Climate Change Reports

Journal Homepage: sciencesforce.com/ccr

Climate Cha. Rep. Vol. 1 (2024) 48–60

Paper Type: Original Article

ICT Innovative for Adapting and Mitigating Climatic Variability: Towards an Integrated Approaches for Sustainable Environment

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Received: 10 Oct 2023 **Revised:** 05 Feb 2024 **Accepted:** 08 Mar 2024 **Published:** 15 Mar 2024

Abstract

The most significant threat to both human and planetary health is climate change, which is caused by changes in the weather and air quality on Earth because of human activities. The climate is changing on a global scale, which has effects on a variety of domains, notably transportation, agriculture, livestock and so on. The variability of climate threatens sustainability and its pillars for any nation. Evidence of that, regarding 68.5 million people were affected, and $131.7 billion in economic losses were incurred; storms, hunger, wildfires, and droughts contributed for almost 93% of these costs. Globally, the many effects of climate change have sparked research efforts to achieve sustainable development (SD). From a scientific standpoint, the concepts of "adaption" and "mitigation" have been embraced to treat obstacles of climate. Hence, the notion of information communication and technology (ICT) is embracing to mitigate and adapt climate variability. Accordingly, the evaluation and ranking alternatives of ICT where this is objective of our study. Herein, mutli-mriteria mecision making (MCDM) techniques are the primary factor in this study. As opinion weight criteria method (OWCM) utilized for analyzing ICT's criteria and sub-criteria and obtaining its weights. Whilst these weights have been utilized in multi-attributive ideal-real comparative analysis (MAIRAC) to rank alternatives of ICT. Whilst Tree Soft Sets is leveraging for modeling ICT'S criteria and its sub-criteria. Essentially, these techniques have ability to apply in uncertainty environment and incomplete information through supporting with Neutrosophic theory which characterized with uncertainty theory especially, single value neutrosophic sets (SVNs) to construct soft decision maker (SDM) framework. Ultimately, the constructed SDM is applied in real world case study. The findings of SDM framework indicated that alternative1 (ALT1) is the optimal conversely (ALT2) is the worst alternative.

Keywords: Opinion Weight Criteria Method (OWCM); Multi-Attributive Ideal-Real Comparative Analysis (MAIRAC); Tree Soft Sets; Single Value Neutrosophic sets (SVNs); Climate Change.

1 | Introduction

Amidst the several anxieties that the world confronts, climate change in [1] is one of the most pressing anxieties that the international community that deeply concerning. Moreover, various scholars described this anxiety as Fawzy et al. [2] who revealed that climate change is the alteration in climatic patterns primarily

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https://doi.org/10.61356/j.ccr.2024.1211

brought about by greenhouse gas emissions (GGEs) from both natural systems and human activity. As a result, these natural systems entailed seas, marshes, permafrost, mud volcanoes, forest fires, earthquakes, and volcanoes [3]. Human activities primarily pertain to the production of energy, industrial processes, forestry, and inappropriate occupation of land. Globally and from the perspective of [4], climate change is an intergovernmental complex problem that affects many aspects of the ecological, environmental, socio-political, and socio-economic disciplines. Evidence of this[5] indicated that the utilization of fossil fuels has released excessive amounts of GGs, such as carbon dioxide (Co2), throughout the past century. These gases trap heat in the atmosphere and lead to global warming. According to prior studies, GGs both produce and absorb radiative energy. Excessive GG release has been linked based on [6] to permafrost melting, droughts, and the retreat of glaciers and sea ice. These events have further increased the earth's temperature since less snow is left to reflect sunlight. Another partner that helped change the climate is discussed in [7] wasteful agriculture practices which entailed in overuse of fuel-based mechanization in agriculture, burning of agricultural leftovers, burning of fossil fuels, and deforestation. Other than these detrimental impacts of human activity, scholars of [8] decided other harms and destruction as climatic catastrophes, damaging local and global infrastructure, human health, and total productivity.

The numerous harms brought on by greenhouse gas emissions from climate change served as a driving force behind the formation of two disciplines "mitigation" and "adaptation" which appeared in many studies. As [9] indicated a thoughtful multidisciplinary strategy is needed for both adaptation and mitigation of climate change.

Herein, this study attempts to adopt the solutions toward mitigation and adaptation the climate change. From the perspective of [10], these solutions entailed leveraging digital technologies, in other words, information communication technologies (ICTs) facilitate and select the optimal technology amongst alternatives of ICTs.

1.1 | Study's Catalysts

There are many factors considered herein as catalysts for conducting this study.

1.1.1| First Catalyst: Threaten Sustainability

According to comprehensive studies, the concept of sustainability is linked to a set of pillars. For instance [11] described the concept of sustainability by exhibiting the main three pillars environmental, economic, and social.

Given that humanity's activities and statistics of the World Meteorological Organization mentioned in [12], the last four decades have all been warmer than any previous decade since 1850 because of activities antagonistic to sustainability and its pillars. Moreover, these activities spawned risks and threats in various directions and pillars. Figure 1 exhibits the negative impact of climate change on pillars of sustainability. For environmental: [13] is great evidence of this where authors demonstrated that natural catastrophes like droughts and floods are becoming more frequent and severe due to climate change. Moreover, the crops will suffer harm, be destroyed, and sustain damages. Thus, there will be detrimental economic effects on the nation. Also, [14] highlighted that changing climate can affect in economy directly worsening existing symptoms, and causing new ones. Also, indirectly by affects the possession of food and clean water, housing, power, transportation, medical care, communication networks, and other social determinants of health.

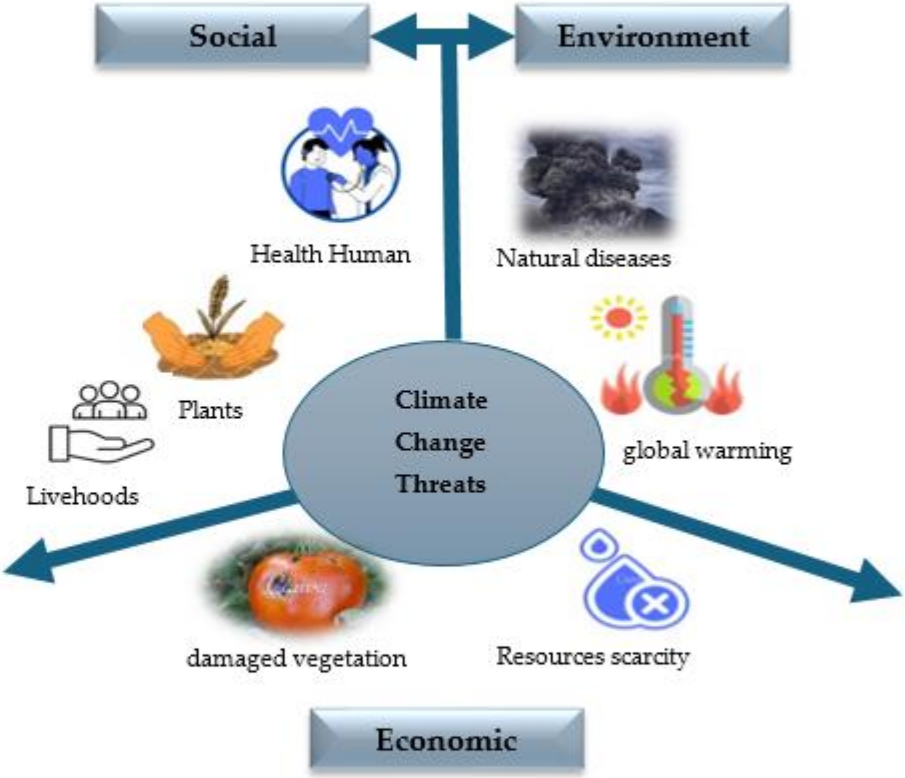

Figure 1. Implications of climate on pillars of sustainability.

	First Issue	Second Issue	Third Issue
Transportation	Interruptions to transportation networks' operations	Growing crowding, lines, and delays in traffic	Decrease worker productivity and raise disturbances for passenger
Agriculture	Farmers' future planning and decision-making will be impacted by rising global warm and climate change.	As a result of more extreme weather occurrences including droughts, heat waves, and heavy rains that cause floods, the soil is becoming more vulnerable to leaching and erosion.	Crop productivity is susceptible to variations in the climate.
Livestock	Reduction in the production of forages, a drop in feed quality,	Increased the diseaes in livestocks as mastitis	Large-scale livestock deaths by climatic unpredictability, together with a decrease in herders' savings

Figure 2. Overview of climate change implications on various domains.

1.1.1|Second Catalyst: Climate Implications on Various Domains

Climate change obstacles threaten the nation and the livelihoods of its inhabitants. As well as threaten the country's sustainability which is mentioned aforementioned. Numerous studies have looked at how much climate fluctuations influence different sectors as mentioned in Figure 2. For instance [15] investigated how crops and water requirements are influenced by climate change.in the same vein [16] highlighted that crop productivity is influenced by fluctuations in the environment and rising temperatures. On the other hand, [17] highlighted the degree to which climate change affects livestock, making it challenging for stakeholders to calculate and forecast the effect of climate change on livestock illnesses because of the characteristics of the disease and the modifications brought about by climate change in cattle. The damage did not stop there; it also had an impact on governmental and public interests, notably transportation. Evidence of this [18] demonstrated that there are several detrimental consequences of climate change on transportation networks, and rising sea levels and global temperatures might have an immediate negative impact on these networks.

1.2 |Objectives: Visions Adopted Toward Adaptation with Climate Variability

Owing to the severity of climate change on several avenues, the nations must now establish actions and plans to deal with these disruptions and to qualify it to be proactive.

I. Global Vision:

- At climate summits, nations are eager to share strategies and ideas to address these disruptions and achieve sustainable development (SD).
- Annually, nations that have ratified the United Nations Framework Convention on Climate Change (UNFCCC) convene to assess advancements and discuss global climate change measures.
- According to the Conference of the Parties (COP), The climate movement has established standards that include cutting carbon emissions, quickening the world's energy transition, and assisting nations in strengthening their capacity to adapt to and withstand the effects of climate change.

II. Scientific research Vision:

Numerous earlier studies have examined how this phenomenon is addressed through embracing the notion of adaptation and mitigation. Whilst [19] highlighted the purposes of mitigation are implementing strategies that minimize emissions by utilizing carbon accounting applications, and emissions monitoring systems through using digital technologies or in other words information and communication technology (ICT). The purpose of adapting is exhibited in [20] while monitoring environmental changes including sea level rise, deforestation, and land degradation is made possible by ICT as satellite imagery and remote sensing technology. This information facilitates the planning of adaptation measures and the identification of sensitive areas. Other perspectives as [13] suggested possibilities and scenarios for Iran's agricultural water resources system's response to climate change. After that, the scholars evaluated these scenarios using MCDM techniques to obtain the optimal scenario.

III. **Study's Vision:** Herein, we are adopting and implementing digital technologies or ICT toward adapting and mitigating climate variability. Moreover, evaluating the utilization and adopting these digital technologies as alternatives is an important phase to obtaining optimal alternatives of digital technologies.

1.3 | Contribution: Dealing with Obstacles of Climate Variability

In this study, we are implementing methodologies for treating climate obstacles through adapting and mitigating this phenomenon. To achieve the study's objective, we follow a set of steps.

- Conducting surveys for prior solutions in literature studies.
- Deciding the methodologies which embracing for treating with these climate's obstacles.

- Evaluating these methodologies based on a set of criteria.
- Modeling the determined criteria and its sub-criteria into the form of levels of a tree. Each level has a set of nodes of sub-criteria. This approach is called Tree Soft Set (TrSS) which was introduced by Smarandache [21].
- The modeled criteria and sub-criteria contributed to evaluating alternatives of embraced digital technologies through using MCDM as a multi-criteria methodology that can treat conflicting criteria.

To bolster MCDM techniques in ambiguous situations and protect them from hazardous decisions based on incomplete information, we contribute uncertainty theory with MCDM to boost it. Hence, the Neutrosophic theory proposed by Smarandache is merged with MCDM to enhance the decision.

2 | Related Works

This section illustrates the previous works and perspectives on climate change. Hence, the objective of this section illustrate the role of MCDM based on Neutrosophic in climate change. MCDM techniques especially the Analytic Hierarchy Process (AHP) and the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) are utilized in [22] for determining water allocation Priorities for climate change adaptation. While [23] discussed the importance of transportation for any country. Hence, MEREC (Method using the removal effects of criteria), RS (Rank sum), and the MULTIMOORA (Multi-attribute multi-objective optimization based on the ratio analysis) for evaluating three strategies for climate change resilient transportation networks are defined: climate readiness; alternate routes and methods for the transportation systems; and climate change resistant design of transportation infrastructure. Others as [1] embraced ICT to adapt and mitigate climate change. Also, evaluating, and ranking ICT through using Fuzzy-TOPSIS. Ali et al.[24]Applying fuzzy VIKOR to the analysis of the impact of the nation's climatic variety on crops. using the VIKOR approach for analyzing the influence of atmospheric elements on Pakistan's agriculture industry, including high temperatures, heavy rainfall or sleeting, droughts, smog, heat waves, noxious gasses, related humidity, and storms. The study [25] evaluated the 24 Global climate models (GCMs) best performances by using five different MCDM approaches to evaluate ranks. For assessing negative emissions technologies(NETs) in [26], a brand-new neutrosophic data envelopment analysis (NDEA) model is created. A comparative analysis according to [27] has been conducted to compare the findings obtained from the conventional method with the neutrosophic approach. The findings indicated that neutrosophic appeared to be more trustworthy and elaborated on extra analytical aspects that the conventional technique is unable to provide.

According to the surveys conducted for literature studies, the Neutrosophic theory is utilized in MCDM to construct robust soft decision makers (SDM).

3 | Methodology and Materials: Toward mitigation-adaption climate's obstacles

The study's objective is to construct a robust Soft Decision-Maker (SDM). Hence, we leveraged a novel technique and merged it to serve study in constructing SDM. Thus, we are exhibiting these novel techniques in the following sub-section.

3.1 | Preliminary

3.1.1| Tree Soft Sets

The novel approach of TrSS was introduced by Smarandache [21] also, who is the founder of the Neutrosophic theory. The main idea of this approach is illustrated as follows:

Assum $\mathfrak{H}$ be a universe of discourse, and $\mathcal{H}$ a non-empty and subset of $\mathfrak{H}$, whilst the powerset of $\mathcal{H}$ denoted as P($\mathcal{H}$).

- Level 1: included main nodes encompass main criteria and symbolled as $\mathfrak{R}$. Accordingly, $\mathfrak{R}$ has a set of $\mathfrak{R}_s$ with (one-digit indexes) = $\{\mathfrak{R}_1, \mathfrak{R}_2, \ldots \mathfrak{R}_n\}$.
- Level 2: encompassed sub-nodes of sub-criteria which have two-digit indexes and symbolled as: $\{\mathfrak{R}_{11}, .. \mathfrak{R}_{1n}\}$ are sub-nodes of $\mathfrak{R}_1$, $\{\mathfrak{R}_{21}, .. \mathfrak{R}_{2n}\}$ are sub-nodes of $\mathfrak{R}_2$, and $\{\mathfrak{R}_{31}, .. \mathfrak{R}_{3n}\}$ are sub-nodes of $\mathfrak{R}_3$.
- In a graph method, the tree is formed as Tree(ℵ), whose root is considered of level zero, then nodes of level 1, level 2, up to level n.
- We call the leaves of the graph-tree, all terminal nodes (nodes that have no descendants).

  Accordingly, TrSS is F: P(Tree(ℵ)) ⟶ P($\mathcal{H}$).
- Hence, All node sets of TrSS of level m are: Tree(ℵ) = {ℵi1 | i1= 1, 2, ... }.

3.1.2 | Single-Valued Neutrosophic Sets (SVNSs [28]

The approach of SVNSs is considered a branch of Neutrosophic theory that was introduced by Smarandache. This approach differentiates from other approaches as fuzzy and its extensions by considering three measurements and probabilities as Truth (ϑ), Falsity (ν), and Indeterminacy (δ). Three measurements are formed:

- Assume that χ is a universal set and κ is an element in χ and this element is formed as: $\vartheta_\kappa(\omega)$, $\nu_\kappa(\omega)$, $\delta_\kappa(\omega)$.
- $0 \le \sup \vartheta_\kappa(\omega) + \sup \nu_\kappa(\omega) + \sup \delta_\kappa(\omega) \le 3$.
- The operations in SVNSs formed as:

  Addition of two sets : $\widetilde{\text{Neu}}_1 + \widetilde{\text{Neu}}_2 = \langle(\tau_1 + \tau_2 - \tau_1 \tau_2, \gamma_1, \gamma_2, \varphi_1\varphi_2)\rangle$.

  Multiplication of two sets : $\widetilde{\text{Ne}}_{u1} + \widetilde{\text{Neu}}_2 = \langle(\tau_1 \tau_2, \gamma_1 + \gamma_2 - \gamma_1 \gamma_2, \varphi_1 + \varphi_2 - \varphi_1 \varphi_2)\rangle$.

3.2 | Soft Decision-Maker (SDM)

Hrein, we are employing MCDM techniques as TrSS to model the determined criteria and sub-criteria and illustrate the relation between them. These criteria and sub-criteria are analyzed through the OWCM Method to determine the weights of criteria and sub-criteria. After that MAIRCA is starting to evaluate and rank alternatives of digital technologies toward adaptation and mitigation to obstacles' climate. Overall, all these techniques are working under the authority of SVNSs as a branch of neutrosophic theory to construct SDM which works as follows.

3.2.1 | Forming the Criteria and Sub-Criteria into Tree Soft

- Determining the set of alternatives of digital technologies that contribute to the evaluation process based on SDM.
- Determining the influenced criteria and sub-criteria that contribute to the evaluating process.
- DMs panel is formed for rating alternatives based on modeled criteria and sub-criteria into TrSS.

3.2.2 | Weighting levels of TrSS using SVNSs- OWCM

- OWCM is applied for the first time in [29]. This technique is suggested by [30] to obtain weights for level 1 and level 2.

- Neutrosophic decision matrices based on the number of DMs for evaluating alternatives based on criteria of level 1 through utilizing SVNS as in [31].
- The constructed Neutrosophic matrices are converted to de-neutrosophic matrices through Eq. (1).

$$\boldsymbol{s}\,(Q_{ij}) = (2+g-\partial-\wp)\,/\,3 \tag{1}$$

Where: g, ∂, $\wp$ refers to truth, false, and indeterminacy respectively.

- Deneutrosophic matrices are aggregated into a single matrix called aggregated matrix by Eq. (2).

$$\sigma_{ij} = \frac{\sum_{j=1}^{N} Q_{ij}}{S} \tag{2}$$

Where: Qij refers to the value of criterion in the matrix, S refers to the number of decision-makers.

- Normalizing an aggregated matrix through employing Eq. (3).

$$\partial_{ij} = \frac{\sigma_{ij}}{\max\limits_{\sigma_{ij}}} \tag{3}$$

Where: $\max\limits_{\sigma_{ij}}$ refers to max number in σ_{ij} matrix per column, σ_{ij} refers to each element in σ_{ij} matri.

- Calculating the average score of the decision matrix is as follows.

$$\mathcal{B} = \frac{1}{N}\sum_{i=1}^{m} \partial_{ij} \tag{4}$$

Where: N refers to the number of alternatives.

- Preference variation for each criterion is calculated as in Eq. (5).

$$\mho_j = \sum_{j=1}^{m} [\partial_{ij} - \mathcal{B}]^2 \tag{5}$$

- Eq.(6) is applied for calculating the deviation in preference values is calculated based on $\varepsilon_j = 1 - \mho_j$ (6)
- Finally, weights for criteria are calculated as in Eq. (7).
- $$\omega_j = \frac{\varepsilon_j}{\sum_{j=1}^{m} \varepsilon_j} \tag{7}$$

3.2.3 | Ranking alternatives using SVNSs- MAIRCA

- Leveraging the aggregated matrix of the previous step of Weighing levels of TrSS using SVNSs-OWCM for calculating theoretical evaluation matrix (TP) toward estimating preferences of alternatives based on Eq. (8).

$$P_{Aj} = \frac{1}{x} \quad , \sum_{j=1}^{x} P_{Aj} = 1 \;,\; j = 1, \ldots \ldots n \tag{8}$$

Where: x indicates the number of alternatives

- Calculating real evaluation matrix (TR) according to Eqs. (9),(10).

$$\mathrm{tr_{ij}} = \mathrm{tp_{ij}} \left(\frac{x_{ij} - \bar{x}_i}{x_i^{+} - x_i^{-}}\right), \text{for maximum} \tag{9}$$

$$\mathrm{tr_{ij}} = \mathrm{tp_{ij}} \left(\frac{x_{ij} - x_i^{+}}{x_i^{-} - x_i^{+}}\right), \text{for minimum} \tag{10}$$

- Eq (11).is applied for calculating criteria function (Q).

$$Q_i = \sum_{i=1}^{m} g_{ij} \quad (11)$$

Where,

$$g_{ij} = t_{p_{ij}} - t_{r_{ij}} \quad (12)$$

4 | Exemplary instance of an application

To validate the accuracy of our SDM framework, we applied this framework in a real-time case study.

4.1 | Problem Description

In this case study, seven alternatives of ICT are contributed to the evaluation process by using the SDM framework. Five decision makers (DMs) are contributing to the evaluation process. These alternatives play a vital role in treating climate change through collecting and analyzing data on climate as:

ALT1: Geographical Information Systems (GIS): Unquestionably, GIS contributes to climate change adaptation by using a variety of data for automated GIS production, analysis, and operations [10].

ALT2: Embedded system and Internet of Things (IoT): The internet-based networking of computing devices integrated as sensors in climate-related objects, allowing them to exchange data[10].

ALT2:Intelligence Techniques (ITs): High-level analysis has been carried out with the assistance of ITs as machine learning(ML) and data mining (DM) to obtain precise data and information even from remote and dangerous settings [32].

4.2 | Modeling the Criteria and Sub-cCriteria for ICT Alternatives using TrSS

Herein, we construct three nodes for three criteria at level 1 and each node divides into sub-nodes for sub-criteria as in Figure 3.

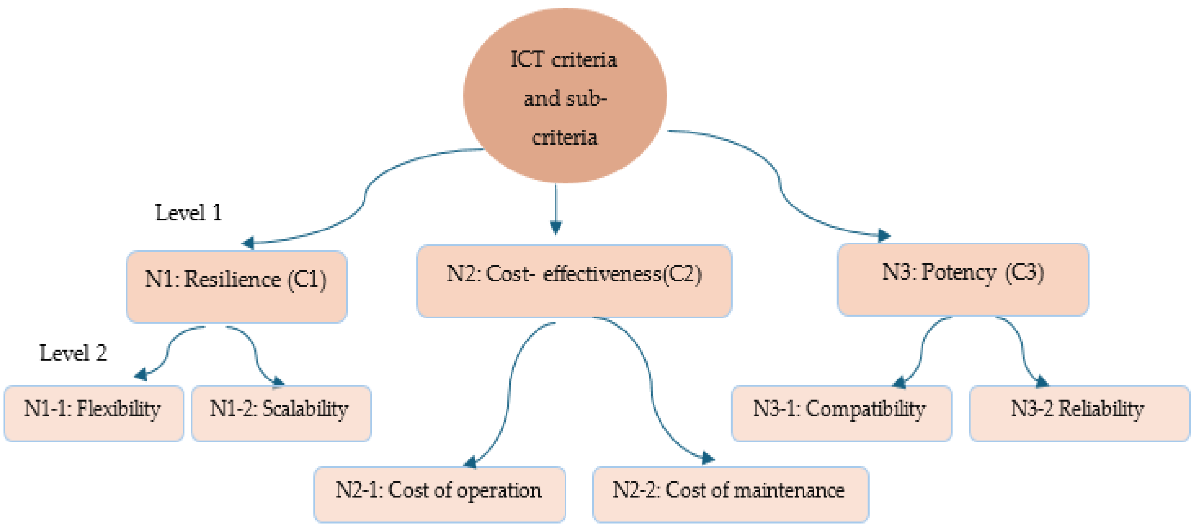

Figure 3. Modeling criteria and sub-criteria based on Tree Soft.

4.3 | Valuating and Weighting Level 1 and Level 2 based on SVNSs- OWCM

4.3.1| Weighting criteria of Level 1

4.3.1.1| Five neutrosophic decision matrices are constructed by rating them by three DMs based on scales of SVN in Table 1.

4.3.1.2| Deneutrosphic these matrices using Eq.(1), and aggregated these matrices into an aggregated matrix through Eq.(2) and results listed in Table 2.

4.3.1.3| Normalizing matrix produced through applying Eq.(3) on Table 2 and results showcased in Table 3.

4.3.1.4| Preference variation based on Eq.(5) for each criterion through leveraging average scores are results of Eq.(4).

4.3.1.5| According to Eq.(6) the deviation in preference values are calculated and results are used in Eq.(7) to obtain the final criteria's weights in level 1 as listed in Figure 4.

4.3.2| Weighting sub-criteria of Level 2

4.3.2.1| We applied the previous steps of weighting criteria of Level 1 in sub-section 4.3.1. The final sub-criteria weights at level 2 are illustrated in Figures 5, 6 and 7.

Table 1. Scale of Single Value Neutrosophic.

Synonymy	Acronym	Scale		
		T	I	F
Extremely Weak	EW	0.00	1.00	1.00
Absolutely Weak	AW	0.10	0.90	0.90
Very Weak	VW	0.20	0.85	0.80
Weak	W	0.30	0.75	0.70
Fairly Weak	FW	0.40	0.65	0.60
Fairly	F	0.50	0.50	0.50
Fairly Well	FW	0.60	0.35	0.40
Well	W	0.70	0.25	0.30
Very Well	VW	0.80	0.15	0.20
Absolutely Well	AW	0.90	0.10	0.10
Extremely Well	EW	0.10	0.00	0.00

Table 2. Aggregated matrix For main criteria at Level 1.

Alternatives Criteria	C1	C2	C3
ALT1	0.513333333	0.253333333	0.58
ALT2	0.44	0.493333333	0.5
ALT3	0.416666667	0.646666667	0.7

Table 3. Normalized matrix for main criteria at Level 1.

Alternatives Criteria	C1	C2	C3
ALT1	1	0.391752577	0.828571429
ALT2	0.857142857	0.762886598	0.714285714
ALT3	0.811688312	1	1

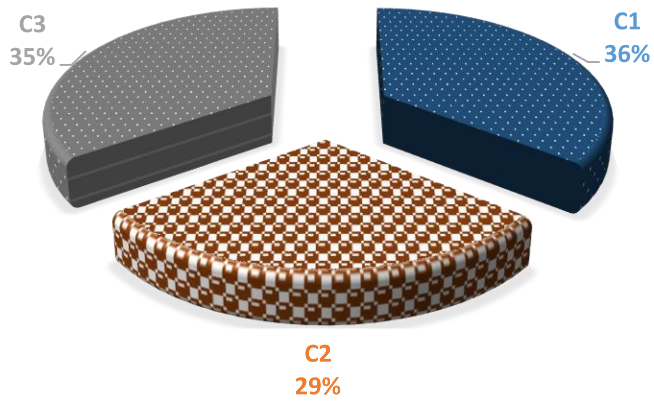

Figure 4. Final criteria weights at level1.

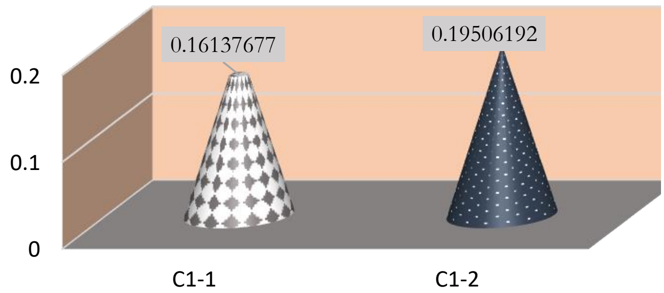

Figure 5. Weight of sub-criteria of criteria 1 at level 2

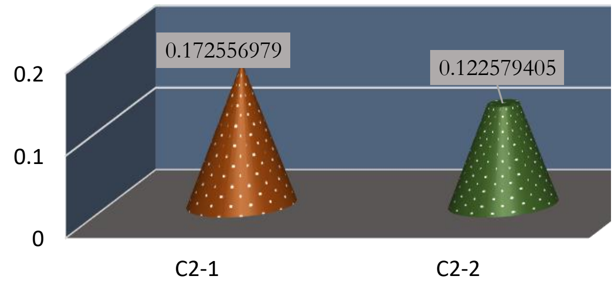

Figure 6. Weight of sub-criteria of criteria 2 at level 2.

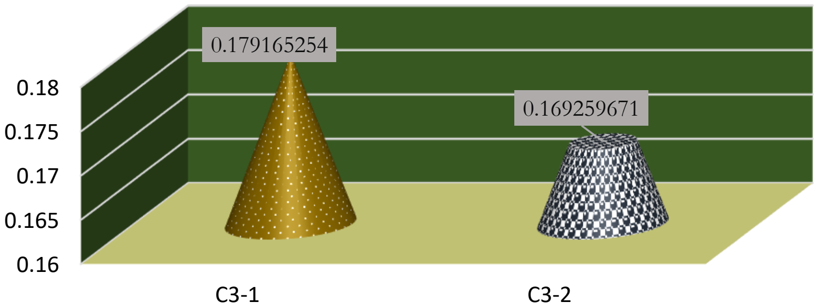

Figure 7. Weight of sub-criteria of criteria 3 at level 2.

4.4 | Recommending the optimal alternative using SVNSs- MAIRCA

4.4.1| Theoretical evaluation matrix (TP) is produced as in Table 4 through implementing Eq. (8) in the aggregated matrix in Table 2

4.4.2| Calculating real evaluation matrix (TR) through employing Eq. (9) for maximum whlist Eq.(10) for minimum as shown in Table 5.

4.4.3| Utilizing Eqs. (9) and (10) for calculating criteria function (Q) based on and final ranking for alternatives is shown in Figure 8. This Figure indicates that ALT 1 is the optimal alternative otherwise ALT 2 is the worst alternative.

Table 4. Theoretical evaluation matrix(TP).

Alternatives Criteria	PA	C1	C2	C3
ALT1	0.33	0.117624768	0.097395007	0.114980225
ALT2	0.33	0.117624768	0.097395007	0.114980225
ALT3	0.33	0.117624768	0.097395007	0.114980225

Table 5. Real evaluation matrix (TR).

Alternatives Criteria	C1	C2	C3
ALT1	0.117624768	0.097395007	0.04599209
ALT2	0.028392185	0.037967545	0
ALT3	0	0	0.114980225

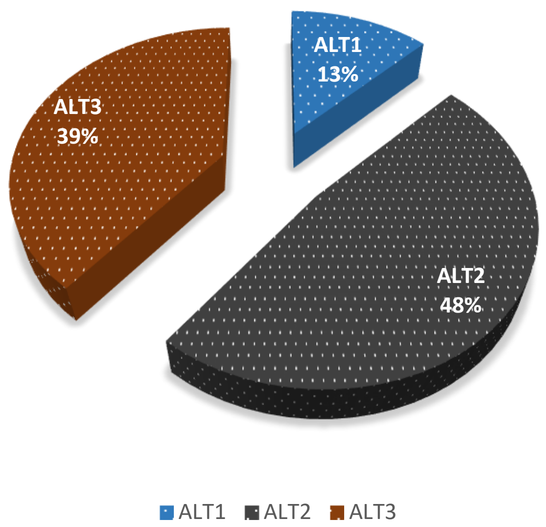

Figure 8. Final ranking for ICT alternatives.

5 | Conclusion

Global sustainability has been significantly impacted by climate change due to its disruptive nature. Also, people's lives and means of sustenance have been destroyed by the worst natural catastrophes caused by harsh weather. Consequently, there has been a decrease in productivity in areas including infrastructure, agriculture, health, and water supply that are sensitive to climate change. To attain and sustain SD, the nations organized climate conferences periodically to create plans and strategies for adaptions and mitigation of climate change. On the other hand, scholars conducted studies and suggested strategies for serving SD with its pillars. The aforementioned strategies are also assessed to confirm their effectiveness by utilizing mathematical frameworks based on MCDM techniques. In the same vein, other scholars leveraged MCDM techniques for evaluating ICT or digital technologies in obstacles climates.

Generally speaking, we are leveraging the prior scholars' perspectives by embracing ICT in climate change. Herein, three alternatives (ALTs) are utilized as ICT alternatives where these ALTs are evaluated based on a set of criteria and sub-criteria.

Hence, TrSS is applied in this study for modeling criteria and sub-criteria into various levels which encompassed nodes. After that, MCDM techniques such as OWCM are utilized for analyzing the criteria and sub-criteria and obtaining weights for them. Also, the MAIRCA of MCDM techniques is leveraging generated weights from OWCM for ranking ALTs to obtain optimal ALT. these techniques are working under the authority of SVNSs to bolster these MCDMs and DMs in uncertain situations.

Finally, the constructed SDM framework is applied to real real-time case study to validate the ability and efficiency of SDM to make decisions. The findings of SDM indicated that ALT1 (GIS) is optimal on the contrary ALT2 (IoT) is the worst ALT as shown in Figure 8.

Acknowledgments

The author is grateful to the editorial and reviewers, as well as the correspondent author, who offered assistance in the form of advice, assessment, and checking during the study period.

Author Contribution

All authors contributed equally to this work.

Funding

This research has no funding source.

Data Availability

The datasets generated during and/or analyzed during the current study are not publicly available due to the privacy-preserving nature of the data but are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that there is no conflict of interest in the research.

Ethical Approval

This article does not contain any studies with human participants or animals performed by any of the authors.

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