Machine Translation Quality Assessment : A Quantitative-Qualitative Analysis of English- into- Arabic Translation in The Climate Change Discourse

(Yara Tarek El-Outify, Misr International University)

Abstract

The present research demonstrates a specialized quality-assessment of English -into-Arabic in Machine translation based on three speeches that were delivered in the UN .The translation is generated by two AI systems which are ChatGPT 3.5 and Gemini systems.The research includes a mixed-method that combines qualitative analysis with quantitative error-frequency evaluation. The two main frameworks guiding the assessment of this research are TAUS Error Typology, which classifies errors that occur in translation into four main classes, and the Eco-translation theory, which expresses the ethical, ecological, and cultural responsibility in translation.The results show the errors according to four main categories which are accuracy;terminology,verity,and fluency. The results show that ChatGPT 3.5 and Gemini proceed with a similar number of errors in translating metaphors and cultural reference, accuracy, also they have equal terminology errors rate .Although both systems maintain sentence fluency, they struggle with cultural and ecological adaptation. In light of these results,the research highlights the urgent need for an extensive integration of eco-conscious strategies in specific domains of AI models for enhancing its performance as well as for reliable and effective climate change communication.

Keywords:

Machine translation (MT), Translation Quality Assessment, Climate change, Eco-translation Theory, UN Speech.

تقويم جودة الترجمة الآلية: تحليل كمي-نوعي للترجمة من الإنجليزية إلى العربية في خطاب تغيّر المناخ

المستخلص

يقدم هذا البحث تقويمًا متخصصًا لجودة الترجمة من الإنجليزية إلى اللغة العربية في الترجمة الآلية، استنادًا إلى ثلاث خطب ألقيت فى أروقة الأمم المتحدة. و تتم الترجمة بواسطة نظامين من أنظمة الذكاء الاصطناعي وهما تشات جى بى تى 3.5 وجيميناى. ويتبنى البحث منهجًا مختلطًا يجمع بين التحليل النوعي وتقويم تكرار الأخطاء كميًا. ويستند التقويم إلى إطارين أساسيين: تصنيف أخطاء TAUS، الذي يصنّف الأخطاء إلى أربع فئات رئيسة، ونظرية الترجمة البيئية، التي تعبّر عن المسؤولية الأخلاقية والثقافية والبيئية في الترجمة.

و تعكس النتائج وجود أخطاء ضمن أربع فئات رئيسية هي: الدقة، والمصطلحات، والصدق الثقافي، والطلاقة. كما تعكس النتائج أن تشات جى بى تى 3.5 وجيميناى لديهما عدد مشابه من الأخطاء في ترجمة الاستعارات والمراجع الثقافية والدقة، كما أنهما سجّلا معدلًا متقاربًا في أخطاء المصطلحات. ومع ذلك، حافظ النظامان على طلاقة التركيب النحوي للجمل. وفي ضوء هذه النتائج، يؤكد البحث الحاجة الملحة إلى دمج استراتيجيات واعية بيئيًا ضمن مجالات محددة داخل نماذج الذكاء الاصطناعي، بهدف تحسين أدائها وضمان تواصل فعّال وموثوق بشأن قضايا تغيّر المناخ.

الكلمات المفتاحية:

الترجمة الآلية، تقويم جودة الترجمة، تغيّر المناخ، نظرية الترجمة البيئية، خطابات الأمم المتحدة.

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1.Introduction

One of the most important global challenges in today's world is climate change. This issue is characterized by its strong ethical correlation, which necessitates precise and culturally aware cross-linguistic communication to guarantee that its intricate problems are recognized and addressed internationally. Translation contributes to framing the concept of climatic change discourse among multilingual contexts,since the urgency of communication and need for a precise, active cultural translation are in high demand, especially in regions that lack effective climate-related language transfer (Cronin, 2017).

Since the models of MT spread widely due to their major advantages as high accessibility and speed (Pym, 2014), this research focuses on the idea of evaluation of English-into-Arabic translation, resulting from ChatGPT and Gemini using both TAUS Error Typology and eco-translation theory. TAUS Error Typology represents a large infrastructure that is responsible for the identification and classification of errors according to main categories like accuracy, verity, terminology and fluency (TAUS, 2020). This framework includes well-defined techniques to evaluate and assess translations, ensuring formal quality principles for different linguistic products. Additionally, the study applies the eco-translation theory to address linguistic elements. This theory highlights the cultural and environmental translation responsibility, particularly in tackling special domains like climate change. This theory pertains to linguistic, ecological issues and cultural balance (Cronin, 2017). The use of both frameworks provides extensive and detailed balanced evaluation for translation quality in the climate change domain. TAUS includes detailed error analysis and categories regarding accuracy and fluency. On the other hand, eco-translation theory provides another positive aspect in relation to the adaptation of the cultural and environmental text. Hence, these two frameworks complement each other and provide a more adaptive language that is essential to deliver the clearer climate change and develop public awareness for issues related to climate-change.

0.2 Research Gap-Filling

This study fills in a gap through the comparative analysis of Gemini and ChatGPT translation performance within the Arabic context by using a single speech of United Nations climate- change content written in English. The study guarantees the relevance and applicability of its conclusions to current translation procedures by concentrating on authentic, real-world material. As a result, it provides a more comprehensive viewpoint that integrates environmental and cultural aspects into translation quality assessment in addition to conventional evaluation measures.

This research depends on the mixed approach method of qualitative and quantitative analysis to ensure a great assessment of translation quality. This research provides both frameworks, TAUS Error Typology and eco-translation theory, to evaluate the English-to-Arabic translation in the domain of climate change produced by Gemini and ChatGPT. This study incorporates both frameworks in the analysis of translation errors to reach effective suggestions that may enhance MT systems to provide effective climate-change communicative feedback in Arabic-speaking societies.

0.3 Research Questions

This research involves some research questions, which are:

1. Are there differences in the translation of climate-change terminology between ChatGPT and Gemini?
2. What kind of errors are generated by ChatGPT and Gemini according to TAUS Error Typology?
3. To what extent do these MT systems align with eco-translation theory in translating climate-change discourse from English into Arabic?

0.4 Objective of the Study

This research aims to establish a comparison and evaluation of the accuracy and consistency of the English into Arabic translation of climate-change discourse as well as identify and classify translation errors according to TAUS categories, focusing on (accuracy, fluency, verity, and terminology). The study applies the eco-translation theory to assess the ecological issues, besides the cultural and ethical principles of MT. By adopting a mixed approach method, the study aims to express a statistical error analysis and provide a contextual assessment of MT products. Finally, the study aims to suggest recommendations to increase interest in MT systems, particularly when translating climate change communication.

0.5 Significance of the Study

The significance of this study is its clear contribution to the literature on translation quality assessment, through the integration of both eco-translation theory and TAUS Error Typology. It also addresses a notable gap in research by focusing on the domain of climate-change that requires certain communication. This research focuses on important insights for MT developers in reference to enhancement of metaphor translation, ecological adaptation, and cultural sensitivity. The results of the study are essential for some environmental organizations and suit their policy in ensuring effective communication in climate change campaigns, especially if Arabic speaking communities are their target audience. This study contributes to increasing linguistic and ecological awareness since it highlights the impact and responsible role of MT in climate-change discourse.

Review of the Literature

1.1 Historical Development of Machine Translation

Since the 20th century, MT has witnessed significant technological evolution. The advancement from rule-based machine learning systems to neural networks in the 21st century has been clearly reflected in more powerful MT systems. In the 1950s, the development of early rule-based systems that used hand-coded rules in translation, depending on dictionaries and syntax started at organizations like IBM and Georgetown University (Hutchins & Somers, 1992). However, they have some limitations in the coverage of linguistic aspects and some difficulties in handling complex contexts (Kumar, 2024; Riveriee, 2021). Rule-based systems were inflexible in idiomatic expression translation. Statistical machine translation (SMT), which used huge bilingual corpora to produce more flexible, context-aware translations, reignited interest in machine translation in the late 1990s (Koehn, 2009). This statistical method has been a significant change because SMT is better at handling linguistic variances than rule-based techniques. Around 2014, the emergence of neural machine translation (NMT), which framed translation as a sequence-to-sequence problem, marked another advance in the area. Vaswani et al. (2017) significantly transformed NMT with the inclusion of the Transformer model, which enables models to capture long-range dependencies, leading to more accurate and fluent translations.

Developments in AI and NLP, particularly the application of attention mechanisms and transfer learning have greatly improved the quality of MT (Vaswani et al., 2017). Transfer learning, for example, allows MT

systems to improve performance for low-resource languages by utilizing knowledge from high-resource language pairs. By facilitating improved contextual awareness and fine-tuning for particular translation tasks, pre-trained models like BERT and GPT have significantly improved machine translation systems (Devlin et al., 2018). However, because training huge models is computationally intensive, these technical developments have an impact on the environment, which raises concerns about MT's ecological sustainability.

1.2.2 TAUS Error Typology.

Assessment of MT is an essential step in evaluating both Gemini and ChatGPT, for the present study. TAUS Error Typology offers a comprehensive framework for assessment of content quality of translated and localized text. Errors are classified into various categories to address translation accuracy in different contexts:

Fluency: It refers to errors affecting grammatical structure, readability, and punctuation. Fluency is the most important element for smooth understanding and clearness for different audiences in the climate change context. Thus, in technical text translation, some structures and improper sentences with incorrect phrases may affect the clarity of message delivery to the reader.

Accuracy: This includes the errors that result due to misrepresentation of the meaning of the source text in the target text, like key information omission-related problems. Some deviations in meaning can lead to misunderstanding, especially in the climate change domain. In climate change policies and reports accuracy is essential as minor errors can change how environmental regulations are interpreted (Pym, 2021).

Style: Related to tone and formality between the target and source texts. For example, scientific documents on climate change should include a formal tone, especially for policy or academic audiences .

Terminology: This involves the inability to use correct and consistent terms like "climate change" instead of "global warming" or "carbon sequestration" and "greenhouse gases" (Baker, 2018). TAUS highlights the significance of using specific terms, as words like "carbon offset" or "net-zero emissions," which are inaccurate in climate domain, can deceive the stakeholders. To satisfy the high requirements in climate context, both Gemini and ChatGPT need to preserve the consistency of the terminology. The way each system handles specialized terms affects the overall trustworthiness of translation (TAUS, 2020).

Locale Convention: This refers to translational adaptation that fits regional and cultural norms, such as numerical expressions and data

format, which is important when translating into Arabic, especially as regards the correct directionality of the numbers (TAUS, 2020).

Verity: Involves translating cultural allusions that might fail to capture the precise equivalent in target language (TL), which could result in inaccurate translations.

Design: Includes layout and font issues and visual alignment errors, which can negatively impact content presentation.

By using the TAUS framework, post-editors can determine precise places where translations of climate documents need to be improved, allowing for more focused corrections in terminology and correctness (TAUS, 2020). For example, post-editors can use error categories to help them revise culturally sensitive terminology in translations produced by Gemini or ChatGPT.

The following table shows the seven primary TAUS error typology categories, each with a distinct focus and several sub-categories, to help recognize and assess various kinds of translation problems.

TAUS Error Typology Table

Category	Subcategory	Definition	Examples
Accuracy		Evaluates the faithfulness of the translated text if it conveyed the actual meaning of the original text without any kind of omission,exaggeration or distortion.	Translating the Italian word 'canali' into English as 'canals' instead of 'channels'.
	-Addition		-A translation includes portions of another translation that were inadvertently pasted into the document. EN: *"We must act now."* AR: "يجب أن نتحرك الآن لإنقاذ كوكب الأرض."
	-Omission	-The TL includes a text not present in the SL	-A paragraph present in the source is missing in the translation. EN: *"We must ensure a just and **inclusive** transition."* AR: "يجب أن نضمن انتقالًا عادلًا."
	-Under-translation	-Content is missing from the translation that is present in SL	-A source text states that a medicine should not be administered in doses greater than 200 mg, but the translation states that it should be administered in doses greater than 200 mg (i.e., negation has been omitted). EN: *"The report addresses methane, nitrous oxide, and hydrofluorocarbons."* AR: "يعالج التقرير الغازات المسببة للاحتباس."
	-Over-translation	-The TL content doesn't accurately represent the source content.	-The source text refers to a *boy* but is translated with a word that applies only to young boys rather than the more general term. EN: *"We need more investments in adaptation."* AR: "في التكيف مع تغير المناخ نحتاج إلى استثمارات حكومية وخاصة."
			-The source text uses words that refer to a specific type of military officer but the target text refers to military officers in general. EN: *The Paris Agreement commits signatory states to limit global warming to well below 2°C, preferably to **1.5°C**.* AR: أقل من درجتين مئويتين يلزم اتفاق باريس الدول الموقعة بالحد من الاحترار العالمي إلى.
			-A sentence in a Japanese document translated into English is left in Japanese.

		-The target text is more specific that the source text	EN: *"The IPCC's AR6 Synthesis Report outlines key actions."* AR: **"The IPCC's AR6 Synthesis Report** يحدد الإجراءات
	-Under-translation		-A TM system returns *Press the Start button* as an exact (100%) match when the proper translation should be *Press the Begin button*. EN: *"Reduce emissions from stationary sources."* TM output: "قلل الانبعاثات من المصادر الثابتة."
		The target text is less specific that the source text	
	Untranslated-translation		
	- Improper exact TM match	Content that have should been translated has been left untranslated.	
		A translation is provided as an exact match from a translation memory (TM) system but is actually incorrect.	
Fluency		Issues related to the form or content of a text, irrespective as to whether it is a translation or not.	A text has errors in it that prevent it from being understood.
	Punctuation		-An English text uses a semicolon where a comma should be used.
		-is used incorrectly (for the locale or style).	EN: The Earth is warming; we must act. AR: الأرض تزداد حرارتها، يجب أن نتحرك.
	Spelling		The German word *Zustellung* is spelled *Zustetlugn*. EN: Global temperature rise AR: إرتفاع درجة حرارة الأرض
		Issues related to spelling of words.	
	Grammar		An English text reads: The *man was seeing his wife.* *EN:Climate change has impacts.* *AR:*آثار لها تغير المناخ
		Issues related to the grammar or syntax of the text, other than spelling and orthography.	
	Grammatical register		A text used for a highly formal announcement uses the Norwegian *du* form instead of the expected *De*. EN: Policymakers must respond decisively to climate risks. AR: يسرعة على مخاطر المناخ يردوا يجب على واضعي السياسات.
		The content uses the wrong grammatical register, such as using informal pronouns or verb forms when their formal counterparts are required.	
	Inconsistency		A text uses both *app.* and *approx.* for *approximately*.
	Link/cross-reference		An HTML file contains numerous links to other HTML files; some have been updated to reflect the appropriate language version while some point to the source language version.
			A text document in UTF-8 encoding is opened as ISO Latin-1, resulting in all *upper*

	Character encoding	The text shows internal inconsistency.	*ASCII* characters being garbled.
		Links are inconsistent in the text.	
		Characters are garbled due to incorrect application of an encoding.	
Terminology	-Inconsistent with termbase	-A term (domain-specific word) is translated with a term other than the one expected for the domain or otherwise specified.	-A French text translates English e-mail as e-mail but terminology guidelines mandated that courriel be used.The English musicological term dog is translated (literally) into German as Hund instead of as Schnarre, as specified in a terminology database. -A termbase specifies that the term *USB memory stick* should be used, but the text uses *USB flash drive*. EN: "Greenwashing" AR: "الغسل الأخضر"
		A term is used inconsistently with a specified termbase.	-The text refers to a component as the brake release lever, brake disengagement lever, manual brake release, and manual disengagement release. EN:Carbon footprint/Green washing AR:أثر الكربون-انبعاثات الفرد-البصمة الكربونية/الغسل الأخضر-التزييف الأخضر-التضليل البيئي
	-Inconsistent use of terminology	-Terminology is used in an inconsistent manner within the text.	
Verity		-The text makes statements that contradict the world of the text.	-The text states that a feature is present on a certain model of automobile when in fact it is not available.
	Culture specific reference	-Content inappropriately uses a culture-specific reference that will not be understandable to the intended audience.	-An English text refers to steps in a process as *First base*, *Second base*, and *Third base*, and to successful completion as a *Home run* and uses other metaphors from baseball. These prove difficult to translate and confuse the target audience in Germany. -EN: This solution knocks it out of the park. AR: هذا الحل يضرب الكرة خارج الحديقة

1.2.3 Eco- Translation Theory.

According to Cronin (2017), this theory represents translation as a dynamic process that adopts cultural and linguistic diversity. It refers to the combination between the process of translation and ecological issues. Cronin argues that translation transfers meaning between languages and at the same time actively sustains the ecosystems of communication (Cronin, 2017). He compares biological ecosystems to linguistic systems, maintaining that similar species languages exist in interdependent relations and face extinction due to the homogenizing forces of globalization (Cronin, 2006). He claims that linguistic diversity and smooth cross-cultural communication is crucial to cultural sustainability. Translation can prevent language hegemony by preventing one language from dominating the discourse on a certain topic or in a certain domain.

Translation facilitates cross-linguistic communication while preserving the distinct features of each language. Cronin suggests that translation acts as a force of resistance against the "monolingual paradigm" by enabling multilingual exchange without cultural assimilation (Yildiz, 2012). It aims to preserve both cultural and environmental identity regarding the sensitive translation practices of the context. Eco-translation theory integrates environmental ethics into the practices of translation. By acting as a preservation mechanism, translation ensures the sustainability of languages. It maintains coexistence between multiple languages rather than replacement, thus sustaining linguistic diversity. Therefore, in this research eco-translation theory is used to assess the translation of climate change related context and examine the way translation can preserve culturally specific terminology and promote global climate discourse without hegemony.

This theory provides a comprehensive framework for studying whether MT can deal with environmentally and culturally sensitive terminology or support the fidelity of translation of the source text in light of the following aspects:

Linguistic and cultural diversity: The theory emphasizes that translation should respect the environmental context and cultural specifications of the target language. MT tools facilitate translation practices and allow for wider intercultural dialogue. Cronin (2012) claims that translation is a cultural act. This view allows for assessing MT output beyond grammatical implications and puts greater weight on evaluating the success of the translation to preserve cultural nuance and ideological perspectives, especially in sensitive domains like climate change.

Ethical Responsibilities: Translators should be mindful and accurate in their translation process of texts related to climate change. They should select ecologically and culturally relevant terminology that is helpful to convey the message in a well-defined form to the audience. Cronin (2017) perceives translators as ethical actors that have the responsibility of "curating" cultural discourse in a way that preserves the cultural and environmental boundaries. The assessment of the translation takes into consideration the correct use of cultural references, idioms, and terminology leading to the advancement of a cross-cultural dialogue on global environment issues.

Sustainability: In light of Cronin's views, sustainability is related to the impact of translation tone and process on the fidelity, readability, and cultural-ecological impact of the target text to avoid linguistic

homogenization and environmental bias. Fidelity means that the translation preserves the intended meaning, while readability refers to the effective functionality of the target text and cultural impact is concerned with using translations to reinforce ecological consciousness. "Sustainability requires resisting the commodification of translation. We must ask not just, 'Does this read well?' but 'Does this sustain the source's cultural habitat?'" (Cronin, 2017). Translators should select sustainable practices to preserve the source text's cultural and ecological "habitat" and ensure that the meaning is adequately reflected in the target language. Cronin claims that if translations fail to capture the intended meaning of specialized discourse or support ecological action it does not guarantee linguistic diversity nor sustainability (Cronin, 2017).

Translation and Technology Interaction: MT tools should enhance translation practices and enrich human experience. This involves efficient digital resources and eco-friendly tools working with a lower carbon footprint. Collaboration between technology and translation can "promote and enhance language diversity in the digital age" (Cronin 2012). Cronin believes that MT is redefining the role of a translator and calls for assessing the role of post-editing and quality control in MT. When assessing MT output there should be a focus on the semantic and linguistic aspects lost and the assessor should evaluate the effect of such loss on the target audience. Cronin (2012) calls upon translators to critically engage with technology and not rely on it blindly. Human intervention is required to make translation idiomatic, culturally conscious and context appropriate.

As seen from the above discussion, eco-translation theory compliments the TAUS Error Typology as it goes beyond the quantitative metrics and provides a ground for a qualitative discussion of the cultural, ethical and communicative effectiveness of the output of MT tools.

3.Methodology

This research depends on a mixed method research design of quantitative and qualitative analysis to ensure a comprehensive evaluation of MT. The target of the quantitative analysis is to enable the comparison between the translation outputs of ChatGPT and Gemini objectively by measuring the frequency and types of translation errors. This approach allows for statistical assessment of the translation errors and unbiased assessment of each system. Qualitative analysis complements the quantitative analysis by focusing on the contextual appropriateness and ecological fidelity of the translations in reference to the climate change discourse. The study employs the TAUS Error Typology as a

standardized framework for error categorization and eco- translation theory to evaluate the environmental and cultural dimensions of translation. The integration of these methods ensures an in-depth analysis of the accuracy and effectiveness of machine-generated translation in communicating environmental issues.

Sampling Method

The analysis of the UN climate change speech is done through random sampling technique. The quality of translations produced by ChatGPT and Gemini is evaluated based on the sample that is obtained from UN official source. The goal of collecting such data is to address a wide range of topics under the broader theme of climate change.

Table (2) shows the list of the speeches used

1	António Guterres	Special Address on Climate Action: "A Moment of Truth"	5 June 2024	UN Headquarters, New York	Decarbonization, tipping points, policy urgency	915
2	Simon Stiell, UN Climate Chief	"New Climate Weeks Aim to Fast-Track the Journey from Ambition to Implementation"	15 March 2025	UNFCCC Online Announcement	Implementation, regional action, urgency of policy enforcement	567
3	Simon Stiell, UN Climate Chief	"Strong New National Climate Plans an Antidote to Economic Uncertainty"	3 May 2025	UNFCCC Online Platform	Climate planning, economic stability, national commitments	775

frequency Calculation

The frequency of each error category in the data set is measured through the quantitative approach according to the TAUS framework that compliments the qualitative approach to enrich the analysis. The detected errors are categorized according to the fluency, accuracy, verity, and terminology error categories. They frequency percentage is identified by the below formula:

$$\text{Frequency}\ (\%) = \left(\frac{\text{Number of errors in category}}{\text{Total number of errors}} \right) \times 100$$

Data Analysis

Example 1:

Pandora's Box Metaphor

English ST:

"Last week I delivered my annual priority speech to the General Assembly and said that our world is facing a ***Pandora's box of troubles***. We face widening geopolitical divisions, rising inequalities, and assaults on human rights. And we see a multiplication of conflicts, some of which are leading to the reshaping of different parts of the world."(Guterres, 2024)

ChatGPT Arabic MT

"في الأسبوع الماضي، ألقيت خطابي السنوي حول الأولويات أمام الجمعية العامة وقلت إن عالمنا يواجه" صندوق باندورا من المشاكل". نحن نواجه انقسامات جيوسياسية متزايدة، وتفاوتات متزايدة، وهجمات على حقوق الإنسان. كما نشهد تضاعفًا في الصراعات، بعضها يؤدي إلى إعادة تشكيل أجزاء مختلفة من العالم."

Gemini Arabic MT:

"في الأسبوع الماضي، ألقي خطابي السنوي حول الأولويات على الجمعية العامة وقلت إن عالمنا يواجه صندوق بندورة من المشاكل. نواجه انقسامات جيوسياسية متزايدة، وتفاوتًا متزايدًا في الدخل، وانتهاكات لحقوق الإنسان. ونرى مضاعفة الصراعات، بعضها يؤدي إلى إعادة تشكيل أجزاء مختلفة من العالم."

ChatGPT translates "Pandora" as "صندوق باندورا", trying to maintain the accuracy while preserving the allusion and mystery of the Greek myth referring to the unexpected hidden consequences of human curiosity. The myth of Pandora and the jar are traced back to show how punishment can be disguised in a form of gift symbolizing the severe outcomes of people's inquisitiveness. The text is transliterated to capture the hidden meaning of the metaphor. Nevertheless, ChatGPT failed to localize the Greek myth metaphor in TL which may lead to misunderstanding in Arab societies.

Gemini mistranslates "Pandora" as "صندوق بندورة" as (tomato), which leads to the loss of the meaning as the original metaphor is not translated appropriately. (بندورة) is a common Arabic word for tomato and has no relation to the myth. The findings show that accuracy and verity violate translation credibility. The mistranslation of cultural reference causes confusion for Arabic audiences. This is inconsistent with eco-translation principles, which is concerned with preservation of the cultural context.

Example 2

English ST:

"Our fossil fuel addiction is ***a Frankenstein monster***, sparing nothing and no one. All around us, we see clear signs that the monster has become master. 2024 has been the hottest year and the hottest decade in recorded

history. Rising temperatures have pushed us past the 1.5° threshold for the first time, a critical point identified by the Paris Agreement."(Guterres, 2024)

ChatGPT Arabic MT:

"إن إدماننا على الوقود الأحفوري هو بمثابة وحش فرانكشتاين، لا يوفر شيئًا ولا أحدًا. في كل مكان حولنا، نرى إشارات واضحة على أن الوحش أصبح السيد. كان عام 2024 الأكثر حرارة، وكذلك العقد الأكثر حرارة في التاريخ المسجل. لقد دفعتنا درجات الحرارة المرتفعة لتجاوز عتبة 1.5° لأول مرة، وهي نقطة حرجة حددها اتفاق باريس."

Gemini Arabic MT:

"إن إدماننا على الوقود الأحفوري هو وحش فرانكشتاين، لا يرحم شيئًا ولا أحدًا. في كل مكان حولنا، نرى علامات واضحة على أن الوحش أصبح سيد الموقف. كان عام 2024 هو العام الأكثر سخونة والعقد الأكثر سخونة في التاريخ المسجل. أدى ارتفاع درجات الحرارة إلى تجاوزنا عتبة 1.5 درجة مئوية لأول مرة، وهي نقطة حرجة حددها اتفاق باريس."

ChatGPT and Gemini transliterate "***Frankenstein monster"*** as " وحش فرانكشتاين" keeping the literal meaning but is inefficient to convey the intended ecological and cultural meaning. The metaphor of a Frankenstein monster illustrates an unpredictable ecological disaster, without significant resonance in Arabic as the metaphor is deeply embedded in the western culture. This translation loses the opportunity to adapt the metaphor to a cultural equivalent, which possesses better communication with ecological awareness and pressing immediate response. Based on eco-translation theory, metaphors should be localized to TL to enhance comprehension and preserve the ecological context.

Example 3

English ST:

And humanity is just one small blip on the radar, but like ***the meteor that wiped out the dinosaurs***, we are having an outsized impact. In the case of climate, we are not dinosaurs, **we are the meteor. We are not only in danger.** (Guterres, 2024)

ChatGPT Arabic MT:

والإنسانية هي مجرد نقطة صغيرة على الرادار، ولكن مثل النيزك الذي قضى على الديناصورات، نحن نترك تأثيرًا كبيرًا. في حالة المناخ، نحن لسنا الديناصورات، نحن النيزك. نحن لا نواجه الخطر فقط.

Gemini Arabic MT:

والبشرية مجرد ومضة صغيرة على الرادار. ولكن مثل النيزك الذي قضى على الديناصورات، فإننا نؤثر بشكل كبير. في حالة المناخ، لسنا الديناصورات، بل نحن النيزك. نحن لسنا في خطر فقط.

Both MT systems failed to convey the hidden meaning of *"we are the meteor" metaphor* transliterating it without cultural adaptation, this led to lack of ecological message delivery stating that humanity is not the

destructive force “the meteor” but the passive victim “the dinosaurs” which shows the inability to preserve the metaphorical meaning in TL. On the other hand, "we are not only in danger" is misinterpreted showing that humanity is at risk rather than its responsibility of causing it which shows the inaccurate translation that does not align with eco-translation principles for prioritizing the ecological nuances clarity.

Example 4

English ST:

We are witnessing **apocalyptic fires and floods**.(Guterres, 2024)

ChatGPT Arabic MT:

"نشهد حرائق مدمرة وفيضانات كارثية".

Gemini Arabic MT:

" نشهد حرائق مروعة وفيضانات وكوارث طبيعية".

Both MT failed to capture the exact meaning, ChatGPT does not deliver the intense meaning of "apocalyptic" which refers to world devastating ending and uses “مدمرة" which is (destructive), which lowers the catastrophic tone. Therefore, the original message translation is inefficient and lacks emotional intensity. This translation does not maintain the sustainability of MT as it reduces meaning and does not emphasize the link to human-caused climate deterioration and fails to urge the readers to take action. On the other hand, Gemini’s version broadens the original term by adding "كوارث طبيعية" (natural disasters). This unnecessary addition of "natural disasters" generalized the impacts distracting the actual focus of "apocalyptic fires and floods" which only refers to fires and floods. This overtranslation leads to an overgeneralization of the impact of the original expression.

Example 5

English ST:

″The world is experiencing new records in **global heating.**"Guterres (2024)

ChatGPT Arabic MT:

"العالم يشهد ارتفاعات جديدة في درجات حرارة الأرض.″

Gemini Arabic MT:

"العالم يشهد ارتفاعات جديدة في الاحترار العالمي".

“Global heating" is a stronger, more urgent term than "global warming" as it emphasizes the human responsibility for the phenomenon. ChatGPT uses a more general term which is “درجات حرارة الأرض" (Earth's temperatures), it does not have a specific significance in the climate change domain. Also, using this term may appear more comprehensible for public audiences but it reduces the scientific accuracy of the original

term. Gemini's translation uses the technical term which is "الاحترار العالمي" (global heating), as it is more consistent with the climate change domain. This difference shows a terminology inconsistency as ChatGPT's translation is more generalized, but Gemini provides a more technical word suitable for scientific discussion. In this case Gemini translation aligns better with eco translation theory that directly tackles specific issues in the domain. Gemini's MT is more precise and fits better within the environmental discourse, raising awareness about the global heating issue.

Example 6

English ST:

"**The monster has become master** as fossil fuel dependency spirals out of control."(Guterres,2024)

ChatGPT Arabic MT:

"لقد أصبح الوحش سيدًا مع خروج الاعتماد على الوقود الأحفوري عن السيطرة."

Gemini Arabic MT**:**

"أصبح الوحش سيد الموقف مع تفاقم اعتمادنا على الوقود الأحفوري خارج السيطرة."

Both translations have the same error which is mistranslating the metaphor "the monster has become master," which conveys the rising power and unpredictable unmanageable dependency on fossil fuel. The translation's main concern is to deliver the uncontrollable dependency but fail to fully adapt the metaphor to a context that would be immediately clear to an Arabic-speaking audience. ChatGPT's translation remains closer to a literal rendering, which misses the nuance that fossil fuel dependency is a powerful force now dominating the world's political and environmental systems. ChatGPT MT thus lacks rhetorical force. Gemini's translation slightly improves on this as it implies control over the situation "سيد الموقف" but sounds unnatural in Arabic.

Nevertheless, the full metaphor of a "monster" controlling humanity could be better expressed in a culturally relevant way.

Under eco-translation theory lens, both translations show a partial understanding of the message. They fall short in expressing the metaphor's more profound cultural connotations, though. In the original English, the "monster" stands in for the destructive and uncontrollably growing influence that the world's reliance on fossil fuels has on it. A clearer explanation or example that would be more relatable to Arabs that will help to improve this metaphor's adaptation. Gemini's translation does not properly contextualize the "monster" as a destructive force, but it does move the issue closer to an ecological understanding by providing a little more detail on the "worsening" element. Gemini's MT prioritizes fluency over cultural resonance. Making this connection clearer and assisting the

reader in connecting the idea to well-known local ecology should be a more localized tactic.

Example 7

English ST:

"First, Efficiency – clustering mandated events to save time, costs, and **carbon**."*(Stiell, 2025a)*

ChatGPT Arabic MT:

"أولاً، الكفاءة – تجميع الأحداث المكلفة لتوفير الوقت والتكاليف والانبعاثات"

Gemini Arabic MT:

"أولاً، الكفاءة – تجميع الأحداث المكلفة لتوفير الوقت والتكاليف والكربون"

Table 3.7. TAUS Error Analysis for MT of *carbon*

Error Category	ChatGPT	Gemini	UN Standards	Suggested version
Accuracy (Addition/omission)	Omits "Carbon" and adds "انبعاثات"	Adheres to the ST.	Translation should be delivered without any additional	لتوفير الوقت والتكاليف والحد من انبعاثات الكربون

According to TAUS Error Typology framework, in this example Gemini demonstrates a more accurate translation of the term "carbon" by preserving it as "الكربون", in contrast ChatGPT uses "الانبعاثات" (emissions), which is perceived as inaccurate translation that can be penalized by a quality reviewer. However, if one takes a deeper look at the intended meaning, ChatGPT successfully adheres to eco-translation standards which emphasize ecological awareness and linguistic sustainability in translation. The ethical responsibility of the translators implies that they should not only translate meaning accurately, but to preserve the ecological message and convey it in a culturally appropriate way. By using "الانبعاثات" (emissions), ChatGPT implicitly refers to carbon, more specifically carbon dioxide as the primary source of emissions in the environment. This term can be more understandable to Arabic speakers and to the aim of the speaker who obviously does not want to save carbon, but to reduce its effect. Gemini's translation on the other hand dilutes the meaning and shifts concern from saving the planet to saving "carbon". This may weaken the ecological fidelity and accountability of the translation. Therefore, while Gemini maintains the terminological accuracy of the MT, it lacks the ecological integrity of the original text.

Example 8

English ST:

That would be **a death sentence** for large parts of the planet. (Stiell, 2025a)

ChatGPT Arabic MT:

سيكون ذلك كارثة كبرى تهدد حياة الملايين.

Gemini Arabic MT:

حكم بالإعدام على أجزاء واسعة من الكوكب.

Table 3.8. TAUS Error Analysis for MT of *would be a death sentence*

Error Category	ChatGPT	Gemini	UN Standards	Suggested version
Verity	Culturally appropriate and deliver the intended meaning.	Culturally inappropriate and cause misunderstanding.	The translation should correctly convey the meaning without distortion, adapting metaphors or idiomatic expressions, and culturally appropriate	هذا سيكون كارثة مدمرة لأجزاء واسعة من الكوكب

ChatGPT shows a successful translation and adaptation by delivering the meaning of SL precisely in a culturally appropriate way and natural Arabic flow of the context conveying the catastrophic effects and impacts on human lives without affecting the audience's cultural norms and emotional understanding. This technique maintains eco-translation theory concepts by keeping the ecological importance message without any distortion. In contrast, Gemini's literal translation which is precise but affects and distorts the translation giving a negative connotation without any adaptation to the meaning to suit the Arabs culture and detached away from the intended meaning.

Example 9

English ST:

The same droughts that plague the canal are affecting essential commodities worldwide. Reducing harvests, emptying shelves, and pushing families into hunger. **Famine is back**, and the role of global heating cannot be ignored. (Stiell, 2025b)

ChatGPT Arabic MT:

نفس موجات الجفاف التي تعاني منها القناة تؤثر على السلع الأساسية في جميع أنحاء العالم، مما يقلل المحاصيل، ويؤدي إلى نفاد الرفوف، ويدفع العائلات نحو الجوع. المجاعة عادت، ولا يمكن تجاهل دور الاحتباس الحراري العالمي.

Gemini Arabic MT:

نفس حالات الجفاف التي تعاني منها القناة تؤثر على السلع الأساسية في جميع أنحاء العالم، مما يقلل من المحاصيل ويفرغ الرفوف ويدفع العائلات إلى الجوع. لقد عاد شبح المجاعة ،ولا يمكن تجاهل دور الاحترار العالمي.

Table 3.9: TAUS Error Analysis for MT of *Famine is back*

Error Category	ChatGPT	Gemini	UN standards	Suggested d version
Verity	Uses "المجاعة عادت", which preserves the metaphor in a way, but lacks rhetorical or emotional depth.	عاد شبح المجاعة Intensifies the metaphorical force of the phrase	Preserving metaphors in technical texts	

Gemini's translation better preserves fidelity and is preferable in this context. In addition, ChatGPT's translation does not amplify the ecological urgency of the message and does not call upon the audience to act against the "famine". Gemini uses " عاد شبح المجاعة a familiar rehtorical frame that shows famine as a "ghost" that can haunt communities. This translation conveys the metaphorical depth showing the haunting presence of famine and urges people to act quickly to avert its impact. Therefore, it aligns better with the eco-translation principles by adapting the metaphor and respecting the culture of Arabic speakers.

Results & Discussion

This table shows that both systems have a similar number of errors in each category.the accuracy error rate represents 25%,verity errors represents 62.5%,terminology represents 12.5%,and fluency represents 0%. This means that both struggle in translating the context in terms of the 3 categories but one advantage for both systems is maintaining fluency.

Error Category	ChatGPT (Count)	ChatGPT (%)	Gemini (Count)	Gemini (%)
Accuracy	2	25%	2	25%
Verity	5	62.5%	5	62.5%
Terminology	1	12.5%	1	12.5%
Fluency	0	0%	0	0%
Total Errors	8		8	

D.Limitation of the study

This comparative study involves several limitations that should be noted when analyzing the results,first the translation evaluation is based on English to Arabic languages in the climate- change specialized domain that can not be generalized.Second,the evaluation based on TAUS error typology which is a comprehensive and useful framework but, it may not fully comprehend the nuances of high translation quality. Third, the area of AI and MTs developing continually so the translation that is generated by two MTs at a specific moment may be enhanced frequently so, their capability of translation may be changed by time so the results

may need to be reassessed as technology develops.Moreover, the assessment uses eco-translation theory, which is mainly concerned with how translation can be more ecological and culturally appropriate. The theory does not have specific rules to measure translation quality accurately, concerns more about principles and beliefs rather than error categories, so it is challenging to assess (MTs) performance. Finally,the analysis process includes human intervention and judgment which may lead to subjectivity. As a result many reviewers may have different evaluation and interpretation for the same translation according to different points of view.

E.Recommendations

The study may broaden the datasets to include a wide range of texts for a deeper comprehension of AI translation system performance.Second,providing specialised training on the ecological and cultural adaptability for the translators to align with error identification, this could be enhanced by a cooperation protocol between linguists, ecologists, AI developers, and translation experts. Furthermore, the study may explore other AI systems, rather than Gemini and ChatGPT, creating specialised and unique prompts that evaluate the cultural and linguistic contexts. Surveys and interviews of qualified and professional translators may enhance the assessment by adding their perception and practical experience.

Conclusion

The above research was conducted in order to evaluate the quality of translation between Gemini and Chat GPT 3.5 from English -to-Arabic in the climatic-change domain context by using TAUS Error Typology and eco-translation theory.The results reveal that both systems results in positive and fluent findings but, with a strong struggle with the content ecologically and culturally especially in major points as specific context expressions and in metaphor handling.One of the observed errors were verity which is a great indicator for a high demand to cultural adaptation.In conclusion both systems show negative points in terminology and accuracy neither fully aligned with eco-translation principles.The scope of this research is to foreshadow light on the cultural integration importance with spread of ecological awareness through machine translation systems in orders to achieve a highly effective and more potential communication in specific domains as climate-change**.**

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Appendix1

Speeches

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