



Case study on The Location Trend of Day Service Facilities in Yamaguchi Prefecture

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1.0 BACKGROUND AND PURPOSE OF THE RESEARCH

The system reformation of social welfare proceeded from the latter half of 1980's, the decision of new gold plan that emphasis was put for the service base maintenance (1994), the formation of care insurance law (1997), and the gold plan 21 (1999) that the basis was put on at-home welfare was settled on based on the health coverage system. Next year, the health coverage system was introduced to attempt the area welfare support system (2000), at the same time, social welfare law was concluded and the social welfare business law was revised (2000), and (1) Construction of the social welfare system from the user's standing point (2) Improvement of service quality (3) Fulfillment and activation of social service and (4) Increase in area welfare were made the pillar of the law. By the reformation of these social welfare systems, day care facilities are increasing drastically after 2000.

In the present when ten years passed from the care insurance system introduction, from the viewpoint of district-facility planning theory, it is thought with the necessary time that the grasp and evaluation of the secured condition of the quality and quantity of facilities which balanced to the demand and location of facilities corresponding to user's distribution in the area.

This paper aims to verify the local demand characteristics of day-care services, and the conformity of facilities location. Yamaguchi Prefecture where the elderly ratio is nationwide high and the city structure of distributed type is characteristics is made the research object. At first, the location characteristics of elderly-people day-care service facilities are analyzed for the facilities built after the public-nursing-care-insurance which supports home care introduction (2000), next the evaluation of the fill rate and pick-up efficiency of facility utilization area unit is performed.

2.0 METHOD OF RESEARCH

The method of research is as follows. (1) The database of day care homes (478cases) registered in Yamaguchi Prefecture at November 2010 was made. (2) By using Arc View of GIS software, map of per district of each city in Yamaguchi Prefecture was created. (3) The location data of day care home with latitude longitude information was plotted on the per district layer by "CSV Address Matching Service" of Tokyo university Space Information Research Center. (4) The Boronoi division was performed, and the square of each division area was calculated by using the "Create Thiessen Polygons 3.0" tool of Arc View. Moreover, the elderly population (over 65 and 75 years) of each area was computed by the area proportional distribution method with geometrical change tool Ver. 2.x of Arc View. (5) The Boronoi divisions were classified by the cluster analysis with PASW Statistics.

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3.0 CONSTRUCTION CONDITIONS OF DAY CARE HOMES IN Yamaguchi Prefecture

3.1 Construction trend of day care homes

Transition of the amount of new supplies of day care service facilities which made five years 1 unit in Yamaguchi Prefecture is shown in Fig. 1. After the Care Insurance Law establishment in 2000, the number of supply is increasing drastically. The amount of supply from 1995 to 1999 was 30 facilities, but 160 or more facilities were supplied from 2000 to 2004 and 260 or more were supplied newly from 2005 to 2009.

Examining by fixed number, facilities of 11- 30 person’s fixed number were supplied mainly till 1999; and small-scale facilities (fixed number: ten or less persons) and large-scale facilities (fixed number: 30 or more persons) were increased drastically from 2000 to 2004, moreover small-scale facilities has been increasing rapidly from 2005 to 2010, in contrast large-scale facilities has been decreasing in number.

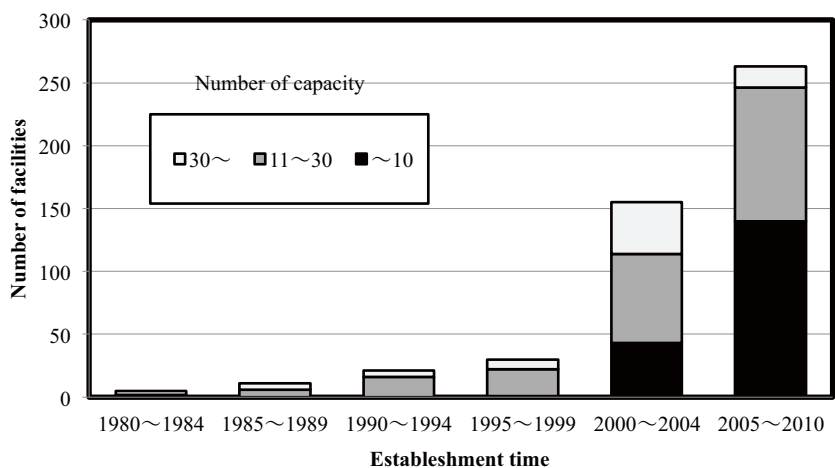


Figure 1: Transition of the amount of new supplies of day care service facilities which made five years 1 unit in Yamaguchi Prefecture

3.2 Location of day care homes

The facilities location trend according to the number of capacity is shown in Figure 2. The facilities supplied before 1999 years which were around the middle scale (11-30 peoples) located in the whole area of Yamaguchi Prefecture. On the other hand, the great portion of facilities supplied from 2000 to 2010 has been located in urban areas and the most is ten or less person’s small-scale facilities. Thus, the location trend specified for the city part is shown from 2000 to 2010.

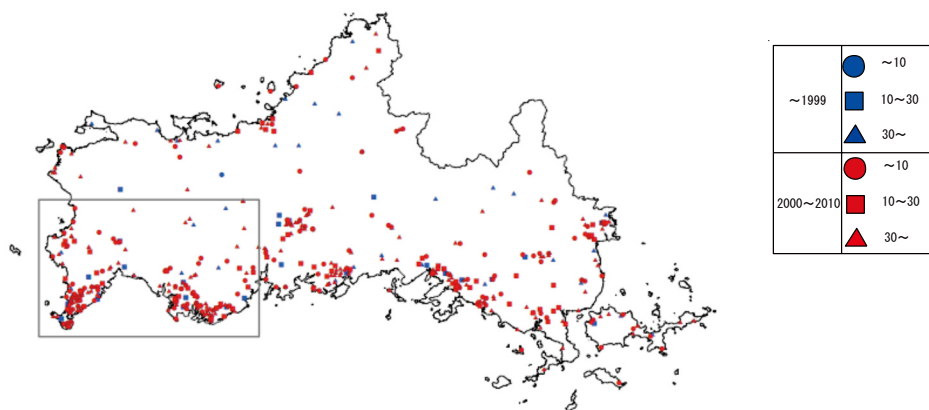


Figure 2a: The facilities location trend according to the number of capacity

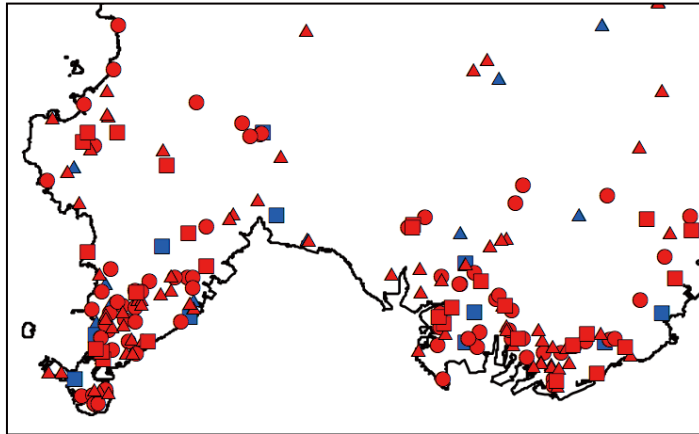


Figure 2b: Elements on larger scale

4.0 METHOD OF BORONOI DIVISION AND POPULATION DISTRIBUTION

When old people use a day service, it is supposed that the facility whose distance from home is the shortest is used for, therefore the boronoi division method is applied in this study.

The boronoi division is the method which the sphere where a straight line distance from the residence area (an optional point) to the facilities becomes the shortest is set up to. As shown in the figure 3, the plural facilities arranged on the plane are decided with mother point, and each mother point is connected with a line, when the vertical bisection line of each triangular side is connected more, a sphere is made finally.

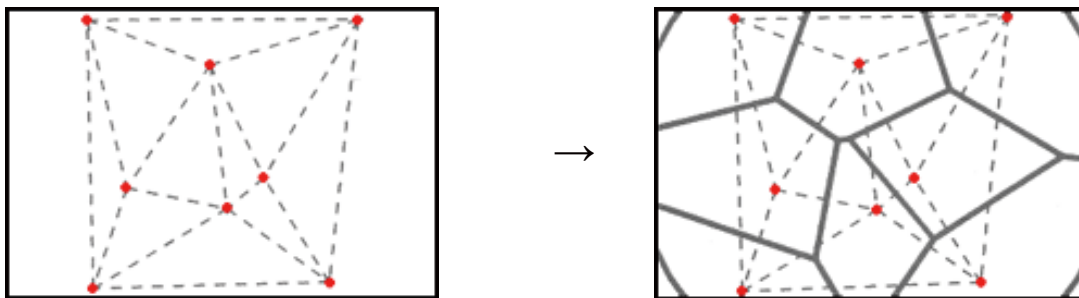


Figure 3: Boronoi division method

Next, the proportional distribution method is applied for populational distribution. It is assumed that population is distributed uniformly in one zone. In case that one zone is divided into two or more areas by boronoi division, according to the square ratio, the population is distributed to each divided area. As shown in Fig.4, the population in one area of size S_n is defined as P_n and the one in one area of size $S_{n'}$ is defined as $P_{n'}$, the number of population in one area is calculated by the formula $\sum P_{n'} = \sum (S_{n'} \times P_n \div S_n)$ from the relation $S_n : S_{n'} = P_n : P_{n'}$.

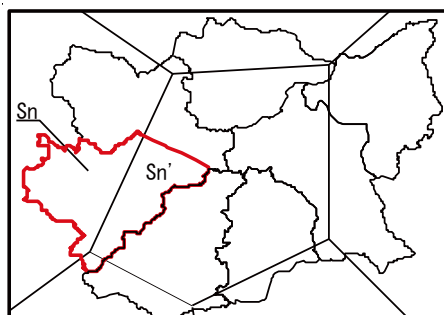


Figure 4: Pattern diagrams of population distribution

5.0 ANALYSIS OF FILL RATE AND PICK-UP DISTANCE OF UNIT SPHERE

5.1 Fill rate

The fill rate (/1000) is defined as follows.

The fill rate (/1000) = fixed number of facility / number of inhabitants aged 75 and over \times 1000

The fill rate of each use sphere is shown in Fig. 5. Variation of fill rate is looked at. In mountainous areas located the large use sphere of size, the high and low fill rate use sphere are intermingled, and the correlation with use sphere size is seldom seen. The reason is that even if the use sphere size and elderly population density are same, the difference of fill rate arises when the fixed number of facility is different. But there is a tendency that the use spheres of high fill rate more than 118 (/1000) are concentrated on small use spheres.



Figure 5: The fill rate of each use sphere

Next, the scatter diagram of fixed number density and population density aged 75 and over is shown in Fig. 6. On the whole, the tendency for fill rate is high in case that fixed number density is high and population density aged 75 and over is low, and the tendency for fill rate is low in case that fixed number density is low and population density aged 75 and over is high.

But, although the value of fixed number and population density are low together, many cases of different fill rate are concentrated near the original point, and this situation shows that high and low fill rate are mixed in large use spheres of size.

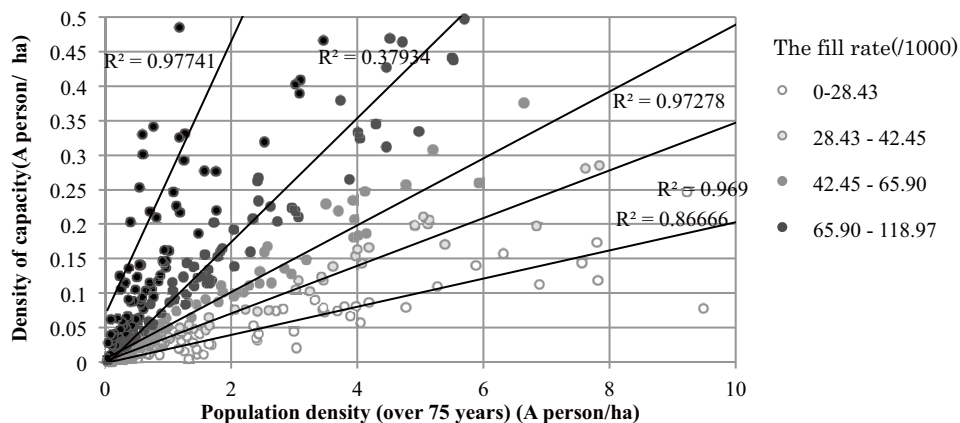


Figure 6: The scatter diagram of fixed number density and population density aged 75 and over

5.2 Pick-up distance

The use of the pick-up service is general in case of using day care facilities. It is thought that user's physical and mental burden becomes large by increasing in movement distance and time. Moreover, it is common that the expense by pick-up service increases with the increase in distance. Therefore, the pick-up distance is applied to the index of pick-up efficiency. The diagram of the calculative method of pick-up distance is shown in Fig. 7. First, the actual use sphere form is changed into the rectangle form of the same size. Next the use sphere square per person is defined as S' (= use sphere square / fixed number) and S' is assumed to be a circle of radius $(=\sqrt{S'/\pi})$. And the circle of S' is spread into the rectangle. The length which connected the center of circles with the line segment is defined as the pick-up distance. Therefore, the pick-up distance is defined as follows.

$$\text{The pick-up distance (km/ person)} = 2 \times \sqrt{\left(\frac{\text{the fixed number of facility (person)} \times \text{use sphere (ha)} \div \pi}{\div \text{fixed number (person)}} \right)} \cdot \cdot \cdot \quad (1)$$

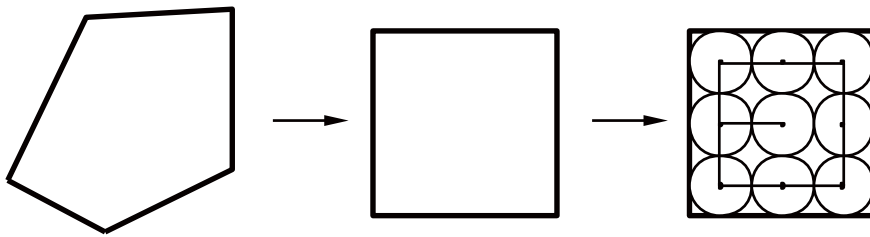


Figure 7: The diagram of the calculative method of pick-up distance

Pick-up distance (aged 75 and over) per person is shown in Fig. 8. It is shown that most of large use sphere of size located in mountainous area have a long pick-up distance, so the pick-up efficiency is low. On the other hand, most of small use sphere of size located in urban area have a short pick-up distance, and shows the high pick-up efficiency. However, the use spheres with long pick-up distance also exist, and it is the case that elderly population density is low and fixed number of facility is few.

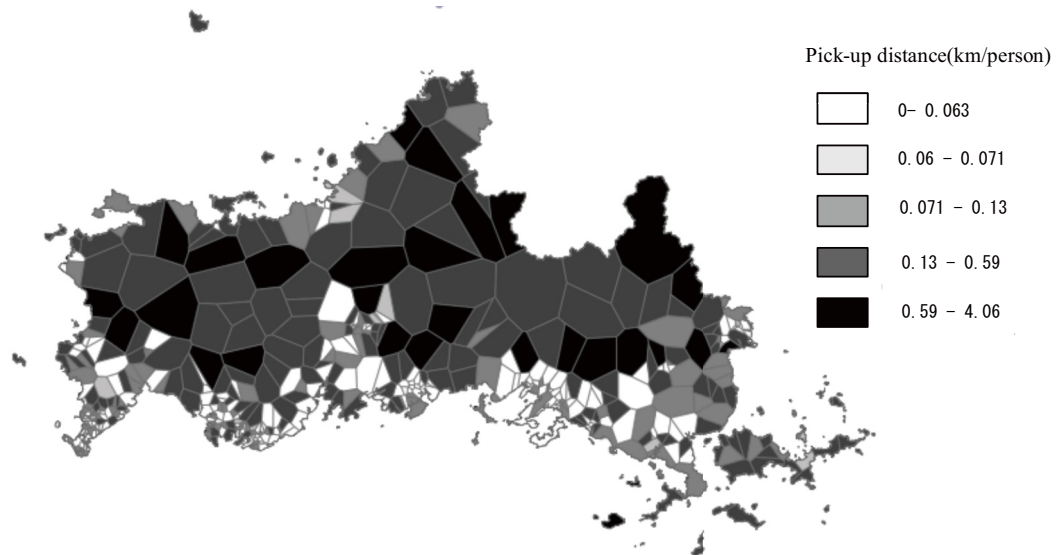


Figure 8: Pick-up distance (aged 75 and over) per person

Next, the relation between the opposite numerical value of use sphere size and pick-up distance is shown in Fig. 9. When the use sphere size becomes large, pick-up distance per person is increased as the fixed number of facility decreases and in case of the small-scale facilities like as the fixed number is ten or less, the distance is increased over 1 km. On the other hand, if use sphere size becomes small, the difference of the pick-up distance per person is not seen so much by the fixed number.

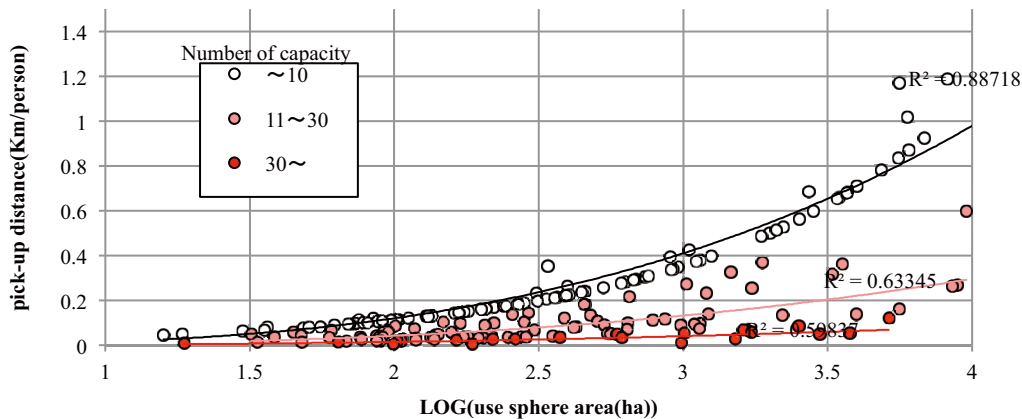


Figure 9: The relation between the opposite numerical value of use sphere size and pick-up distance

6.0 CLASSIFICATION OF USE SPHERE AND DISTRIBUTIONAL CHARACTER

6.1 Classification of use sphere by cluster analysis

The cluster analysis which made use sphere size, fixed number density, population density, elderly ratio and pick-up distance the index is made, and the facilities use sphere was classified in six types. The cluster dendrogram is shown in Fig. 10, and the index average value by type is shown in Table 1. The average use sphere square of Type1 (44 cases) is the smallest with 60.2ha, though the elderly population density (622 person / ha) is high, the fixed number density (63.1 person / ha) is the highest, so the fill rate shows also the high value with 228/1000 person. Moreover, pick-up distance is short with 2.84 km/person, it can be called the type with the highest pick-up efficiency. Type2 (78 cases) has small use sphere square with 121.1ha next to Type1, and elderly population density (328 persons / ha) is about 1/2 of Type1. But, the fixed number density (22.8 persons / ha) is about 1/3 of Type1, so the fill rate is 94/1000 person's level. Although the pick-up distance also becomes long with 4.13 km/person according to the decline of fixed number density, relatively it is the type with high pick-up efficiency next to Type1. As for Type3 (189 cases), the square of use sphere becomes larger with 459.0ha, and elderly population density (101 persons / ha) is about 1/3 of Type2. The use sphere size is large and fixed number density (7.5persons / ha) is also about 1/3 of Type2, and the pick-up distance is long with 7.87 km/person. On the other hand, the fill rate is 103/1000 person's level and it is in the level a little higher than Type2. The average square of use sphere of Type4 (45 case) is 1331.4ha and it is beyond the double of Type3, and elderly population density (43.3 persons / ha) is about 1/2 of Type3. The use sphere size is large and the fixed number density is declined to 2.0 persons / ha, so the pick-up distance is long with 14.64 km / person. The fill rate is 77.7/1000 person's level, and it is the level lower than Type2. Another feature of this type is that the elderly ratio 75 and over is the highest with 25.4 percent. The average square of use sphere of Type5 (96 cases) is 2558.0ha and it is near the double of Type4, and elderly population density is declined to 27.3 persons / ha. Since the use sphere size is large and the fixed number density is declined to 0.9 persons / ha, so the pick-up distance is long with 21.0 km/person. Since elderly population density is declined, the fill rate is 49.5/1000 persons. Type6 (26 cases) has the largest square of use sphere with 8339.7ha, and the elderly population density is the lowest with 7.16 person / ha. Since the use sphere size is large and the fixed number density is declined to 0.2 persons / ha, the pick-up distance is the longest with 43.5 km / person. Since elderly population density is low, the fill rate is the lowest level with 32.1 /1000 persons.

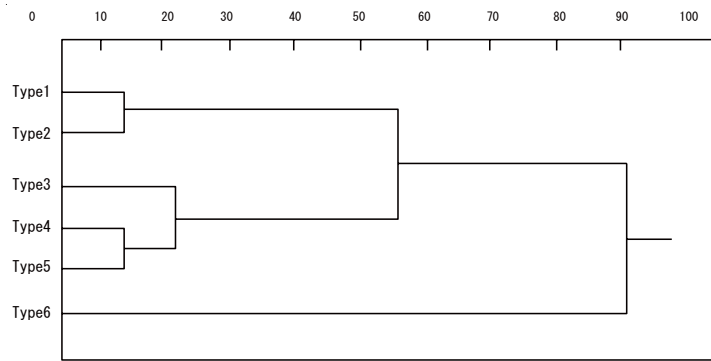


Figure 10: The cluster dendrogram

Table 1: The index average value

	Number of cases	Use sphere area (ha)	Population density(over 75 years)	Density of capacity	Rate of aging(over 75 years)	pick-up distance	The fill rate
Type1	44	60.2	622.11	63.07	14.02	2.84	228.02
Type2	78	121.05	327.99	22.79	9.85	4.13	93.81
Type3	189	458.95	100.82	7.45	10.56	7.87	103.39
Type4	45	1331.4	43.27	2.02	25.39	14.64	77.68
Type5	96	2557.95	27.28	0.9	15.18	20.99	49.52
Type6	26	8339.68	7.16	0.19	21.87	43.54	32.1

6.2 Distributional characteristics of use sphere type

Distribution of use sphere type is shown in Fig. 11a. Type1 and 2 are located in the urban area along the shore where the population density is high. On the other hand, Type6 is located mostly in the central zone of the prefecture where the mountainous and rural area is occupied most and the population density is lowest. Type3, 4, and 5 are being located in those middle area. Type3 is close to city area, Type4 has many detached islands, and it is the feature that Type5 is close to the mountainous area of prefectural central zone. Thus, Type1 and Type2 are placed as the city location types, Type3 is the city surrounding area location type, Type4 is the island or rural area location type, Type5 is the rural area location type, and Type6 is the mountainous area location type.

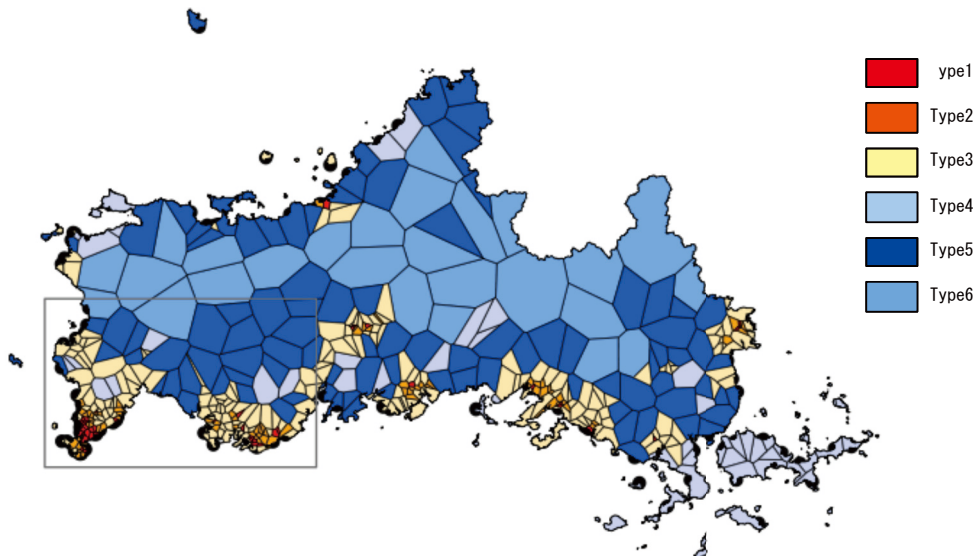


Figure 11a: Distribution of use sphere type

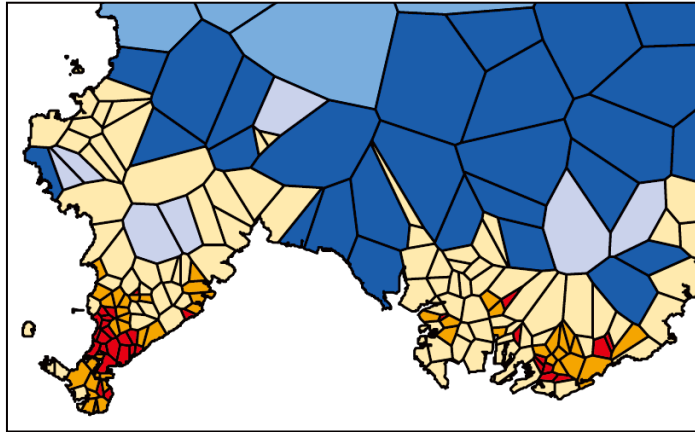


Figure 11b: Elements on larger scale

Next, the component ratio of the management subject (whole) is shown in Figure 12. The city location type has many private enterprises such as corporation for profit and medical corporation and the rate of social welfare corporation is less than 20percent. In the city surrounding area location type, the rate of social welfare corporation, NPO and municipal corporation is high and the rate of profit corporation is low compared with the city location type.

In the island and a rural area location type, the rate of social welfare council is high, more than 50 percent (17/33) is being located in the detached island, and as shown in Fig. 15, in the detached island, social welfare council occupies 50percent of the whole. In the rural area location type, the rate of social welfare corporation or municipal corporations is high comparing with the city surrounding area location type, and the rate of medical corporation that occupies a fixed rate in the city location type is low. In the mountainous area location type, nonprofit institutions, such as social welfare corporation, NPO or municipal corporation occupy 60 %, and there are few profit-making organizations such as profit corporation.

Like this, in case of city location type or city surrounding area location type, there are many management subjects aiming at profit, and in case of island and rural area location type or mountainous area location type, the rate of nonprofit management subject is high.

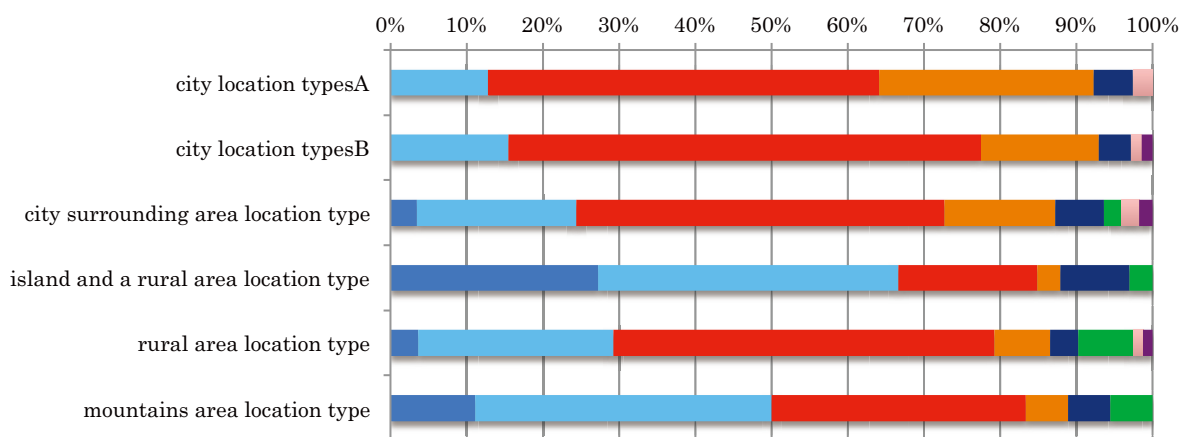


Figure 12: The component ratio of the management subject (whole)

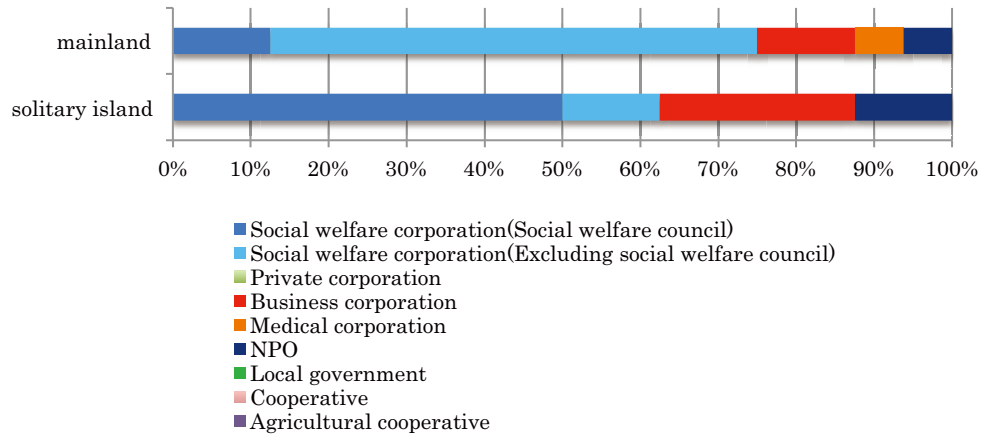


Figure 12: The component ratio of the management subject according to mainland and island in the island and a rural area location type

7.0 Conclusion

(1) The number of day care homes in Yamaguchi Prefecture is on the increase every year. Especially the increase of small-scale facilities with ten or less fixed number is remarkable, and it occupies a majority of the number of new establishment after 2005 years. As for the management subject, the social welfare corporations (excluding the social welfare council) and profit-making corporations (private company) occupy 70%, and corporations for profit are increasing in number especially after 2000 years. In addition, new entry of medical corporation, NPO etc. is also increasing.

(2) In every facility use sphere, the fill rate (fixed number of facility / population over 75 year's $\times 1000$) and the pick-up distance $\{2 \times \sqrt{\text{fixed number of facility} \times \text{square of use sphere} / \pi}\}$ were calculated and made into the index of evaluation. The fill rate changes a lot with the ratio of elderly population and fixed number of facility in the use sphere, and variation is seen in urban and rural areas. The pick-up distance is affected by the influence of use sphere square, and it becomes large by the small-scale facilities. The fill rate and pick-up efficiency are low in the wide range of rural areas comparing with urban areas.

(3) In order to clarify the difference of use sphere, the facilities use sphere was classified in six types by cluster analysis, there are 2 city location types, city surrounding area location type, island and rural area location type, rural area location type and mountainous area location type.

The profit management organizations are located more than 50% at city areas, and the fill rate and pick-up efficiency are also high. And the rate of social welfare corporation is high in the city surrounding area location type and island and rural area location type. In particular, in the island and rural area location type, detached islands are more than 50% and a social welfare corporation occupies 60 percent. On the other hand, the nonprofit management organizations are located more than 50% in mountainous area location type, the fill rate and pick-up efficiency are also low.

From the above results of the fill rate and pick-up efficiency of facility use sphere unit, the followings are pointed. Firstly, in the city area or city surrounding area where the elderly population density is high and high pick-up efficiency is expected, the small-scale facilities are accumulated by private corporations for profit, as a result the high fill rate level is secured also. Secondly, the demand of day-care services is high because of high elderly ratio in rural area or island area. However, since elderly people's population density is low, management by social welfare corporation etc. is the main, so there is little new facilities location, as the result the use sphere is large and pick-up efficiency is low and the fill rate is in low level relatively comparing with city area. Thirdly, in the mountainous area, there are especially few facilities, so the use sphere is the largest and it is pointed out as the result that the fill rate is the lowest level and the pick-up efficiency is low too. Finally, in rural and island area or mountainous area, in addition to the nucleus facility by social welfare corporation etc., the promotion of day-care service network formation by maintaining small-scale day care facilities which utilized the private house etc. in the central zone of old village unit will become the effective policy which raises the pick-up efficiency and fill rate.

8.0 REFERENCES

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