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# The Perceptions of Local Communities on Human-Elephant Conflict in Malaysia: A Fuzzy Delphi Approach

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**Abstract**
The fast development of the economy and population growth creates massive demands and pressures on wildlife resources and their living environment. However, development is necessary to improve the livelihoods and socio-economic conditions of local communities but is often difficult to reconcile with the preservation of surrounding ecosystems and biodiversity, including elephants. One of the most visible expressions of this imbalance is human-elephant conflict (HEC), which is a direct result of habitat loss and subsequent conversion of natural land to farmland, leading to increased human-elephant interactions. The purpose of this study is to acquire expert agreement on the perceptions of local communities on the human-elephant conflict in Malaysia by using the Fuzzy Delphi method. This study includes two phases of the development of the elements of the questionnaire, namely the first phase, in which the researcher conducts a literature analysis to identify the elements required for assessing the perceptions of local communities on the human-elephant conflict in Malaysia. In the second phase (Fuzzy Delphi phase), after all items have been obtained, the researcher forms an expert questionnaire, in which 7 items are distributed to 5 experts with specific expertise, and the data collected were analysed using Fudelo 1.0 software. The results of the Fuzzy Delphi analysis of the expert consensus of the theme are at a satisfactory level. The overall expert consensus agreement is greater than 75%, the overall value of the threshold (d) is 0.2 and the α-cut is more than 0.5. This study gives valuable insights into the human-elephant conflict issue for further improvement in future research.
**Keywords:** Asian Elephant, Conservation, Habitat Loss, Human-Wildlife Conflict, Fuzzy Delphi Approach

## Introduction

The fast development of the economy and population growth creates massive demands and pressures on wildlife resources and their living environment (Su et al., 2020). However, development is necessary to improve the livelihoods and socio-economic conditions of local communities but is often difficult to reconcile with the preservation of surrounding ecosystems and biodiversity, including elephants. One of the most visible expressions of this

imbalance is human-elephant conflict (HEC), which is a direct result of habitat loss and subsequent conversion of natural land to farmland, leading to increased human-elephant interactions (Sampson et al., 2019; Nelson et al., 2003). Human-wildlife conflicts become unavoidable when the area for human habitation overlaps with wildlife habitat (Su et al., 2020). As a result, it led to crop-raiding, livestock destruction and sometimes the loss of life for both people and/or elephants (Kitratporn et al., 2022; Sampson et al., 2019; Nelson et al., 2003).

Human-elephant conflict has proven destructive and costly, preventing economic growth, social equality and resource sustainability (Taher et al., 2021, Zafir et al., 2016). Human Elephant Conflict (HEC) is a major concern of conservation efforts as it creates negative attitudes among the people affected (Nair et al., 2021). Furthermore, the human-elephant conflict has become a danger to biodiversity conservation, and addressing such conflict is a priority goal for elephant conservation in various countries (Shaffer et al., 2019).

**Human-elephant Conflict in Malaysia**

In Peninsular Malaysia, HEC has become one of the major wildlife issues which has also turned out to be a global conservation priority (Zafir et al., 2016). In 2016 alone, there were 328 cases of human-elephant conflict filed with The Department of Wildlife, Malaysia (PERHILITAN MALAYSIA, 2021). Millions of Ringgit were loss due to conflict caused by elephants and the problem continues until today. Furthermore, a loss of nearly RM3.08million due to wildlife was reported by The Department of Wildlife, Malaysia (PERHILITAN MALAYSIA, 2021).

Based on the previous studies highlighted by the researchers, we found that there is no scale that specifically measures the perceptions of local communities on the human-elephant conflict in the Malaysian context. Therefore, we see the need for the construction of a valid measurement tool that needs to be adapted to the context of Malaysian society. Therefore, in this study, we performed revalidation specifically in the context of Malaysian respondents for utility specifically in Malaysia.

**The Research Aims**

This study is to acquire expert agreement on the perceptions of local communities on the human-elephant conflict in Malaysia by using Fuzzy Delphi method.

**Methodology**

Exclusively, this study employs the Fuzzy Delphi method (FDM). This study was selected because it is a unique method of obtaining expert consensus to determine a specific decision. This study uses two phases of forming the items of the study questionnaire, namely through the literature review. This study includes two phases of the development of the elements of the questionnaire, namely the first phase, in which the researcher conducts a literature analysis to identify the elements required for assessing the attitudes and perceptions of local communities on the human-elephant conflict in Malaysia (see Table 1). In the second phase (Fuzzy Delphi phase), after all items have been obtained, the researcher forms an expert questionnaire, in which 7 items are distributed to 5 experts with specific expertise, and the data collected were analysed using Fudelo 1.0 software.

**Sampling Procedure**

Targeted sampling is used in this analysis. Since the researcher aims to get an expert agreement on something given, this technique is appropriate. According to Hasson, Keeney, and McKenna (2000), the most acceptable strategy in the fuzzy Delphi method is targeted sampling. In the meantime, 5 experts have taken part in this study. The experts who agreed to participate are listed in Table 1. These specialists have been selected based on their expertise and credentials. If all the specialists involved in this analysis are the same, the number of experts needed ranges from 5 to 10. If there is some degree of agreement, the minimum number of Delphi experts varies from 10 to 15 people (Adler & Ziglio, 1996).

Table 1
*List of experts*

| Expert | Field of expertise | Institution |
|---|---|---|
| 2 Senior Lecturers | Management | Public university |
| 1 Senior Lecturer | Islamic Studies | |
| 1 Senior Lecturer | English Language Studies | |
| 1 Lecturer | Management | |

**Expert Criteria**

An expert is identified as anyone who has knowledge and skills in a particular subject or sector (Cantrill et al., 1996; Mullen, 2003). According to Booker and McNamara (2004), experts are known as those who have received their qualifications, education, experience, professional membership, and peer recognition because of hard work and dedication (Nikolopoulos, 2004; Perera et al., 2012). Expert selection is an essential issue to be considered in implementing fuzzy Delphi research. When expert selection is poor and based on criteria, concerns such as the legitimacy, validity, and reliability of study results can be questioned (Mustapha & Darusalam, 2017). According to Kaynak and Macauley (1984), the specialists involved in the research must represent or have knowledge of the subject or issue being studied. The researcher selects experts with at least seven years of experience and experts who are right in their field and relevant to the study based on a set of very demanding criteria.

**Fuzzy Delphi Step**

Table 2
*Fuzzy Delphi step*

| Step | Formulation |
|---|---|
| 1. Expert selection | • Altogether 5 experts were included in this report. A panel of experts was gathered to examine the significance of the assessment parameters on the items to be analysed using linguistic variables. The definitions of possible problems with piece and others were also assessed. |
| 2. Determining linguistic scale | • In this method, all linguistic variables are translated into counting fuzzy triangles (triangle fuzzy numbers). This step also involves adding fuzzy numbers to translate linguistic variables (Hsieh et al., 2004). The triangular fuzzy number represents the values m1, m2 and m3 and is |

written as (m1, m2, m3). The value of m1 represents the smallest possible value, the value of m2 represents a rational value, and the value of m3 represents the highest possible value. While Triangular Fuzzy Number is used to generate Fuzzy Scale to convert linguistic variables into fuzzy numbers.

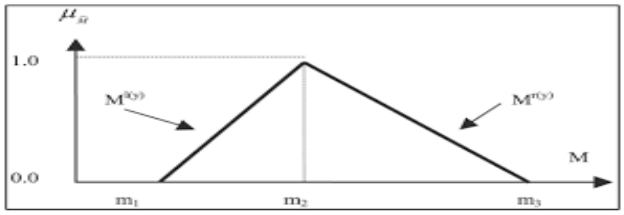


Figure 1: Triangular fuzzy number

| | |
|---|---|
| 3. The Determination of Linguistic Variables and Average Responses | • As soon as the researcher receives input from the specified expert, the researcher must convert all measurement results into fuzzy scales. This is often recognized as an acceptance of each answer (Benitez et al., 2007). |
| 4. The determination of threshold value "d" | • The threshold is important for the level in determining the degree of agreement among experts (Thomaidis et al., 2006). The distances for each fuzzy integer m = (m1, m2, m3) and n = (m1, m2, m3) are determined using the formula as shown below: $d(\bar{m},\bar{n}) = \sqrt{\frac{1}{3}[(m1-n1)^2 + (m2-n2)^2 + (m3-n3)^2]}$ |
| 5. Identify the alpha cut aggregate level of fuzzy assessment | • When an expert agreement is reached, each piece is assigned a fuzzy number (Mustapha & Darussalam, 2017). The following is the approach to calculating and measuring fuzzy values: (1) 4 (m1 + 2m2 + m3) Amax. |
| 6. Defuzzification process | • This process applies the formula Amax = (1)⁄4 (a1 + 2am + a3). If the researcher uses Average Fuzzy Numbers or average response, the resulting score number is a number that ranges from 0 to 1 (Ridhuan et al., 2013). There are three formulas in this process, namely: i. A = 1/3 * (m1 + m2 + m3), or; ii. A = 1/4 * (m1 + 2m2 + m3), or; iii. A = 1/6 * (m1 + 4m2 + m3). A-cut value = median value for '0' and '1', where α-cut = (0 + 1) / 2 = 0.5. If the resulting A value is less than the α-cut value = 0.5, the item is rejected because there is no expert agreement. According to Bojdanova (2006), the alpha cut value should exceed 0.5. This is supported by Tang & Wu (2010) who stated that the α-cut value should be more than 0.5. |

| | |
|---|---|
| 7. Ranking process | • The positioning process is performed by defining elements based on defuzzification values based on the expert agreement that the element with the highest importance is the most important place for a decision (Fortemps & Roubens, 1996). |

**Instrumentation**

The Fuzzy Delphi research tool was designed by the researcher using existing related literature material. Researchers can generate questionnaire items based on literature, pilot studies, and experience, (Skulmowski et al., 2007). As a result, they used research literature, expert interviews, and focus group approaches when developing questions for the fuzzy Delphi method (Mustapha & Darussalam, 2017). Furthermore, Okoli and Pawlowski (2004) argue that the development of articles and pieces of content for research should begin with a review of relevant literature. Therefore, researchers have compiled the most important perceptions of local communities on the human-elephant conflict in Malaysia based on published works/literature. A list of expert questions is then created using a 7-point scale. The 7-point scale was implemented because the more scales used, the more accurate and perfect the results were (Chang et al., 2011). To make it easier for professionals to answer the questionnaire, the researcher changed the fuzzy score in Table 4 with a 17-scale score, as shown.

Table 3
*Fuzzy Scale*

| Item | Fuzzy number |
|---|---|
| Strongly disagree | (0.0, 0.0, 0.1) |
| Disagree | (0.0, 0.1, 0.3) |
| Somewhat disagree | (0.1, 0.3, 0.5) |
| Neutral | (0.3, 0.5, 0.7) |
| Somewhat agree | (0.5, 0.7, 0.9) |
| Agree | (0.7, 0.9, 1.0) |
| Strongly agree | (0.9, 1.0,1.0) |

**The Development of Perceptions of Human-Elephant Conflict Elements**

Researchers emphasized the critical features that influence the perceptions of local communities on the human-elephant conflict in Malaysia based on a literature review. Next, researchers will utilize the Fuzzy Delphi approach to establish the validity and expert consensus on whether this aspect is suitable for inclusion in this model.

Table 4
*The list of the perceptions of local communities on human-elephant conflict*

| | Early item rank | Perceptions of human-elephant conflict |
|---|---|---|
| The perceptions of local communities on human-elephant conflict | HEC1 | Protected areas and conservancies have brought positive changes to the community |
| | HEC2 | Protected areas and conservancies have caused conflicts among local villagers |
| | HEC3 | Elephants have become a problem to the community |
| | HEC4 | Elephants are responsible for more damage than they are worth |
| | HEC5 | Protected areas and conservancies do not protect elephants |
| | HEC6 | I live better because of the conservancies |
| | HEC7 | There are too many elephants in nearby protected areas. |

**Finding**

This section will provide expert agreement on aspects of local communities' perceptions of human-elephant conflict in Malaysia. Fuzzy Delphi questions were presented to 5 experts in the relevant fields and the results were collected based on the answers they provided. These are the results of the study:

Table 5
*The analysis result*

| Results | Item1 | Item2 | Item3 | Item4 | Item5 | Item6 | Item7 |
|---|---|---|---|---|---|---|---|
| **Expert1** | **0.27713** | 0.02309 | 0.09238 | 0.04619 | 0.01155 | 0.08083 | 0.02309 |
| **Exper2** | 0.06928 | 0.03464 | 0.08083 | 0.12702 | 0.01155 | 0.03464 | 0.02309 |
| **Expert3** | 0.04619 | 0.02309 | 0.09238 | 0.01155 | 0.10392 | 0.08083 | 0.03464 |
| **Expert4** | 0.18475 | 0.02309 | 0.02309 | 0.04619 | 0.01155 | 0.09238 | 0.02309 |
| **Expert5** | 0.06928 | 0.03464 | 0.08083 | 0.04619 | 0.06928 | 0.03464 | 0.03464 |

| Statistics | Item1 | Item2 | Item3 | Item4 | Item5 | Item6 | Item7 |
|---|---|---|---|---|---|---|---|
| **Value of the item** | 0.12933 | 0.02771 | 0.07390 | 0.05543 | 0.04157 | 0.06466 | 0.02771 |
| **Value of the "D" construct** | | | | | | | 0.06004 |
| **Item < 0.2** | 4 | 5 | 5 | 5 | 5 | 5 | 5 |
| **% of item < 0.2** | 80% | 100% | 100% | 100% | 100% | 100% | 100% |
| **Average of % consensus** | | | | | | | 97 |
| **Defuzzification** | 0.58 | 0.96 | 0.86 | 0.92 | 0.88 | 0.84 | 0.94 |
| **Ranking** | 7 | 1 | 5 | 3 | 4 | 6 | 2 |
| **Status** | Accept | Accept | Accept | Accept | Accept | Accept | Accept |

After the data was analysed and processed, it can be seen in Table 5 that the bold threshold is greater than the threshold value of 0.2 (>0.2). It means that there are experts who do not agree on some matters. Nevertheless, the average threshold value of the "D" construct (d)

0.2, or 0.06004, for all perceptions of local communities on the human-elephant conflict in Malaysia, is below <0.2. If the average (d) value is below 0.2, the item has a high level of expert agreement (Cheng & Lin, 2002; Chang et al., 2011). On the other hand, the total percentage of the expert agreement shows a value of 97 percent, which is above 97 percent (>75 percent), implying that the requirements of expert agreement on this item have been fulfilled. In addition, all defuzzification value of Alpha-cut value exceeds α-cut = >0.5. The elements approved by the agreement of the panel of experts are ranked as shown in Table 6.

Table 6
*The list based on expert consensus*

| | Early item rank | New item rank | Perceptions of human-elephant conflict |
|---|---|---|---|
| The perceptions of local communities on human-elephant conflict | HEC1 | HEC7 | Protected areas and conservancies have brought positive changes to the community |
| | HEC2 | HEC1 | Protected areas and conservancies have caused conflicts among local villagers |
| | HEC3 | HEC5 | Elephants have become a problem to the community |
| | HEC4 | HEC3 | Elephants are responsible for more damage than they are worth |
| | HEC5 | HEC4 | Protected areas and conservancies do not protect elephants |
| | HEC6 | HEC6 | I live better because of the conservancies |
| | HEC7 | HEC2 | There are too many elephants in nearby protected areas. |

**Conclusion and Suggestion**

In conclusion, this study aimed to identify the perceptions of local communities on the human-elephant conflict in Malaysia. Human-elephant conflict and habitat loss have diminished the population of elephants in the country. It is important to instill conservation education in the mindset of local communities so that elephant conservation can be supported by them. Nonetheless, the conservation agencies could also play their role to improve and cultivate positive perceptions among the local communities on the importance of the Asian elephant in the country. It is believed by doing so, it could alleviate all the possible reasons of having negative perceptions from the local communities on the human-elephant conflict in making conservation strategies become more successful. Hopefully, this study would be beneficial in assisting the Malaysian government and other related agencies in addressing the human-animal conflict issues, not only the human-elephant conflict.

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