Development on the Rice Paddle Fieldwork Data Management System in an Agricultural Workforce Organization in Hyogo, Japan

Hajime KAWAMUKAI, Nobuhiko WASHIO, Chao Chen and Qinghao Li

Abstract: In this article, the authors would like to present the brief sketch of our currently developing the Rice Paddle Fieldwork Service Information Management System, its background, and its usage in JA Hyogo Mirai Agri-Support, a Japanese agricultural workforce organization. Having started its development since 2010, and we have been developing our system, based on GIS. We also mention some changes happening in JA Hyogo Mirai Agri-Support and its founding organization.

Keywords: Sight specific fieldwork service information management system, Agriculture, Agricultural workforce organization, fieldwork service record on rice paddle field parcels, Aged rural society

1. Background of our agricultural fieldwork Service Information management system development

As Wilson (1999) mentioned, huge sum of money have been invested on GIS in agricultural sector, from the farming parcel identifiable level to global environmental resource management level. In Japan, too, large amount of money have been devoted to develop many GIS based agricultural applications, like Kobayashi and Sakai (1995) and so on. Many local governments, and agricultural resource management organizations, like National Federation of Land Improvement Association in Japan, also invested on GIS for agricultural land use management systems. In last five years, some independent software developers, software developers of huge ICT venders, and some Japanese agricultural machinery makers, like Kubota Tractor Cooperation, have started to release cloud base services for fieldwork data management on land parcels, in Japan. Some agricultural production organizations and agricultural fieldwork service contractors began to use these systems, in order to develop their fieldwork record database for reporting service records to the fieldwork contractees.

In the background of the current increase of system development for the agricultural fieldwork services, there are some special structures of Japanese agriculture, i.e., existence of many small size family based farmers, due to the GHQ orders in occupied Japan era, and the aging of farmers. The average age of active farmers have increased rapidly in past three decades, due to the economic growth gaps between rural and urbanized area reduce the numbers of young farmers in rural area, therefore. The figure 1 shows the change of the average size of paddle fields for families of rice farmers in Hyogo and Japan. The increase of average size of paddle fields per families of rice farmers since 1970s, represents the fact of reduction of the numbers of rice farmers in Hyogo Prefecture and Japan. Figure 2 depicts the average age of agricultural workers in Hyogo Prefecture and Japan. We can see the rapid progress in aging of farmers in the last 2 decades. These figures indicate the severe conditions for rice farmers in Hyogo Prefecture and Japan.

Many local agricultural cooperative organizations have organized agricultural fieldwork supporting organizations,

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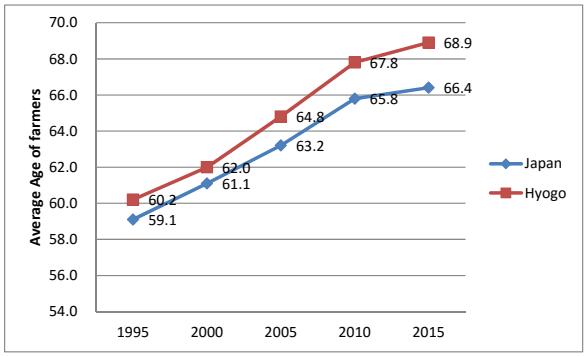

Figure 1. Average Age of Rice Farmers

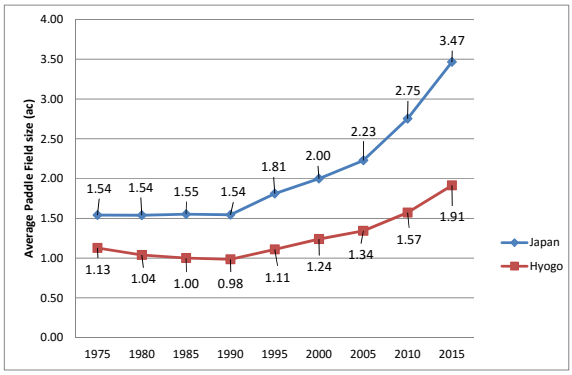

Fig 2 Change of Average Paddle Field Size (in ac)

like JA Hyogo Mirai Agri-Support, hereafter, Mirai Agri-Support, aiming the continuation of agriculture as industries. We also have many agricultural field service organizations, established as local government subsidized organizations, in order to support local farmers.

Since 2008, the established year of Mirai Agri-Support, it has started receiving fieldwork orders from rice farmers in the cities of Miki, Kasai, and Ono, shown in figure 3. The numbers of orders for fieldwork service are steadily increase year by year. Mirai Agri-Support has been servicing for more than 170 rice farmers. Most of them plant both ordinary rice grains for cooking, and special rice grain, called Yamada Nishiki, for Japanese sake brewing, traded at high trading price exclusively with specific Japanese Sake brewers.

In order to complete fieldwork services on behalf of the contractees, in both 2008 and 2009, Mirai Agri-Support used photocopies of paper based large-scale maps with land parcel shapes, as base maps for hand colored maps to represent the required fieldwork services.

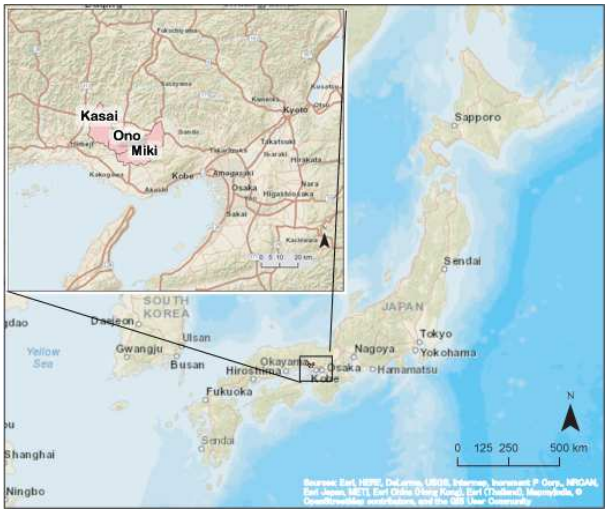

Fig 3 Service Area of Mirai Agri-Support

The different colors represent different fieldwork services for different types of rice grains, in order to avoid wrong fieldwork operations in the wrong rice paddle field. After copying hand colored land parcels maps, fieldwork operators received copies of these maps as guide maps for their fieldworks. However, the coloring maps were quite tedious tasks and required sincere attention of map coloring workers in Mirai Agri-Support. Regardless the most of colored maps could be reused forthcoming years, most of them were disappeared and deteriorated by the heavy working conditions, like working in rain and muddy fields.

2. Dataset Development in Mirai Agri-Support as Geo-Database

In order to reduce the heavy workloads of coloring maps, two of us started developing GIS based system in 2010. At this early stage, we developed paddle field parcel spatial database, based on the scanned paper maps of large scale views, like maps with the scale of 1/2,500 or 1/5,000, through map digitizing on computer screens, with the assistance of three graduate students.

In 2010, we struggled developing spatial paddle field database, due to the limited access to the large-scale view digital map data and airy photos or satellite image data, as open data.

Georeferencing the scanned map images based on the Digital Map 2500 of Japan, we started digitizing the shape of the paddle fields, including data entries of land parcel IDs shown on the scanned maps images. The development of spatial datasets for paddle fields took more than 18 months.

After the development of database in shape file format, we connected data of the owners and users of paddle fields utilizing information of the “Cultivation Record Book”, accumulated in Excel files. By connecting these two data, using land parcel IDs as the connecting key fields, we finally obtained the spatial dataset of our system for more than 60 thousands of land parcels.

For more than four years, we had been managing the database, via one by one editing method on paddle field database, using Q-GIS 1.7.3. For further detail, see Yabunishi et al (2014).

As the numbers of the orders for Mirai Agri-Support increased, the one by one data updating method caused a sort of workload issues in the Mirai Agri-Support. Therefore, we started development of the more efficient data management tools.

3. Change of Base GIS Software and Development of Data Management Tools

We decided to move onto the usage of ArcGIS10.1, instead of Q-GIS usage, as the base system, in August 2015. The reasons for this change are as follows. (1) Stability of its printing map services compared with Q-GIS, in our environment, (2) the readiness for the adding user original functions, utilizing model builder function, (3) the possibilities of function development in Python language, (4) improvement in the availability of the books on ArcGIS in Japanese, and (5) improved visibility of satellite and airy photo image, as base maps.

We have developed some data management tools, like a data-matching tool for the dataset in excel worksheets (see Fig 4), a detector of the unmatched data, and so on.

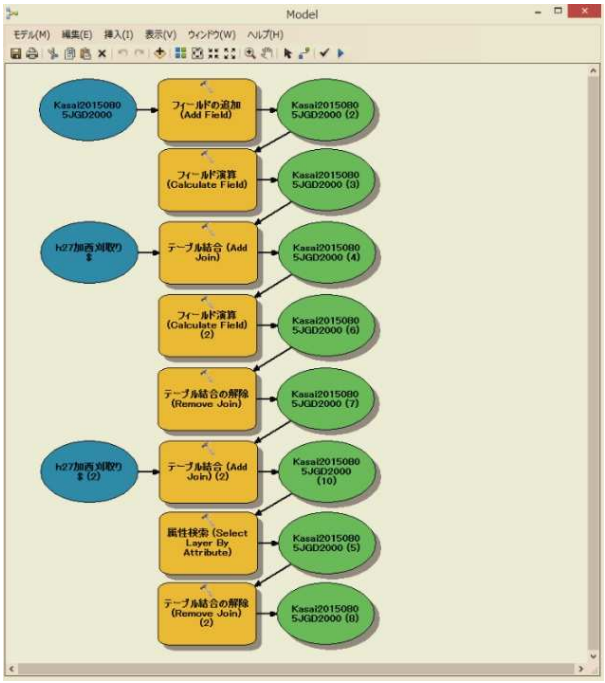

Fig 4 A tool developed in Model Builder in ArcGIS

Even though matched rate of our original data connection tools varies from 49% to 63%, which varies amongst the area groups, our new tools dramatically reduce the workload of tedious data maintenance tasks.

4. Some Further Changes by the Introduction of the Geo-database and Further Tool Development

Currently, the personnel of Mirai Agri-Support started wondering to expand some other functions for the work efficiency improvement, like a new automatic map printing tool for each township, another data management tool for fertilizer distributing field service and its routing, map distribution tools via PDF file formats, and so on.

One of the personnel also started to develop voluntarily their own manuals, for their routine work on our systems in 2015.

In August of 2016, one of the authors had a hands-on seminar of GIS system for 3 days long, two fieldwork managers of Mirai Agri-Support and more than 10 officers from JA Hyogo Mirai, the founder of Mirai Agri-Support, attended the seminar. At the end of every

seminar session, these officers have voluntary started free discussions on the utilization of GIS in order to make breakthroughs for their own daily tasks.

5. Some Findings of our Paddle Field Service Development

Some software developers use the Google Maps as base map service for the agricultural information services, in which point icons represent land parcels of agricultural land use, like National Chamber of Agriculture (2015). Representing the agricultural land parcels by point icons is quite convenient and reduces huge tedious workload of polygon creation, though it may contradict the intuitions and insights of the actual fieldwork service operators. At the early stage of our system development, one of us proposed to represent land parcels as point icons. Most of the fieldwork service operators gave us quite negative comments on the thoughts of the point icon representation for agricultural land parcels. From further interviews on this matter, we understood the reasons for strong preference on polygon style representations for land parcels, i.e., clear visibility in case of bad weather and in dark service environment after twilight.

Another fact we found is that the personnel in the headquarters of Mirai Agri-Support prefer to use the divided processing modules, rather having one continuous modules, like Fig 4. They prefer the divided style modules because divided modules are simple, and more understandable and modifiable by themselves.

6. Open Data and Agricultural Information Systems

When we have started our system development, we had to create the same dataset, which the local governments already have. We could reduce the cost of the spatial database development drastically, and avoid unnecessary double investment, if we could use the spatial dataset, which already existed. Now, here in Japan, some representative government officers advocate promoting usage of the open data, provided by governments, with loud voices. However, the size of the windows for the open data users is quite small, even today. We surely hope that open data societies, with the huge welcoming gates for the users of open data in the bodies of national and local governments, will arrive as soon as possible. Here, we would like to insist on widening the current small window size for the open data users in Japan, which have been the major obstacle in developing agricultural information systems.

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References

Kobayashi, H. and Y. Sakai(1995). The Mapping System for the Computer System on a Field Management of Paddy Farm, *Bull. Fac. Agric., Tottori University*, Vol. 48, pp.113-120, (in Japanese).

National Chamber of Agriculture (2015), Navigation system for Agricultural Land Information System of Agricultural Committee, available at: https://www.alis-ac.jp/ (accessed 6 Aug. 2016).

Yabunishi, F., H. Kawamukai, and N. Washio (2013), GIS Utilization as Agricultural Field Parcel Information Management System, Proceedings of Geographic Information Systems, Vol 22., E-3-3, Avaiable at: http://www.gisa.Japan.org/conferences/proceedings/2013/papers/E-3-3.pdf,(accessed 8 Aug. 2016) in Japanese.

Wilson, J.P. (1999), “Local, national and global applications of GIS in agriculture”, In Longley, P.A., Goodchild, M.F., Maguire, D. J., and Rhind, D.W., eds, *Geographic Information Systems*, Volume 2.. John Wiley and sons, Inc,.