GIS and Spatial Dependent Variable on Modeling Conventional Recreational Demand for Phu Jong Na Yoi National Park Tourism, Ubon Ratchathani, Thailand

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Abstract

The objectives of this research is twofold: first, to study the role of spatial dependency, as well as other factors, on estimating a recreational demand model for the Phu Jong Na Yoi National Park by using the Geographical Information System (GIS) as a tool in order to support the hypothesis that spatial dependence influences the estimation of the Travel Cost recreation demand for tourism in the park and second, to measure the economic value of the use of the park's natural resources in order to provide tourism benefits for visitors. Because of knowing the value of park use could help both Government and local officials decide whether or not to open parks' pristine land to public use, how much to spend on park maintenance each year, and how much capital to invest on park amenities. The estimated spatial autoregressive model shows validity and robustness with the significant R^2 and F values at 95% confidence intervals. The estimated park consumer surplus from the model estimated is 56.29 baht per person or 1.89 million baht per year. The valuation of resource use for tourism in the park is important for local administrative policies on environmental and natural resource management in the future.

Keywords: Spatial Dependence, Travel Cost Model, Consumer Surplus, Geographical Information System, Tourism, Phu Jong Na Yoi National Park, Recreational Demand

1. Introduction

This paper presents how spatial dependence should be incorporated into the conventional recreational demand model. The geographical area studied was the Phu Jong Na Yoi National Park, Ubon Ratchathani, Thailand. The Geographical Information System (GIS), which helps to provide accurate traveling distance data of park visitors is utilized. The economic value of park tourism has been estimated, and some policies on the park's tourism are discussed.

Generally, park tourism, a type of nature-based tourism, is an alternative to mass tourism. It is a means of economic development and environmental conservation. Its role is to protect the environment, educate and provide pleasure for both the local people and visitors, as well as generate revenue for the local community. Activities that conserve the park's ecosystem and environment are nature-based, ecologically concerned, educational, and enjoyable. For example, these activities consist of bird watching and nature interpretation activities. These activities are valuable assets in that people can enjoy a flow of services. When we look at it as an opportunity of economically potential outdoor recreation, tourism could help sustain local economies. However, Government's public policies and actions of individuals can lead to changes in park services.

While it is clear to policy makers, park officers, local officials and visitors that national parks are important resources, little is known about the economic value visitors place on parks. Knowing the value of park use could help both Government and local officials decide whether or not to open parks' pristine land to public use, how much to spend on park maintenance each year, and how much capital to invest on park amenities such as parking lots, restrooms, and accommodation services.

Unfortunately, measuring economic values of national parks are not properly interacting in markets because of their public good characteristics of non-excludable and non-rival consumption (Tietenberg, 2006). Especially, for all small Thai national parks, economic valuation of park ecotourism is rarely conducted by researchers. Moreover, most research studies of tourism in small national parks have often neglected valuations of tourism benefits since this is considered as a small amount of revenue in relation to the whole economy. However, most people, especially local communities, could gain benefits of the direct use of small national parks, which include ecotourism, ecosystem study and experiment stations for students and community training. Therefore, the valuation of resource use for tourism in the park is important for local administrative policies on environmental and natural resource management in the future.

Government agencies and many research organizations often need to estimate the economic values of natural resource services for a cost - benefit analysis or for the facilitation of natural resource policy making and management decisions in general. Estimates of values depend on the accuracy of the measurement of variables considered in the demand function. Problems concerning the correct measurement of variables, especially the distance variable, is addressed in many studies (see, for example, Hanink and White, 1999; and Zawacki, 2000). Given the natural characteristic of the park, a distance could involve any kind of tourists' factors, for example, leisure time, travel cost and others. The results of the distance influence appearing on economic variables are called spatial dependence. Therefore, measurement of travel distance is an important step toward recreational demand function estimation.

The objectives of this research is twofold: First, to study the role of spatial dependency and other factors on estimating a recreational demand model for the Phujong Na Yoi National Park, Ubon Ratchathani, Thailand by using the GIS as a tool in order to support the hypothesis that spatial dependence influences the estimation of the conventional Travel Cost recreation demand for tourism in the park, and second, it measures the economic value of the use of the park's natural resources in order to provide tourism benefits for visitors. Additionally, policy implications for the park's tourism management are discussed.

2. Literature Review

Government and local community have economic incentives to maintain national park areas in a natural condition in order to ensure continued visits by eco-tourists. Therefore, nature tourism is promoted as a tool for biodiversity conservation and rural development (Hvenegaard and Dearden, 1996). Tourism planning for the park should include decision-making among all segments of society. The tourism resource used by visitors can coexist between biodiversity conservation and rural development.

Previous studies report the influence of spatial effects on outdoor recreation demand studies (Kerkvliet, 1999; and Smith and Kopp, 1989). Inappropriate considerations of spatial dependence in model variables can falsify the standard assumption on the correlation of error term in the classical econometric demand model and lead to prediction problems. This study uses GIS which provides an efficient method of spatially referencing geographic and economic information. A GIS approach to the measurement of travel distance from the visitors' origin to a recreation site is applied as a weight to spatial econometric travel cost demand models. In comparing

the improved models with the conventional Travel Cost Model, this study then uses the estimated models in order to measure the economic value of tourism in the small remote national park of Phu Jong Na Yoi.

Many disciplines and application areas related to the characteristics of tourism and GIS are shared by the relationship of tourism interests (Bahaire and Elliott-White, 1999; and Bhat, 1997). Managing, analyzing and displaying large volumes of diverse data pertinent to local and regional tourism planning activities increase the use of the GIS technical tool. The goal for the achievement of sustainable tourism development is very impressive since GIS is user- friendly (McAdam, 1994; and Joerg Schaller, 1995). GIS has tremendous potential for application in tourism planning in Thai national parks. However, due to the general lack of tourism databases and inconsistencies in data, its applications are limited. For example, there is very little site-specific information about visitors' origin and destination, travel motivation, expenditure patterns, spatial patterns of recreation and tourism use, levels of use and impacts, and suitability of sites for recreation/tourism development--all of which are suitable applications of GIS. Therefore, this research conducts an on-site specific database from the use of a field survey.

Eco-tourism, a type of tourism that emerges between human (i.e., tourists, local population, etc.) behavior and ecological services, observed by socioeconomic activities, at the location and its neighboring location can be viewed as spatial things (Florax, 2000). For example, tourism demand may be related to the distance from a gateway (i.e., town, city, and airport) to a local destination zone in the park. The geo-ecological features of each different neighboring zone may determine the demand for tourism. However, the data attribute of this research relates to the discrete types concerning geo-coded socioeconomic data sets (i.e., data sets that contain the location of the observed units). The raster model could be a major consideration in the analysis. In this study, the raster data were GIS data which were used for mapping the site visit and estimate the travel distances.

This study initially tried to incorporate a distance influence in an autoregressive model. However, as claimed by Anselin (1999), in a geographic (cross-sectional) data set, the standard econometric techniques often fail in the presence of spatial autocorrelation; therefore, this research uses a spatial autoregressive model in order to specify, estimate, and test the presence of spatial interaction in the recreational demand models. Concerning spatial relationships, according to Anselin (1999 and 2002) and Lesage (2002), spatial dependence occurs when the value of variable y for observation i depends on the value of observation j. Formally, spatial dependence in a collection of sample data implies that the observation at location i depends on other

observations at locations $j \neq i$.

$$\text{States: } y_i = f(y_j), \, i = 1,\ldots,n \text{ and } j \neq i \tag{1}$$

As in Eq. (1), spatial autoregression, it implies that a sample contains less information than the uncorrelated counterpart. Thus, this limits the ability to carry out statistical inference. Explicit spatial dependence in ecological and socioeconomic data on ecotourism demands need to deal with a statistical analysis with correlation in the data. Thus, introducing spatial econometrics seems to be more suitable for this study.

The notion of spatial econometrics is used to the recreational demand model in the study. The expected related variables that determine the demand for ecotourism are proposed in the next section. After determining the related variables, all the variables will be assigned to the model. This study will consider the following areas of interest: (a) the formal specification of spatial effects in econometric models; (b) the estimation of models that incorporate spatial effects; (c) specification tests and diagnostics for the presence of spatial effects; and (d) spatial prediction (interpolation).

3. Materials and Methods

3.1 Data Used for GIS Study

This study used GIS as a tool in which to relate spatial influences to an economic model. The following GIS databases and information were used as inputs in order to create output maps of the park and construct the distance weighted variable for the economic model analysis. The input maps and database are as follows (RFD, 2005):

1. The satellite data from LANDSAT-5 TM for Northeast Thailand
2. Geographic Maps of the Northeast 1:50,000 series L7018 from the Military Mapping Department
3. National Park Zoning Maps for Phu Jong Na Yoi National Park 1:250,000 from the Royal Forestry Department
4. Road Network Maps of Ubon Ratchathani 1:250,000 from the Office of Rural Rapid Developing Department
5. Other maps from the Tourism Authority of Thailand, used as the input data for geographical database. ArcGIS software for GIS was used for the analysis. The results are digital maps containing all databases of the park's visiting sites. The data can be retrieved and used in the potential park tourism map analysis
6. Recent 2006 Census Data.

The above GIS database has been used to create a specific output map, as shown in Figure 1. Because the research focuses on spatial distance weight, the accurate lattice on the map was reproduced along with the coordinate given by the park's Officer. The research can determine the distance between the pair of coordinates related to the travel path of visitors. A modified distance function was used to create a spatial weight function as shown in Eq. (11).

3.2 Sampling Design and Data

There are two parts to the data sampling from the field surveys. First, for the park officer interview, the study used questionnaires for park officers on a pre-survey in order to collect the opinions on park activities from 92 park officers; and only 20 samples were received due to the rest of park officers are on duties. This part was carried out in May 2005. The data consisted of general information and on the operation of the park. The questionnaire covered officials' attitudes toward activities of forest protection and tourism, working, and income. Second, 750 sets of questionnaires for visitors were used to collect data from on-site visitors at the park during November 2004 to April 2005. 620 samples were returned and the completed 604 questionnaires were used for the analysis. The questionnaire was split into three sections in order to capture the visitors' socio-economic characteristics and attitudes toward visiting the national park. The first section was completed by visitors. The second section of the survey contained information about activities that the visitors were involved with during their trip and their opinions on site activities. The third section of the survey contained information about the visitors' opinions on park conservation learning and its tourism services, such as the suitability of fees (including entrance, and accommodation). Additional information consisted of the Park's substitute site and visiting cost.

Figure 1 Visiting Sites: Phu Jong Na Yoi National Park
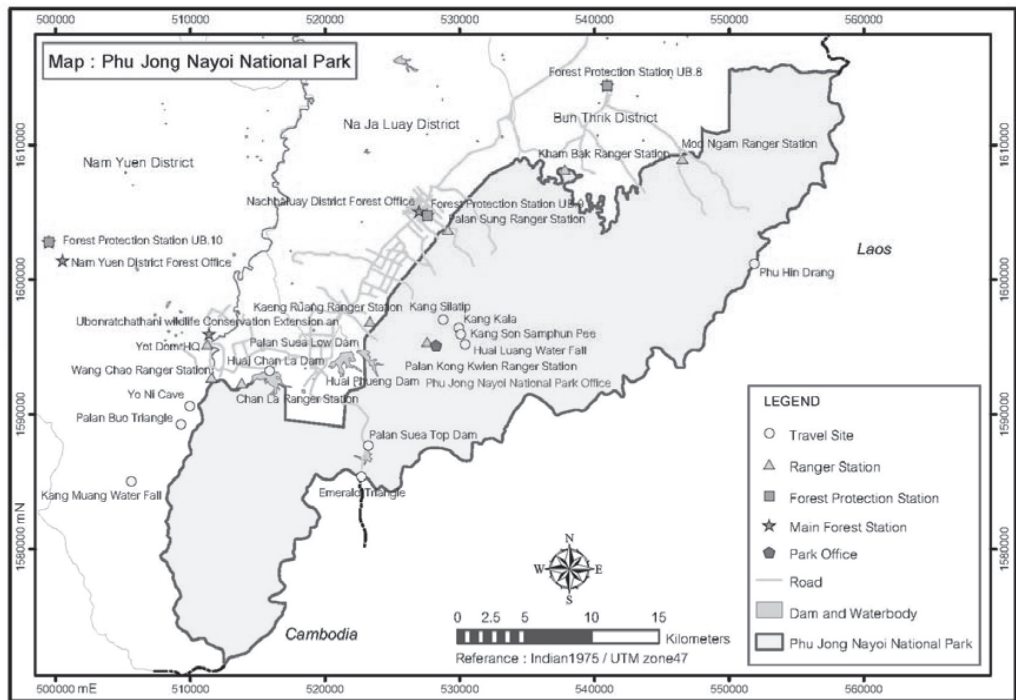
3.3 Single Site Travel Cost Model Estimation and Analysis

A recreational demand model was proposed by modifying the single site travel cost model (TCM). This method links information on the distance people travel to visit the park to information on how many times they visit the park each year, and other variables; travel cost, income, and demographic. Data on variables from the sampled visitors were used to estimate a demand function for the number of trips to the park. The resulting demand function provides the approximate value of a visit to the park. The brief review of the single site TCM model has been given by Parson (2000) as follows:

Formally, the visitors' maximization problem is to maximize utility with income and time constraint, as follows:

$$\text{Max} \quad U(r, s, z, d) \tag{2}$$
$$\text{s.t.} \quad wH = z + (tc_r \bullet r) + (tc_s \bullet s)$$
$$T = H + (tm_r \bullet r) + (tm_s \bullet s)$$

where r = the number of trips to the site of interest, s = a vector of number of trips taken to substitute sites, z = a composite of other goods and services, and d = a vector of demographic variables believed to capture the differences in preferences across the population. The units of goods and services for tourism are defined such that its price is one. The individual then chooses recreation trips and other goods and services in order to maximize the utility subject within the two constraints shown below:

The first constraint is income, where w = the hourly wage, H = the hours worked over the season, tc_r = the trip cost, entrance fee, and any other out-of-pocket expenses necessary to make the trip to the site of interest, and tc_s = a vector of similar costs for each substitute site. Therefore, individuals spend their income on recreation trips and other goods and services which cannot exceed their income.

The second constraint is over time (T), which states that the individual divides time between work and leisure during the season, tm_r = time spent traveling to and from the site and the on-site necessity which makes one trip possible and tm_s = a similar vector for each substitute site. This constraint simply states that the individual divides time between work and leisure (where recreation is the only form of leisure in this model), and the time spent cannot exceed the available time over the season.

Rewriting the time cost constraint as $H = T - tm_r \bullet r - tm_s \bullet s$, substituting into income constraint, and rearranging terms which give a simplier form for the utility maximization problem. The general form of that demand function is (see Figure 2).

$$r = f(tc_r, tc_s, inc, dem) \tag{3}$$

A negative relationship, like any demand curve, exists between the quantity demand (trips; r) and price (trip cost; tc_r). A positive coefficient on tc_s will pick up as the substitution effect. Income (inc) and the demographics (dem) work as typical demand shifters. Common shifts are age, education, gender, and number of trips in days.

The unit of observation for the analysis is the individual. The sample size is the number of completed surveys. Each person's trip cost (to the study site and its substitutes) is estimated by measuring the distance to and from the site multiplied by a reasonable per hour travel cost. To estimate the time cost component of the trip cost, the researcher measured the round trip time to and from a site and multiplied this by a reasonable cost per hour estimate.

The two most common forms used in estimating Eq. (3) are the linear and semi-log models. The following models were used for the study analysis.

Linear: $r = \beta_r tc_r + \beta_s tc_s + \beta_y inc + \beta_d dem + e$ (4)

Semi-log: $\ln(r) = \beta_r tc_r + \beta_s tc_s + \beta_y inc + \beta_d dem + e$ (5)

Valuation of access to a site, which is affected by policies or situations where the entire site is lost or gained is a person's total consumer surplus for the site, which is calculated by integrating the demand function in the previous section taken from tc_{rn} to tc^*_{rn}, where tc_{rn} is the trip cost of individual n and tc^*_{rn} is the trip cost at which the number of trips taken in the estimated demand function fall to zero. The consumer surplus for individual n (area A) is taken from:

$$cs_n = \int_{tc_{rn}}^{tc^*_{rn}} f(tc_{rn}, tc_s, inc, dem)\, dtc_{rn} \qquad (6)$$

Eq. (6) is the total willingness to pay to have access to the site for the season. Notice in Figure 2 and Eq. (6) that as the trip cost rises, all else constant, the access value declines.

Figure 2 Travel Cost Demand Curve and Consumer Surplus
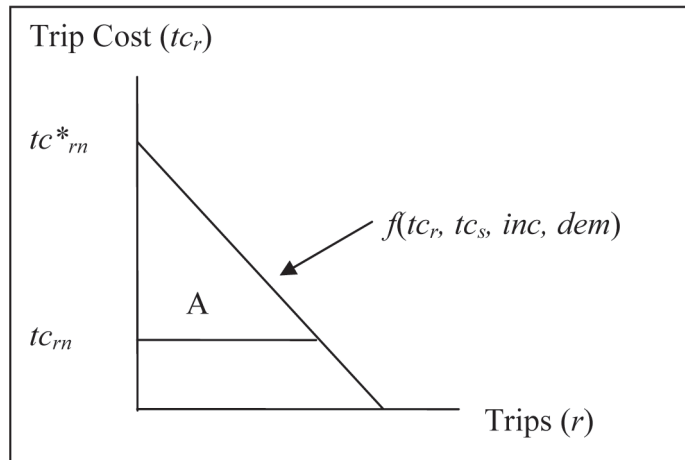
Source: Modified from Parsons, 2000.

The consumer surpluses for individual n in Eq. (6) are as follows:

$$\text{cs}_n \ (\text{linear}) = \frac{r_n^2}{\left(-2\beta_r\right)} \tag{7}$$

$$\text{cs}_n \ (\text{semi-log}) = \frac{r_n}{\left(-\beta_r\right)} \tag{8}$$

where r_n is the number of trips by person n and β_r is the coefficient on the trip cost in the demand function. For a linear (Eq. (4)) or semi-log (Eq. (5)), the demand function is estimated as follows:

3.3.1 Model Specification without Spatial Dependence

Model 1 linear: for eq. (4),
$$r = \beta_r \, tc_r + \beta_s \, tc_s + \beta_y \, inc + \beta_d \, dem + e. \tag{9}$$
or num_trip = constant + β_1 t_cost + β_2 t_cost_sub + β_3 inc_year + β_4 v_day
$\qquad$ + β_5 sex + β_6 edu + β_7 reage + β_8 local_part + β_9 satisfied,

Model 2 semi-log: for eq. (5),
$$\ln(r) = \beta_r \, tc_r + \beta_s \, tc_s + \beta_y \, inc + \beta_d \, dem + e. \tag{10}$$
or ln(num_trip) = constant + β_1 t_cost + β_2 t_cost_sub + β_3 inc_year + β_4 v_day
$\qquad$ + β_5 sex + β_6 edu + β_7 reage + β_8 local_part + β_9 satisfied,

and the descriptions of the variables are summarized in Table 1.

3.3.2 Model Specification with Spatial Dependence

In this study, the functional relationship between the trip of each individual and his/her socio-economic characteristics (independent variables) has been analyzed by implementing a distance-based weight as a spatial effect within the model estimated. As claimed by Lesage (2002), the distance vector along with a distance decay parameter (geographically weighted regression, GWR) could be used to produce locally linear regression estimates for every point in space. To construct the weighted function (W_i), this study used a modified initial functional form,

$$W_i = \frac{1}{\left(d_i \big/ \theta\right)^2} \tag{11}$$

where θ is a decay or bandwidth parameter, d_i in this equation is a studied distance along the lattice of the visited site to the visitor's residence. A single value of the bandwidth parameter θ is determined by using a cross-validation procedure often used in locally linear regression methods. The score function takes the form:

$$\sum_{i=1}^{n} \left[y_i - \hat{y}_{\neq i}(\theta) \right]^2 \ , i = 1 \text{ to } n, \tag{12}$$

where y is the dependent variable as in the Eq. (1), then the function goes to error sum of square which can take minimization as in ordinary least square (OLS). We can write the simple spatial autoregressive model (SAR) with the weighted distance decay variable as in Eq. (1). Eq. (4) and Eq. (5) can be changed from a general model to weighted regression within the Travel Cost model as follows:

Linear: $r = \rho \ W_i y + \beta_r \ tc_r + \beta_s \ tc_s + \beta_y \ inc + \beta_d \ dem + e$ (13)

Semi-log: $\ln(r) = \rho \ W_i y + \beta_r \ tc_r + \beta_s \ tc_s + \beta_y \ inc + \beta_d \ dem + e$ (14)

In Eq. (13) and Eq. (14), the ρ is a vector of parameters to be estimated which is conditional on θ. That is, changing θ will produce a different set of SAR estimates. Under Ordinary Least Square (OLS) estimations, as in Eq. (9) and Eq. (10), when spatial dependencies are present, the estimated parameters are biased and/or inefficient.

Model 3 linear: for eq. (4), Linear spatial autoregressive model

$$r = \rho\beta_w \ wr + \beta_r \ tc_r + \beta_s \ tc_s + \beta_y \ inc + \beta_d \ dem + e. \tag{15}$$
or num_trip $= \rho$w num_trip $+ \beta_1$ t_cost $+ \beta_2$ t_cost_sub $+ \beta_3$ inc_year $+ \beta_4$ v_day
$+ \beta_5$ sex $+ \beta_6$ edu $+ \beta_7$ age $+ \beta_9$ local_part $+ \beta_{10}$ satisfied

Model 4 semi-log: for eq. (5), Semi-log spatial autoregressive model (SAR)

$\ln(r) = \rho\beta_w \ wr + \beta_r \ tc_r + \beta_s \ tc_s + \beta_y \ inc + \beta_d \ dem + e.$ (16)
or $\ln$(num_trip) $= \rho$w num_trip $+ \beta_1$ t_cost $+ \beta_2$ t_cost_sub $+ \beta_3$ inc_year
$+ \beta_4$ v_day $+ \beta_5$ sex $+ \beta_6$ edu $+ \beta_7$ age $+ \beta_9$ local_part $+ \beta_{10}$ satisfied

Spatial dependencies affect the studied models either from structural relationships among the observations (lagged dependency) or from the omission of

spatially correlated explanatory variables that impact the spatial dependency among the error term. This spatial dependence can be solved with the models in Eq. (15) and Eq. (16). The models were used for the analysis and result comparison.

3.4 Measuring Travel Distances

In the Travel Cost Model, a key element is the distance assumed relevant for each individual's trip to a recreation site. Measuring distance has changed rapidly with access to modern microcomputer based softwares such as ArcGIS packages. The respondents are reasonably accurate about the distance to the recreation site they recently visited (or where they were interviewed, if data were collected in an intercept survey). This claim is supported by the Bateman et al. (1996) study, cited in Phaneuf and Smith (2004), which recently confirmed this information, suggesting that the highest resolution of GIS computation is quite close (on average) to respondent reports.

The technique used in this study is to measure the distance by using a geo-coordinate at points or sites located on different geographic regions. This was done by a map operation on a computing procedure which is supported by the GIS software. The measured distances were used for deriving a geographical weight function, as in Eq. (11). The weight is imported into Eqs. (15) and (16) for model evaluation.

Table 1 Descriptive Statistics and Expected Signs

Variables	Description	Expected Sign
num_trip	Number of trips to the site of interest (times) (Dependent variable)	~
t_cost	Total cost of gaining access to the site (baht)	(-)
t_cost_sub	Total cost of gaining access to the substitute site (baht)	(+)
inc_year	Income per year (before tax) (baht)	(+)
v_day	Number of days to visit (days)	(+)
sex	Gender (1 = female, 0 = male)	(shifter)
edu	Level of education (0 = null, 1 = elementary, 2 = high school, 3 =vocational, 4 = university)	(shifter)
reage	Real age	(+/-)
local_part	Local people participation in park tourism (0 = no, 1 = yes)	(+/-)
satisfied	Visitors' opinion on the park tourism both facilities and services (overall, 1 = poor, 2 = fair, 3 = good, 4 = very good)	(+/-)

Source: Modified from Worboys, G.L., De Lacy, T., Lockwood, M. 2000.

4. Estimation Results

Table 2 Summary of Visitors' Demographic and Economic Results

	Sum	Mean		Std. Deviation
	Statistic	Statistic	Std. Error	Statistic
Distance from home (km.)	90,764	150.27	5.438	133.654
Travel time to park (hrs.)	1,587.40	2.63	.0964	2.3699
Number of days to visit (days)	977	1.62	.034	.841
Number of visitors (persons)	28,082	46.49	2.749	67.573
Total actual expenditure* (baht)	902,450	1,494.12	142.779	3,508.984
Total time for park visiting (times)	2,675	4.23	.234	5.739

Note: * Vehicle expenses, food and drink expenses, fees, and other expenses (i.e. tents, clothes and personal accessories).

Visiting sites: Huay Luang Water fall, Kaeng Ka Lao, Kaeng Sam Pun Pee, Palan Pa Chat, Phu Hin Dang, Emerald Triangle, Kaeng Silatip, Narai Sculpture, and Kerng Mae Fong Water Fall.

Visiting substitute sites: Kaeng Lum Duan, Kaeng Tana, and Pha Tam (25 km., 80 km., and 100 km. far from the Park, respectively)

Visitor's activities: swimming, picnicking, wildlife watching, nature trailing, scenery enjoying, photo shooting, researching, bird watching, camping, seminar attending, sporting, conservation learning, historical place visiting, astrology learning.

The hypothesis testings of the estimated models are represented by the computed D.W. statistics for Models (1), (2), (3), and (4) in Table 3 which equal 1.626, 1.403, 1.346, and 1.781, respectively. The null hypothesis test indicated that Models (1), (2), and (3) indicate significant evidence of positive autocorrelation because d-computed is lower than 1.675 which is the lower bound d_L of D.W. significance points at 0.05 level of significance for n = 200, k = 9 (Gujarati, 1995). This means that the null hypothesis test was not passed and the models indicate evidence of positive autocorrelation. These models are involved with correlation in error terms leading to inconsistency for the model estimation. However, in Model (4), the null hypothesis test provides significant evidence of positive autocorrelation can not use for any decision making. By rule, because the d-computed is 1.781, there is no decision on the null hypothesis.

However, we have seen that the F statistic value and expected signs of Model (4) improved. The F statistic value and reasonable expected signs showed that Model (4) is more robust than the other models. Because of the different forms of models, using R^2 for comparison among the models may not be suitable. The F statistic value is used for model testing. When the F-value equals 87.061, at the 5% level of significance, the test of overall significance of the estimated regression indicates that we can reject the joint hypothesis test for all of the coefficients. We accepted that all coefficients are not equal to zero.

With the specific type model of Travel Cost, the study tried to improve the prediction efficiency of the model purposed. Therefore, introducing the semi-log function with the SAR model proves more useful. Therefore, Model (4) gives us more validity and should provide more accurate predictions when this model is used.

The results of Model (4), with an appropriate semi-log SAR functional form have been proven in this study that the estimated conventional Travel Cost Model could improve prediction performance. This study utilized this model for estimating the economic value of the park.

Table 3 Results of Model Estimation

Variables	Model 1 Linear w/o weight	Model 2 Semi-log w/o weight	Model 3 Linear w/SAR	Model 4 Semi-log w/ SAR
(Dependent variable)	Num of trips	LN num of trips	Num of trips	LN num of trips
(Constant)	6.152*** *(4.210)*	.430***(2.274)	.065 *(.1268)*	-.167* *(-1.333)*
Weighted visiting trips	-	-	1.00**(706.740)	.754***(28.263)
Total trip cost	-.040 *(-.835)*	-.086** *(-1.814)*	.014***(8.595)	-.045* *(-1.462)*
Total trip cost to substitute site	.016 *(.373)*	.004 *(.094)*	-.002* *(-1.617)*	-.010 *(-.354)*
Income per year	.024 *(.493)*	.040 *(.839)*	.005***(2.918)	.026 *(.829)*
Num. of days to visit	.058* *(1.332)*	.163*** *(3.805)*	.002* *(1.369)*	.122*** *(4.328)*
Gender	.055* *(1.323)*	.020 *(.488)*	-.003** *(1.922)*	-.023 *(-.864)*
Level of education	-.067* *(-1.380)*	.000 *(-.005)*	.002 *(1.268)*	.051* *(1.641)*
Real age	-.006 *(-.125)*	.007 *(.138)*	-.001 *(-.497)*	.011 *(.336)*
Local participation	.017 *(.417)*	.110*** *(2.716)*	-.002* *(-1.413)*	.096*** *(3.616)*
Overall satisfaction	-.169*** *(-4.136)*	-.137*** *(-3.359)*	-.002* *(-1.507)*	-.011 *(-.398)*
R-square	**.038**	**.049**	**.999**	**.595**
R-square Adjusted	**.023**	**.035**	**.999**	**.588**
D.W.	**1.626**	**1.403**	**1.346**	**1.781**
F value (sig at 5% level)	**2.605 *(.006)*** df. (9,594)	**3.405 *(.051)*** df. (9,594)	**51921.543(.000)** df. (10,593)	**87.061 *(.000)*** df. (10,593)

Note: ***, **, * indicate coefficients are significantly different from zero at 1%, 5% and 10% levels, respectively.

Consumer surplus can be measured by using Eq. (8). Table 4 shows that with the different functional forms, the consumer surplus could be different. Model (4), with spatial autoregressive regression, should be an appropriate model for the park tourism economic valuation. For the 604 visitors, the total consumer surplus is equal to the sum of each individual visitor's consumer surplus. The consumer surplus for Model (4) equals 56.29 baht per person or 1,891,287.71 baht per year.

Table 4 Consumer Surplus for Model Estimations

Model	Coefficient estimate of Total trip cost (β_r)	Total Consumer Surplus for 604 persons (baht/season)	Average Consumer Surplus (baht/person/trip)	Total Economic Value* (baht /year)
Model 1	-0.040	296,225.00	490.42	16,477,621.58
Model 2	-0.086	17,790.70	29.45	989,490.55
Model 3	0.014	-846,357.00	-1401.25	-47,080,598.75
Model 4	-0.045	34,000.00	56.29	1,891,287.71

* Total economic values equal total number of visitors per year multiplied by the average consumer surplus (by using 33,599 visitors in 2006).

5. Discussion

This paper investigates the influence of spatial effects on a Travel Cost Model and explores two particular regression models, each containing the same sets of variables in vector regressors. The total trip cost, tc_r, is the price of a trip to the park for visitors. Trip prices were calculated from the sum of the actual trip costs and travel time. Distances were calculated from a round trip distance from the visitors' center of the park to the latitude and longitude coordinates of the geographical place where the visitors initially left for the trip. For the assumptions of this study analysis, besides the assumption on the cost of operating the vehicle, there is also an assumption on travel time which is the opportunity cost. The local wage rate of 150 baht per day was also used because most visitors were students who had no income report and young people and local people who lived and worked in Ubon Ratchathani and nearby. Therefore, including the time cost, the computed total trip cost could be greater than the actual trip cost.

Given that this study focused on recreation at only one site, the single travel cost model was used to estimate the recreational demand function. Although the single site model does not completely capture the potential for site substitution, prices or total trip cost of alternative sites were included in the model in order to capture these effects. However, these estimates may be expected to overestimate the economic value, depending on the size of substitution effects. However, with the selected Model (4) in this study, the effect of the substitution site may be very small since the test statistic of the coefficient estimate of the total cost of the substitute site was not significant.

Results from the estimated travel cost demand function are in Table 3. The number of trips and natural log of number of the trips (ln num_trip) were used as the dependent variable in the regression model. All of the models are defined in Eqs. (9), (10), (15) and (16). The results showed that estimated Model (4) has the best test statistic, F-value, when compared with the rest of the estimated Models. This is because using the semi-log functional form minimizes the problem of heteroskedasticity, as well as eliminating the potential problem of negative trip predictions, which can occur using a linear functional form (Parsons, 2000).

However, the null hypothesis testing of D.W. for d-computed was not passed in Models (1), (2), and (3). D-computed are 1.626, 1.403, and 1.346, which are less than d_L (= 1.675), and the test is inconclusive in Model (4). With its good looking characteristic, being better than the previous models because of its improved expected signs and F-value properties, Model (4) could be used to represent the relationship between the dependent variable and the independent variables.

In Model (4), the semi-log model specification makes the interpretation of the coefficients easier. Each coefficient is measured as a growth/decay rate because it measures the relative change in the number of trips resulting from an absolute change in the independent variable. The model also provides additional information on the relationship between the cost of a trip and the number of trips taken. The slope coefficient of -.045 of the trip cost variable describes the constant relative change in the number of trips for a given absolute change in the trip cost. That means the reduction of 4.5 percent in the number of trips is likely to occur if the absolute trip cost increases by one percent.

In addition, the total trip cost to substitute site variable in Model (4) has an opposite expected sign. This shows that those substitute sites may not be good representative sites. Since each visiting site has unique characteristics, they should not be substitutions. There could be alternate additional sites which may be less preferable than the main destination, and visitors will make their own choices as concerns this if needed. Therefore, utilizing the variable in the model may not be appropriate. However, the variable is not statistically significant.

The demand for park visiting in Model (4) was significantly determined by the number of days to visit the park and visitors' level of education. The increase of these values by one percent could increase the number of visitors' trips by 12.2 and 5.1 percent.

Interestingly, with highly statistical significance, local participation determined the number of visitors' trips. The visitors think that locals ought to be a part of park operation and management, both in protection and tourism. The number

of visitors' trips could increase by 9.6 percent if there is participation of the local people in the administrative process of the park. Also, income and overall satisfaction are both positive in relation to the number of visitors' trips, but they are not statistically significant. The results of study shown that visitors gave more attention on tourism benefits to local people who should be a part of resource use and park management.

Improvement of the model from spatial dependence could help calculate consumer surplus more accurately. Model (4) with spatial autoregressive regression should be a good model for park tourism economic valuations. From Model (4), the calculated consumer surplus for the park is 56.29 baht per visitor per trip. Based on 33,599 visitors in 2006 (by interview, May 2007), the net economic value of park tourism is about 1,891,287.71 baht per year (see table 4). These estimates can provide helpful information to policy makers, park managers, and other interested individuals. The value estimates are considered in addition to any direct expenditure users undertake during their visits. They are the benefit excess of the expenditures for transportation and other goods and services, and they are often called the "non-market" benefit. These values accrue to park users, who may be local residents, or visitors from distant locations. The expenditures for transportation and other goods and services accrue to the local economy, except for the park revenues, which were collected and sent to the central government. According to the park revenues report in 2007 (October 2006 - September 2007), the amount of 737,200.00, 497,190.00, 5,210.00, and 152,083.00 baht were collected from the entrance fee, accommodation services, donation, and other services, respectively.

Annually the park received the budget of around 1.2 million baht for its operation and management, according to Phu Jong Na Yoi's financial record (by interview, May 2007). About 500,000 baht of the total budget was used for park maintenance. Assuming that this cost of maintenance is for the park tourism facility and service improvement, the estimated net economic value of park tourism from this study shows that park tourism is still productive as concerned economic gain.

To consider the rest of the models, the use of the Travel Cost Model should include further investigation in many aspects. For example, choosing the weight function is important, although this research study has tried to propose an alternative way in which to apply the spatial weighted regression, there are many types of spatial weight functions or matrices that had been created and used by researchers. Also, there is no specific type of weight function as claimed by Bao (2001) that researchers can specify and thereby use the weight metrics for their specific interest.

Although this research was carried out in order to develop the interconnections between spatially separate locations by linking distance measures to the remote small recreation site of Phu Jong Na Yoi, the research did not take into consideration the possible changes of the site's attributes, for example, water quality and other impacts. For example, as argued in von Haefen (1998), and cited in Phaneuf and Smith (2004), changing the water quality has an impact on recreation. For this research study, the analysis of such an impact could not be performed because the research needs to have more environmentally targeted data and supporting resources. For the park itself, there is still a lack of information on quality impacts. This should be a matter of concern and should be considered for future research.

6. Policy Recommendations

Based on the analysis results of Model (4), this study can provide useful information for any policy making for the park. They can also help guide the park's management. An increasing number of visitors' trips could be an opportunity in which to raise park revenues. Therefore, the park policies should be set by taking the following issues into considerations:

1) Number of days to visit. This analysis and results show that the increase of number of days to visit the park would raise the visitors' number of trips. There are many ways in which to increase trip days. First if the addition in adding more attractive activities through visitors' demands. All park activities, including conservation and protection, should be diversified and designed to be more compatible with visitors' demand. Adding more attractive activities, such as nature trailing, trekking, and setting the park as a site for educational and scientific ecotourism and other biodiversity, would induce visitors to spend more days at the park. Certainly, visitors who stay longer will spend more for park services.

2) Level of education of visitors. Based on the analysis and results, the park could make the policy on providing different visiting programs for target groups with different levels of education. For example, high school and undergraduate visitors, who are the majority of the park's tourists, have more demand for adventure and educational activities than other groups. The park should add more special events to impress young visitors in particular, which may include nature trails and camping. The activities should also be designed in order to meet the need of other target visitors with different levels of education.

3) Local participation. The park policy on tourism should be decentralized by giving an opportunity for the local community to be involved as much as possible. The tourism benefit should be mobilized to include low income local villagers. Besides

being park employees, local villagers can create their own business, for example food shops, restaurants, nature interpreters as local wisdom, home stay, and private lodging services. Under the cooperation between the park and local administrative organization, local villagers may be trained to operate their own small businesses, both privately and in a group network. This involvement would be inclined to induce local people in realizing the importance and potential of the park. Thus, participation should benefit park protection and conservation programs.

4) Fees and charges. Since the total trip cost includes fees and charges, the raise, if needed, of the park's entrance fee, accommodation, and other service charges may need to be considered carefully. Increasing fees and charges of any park services could boost the park revenue but may in turn reduce the number of visitors. Therefore, in considering visitors' satisfaction concerning park facilities and visiting programs, the park authority should be concerned about the overall quality of services. The park needs to improve the quality of its amenities and facilities, for example, parking lots, restrooms, and accommodation services. It may also need to invest in new attraction sites in order to attract more visitors. All these will make it more reasonable to increase the fees and charges in order to raise park revenue.

7. Conclusion

Past researchers have acknowledged the relationship between the number of trips and demographic factors, such as distance, in the study of the demand system for tourism. However, if spatial dependence in model variables is not appropriately considered, it can falsify the standard assumption on the correlation of error term in the classical econometric demand model and lead to prediction problems. Using the hypothesis that spatial dependence influences the estimation of the Travel Cost recreation demand for tourism in the parks, this study used the GIS in order to provide an efficient method of spatially referencing geographic and economic information. A GIS approach measured the travel distance from the visitors' origin to a recreation site and was applied as a distance decay weight to spatial econometric travel cost demand models. The distance decay weight was applied in two functional forms of the Travel Cost Model: semi-log linear and linear. The Durbin-Watson statistical test for the hypothesis of autocorrelation as spatial dependence was utilized. The results of the hypothesis test for autocorrelation on the estimated models in different functional forms showed that Model 4 has improved its expected signs of independent variables and F-statistic value. Also, by the hypothesis testing rule, this study can not make a decision on positive or negative autocorrelations. Therefore, using Model 4 to represent the recreation demand for the Phu Jong Na Yoi National Park is the most

appropriate.

Using the improved Model 4, the demand for tourism in the park was significantly determined by the total trip cost, number of days to visit the park, visitors' level of education, and local participation. The coefficient estimates of these variables can be applied to the entrance fee policy and local participation in park operation and management. Changing these values could change the number of visitors' trips. Visitors' income, total cost of substitute site, and overall satisfaction of facilities and services used were not statistically significant.

The coefficient estimate of the total trip cost was used to estimate consumer surplus of park tourism. The estimated consumer surplus of park tourism is 56.29 baht per visitor per trip, or about 1,891,287.71 baht per year. These estimates can provide helpful information to policy makers, park managers, and other interested individuals. Considering the park's annual budget for maintenance, this study confirms that tourism in the national park still has a positive net economic value to the country. Therefore, any supportive policy should be used for park ecotourism development. This study also confirms that there is an opportunity to gain from park tourism if local participation is allowed within the realm of operation and management. The local people and park authorities could have mutual benefits from income distribution and park conservation.

Future research should incorporate more quality variables, and separate spatial locations within the linking of distance measures, for example traveled distance and site qualities could influenced the number of visiting into the sites. Also, the model should investigate the model specification that may have hindered the model results due to multicollinearity among explanatory variables.

Overall, this study has shown that GIS-spatial linkage produces a robust Travel Cost Model. With GIS properties, the distance decay weight can be established more reliably and accurately. As this study shows, an improvement of model predictability could be utilized in order to improve an economic valuation of environmental services.

Acknowledgements

References

Aselin, Luc. (1999). *Spatial Econometrics*. Bruton Center, School of Social Sciences, University of Texas at Dallas, Richardson, TX 75083-0688.

_____. (2002). *Spatial Externalities, Spatial Multipliers, and Spatial Econometrics*. Regional Economics Applications Laboratory (REAL), Dept. of Agricultural and Consumer Economics, U. of Illinois, Urbana-Champaign, USA.

Bhat, Gajanan. (1997). *An Ecoregional Approach to Valuation of Recreational Activities in the United States*. Ph.D. Dissertation, University of Georgia, USA., 148p.

Bahaire, T., M. and Elliot-White. (1999). *The Application of Geographical Information Systems (GIS) in Sustainable Tourism Planning: A Review.* Journal of Sustainable Tourism 7, 2.

Bao, S. (1995). *Literature Review of Spatial Statistics and Models*. University of Michigan, manuscript. [online] Available from: http:// www.umich.edu. [2006, May 15].

Florax, J.G.M. Raymond. (2000). *Spatial Econometrics: An introduction*. IAAE Spatial Analysis Learning Workshop, USA.

Gujarati, D.N. (1995). *Basic Econometrics*. McGraw-Hill, 3rd ed., USA.

Hvenegaard, Glen T. and Philip Dearden. (1996). *Risks and Benefits of ecotourism in the Northern of Thailand*. [online] Available from: URL: http://www. IDRC.org.

Hanink, D.M. and White, K. (1999). Distance Effect in the Demand for Wildland Recreational Services: the Case of National Parks in the United States. Environment & Planning A., 31, 3: 477-483.

Head of Phu Jong Nai Yoi National Parks. May 20, 2007. Interview.

Joerg Schaller, Kranzberg. (1995). *GIS Application in Landscape Planning*. *Photogrammetric Week '95,* D. Fritsch & D. Hodbbie, Eds., Wichmann Verlag, Heidelberg: 313-318.

Kerkvliet, Joe and Clifford Nowell. (1999). *Heterogeneous Visitors and the Spatial Limits of the Travel Cost Model*. Journal of Leisure Research, 31,4: 400-419.

Lesage, James P. (2002). *Spatial Econometrics: Class Note*. Department of Economics, University of Toledo, Ohio,USA.

McAdam, D. (1994). *The Value and Scope of Geographical Information Systems in Tourism Management*. Journal of Sustainable Tourism, 7, 1:77-79.

Parsons, George R. (2000). *Travel Cost Model: Class Note*. Department of Economics, University of Delaware, USA.

Phaneuf, Daniel J. and Kerry J. Smith. (2004). *Recreation Demand Models*. Handbook of Environmental Economics, K. Maler and J. Vincent, editor. January, 29.

Royal Forest Department (RFD). [online]. Available from URL: http://www.forest. go.th (2005 December, 20).

Smith, Kerry V. and Raymond J. Kopp. (1989). *The Spatial Limited of the Travel Cost Recreational Demand Model*. Land Economics, 56,1: 64-72.

Tietenberg, Tom. (2006). *Environmental Natural Resource Economics 7thed*. Pearson International Edition, USA.

Wearing, S and John Neil. (2000). *Ecotourism: Impacts Potential and Possibilities*. Butterworth-Heinemann, Reed Educational and Professional Publishing Ltd., Linacre House, Jordan Hill, Oxford OX2 8DP, 225 Wildwood Ave., Woburn, MA, reprinted 2000.

Worboys, G.L., De Lacy, T., and M. Lockwood. (2000). *Protected Area Management Principles and Practice,* Oxford University Press, Sydney [online]. Available from URL: http://www.nrsm.uq.edu.au/iucn (2004 May, 25).

Zawacki, William Thomas. (2000). *Methodological Advancements in Travel Cost Models*. Ph.D. Dissertation, Clemson University, USA. 114p.