TRIALS OF PRECISION RESTORING AGRICULTURE IN JAPAN

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ABSTRACT

The objective of the paper is to describe a tentative scheme of precision restoring in Japan in a view of agricultural engineering. On March 11th in 2011 the northeast Japan was attacked by the tri-disaster; a M 9.0 super earthquake, more than 10-m–high huge Tsunami, and explosions of Fukushima nuclear power station. Tremendous damage has been confirmed across the cities and rural communities, including agriculture and industry. In three weeks after the catastrophe, the author organized a project team in the Society of Agricultural Machinery to investigate the damages and to look for avenues on not only community-based reconstruction but also removal of radioactive contamination from the farm land. Two actions were made for immediate requests. The one was to develop machines to remove the top thin layer of agricultural land with highly dense radioactive contaminations. The second one was to look over the farm land damaged by the Tsunami and to find avenues for recovery. These actions have made linkage with many related activities and policies, and have still continued.

Key Words: Disaster, Resilience, Restoring, Farm assurance, Traceability

INTRODUCTION

"3.11" in 2011 is the day the northeast Japan was attacked by the tri-disaster; a M 9.0 super earthquake, more than 10-m–high huge Tsunami, and explosion of nuclear power stations. Huge damage has been confirmed across the cities and rural communities, including agriculture and industry sectors. The Japanese Society of Agricultural Machinery: JSAM (now The Japanese Society of Agricultural Machinery and Food Engineers: JSAM) has conducted to help and recover from the damage of disasters (Shibusawa 2012).

We have had less experience to combat against such a big catastrophe of complex huge disasters. One of the useful approaches will be in precision agriculture that has been applied into not only agricultural sectors but also environment and construction fields (Berry et al 2005, Shibusawa 2004, 2008, 2009). That have lead us to the evidence-based approaches and precision thinking

in the practice of precision agriculture.

The first action was, on March 12th, to ask for confirmation of safety of all members belonging to JSAM through e-mails, cellular phones, internet service, and so on. It took one week for Kanto area and two weeks for Tohoku area to be completed. Unfortunately we had received the information that three student members were killed by Tsunami at Sendai airport.

Information through the media and direct calls to us, lead us to organize the working team of JSAM on March 30th, 2011. The missions of the team were (1) to validate the facts and information on the disasters since there were confusion and complexity, (2) to investigate the damages in terms of agricultural machinery and farm management, and to (3) propose better scenarios of reconstruction for community-based agriculture. The actions were to have recommendations on removal of the radioactive contaminations, on restoring of agricultural mechanization damaged, and on extension such as having symposium.

First of all people have to reminder the potential of Tohoku agriculture as shown in Fig. 1. Statistics in 2010, compiled by Tohoku regional agricultural administration office in Sendai, said that agricultural production was 1,359 billion yen with an occupation of 16 % of total production in Japan, including 496 billion yen of rice, 383 billion yen of livestock and 228 billion yen of vegetables. Number of growers was 463 thousand with a ratio of 16% to the whole growers in Japan. The ratio of growers above 65-yr was 30 % and it was lower than the national average of 58% in Japan. Self-sufficiency of food production in Tohoku region was more than twice of the national average. Apple fruits production of Aomori occupied by 53 % in whole production of Japan, cherry of Yamagata was 71 % and peach of Fukushima was 20 %.

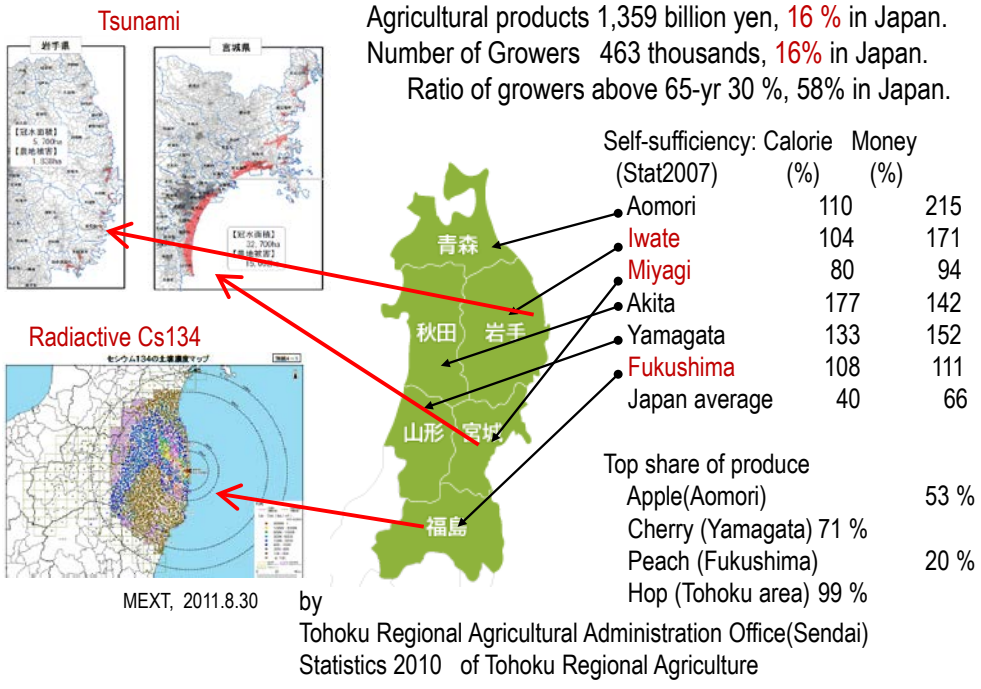

Figure 1. Agricultural potential of Tohoku region attacked by the disaster.

In the last three years, restoring stages has changed. Fukushima prefecture has still issues on measures of both radioactive contamination and Tsunami damage. While Miyagi and Iwate prefectures are focusing on the recovery from Tsunami Damages. This paper describes brief outlines of the state of the projects.

RADIOACTIVE CONTAMINATION

Requests

With the information on radiation dose as shown in Fig.1, the Ministry of Agriculture, Forestry and Fisheries has appealed to the public for research project on removal of radioactive contamination from the arable land, as shown in Fig. 2. The JSAM working team has investigated technologies to precisely remove the top contaminated soil using agricultural machinery techniques.

Functions of work required were as follows:

- ✧ To shave off the top thin soil.
- ✧ Uniform cuts off the top soil.
- ✧ Removal of the upland top soil.
- ✧ Perfect soil turning by deep plow-in.
- ✧ Top soil collection by suction.
- ✧ Ridge cleaner and weed ripper.
- ✧ Precise work on the slope.

Replying to the government requests, a couple of project teams were organized by companies of agricultural machinery and NARO Bio-oriented Technology Research Advancement Institution (BRAIN), and then achieved the precise handling system by improvements of conventional machines. A concept of machine design included (1) users should be farmers, (2) based on the

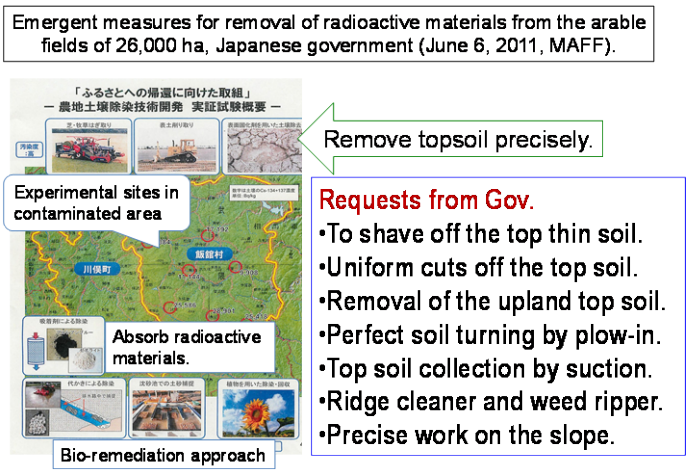

Figure 2. Projects on removal of radioactive contamination (June 6, 2011, MAFF).

conventional machines familiar with handling, and (3) short-time development within one year.

Machines Developed

Top soil removal machines working in the field were relatively easy to be developed since paddy management machines were widely used. Another big issue for the removal was laid on the edges of individual fields including farm loads. In Japan there are so many small scale fields with ridges, irrigation furrows, and narrow farm roads in order to divide into respective fields of owners. Figure 3 shows the machines for special uses in reduction of radioactive dose. Figure 4 shows tractor cabins developed for radioactive protection in the field work.

Figure 3. Top soil removal machines to clean off the radioactive materials across the fields.

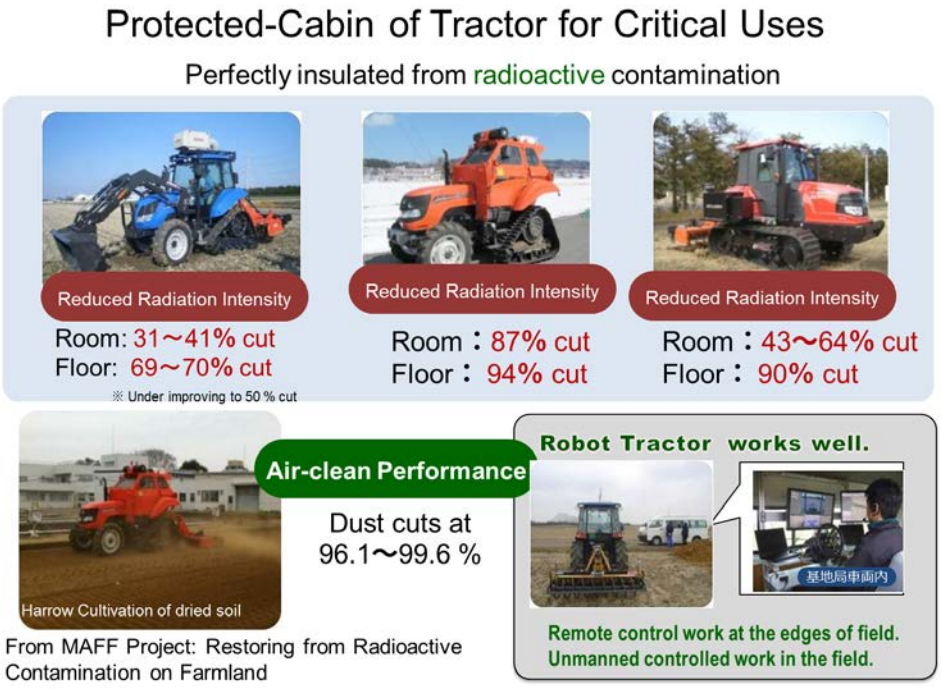

Figure 4. Protected cabins robot tractor against radioactive contaminations.

Precision Restoring Agriculture

Goto et al. (2013) have organized a JST (Japan Science and Technology Agency)-funded 3-year project on precision restoring agriculture in Fukushima area in 2012, as shown in Fig. 5. In particular people in Fukushima have received the serious damage by not only the northeast Japan earthquake disasters, but also rumors related to collapse of the nuclear power plant, and in addition they have nowadays rural issues on farmer's aging, depopulation in the village, service "desert", and so on. Therefore, it is an important issue for the future agriculture of Japan to revive the agriculture of this area.

A conventional way of thinking and approach is hopeless when such a catastrophic disaster occurs. Recognizing this context, one farmer and one local company has jumped into innovation: creating an evidence-based farm management system to persuade the misunderstanding customers, using IT and a concept of precision agriculture. ADS Ltd. has replied to the request and organized the project team.

The goal of the project is to create an information-oriented field to meet the request of consumers. Within a limited budget, a real-time soil sensor was introduced to monitor the within field soil condition, and the sensor posts were setup in the field to monitor a dose of radiation, wind velocity, a wind direction,

rainfall, etc. They are welcome a company with a yield monitor system.

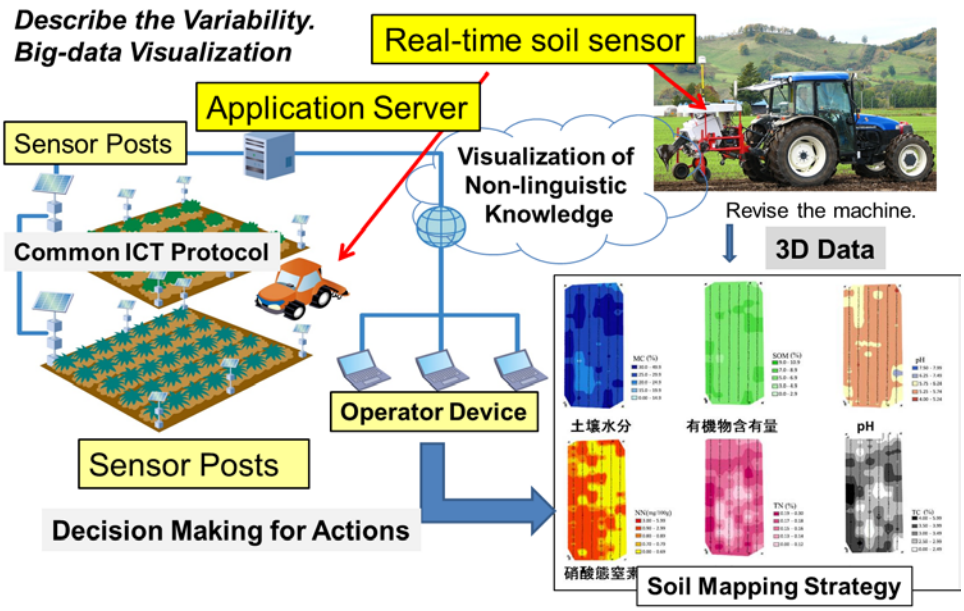

Figure 5. JST-funded project on precision restoring agriculture of paddy in Fukushima towards traceable management against rumor damage.
Project leader: ADS Ltd., Research leader: TUAT.

FARM RESTORING

Site Visit and Recommendations

The JSAM working team conducted a short visit to paddy fields at Kitakami of Ishinomaki city and protected horticultural fields at Watari of Natori city in Miyazaki prefecture on September 12th and 13th, 2011, and published a report (Shibusawa and Sugiyama 2012).

The one site that they visited was Kitakami riverside at around 10 km distance from the coast. People talked: (1) Tsunami brought lot amount of rubble on a way of over 10 km distance from the coast, and they had still removed it (Fig. 6. (c)), (2) they cut and removed the weeds on the paddy fields for preparing the next cropping season (Fig. 6 (a)), (3) they had less concern of salty sludge since the sludge used to be applied in the paddy for soil improvement, (4) they needed recovering the transportation, repairing the drain pumps and recovering machines and facilities for re-start of the farm work. A local dealer was continuing the work on repairing the machines flooded with sea water (Fig. 6 (d)). It was difficult to repair perfectly because of salt and sludge invading into space to space without recognition.

Watari was famous for its protected horticulture of strawberry, located at a distance of a few kilo meters from the coast. They had 380 strawberry growers producing 3.5 billion yen occupying a good shear in Sapporo market. Tsunami flushed away all of the facilities and more than 1-m-depth sea water stayed in weeks. They had emergent requests: (1) need to purify the groundwater as soon as possible, (2) need to improve salty soil, (3) need to remove small rubble in the fields to start farm work, and (4) eager to recover the local markets. A hundred growers started cropping, though many growers will give up cropping with no prospects.

With evidence of survey the JSAM proposed five recommendations, (1) have a strategy for land consolidation and for newcomers for agricultural management, (2) protect the intellectual properties of farmers, (3) provide a service network of agricultural mechanization, (4) reconstruct the systems for both producers and retailers at the same time, (5) keep the farm assurance and farm management standard such as GLOBAL G.A.P.

Figure 6. People's combat against Tsunami disasters of paddy fields in Ishinomaki city, Miyagi.

Figure 7. Horticultural facility and fields damaged by Tsunami disaster at Watari, Miyagi.

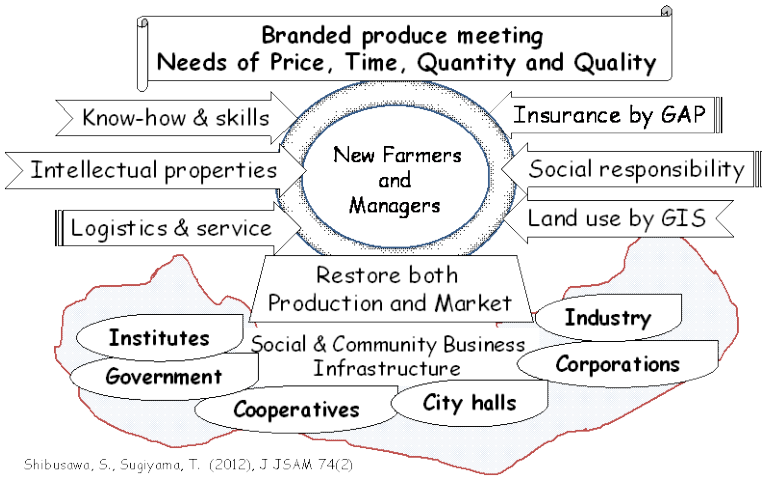

Figure 8. A recommendation of JSAM towards restoring agriculture.

National Projects

The Ministry of Agriculture, Forestry and Fisheries has launched many big projects for recovering from the disasters. Scale was so wide, damage was much heterogeneous and so huge, responsible people were so high-aging and small number. Therefore national projects organized had offered wide scope and bottleneck concentration at the same time. One of the main projects was the

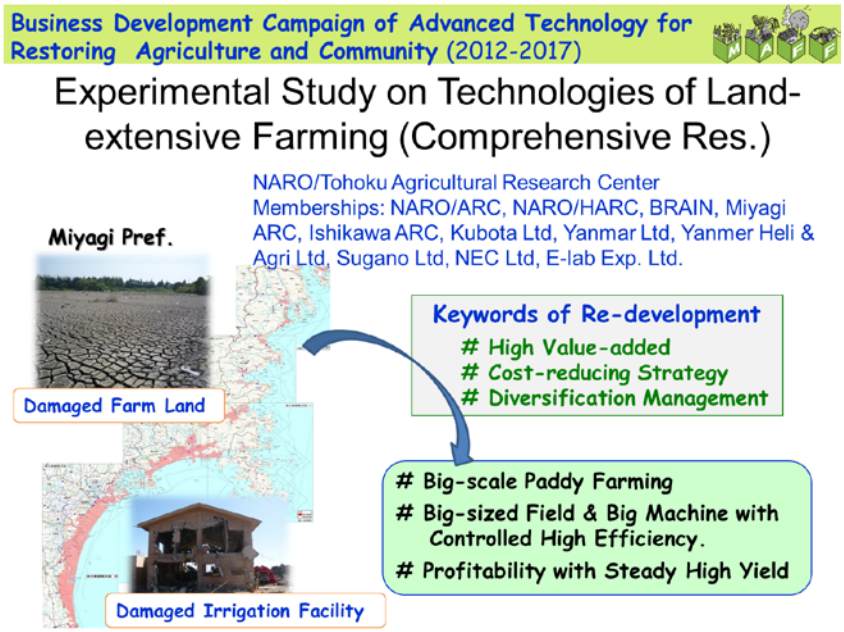

Figure 9. Government restoring project on big scale paddy-farming.

business development campaign of advanced technology for restoring agriculture and community in 2012-2017, as shown in Figs. 9 to 11. Figure 9 shows a project for arable land farming of cereal crop rotation and a private sector has joined the project (Fig.10). Figure 11 shows a project for multi-function greenhouse system. Details of these projects will be introduced elsewhere.

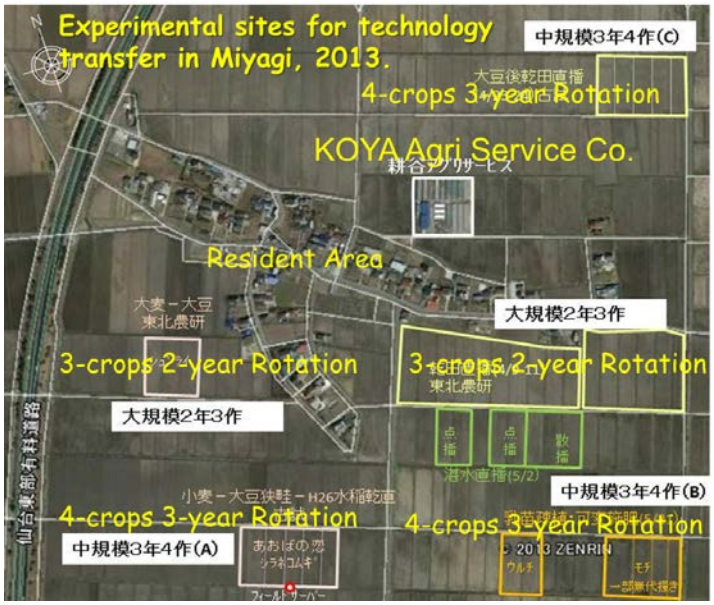

Figure 10. KOYA Agri Service Company has re-started farming and joined the government paddy project.

Figure 11. A multi-task advanced greenhouse system has launched in Miyagi.

Farm Insurance with GLOBAL G.A.P.

On the other hand dangerous works have been existed in agriculture with 400 victims by farm work accidents every year, followed by food safety issues and environment issues, in addition to restoring projects from the East-Japan catastrophe (Shibusawa 2012). This has led us to concentrate into a strategy of agro-architecture which is implying the re-construction of all of the agriculture. One of the keen issues is a risk management approach of GAP good agricultural practice. The GLOBAL G. A. P. statement is a worldwide farm management strategy of integrated farm assurance, food safety practice HACCP-based, cost of compliance, and integrity of farm assurance. The one-step-up and -down strategy offers a key protocol of traceable farm management (Baerdemaeker 2012). The GLOBAL G. A. P. rules should be implemented while taking account local legislation into. The G. A. P. growers have to find best collaborators from a pool of suppliers, wholesalers and retailers to create best food chains.

In 2010 Japan had a package of domestic regulations as a guideline for G. A. P. promotion, which was a table of control points and critical compliance on food safety, environmental conservation and workers protection, administrated by Agricultural Production Bureau, Ministry of Agriculture, Forestry and Fisheries. The guideline covers all crops of fresh vegetables, rice edible, wheat edible, fruits edible, tea, forage crops, other edible crops, other non-edible crops, and mushrooms, except for livestock farming and aquaculture (Shibusawa 2013).

Recording is the fundamental action of the G. A. P., which is familiar with precision agriculture of evidence-based farm management, followed by information-oriented fields and information-added produce.

CONCLUSIONS

With an idea of precision restoring, the activity of JSAM project team was introduced for recovering the 3.11 catastrophe. A feature of the catastrophe was described as the tri-disaster: M 9.0 super earthquake, 10-m–high huge Tsunami, and explosion of nuclear power station. The actions of the project team were: (1) to validate the facts and information on the disasters since there were confusion and complexity, (2) to investigate the damages in terms of agricultural machinery and farm management, and (3) to propose better scenarios of reconstruction for community-based agriculture. With potential agriculture of Tohoku region, a tentative scheme of restoring was introduced. New projects on precision restoring agriculture also began in collaboration with farmers, companies and institutes.

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