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The Application of Fuzzy Delphi Method (FDM) For Evaluating The Factors Affecting Sustainable Tourism in Order To Develop A Model For Sustanable Tourism

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Abstract: *Regarding with the effect of disease transmission and environmental pollution caused by passengers and immigrants' entrance on sustainable tourism and also considering the impact of medical tourism on sustainable tourism, in this chapter according to Sadler's Model, the researcher has designed a new model in which she added the health care as an effective factor on sustainable tourism and also s/he illustrated the significant role of information technology (as an influential factor) on all effective factors of sustainable tourism in the designed model. In this research Fuzzy Delphi Method (FDM) was used to obtain the critical factors of the sustainable tourism by seeking opinion of tourism experts to establish a new model for sustainable tourism.*

Keywords: *sustainable tourism, Fuzzy Delphi Method (FDM),information and communication technology (ICT), healthcare.*

I Introduction

Sustainable tourism cannot be discussed separately from the concept of sustainable development; therefore, the concept of sustainable development in the tourism sector can be explained in terms of macroeconomic concepts of sustainable development. Sustainable tourism emphasizes the need to use and develop tourism resources in wholesome routes (Hasanpourloumer, 2014). The underlying approach that is already used in tourism planning and other types of development is the approach of achieving sustainable development

Sadler was among the first who proposed the model for sustainable ecotourism model in 1990. He depicted three goals in his model social, economic and environmental goals they were. Social goals include the provision of social benefits, participation in planning, training and employment of local residents. Economic goals include economic benefits for local communities as well as sustainability in the economy of these regions. Environmental goals include the protection of natural resources, prevention of degradation and management of those resources. Sadler's model shows that the confluences of these goals indicate sustainable ecotourism (Sadler, 1990).

Figure 1 illustrates the challenge of applying the concept of sustainable development. The intersection of these circles represents the zone of sustainability. The present situation, illustrated by three circles of different sizes, reflects the importance currently placed on the three different dimensions of sustainable development.

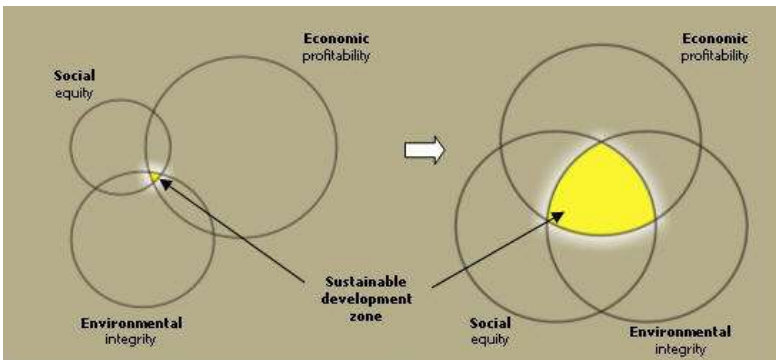

Figure 1: Sustainable Tourism Model
Source: Adapted from Jacob, P. and B. Sadler, 1990 and MENV, 2004.

Evaluation Model for Sustainable Tourism

Regarding with the effect of disease transmission and environmental pollution caused by passengers and immigrants' entrance on sustainable tourism and also considering the impact of medical tourism on sustainable tourism, in this chapter according to Sadler's Model, the researcher has designed a new model in

which s/he added the health care as an effective factor on sustainable tourism and also s/he illustrated the significant role of information technology (as an influential factor) on all effective factors of sustainable tourism in the designed model. This signifies that adding healthcare as the effective factor on sustainable tourism, not only causes implementation of policies for avoiding transmission of diseases and pollution caused by tourist to the touristic area but it is also spreads awareness among tourists regarding diseases and possible and popular pollutions in the area for the sake of tourists themselves and for maintaining a sustainable tourism. In this research FUZZY DELPHI METHOD (FDM) was used to obtain the critical factors of the sustainable tourism by seeking opinion of tourism experts to establish a new model for sustainable tourism. (Figure 2)

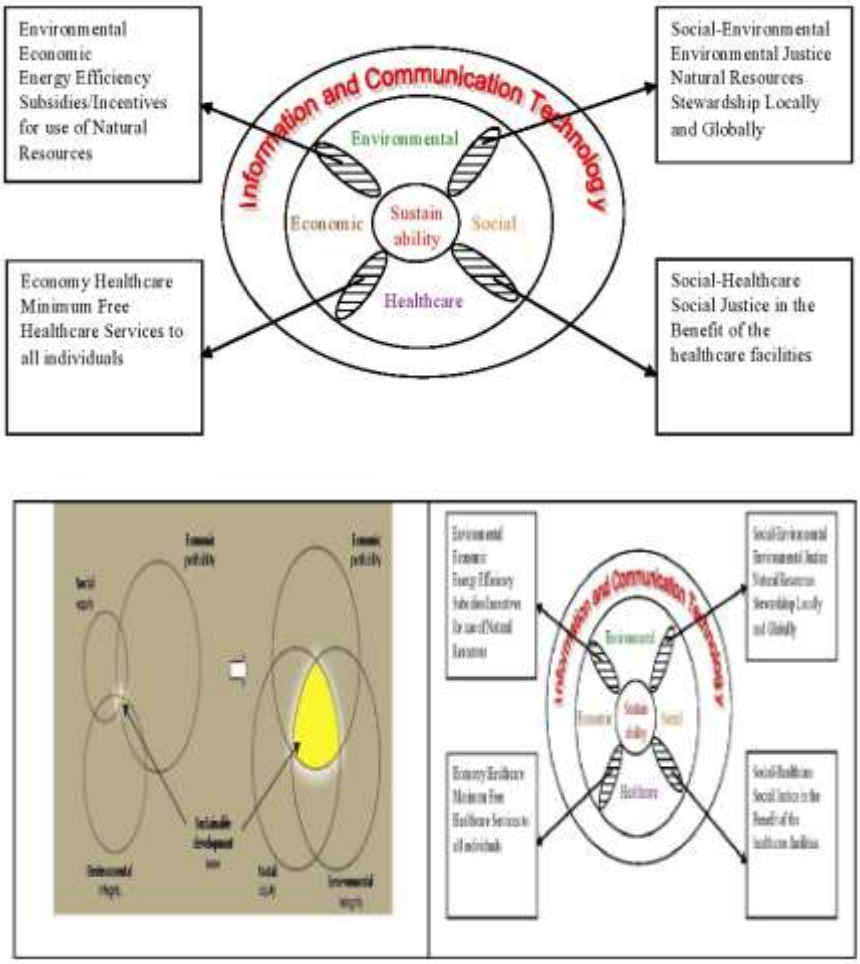

Figure 2: New Sustainable tourism model
Source: Developed by researcher

Validity and Reliability
Validity

Validity can be defined as the degree to which a test measures what it is supposed to measure. There are three basic approaches to the validity of tests and measures as shown by Mason and Bramble (1989).
The validity for questionnaire is obtained by **KMO and Bartlett's Test** by SPSS19 software.

Reliability

Reliability of questionnaire is obtained by **Cronbach's Alpha Test** by SPSS19 software. (Reliability in this part of the study, this coefficient of 0.696 the higher is the minimum acceptable)

The Research Methods

The study is to establish the key parameters for evaluation of the sustainable tourism analyzing, and use FDM by consulting and employing twenty Tourism experts in the ministry of tourism, New Delhi and academician in jamia milliai slamia and Delhi University formed the population. Out of this ten academicians and ten experts from ministry of tourism were selected for the study based on the judgment of Researcher in

order creation a model for sustainable tourism in order to find out the important factors to be conceded.
The survey methodology was used to gather the data and to build the sustainable tourism criteria. Before designing the survey, the researcher gathered the evaluation criteria from literature studies and some expert idea. Beside, according the literatures, researcher combined the criteria of sustainable tourism elements and prior researches in related or other arenas and generalized 74 factors of which 68 selected as important constructs five important aspects in all they were 74 parameters in the first round and 68 parameters in the second round**,** respectively five point Likert scale was used of the study. Where in 5 indicated. Strongly disagree, disagree, neutral, agree, and strongly agree.

II Fuzzy Delphi Method

Fuzzy Delphi Method was proposed by Ishikawa et al. (1993), and it was derived from the traditional Delphi technique and fuzzy set theory. Noorderhaben (1995) indicated that applying the Fuzzy Delphi Method to group decision can solve the fuzziness of common understanding of expert opinions. As for the selection of fuzzy membership functions, previous researches were usually based on triangular fuzzy number, trapezoidal fuzzy number and Gaussian fuzzy number. This study applied the triangular membership functions and the fuzzy theory to solving the group decision. This study used FDM for the screening of alternate factors of the first stage. The fuzziness of common understanding of experts could be solved by using the fuzzy theory, and evaluated on a more flexible scale. The efficiency and quality of questionnaires could be improved. Thus, more objective evaluation factors could be screened through the statistical results (L.A. Zadeh, 1965) (R.Zhau, R. Goving,1991).

The FDM steps are as follows:

1. ***Collect opinions of decision group*:** Find the evaluation score of each alternate factor's significance given by each expert by using linguistic variables in questionnaires.
2. ***Set up triangular fuzzy numbers:*** Calculate the evaluation value of triangular fuzzy number of each alternate factor given by experts, find out the significance triangular fuzzy number of the alternate factor.

This study used the geometric mean model of mean general model proposed by Klir and Yuan (1995) for FDM to find out the common understanding of group decision. The computing formula is illustrated as follows:
Assuming the evaluation value of the significance of
No. j element given by No. i expert of n experts is
w_{ij} (a_{ij} , b_{ij}), i =1, 2, ..., n; j =1, 2, ..., m. Then the
fuzzy weighting w_j of No. j element is w_j (a_j , b_j , c_j),
j =1,2, ..., m
$a_{j=}$ $Min_i(a_{ij})$, b_j= $\frac{1}{n}\sum_{i=1}^{n} bij$, c_j= $Max_i(c_{ij})$
3. Defuzzification: Use simple centre of gravity method to defuzzify the fuzzy weight w_j of each
alternate element to definite value S_j , the followings
are obtained:
S_j = $\frac{aj+bj+cj}{3}$ j=1, 2, ..., m
4. Screen evaluation indexes: Finally proper factors can be screened out from numerous factors by setting the threshold a. The principle of screening is as follows:
If Sj $\geq \alpha$, then No. j factor is the evaluation
index.If $S_j<\alpha$, then delete No. j factor. Schematic diagram of Fuzzy Delphi Method threshold is shown in Fig. 6.3

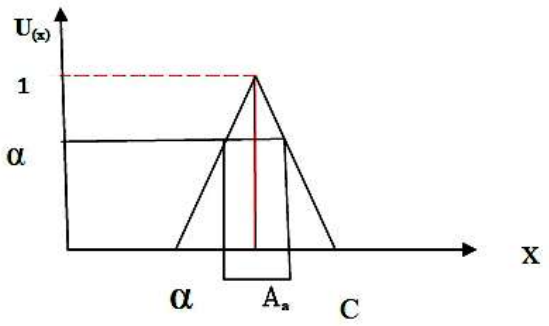

Figure 3: schematic diagram of Fuzzy Delphi

To collect the fuzzy numbers which have derived from directly from expert idea, In this study we have

(5) Aij = [αij],αij× α ji ≈ 1 , ∀i,j=1,2,3.....
To calculate the fuzzy relative weight we have used the following relations numbers (6), (7) and (8):

(6) . αij ⊗ ……. ⌣ αij]
(7) Zi = [αij ⊗ …….. ⊗ αij]$^{-1}$

(8) Wi= Zi ⊗ (Zi ⊕……. ⊕ Zn)

6. Defuzzification: Convert fuzzy numbers to easy-comprehended definite values, this study adopts the geometric mean method to solve fuzzy numbers proposed by *Liu and Chen, (2007),according torelation number :*
used triangular method therefore a fuzzy number s defined according relations numbers
(1) to (4):
(1) αij=(αij,**d**ij,**gij**)
(2) αij=Min(bijk), k=1,….n

(3) **dij**=(ΠⁿBijk)$^{1/n}$, k=1,….,n
(4) **gij**=Max(bijk), k=1,….,n
Fig.2 shows a typical fuzzy number which we have used in this study:

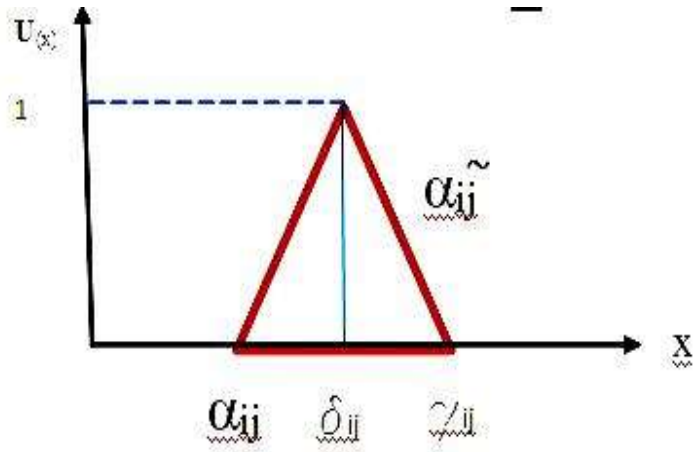

Figure 4: schematic diagram of Fuzzy Delphi method

Source: liu and chen,2007
In which bijk is the relative preference parameter
"i" to parameter "j" from expert "k" view, αij and gij are the lower and upper limits of expert view, respectively and dij is the geometric mean of experts views. Therefore parameters are so defined that: αij≤dij ≤gij
Then according to calculated fuzzy numbers as mentioned above, paired matrices between various parameters the inverted matrices are set up for fuzzy numbers according relation (5):

(5) Aij = [αij],αij× α ji ≈ 1 , ∀i,j=1,2,3.....
To calculate the fuzzy relative weight we have used the following relations numbers (6), (7) and (8):

(6) . αij ⊗ ……. ⌣ αij]
(7) Zi = [αij ⊗ …….. ⊗ αij]$^{-1}$

(8) Wi= Zi ⊗ (Zi ⊕……. ⊕ Zn)

6)Defuzzification: Convert fuzzy numbers to easy-comprehended definite values, this study adopts the geometric mean method to solve fuzzy numbers proposed by Liu and Chen, (2007), according to relation number :

2. (9) Wi=(

7. Sequencing: Sequence defuzzified criteria.

Fuzzy number Definition	
1= (1,1,1)	Equally important
3=(2,3,4)	↔ Moderately more important
5=(4,5,6)	↔ Strongly more important
7=(6,7,8)	↔ Very strongly more important
9=(8,9,9)	↔ Extremely important

Table 1 : Fuzzy number Definition

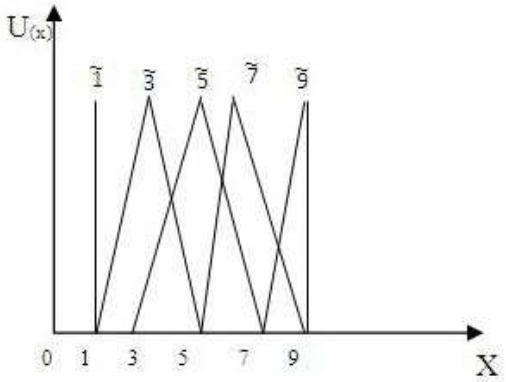

Figure 5: Scale of fuzzy numbers

Evaluating model Application and Results

***A)* Reviewing relevant literature of Sustainable tourism Investigation and proposing important criteria:**

More than 74 criteria (Parameter) for Sustainable tourism Investigation based on reviewing relevant literature and adopted Table 2

Table 6 : 74 Criteria (Parameter) for Sustainable tourism

	Aspects	Criteria (Parameters)		Aspects	Criteria (Parameters)
1	Organization of ICT in the tourism industry	Execute phase	38	Economic	Health standardization
2		Measurement	39		Low Price
3		Strategy	40		High Quality
4		professional support	41		ICT innovation as desirable.
5		Marketing	42		Economic information
6		Attract tourists	43		use of natural resources
7		Tourists' Return Intention	44		Crafts in each area
8		Planning	45		economic self-sufficiency
9		Data management	46		Planning managers
10		Sharing information	47		Investment
11		Matching Technology	48		people's participation
12		Data Quality	49		Entrepreneurship
13		Use of non- tourist sites	50		unique products
14		Infrastructure	51		cooperate in activities related to tourism
15		Capabilities	52		use of natural resources
16		Cognitive benefits	53		economic self-sufficiency
17		Development Activities	54		invest financially
18		Properties tourism	55		local organizations
19		Privacy	56	Social	Social information
20		Creating databases	57		Traditional Art
21		IT to target tourists	58		Traditional lifestyles
22		ICT in the tourism industry	59		Values
23		competitive advantage	60		Behaviors
24		eTourism	61		Host Population
25		tourism executives	62		Knowledge management and learning
26		maintaining long-term relationships with tourists	63		Heritage
27		ease and control of management	64		Language

28		Management support		65		Religion
29		respect and care for the tourists.		66		Environmental information
30		Honest and reliable communication system		67		environmental protection
31		needs of tourists		68		environmental and social baseline studies
32		health information		69		negative impacts of tourism
33	**Health Information**	health information infrastructure undermines		70		Natural resources
34		controlling healthcare		71	**Environmental**	Visual impact
35		improving health services		72		Urban form
36		sharing of medical information online		73		Infrastructure
37		control of communicable diseases and epidemics		74		Restoration

B) Screen important criteria (Parameters) by Fuzzy Delphi Method.

This stage includes three sections. Firstly, it lists five main aspects and 74 items as the key evaluation items of Sustainable tourism Investigation, and a FDM interview framework is set up. The second section is the interview with twenty experts from the academic community in India. Delphi Method mostly aims at easy common understanding of group opinions through twice provision of questionnaires.

FDM formed by adding the fuzzy theory in, not only maintains the advantage of Delphi Method, but also reduces the provision times of questionnaires when using traditional Delphi Method as well as the cost.
For the third section, the opinions of experts in FDM questionnaires are converted to triangular fuzzy numbers, and defuzzified values can be figured out after calculation. This stage adopts elements with threshold above 6, and the key evaluation items with threshold below 6 are deleted. The important evaluation items after screening are listed in Table 3

Table 3: New evolution Criteria after Fuzzy Delphi Method

	Aspects	**Criteria(Parameters)**	Code Number	**Score**			
				Min	Mean	Max	Defuzzification
1	**Organization of ICT in the tourism industry**	Execute phase	A1	5	7.4	9	7.1
2		Measurement	A2	5	6.5	9	6.8
3		Strategy	A3	3	6.4	9	6.1
4		professional support	A4	3	7.2	9	6.4
5		Marketing	A5	3	6.2	9	6.1
6		Attract tourists	A6	3	6.3	9	6.1
7		Tourists' Return Intention	A7	3	6.3	9	6.1
8		Planning	A8	3	6.4	9	6.1
9		Data management	A9	3	7	9	6.3
10		Sharing information	A10	3	6.4	9	6.1
11		Matching Technology	A11	3	7.3	9	6.4
12		Data Quality	A12	3	6.4	9	6.1
13		Use of non- tourist sites	A13	3	6.7	9	6.2
14		Infrastructure	A14	3	6.4	9	6.1
15		Capabilities	A15	3	6.7	9	6.2
16		Cognitive benefits	A16	3	6.3	9	6.1
17		Development Activities	A17	3	7.3	9	6.4
18		Properties tourism	A18	3	6.7	9	6.2
19		Privacy	A19	3	6.3	9	6.1
20		Creating databases	A20	3	6.7	9	6.2
21		IT to target tourists	A21	3	6.7	9	6.2
22		ICT in the tourism industry	A22	3	6.7	9	6.2
23		competitive advantage	A23	3	7.3	9	6.4
24		eTourism	A24	3	6.7	9	6.2
25		tourism executives	A25	3	6.4	9	6.1
26		Honest and reliable communication system	A26	3	6.7	9	6.2
27	**Health Information**	health information	B1	5	7	9	7.0
28		health information infrastructure undermines	B2	5	7.4	9	7.1
29		controlling healthcare	B3	5	7	9	7.0
30		improving health services	B4	5	7.2	9	7.1
31		sharing of medical information online	B5	3	6.5	9	6.2
32		control of communicable diseases and epidemics	B6	5	7.2	9	7.1
33		Health standardization	B7	3	6.5	9	6.2
34		Low Price	B8	5	7.4	9	7.1
35		High Quality	B9	5	7	9	7.0
36		ICT innovation as desirable.	B10	3	6.5	9	6.2

37		Economic information	C1	5	6.7	9	6.9
38		use of natural resources	C2	5	6.8	9	6.9
39		Crafts in each area	C3	5	6.2	9	6.7
40		economic self-sufficiency	C4	5	6.6	9	6.9
41		Planning managers	C5	5	6.5	9	6.8
42		Investment	C6	5	6.8	9	6.9
43		people's participation	C7	5	7.2	9	7.1
44		Entrepreneurship	C8	3	6.5	9	6.2
45		unique products	C9	5	6.7	9	6.9
46		cooperate in activities related to tourism	C10	5	6.6	9	6.9
47	**Economic**	use of natural resources	C11	5	6.5	9	6.8
48		economic self-sufficiency	C12	5	7.4	9	7.1
49		invest financially	C13	5	7	9	7.0
50		local organizations	C14	3	6.5	9	6.2
51		Social information	D1	7	8.4	9	8.1
52		Traditional Art	D2	5	7	9	7.0
53		Traditional lifestyles	D3	5	7.1	9	7.0
54		Values	D4	5	7.6	9	7.2
55		Behaviors	D5	5	7.5	9	7.2
56		Host Population	D6	5	7.5	9	7.2
57		Knowledge management and learning	D7	5	6	9	6.7
58	**Social**	Heritage	D8	3	6.5	9	6.2
59		Language	D9	5	7.5	9	7.2
60		Environmental information	E1	5	7.1	9	7.0
61		environmental protection	E2	5	7.1	9	7.0
62		environmental and social baseline studies	E3	5	6.5	9	6.8
63		negative impacts of tourism	E4	5	6	9	6.7
64		Natural resources	E5	5	7.1	9	7.0
65		Visual impact	E6	5	7.6	9	7.2
66		Urban form	E7	5	6.6	9	6.9
67		Infrastructure	E8	5	6.5	9	6.8
68	**Environmental**	Restoration	E9	3	6.5	9	6.2

C) Design model based on factors approved by experts.

The Sustainable tourism Investigation can be evaluated based on five evaluation aspects and 68 evaluation criteria or Parameters and Therefore, the model proposed by the researchers taking into account 68 parameters in 5 aspects and one purpose was approved by experts.

III Conclusions

Reviewing relevant literature of sustainable tourism and investigation and proposing important criteria: (More than 74 criteria Parameter) for Sustainable tourism Investigation based on reviewing relevant literature and adopted Table 6.2B) Screen important criteria (Parameters) by Fuzzy Delphi Method. This stage includes three sections. Firstly, it lists five main aspects and 74 items as the key evaluation items of sustainable tourism Investigation, and a FDM interview framework is set up. The second section is the interview with twenty experts from the academic community in India. Delphi Method mostly aims at easy common understanding of group opinions through twice provision of questionnaires.

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