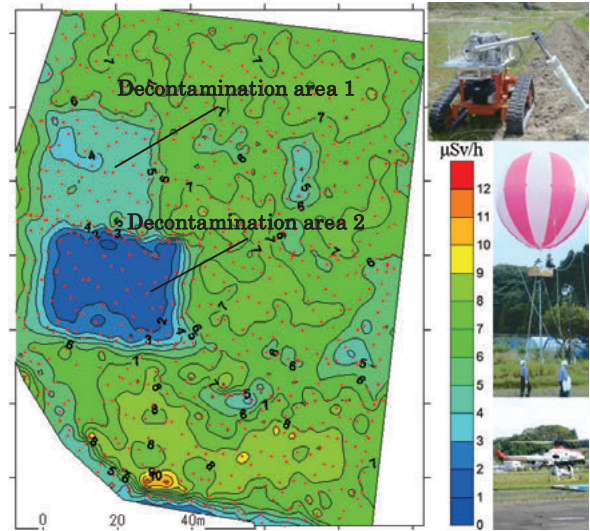


Fig. Gamma-ray air dose rate measured with a balloon after decontamination (5 cm in height) .

37. Method for decontamination of radioactive contaminated farmlands by stripping surface soil under freezing conditions

[Keywords]

Radioactive substance, Decontamination, Soil freezing, Stripping surface soil

[Abstract]

Up to 8,000 ha of farmlands were radioactively contaminated due to the accident of Fukushima No.1 NPP. A previous study showed that large amounts of radioactive Cesium accumulated within a few centimeters of the surface soil. Therefore, stripping the surface soil proved to be an effective way to decontaminate the farmlands. However, in farmlands located in mountainous areas, the soil is frozen in the winter, making it difficult to strip the surface soil. To overcome this problem, we proposed a new method consisting of two stages: (i) till 3-5 cm of the surface soil prior to soil freezing, (ii) strip the tilled surface layer after freezing. The method proved effective in a field experiment conducted in the winter of 2013 at Iidate Village in Fukushima Pref.



Photo. Soil stripping by the proposed method (upper) and a traditional method (lower).

38. Estimation of the transfer rate for radioactive cesium from sediment to the liquid phase in farm ponds

[Keywords]

Radioactive Cesium, Pond sediment, Transfer from sediment to liquid phase, Undisturbed sediment core sample

[Abstract]

A method for estimation of the transfer rate for radioactive cesium from sediment to the liquid phase was provided as a laboratory test using undisturbed sediment core samples collected from farm ponds. Calculation of the transfer rates allows comparisons between different sediments, and transfer rate is a useful indicator for risk assessment of increases in radioactive cesium concentrations in pond water used as irrigation water.

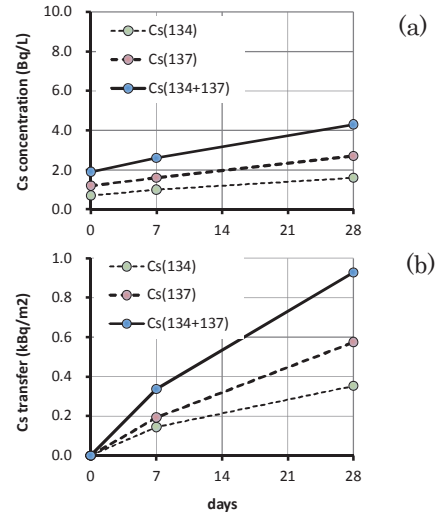


Fig. Radioactive cesium concentrations in the liquid phase (a) and transferred to the liquid phase (b) during the estimation test.

39. Spatial distribution and particle-size fractional distribution of radiocesium in irrigation pond sediments

[Keywords]

bottom sediments, core-sampling, spatial distribution, fraction

[Abstract]

Radiocesium (Cs) accumulates in the surface of sediments as well as deeper areas, even though Cs values differ by an order of magnitude between adjacent stations. From the results of soil particle fractionation, Cs concentrations in the clay fraction were lower than 1.5 times that of the same sample before fractionation. These values suggest that suspended clay from sediments does not cause significant problems for irrigation water use.

[Reference]

Yoshinaga et al. (2013) Water, Land and Environmental Engineering, 81(9):19-22

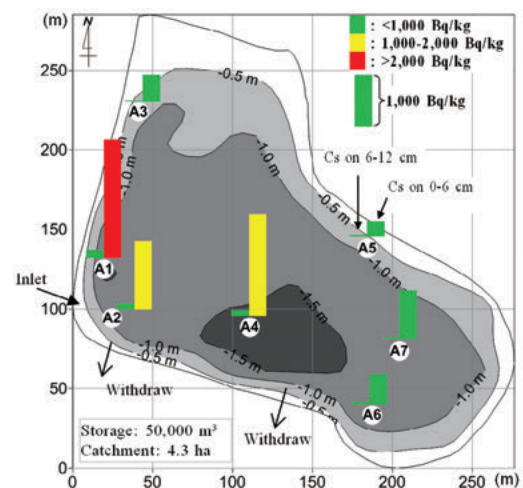


Fig. Inventory of Radiocesium in 6 cm slices of bottom sediments

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