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A Study on Route Choice Model in the Case of Recreational Trip

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This study aims to suggest an appropriate road improvement planning for regional exchange, with a view to regard recreational trip as main behavior of regional exchange. We have clarifyied how the facilities which will contribute to regional development influence route choice.

This paper reported the results of the evaluation concerning the attractiveness of recreational facilities which influence route choice in case of a recreational trip, by quantification theory I, using the questionnaire data carried out in Fukui Prefectural TAN-NAN region. These results of analysis of attractive factors suggest that the model using the staying time has most applicable interpretation. However, further investigation on the grasp of the number of visitors is necessary.

Key Words: Route Choice Model, Recreational Trip, Regional Exchange, Attractiveness Quantification Theory I

1. Introduction

Many conceptions to formulate diverse regional connection are suggested, and regional activity is groped by setting new exchange area. Under the situation that regional development goes on by using regional resources as environmental history and culture at many districts, road network is a matter of great importance, in order to connect these developments organically. However, although highway network is concerned with regional connection, route choice of inner region is not considered enough. This study aims to suggest an appropriate road improvement planning for regional exchange, with a view to regard recreational trip as main behavior of regional exchange, by clarifying how the facilities which will contribute to regional development influence route choice.

In this Papers, firstly significance of this study and relations to previous studies are described by reviewing existing studies. Secondly the frame of this study is shown. And as a premise of this frame, we make the assumption that driver's route choice are not based on the shortest route or time but based on the attractiveness of recreational facilities. Then, the result of the questionnaire, which was carried out for the citizens in TAN-NAN region of FUKUI prefecture in

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order to survey the number and the staying time of visitors at recreational facilities and to verify the assumption, is reported. Lastly we will propose the structure of attractiveness of recreational facilities by the analysis of attractive factors with quantification theory I.

2. Existing studies

In the previous studies concerning this study, main theme are demand estimation and behavior analysis for the recreational trip and holiday traffic. Hanaoka et al.[1)2)] attended to service for recreational arterials as evaluation factors of recreational road and proposed that improvement menu. Morichi et al.[3)4)] and Morikawa et al.[5)] tried to express recreational trip models by one-day trip or infrequent trip, and Tamura et al.[6)] analyzed recreational trip by the staying time as attractiveness. Shimizu et al.[7)] tried to make clear attractive functions of river parks from the analysis of the staying time. Isobe et al.[8)] showed that travel mode and duration of activities on non-work days are related with those in weekdays. Yoshida[9)] make clear the characteristics of recognition and reaction in sightseeing information, and Wang et al.[10)]analyzed the relation between tourist movement and tourist resources. As the route choice models, models with endogenous rational expectations formation by Kobayashi et al.[11)], dynamic traffic simulation model by Iida et al.[12)13)] and mapping out method by Takayama[14)] are known.

The frames of the previous studies on traffic behavior analysis of recreational area and road might be applied to this study, because this study intend to analyze the recreational trip too. However, as the structure of attractiveness was not clarified in previous studies, the significance of this study is notable. And, route choice models were mainly dealt in urban area, and applying this model in recreational area is useful to an appropriate road improvement planning.

3. Conception of route choice model

When persons start recreational trip, they will chose a certain destination. Then, in choosing the route to destination, many attractive facilities and scenic spots along the route may affect the route choice. Assuming that these regional resources are reasons of route choice, we can presume that persons will choose the most attractive route with much resources, in case of going to the same destination. Following model shows the details.

1) Attractive resources have independent attractiveness X_i regardless of location. As the factors affecting attractiveness are following things.
   X_i : Attractiveness of regional resources i
   $X_i = f$ (Scale of facilities, Admission fee, Scale of parking space, etc.)
2) Considering that attractiveness of regional resources i relate with accessibility from route j, accessibility from route j to regional resources i is assumed as L_i. As the factors affecting accessibility are following things.
   L_i : Accessibility from route j to regional resources i
   $L_i = f$ (Distance, Structure of road, Configuration, Information service, etc.)
3) We make the assumption that both Attractiveness X_i and Accessibility L_i affect the route choice j because of gravitation Y_{ij}. Generally it is considered that gravitation Y_{ij} is as lower as Attractiveness X_i, and Y_{ij} is as higher as X_i. And gravitation Y_{ij} is as lower as accessibility L_i according to long distance and bad pavement, and Y_{ij} is as higher as L_i

according to short distance and well pavement.

Y_{ij} : gravitation of regional resources i in case of route choice j

$Y_{ij} = f(X_i, L_i)$

4) Based on these process, the summation of gravitation Y_{ij} by each regional resources i through route j is defined as valuation of route j.

Y_j : valuation of route j

$Y_j = \sum_{i=1}^{n} Y_{ij}$

The route j to some destination is not restricted only one. Therefore, in this study, in comparison with valuation of another route j, most high valuation route j is considered to choose. The relationships among these are depicted in Figure 1.

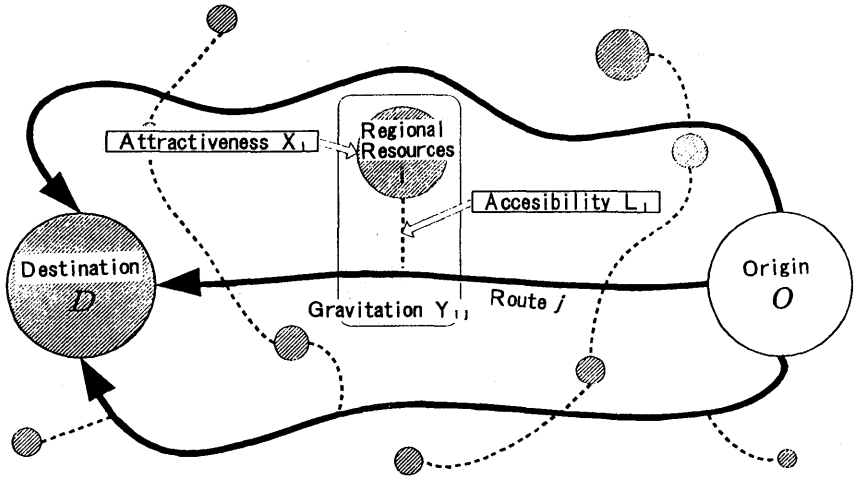

Fig.1 Conceptual chart of route choice model

4. Attractiveness model

Considering the attractiveness model of recreational facilities, it seems to be quite all right to consider that attractive facilities are used by many persons and stayed for a long time. Therefore, in this study, the number of visitors, the staying time and the total staying time of visitors are defined as the attractiveness X_i of recreational facilities.

1) The number of visitors (persons)

Average numbers of visitors : $X_i^1 = \frac{1}{n} \sum_{k=1}^{n} N_k$

N_k : Number of visitors at facilities i by examinee k

n : Number of examinee who answered to visit facilities i

Though it is possible to grasp the actual number of visitors by records of management at facilities, because of unknown number of visitors at objective facilities of this study, we tried to grasp by questionnaire.

2) The staying time (minutes)

Average staying time of visitor : $X_i^2 = \frac{1}{n} \sum_{k=1}^{n} T_k$

T_k : Staying time at facilities i by examinee k

We tried to grasp staying time at objective facilities of this study by questionnaire.

3) The total staying time of visitors (persons · minutes)

$$X_i^3 = \frac{1}{n} \sum_{k=1}^{n} (N_k \cdot T_k)$$

Tab. 1 Result of actual survey

	Name of recreational facilities	attractiveness X_i						Best 10 order
		Ave. numbers of visitors		Ave. staying time		Ave. total staying time		
		(person)	order	(minute)	order	(p·m)	order	
1	ECHIZEN Cape Polyanthus Land	3.53	28	49.6	27	183	27	11
2	YUKYU ROMAN Forest	6.65	1	127.7	5	938	3	6
3	Botanical Garden PLANTOPIA	4.00	24	84.1	20	380	21	10
4	ECHIZEN Ceramics Park	4.74	13	101.6	14	562	12	15
5	MURASAKI-SHIKIBU Park	3.49	30	43.7	29	168	28	21
6	ECHIZEN Village Park	3.51	29	54.4	26	228	26	23
7	NISHIYAMA Park	4.35	15	92.3	19	498	14	5
8	HANAHASU Park	4.03	23	59.6	25	258	25	18
9	HIRONO Dam Park	3.63	26	70.6	22	308	24	19
10	KOHNO River Park	4.88	10	66.8	23	444	15	27
11	OTAIKO Hills	4.35	16	94.6	18	424	17	20
12	FUKUI Ceramics Hall	5.32	6	107.7	10	578	10	12
13	Nife Villege Workshop	4.22	20	61.9	24	314	23	16
14	Eye-glass Hall	3.64	25	36.4	30	144	30	28
15	Papyrus Hall	4.23	19	71.2	21	335	22	14
16	FURUSATO Workshop	5.73	4	113.5	8	819	5	7
17	SOBA Workshop	5.15	7	109.2	9	586	8	9
18	KITAMAEBUNE Hall	3.56	27	45.1	28	155	29	22
19	La Pose KAWADA	6.62	2	155.1	2	1,090	2	1
20	OTOTO Village	4.75	12	119.0	6	603	7	17
21	ECHIZEN Spa [SUISEN NO YU]	4.24	18	102.3	13	429	16	24
22	TAMAGAWA Spa	5.00	9	107.1	11	568	11	26
23	KURIYA Spa	4.66	14	105.2	12	503	13	25
24	ISARIBI Spa	4.05	22	96.8	17	391	20	8
25	AMADANI Spa	4.33	17	96.8	16	409	19	29
26	KAMIKOUTI Spa	4.20	21	99.1	15	419	18	30
27	Stream Spa [KANMURISOU]	6.49	3	155.4	1	1,144	1	3
28	IMAJYO Spa [YASURAGI]	5.01	8	130.4	4	664	6	2
29	KOUNO Spa [YUUBAE]	4.76	11	115.8	7	580	9	13
30	NANJYO Spa [SOMAYAMA]	5.73	5	133.8	3	827	4	4
	Average of total facilities	4.63		93.6		498		
	Standard deviation	0.91		32.06		260.76		

Tab. 2 Correlation coefficient table

Type of facility	Theme park	Cultural institution	Spa	Total
Correlation coefficient	0.258	0.516	0.332	0.276

5. Actual survey

TAN-NAN region which became the object of this study is one-day car trip area. Then, famous and usable 30 recreational facilities with much local colour in TAN-NAN region were chosen as regional resources /. These are each 10 theme parks, cultural institutions and spas.

As an information of facilities, name, abstract, charge, parking, distance from main road(prefectural road) and map plotting the location of facilities were shown to examinee.

Examinees were required to answer the number of visitors and the staying time under the assumptions that they visit these facilities, and to fix the best 10 rank of facilities in useful order. And, if examinee didn't think to visit some facility, he was required to write zero minute as the staying time. Examinees were chosen from public (prefecture ,city and town) officials, members of consultant and students, because objective facilities were fa ıiliar to them. 101 persons answered effectively, age rank being as follows ; 41 persons were aged under 30, 31 persons were aged 30-39, 21 persons were aged 40-49, 5 persons were aged over 50. 72 persons were male and 26 persons were female, and 3 persons' age and sex were unknown.

The results of the survey are displayed in Table 1. The number of visitors, the staying time and the total staying time shown at previous chapter were compared with the best 10 ranking, and 6 higher ranking facilities were nearly same. The facilities from first to 6th ranking such as KANMURI-SOU spa, La pose KAWADA, FURUSATO workshop, YUKYU ROMAN forest, SOMAYAMA spa and YASURAGI spa are located in forest area far away from urban area, and these suggest they be a good one-day car trip recreational zone.

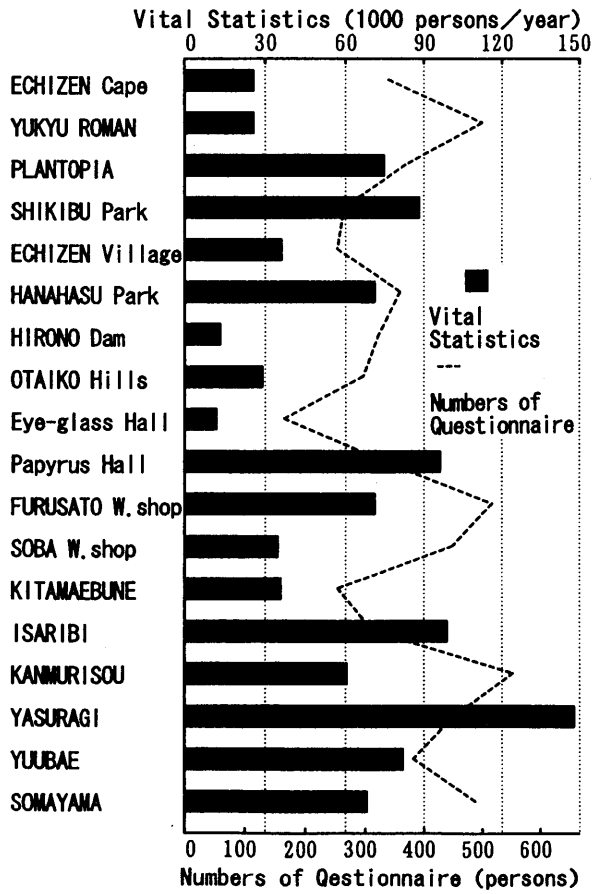

Fig. 2 Comparison of visitors between the numbers of questionnaire and annual vital statistics

Comparing with three types of facilities, such as theme park, cultural institution and spa, though an average error of the number of visitors was relatively small, an average of the staying time of theme parks was shorter and that of spas was longer than that of total facilities.

We adopted the number of visitors by questionnaire as one of the measures to estimate attractiveness. In order to determine whether the results of the survey was applicable or not, we tried to compare the number of visitors by questionnaire with annual vital statistics of tourist at same facilities, which was published by FUKUI prefectural government. Comparison between the number of questionnaire and vital statistics except ECHIZEN ceramics park and NISHIYAMA park, which had over 300 thousands annual visitors, are displayed in Figure 2.

A correlation coefficient table between the number of questionnaire and vital statistics by three types of falilities is displayed inTable 2. In case of cultural institutions it might reveal a positive correlation, but in case of other two types the correlation was not found. The reasons of non-correlation were the gap between the number of questionnaire and vital statistics concerning YUKYU ROMAN forest, MURASAKISIKIBU park, KANMURISOU spa and SOMAYAMA spa.

Though it is considered that many skiers from other prefectures are included in annual vital statistics of tourist, comparing that examinee live in Fukui prefecture, it is the subject for a future study.

6. Analysis of attractive factors by quantification theory I

We tried to make up the estimation model of attractiveness of recreational facilities by use of quantification theory I. The outline of the method is to define the type, admission fee, the scale of the parking and the distance from main road as nine predictor variable, which were classified by two or three categories, and to define the previous three attractiveness (The number of visitors, The staying time, The total staying time) as criterion variable, and to calculate the structure of attractiveness by quantification theory I.

Comparing multiple correlation coefficient of three trials, it is clarified that the model using the staying time have most applicable interpretation. The results of the analysis are displayed in Table 3. Trough the considerations of Table 3 , following ideas are obtained. The items which influenced the staying time were orderly as follows; the type of facility, admission fee and the scale of parking. By the view point of type of facility, spas had the longest staying time. By the view point of admission fee and the scale of parking, the staying time was increasing at facilities with toll and large parking space, in other words, at improved facilities. In case of distance from main road, range and partial correlation coefficient were so lower that it was thought proper to have no interpretation.

Multiple correlation coefficient of model using the staying time is not so high that the grasp of the number of visitors by this questionnaire may be inadequate, but, further investigation is necessary.

Tab. 3 Result of analysis of attractive factors

Item	Category	Numbers of sample	Value	range	order	partial correlation coefficient	order
Type of facility	1 Park	10	-11.642	27.937	1	0.359	1
	2 Culture	10	-4.654				
	3 Spa	10	16.295				
Admission fee	1 Free	9	-14.305	19.507	2	0.270	2
	2 Pay	21	5.202				
Scale of parking	1 Under 50	13	-6.691	11.808	3	0.218	3
	2 Over 50	17	5.117				
Distance from Rd.	1 face	21	0.525	0.701	4	0.031	4
	2 Over 100m	9	1.226				

7. Conclusion

This paper reported the results of the evaluation concerning the attractiveness of recreational facilities which influence route choice in case of a recreational trip. The subjects for a future study are as follows.

1) Whether the verification with trip generation and attraction standard unit of recreational trip using the estimation model of the attractiveness of recreational facilities is possible or not.
2) How the distribution of recreational facilities influence the cognition of the attractiveness.
3) Are there any other factors influencing to the cognition of the attractiveness ?

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