論文 7-3-11

A STUDY ON LAND USE APPRAISAL MODEL (I)

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ABSTRACT

In This study, an attempt has been made to build a land use appralsal model as a basis for assessing the abatement effectiveness of air pollution within Seoul city due to nitrogen oxides emitted from motor trucks.

Furthermore, the model is used to predict the city's traffic volume and its validity is ascertained by comparing it with the actual recorded traffic volume data.

Through a series of land use planning alternatives established in this study, the abatement effectiveness of Seoul city is assessed.

요 약

본 연구는 서울 대도시에 있어서 자동차에서 배출되는 질소산화물(NOx)의 대기오염 삭감 효과를 평가하기 위한 토지이용 Appraisal Model을 설계하는 연구이다.

더우기 대도시 교통량을 예측하는데 사용된 Model과 실제 교통량 data와 비교함으로써 그 타당성이 확인되었다. 또한 본 연구에서 구축한 토지이용 Model로 서울특별시의 대기오염삭감효과를 분석하였다.

I. INTRODUCTION

In recent year, the dispersive policy of population and industries in dig cities of the developing countries especially those of the NIES (Newly Industrializing Economies) in which the agglomeration of population and industries is alarmingly disproportionate has been a focus of intense research activity. Most of these studies, however, have been undertaken from myopic of perspectives. To ensure a long-term solution, this study deviates from the previous line of research by approaching the problem in a comprehensive manner. This involves the idea of land use relocated.

II. ENVIRONMENTAL JUDGEMENT CRITERION VALUE

When we apportioned a 10 percent and 30 percent respectively of all industrial land use activities within the Seoul city into the Seoul Sub-

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urbs District and the Seoul Fringe District, it is one of the objective of this study to investigate the sensitive degree of the abatement effectiveness of motor truck exhaust in Seoul city. The transfer-policy of land use is divided into 6 cases (case 1-6) of the equal apportionment and 6 cases (case 7−12) of the selective apportionment. In case of adopting the selective apportionment, particularly, the establishment of Environmental Judgement Criterion Value as the estimated value of exhaust density of each zone is needed. Therefore, the Environmental Judgement Criterion Value whs designed as follows.

Let 1 denote Seoul city and let 2 denote the Seoul Suburbs District and let 3 denote the Seoul Fringe District. Let il denote the number of Seoul city and let i2 denote the number of zones of the Seoul Suburbs District and let i3 denote the number of zones of the Seoul Fringe District. Let λil denote the exhaust volume of each zone of Seoul city and let λi2 denote the exhaust volume of each zone of the Seoul Suburbs District and let λ i3 denote the exhaust volume of each zone of the Seoul Fringe District.

Let Φil denote the area of each zone of Seoul city and let Φi2 denote the area of each zone of Seoul Suburbs District and let Φi3 denote the area of each zone of the Seoul Fringe District. Then the exhaust density of each zone is denoted as follows:

$$dij=\frac{\lambda ij}{\Phi j}\ [kg/cm^2] \qquad (1)$$

Then the Environmental Judgement Criterion Value (EJCV) can be represented as follows:

$$EJCV=\frac{\sum_{1}\sum_{j} d\,i\,j}{\sum i\,j}$$

$$=\frac{\sum di1+\sum di2+\sum di3}{i1+i2+i3}$$

$$\fallingdotseq 7.3 \qquad [kg/km^2] \qquad (2)$$

This EJCV is used for judgement the environmental level of each zone and is made 12 land use indexes by it. That is, this value becomes the value of judgement criterion for transfer apportionment.

III. EXTRACTION LAND USE MODEL

The method extracting the industrial area of Seoul city is sorted out into : the method extracting it equally and the method extracting it selectively.

1)LAND USE MODEL OF EQUAL EXTRACTION

This extraction method means to extract the industrial area from each zone of Seoul city. The original industrial area to be extracted is to be extracted is to be filled up by the residential area.

Let ϕil denote the industrial area of each zone in Seoul city and let ρ denote the extracting ratio. Hence, the sum of industrial area in Seoul city becomes

$$\sum_{i=1}^{17}\phi\,i1=14.447km^2 \qquad (3)$$

The area to be extracted from Seoul city can be represented as follow:

$$\Phi\,i1=\rho\sum_{i=1}^{17}\phi\,i1=\begin{matrix}1.445km^2:\rho=0.1\\4.334km^2:\rho=0.3\end{matrix} \qquad (4)$$

2)LAND USE MODEL OF SELECTIVE EXTRACTION

The method of selective extraction considers the environmental level of each zone in Seoul city obtained from the Environmental Judgement Criterion Value and then extracts the industrial area of only zones being over the Environmental Judgement Criterion Value. The Land Use Model of Selective Extraction distinguishes the exhaust density of 17 zones of Seoul city from the Environmental Judgement Criterion Value and it is the model to extract the industrial area according to the rate of pollution contribution of zones being over the Envirnmental Judgement Criterion Value.

The number of zones being over the Environmental Judgement Criterion Value is 14 zones. In all zones of Seoul city, the zones of low exhaust density such as

$$dij \langle EJCV$$

are excluded from the target of extracting zones and we consider only the remaining zones. The rate of industrial area to extract can be represtented as follows:

$$\nu i1 = \frac{di1 - EJCV}{\sum_{i}(di1 - EJCV)} \quad \text{——————(5)}$$

EJCV ; ENVIRONMENTAL JUDGEMENT CRITERION VALUE

Here, we have to consider the following two cases to decide the industrial area to extract :

① $\phi i1 \leq \rho \nu\, i1 \sum_{i=1}^{17} \phi i1$

In case of ① we extract ρ of zone i'. that is, each extraction area $\Phi i'1$ can be represented as follow :

$$\Phi i'1 = \phi i'1 \quad \text{——————(6)}$$

② $\phi i1 \rangle \rho \nu\, i1 \sum_{i=1}^{17} \phi i1$

In case of ②, if we recalculated the ratio of zones i'' excluded in ① then $\nu''i''1$ can be reprsented as follows :

$$\nu''i''1 = \frac{di''1 - EJCV}{\sum_{i''}(di''1 - EJCV)} \quad \text{——————(7)}$$

Here, each extraction area $\Phi i''1$ can be expressed as

$$\Phi i''1 = \nu''i''1 \left(\rho \sum_{i=1}^{17} \phi i1 - \rho \sum_{i'} \phi i'1\right)$$

$$= \frac{di''1 - EJCV}{\sum_{i''}(di''1 - EJCV)} \left(\rho \sum_{i=1}^{17} \phi i - \rho \sum_{i'} \phi i'1\right) \quad \text{——————(8)}$$

Here,

$$\rho \sum \phi i1 = \sum \Phi i'1 + \sum \Phi i''1 \quad \text{——————(9)}$$

Ⅳ. APPORTIONMENT LAND USE MODEL

The method to apportion the industrial area extracted from Seoul City is sorted out into three cases as :

The apportionment to the Seoul Suburbs District,the apportionment to the Seoul Fringe District and apportionment to the Suburs and the Fringe on 50 percent to 50 percent basis. Furthermore, there are two methods as the equal apportionment and the selective apportionment, and there are two methods like the extraction ratio of 10 percent and 30 percent.

For this once, we established six land use models (3*2) as follows.

1)LAND USE MODEL USING EQUAL APPORTIONMENT TO THE SUBURBS DISTRICT

The apportionment methods means to extract the industrial area equally from 17 zones of Seoul city and to apportion it equally to 12 zones of the Seoul of Seoul SuburbsDistrict.

The sum of the indrstrial area to extract from Seorl city was represented as

$$\rho \sum_{i=1}^{17} \phi i1$$

We apportion it equally to the Seoul Suburbs District.

Here, the area Φi2 to be apportined to each zone can be represented as follows :

$$\Phi i2 = \frac{p}{i(2)} \sum_{i=1}^{17} \phi ij \fallingdotseq 0.120 \ [km^2] \quad \text{——————(10)}$$

2)LAND USE MODEL USING EQUAL APPORTIONMENT TO THE FRINGE DISTRICT

This apportionment method means to extract the industrial area equally from 17 zones of Seoul city and to apportion it equaully to 9 zones of the Seoul Fringe Distrect. The sum of the industrial area extracted from the Seoul city was represented as

$$\rho \sum_{i=1}^{17} \phi ij$$

We apportion it equally to the Seoul Fringe District. Here, the area $\phi i3$ to be apportioned to each zone can be represented as follows :

$$\Phi i3 = \frac{\rho}{i(3)} \sum_{i=1}^{17} \phi ij \fallingdotseq 0.160[km^2] \quad \text{———(11)}$$

3)LAND USE MODEL USING EQUAL APPORTIONMENT TO THE SUBURBS AND THE FRINGE ON 50% TO 50% BASIS

This apportionment method means to extract the industrial area equally from 17 zones of the Seoul city and to apportion it equally to be Seoul Subrbs District and Seoul Fringe Distict on 50 percent to 50 percent basis. The sum of the industiral area to extract from the Seoul city was represented as

$$\rho \sum_{i=1}^{17} \phi ij$$

We apportion it equally to the Seoul Suburbs District and Seoul Fring District an 50 percent to 50 percent basis. Here, the areas Φ′i2 and Φ′i3 to be apportioned to each zone can reperseted as follows :

$$\Phi' i2 = \frac{\rho}{2i(2)} \sum_{i=1}^{17} \phi ij \fallingdotseq 0.060[km^2]$$

$$\Phi' i3 = \frac{\rho}{2i(3)} \sum_{i=1}^{17} \phi ij \fallingdotseq 0.080[km^2] \quad \text{——(12)}$$

5. ANALYSIS AND CONCIDERATION OF LAND USE

1)EQUAL APPORTIONMENT TO THE SUBURBS DISTRICT

When we apportioned equally of 10 percent or 30 percent of the industrial area from 17 zones of Seoul city to zones of the Seoul Suburbs District, the abatement effectiveness of vehicle kilometers traveled per area per day of Seoul city was obtained as shown in Table 1. When we apportioned equally 10 percent of the industrial area of Seoul city to the Seoul Suburbs District, the vehicle kilometers traveled per area per day of Seoul

city is about 2,329 Veh.km and shows the abatement effectiveness of 1.19 percent. Also, the vehicle kilometers travaled per area per day of the Suburbs is about 447 Veh.km increasing rate of 2.05 percent. The vehicle kilometers traveled per area per day of the Fringe is about 68 Veh.km and shows no variation.

Table 1 The Results of Simulation of Veh.km/㎢/day of each District using Equal Apportionment to Suburbs

Unit : Veh.km/km²/day

DISTRICT / CASE	SEOUL	SUBURBS	FRINGE
INITIAL VALUE	2357	438	68
CASE (I)	2329 (−1.19%)	447 (+2.05%)	68
CASE(Ⅶ)	2261 (−4.07%)	464 (+5.94%)	68

2)EQUAL APPORTIONMENT TO THE FRINGE DISTRICT

When we apportioned equally of 10 percent of 30 percent of the industrial area from 17 zones of Seoul city to 9 zones of the Seoul Suburbs Disrict, the abatement effectiveness of vehicle kilometers traveled per area per day of Seoul city was obtained as shown in Table 2. When we apportioned equally 10 percent of the industrial area of Seoul city to the Seoul Suburbs District, the vehicle klometers traveled per area per day of Seoul city is about 2,311 Veh.km and shows the abatement effectiveness of 1.95 percent. Also, the vehicle kilometers traveled per area per day of the Suburbs is about 442 Veh.km and shows the increasing rate of 0.91 percent. The vehicle kilometers traveled per area per day of the Fring is about 75 Veh.km and shows the increasing rate of 10.29 percent.

Table 2.The Results of Simulation of Veh.km/km²/day of each District using Equal Apportionment to the Fringe

Uint : Veh.km/km²/day

DISTRICT / CASE	SEOUL	SUBURBS	FRINGE
INITIAL VALVSE	2357	438	68
CASE (II)	2311 (−1.95%)	442 (+0.91%)	75 (+10.29%)
CASE(Ⅶ)	2203 (−6.53%)	449 (+2.51%)	89 (+30.88%)

3)EQUAL APPORTIONMENT TO THE SUBURBS AND THE FRINGE ON 50 PERCENT TO 50 PERCENT BASIS

When we apportioned equally of 10 percent or 30 percent of the industrial area from 17 zones of Seoul city to 12 zones of the Seoul Suburbs District and 9 zones of the Seoul Fring District on 50 percent to 50 percent basis, the abatement effectiveness of vehicle kilometers trveled per area per day of Seoul city was obtained as shown in Table 3. When we apportioned equally 10 percent of the induatrial area of Seoul city to the Seoul Suburbs District and the seoul Fringe District on 50 percent to 50 percent basis, the vehicle kilometers traveled per area per day Seoul city is about 2,306 Veh. km and shows the abatement effectivenss of 2.16 percent. Also, the vehicle kilometers traveled per area per day of the Suburbs is about 445 Veh.km and shows the increasing rate of 1.60 percent. The vehicle kilometers

traveled per area per day of the Fring is about 72 Veh.km and shows the inereasing rate of 5.88 percent.

Table 3 The Results of Simulation of Veh. km/km²/day of each District using Equal Apportionment to the Suburbs and the Fringe on 50% to 50% basis

Uint : Veh. km/km²/day

DISTRICT / CASE	SEOUL	SUBURBS	FRINGE
INITIAL VALUSE	2357	438	68
CASE (Ⅲ)	2306 (−2.16%)	445 (+1.60%)	72 (+5.88%)
CASE(Ⅸ)	2236 (−5.13%)	456 (+4.16%)	78 (+14.71%)

V. CONCLUSION

Apportioning 10% and 30% of the industrial area from Seoul city to the Suburbs, We can obtain the abatement effectiveness of 1.16% and 5.70% using equal apportionment. Howerer, apportioning 10% and 30% the industrial area from Seoul city to the Fringe, we can obtain the abatement effectiveness of 1.96% and 6.5% using equal apportionment. Also, apportioning 10% and 30 % of the industrial area from Seoul city to the Suburbs and the Fringe of 50% to 50%, we can obtain the abatement effectiveness of 2.14% and 5.17% using equal apportionment.

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