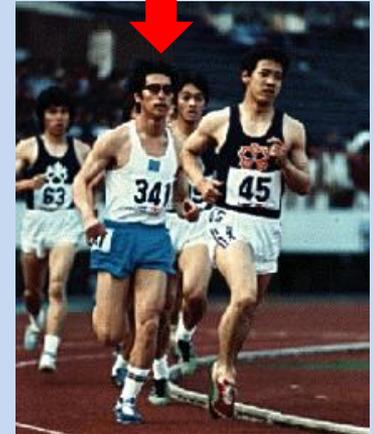


# Field Monitoring System to Promote Data Science-based **Smart** Agriculture



Prof. Masaru *Mizoguchi*

Lab. of International Agro-Informatics  
Dept. of Global Agricultural Sciences  
Univ. of Tokyo



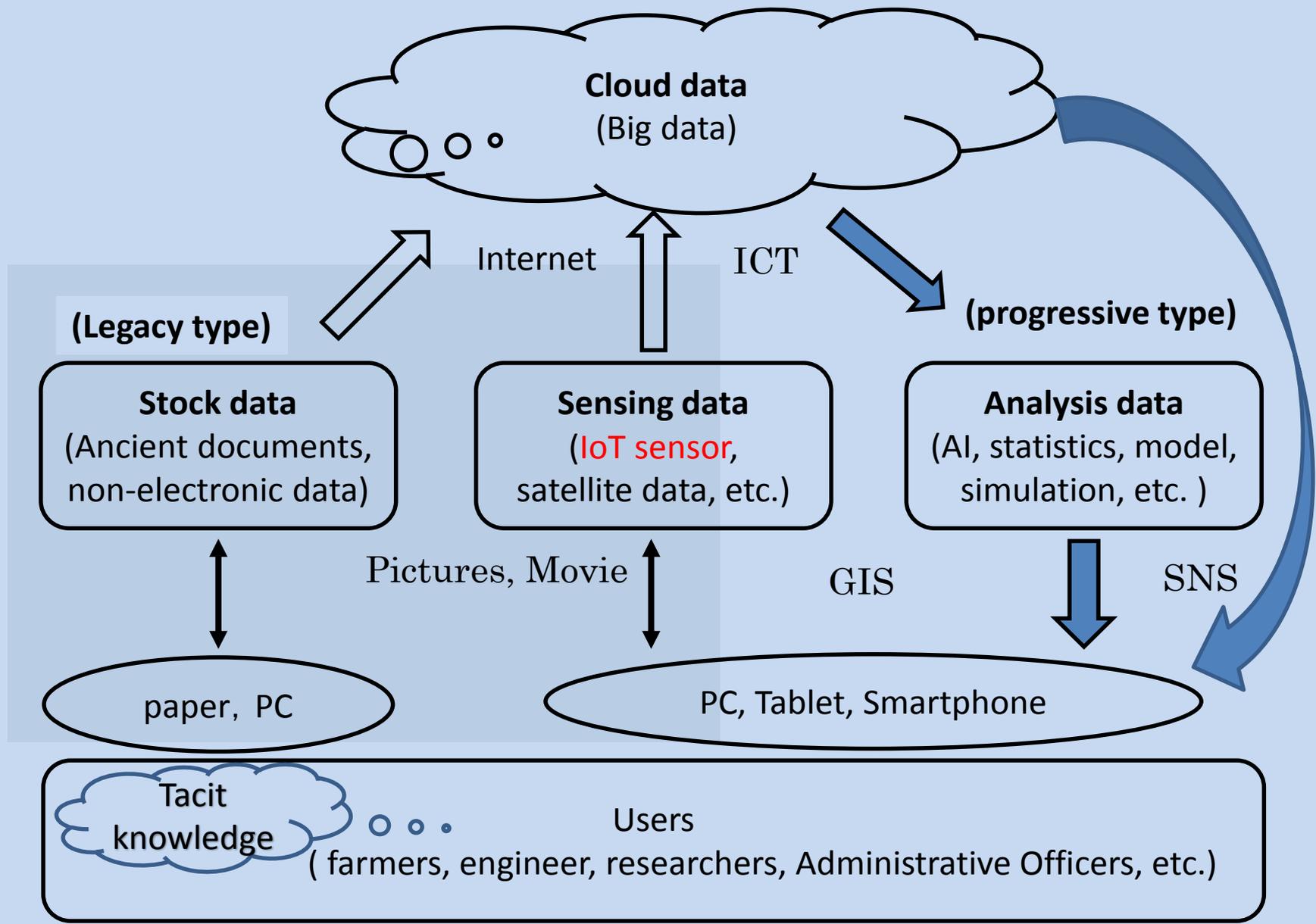
(1980)



# Introduction

- Farmers
  - can diagnose empirically conditions of complex soils.
  - have the technology to make the best environment for crops.
- Amateur of agriculture
  - can not learn these technologies in a short time .
  - However, can approach farmer's technology if there is a suitable soil sensor.
- In this presentation, I will outline the field monitoring system to Promote Data Science-based Smart Agriculture

# Strategy of Agri-data science in Mizo lab.



# Original devices developed by Mizo lab.

Co-developer =XASN <http://x-ability.co.jp/sp/index.php>



FieldRouter

特願2013-529029  
公開番号WO2013-024877

HALKA(遥)

Patent 2017-092956

Smart electric fence  
(now developing)



# ICT Agriculture in future

Toyota Kanban-system → Agri Kanban-system

## Overseas local production

- Toyota's agricultural version
- Agricultural production
- Apple, strawberry
- Earth Observation Data
- Robotics

## City

- Place of interaction and encounter

## Rural area

- Child-rearing
- three generations family
- Industrial diversification
- Information infrastructure
- SNS, IoT



# Sensors for Agriculture

- Agricultural land monitoring
  - Meteorological parameters
    - Air temperature, precipitation, solar radiation, wind, etc
  - Soil data (soil moisture, temperature, nutrient)
  - Crop data (growth rate, color)
  - Environment (radioactivity, etc.)
- **Agricultural land is not in the city!**
  - **No electric power, No WiFi**
- It is desirable not to use wired on farmland
  - Cutting with a mowing sickle and a tractor
  - Cutting by animals



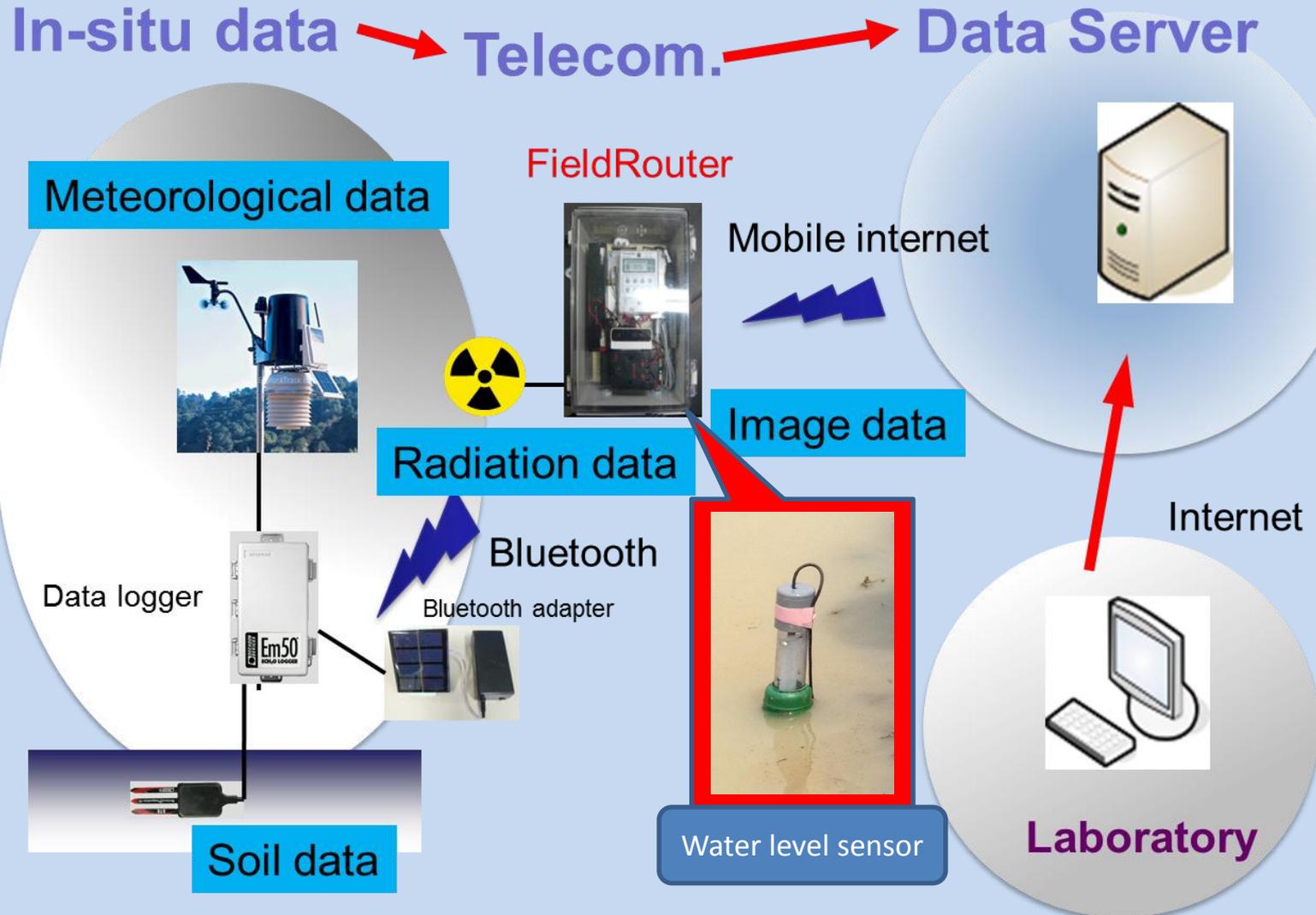
# Soil sensor

<https://www.metergroup.com/environment/>

- Soil moisture sensors measure
  - volumetric water content accurately and economically
  - the dielectric permittivity of the soil
- Benefits include:
  - TDR-level performance at a fraction of the cost
  - Very low power requirement
  - Easy installation at any depth and orientation

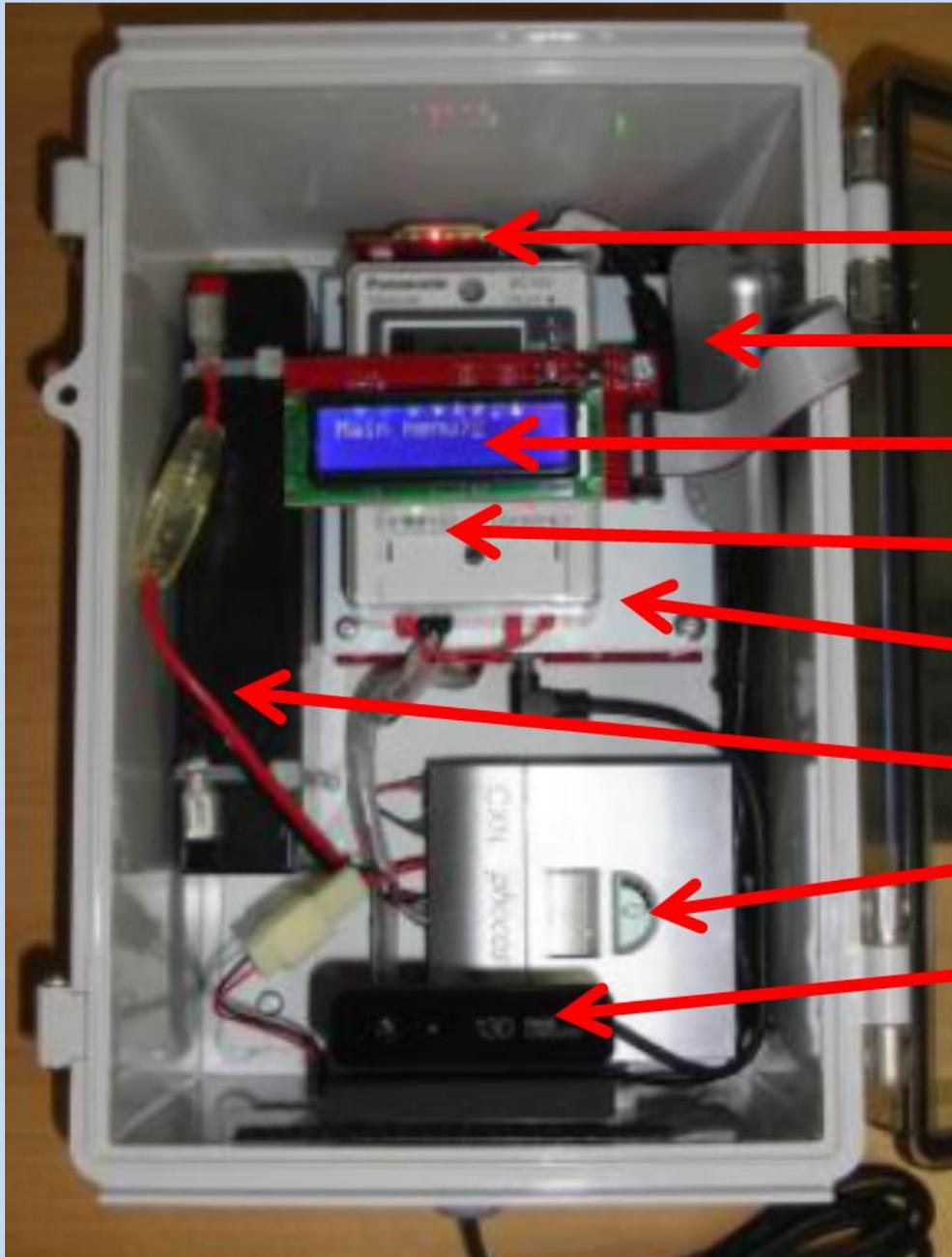


# Field Monitoring System (FMS)



(Soil sensor : Soil moisture, temperature, electrical conductivity)

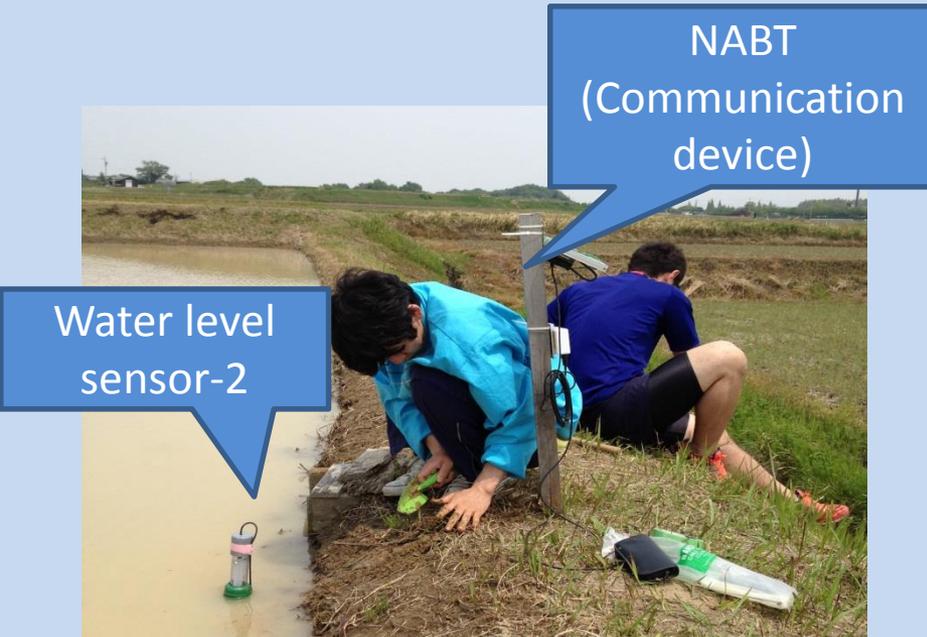
# FieldRouter



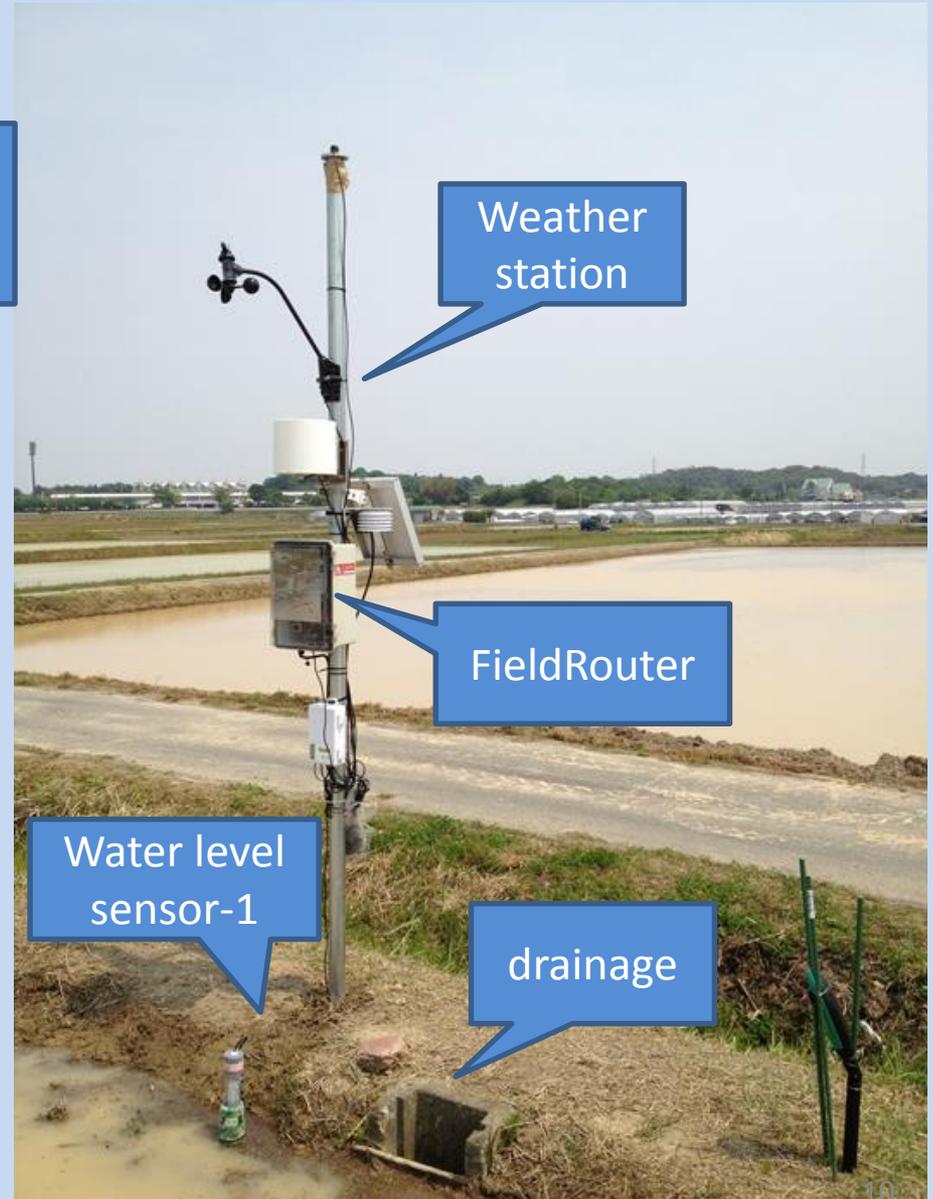
- Status lamp
- USB modem
- Status display
- Timer
- Micro-PC
- Battery
- Charge controller
- Web camera

(38 cm x 25 cm x 10 cm)

# Setup images of FMS in paddy



Handa, Aichi Prefecture  
in Japan (2014)

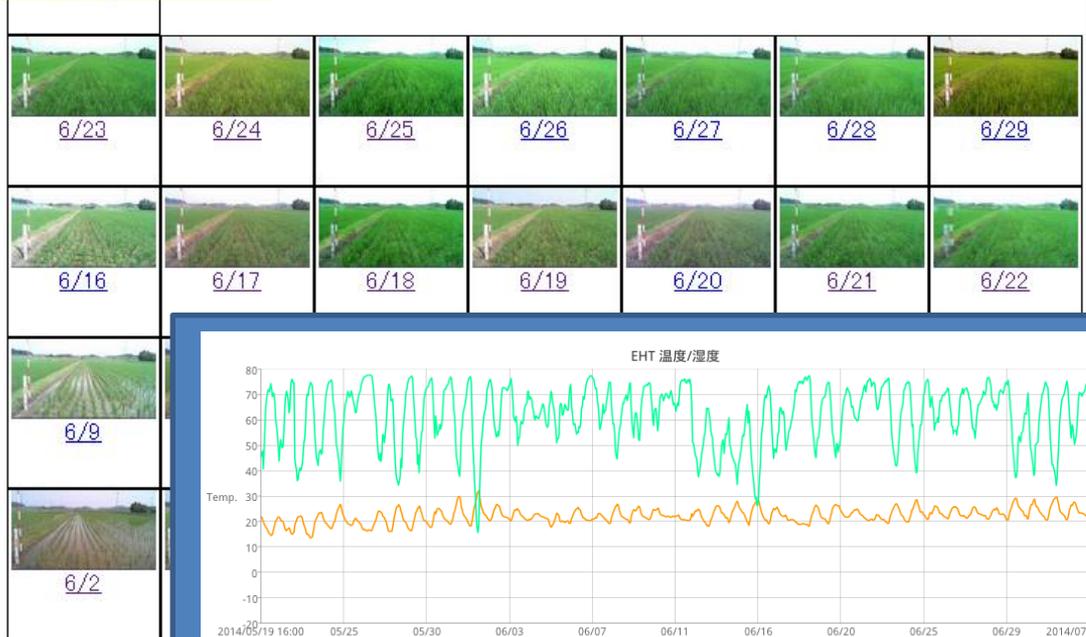


# Monitoring data



2014 / 6  
Wed. Thu. Fri. Sat. Sun.

calendar



[6/23](#)

[6/24](#)

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[6/26](#)

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[6/29](#)

[6/16](#)

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[6/18](#)

[6/19](#)

[6/20](#)

[6/21](#)

[6/22](#)

[6/9](#)

[6/2](#)

[Images](#)

[image0]2014/07/03 08:19 (156.2K) [calendar](#)



Image at 8:00



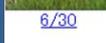
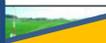
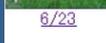
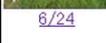
Sensing data

[Data](#)

HandaMet	logger time:2014-7-3 8:12:20
HandaW1	2014/07/03 08:15 battery:59 logger time:2014-7-3 8:14:52
HandaW2	2014/07/03 08:14 battery:100 logger time:2014-7-3 8:13:49

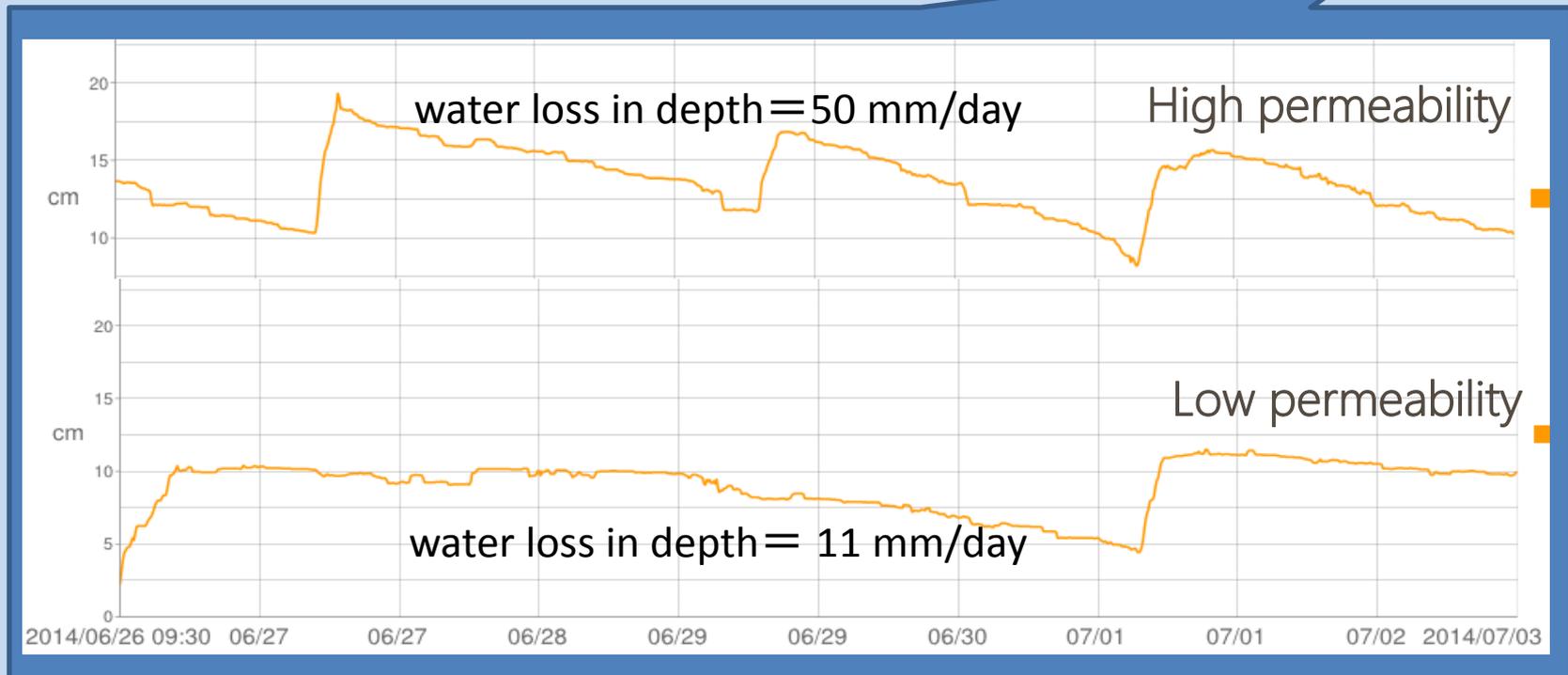
# Water level in a paddy field



2014 / 6						
Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.
						
						
						
						



# Water level



# View of individual site

[通信記録一覧 vbox0104](#) 最終通信日時 :

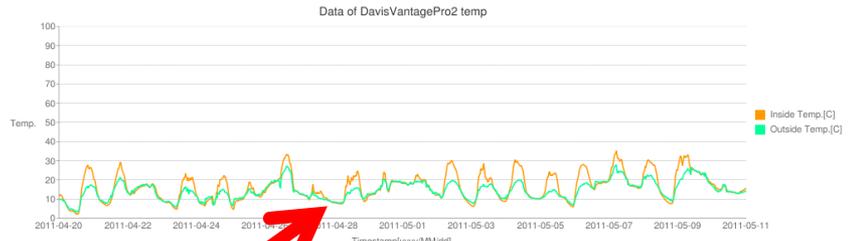
2018/06/06 12:20 (14 分) 日本時間



画像一覧

[image0]2018/06/06 12:16 (84.8K)

カレンダー形式



#Name = Davis Vg	Battery =	Timestamp	Firmware = Oct 26 2008						
1									
2									
3	Timestamp	Outside T	High Outs	Low Outs	Rain fall[ti	High rain	Baromete	Solar radi	Number of Insk
4	2011/4/7 10:30	17.22	17.22	16.22	0	0	1017.98	470	702
5	2011/4/7 11:00	17.94	18	17.22	0	0	1017.75	587	703
6	2011/4/7 11:30	18.5	18.67	17.99	0	0	1016.86	652	702
7	2011/4/7 12:00	18.89	18.89	18.22	0	0	1016.59	515	703
8	2011/4/7 12:30	19.17	19.39	17.72	0	0	1016.36	477	702
9	2011/4/7 13:00	19.61	19.61	19.17	0	0	1016.42	459	703
10	2011/4/7 13:30	20.44	20.44	19.61	0	0	1016.32	495	630
11	2011/4/7 14:00	21	21	20.5	0	0	1016.05	651	703
12	2011/4/7 14:30	21.5	21.44	21.06	0	0	1015.21	652	702
13	2011/4/7 15:00	22	22.06	21.33	0	0	1014.46	612	702
14	2011/4/7 15:30	21.72	22.33	21.72	0	0	1014.09	461	703
15	2011/4/7 16:00	21.5	21.78	21.39	0	0	1013.95	255	702
16	2011/4/7 16:30	21.61	21.72	21.5	0	0	1013.88	292	703
17	2011/4/7 17:00	21.06	21.61	21.06	0	0	1014.02	226	702
18	2011/4/7 17:30	20.83	21.06	20.72	0	0	1014.36	150	703
19	2011/4/7 18:00	20.28	20.83	20.28	0	0	1014.7	91	702

データ一覧

tana2017

time:2018/06/06 12:11

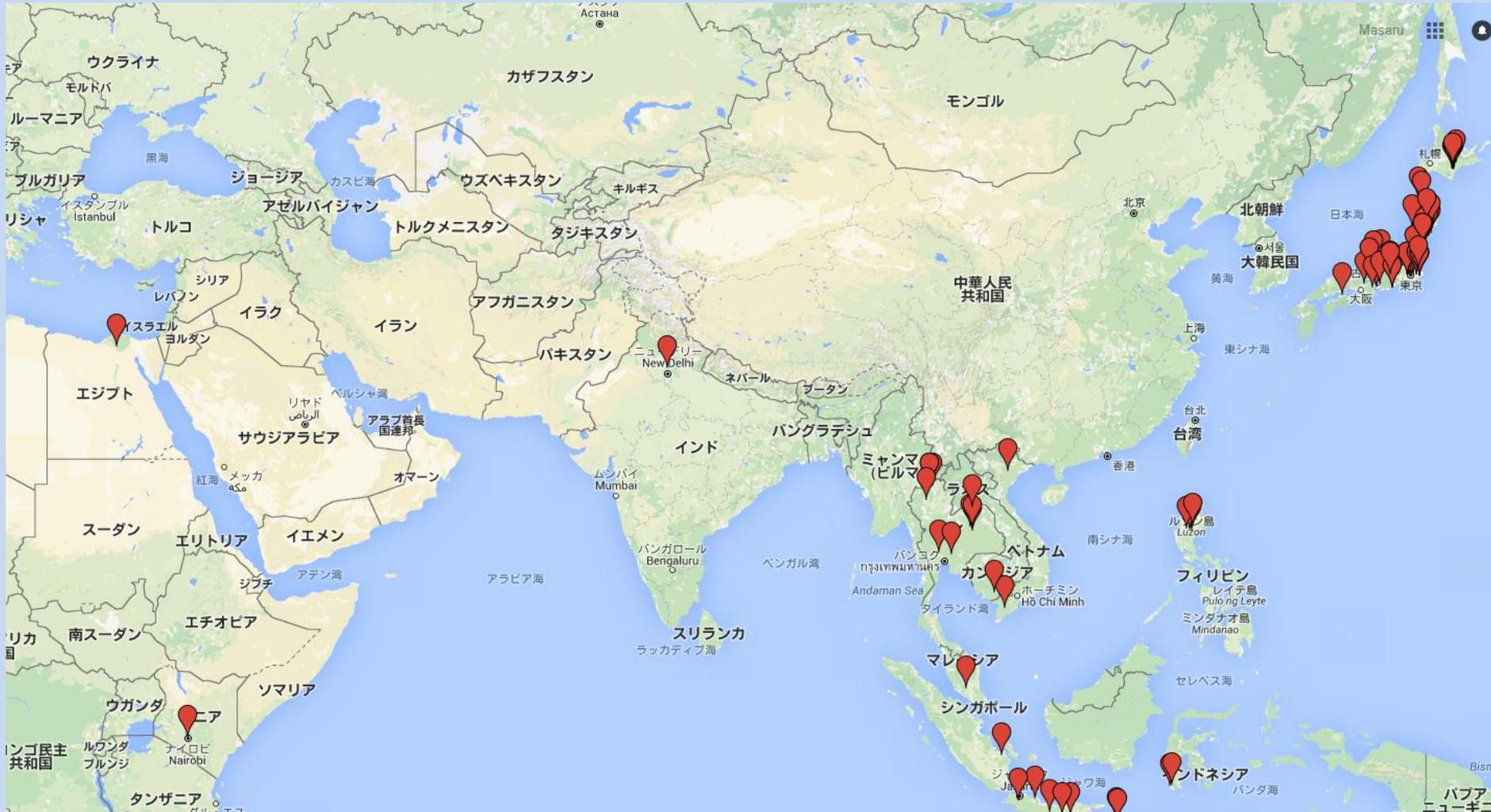
バッテリー残量:57

[CSV \(1.5K\)](#)

ロガー時刻:2018-6-6 11:56:44 +36

- Weather and soil data can be downloaded in CSV format
  - The data can be processed freely using EXCEL

# Monitoring sites by FMS



デモ

<http://www.iai.ga.a.u-tokyo.ac.jp/mizo/edrp/fukushima/monitoringsite.html>

# Monitoring of Spinach field for food safety in Thailand (2008)



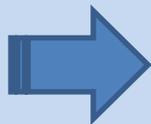
Installed on Dec. 20, 2007



# Farm to Table Experiment of Imported Spinach with ICT for bridging Thai Producer and Japanese Consumer



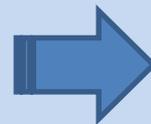
Fieldserver in Spinach field in Thailand



Calendar Month (Dec. 2008)  
SITEID: ChiangMai,ChiangMai\_com

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
..	..	..	..	..	..	..

Information discovery tools



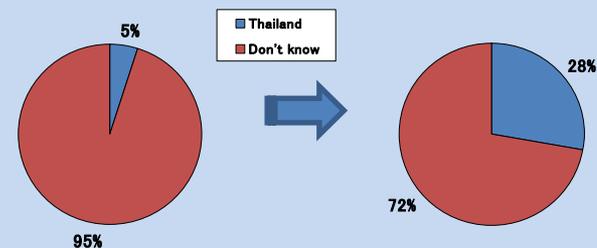
Display of real time monitoring in Univ. cafeteria



Imported spinach



Contents design and experiment by Mizo lab.



Recognition increased that "Spinach is from Thailand" Food communication

# Rice terrace monitoring in Indonesia (2014)



2014 / 11

Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.
 <a href="#">11/24</a>	 <a href="#">11/25</a>	 11/26	 <a href="#">11/27</a>	 <a href="#">11/28</a>	 <a href="#">11/29</a>	 <a href="#">11/30</a>
 <a href="#">11/17</a>	 <a href="#">11/18</a>	 <a href="#">11/19</a>	 <a href="#">11/20</a>	 <a href="#">11/21</a>	 <a href="#">11/22</a>	 <a href="#">11/23</a>
 <a href="#">11/10</a>	 <a href="#">11/11</a>	 <a href="#">11/12</a>	 <a href="#">11/13</a>	 <a href="#">11/14</a>	 <a href="#">11/15</a>	 <a href="#">11/16</a>
 <a href="#">11/3</a>	 <a href="#">11/4</a>	 11/5	 <a href="#">11/6</a>	 <a href="#">11/7</a>	 <a href="#">11/8</a>	 <a href="#">11/9</a>
				 11/1		 <a href="#">11/2</a>



# Flood paddy monitoring in Thailand (2011)

2011.10.3



2011.10.5



2011.11.7



[11/7](#)



[11/8](#)

11/9

11/10



[11/1](#)



[11/2](#)



[11/3](#)



[11/4](#)

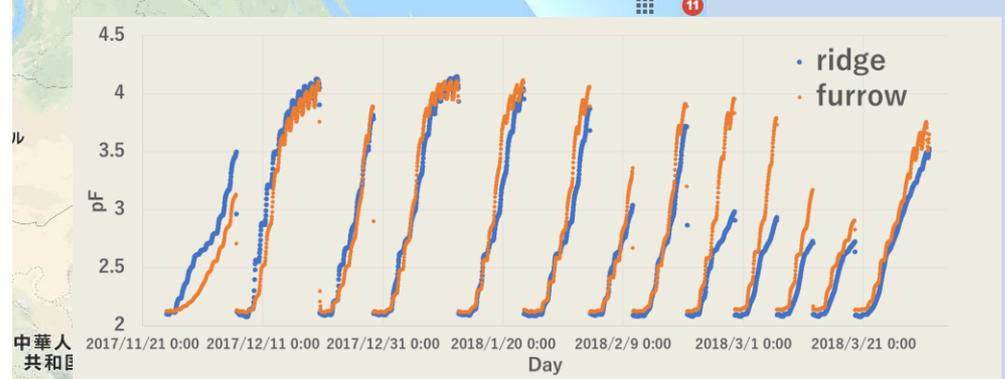
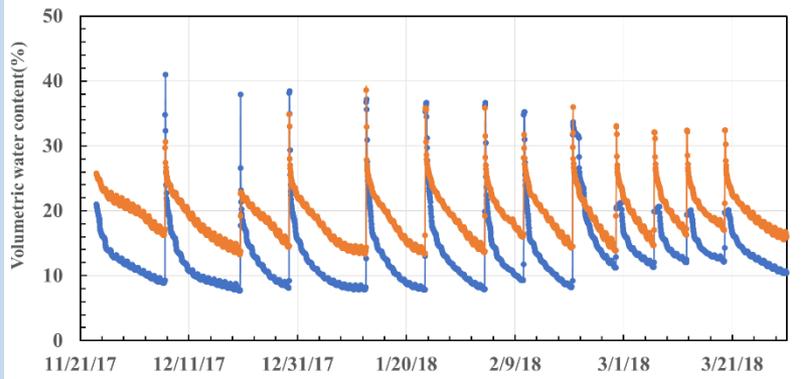


[11/5](#)

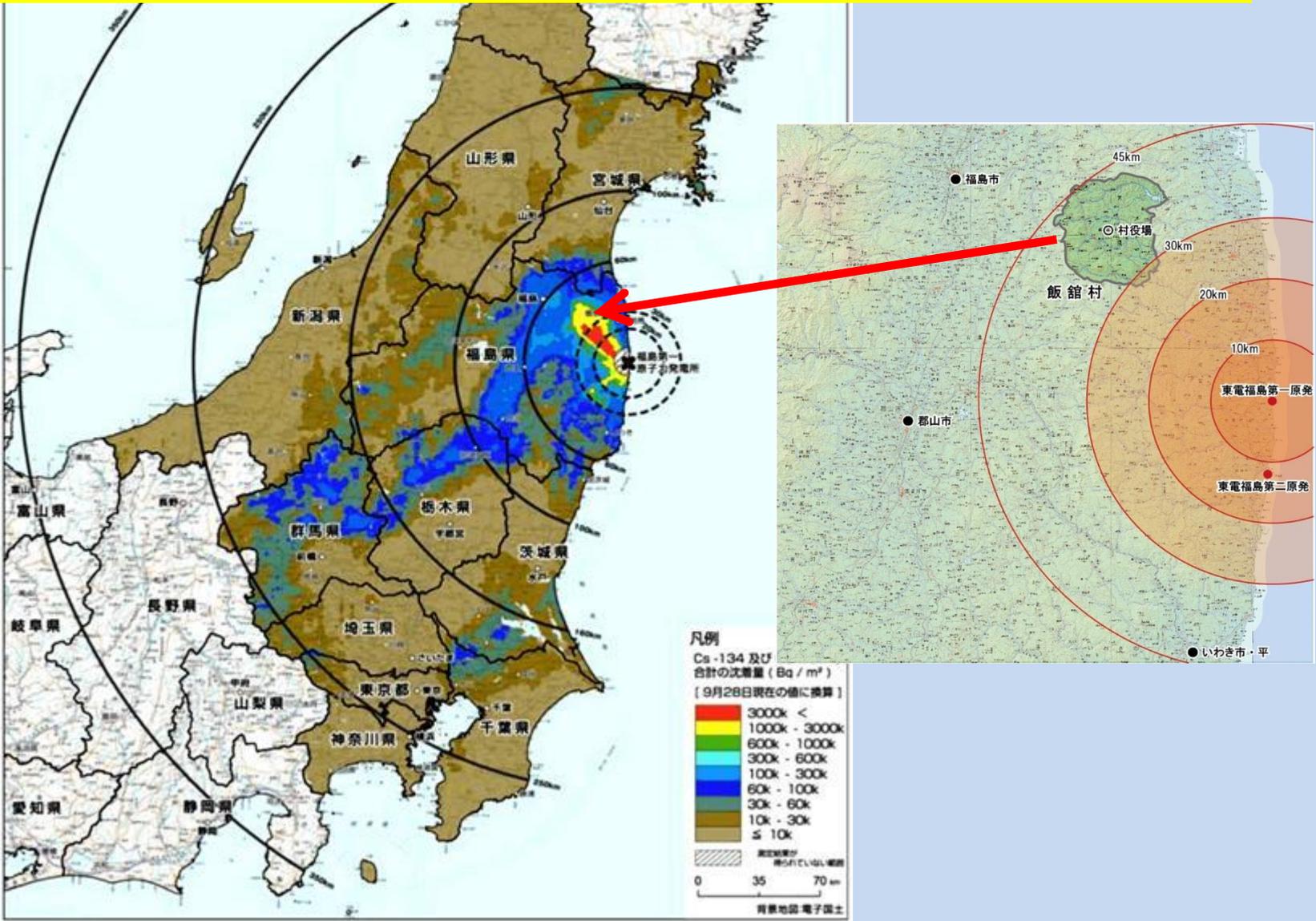


[11/6](#)

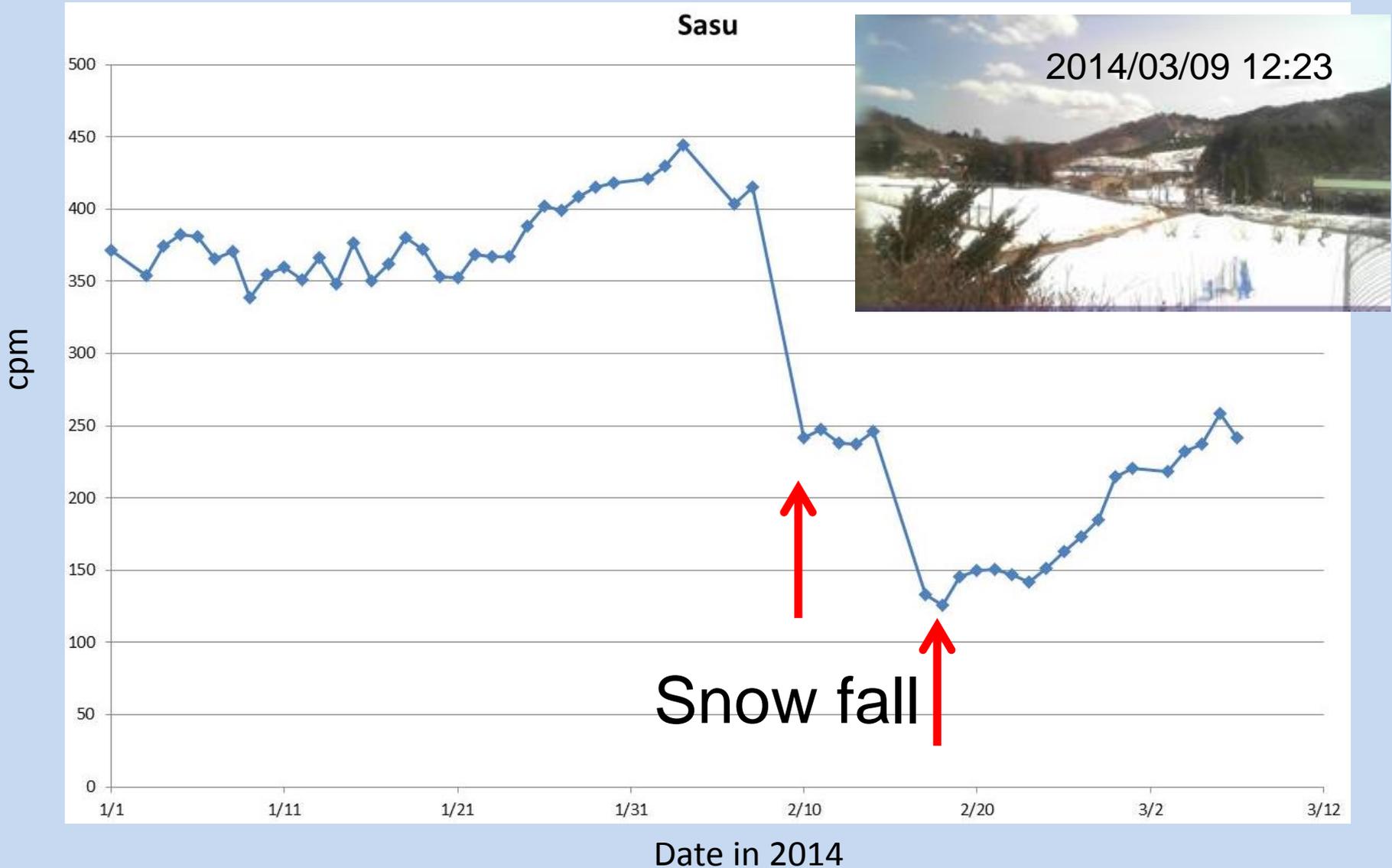
# Water Management for Optimal Crop Management in India (2018)



# IoT application to Monitoring Iitate Village in Fukushima Prefecture (2011-)



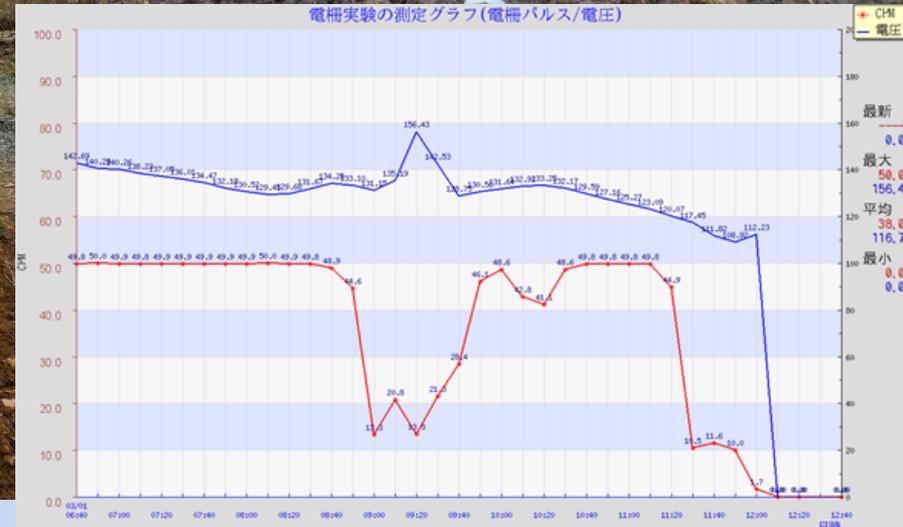
# Effect of radiation shielding by snow



# Smart fence to protect wild boar's attack

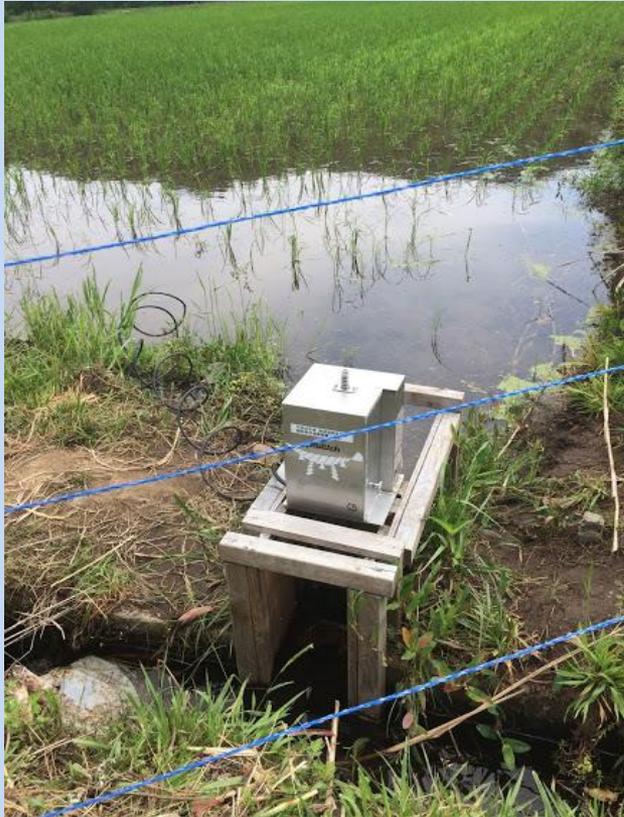


2012/4



# Irrigation-water control in paddy field in Iitate Village, Fukushima (2018)

- <https://paditch.com/product/paditch-gate>



1. Set Paditch



2. Add camera



3. Control gate

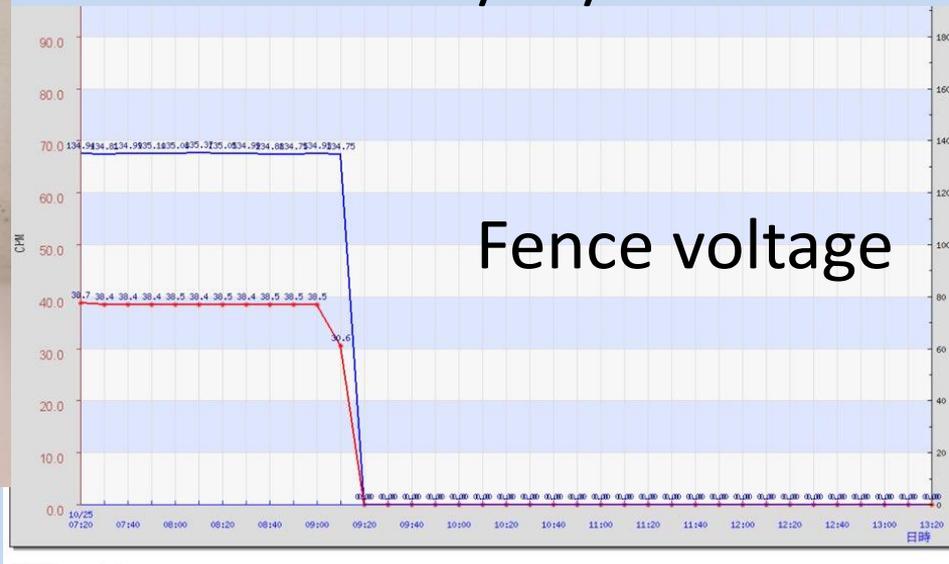


Like Phoenix

ng by Field camera

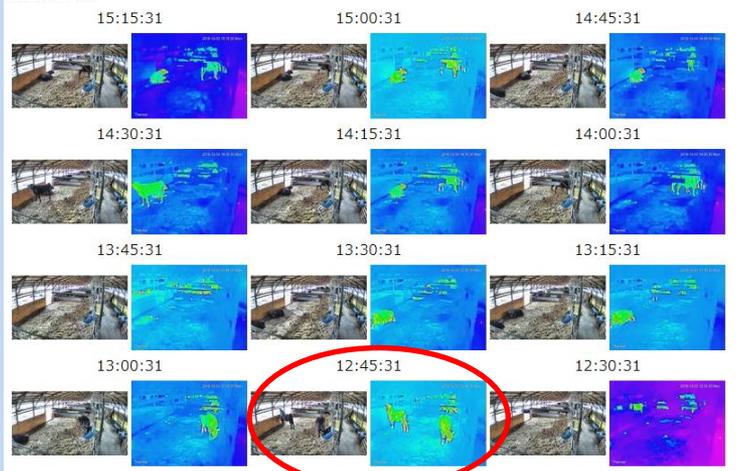
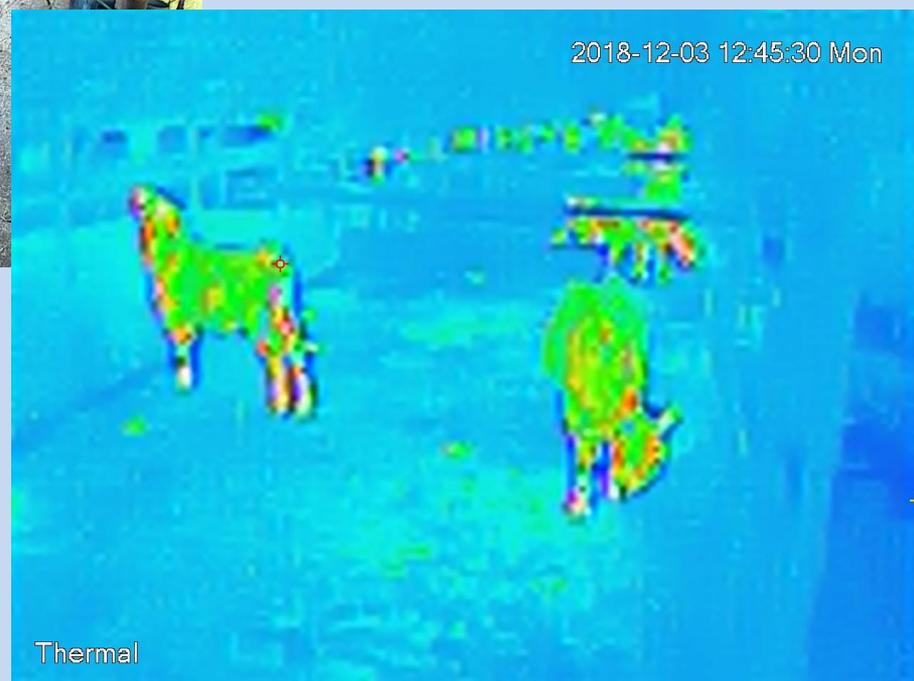
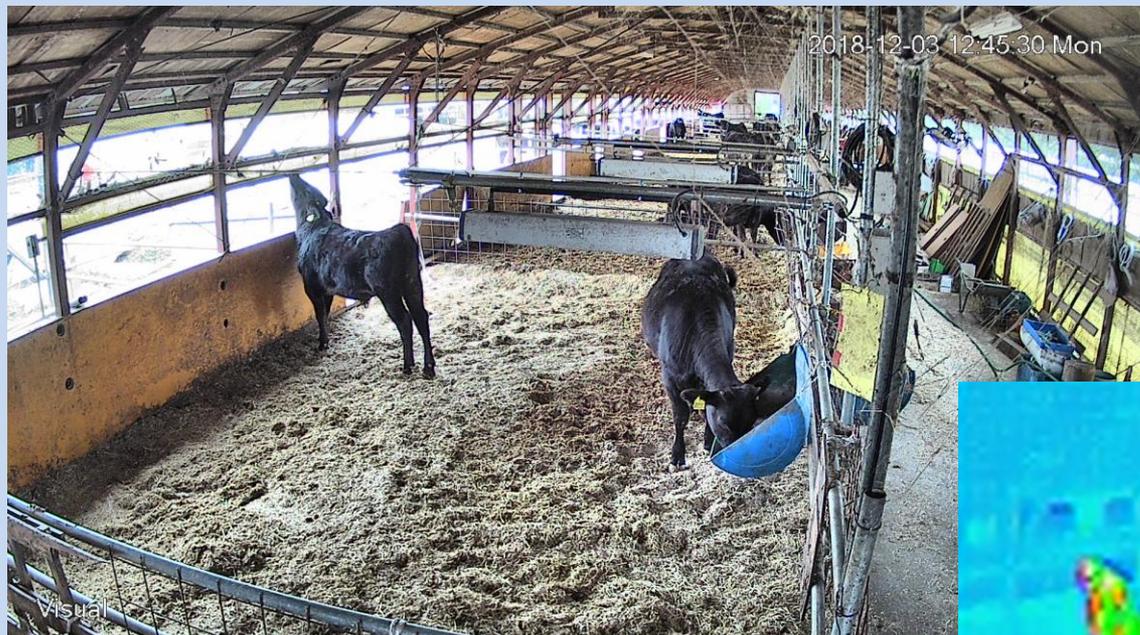


2018/10/25



Fence voltage

# Cattle (Wagyu) monitoring in litate village using image and thermal camera



# Conclusions

- Field Monitoring System (FMS) using sensors for agriculture is quite promising for smart agriculture
- We can use this system in all over the world fields where we can use mobile phone and solar panel
- Data analysis system using AI is needed

# Thank you for your attention

