Journal of Sustainability Science and Management
Volume 19 Number 4, April 2024: 86-107
eISSN: 2672-7226

MAPPING OF SENTIMENT ANALYSIS ON FOOD SECURITY AMONG MALAYSIANS USING SOCIAL MEDIA ANALYTICS

NORADILA RUSLI[1,2]*, LEE YOKE LAI[3]*, MUHAMAD SOLEHIN FITRY ROSLEY[4], LEE CHER ENN[3], MAHERAN HAMZAH[2], NURUL EZAILA ALIAS[5], NORAINI BAHARI[6] AND MOHD RAZIF MAMAT[7]

[1]Centre for Innovative Planning and Development, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia. [2]Geospatial Research in Spatial Planning, Urban and Regional Planning Programme, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia. [3]Landscape Architecture Programme, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia. [4]Institute of the Malay World and Civilization, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia. [5]Faculty of Electrical Engineering, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia. [6]Center of Studies for Landscape Architecture, College of Built Environment, Universiti Teknologi MARA, Puncak Alam Campus, 42300 Puncak Alam, Selangor, Malaysia. [7]Malaysia Genome and Vaccine Institute, National Institutes of Biotechnology Malaysia, Jalan Bangi, 43000 Kajang, Selangor, Malaysia.

**Corresponding authors: noradila@utm.my, lylai@utm.my*
http://doi.org/10.46754/jssm.2024.04.008
Submitted final draft: 31 October 2023 *Accepted: 12 December 2023* *Published: 15 April 2024*

Abstract: The study investigates the spatial distribution of sentiment in food security-related tweets among Malaysians, aiming to identify hotspots of positive, negative, and neutral sentiments. Note that data collection involved gathering 2,218 tweets on basic necessity products from January 2019 to August 2022, capturing the impact of the COVID-19 pandemic. Pre-processing and content analysis techniques identified the main themes in the tweets, while sentiment analysis categorised them using Valance Aware Dictionary and Sentiment Reasoner (VADER). ArcGIS and hotspot analysis visualised and analysed tweet density. Regional trends were observed, with the East Coast states and certain West Coast states having the highest number of tweets. Urban areas expressed concerns about food security and living costs due to urbanisation and limited agricultural land. Here, sentiment visualisation revealed negative sentiments prevalent in developed cities (46.8%) and positive (33.9%) or neutral (19.4%) sentiments in suburban areas. This study emphasises the growing use of social media platforms and the integration of social media data in spatial analysis, highlighting the importance of uncovering hidden patterns for increased social awareness and meaningful dialogue. Understanding the sentiments expressed by Malaysians on social media regarding rising food prices can provide valuable insights for policymakers and stakeholders to address these challenges effectively.

Keywords: Spatial pattern, sentiment analysis, tweet, living cost, hot spot, food prices, food security.

Introduction

Urbanisation is a global phenomenon driven by population growth, with an estimated 9 billion people projected to inhabit the world by 2050, two-thirds of whom will be in urban areas (United Nations, 2021). The ongoing migration of people from rural to urban areas has contributed to the steady increase in the global urban population (Murdad *et al.,* 2022) insufficient urban food sources, and the inability of some urban communities to afford food due to rising costs. Food supply can also be jeopardised by natural and man-made disasters, such as warfare, pandemics, or any other calamities which result in the destruction of crop fields and disruption of food distribution. The COVID-19 pandemic exposed the impact of such calamities on the fresh food supply chain in Malaysia, especially when the Movement Control Order (MCO), particularly in low to medium-income countries. Malaysia is a prominent example, with a high level of urbanisation compared to other Southeast Asian nations. More than 70% of Malaysia's population resides in cities or urban areas. As urbanisation progresses,

population density in cities continues to rise. In Malaysia, the urbanisation rate reached 75.1% in 2020, with 24.3 million people living in urban areas, compared to 70.9% (19.5 million people) in 2010 (Department of Statistics Malaysia, 2021a). Note that the Federal Territory of Kuala Lumpur and the Federal Territory of Putrajaya have the highest population densities in Malaysia. Kuala Lumpur, with a population density of 8,157 people/km^2, is followed by Putrajaya, which has a density of 2,215 people/km^2 (Department of Statistics Malaysia, 2021a).

As in many other countries, the rapid urbanisation in Malaysia poses challenges to food security and nutrition. As communities transition from rural to urban areas, they may lose access to agricultural land and natural resources, impacting their food security. Consequently, the demand for food is also increasing with population growth, including the projected increase of 2.5 billion people by 2050, resulting in a greater demand for food in cities. Malaysia, despite its early reliance on agriculture as an economic cornerstone, currently faces food security issues and insufficiency. The country depends heavily on food imports, amounting to USD 12.42 billion, as indicated by the Import Dependency Ratio (IDR) (Department of Statistics Malaysia, 2021).

The agriculture sector's contribution to Malaysia's GDP has declined over the years, with the industrial sector surpassing it in importance. In 2020, agriculture accounted for only 7.4% of the total gross domestic product (GDP), lagging behind neighbouring countries like Indonesia (13.7%) and Thailand (8.6%) (Department of Statistics Malaysia, 2021a). Urbanisation poses not only environmental challenges but also social impacts, such as urban poverty, food security, and food insufficiency. The COVID-19 pandemic has further exacerbated these issues by imposing restrictions on movement, transportation, and logistics, leading to temporary food shortages and price increases. The pandemic has highlighted the vulnerability of urban residents' access to food supplies and the movement of agricultural products into cities (Murdad *et al.,* 2022) and acknowledging it as a paramount global concern necessitates a collaborative approach to address this challenge (Omidi-Najafabadi, 2023).

Malaysia was ranked 41st out of 113 countries in the 2022 Global Food Security Index (GFSI) (Marzuki & Jais, 2020; Department of Statistics Malaysia, 2022). This places Malaysia's performance favourably among countries in the Asia-Pacific region, including Singapore, which ranked 28th. According to an Economist Intelligence Unit (EIU) report, Malaysia has made significant progress in ensuring sufficient food quantities at affordable prices and maintaining the safety and quality of its food supply (Ali & Rahim, 2019). Moreover, the country's efforts to promote sustainable food self-sufficiency, leveraging its diverse food supply of agricultural products, seafood, and imports, indicate the potential to become a food-secure nation (Ali & Rahim, 2019).

Other than that, advancements in technology and effective food delivery services have contributed to a shrinking gap between rural and urban areas, minimising the influence of geographical location on food availability and consumption (Alam *et al.,* 2016; Bala *et al.,* 2017). The report suggests that Malaysia does not currently face significant food availability issues. However, challenges remain in terms of food affordability, particularly for lower-income groups (Bala *et al.,* 2017). In August 2022, Malaysia experienced a 7.2% increase in its overall food inflation rate compared to the same month in 2021. Categories such as 'Meat', 'Vegetables', and 'Food Away from Home' saw some of the highest price increases, reaching 9.9%, 8.9%, and 8.4%, respectively (Sharifulden, 2022).

The Department of Statistics Malaysia reports that the value of food imports in 2022 amounted to RM1,296.6 billion, representing a 31.3% increase from the previous year (Salim, 2022). This high dependency on imported food has affected Malaysians' food affordability. The Institute for Democracy and Economic Affairs (IDEAS) has highlighted the vulnerability of

Malaysia's heavy reliance on food imports, exposing the country to price fluctuations and supply disruptions. Correspondingly, the World Bank's 2019 assessment emphasises Malaysia's high food imports and low food self-sufficiency, with a food import dependency ratio of 14.4%, indicating a substantial quantity of imported food (Darhak & Masdek, 2023). Additionally, high living costs and food expenditures among lower-income groups have been observed, with the bottom 40% of households in Malaysia spending 77.6% of their income on basic needs, including food (Department of Statistics Malaysia, 2022).

These statistics reveal that Malaysia still faces challenges regarding food availability, accessibility, and affordability, particularly for segments of the population with lower incomes. This situation may limit their access to diverse and nutritious diets, potentially impacting their health and well-being (Tan *et al.,* 2022). Moreover, the reliance on food imports exposes the country to supply chain disruptions and price fluctuations, underscoring the importance of recovering food self-sufficiency and promoting sustainable food production (Bala *et al.,* 2017; Shukor, 2020).

During the COVID-19 pandemic outbreak in 2020, the Malaysian government implemented the Movement Control Order (MCO), which led to panic buying and stockpiling of food, causing food inflation and shock (Mouloudj *et al.*, 2020; Shukor, 2020). This had a significant impact on low-income households, particularly the B40 cluster [bottom 40% with income below RM4,849.00 (USD 1017.42)] who were already vulnerable to the effects of the pandemic (Alam *et al.,* 2016; Mouloudj *et al.,* 2020; Shukor, 2020). Furthermore, the restrictions imposed by the MCO also had adverse effects on job opportunities and livelihoods in urban areas, particularly in the tourism and hospitality sectors, disrupting marketing activities, production, and supply chains.

These circumstances resulted in food supply shortages and difficulties in getting food from farms to markets, leading to food wastage and increased prices for local communities (Mouloudj *et al.,* 2020). To address the issue of food affordability and ensure food security, Malaysia has been taking steps to promote sustainable food production and reduce its reliance on food imports (Shukor, 2020; Department of Statistics Malaysia, 2021b). The National Agrofood Policy (NAP) 2021-2030 has been established to transform the agriculture sector, increase productivity, and promote sustainable farming practices [National Agrofood Policy 2021-2030 (NAP2.0): Scope and Priorities]. Subsequently, the policy encourages small-scale farmers to adopt sustainable agriculture practices, promotes urban farming and community gardening, and invests in research and development of new agricultural technologies. Despite these efforts, Malaysia still faces challenges in achieving food security due to external factors such as climate change, global economic trends, poverty, and income inequality, impacting the effectiveness of government initiatives in food production, affordability, and accessibility (Paul, 2013; Zurek *et al.,* 2018; Md Ibharim & Salim, 2020; Tapia *et al.,* 2021). The desired outcomes of these initiatives may take longer to materialise, given the complexities of the food system and the broader socioeconomic context.

Comparison of Malaysia's Food Security Before and After the Pandemic

Before the pandemic, Malaysia had relatively stable food production and sufficient supply to meet demand (Table 1). However, the COVID-19 pandemic led to disruptions in the food supply chain, causing temporary shortages of certain food items in specific areas (Mouloudj, 2020; Abdullah *et al.,* 2021). Consequently, movement restrictions and border closures affected the transportation and distribution of food, resulting in inadequate supply and increased demand.

To address these challenges and improve food security, Malaysia has implemented the NAP 2021-2030, which aims to promote sustainable food production and reduce reliance on food imports (Murdad *et al.,* 2022). The government's efforts to increase domestic

Table 1: Food security in Malaysia before and after the Pandemic

Food Security Indicators	Before Pandemic (2019)	After Pandemic (2020)
Availability of food	Generally good, with occasional price spikes for certain goods.	Food supply disruptions occurred due to strict lockdown measures, with a slight increase in production.
Accessibility of food	Generally good, with some disparities between urban and rural areas.	Access to food became more challenging for specific segments of the population due to the economic impact of the pandemic.
Affordability of food	Generally affordable, with occasional price increases for certain goods.	Affordability became a greater concern for many Malaysians due to the economic impact of the pandemic.

food production have shown positive results, contributing to long-term food security and reducing vulnerability to supply chain disruptions. Correspondingly, the pandemic has stimulated demand for locally produced food, which may have incentivised farmers to increase production. However, it is important to recognise the vulnerability of the Malaysian food supply chain and the need for better initiatives and resilience during crises. The disruptions caused by the pandemic highlight the importance of strengthening the food system and ensuring its ability to withstand future shocks and challenges.

In short, overcoming the COVID-19 pandemic requires a resilient and sustainable food system that can adapt to unexpected changes and disruptions. Even though Malaysia's food production increased slightly during the pandemic, temporary shortages in some areas persisted due to disruptions in the food supply chains, particularly affecting vegetables and other fresh produce. Therefore, Malaysia must focus on food security recovery by addressing underlying issues contributing to food insecurity, such as poverty and income inequality, and promoting sustainable and equitable food systems that ensure long-term security in the country (Grima *et al.,* 2020).

Hence, this study aims to investigate the spatial distribution of sentiment toward food security-related tweets among Malaysians, with a focus on identifying hotspots of positive, negative, and neutral sentiments and analysing the content and themes within the opinionated tweets to identify key concerns expressed on rising food prices. By examining and interpreting Twitter users' sentiments and personal opinions about food security in the country, this study seeks to provide insights into how Malaysians perceived and reacted to food security issues during the pandemic.

Materials and Methods

Data mining on Twitter was conducted using snscrape, a Python programming module, which can be accessed at https://pypi.org/project/snscrape/ (accessed on 20th March 2023) (Grigore, 2021). Snscrape is a powerful tool that enables the scraping of various types of data from Social Networking Services (SNS), including user profiles, locations, hashtags, and searches and provides the retrieved items, including relevant posts. It is particularly useful for scraping historical tweets without requiring a Twitter Developer Account. Note that snscrape operates on Python 3.8 and is commonly used for research projects involving public data from Twitter. It offers an alternative to the limitations of the Twitter Application Programming Interface (API) by allowing researchers to bypass these limitations.

For this study, the researchers utilised snscrape to extract 3,299 tweets related to basic necessity products, such as the cost of living, chicken prices, meat prices, vegetable prices, fish prices, and egg prices, from across Malaysia. The data collection spanned from

January 2019 to August 2022, a period during which Malaysia experienced significant impacts from the COVID-19 pandemic. Considering that the majority of Malaysians are proficient in both English and Malay languages, keyword mining was conducted using both languages.

Data Pre-processing and Analysis

Out of the total of 3,299 collected tweets, a thorough screening process was conducted to ensure the relevance and accuracy of the data (Agustiningsih *et al.,* 2021). The screening involved removing tweets that did not meet specific criteria: Geotagging within Malaysia, discussing food security issues related to basic necessity product prices, and excluding advertisements or promotions for food products or services. By employing this rigorous screening process, the collected data was ensured to be accurate, relevant, and aligned with the study's objective.

After the screening, a total of 2,218 tweets were obtained, written in both Malay and English languages. To maintain data quality and reliability, the tweets underwent pre-processing steps that involved the removal of hashtags, usernames, uniform resource locaters (URLs), stop words, lowercase letters, title postfixes, and punctuation. The cleaned tweets were then translated into English while preserving the original context and meaning. For this translation task, the study utilised the advanced translation capabilities of ChatGPT-4, a powerful language model developed by OpenAI (Jiao *et al.,* 2023). Note that ChatGPT-4 has been extensively trained on diverse, multilingual data, including Malay and English, enabling it to generate accurate translations.

To ensure the accuracy of the translations, eight Malay native speakers were engaged as experts to review and validate the translated text. Their meticulous examination ensured that the translated tweets conveyed the same message as the original tweets. This rigorous validation process, combined with the translation capabilities of ChatGPT-4, contributed to the quality and accuracy of the translations. It is worth noting that in Malaysia, it is common for individuals to mix Malay and English in their daily conversations, including in tweets. Additionally, the use of short forms, abbreviations, and dialects specific to certain regions is prevalent. Nevertheless, ChatGPT-4 demonstrated its ability to translate such tweets appropriately.

We followed the best practices of Twitter data analysis, ensuring the protection of user privacy by removing potentially identifying information such as usernames and biographical details (Williams *et al.,* 2017). The data collected for this study is categorised as secondary data, obtained through social media monitoring, which is an effective method for gaining insights into user thoughts and opinions on a specific topic (Stieglitz *et al.,* 2018). The data collection process involved web crawlers that collected datasets based on the keywords used in the study, and the sample size was determined by the keywords selected (Mirtaheri *et al.,* 2014). These data collection methods ensured that we obtained high-quality and reliable data for analysing the food security situation in Malaysia. After pre-processing and translating the tweets, content analysis was conducted to identify the main themes or categories that the tweets fell into. Content analysis is a research method used to systematically analyse qualitative data and identify patterns, themes, or categories within it (Erlingsson & Brysiewicz, 2017). In this study, a deductive approach was used, where predefined categories were developed based on the research questions and objectives, informed by the existing literature on food security.

ChatGPT-4, with its advanced algorithms and deep learning techniques, was utilised to speed up the content analysis process (Zhuo *et al.,* 2023). Trained on a vast amount of text data, ChatGPT-4 can recognise patterns and relationships within large sets of text, including unstructured data like social media posts (West, 2023). Its Natural Language processing (NLP) capabilities enable it to understand the context and meaning of words and phrases, facilitating high-quality translations and content analysis (Ji *et al.,* 2023). Two independent human raters

reviewed and analysed the tweets, validating the predefined categories generated by ChatGPT-4 for each tweet. Any disagreements were discussed and resolved through consensus. The number of tweets falling under each category was counted, and the data were analysed to identify patterns and trends in the themes and topics discussed by Twitter users regarding food security in Malaysia. Consequently, categorising the tweets into thematic areas provided a better understanding of the diverse issues and concerns related to food security expressed by Twitter users.

The sentiment analysis was conducted using a Valence Aware Dictionary and Sentiment Reasoner (VADER). It is a rule-based sentiment analysis tool and a lexicon used to express sentiments on social media. Here, we used the VADER Sentiment Analyser to classify the pre-processed text as positive, negative, or neutral. The typical threshold values used are:

Positive : Compound ≥ 0.05,
Neutral : (compound > -0.05) and (compound < 0.05),
Negative : Compound ≤ -0.05.

We calculated the compound score by adding the valence ratings of each word in the lexicon, adjusting them according to the predefined rules set by VADER, and then normalising them to fall between −1 (extremely negative) and +1 (extremely positive). This is the most relevant metric if one unidimensional assessment of a sentence's sentiment is required.

The results obtained were validated using evaluation metrics such as precision, recall, and F-score. These metrics were computed based on a sample of 100 messages, following the recommendation in the literature (Sokolova & Lapalme, 2009; Tausczik & Pennebaker, 2010; Kiritchenko & Mohammad, 2016). To ensure the accuracy of the sentiment analysis results, two human raters were involved in annotating the messages according to established criteria, as presented in Table 2. Any disagreements between the raters were resolved through discussions aimed at reaching a consensus. In cases where disagreements could not be resolved, the final decision on the sentiment category was made by the leader of the research, taking into account the judgments of the annotators (Rusli *et al.,* 2023).

The distinguishing feature of this study is its use of ArcGIS to visualise the location of tweets on a map. By employing the hotspot analysis tool (Getis-Ord Gi*) in ArcGIS, the study examines tweet density in different regions and generates a hotspot map. This map highlights areas with high and low tweet activity, enabling researchers to identify patterns and trends in tweet distribution. Subsequently, by analysing the hotspot map, the study can reveal areas with a significant concentration of Twitter users or identify popular topics specific to certain regions (Getis & Ord, 2010; Önden *et al.,* 2014). The overall methodology of this study is depicted in Figure 1.

Table 2: The criteria of human raters

Criteria	Description
Language proficiency	Understand the language used in the messages to be annotated thoroughly. They should be able to interpret nuances in meaning and tone and be conversant in the language. The raters were given 100 messages in both languages; English (with sentiment analysis value) and Malay (to interpret nuances in meaning and tone).
Consistency and reliability	The raters' annotations should be consistent, and they should be able to achieve a high level of inter-rater reliability. Inter-annotator measurement metric (Kiritchenko & Mohammad, 2016); (Read & Carroll, 2009) was calculated using Cohen's kappa.
Objectivity and impartiality	The raters' annotations must be neutral and fair, with no biases or prejudices that might influence their conclusions.

Source: Adapted from (Rusli *et al.,* 2023).

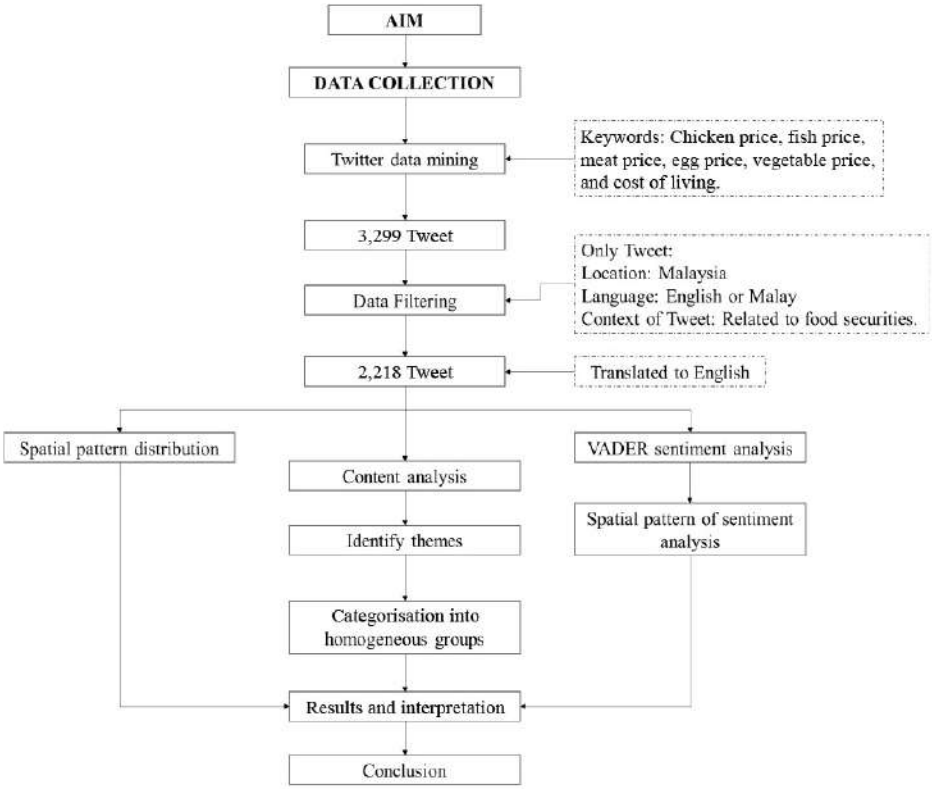

Figure 1: Overall research methodology

Results and Discussion

Spatial Location of Tweet

We successfully identified the spatial location of Twitter users and visualised it on the map illustrated in Figure 2 using ArcGIS 10.8 software. By utilising the latitude and longitude information of the tweets, we clustered them to plot the points on a map representing 14 states in Malaysia. From the map (Figure 2), it is evident that the West coast of the Malaysia Peninsula, including the states of Perlis, Pulau Pinang, Kedah, Perak, Selangor, Negeri Sembilan, Melaka, and Johor, received a high volume of tweets. This was followed by the East coast of the peninsula, comprising the states of Terengganu, Pahang, and Kelantan. Conversely, the density of tweets was lower in the Bornean states of Sabah and Sarawak.

We observed that states such as Selangor (1,078 tweets), Johor (175 tweets), Putrajaya (173 tweets), Kuala Lumpur (149 tweets), and Perak (122 tweets) had a higher number of tweets related to the cost of living compared to other states (Figure 3). This is expected as these states have undergone rapid urbanisation, limiting available land for agricultural activities. Cities such as Kuala Lumpur, Ipoh in Perak, Putrajaya, and satellite townships in Selangor like Petaling Jaya, Kajang, and Shah Alam are highly urbanised areas in Malaysia. The economic, social, and political factors in these cities have made food security and the cost of living crucial issues in people's daily lives.

Given that abundant natural resources in rural areas ensure that food accessibility is not a significant concern, it is a privilege for urban communities, particularly in these highly urbanised regions, due to high demand

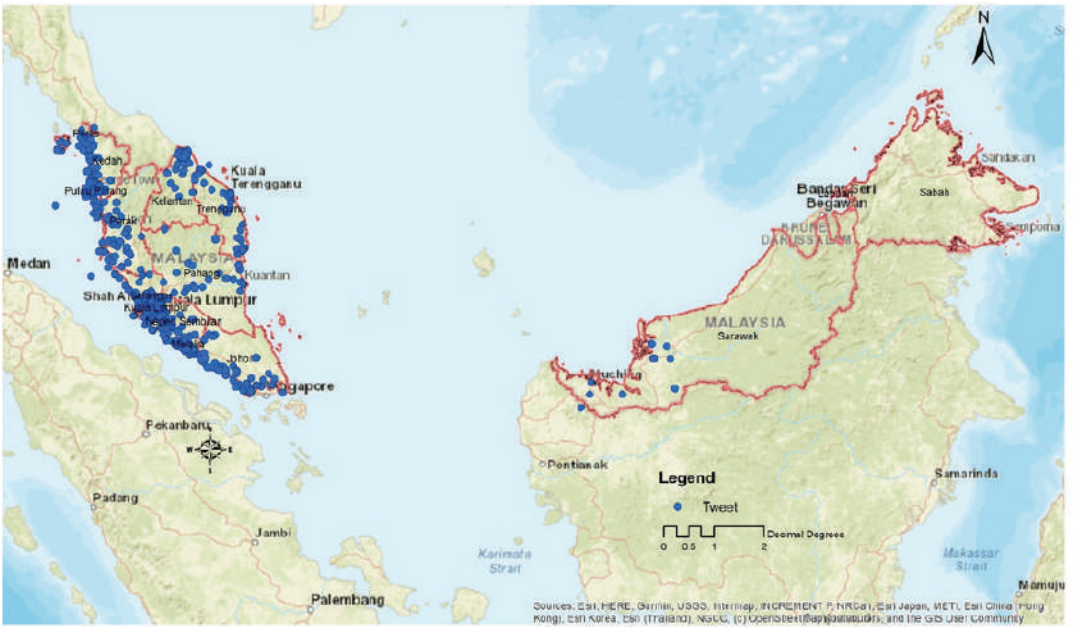

Figure 2: The spatial location of tweets by Malaysians related to food prices

and limited food supply. Selangor, Malaysia's most populous state, faces high living costs as it has a market economy focused on commerce, high-tech industries, and services due to its strategic location in the Klang Valley. However, agricultural activities in Selangor are insufficient to meet the demands and needs of its residents. The rural areas of Selangor, such as Hulu Selangor, Kuala Langat, and Sabak Bernam, known for agrotourism and ecotourism activities, represent the remaining agricultural areas. Nonetheless, the quality of life in these areas cannot be compared to the lifestyle in other states, particularly on the east coast and northern parts of the peninsula.

Many tweets shared experiences of living in rural areas of the East Coast and nostalgically compared them to the present lifestyle in Selangor and Kuala Lumpur. They recalled how food was readily available and easily gathered or foraged from their surroundings. In contrast, they expressed how herbs or "ulam," which used to grow abundantly in their kampung's backyard, have become expensive in the current neighbourhood markets.

In Johor, people expressed dissatisfaction with food prices, which may be attributed to their perception of competition with Singaporean citizens who take advantage of their stronger currency. Being the gateway to Singapore and located near the Riau Archipelagoes in Indonesia, the strategic location of Johor, especially Johor Bahru, presents both opportunities and challenges for the locals. It is common to see a large number of Singaporeans travelling to Johor for leisure activities and daily errands in Johor Bahru, benefiting from their higher purchasing power compared to the local population.

Despite Ipoh being known as one of the most affordable cities to live in in Malaysia and the world, it is not immune to the skyrocketing food prices following the COVID-19 pandemic. Moreover, as people in Ipoh are accustomed to spending less compared to other regions in Malaysia, the increase in prices within the food chain industry has had a significant impact on them.

Several tweets discussed the uncontrollable price of poultry, particularly fresh chicken, which has gone beyond their normal budget.

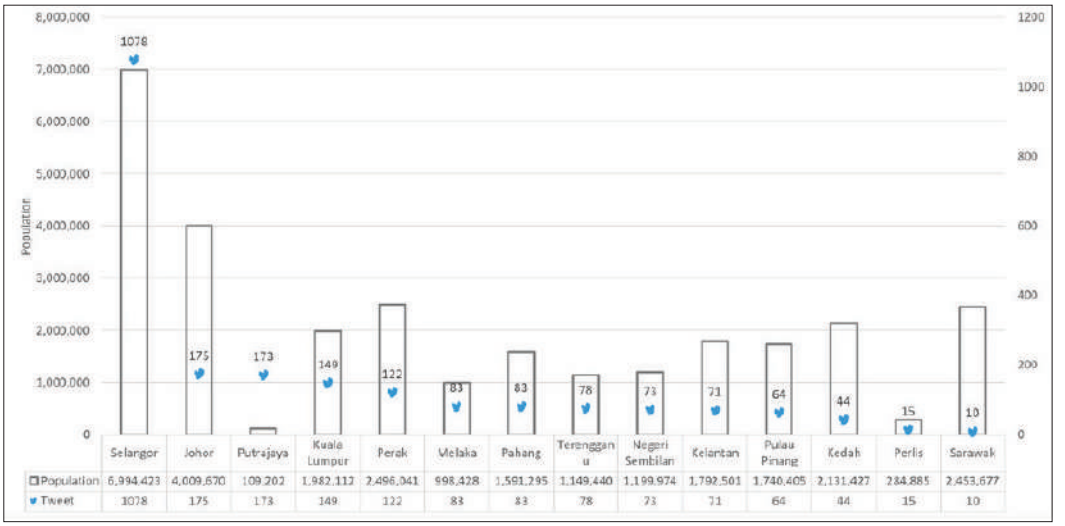

Figure 3: Total number of tweets according to state in Malaysia

Many individuals have resorted to cutting back on their expenses and downgrading their lifestyles. Families and the middle-income group expressed concerns about the rising prices of poultry and meat products, which used to be affordable and accessible to everyone. Some tweets criticised the efforts of previous and current governments in subsidising necessities and the stagnation of salaries, as these factors have greatly affected their quality of life in Ipoh and Perak in general.

Figure 4 illustrates that the highest trend of tweeting among users was recorded between 3 a.m. and 10 a.m. This suggests that tweets related to food prices and the high cost of living have led to an unhealthy lifestyle, both psychologically and physically, among Twitter users. The social platform serves as their virtual refuge for expressing their thoughts and feelings on this matter. However, this constant engagement with the issue may disrupt their sleep quality and potentially harm their mental and physical well-being.

Additionally, there were two specific days when the number of tweets significantly increased compared to usual. On April 14, 2021, the trending topic revolved around dissatisfaction with the current government's policies regarding the increasing food prices during COVID-19 (MCO). Many tweets argued about the relevance of having a large number of new ministers in terms of efficiency and effectiveness while ironically failing to address the rising prices and shortage of fresh poultry in the market. Consequently, the situation worsened on November 25, 2021, when the country was shocked by the soaring prices of local fresh products, such as vegetables and eggs, due to disruptions in the food supply chain across the country. The tweets expressed anger, anxiety, and disappointment towards the government's initiatives and unfulfilled political promises in addressing the difficulties faced by Malaysians. Critics also compared the economic and financial subsidisation actions taken by the previous government despite concerns about transparency and negative perceptions related to the embezzlement of Malaysian sovereign wealth. In this context, people's daily needs are of utmost concern, as they focus more on surviving daily.

To identify the locations of the 2,440 tweets, hotspot analysis using the Getis-Ord Gi hotspot method was employed in this study, as shown in Figure 5. The calculation of the Getis-Ord Gi hotspot method was conducted using the formula within the ArcGIS mathematical system, as described earlier. Here, different tones or colours (Figure 5) were used to classify the

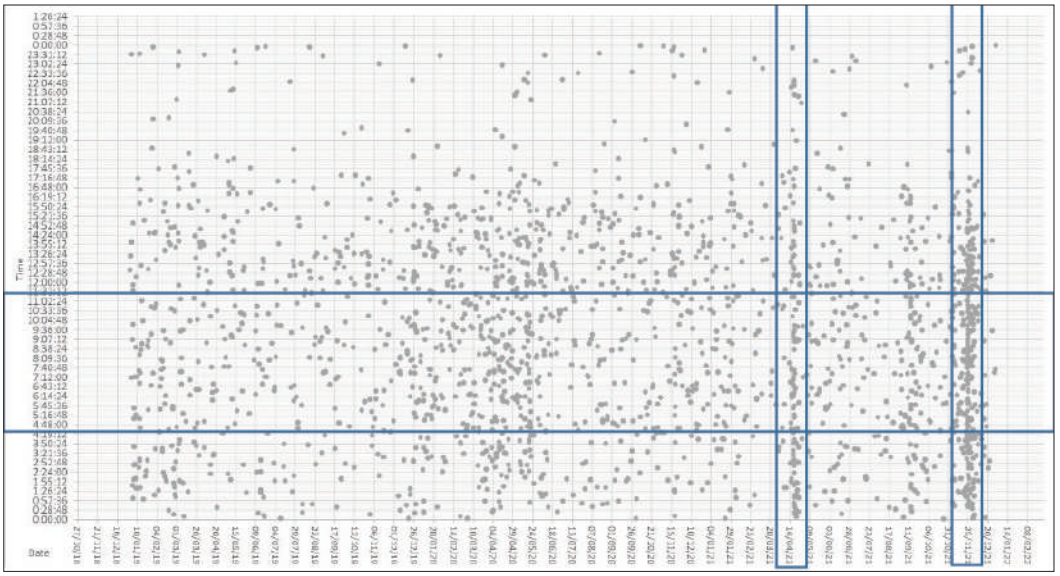

Figure 4: Date and time of tweets

high and low values of the tweets, allowing for visual identification of tweet activity hotspots.

Additionally, there were two specific days when the number of tweets significantly increased compared to usual. On April 14, 2021, the trending topic revolved around dissatisfaction with the current government's policies regarding the increasing food prices during COVID-19 (MCO). Many tweets argued about the relevance of having a large number of new ministers in terms of efficiency and effectiveness while ironically failing to address the rising prices and shortage of fresh poultry in the market. The situation worsened on November 25, 2021, when the country was shocked by the soaring prices of local fresh products, such as vegetables and eggs, due to disruptions in the food supply chain across the country. The tweets expressed anger, anxiety, and disappointment towards the government's initiatives and unfulfilled political promises in addressing the difficulties faced by Malaysians. Furthermore, critics also compared the economic and financial subsidisation actions taken by the

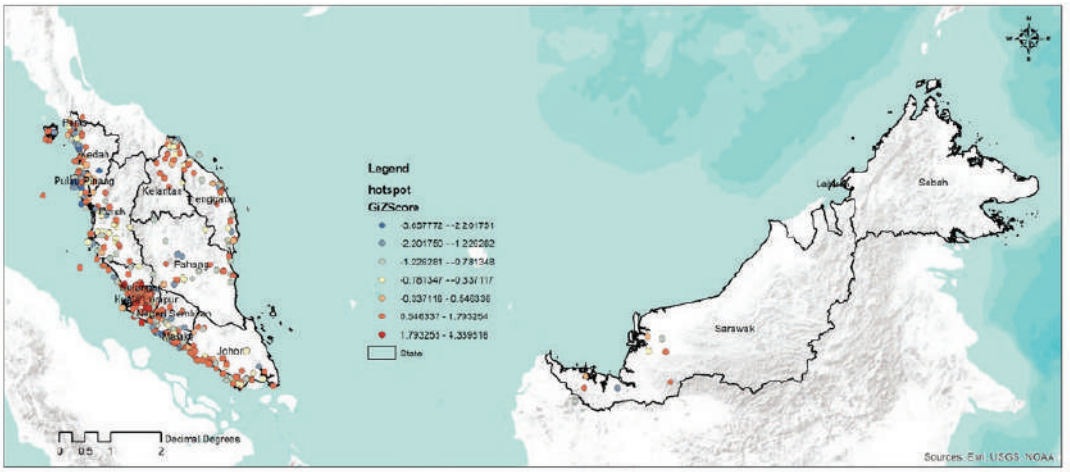

Figure 5: Hotspots of tweets

previous government despite concerns about transparency and negative perceptions related to the embezzlement of Malaysian sovereign wealth. In this context, people's daily needs are of utmost concern, as they focus more on surviving daily.

Furthermore, these large cities serve as centres of services and are well-developed, resulting in better internet accessibility and connectivity with fewer interruptions. The availability of affordable and widespread internet coverage enables people to fully utilise social media platforms as a means of expressing and sharing their thoughts virtually. Moreover, the significant presence of the youth population in urban areas may contribute to the high number of tweets, as they are more exposed to daily internet usage and possess higher levels of internet and digital literacy. The government's initiatives towards Indus-trial Revolution 4.0 (IR 4.0) have transformed the social ecosystem by increasing people's acceptance of technology as a part of their daily activities and transactions. Consequently, this has led to increased internet and digital literacy, particularly among urban dwellers.

Spatial Pattern of Sentiment Analysis

Sentiment analysis was conducted using VADER, which classified the tweets into three categories: Positive, neutral, and negative sentiments (Figure 6). The adaptation of the method proposed by (Rusli *et al.,* 2023) allowed for the precise and reliable linking of sentiment analysis with the geolocation of the tweets. Out of the 2,218 collected tweets from across Malaysia, approximately 33.9% were classified as positive sentiments. Most of the positive sentiments scored between 0.0258 and 0.9539 and were predominantly shared in the early morning hours between 2 a.m. and 9 a.m. (Figure 6).

Some examples of positive sentiments include individuals adapting and accepting the upward trend of food prices and the cost of living as a normal scenario that occurs yearly, with a positive score of 0.4754. These sentiments originated from Rembau and Negeri Sembilan. However, it is important to note that some positive reactions were not entirely genuine and carried a sense of sarcasm towards the government. These tweets expressed a rejection of the government's ineffective solutions in addressing food shortages and unaffordable prices. Many netizens sarcastically expressed their gratitude to the government for making their lives more difficult due to stagnant wages and reduced purchasing power. For instance, one tweet from Gombak, a highly urbanised area in Selangor, stated, "We are very grateful, especially as teacher trainees living in the middle of this metropolitan area, due to the high cost of living. Hopefully, IPG Malaysia will be considerate of the potential teacher trainees who will educate and shape the future generation" (score: 0.5983).

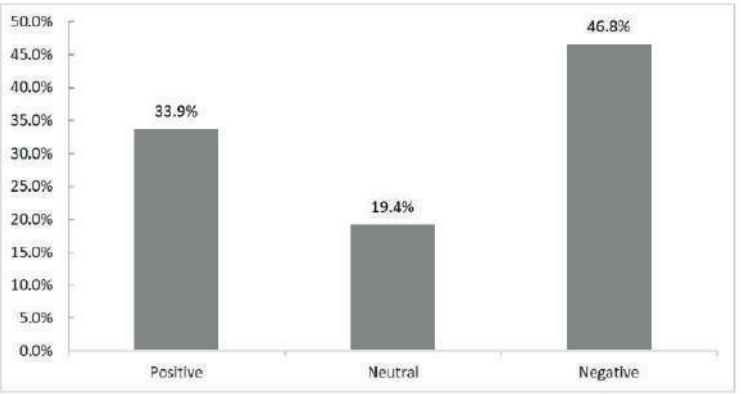

Figure 6: Percentage of sentiment

However, some netizens recognised that this trend of increasing prices was an irreversible process and called for creative solutions. Some proposed urban farming activities in Kuala Lumpur to cope with the rising prices of fresh vegetables. For example, one tweet stated, "With the increase in vegetable prices, perhaps now is the best time to cultivate one's edible garden" (score: 0.2732), while another mentioned, "Dad's chilli plants are so plump in his edible garden and worth to sell right now due to the high demand" (score: 0.4215). These statements reflect an awareness of the benefits of having an edible garden or engaging in urban farming activities as a means to reduce the cost of living. Negative sentiments dominate the sentiment analysis results, accounting for 46.8% (Figure 7) of the overall sample. The scores for negative sentiments range from -0.0258 to the highest score of -0.936.

The trend of negative sentiments gradually increases from midnight to almost 5 a.m. (Figure 7). Issues such as the cost of living, government policies, and food prices are among the topics discussed in these tweets.

Many Malaysians expressed their anger and frustration regarding the unexpected and rapid increase in food prices. For example, a tweet from a fresh graduate expressed hopelessness in securing job opportunities due to the impact of the rising cost of living in Malaysia. Note that the individual felt that education had lost its significance in providing a better future for the people. The tweet stated, "The cost of living affects everyone's lives. The issue is that the starting pay for fresh graduates is low. They may have qualifications, but the jobs they are offered may not fully utilise their skills. For example, why hire a degree holder for RM2.5k when a diploma holder can do the job, and two years of experience can be equivalent to a degree?" (score: -0.771). It is noteworthy that this tweet originated from Machang, Kelantan, where the cost of living is among the lowest in Malaysia. However, it reflects the economic challenges faced by the state and the perception of it being an economic backwater for locals.

The criticism of government incompetence goes beyond boundaries, with many blaming government policies and administration for

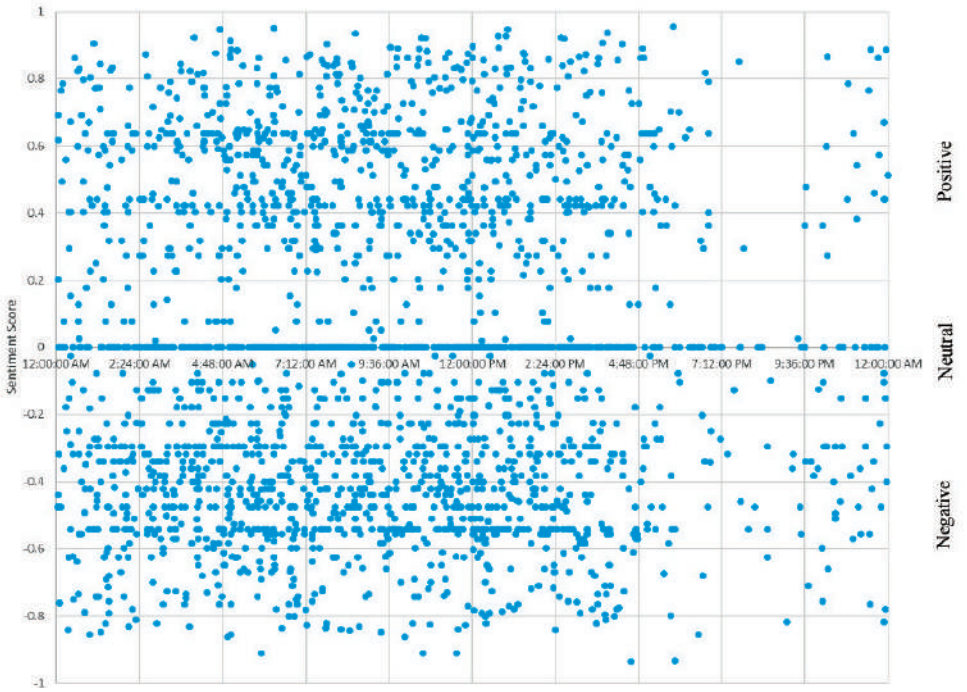

Figure 7: Sentiment score year 2019-2022

failing to secure domestic and international food supplies. Some tweets express fury over the declining value of the Malaysian currency, which has impacted people's purchasing power. Onions, in particular, have become a metaphor for expressing anger, frustration, and low confidence in government initiatives. For example, tweets such as "Small onions have skyrocketed in price. These are the challenges and tests faced by traders, where the prices of raw materials fluctuate rapidly" (score: -0.3123) and "The price of onions has increased! From RM23.00 to RM61.00" (score: -0.512) highlight people's concerns about their daily survival. While these price increases may seem inconsequential, they have a significant impact on B-40 and some low M-40 income groups, further reducing their household income.

ArcGIS 10.8 is used for visualising the location of sentiment analysis due to its interactive and advanced mapping capabilities compared to conventional methods. Figure 8 displays the visualisation, which showcases the collective and highest density of negative, positive, and neutral sentiments. On a macro scale, negative sentiments are densely accumulated in most of the developed cities in Malaysia, particularly in Kuala Lumpur, Penang, and Johor Bahru, which are known for being expensive cities to live in. Conversely, positive and neutral sentiments are more prevalent in suburban areas and less developed cities and states such as Melaka, Negeri Sembilan, Perlis, Kedah, Terengganu, Pahang, and Kelantan. This sentiment visualisation provides insights into the trends and patterns of social platforms' usage and integration with spatial data and mining activities in Malaysia. Other than that, it also highlights the importance of identifying hidden patterns within user-generated data to promote social awareness and facilitate effective dialogue on relevant issues.

Content Analysis

The analysis of the Twitter data revealed several prominent topics, which are summarised in Table 3. The topic of 'food' emerged as the most frequently discussed topic in the data. This encompasses conversations related to food costs, food quality, food availability, and food safety. Additionally, other important topics that emerged include the cost of living, government, business, consumers, the economy, the environment, society, and politics. The findings highlight a significant amount of discourse surrounding the affordability of living and the price of food. This can be attributed to the essential nature of food in sustaining life and the observed upward trend in food prices over recent years. Furthermore, the analysis indicates substantial discussions involving the

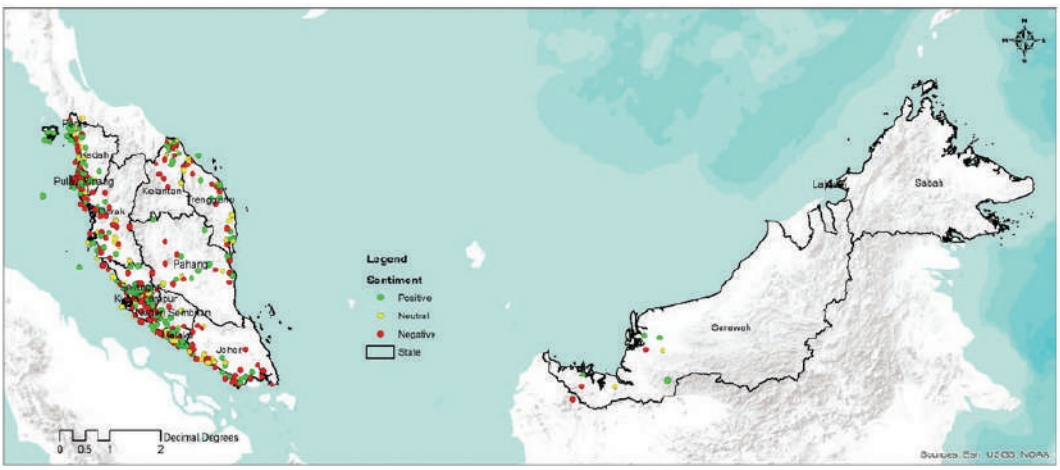

Figure 8: Sentiment analysis in spatial form

Table 3: Themes found in tweets

Theme	Topic Cover
Food	Food prices, food quality, food availability, food safety, food culture, food waste, and food security
Cost of living	Inflation, price increase, price decrease, price stability, cost of living, and purchasing power
Government	Government policy, government intervention, government regulation, government subsidies, and government assistance
Business	Business practices, business ethics, business sustainability, business innovation, and business growth
Consumer	Consumer behaviour, consumer demand, consumer protection, consumer rights, and consumer satisfaction
Economy	Economic growth, economic recession, economic inequality, economic development, and economic stability
Society	Social justice, social welfare, social inequality, social cohesion, and social change
Politics	Political stability, political change, political polarisation, political corruption, and political participation

government, businesses, and consumers. This is likely due to the influential roles played by these entities in both the economy and society at large.

The prevalence of discussions about food on social media can be attributed to the recognition that food is a fundamental necessity for survival and a topic of personal interest. This preoccupation stems from the understanding that food plays a crucial role in meeting basic physiological needs and maintaining overall well-being (Anto, 2018). The multifaceted nature of food-related discussions arises from the complex interplay of socioeconomic factors, personal preferences (Aldaz *et al.*, 2022) and health considerations.

One of the primary concerns consistently raised in discussions about food is its price. Individuals from various socioeconomic backgrounds express concerns about the affordability of food, particularly given the increasing costs associated with agricultural production, distribution, and inflation. Malaysians, for example, often express dissatisfaction with the prices of vegetables, meat, fish, and eggs. Moreover, inflation data provided by the Department of Statistics of Malaysia (Figure 9) presents that fresh vegetables have the highest inflation rate among food items, surpassing meat, fish, and eggs. In mid-2008, food price inflation reached its peak at 8.8%, compared to an overall inflation rate of 5.5% during the same period, largely attributed to the surge in global commodity prices. However, recent government efforts to rationalise food and energy subsidies have also contributed to higher-than-normal headline inflation figures, causing public concern. The determinants of food price inflation in Malaysia include world food commodity prices, real effective exchange rate, per capita GDP, petrol prices, population, and unemployment (Geetha *et al.,* 2015; Norazman *et al.,* 2016; 2018).

Furthermore, food quality represents another salient point of interest and contention. Tweets by Malaysians have become increasingly discerning regarding the nutritional composition, origin, and production methods of the food they consume. Concerns surrounding the presence of additives, pesticides, hormones, and Genetically Modified Organisms (GMOs) have garnered significant attention, reflecting a growing desire for wholesome, unadulterated food options. This emphasis on food quality aligns with broader societal trends toward health consciousness and sustainable living.

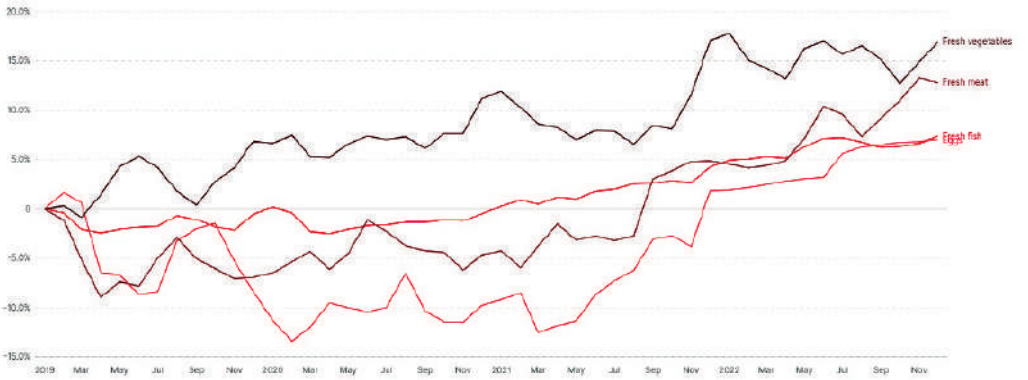

Figure 9: Inflation trends for specific items in Malaysia from the year 2019 to 2022
Source: Generated from https://open.dosm.gov.my/consumer-prices. Accessed on: 16th May 2023.

Food availability, both geographically and temporally, remains a pressing issue in Malaysia. Unequal distribution of food resources across regions and seasons can have significant implications for food security and exacerbate global disparities. Discussions among Malaysians often revolve around topics such as food deserts, limited access to fresh produce in certain areas, and the impact of climate change on agricultural productivity. These concerns highlight the need for equitable distribution systems, sustainable farming practices, and efforts to mitigate the effects of climate variability on food production. The discussions surrounding food reflects its fundamental role as a basic human necessity and a topic of significant interest. People express concerns about food price, quality, and availability, which are influenced by socioeconomic factors, personal preferences, and health considerations. Understanding and addressing these concerns are crucial for policymakers, industry stakeholders, and individuals to work towards a more equitable, sustainable, and nourishing food system.

Furthermore, the increasing cost of living is another significant subject that receives considerable attention and discussion among Malaysians. The findings indicate that individuals are concerned about the steady rise in the cost of living and actively seek ways to cut costs and save money. This heightened concern can be attributed to various interconnected factors that impact individuals' economic well-being and overall quality of life. Rising costs of essential goods and services, including housing, healthcare, education, and transportation, put significant strain on household budgets. Inflationary pressures often outpace income growth, leading to reduced purchasing power and increased financial vulnerability for individuals and families. Studies, such as the one conducted by (Sulaiman *et al.,* 2019), reveal negative perceptions among Malaysian households regarding the increasing cost of living. The introduction of the Goods and Services Tax (GST) as a replacement for the Sales and Services Tax (SST) has also contributed to the rising cost of living.

The escalating trend of household debts related to mortgages is another factor driving the cost of living. This trend is influenced by increasing house prices, fluctuating interest rates, and speculative activities undertaken by investors, as noted in a study by (Sahiq *et al.,* 2018). Addressing the concerns related to the cost of living requires comprehensive approaches, including measures to mitigate inflationary pressures, promote income growth, improve access to affordable essentials, and enhance financial literacy and stability among individuals and families. By understanding and actively addressing these concerns surrounding food and the cost of living, policymakers,

industry stakeholders, and individuals can work together to create a more equitable and sustainable society that promotes the well-being of all Malaysians.

Note that a broader macroeconomic context plays a pivotal role in shaping the discourse on the cost of living. Factors such as inflation, interest rates, taxation policies, and fluctuations in the job market contribute to the overall economic landscape that influences individuals' financial circumstances (Sahiq *et al.,* 2018). Economic downturns, for instance, can exacerbate concerns about the cost of living, as they can lead to reduced employment opportunities, stagnant wages, and diminished consumer confidence. In response to the mounting financial pressures, individuals actively seek ways to curtail costs and optimise their spending. Strategies such as budgeting, cost comparison, and seeking out discounts and promotions have become commonplace as individuals strive to stretch their financial resources. Furthermore, the emergence of technological advancements and online platforms has facilitated the rise of the sharing economy, enabling individuals to access goods and services at reduced costs through peer-to-peer sharing and collaborative consumption.

The impact of the cost of living extends beyond individual households, reverberating across society. It can exacerbate income inequality, as lower-income individuals and marginalised groups bear a disproportionate burden of rising expenses. Additionally, the cost of living can shape social mobility, influencing individuals' ability to invest in education, secure stable housing, and accumulate savings for the future. The escalating cost of living engenders substantial attention and serves as a subject of fervent discussion among individuals. The multidimensional nature of this issue necessitates a comprehensive understanding of the complex interplay between economic factors, household budget constraints, and societal implications. Hence, by recognising the challenges posed by the rising cost of living and implementing targeted measures, stakeholders can strive to alleviate financial burdens, enhance economic well-being, and foster a more equitable society.

The government is yet another significant institution that receives a great deal of attention from Malaysians on Twitter. The findings indicate that people are concerned about the role that the government plays in the economy. As a result, they are searching for other ways to hold the government accountable for its actions. Twitter users in Malaysia are concerned about the government's role in controlling food prices and are searching for ways to hold the government accountable for its actions. The COVID-19 pandemic has had a significant impact on the Malaysian economy, with many businesses forced to cease operations due to government stringency measures such as the MCO (Amirul & Saudi, 2022).

The marketplace has become the main source for most people to buy their essential food items, and the announcement of the enforcement of the lockdown led to panic buying, which had a huge impact on the supply and price of groceries, including vegetables. B40 households in Malaysia have experienced income shocks due to the COVID-19 crisis (Ibrahim & Othman, 2020), and many have resorted to buying goods in stores that offer low prices, borrowing money from relatives or neighbours, picking vegetables around the house area, and doing business online. Individuals are keenly aware of the profound impact that government decisions can have on economic stability, job creation, income distribution, and overall societal well-being. Consequently, they express a growing interest in understanding and evaluating the government's actions and policies to ensure transparency, effectiveness, and alignment with their needs and expectations. One of the primary motivations driving the desire for increased accountability is the recognition that government decisions can have far-reaching consequences. Consequently, citizens feel empowered and obligated to scrutinise government actions and demand transparency.

The business world is another significant organisation that receives much attention from

the general public. The findings indicate that people are concerned about the actions of corporations, and as a result, they are seeking solutions to safeguard the rights of customers (Kulkarni & Bhalerao, 2021). The term "consumer" refers to a person who buys goods or services and is another significant subject that is frequently discussed. The findings indicate that individuals are worried about their rights as consumers and are seeking ways to receive a fair price on the products they purchase. For example, there have been tweets expressing dissatisfaction regarding the dimensions of the chicken served at a prominent fast-food establishment, primarily due to its inflated price relative to its diminutive proportions.

The economy is a subject of considerable importance, commanding substantial attention from the general public. Within these discussions, several key themes emerge, including economic growth, economic recession, economic inequality, economic development, and economic stability. Therefore, economic growth is a fundamental objective for societies, representing an increase in the production and consumption of goods and services over time. Achieving sustained economic growth is crucial for fostering prosperity and enhancing living standards (Ramanayake & Lee, 2015). However, the COVID-19 pandemic has had a significant impact on Malaysia's economy in 2020-2022, disrupting markets and causing unprecedented shocks (Lee *et al.,* 2020). This has led to a decrease in Malaysia's GDP during the pandemic period (Figure 10). The pandemic has also contributed to high unemployment rates, as illustrated in Figure 11.

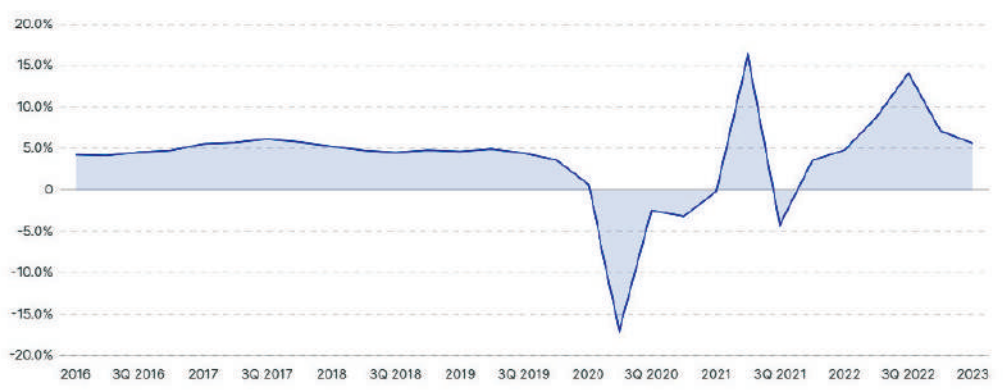

Figure 10: GDP trending for Malaysia
Source: Generated from https://open.dosm.gov.my/gdp. Accessed on: 17th May 2023.

Figure 11: Unemployment rate trending 2019-2022
Source: Generated from https://open.dosm.gov.my/labour-market. Accessed on: 17th May 2023.

The tweet highlights the challenges faced by young Malaysians in finding employment. It mentions the increasing number of graduates and the decreasing job opportunities, as well as the mismatch between basic wages and the rising cost of living. The tweet suggests that instead of relying on finding jobs, young people should be encouraged to become entrepreneurs, but it also acknowledges the criticism faced by young entrepreneurs. Additionally, the tweet refers to the migration of people from Kelantan to other areas in search of work, indicating regional disparities in job availability and wage levels.

Politics is another significant topic that is frequently discussed. The tweet mentions various issues related to Malaysian politics, including the increase in prices of goods and tariffs after the 14th General Election (GE14). It highlights promises made by political parties during the election and expresses scepticism and frustration when those promises are not fulfilled. The tweet criticises the current government administration's handling of prices, natural disasters, and daily affairs. It reflects public scrutiny and expectations regarding government actions and their impact on daily life. Socioeconomic challenges such as the cost of living, minimum wage, and rising prices of goods are also mentioned in the tweet. Other than that, the increase in vegetable prices and its impact on lower-income individuals are specifically highlighted. These issues have significant implications for Malaysians' quality of life and financial well-being. The word cloud analysis in Figure 12 represents the categories of tweet content analysis from 2019 to 2021, capturing the key topics and themes discussed on Twitter during that period.

Conclusions

The analysis of Twitter data in the context of Malaysia reveals distinct spatial patterns of tweet distribution across different regions. The West coast of the Malaysian Peninsular, including states like Perlis, Pulau Pinang, Kedah, Perak, Selangor, Negeri Sembilan, Melaka, and Johor, stands out with a significant concentration of tweets, followed by the East coast states of Terengganu, Pahang, and Kelantan. In contrast, the Bornean states of Sabah and Sarawak show a relatively lower concentration of tweets.

Figure 12: The word cloud of tweets from 2019-2021

Notably, states like Selangor, Johor, Putrajaya, Kuala Lumpur, and Perak emerge as the top contributors to tweets discussing the cost of living, largely due to substantial urbanisation and limited available land for agriculture in these regions. Rapid urban growth driven by economic, social, and political factors has led to concerns about food security and the cost of living. High demand for essential goods, limited supplies, and elevated expenses in urban areas have negatively impacted residents' quality of life. Conversely, rural areas in Malaysia, with their abundant natural resources, enjoy better food accessibility.

The analysis also provides insights into the accessibility of natural resources, internet connectivity, and technological literacy, with developed cities like Kuala Lumpur, Selangor, and Putrajaya facing challenges related to limited resources and high living costs.

The sentiment analysis of Twitter data reveals a predominance of negative sentiments, especially during the early morning hours, with discussions primarily focusing on the cost of living, government policies, and food prices. Consequently, these discussions express frustration and anger towards the sudden increase in food prices and criticise the government's perceived incompetence in securing food supplies.

Visualising sentiment distribution highlights that negative sentiments are concentrated in developed cities known for their high cost of living, while positive and neutral sentiments prevail in suburban and less developed areas. This visualisation underscores the importance of utilising social media data in spatial analysis for social awareness and effective dialogue.

Overall, the tweet dataset offers valuable insights into the current public discourse in Malaysia, aiding in public policy decisions, understanding public opinion, monitoring trends, and facilitating research across various fields. It serves as a critical resource for making informed decisions, addressing societal concerns, and striving for an improved quality of life.

Conflict of Interest Statement

The authors declare that they have no conflict of interest.

Acknowledgements

The authors would like to express their heartfelt gratitude to all who have made this study possible. Special recognition is due to the UTM Quick Win Research Grant team (R.J130000.7752.4J555) for their invaluable support and expert guidance throughout the study.

References

Abdullah, R. G., Mersat, N. I., & Wong, S. K. (2021). Implications of COVID-19 pandemic on household food security: Experience from Sarawak, Malaysia. *International Journal of Business and Society*, *22*(1), 1-13. https://doi.org/10.33736/IJBS.3159.2021

Agustiningsih, K. K., Utami, E., & Al Fatta, H. (2021). Sentiment analysis of COVID-19 vaccine on Twitter social media: Systematic literature review. *2021 IEEE 5th International Conference on Information Technology, Information Systems and Electrical Engineering (ICITISEE)*, 121-126. https://doi.org/10.1109/ICITISEE53823.2021.9655960

Alam, M. M., Siwar, C., Wahid, A. N. M., & Talib, B. A. (2016). Food security and low-income households in the Malaysian East Coast economic region: An empirical analysis. *Review of Urban and Regional Development Studies*, *28*(1), 2-15. https://doi.org/10.1111/rurd.12042

Aldaz, K. J., Flores, S. O., Ortiz, R. M., Rios, L. K. D., & Dhillon, J. (2022). A cross-sectional analysis of food perceptions, food preferences, diet quality, and health in a food desert campus. *Nutrients*, *14*(24). https://doi.org/10.3390/nu14245215

Ali, R., & Rahim, H. (2019). *Food Security and Sustainability: Malaysia Agenda Relationship*

between Motivational Dimensions towards Intention to Purchase Green Food Products in Malaysia View project Resource Management and Conservation Options of Tasek Bera Wetland Pahang Malaysia Vie. https://www.researchgate.net/publication/342276962

Amirul, A. S. M., & Saudi, N. (2022). The impact of government response to the pandemic COVID-19 on vegetable prices in Malaysia. *Business*.

Anto, T. (2018). Diet changes lives. *JOJ Nursing & Health Care*, *7*(5), 1-2.

Bala, B. K., Arshad, F. M., & Noh, K. M. (2017). *Modelling of Food Security in Malaysia* (pp. 199-216). https://doi.org/10.1007/978-981-10-2045-2_10

Darhak, R. A., & Masdek, N. R. N. M. (2023). Trade liberalization in ASEAN and its impact on Malaysia's food security. *FFTC E-Journal*, *15*. https://ap.fftc.org.tw/article/3397

Department of Statistics Malaysia. (2021a). *Labour Force Survey Report, Malaysia 2020*. shorturl.at/hBHV5

Department of Statistics Malaysia. (2021b). *Supply and Utilization Accounts Selected Agricultural Commodities, Malaysia 2016-2020*. DOSM.

Department of Statistics Malaysia. (2022). *Launching of Report on The Key Findings Population and Housing Census of Malaysia 2020*. Department of Statistics Malaysia. https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=117&bul_id=akliVWdIa2g3Y2VubTVSMkxmYXp1UT09&menu_id=L0pheU43NWJwRWVSZklWdzQ4TlhUUT09

Erlingsson, C., & Brysiewicz, P. (2017). A hands-on guide to doing content analysis. *African Journal of Emergency Medicine*. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6234169/pdf/main.pdf

Geetha, C., Mohidin, R., Chandran, V. V., Karim, M. R. A., & Jundam, R. (2015). An empirical analysis of the determinant of food price inflation in Malaysia. *International Journal of Arts and Sciences*, *8*(5), 227-238. http://www.universitypublications.net/ijas/0805/pdf/H5V332.pdf

Getis, A., & Ord, J. K. (2010). The analysis of spatial association by use of distance statistics. In L. Anselin & S. J. Rey (Eds.), *Perspectives on Spatial Data Analysis* (pp. 127-145). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-01976-0_10

Grigore, M. (2021). *Scraping historical tweets without Twitter API*. https://www.kaggle.com/code/mishki/scraping-historical-tweets-without-twitter-api

Grima, N., Corcoran, W., Hill-James, C., Langton, B., Sommer, H., & Fisher, B. (2020). The importance of urban natural areas and urban ecosystem services during the COVID-19 pandemic. *PLOS ONE*, *15*(12 December). https://doi.org/10.1371/journal.pone.0243344

Ibrahim, A. Z., & Othman, Z. (2020). COVID-19: Coping strategies among B40 households in Malaysia to achieve food security during movement control order (MCO). In *European Journal of Molecular & Clinical Medicine* (Vol. 7, Issue 06).

Ji, Y., Gong, Y., Peng, Y., Ni, C., Sun, P., Pan, D., Ma, B., & Li, X. (2023). *Exploring ChatGPT's Ability to Rank Content: A Preliminary Study on Consistency with Human Preferences* (p. ArXiv ID: cs.CL/2303.07610).

Jiao, W., Wang, W., Huang, J., Wang, X., & Tu, Z. (2023). *Is ChatGPT A Good Translator? Yes With GPT-4 As The Engine*.

Kiritchenko, S., & Mohammad, S. M. (2016). Capturing reliable fine-grained sentiment associations by crowdsourcing and best–worst scaling. *Proceedings of the 2016 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies*, 811-817. https://doi.org/10.18653/v1/N16-1095

Kulkarni, M., & Bhalerao, V. (2021). Impact analysis of developed information package for consumers. *International Journal of Current Microbiology and Applied Sciences*, *10*(2), 358-366.

Lee, H., Noh, E. B., Choi, S. H., Zhao, B., & Nam, E. W. (2020). Determining public opinion of the COVID-19 pandemic in South Korea and Japan: Social network mining on Twitter. *Healthcare Informatics Research*, *26*(4), 335-343. https://doi.org/10.4258/hir.2020.26.4.335

Marzuki, A., & Jais, A. S. (2020). Urbanisation and the concerns for food security in Malaysia. *Planning Malaysia*, *18*(3), 202-217. https://doi.org/10.21837/PM.V18I13.786

Md Ibharim, L. F., & Salim, S. A. (2020). The framework of urban farming towards enhancing quality of life in Malaysia. *International Journal of Supply Chain Management*, *9*(1), 520-526.

Mirtaheri, S. M., Dinçtürk, M. E., Hooshmand, S., von Bochmann, G., Jourdan, G. V., & Onut, I.-V. (2014). A brief history of web crawlers. *CoRR*, *abs/1405.0*. http://arxiv.org/abs/1405.0749

Mouloudj, K., Ahmed Chemseddine, B., & Fechit, H. (2020). The impact of Covid-19 pandemic on Food Security Hamid Fechit. *Les Cahiers Du Cread*, *36*(03). https://doi.org/10.6084/m9.figshare.13991939.v1

Murdad, R., Muhiddin, M., Osman, W. H., Tajidin, N. E., Haida, Z., Awang, A., & Jalloh, M. B. (2022). Ensuring urban food security in Malaysia during the COVID-19 pandemic—Is urban farming the answer? A review. *Sustainability (Switzerland)*, *14*(7). https://doi.org/10.3390/su14074155

Norazman, U. Z., Khalid, H., & Ghani, G. (2016). Identifying key drivers of food price inflation in Malaysia. *Persidangan Kebangsaan Ekonomi Malaysia Ke 11, Putrajaya*. http://irep.iium.edu.my/51485/

Norazman, U. Z., Khalid, H., & Ghani, G. (2018). Food inflation: A study on key determinants and price transmission processes for Malaysia. *International Journal of Business and Society*, *19*(1), 117-138. http://www.ijbs.unimas.my/images/repository/pdf/Vol19-no1-paper9.pdf

Omidi-Najafabadi, F. N.-A. F. L. S. M. M. (2023). Modelling factors that influence food security among wheat farmers. *Journal of Sustainability Science and Management*, *18*(4), 152-165. https://jssm.umt.edu.my/wp-content/uploads/sites/51/2023/05/JSSM-Volume-18-Number-4-April-2023-11-Draf-2.pdf

Önden, İ., Eldemir, F., & Çancı, M. (2014). Clustering logistics facilities in a metropolitan area via a hot-spot analysis. *Journal of Business Research-Türk*, 6-15. https://www.isarder.org/isardercom/2014vol6issue4/vol.6_issue.4_article01_full_text.pdf

Paul, B. (2013). *Food Security in Malaysia: Challenges and Opportunities for Malaysia of Present and in 2050*. https://doi.org/10.13140/2.1.2707.7923

Ramanayake, S. S., & Lee, K. (2015). Does openness lead to sustained economic growth versus other variables as determinants of Economic Growth? *Journal of the Asia Pacific Economy*, *20*, 345-368. https://doi.org/10.1080/13547860.2015.1054164

Read, J., & Carroll, J. (2009). Weakly supervised techniques for domain-independent sentiment classification. *Proceedings of the 1st International CIKM Workshop on Topic-Sentiment Analysis for Mass Opinion*, 45-52. https://doi.org/10.1145/1651461.1651470

Rusli, N., Nordin, N. Z., Ak Matusin, A. M. R., Yusof, J. N., Rosley, M. S. F., Ling, G. H. T., Mohd Hussain, M. H., & Abu Bakar, S. Z. (2023). Geospatial mapping of suicide-related tweets and sentiments among Malaysians during the COVID-19 pandemic. *Big Data and Cognitive*

Computing, *7*(2). https://doi.org/10.3390/bdcc7020063

Sahiq, A. N. M., Sukardi, S. N., Haron, N. H., Ismail, S., & Othman, R. (2018). Macroeconomic determinants and Mortgage Debt Accumulation: Evidence from Malaysia. *International Journal of Academic Research in Business and Social Sciences*, *8*(11), 97-113. https://doi.org/10.6007/IJARBSS/v8-i11/4708

Salim, S. (2022). *Malaysia posts the highest quarterly trade, export, and import values — DOSM*. https://theedgemalaysia.com/article/malaysia-posts-highest-quarterly-trade-export-import-values-does

Sharifulden, N. S. A. N. (2022). The looming global food crisis: An overview. *Khazanah Research Institution*, *25*.

Shukor, M. M. (2020). Evolution of migration for urban and rural.

Sokolova, M., & Lapalme, G. (2009). A systematic analysis of performance measures for classification tasks. *Inf. Process. Manag.*, *45*, 427-437. https://doi.org/10.1016/j.ipm.2009.03.002

Stieglitz, S., Mirbabaie, M., Ross, B., & Neuberger, C. (2018). Social media analytics – Challenges in topic discovery, data collection, and data preparation. *International Journal of Information Management*, *39*, 156-168. https://doi.org/https://doi.org/10.1016/j.ijinfomgt.2017.12.002

Sulaiman, N. F. C., Sanusi, N. A., & Muhamada, S. (2019). Survey dataset of Malaysian perception on the rising cost of living. *Data Brief.* https://doi.org/10.1016/j.dib.2019.104910

Tan, S. T., Tan, C. X., & Tan, S. S. (2022). Food security during the COVID-19 home confinement: A cross-sectional study focusing on adults in Malaysia. *Human Nutrition and Metabolism*, *27*. https://doi.org/10.1016/j.hnm.2022.200142

Tapia, C., Randall, L., Wang, S., & Aguiar Borges, L. (2021). Monitoring the contribution of urban agriculture to urban sustainability: An indicator-based framework. *Sustainable Cities and Society*, *74*. https://doi.org/10.1016/j.scs.2021.103130

Tausczik, Y. R., & Pennebaker, J. W. (2010). The psychological meaning of words: LIWC and computerized text analysis methods. *Journal of Language and Social Psychology*, *29*(1), 24-54. https://doi.org/10.1177/0261927X09351676

United Nation. (2021). *The world population is projected to reach 9.8 billion in 2050, and 11.2 billion in 2100*. https://www.un.org/en/desa/world-population-projected-reach-98-billion-2050-and-112-billion-2100#:~:text=COVID-19-,World population projected to reach 9.8 billion in 2050%2C and, Nations report being launched today.

West, C. G. (2023). *AI and the FCI: Can ChatGPT Project an Understanding of Introductory Physics?*

Williams, M. L., Burnap, P., & Sloan, L. (2017). Towards an ethical framework for publishing Twitter data in social research: Taking into account users' views, online context and algorithmic estimation. *Sociology*, *51*(6), 1149-1168. https://doi.org/10.1177/0038038517708140

Zhuo, T. Y., Huang, Y., Chen, C., & Xing, Z. (2023). *Exploring AI Ethics of ChatGPT: A Diagnostic Analysis*.

Zurek, M., Hebinck, A., Leip, A., Vervoort, J., Kuiper, M., Garrone, M., Havlík, P., Heckelei, T., Hornborg, S., Ingram, J., Kuijsten, A., Shutes, L., Geleijnse, J. M., Terluin, I., van't Veer, P., Wijnands, J., Zimmermann, A., & Achterbosch, T. (2018). Assessing sustainable food and nutrition security of the EU food system integrated approach. *Sustainability (Switzerland)*, *10*(11). https://doi.org/10.3390/su10114271