Rice Objective Yield Survey in Japan

17th Feb, 2014

Climate Condition in Japan

[Graph showing monthly precipitation and average temperature from January to December, with a highlighted period indicating the growing season of rice.]
Planted Area and Production of Rice

Purpose of the Survey

- The rice objective yield survey is conducted to prepare necessary documents for administrative measures in the fields of agriculture, forestry and fisheries, such as the estimation of supply and demand for rice and planning measures for the rice production.

- Therefore high accuracy is required and aimed precision of the survey is approx. 1% in each prefecture.
Organization

(HQ) Ministry of Agriculture, Forestry and Fisheries (MAFF)

(Regional Level) Local Agricultural Administration Office (9 Offices)

(Local Level) Area Center (69 centers + 38 branches)

Survey System

Preparation of Population

Selection of sample survey fields

Survey with actual measurement, field observation survey, information collection, etc.

Rice crop general condition survey

[Publication (July, August and September)]
July: literary information on crop condition (early planted rice)
August: information on rice growth (late delivering rice) and literary information on rice crop condition (early delivering rice).
Crop situation index (early planted rice)
September: Crop situation index (nationwide)

Production forecast survey

[Publication (in October)]
Planted area, Production forecast, Crop situation index, etc.

Production survey

[Publication (in December)]
Planted area, Production, Crop situation index, etc.
### Survey Item

#### Growing Stage of Rice

<table>
<thead>
<tr>
<th>Survey items</th>
<th>Rice crop general condition</th>
<th>Rice cultivation technology, etc.</th>
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</thead>
<tbody>
<tr>
<td>July</td>
<td>* * * * * * *</td>
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<td>August</td>
<td>* * * * * * * * * * * *</td>
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<td>September</td>
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#### Timing of the Survey

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</table>

Note: Only main survey items are mentioned, due to different stages of rice development in different locations.
Sample Allocation

• To calculate number of samples per prefectures
  No. of sample is calculated by aimed precision and C.V. of each prefecture

• To divided area of each prefecture into some strata
  These strata are set based on geography, cultivated variety and trend of cultivation etc. to increase accuracy.

• To decide No. of sample of each strata
  Sample is allocated to each strata according to product of “Planted Area of Previous Year x population SD of Yield per 10 are (a, 1a = 10 meter x 10 meter)

Selection of Sample Field ①

① The total area of Japan is divided into a grid of 200m x 200m square (a 400m grid square for Hokkaido), which is defined as a “land unit” in this survey. Of all grids, those containing paddy fields are defined as survey population.

② Of the population, approx. 10,000 land units are randomly selected as sample land units.
Selection of Sample Field ②

③ In each selected sample land unit, a parcel of paddy field is randomly selected as “sample survey field (farmland to be surveyed)” out of paddy field planted paddy rice.

④ In each sample survey field, 3 points are randomly selected as points to be surveyed diagonally in farmland from the table of random numbers.

Survey on Sample Fields ① : Selection of Survey Points

① To count number of rows “n” at a sample field

② To select a start row “a” during 1 to 1/3n by using of the table of random numbers and also select 3 rows (a, a+1/3n, a+2/3n) as a sample row

③ To select point at the intersection of longer diagonal with survey rows as survey points
Survey on Sample Fields ②
: Measurement of Survey Items

• Length of Rows/ Length of stocks
   To measure length of 11 rows and 11 stocks
   To calculate number of stocks per 1m²

• Height of Plant
   To measure height of plant of 5 stocks at each
   3 survey points (total 15 stocks) and calculate
   average

• Number of Stems
   To count number of stems of 10 stocks at
   each 3 survey points (total 30 stocks) and
   calculate number of stems per 1m²

Survey on Sample Fields ②
: Measurement of Survey Items

• Number of Panicles
   To count number of panicles of 10 stocks at
   each 3 survey points (total 30 stocks) and
   calculate number of panicles per 1m²

• Number of Grain
   To count number of grain of highest branch
   and 2nd lowest branch and calculate number
   of rice per a panicle and per 1m²
   Number of surveyed stocks are 3 at 1st survey
   point, 4 at 2nd point and 3 at 3rd point (Total
   10 stocks)
Survey on Sample Fields ③: Experimental Cultivation

- Cultivation
  Rice grains are cultivated in an area equal to 1m² in each of the 3 survey points (an equivalent of 3m² in total), and the cultivated rice grains are threshed, dried and hulled.

- Drying / Processing
  Brown rice that is considered fit for the table is selected (i.e. brown rice ranked as third grade or higher as defined by the Agricultural Products Inspection Act and retained on a mesh sieve with openings of 1.70mm and over).

Experimental Harvest
Rice grains are harvested and threshed

Yield per 10a

Dry
Processing
Hulling

Crude Brown Rice

Combine losses ratio
Damage data
Data collected from related institutions

Crude brown rice is divided into two categories - 1) third grade as defined by the Act and retained on a sieve with openings of 1.70mm and over and 2) poorly ripened rice.

Poorly Ripened Rice (For processing)

Estimation of Yield per 10 a

Concept to Calculate Production

Planted Area × Yield per 10a = Production

How to estimate yield per 10a in each survey period

(Harvesting Season) Result of Experimental Cultivation
(Before Harvesting) Multiple regression equation
(Before Planting) Normal Yield per 10a
Forecast before Harvesting Season

Yield per 10a are estimated by actually measurable items in sample survey fields such as number of panicles, number of grains and weight of 1,000 paddy grains and by applying forecasting values derived from prediction formula, that are based on historical weather data and measured data.

\[
\text{Final Value} = \text{Forecasted Value} 
\]

\[
Y = 5.470 + 0.205(x_1) - 0.023(x_2) - 0.003(x_3) 
\]

\[ R^2 = 0.958 \]

- \( Y \): Weight of 1,000 grains
- \( X_1 \): Rate of Insemination
- \( X_2 \): Total number of unripened rice per 1m²
- \( X_3 \): Accumulated 20 days of low temperature after heading of panicle

Example of Prediction Formula
Changes in Yield per 10a by Survey Period

<table>
<thead>
<tr>
<th>Year</th>
<th>Sept.</th>
<th>Oct.</th>
<th>Final Data</th>
<th>Reason of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>528</td>
<td>514</td>
<td>514</td>
<td>Injury of Ripening by typhoon and long period rainfall</td>
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<tr>
<td>2005</td>
<td>536</td>
<td>532</td>
<td>532</td>
<td>Injury of Ripening by high temperature and insects</td>
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<tr>
<td>2006</td>
<td>515</td>
<td>508</td>
<td>507</td>
<td>Salty wind damage</td>
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<td>2007</td>
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<td>2009</td>
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<td>2010</td>
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<td>522</td>
<td>Injury of Ripening by high temperature</td>
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<td>2011</td>
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<td>2012</td>
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<tr>
<td>2013</td>
<td>543</td>
<td>539</td>
<td>539</td>
<td>Typhoon, insects and disease</td>
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</table>

Changes in Crop Situation Index by Survey Period

<table>
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<td>2005</td>
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Normal Yield per 10a ①

[Definition]
Normal yield per 10 is the yield per 10 a of current year forecasted, before paddy rice is planted on the basis of the trend of past production, taking into consideration the improvement in cultivation method and the recent trend in production, on the assumption that weather condition and crop damages are equal to those of normal years.

[Method of calculation]
- Computing trend value
- Examining recent trend in production
  - Changes in crop varieties
  - Changes in cultivation management technology, such as fertilizer application
  - Changes in rice planting period

Normal Yield per 10a ②

① Yield per 10a (1979～)
To remove metrological effect by using of weather index

② Correction Value
Calculating trend value by estimation formula

③ Normal Yield per 10a
Consider additional production factors such as recent planting technology, varieties etc.
Normal Yield per 10a (3)

Estimation of Normal Yield

Normal Yield per 10a (4)

Change in Yield and Normal Yield
Crop Situation Index

Crop situation index is an indicator to measure rice production situation of the year and is defined as a ratio of “forecasted yield per 10a” to “normal yield per 10a”.

\[
\text{Crop Situation Index} = \frac{\text{Yield per 10a}}{\text{Normal Yield per 10a}} \times 100
\]

Change in Survey Method

- Number of Sample, Survey Point at a Sample Field
  - Number of Sample 34,000(1965) → 10,000(2013)
  - Number of Survey Point $3.3 \text{㎡} \times 3(1954) \rightarrow 1 \text{㎡} \times 3(2013)$

- Change in Forecasting Method of Yield per 10a
  - To measure number of grain and forecast based on weather and damage condition
  - To break down yield into basic components and forecast unmeasurable components
  - Improvement of Multiple Regression Equation

- Change in calculation of Normal Yield per 10a
  - Average of the past years
  - Regression Equation (Single regression equation → Square root regression equation → Square root multiple regression equation)
  - Forecasting by Spline Method
Further Issue

- Streamlining Survey Method
  - Reduction of Number of Staff

To need to streamline survey method by keeping accuracy of the survey
(Reduction of Sample size and number of the survey? /
Change in Survey Method? / Introduction new technology?)