Agricultural Regions in the Province of British Columbia, Canada

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Abstract

This study identifies agricultural regions in the province of British Columbia, Canada, by means of statistical analysis. The initial factor analysis was conducted based on census-consolidated subdivisions and 39 agricultural variables selected from Census of Agriculture data, resulting in the 10 maps shown in Figs. 2 and 3. Subsequently, cluster analysis was conducted on the factor scores, allowing the 10 maps obtained from factor analysis to be shrunk into one map with eight clusters. Based on the cluster distribution results and agricultural land characteristics, we propose eight agricultural regions for British Columbia: (I) the Lower Mainland, (II) Southern Vancouver Island, (III) Thompson, Cariboo, and Nechako, (IV) Okanagan Valley, (V) Kootenay and the Rocky Mountains, (VI) The Pacific Coast, (VII) Peace River, and (VIII) the Northern Rockies.

Key words: British Columbia, Census of Agriculture, cluster analysis, factor analysis, regional division

I. Introduction

Located on the west coast of Canada, the province of British Columbia extends over an area of 950,000 km², about 2.5 times larger than Japan. It comprises the Metro Vancouver Regional District in the southwestern part, the population of which is the third largest in the country. Various types of agriculture have developed in the province under its unique geographical conditions. In this study, we examined regional differences in agriculture in the province by means of statistical analysis. Our methodology is based on the former studies of Troughton (1982) and Tabayashi (1991) that distinguished the agricultural regions of Canada. More recent studies of British Columbia's agricultural regions have not focused on the geographical perspective, despite continuous changes in agriculture in the context of time and space. In addition, previous studies dealt with agriculture at the national level; thus, detailed divisions were omitted under provincial-scale examination.

Regarding the methodology, statistical studies of regional divisions have been performed since the early 1970s. Among the cases of Japan, Okuno (1971) suggested an emerging methodology based on factor and cluster analyses. Sakurai (1973) applied the method to the central part of the Kanto district and delimited regional divisions of agriculture (i.e., agricultural regions) based on agricultural variables. Their methodology, utilizing multiple statistical analyses, is effective for cases involving a large number of statistical regions and variables. For instance, Okuno (1985, 1987) examined the regional divisions of Nagano Prefecture by calculating 40 variables and 122 municipalities. In the 1980s, Yamamoto et al. (1988) identified agricultural regions for the entire Kanto district based on 26 variables and 1756 municipalities. Kitamura (1982) also explicated the agricultural regions at the national scale using factor and canonical-correlation analyses for 32 variables and 1140 regions (municipalities and groups of municipalities).

In the 2000s, statistical studies of agricultural regions incorporated qualitative data at the micro-scale and geographic information system (GIS) data at the macroscale. The former, presented by Tabayashi et al. (2003), examine rural sustainability in the Isawa Alluvial Fan in Iwate Prefecture. Specifically, the study carried out factor and cluster analyses on 214 regions and then used qualitative data obtained from interviews with farmers to explain the spatial divisions extracted from the combination of statistical analyses. Regarding GIS, Nihei (2006) presented agricultural regions of Japan at the national scale, in which regional differences in agricultural sustainability were identified; the study methodology was also based on factor and cluster analyses, based on 3336 municipalities and 42 variables selected from the Census of Agriculture and Forestry.

Using cluster analysis, the agricultural regions of Canada were confirmed by Troughton (1979), as one of the participants in "the typology of world agriculture" initiated by the Polish geographer, Kostrowicki (1972). The results were later published as part of a series, "Geography of World Agriculture" (Troughton, 1982). As for the

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methodology, Troughton (1979) applied 24 variables selected from the 1971 Census of Agriculture covering land ownership, area of agricultural land, agricultural labor, materials, sales, and product; the data were then analyzed based on 253 census divisions. The calculation elicited eight agricultural regions. The following four types were matched to British Columbia: (1) small-scale intensive vegetables and poultry, predominant in Newfoundland and Lower Mainland of British Columbia; (2) extensive, medium scale, low intensity crop and livestock in Atlantic Canada and Vancouver Island; (3) extensive, mixed grain and livestock in Northern Ontario, Manitoba, Western Alberta, and Northern British Columbia; and (4) extensive livestock grazing in Interior British Columbia.

Subsequently, Tabayashi (1991) outlined the agricultural regions of Canada using cluster analysis and the distance grouping method of Ward based on 1986 Census of Agriculture data. The study initially selected 17 variables related to land use, sales, and products, and then conducted cluster analysis on 244 census divisions of Canada. Eight groups of regional divisions were obtained and, following the considerations of the cluster group distribution, nine agricultural regions were identified. Among them, the following three corresponded to British Columbia: (1) Type B, signifying small-scale farming, fruit farming, and intensive and profitable farming in southern British Columbia; (2) Type E, signifying low profitable and miscellaneous farming including beef cattle farming, distributed in inland areas of the province; and (3) Type G, signifying large-scale, profitable beef cattle farming or grain production in northeastern British Columbia.

Based on the methods of previous studies, this study applied an approach that combines factor and cluster analyses. In Section II, selection methodologies are described to distinguish statistical regions, the variables for statistical analysis, the program used, and the appropriate mapping procedure. For statistical analysis, we refer to the 2011 Census of Agriculture, the most recently released census upon commencement of this study. Census data provide not only a comprehensive collection of tables but also maps for use in GIS. Methods are explained in detail in this section, as this was one of the first studies of its kind since the 2000s; additionally, the methodological descriptions of former studies were insufficient, due to the significant geographical changes that had developed over time. In Section III, factor analysis results are explained with tables and maps that indicate their spatial distribution. Factor analysis maps are also abridged into one map, based on the cluster analysis results of the factor scores. In Section IV, the agricultural regions of British Columbia are identified by examining the distribution of clusters with reference to the actual location of agricultural land. Quantitative data gained by on-site observations, interviews

with farmers, and several publications of a study group that engages in "empirical study of the construction of an urbanrural symbiotic system by means of commodification of rural space in Canada" are considered in the discussion.

II. Methods

1. Selection of statistical regions

(1) Province and Territory

The largest aerial divisions defined by the national statistics of Canada are set as 10 provinces and three territories. They are assigned with a two-digit specific Standard Geographical Classification (SGC) code as follows: 10 Newfoundland and Labrador, 11 Prince Edward Island, 12 Nova Scotia, 13 New Brunswick, 24 Quebec, 35 Ontario, 46 Manitoba, 47 Saskatchewan, 48 Alberta, 59 British Columbia, 60 Yukon, 61 Northwest Territory, and 62 Nunavut. In the case of provinces, the first digit indicates a serial number, and the second digit the location from east to west, namely, 1 Atlantic coast, 2 Quebec, 3 Ontario, 4 Canadian Prairies, and 5 British Columbia.

(2) Census Agricultural Region

Agricultural statistics are basically published at the scale of census agricultural regions. These regions correspond to census divisions, as explained in the next part, and are not defined in relation to territories. Some of the regions are associated with "crop districts" in the Canadian Prairies. Figure 1 shows the case of British Columbia, in which thick solid lines demarcate eight census agricultural regions in the province. An example of the SGC code for a census agricultural region is 59-02, indicating Lower Mainland-Southwest, British Columbia.

(3) Census Division

Census divisions are practically consistent with the counties and regional districts defined by provinces and the units of public services including local police and ambulance. The regions correspond to census-consolidated subdivisions or census subdivision groups, as described below. In Fig. 1, thick dotted lines show the boundaries of census divisions. There are 29 census divisions in British Colombia: two of them are data confidential in the Census of Agriculture because only a small number of farms practice agriculture in the divisions. Base maps of census divisions for use in geographical information systems (GISs) are available on the website of Census Agricultural Regions Boundary File, Statistics Canada (http://www.statcan.gc.ca/ pub/92-637-x/92-637-x2011001-eng.htm). An example of the SGC code for a census division is 59-02-09, which indicates Fraser Valley, Lower Mainland-Southwest, British Columbia.

(4) Census-Consolidated Subdivision

A census-consolidated subdivision consists of a group of neighboring administrative districts or municipalities. The areas tend to be smaller in and around large cities,



Fig. 1 Statistical divisions in British Columbia, Canada (Source: Statistics Canada and the 2011 Census of Agriculture).

but larger in rural or mountainous areas. As well as census divisions, the base maps of census-consolidated subdivisions are distributed by Statistics Canada for use in GISs. In Fig. 1, thin dotted lines show the censusconsolidated subdivision boundaries. There are 153 Census Consolidated Subdivisions in British Columbia, and 27 of them are confidential in data. An example of a Standard Geographical Classification Code for a census-consolidated subdivision is 59-02-09-052, which signifies Abbotsford, Fraser Valley, Lower Mainland-Southwest, British Columbia. Notably, intensive fieldwork by Tabayashi et al. (2016) and Nihei et al. (2016) identified 22 censusconsolidated subdivisions in Lower Mainland-Southwest. (5) Census Subdivision

Census subdivisions coincide with administrative districts, the smallest statistical region; therefore, they must be suitable for making regional divisions on large-scale maps. However, the 2011 Census of Agriculture does not disclose numerical or boundary data through their website or government offices.

In this study, the census-consolidated subdivision scale was used for statistical analyses, as this scale provides the most detailed regional divisions with accessible data. Thus, by examining the aforementioned five scales of statistical regions, the results of the former studies of Troughton (1979) and Tabayashi (1991) were obtained at the national scale, using census division (a larger category than censusconsolidated subdivision). However, a preliminary study by Nihei (2015) remarked that, at the regional scale, census division did not provide the detail necessary for provincial scale analyses.

2. Criteria for setting agricultural variables

Table 1 shows the factor analysis variables. Ultimately, 39 variables were selected, based on the following factors. The Canadian Census of Agriculture is issued every five years by the Government of Canada. The website of Statistics Canada (http://www12.statcan.gc.ca/census-recensement/pc-eng.cfm) provides the statistical tables of the census after 1996, and the boundary files for mapping after 2001. The statistical tables of the 2011 Census of Agriculture are classified into six large classification categories, 45 middle classification categories, and 363 small classification categories. The large categories are composed of "farm type", "land use, tenure, and land-management practices", "crops", "livestock, poultry, and bees", "farm business characteristics", and "characteristics of farm operators".

As for the criteria to select variables, referring to the methods of previous studies, we made use of the six large categories identified in the census. The selection of variables is the basis for regional divisions, and former studies devised various methods for their selection. For

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Table 1 Variables for factor analysis on the regional divisions of agriculture in British Columbia, Canada

Source: The 2011 Census of Agriculture

example, Kostrowicki (1972) used three characteristics to examine the typology of world agriculture: (1) social and ownership, (2) operational (organization and technical), and (3) production characteristics. Based on Kostrowicki's method, Troughton (1979) applied four categories to explain the agricultural regions in Canada: social, operational, production, and structural attributes. In Japanese cases, Tabayashi, et al. (2003) and Nihei (2006) focused on three basic elements of agricultural management: land, labor, and capital.

In this study, variables are selected through repeated attempts of calculation and mapping; including the early attempts by Nihei (2015), the results of 20 factor analysis trials and 11 cluster analysis trials are preserved by the corresponding author. Among the preliminary calculations, the number of variables for factor analysis varied from 26 to 42. The numbers were rectified in every calculation to elucidate distinct spatial groups. A standard for selection is that the results could be summarized within 10 factors, using as many variables as possible. Finally, three of the 42 variables were omitted, namely, "percentage of hog and pig farms", "number of sheep and lambs per 100 farms", and "number of pigs per 100 farms." The reason for the omission is that their communalities after varimax rotation were less than 0.3. The omission is functional in cluster analysis to single out the groups that included multiple regions¹⁾.

3. Software used and mapping methods

Open source software was used for statistical analysis and making maps. Specifically, R (version: 3.1.3) was used for factor²⁾ and cluster³⁾ analyses, QGIS (2.4.0) was used to display the spatial renderings, and Inkscape (0.47) was applied for mapping. The results are expressed by choropleth maps that were divided by no more than three categories, allowing the readers to distinguish multiple maps easily from their compact arrangement within the figure. The intervals of legends are delimited simply by decimal places of 0 and 5; however, if the groups were difficult to distinguish, multiples of 0.25 were applied.

III. Results

1. Factor analysis of agricultural variables

Factor analysis was performed on a geographic matrix with columns representing 153 regions (census-consolidated subdivisions) and rows representing 39 variables. From this, 10 factors are resolved, as shown in Table 2. Figure 2 shows the distribution of factor scores from 1 to 6. In the factor 1 column, the factor loadings are high in the categories of agricultural machinery ("number of mowers per 100 farms") and "number of tractors per 100 farms"), "percentage of farms that rented land and buildings", "percentage of farms over 400 acres", and "percentage of beef cattle farms".

Considering these categories, we deduced that factor 1 signifies "large-scale farms, mechanization, and rented land". The regions of high factor scores, drawn in black in Fig. 2, are concentrated in the central part of the province. In the list of census-consolidated subdivisions, these regions correspond to Bulkley-Nechako C, E, and G; Cariboo I, J, and K; and Fraser-Fort George E.

Factor 2 loadings were low in the categories of "percentage of fruit farms", "percentage of fruits", "percentage of farms that contract farm work", and "number of employees per farm". Thus, this factor can be interpreted as "fruit farms" in inverse proportion, i.e., the lower the factor loadings, the higher the number of fruit farms. The regions with a low factor score are filled in, in black in Fig. 2, and are concentrated around Okanagan Lake. In the list of census-consolidated subdivisions, the regions correspond to Okanagan-Similkameen A, C, D, and E; all of the associated subdivisions are included in Thompson-Okanagan in the census-agricultural regions.

For factor 3, factor loadings are high in the categories of "percentage of dairy farms", "percentage of farms whose sales exceed \$250,000", "number of dairy cows per 100 farms", and "percentage of cultivated land". Consequently, this factor can be regarded as "dairy farms". The regions with high factor scores are found in the Lower Mainland. In the list of census-consolidated subdivisions, the areas coincide with Fraser Valley D, E, and G. These subdivisions are included in Lower Mainland-Southwest in census-agricultural regions.

For factor 4, factor loadings are low in the categories "percentage of vegetable farms", "percentage of vegetables", and "percentage of farms owning greenhouses". Accordingly, this factor describes the production of "vegetables". The regions of low factor scores are distributed in Vancouver, Vancouver Island, coastal areas northwest of Vancouver, and the foot of the Rocky Mountains. In the list of census-consolidated subdivisions, the regions are consistent with Burnaby, Capital G, Central Kootenay D, Delta, Nanaimo H, Powell River E, Richmond, Skeena-Queen Charlotte D, Squamish-Lillooet D, Sunshine Coast A, and Vancouver.

Factor 5 loadings are high in the categories of "number of beef cows per 100 farms", "area of farmland per farm", and "farm capital per farm". Thus, this factor is associated with the production of "beef cattle". The regions with a high factor score are situated in the central part of the province and at the foot of the Rocky Mountains. In the list of census-consolidated subdivisions, they are equivalent to Cariboo K, East Kootenay F, and Thompson-Nicola M.

For factor 6, factor loadings are high in the categories of "percentage of field crops" and "number of combines per 100 farms". Thus, this factor represents "field crops and mechanization". The regions of high factor scores appear

1 Trensing of registion 0.0	No. Variables	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10 C	Communality
7 Transpectivity -0.0	1 Percentage of vegetable farms	-0.29	-0.09	0.04	-0.80	-0.06	-0.07	0.13	-0.08	0.00	0.06	0.78
	2 Percentage of fruit farms	-0.16	-0.96	0.02	0.05	-0.13	-0.08	0.07	0.02	0.03	0.01	0.98
7 Formage (right) (miss) -00 00<	3 Percentage of greenhouse farms	-0.67	0.04	0.14	-0.46	-0.06	-0.12	0.04	0.04	-0.17	-0.11	0.74
5 Formany of memory (memory (memory)) 0.0 <	4 Percentage of dairy farms	-0.04	0.07	0.87	0.05	-0.11	-0.07	0.03	0.14	0.24	-0.16	0.89
• • Constrained exacts • exact exact • exact • exact	5 Percentage of beef cattle farms	0.68	0.36	-0.09	0.23	0.26	-0.14	-0.12	-0.05	0.03	0.15	0.78
	6 Percentage of poultry farms	-0.67	0.16	0.08	-0.05	-0.03	-0.14	0.03	0.04	0.06	-0.04	0.51
Increases Encoding of lines under 0 mass 0	7 Area of farmland per farm	0.34	0.08	-0.06	0.07	0.90	0.03	-0.03	0.02	0.05	0.05	0.95
	8 Percentage of farms under 69 acres	-0.78	-0.42	0.13	-0.16	-0.14	-0.24	0.08	-0.07	-0.04	-0.07	0.92
$ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $	9 Percentage of farms over 400 acres	0.79	0.29	-0.20	0.11	0.23	0.26	-0.09	0.12	-0.02	0.12	0.91
1 Trenumps of finance 05 010 021 010	10 Percentage of own land	-0.28	-0.03	0.06	0.03	-0.05	0.02	0.00	0.10	-0.04	-0.63	0.49
1 Temps of impact impact of impact of impact of impact impac	11 Percentage of leased land	0.56	-0.03	0.03	0.21	0.10	0.01	0.06	-0.01	-0.07	0.63	0.78
1 1 1 1 0	12 Percentage of irrigated land	-0.25	-0.42	0.38	-0.14	-0.07	-0.13	0.09	-0.07	-0.40	-0.03	0.60
1 Presentation for find constrained for find constraned for find constrained for find constrained for find constrain	13 Percentage of cultivated land	-0.27	-0.13	0.62	-0.15	-0.15	0.22	0.19	-0.05	-0.35	-0.26	0.80
Florenge of frame selence 014 013 016 015 016 016 013 014 014 014 014 014 014 016 015 013 014 016 016 013 014 016 014 016 014 016 014 016 <td>14 Percentage of field corps</td> <td>0.22</td> <td>0.09</td> <td>0.06</td> <td>0.08</td> <td>0.03</td> <td>0.87</td> <td>-0.01</td> <td>0.02</td> <td>0.01</td> <td>0.00</td> <td>0.82</td>	14 Percentage of field corps	0.22	0.09	0.06	0.08	0.03	0.87	-0.01	0.02	0.01	0.00	0.82
6 hereange of firme sound general point 0.16 0.07 0.06 0.04 0.06 0.04 0.06 0.04 0.06 0.04 0.06 <td>15 Percentage of vegetables</td> <td>-0.14</td> <td>-0.13</td> <td>0.10</td> <td>-0.75</td> <td>-0.03</td> <td>-0.03</td> <td>0.19</td> <td>0.00</td> <td>-0.32</td> <td>-0.04</td> <td>0.75</td>	15 Percentage of vegetables	-0.14	-0.13	0.10	-0.75	-0.03	-0.03	0.19	0.00	-0.32	-0.04	0.75
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	16 Percentage of fruits	-0.16	-0.87	-0.05	0.02	-0.06	-0.08	0.04	0.00	-0.14	-0.16	0.84
	17 Percentage of hay and fodder crops	0.38	0.53	-0.02	0.40	0.07	-0.19	-0.15	-0.14	0.06	0.08	0.68
1) Precuencial contrant contrast 011 0.25 0.01 0.01 0.05 0.25 0.21 0.01 0.05 <th< td=""><td>18 Percentage of farms owning greenhouses</td><td>-0.50</td><td>0.02</td><td>-0.05</td><td>-0.64</td><td>-0.06</td><td>-0.10</td><td>-0.04</td><td>0.03</td><td>-0.03</td><td>-0.18</td><td>0.72</td></th<>	18 Percentage of farms owning greenhouses	-0.50	0.02	-0.05	-0.64	-0.06	-0.10	-0.04	0.03	-0.03	-0.18	0.72
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	19 Percentage of farms selling organic products	-0.11	-0.29	0.04	-0.26	-0.07	-0.04	0.01	-0.05	0.32	0.21	0.32
	20 Number of beef cows per 100 farms	0.17	0.04	-0.01	0.06	0.91	0.00	0.05	-0.06	0.07	0.02	0.88
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	21 Number of dairy cows per 100 farms	-0.06	0.02	0.72	0.06	-0.04	0.03	0.02	0.08	0.01	0.00	0.54
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	22 Number of houses per 100 farms	0.53	0.25	-0.16	0.16	0.57	0.10	0.05	0.13	-0.09	0.07	0.76
24 Precruinge of frame whose sales are los than \$10,000 01 0.21 0.23 0.03 0.11 0.14 0.25 0.02 26 Precruinge of frame whose sales are los than \$10,000 0.04 0.03 0.04 0.05 0.01 0.05 0.03 <td< td=""><td>23 Farm capital per farm (1,000 dollars)</td><td>0.10</td><td>-0.36</td><td>0.46</td><td>-0.09</td><td>0.61</td><td>-0.08</td><td>0.08</td><td>-0.03</td><td>-0.32</td><td>0.06</td><td>0.84</td></td<>	23 Farm capital per farm (1,000 dollars)	0.10	-0.36	0.46	-0.09	0.61	-0.08	0.08	-0.03	-0.32	0.06	0.84
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	24 Percentage of farms whose sales are less than \$100,000	-0.16	0.43	-0.71	0.21	-0.18	-0.09	-0.11	-0.14	0.25	-0.22	0.94
26 Precentage of fams that rended and buildings 0.82 0.15 0.09 0.03 0.25 0.04 0.05 0.01 0.05 0.01 0.05 0.03	25 Percentage of farms whose sales exceed \$250,000	-0.04	-0.30	0.83	-0.19	0.13	0.06	0.12	0.13	-0.29	0.06	0.95
27 Number of intactors per 100 firms 0.67 0.01 0.24 0.13 0.21 0.03	26 Percentage of farms that rented land and buildings	0.82	0.15	0.09	-0.03	0.26	0.04	0.06	0.01	-0.05	0.19	0.82
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	27 Number of tractors per 100 farms	0.67	-0.01	0.49	0.24	0.13	0.21	-0.05	0.08	-0.03	0.02	0.82
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	28 Number of combines per 100 farms	0.27	0.09	0.03	0.06	00.00	0.87	0.07	0.12	-0.02	-0.02	0.87
30 Percentage of farms that contract farm work -001 -007 008 003 -014 015 013 <td>29 Number of mowers per 100 farms</td> <td>0.80</td> <td>0.39</td> <td>0.02</td> <td>0.32</td> <td>0.11</td> <td>0.18</td> <td>-0.05</td> <td>0.01</td> <td>-0.02</td> <td>0.06</td> <td>0.93</td>	29 Number of mowers per 100 farms	0.80	0.39	0.02	0.32	0.11	0.18	-0.05	0.01	-0.02	0.06	0.93
31 Number of employees per farm -0.02 -0.73 0.48 -0.11 -0.07 0.08 0.00 -0.13 0.15 0.15 0.15 0.01 0.02 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.02 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.0	30 Percentage of farms that contract farm work	-0.01	-0.73	0.49	-0.20	0.11	-0.07	0.08	0.03	-0.14	0.15	0.88
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	31 Number of employees per farm	-0.02	-0.73	0.48	-0.18	0.11	-0.07	0.08	0.00	-0.13	0.15	0.85
33 Precentage of farms with two or more operators 009 0.14 0.22 0.06 0.01 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.06 0.01 0.03	32 Number of operators per farm	0.12	0.00	0.07	0.13	-0.05	-0.01	-0.77	-0.01	-0.18	0.15	0.69
34 Percentage of operators who lived on the farm -0.06 0.20 0.03 0.01 0.03 0.05 0.68 0.03 35 Operators is sex ratio 0.21 0.21 0.21 0.22 0.02 0.02 0.03 0.01 0.03 0.01 0.03 0.01 0.03 0.01 0.03 0.01 0.02 0.02 0.02 0.02 0.02 0.02 0.01 0.03 0.01 0.03 0.01 0.03 0.01 0.03 0.01 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.03 0.03 0.03 0.02 0.03 0.03 0.02	33 Percentage of farms with two or more operators	0.09	0.14	-0.22	0.06	-0.01	0.00	-0.81	-0.03	0.20	-0.16	0.80
35 Operators's sex ratio 0.21 -0.21 0.33 -0.12 0.02 0.03 0.22 0.12 -0.21 0.08 36 Percentage of operators whose ages range from 35 to 54 years 0.01 -0.05 0.01 -0.02 0.03 0.02 0.03 0.13 -0.02 0.03 0.03 0.03 0.03 0.03 0.03 0.02 0.03 0.02 0.03 0.01 0.02 0.02 0.03 0.01 0.02 0.03 0.01 0.02 0.03 0.01 0.02 0.01 0.02 0.01 0.02 0.01 0.02 0.02 0.01 0.02 0.03 0.03 0.01 0.02	34 Percentage of operators who lived on the farm	-0.06	0.20	-0.09	0.22	0.01	0.00	-0.03	-0.05	0.68	-0.03	0.57
36 Percentage of operators whose ages range from 35 to 54 years 0.01 -0.02 0.04 0.09 0.83 0.18 -0.13 37 Percentage of operators whose ages are over 55 years -0.05 0.06 -0.22 -0.02 0.03 -0.07 0.00 -0.80 0.24 -0.02 38 Percentage of operators whose ages are over 55 years 0.16 -0.30 0.31 -0.22 -0.02 0.02 -0.08 0.24 -0.02 0.01 -0.02 0.01 -0.02 0.02	35 Operators's sex ratio	0.21	-0.21	0.33	-0.12	0.02	0.09	0.52	0.12	-0.21	0.08	0.56
37Percentage of operators whose ages are over 55 years -0.05 0.06 -0.22 -0.02 0.01 -0.80 0.24 -0.02 38Percentage of operators that work more than 40 hours per week 0.16 -0.19 0.31 -0.42 0.02 -0.02 0.08 -0.08 0.02 0.15 39Percentage of operators that are paid by non-farm work 0.16 -0.30 0.37 -0.27 -0.17 -0.09 0.04 -0.41 0.01 0.02 Contribution rate 16.4 11.9 11.7 7.6 7.2 5.0 4.5 4.4 4.1 Contribution rate 16.4 28.3 40.0 47.6 54.7 59.8 64.3 68.7 7.2 76.1 Weight coefficient for cluster analysis: 21.6 15.6 15.6 15.3 10.0 9.4 6.6 6.0 5.7 5.4 4.4 Interpretation of factorsfactorsfield crops,muchor of actors $anther of actorsanther of actorsant$	36 Percentage of operators whose ages range from 35 to 54 years	0.01	-0.05	0.14	-0.01	-0.02	0.04	0.09	0.83	0.18	-0.13	0.77
38Percentage of operators that work more than 40 hours per week 0.34 -0.19 0.31 -0.42 0.02 0.08 -0.08 0.02 0.11 0.02 0.15 39Percentage of operators that are paid by non-farm work 0.16 -0.30 0.37 -0.27 -0.17 -0.09 0.04 -0.41 0.11 0.02 0.15 Contribution rate 16.4 11.9 11.7 7.6 7.2 5.0 4.5 4.4 4.1 3.3 Contribution rate 16.4 28.3 40.0 47.6 54.7 59.8 64.3 68.7 72.8 76.1 Weight coefficient for cluster analysis: 21.6 15.6 15.3 10.0 9.4 6.6 6.0 5.7 5.4 4.4 Interpretation of factorslarge-scale farms, fruit farmsdairy farmsvegetablesbeef cowsfield crops, field crops, fiel	37 Percentage of operators whose ages are over 55 years	-0.05	0.06	-0.22	-0.02	0.03	-0.07	0.00	-0.80	0.24	-0.02	0.75
39Percentage of operators that are paid by non-farm work 0.16 -0.30 0.37 -0.27 -0.17 -0.09 0.04 -0.41 0.11 0.02 Contribution rate 16.4 11.9 11.7 7.6 7.2 5.0 4.5 4.4 4.1 3.3 Contribution rate 16.4 28.3 40.0 47.6 54.7 59.8 64.3 68.7 72.8 76.1 Weight coefficient for cluster analysis: 21.6 15.6 15.3 10.0 9.4 6.6 6.0 5.7 5.4 4.4 Interpretation of factorslarge-scale farms, fruit farmsvegetablesbeef coops, field crops, number of portators 0.1 farm large-scale farmInterpretation of factorsinterpretation of portatorsinterpretation 0.16 0.16 0.16 0.16 0.16 Interpretation of factorsinterpretation of factorsinterpretation 0.16 0.0 5.7 5.4 4.4 Interpretation of factorsinterpretation 0.16 0.0 0.1 0.16 0.16 0.16 0.16 Interpretation of factorsinterpretation of factorsinterpretation 0.00 0.00 0.00 0.00 0.16 0.16 0.16 Interpretation of factorsinterpretation of factorsinterpretation 0.00 0.00 0.00 0.00 0.16 0.16 0.16 Interpretationinterpretationinterpretationinterpretationinten	38 Percentage of operators that work more than 40 hours per week	0.54	-0.19	0.31	-0.42	0.02	-0.02	0.08	-0.08	0.02	0.15	0.64
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	39 Percentage of operators that are paid by non-farm work	0.16	-0.30	0.37	-0.27	-0.17	-0.09	0.04	-0.41	0.11	0.02	0.55
Accumulated contribution rate 16.4 28.3 40.0 47.6 54.7 59.8 64.3 68.7 72.8 76.1 Weight coefficient for cluster analysis: 21.6 15.6 15.3 10.0 9.4 6.6 6.0 5.7 5.4 4.4 Weight coefficient for cluster analysis: 21.6 15.6 15.3 10.0 9.4 6.6 6.0 5.7 5.4 4.4 (contribution rate) large-scale farms, fruit farms dairy farms vegetables beef cows field crops, number of young operators on-farm leased land mechanization, rended land nechanization operators on-farm leased land	Contribution rate	16.4	11.9	11.7	7.6	7.2	5.0	4.5	4.4	4.1	3.3	
Weight coefficient for cluster analysis: 21.6 15.6 15.3 10.0 9.4 6.6 6.0 5.7 5.4 4.4 (contribution rate) / (accumulated contribution rate) are large-scale farms, finit farms dairy farms vegetables beef cows field crops, number of young operators on-farm leased land mechanization, rented land mechanization, rented land	Accumulated contribution rate	16.4	28.3	40.0	47.6	54.7	59.8	64.3	68.7	72.8	76.1	
(contribution rate) / (accumulated contribution rate) large-scale farms, fruit farms dairy farms vegetables beef cows field crops, number of young operators on-farm leased land mechanization of factors interpretation operators on farm leased land mechanization operators on the mechanization operators	Weight coefficient for cluster analysis:	21.6	15.6	15.3	10.0	9.4	9.9	6.0	5.7	5.4	4.4	
Interpretation of factors large-scale farms, fruit farms dairy farms vegetables beef cows field crops, number of young operators on-farm leased land mechanization, rented land rented land rented land	(contribution rate) / (accumulated contribution rate)											
mechanization, mechanization operators operators	Interpretation of factors	large-scale farms,	fruit farms	dairy farms	vegetables	beef cows	field crops,	number of	young operators	on-farm	leased land	
		mechanization, rented land					mechanization	operators		operators		
Destand and the M. to also be the strike we have a second se	المسالمية مترمين منامية ماركم المملم المسالم سمسالا 1 1 1 1											

Source: Table 1 and The 2011 Census of Agriculture.



Fig. 2 Factor score distribution in British Columbia, Canada (factors 1-6) (Source: The 2011 Census of Agriculture and Tables 1 and 2).

only in Peace River. In the list of census-consolidated subdivisions, the regions correspond to Peace River B, C, D, and E.

As for the latter half of the results, Fig. 3 indicates spatial renderings of factor scores for factors 7–10. Factor 7 loadings were low in the categories of "percentage of farms with two or more operators" and the "number of operators per farm"; therefore, this factor can be considered as the "number of operators". The regions with low factor scores, represented by a large number of farm operators, extend to the middle part of the province, along coastal

areas, and around the Rocky Mountains. In the list of census-consolidated subdivisions, the regions correspond to the following: Alberni-Clayoquot D, Bulkley-Nechako G, Capital G, Cariboo B, Central Kootenay D and G, Columbia-Shuswap F, Comox Valley B and C, Cowichan Valley B and F, East Kootenay E, Fraser-Fort George E, Nanaimo E, F, and G, North Okanagan F, Powell River C and E, Squamish-Lillooet B, Strathcona C and D, and Thompson-Nicola E, I, and O.

For factor 8, categories of factor loadings are high in "percentage of operators whose ages range from 35 to 54



Fig. 3 Factor score distribution in British Columbia, Canada (factors 7-10) (Source: The 2011 Census of Agriculture and Tables 1 and 2).

years", and low in "percentage of operators whose ages are over 55 years". Thus, this factor can be interpreted as "young operators". The regions of high factor scores are located in the north of the province, coastal areas, the Lower Mainland, and Vancouver Island. In the list of census- consolidated subdivisions, the regions coincide with Bulkley-Nechako G, Fraser Valley G, Kitimat-Stikine C (Part 1), Northern Rockies, and Powell River A and E.

For factor 9, factor loadings were high in the category of "percentage of operators who lived on the farm". Thus, this factor indicates "on-farm operators". The regions with high factor scores are scattered around coastal areas, at the foot of the Rocky Mountains, and on Vancouver Island. In the list of census-consolidated subdivisions, these regions are situated in Alberni-Clayoquot F, Central Kootenay A and D, Skeena-Queen Charlotte D, and Powell River A.

Factor 10 loadings showed high values in "percentage of leased land" and low in "percentage of own land". Accordingly, this factor indicates "lease land". The regions of high factor scores are dispersed in the south of the province. In the list of census-consolidated subdivisions, these include East Kootenay C, North Okanagan B, Okanagan-Similkameen B and G, Squamish-Lillooet D, Thompson-Nicola I (Blue Sky Country), and Thompson-Nicola J (Copper Desert Country).

2. Cluster analysis of factor scores

By means of Ward's method, hierarchical cluster analysis was carried out on a geographical matrix with columns representing 153 regions and rows accounting for 10 factor scores. To elicit clusters composed of plural regions, a weight coefficient was taken into account for each factor score (see previous Table 2). Figure 4 shows the hierarchical dendrogram results; eight groups (A–H) were obtained by delimiting the dendrogram at a point where the distance between clusters was the largest. The mean values for factor scores are shown in Table 3, and the 10 maps of factor analysis are reduced to eight regions within a map, as shown in Fig. 5.

In the column of cluster A, the mean values of factor scores were the lowest for factor 1. This group is characterized by small-scale unmechanized farms and owned land. In the map, the areas of cluster A are located at the foot of the Rocky Mountains, Lower Mainland, and Vancouver Island.

In cluster B, the mean values of factor scores were



Fig. 4 Cluster analysis dendrogram for the regional divisions of agriculture in British Columbia, Canada (Source: The 2011 Census of Agriculture and Tables 1-3).

Table 3 Results of cluster analysis on factor scores for the regional divisions of agriculture in British Columbia, Canada

Cluster	Number of regions				Means (a	bove) and v	ariances (ber	neath)				Sum of variance
		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10	
А	32	-0.13	0.04	-0.01	0.02	-0.02	-0.01	-0.01	-0.05	0.00	0.00	
		0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
В	50	0.14	0.05	-0.02	0.02	-0.01	0.00	-0.01	0.01	0.00	0.02	
		0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
С	20	-0.18	0.04	-0.08	-0.05	-0.01	-0.01	0.00	0.05	0.03	-0.03	
		0.02	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.06
D	7	0.03	-0.50	-0.10	0.07	-0.03	-0.01	0.01	0.00	0.01	0.00	
		0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Е	3	0.13	0.02	-0.02	0.02	0.04	0.34	0.02	0.02	0.00	-0.01	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
F	8	-0.02	-0.08	0.11	-0.14	0.01	-0.01	0.07	-0.02	-0.12	-0.01	
		0.01	0.03	0.01	0.05	0.00	0.00	0.01	0.00	0.00	0.00	0.11
G	4	-0.05	-0.01	0.63	0.03	-0.01	-0.04	0.00	<u>0.07</u>	0.01	-0.01	
		0.02	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
Н	2	0.18	-0.04	0.04	0.01	0.64	-0.04	0.02	-0.04	0.03	-0.02	
		0.07	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.14

Underline shows more than 0.1 in absolute value after rounding.

Source: Table 2 and The 2011 Census of Agriculture.



Fig. 5 Cluster distribution for the regional divisions of agriculture in British Columbia, Canada (Source: The 2011 Census of Agriculture and Tables 1–3).

highest for factor 1. Consequently, this group contrasts in character to cluster A, as it is characterized by large-scale farms and mechanized and rented land. The areas in this cluster are spread over the central part of the province and the foot of the Rocky Mountains.

In cluster C, the mean values of factor scores were low for factors 1, 3, and 4. In consequence, this group consists of small-scale farms, owned land, and vegetable production. The areas of this cluster are situated on Vancouver and Graham islands, in coastal areas, at the foot of the Rocky Mountains, and in the Northern Rockies.

In cluster D, the mean factor scores were very low for factor 2. This group shows a high percentage of fruit farms. The areas categorized into this cluster converge at Okanagan Valley. In census agricultural regions, they are included in Thompson-Okanagan.

In cluster E, high factor scores were obtained for factors

1 and 6. Therefore, this cluster includes a high percentage of field crop production, large-scale farms with rented land, and mechanization. In census-agricultural regions, only the Peace River includes this group.

In cluster F, the highest factor score was for factor 3, and the lowest scores were for factors 2, 4, and 9. Consequently, this cluster corresponds to the production of vegetables, dairy, and fruits. Additionally, the percentage of "operators who live on the farm" is low. In census-agricultural region data, the areas of this group are included in Lower Mainland-Southwest, Vancouver Island-Coast, and Kootenay.

In cluster G, the mean factor scores were very high for factor 3. Therefore, this group shows a high percentage of dairy farms. In census- agricultural region data, the areas in this group are located only in Lower Mainland-Southwest.

In cluster H, the mean factor scores were highest for

factor 5. Thus, this cluster has a high percentage of beef cattle. In census- agricultural region data, the areas of this cluster are located in Cariboo and Thompson-Okanagan.

IV. Agricultural regions in British Columbia

1. Agricultural regions

By examining the spatial distribution of clusters, the agricultural regions of British Columbia can be categorized into eight regions, as shown in Fig. 6. For some specific areal classifications, we took into account the following gauges. (1) If a large area is covered by a single cluster, small areas consisting of different clusters can be included there. For example, Region III, composed mainly of cluster B, includes small areas of clusters A and H. (2) In cases where several clusters gather like a mosaic, the area can be

grouped as one agricultural region if the clusters are similar. For example, Region I can be delimitated by a group consisting of clusters A, C, and F, because the clusters are similar in terms of containing "small-scale farms". (3) In cases where several clusters gather, the area can be grouped as one agricultural region with subregions, if the clusters are relatively close. For example, Region V consists of two subregions: one is delimited by clusters A, C, and F, and the other is cluster B, as the neighboring clusters A, B, and C are close in the dendrogram (Fig. 4). For comparison with the distribution of agricultural regions, the location of agricultural land, which is represented by the Agricultural Land Reserve defined by the province of British Columbia, is also drawn in Fig. 6. Thus, agricultural regions include not only agricultural land but also the mountains, hills, and



Fig. 6 Regional divisions of agriculture in British Columbia, Canada (Source: The 2011 Census of Agriculture, Fig. 4 and Provincial Agricultural Land Commission).

lakes surrounding them. Such extensive and unpopulated spaces can be considered parts of agricultural regions, because regional agriculture links the environment in terms of rural tourism and branding of agricultural products. In the following sections, characteristics of agricultural regions are described simply, based on recent archives of rural geography and also on the fieldwork of Nihei conducted from 2014 to 2016.

Region I is composed of the Lower Mainland, consisting of two subregions. Region I-1, located in urban and suburban areas, is delimitated by a mosaic of clusters A, C, and F. Accordingly, the region is characterized by small-scale farms, unmechanized farming, owned land, and vegetable and fruit production. The other subregion, Region I-2 that corresponds to Abbotsford and Fraser Valley is located in the urban periphery, between urban and suburban areas. The subregion is delimitated by cluster G; therefore, the regional agriculture consists mostly of dairy farms. Considering the landscape of the region, cultivation of vegetables, berries, and greenhouse horticulture are prominent in urban and suburban areas. Also dairy cows and dent corn are located in the urban periphery. Farmers can sell fresh products for residents in Vancouver, one of the largest consumption centers in the country⁴); those characteristics identify the area downstream of Fraser as the most productive farming area in terms of output per area⁵⁾. Local farming practices are updated frequently on a continuous basis. For instance, farmers market directly to their customers, as shown in Fig. 7 [e.g., U-Pick farm and Circle Farm Tour (a self-guided farm tour) reported by Tabayashi et al. (2016)].

Region II corresponds to Southern Vancouver Island. Clusters A and C dominate; accordingly, the regional agriculture is characterized by small-scale farms, unmechanized farming, and vegetable production. The farmland is narrow and concentrated at the coastline of the Strait of Georgia. Despite the mountainous topography, agriculture receives benefits from a temperate climate, categorized as "warm-summer Mediterranean" by the Köppen climate classification, as well as its proximity to major cities including Victoria and Vancouver. Regarding recent trends in regional agriculture, Kikuchi et al. (2016) reported that the commodification of rural space has progressed in terms of viticulture, winery tours, slow food movement, raising of beef cattle and sheep, and cultivation of special crops such as organic vegetables and tea⁶.

Region III is made up of Cariboo, Nechako, and parts of Thompson, excluding the Rocky Mountains and the Okanagan Valley. Most of the area is composed of cluster B; thus, regional agriculture is characterized by large-scale farms, mechanization, rented land, and beef cattle. The region is located in the middle reaches of the Fraser River, the site of large-ranch cattle grazing. Conversions from extensive to intensive land-use characterize the Thompson region that supports dairy farming, fattening of beef cattle, and vegetable cultivation. Even vineyards appeared, despite the colder climate. However, the cultivation of ginseng has decreased due to fluctuations in the market price. In the Cariboo region, tourist ranches attract visitors to the rural landscape (Fig. 8). An example of this is a ranch at 150 Mile House that initiated farm-direct marketing; the manager drives seven hours to Vancouver and sells "home-



Fig. 7 Pick-your-own farm of strawberries in the Lower Mainland. Visitors pay according to the weight of strawberries picked, in contrast to tourist farms in Japan that sell according to time spent. Visitors also enjoy experiencing the change in seasons. Source: Taken by Nihei in July 2016.



Fig. 8 Cabins at a tourist ranch south of the Cariboo region. The ranch consists of 300 ha of land along Watch Lake and provides cabins, campgrounds, and horseback riding for their guests. Source: Taken by Nihei in July 2016.

grown-beef" to regular customers.

Region IV groups the census-consolidated subdivisions in Okanagan Valley. The cluster making up this region is D; therefore, the percentage of fruit farms is very high. The valley extends about 250 km north and south along the Okanagan River, a tributary of the Columbia. The area was developed after the opening of the Transcontinental Railroad. The climate is relatively dry and warm, as the area is situated leeward of the Cascade Mountains. Apple cultivation began in the early 20th century under the favorable geographical conditions at the time. Since the 1980s, the region has produced grapes. Regarding recent trends in the area, as reported by Yagasaki (2016), wine tourism has become increasingly popular, supported by input from managers with diverse backgrounds.

Region V covers Kootenay and the mountainous areas of Thompson. The area includes two subregions. Region V-1 is located along the valleys of the Kootney, a tributary of the Columbia, and the Rocky Trench. This subregion is composed of clusters A and C; therefore, the agriculture here is characterized by small-scale farms, unmechanized farming, owned land, and the production of vegetables and fruits. The main agricultural products of this subregion are fruits, berries, vegetables, pigs, poultry, and apiary. Among them, organic farming has gained in popularity, based on the constant demand of local residents who include retirees, environmentalists, and antiwar protesters, who have moved to this isolated, picturesque area. The other subregion, Region V-2, surrounds the valley bottoms. It is composed of cluster B; thus, the area is characterized by large-scale farms, mechanization, and rented land. The terrain of the sub-region is hilly, and the main agricultural activity is grazing of beef cattle and pasture production.

Region VI corresponds to the Pacific Coast, and Region VIII the Northern Rockies. These regions are delimited by cluster C. Consequently, the agriculture includes small-scale farms, owned land, and vegetable production. In the Pacific Coast, being hemmed by fjord coasts, the area of arable land is smaller than other regions. Also in the Northern Rockies, farmland is distributed only around the city of Fort Nelson, located at the high latitude of 58 degrees. According to interviews with the Ministry of Agriculture, locally consumed vegetables are produced in the regions; notably, Graham Island is known for its organic farming.

Region VII coincides with the Peace River of censusconsolidated subdivisions. It is delimitated by cluster E; therefore, regional agriculture is characterized by field crops, large-scale farms, mechanization, and rented land. It is situated in the northern part of vast flatland, continued from the Prairies, although the basin belongs to the upper reaches of the Mackenzie River flowing towards the Arctic Ocean. The agricultural production is famous for largescale cultivation of wheat, barley, rapeseed, and the grazing of beef cattle. Additionally, agriculture has developed under the influence of a cold climate and changing prices of global markets. In recent years, not only agricultural production but also various rural activities such as winter tours and geoparks have attracted visitors to the region.

2. Concluding remarks

This study defines the agricultural regions in British Columbia by means of multivariate analysis. From cluster and factor analyses, the agricultural area of the province was divided into eight regions. The former agricultural divisions were derived from national-scale calculations, roughly dividing British Columbia into intensive horticulture in the southwest, extensive ranches in the central part, and largescale farming in the northwest. In addition to such basic characteristics, more detailed divisions were added by this study. For example, in the Lower Mainland, a three-zonal structure can be specified from the map, namely, intensive vegetable farming around Vancouver, large-scale production of fruits and vegetables in the urban periphery, and dairy and poultry farming in suburban areas. The methods and results presented by this study will be helpful not only for future studies in geography but also for education purposes and administrative planning.

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Notes

1) Reasons for selecting some of the variables in Table 1 are explained here.

Variable No. 10 is set as an index to distinguish largescale farms, classified by an area of 162 ha (400 acres) or more in this study. The average farm size in the province in 2011 was 141.8 ha; thus, regarding this categorization, farms that exceed the average size are categorized as large-scale farms. In addition, according to Tabayashi (1991), the average farm size of the province was 126.5 ha, and for all of Canada this was 231.4 ha in 1986; thus, the average farm size has increased.

Variable No. 27 is the percentage of farms whose sales are less than the average, and variable No. 28 corresponds to those whose sales exceeded the average. The average sales of farms in the province is 149,000 Canadian dollars in the 2011 Census of Agriculture data. Those variables are used as rough standards to distinguish high/low incomes.

2) The factor analysis procedure using R is summarized in the command lines below. The lines starting with the hash (#) are comments.

Open R and enter the line as follows:

data01 <-read.csv ("/usr/fac.csv", header = T, row.names =, na.strings = "-99")

data01: name of factor analysis (an example)

read.csv: a command to import a data file of csv format to R

/usr/fac.csv: location of the data file "fac.csv" in computer (an
example)

fac.csv: name of the data file (an example)

header = T,: the data file "fac.csv" includes a header in the first line

row.names = ,: the data file "fac.csv" does not include a label in the first row

na.strings = "-99": missing values in the data file "fac.csv" are replaced by "-99" (an example)

The next two command lines are for determining the number of factors, as the default factor analysis of R is based on maximum likelihood estimation.

Enter the following command line to calculate a correlation matrix:

cor1 <-cor (data01, method = "p", use = "complete.obs"); cor1
cor1: name of correlation matrix (an example)</pre>

method = "p": Pearson correlation coefficient is applied for the linear correlation

use = "complete.obs": missing values are excluded in calculation

Next, on inputting the following command line, eigenvalues will be shown. The number of the eigenvalues that exceed 1.0 is the number of factors.

eigen1 <-eigen (cor1) \$ values; eigen1

To use principal component analysis (principal factor analysis) by R, the command lines listed in the following website are helpful (last accessed June 13, 2019)

http://aoki2.si.gunma-u.ac.jp/R/pfa.html

Then, factor analysis is performed by the following command line.

fact01 <-factanal (na.omit (data01), factors = 10, rotation = "varimax", scores = "regression")

fact01: name of factor analysis (an example)

factanal: a command of factor analysis by means of the maximum likelihood method

na.omit (data01): to import data01 excluding missing values

factors = 10: number of factors estimated by the maximum likelihood method is "10" # rotation = "varimax": a method for the rotation of factor axis # scores = "regression": a method for estimating factor scores Display of factor loadings.

print (fact01, digits = 2, cutoff = .3, sort = FALSE)

digits = 2: factor loadings are displayed down to the second decimal

cutoff = .3: factor loadings whose values are less than 0.3 are not displayed (to do cluster analysis, this part must be deleted)

Display of factor scores for regions. print (fact01 \$ scores)

3) The cluster analysis procedure using R is explained in the following command lines. The lines beginning with the hash (#) are comments.

Open R and enter the line below.

data02 <-read.csv (/usr/clus.csv, header = T, row.names =, na.strings = "-99")

data02: name of cluster analysis (an example)

read.scv: a command to import a data file of csv format to R

usr/clus.csv: location of the data file "clus.csv" in computer (an
example)

clus.csv: name of the data file (an example). The contents are the factor scores calculated by Note 1.

header = T,: the data file "clus.csv" includes a header in the first line

row.names = ,: the data file "clus.csv" does not include a label
in the first row

na.strings = "-99": missing values in the data file "clus.csv" are replaced by "-99" (an example)

Deleting missing values (enter the following command line). data02 <-na.omit (data02)

Normalizing variables.

data03 <-scale (data02)

Calculate the distance by Euclidean distance.

dist01 <-dist (data03, method = "euclidean")

Performing of cluster analysis by Ward method.

clus01 = hclust (dist01, method = "ward.D2")

Display of a tree diagram (dendrogram).

plot (clus01)

- 4) After the conclusion of the North American Free Trade Agreement, the amount of agricultural products exported to Canada increased, e.g., apples from Washington and vegetables from California. However, agricultural products cultivated by local farmers do not compete with these external commodities, as reported by Nihei et al (2016). Incidentally, some types of fruit from British Columbia are internationally competitive, e.g., blueberries and raspberries are sold in Sapporo.
- 5) The agricultural land use in the United States under the Zero Avenue (49.0°N), however, is extensive.
- 6) Regarding rural tourism in the region, cultural tourism has gained in popularity, e.g., self-guided tours of totem poles in Duncan and the outdoor murals in Chemainus, which began after the

economic decline of forestry; additionally, rural tourism related to agriculture flourishes, including farmers' markets and directselling farms. Recently, farm tours have attracted visitors not only from Vancouver but also foreigners from China and the United States. Among the producers of organic farming, some farmers have referenced the book written by Fukuoka Masanobu on natural farming. Even organic tea is cultivated by a local farm (latitude: 48.9°N).

References

- Kikuchi, T., Kaneko, J., Tabayashi, A., Nihei, T. and Waldichuk, T. (2016): Development of wineries and its impact on rural commodification of Cowichan Valley in Vancouver Island, Canada. *Geographical Space*, 9, 115-129. [in Japanese with English abstract]
- Kitamura, S. (1982): The regional structure of Japanese agriculture in terms of part-time farming. *Geographical Review of Japan*, 55, 739-756. [in Japanese with English abstract]
- Kostrowicki, J. (1972): The typology of world agriculture: a preliminary scheme. *In*: Reeds, L. G. (ed.) *Proceedings of the fifth meeting of the commission on agricultural typology: Agricultural typology and land use*. IGU (The International Geographical Union) Commission on Agricultural Typology, Hamilton, Ontario, pp 2-52. [summarized in Japanese by Shirahama, H. and Akagawa, T. (1972): Jerzy Kostrowicki: The typology of world agriculture, a preliminary scheme. *Geographical Review of Japan*, 45, 446-452.
- Nihei, T. (2006): Regional division of Japanese agriculture in terms of comprehensive indices of farm management: development of a method by means of multivariate analyses and GIS. *Studies in Human Geography*, 30, 69-98. [in Japanese with English abstract]
- Nihei, T. (2015): Commodification of rural space in British Columbia, Canada (1): agricultural regionalization by statistical analysis. *Proceedings of the General Meeting of the Association of Japanese Geographers*, 87, 164.
- Nihei, T., Tabayashi, A., Kikuchi, T., Kaneko, J. and Waldichuk, T. (2016): Characteristics of farm direct marketing in the Lower Mainland Region in British Columbia, Canada. *Geographical Space*, 9, 87-113. [in Japanese with English abstract]
- Okuno, T. (1971): Principal component and factor analyses for human geography. *Chiri [Geography]*, 16 (1), 29-46. [in Japanese]
- Okuno, T. (1985): Regionality of Matsumoto basin in Nagano Prefecture: Study on numerical classification. *Chiiki Chousa Houkoku [Area Research Paper, University of Tsukuba]*, 7, 1-12. [in Japanese]
- Okuno, T. (1987): A consideration on the socio-economic regionality of the Matumoto Basin: based on the numerical regionalization framework. *Geographical Reports of Tokyo Metropolitan University*, 22, 153-168.
- Sakurai, A. (1973): Agricultural regionalization in central Kanto district by using factor analysis and numerical taxonomy. *Geographical Review of Japan*, 46, 826-849. [in Japanese with English abstract]
- Tabayashi, A. (1991): Agricultural regions of Canada: Analysis of the

1986 Agricultural Census. *Tsukuba Studies in Human Geography*, 15, 63-85. [in Japanese with English abstract]

- Tabayashi, A., Fujinaga, G. and Nakamura, A. (2003): Sustaining agricultural activities in the Isawa alluvial fan. *Journal of Geography*, 112, 50-72. [in Japanese with English sabstract]
- Tabayashi, A., Nihei, T., Kikuchi, T., Kaneko, J. and Waldichuk, T. (2016): Significance of circle farm tours in the Lower Mainland of British Columbia, Canada. *Geographical Space*, 9, 63-86. [in Japanese with English abstract]
- Troughton, M. J. (1979): Application to the revised scheme for the typology of world agriculture to Canada. *Geographia Polonica*, 40, 95-111.
- Troughton, M. J. (1982): *Geography of world agriculture 10: Canadian agriculture*. Akadémiai Kiadó, Budapest.
- Yagasaki, N. (2016): Wine tourism in the Kelowna area of Okanagan valley in British Columbia, Canada. *Geographical Space*, 9, 131-145. [in Japanese with English abstract]
- Yamamoto, S., Akimoto, H. and Murayama, Y. (1988): Regional structure of agriculture in the Kanto district. *Tsukuba Studies in Human Geography*, 12, 139-163. [in Japanese with English abstract]

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