ENGAGEMENT TOWARDS CLIMATE CHANGE ADAPTATION: A SYSTEMATIC REVIEW

ADAWIYAH, R. B.[1*] – ZAINI, S.[1] – JALALUDDIN, A. M.[1] – AZLAN, A.[1]

[1] *Faculty of Social Science and Humanity, The National University of Malaysia, Selangor, Malaysia.*

**Corresponding author*
e-mail: p97539[at]siswa.ukm.edu.my

(Received 26th March 2021; accepted 15th May 2021)

Abstract. Various adaptation and mitigation studies have been conducted on climate change issues. Nevertheless, studies on the engagement of climate change adaptation have been well-received due to the inconsistent themes used in the studies. Therefore, this study aimed to obtain research scenarios related to the engagement towards the adaptation of climate change. The SCOPUS database was used to collect the data. A systematic literature review (N = 14) was performed, focusing on the inclusion criteria and findings related to climate change adaptation. The evidence showed that perception, understanding, behavior, awareness, experience, motivation, intention, knowledge, and attitude were involved to show engagement in climate change adaptation. The results of the analysis also showed that relevant research was critical to aid policymakers, and an increase of knowledge in the field of research. An appropriate method for future studies is to combine quantitative and qualitative methods. Therefore, it can be concluded that this study can help researchers to further develop future studies by identifying the contribution of knowledge and gaps in past studies.
Keywords: *climate change, adaptation, engagement, systematic literature review*

Introduction

The topic of climate change has become a global issue due to its impacts on the world's population. Despite of the worsening situations, the issues of climate change are increasingly debated because they can be misinterpreted. At the international level, it has been accepted that climate change is a severe threat to human sustainability and environmental integrity (IPCC, 2007). Global climate change is one of the challenges that society needs to face in the present and future (Arbuckle et al., 2015; Hassan et al., 2018). Based on many studies on this issue, scholars have scientifically proven that climate change events are resulted from anthropogenic activities. According to the International Panel of Climate Change (IPCC) report, air temperatures have risen around 0.78◦C (0.72 to 0.85) worldwide since 1900, with a greater trend gradient in the recent decades (Stocker et al., 2013). Daud et al. (2015) reported that greenhouse gas (GHG) emitted by fossil fuel consumption, and land-use changes related to agriculture, logging, and land expansion for development purposes contributed to global warming. Climate change caused by human activities has changed the frequency, distribution and intensity of rainwater rainfall, resulting in increased frequency and intensity of floods and droughts, as well as adversely affecting humans and the environment (Asadieh and Works, 2015).

To address the global climate change issues, an organization has been established, namely The Intergovernmental Panel on Climate Change (IPCC), which is an organization jointly developed by the United Nations Environment Program (UNEP) (IPCC, 2014) and the World Meteorological Organization (WMO). The purpose of this

intergovernmental organization is to assess the causes and effects of climate change, and propose more effective measures to address the challenges of climate change, generating reports every five years. In the global development planning, Sustainable Development Goals (SDGs) have been created as an agenda towards a sustainable country. One of the goals to be achieved is to mitigate climate change. In addressing climate change, the renewable energy, food, health, and water require global monitoring and modeling coordinated with many social, economic, and environmental factors (Owusu and Asumadu-Sarkodie, 2016).

The challenge to create a united nation based on the SDGs is the ability to create equality and social justice such as on biodiversity, ecosystems, and the environment, and they need to be addressed as "whole individuals" (Ravera et al., 2016). Based on the United Nations Framework Convention on Climate Change (UNFCCC), five key aspects have been outlined to address climate change issues: adaptation, mitigation, finance, technology transfer and technological capacity development, and human resources (Rahman, 2018). The IPCC has indeed demonstrated science-based leadership in the field of climate change. However, the IPCC is not a real actor at the climate change stage, but only an assistant. It cannot simply combat climate change without active players, such as national and local governments, and the general public (Jung, 2019). While the awareness on the consequences and disadvantages of climate change is growing among social, economic, and political paradigms, the ability of citizens to influence the direction of climate change in the future is still disputed (Brooks et al., 2009; Manuel-Navarrete, 2010).

Daud et al. (2015) have asserted that the dissemination of knowledge and awareness to the general public is recently a concern raised by many parties, especially those directly involved in scientific studies on climate change. Rahman (2018) has corroborated that the immediate and important action needed to reduce the effects of climate change is to actively involve the public. Saad et al. (2018) stated that Asian countries were among the less focused and supportive countries towards the issue of climate change. One study revealed that increasing number of people in Southern Alberta were worried about climate change, but they did not know what actions to take (Environics Research Group, 2015). Therefore, a question remains: what is the theme used in the study about the actions and engagement of individuals with regards to climate change? Consequently, the purpose of this study was to analyze the factors of individual engagement towards climate change adaptation. The first aspect of the study searched the literature, focusing on classifying the best possible solutions under different scenarios projected from the current situation. We mapped the literature to understand lessons from the past and discussed the possible future scenarios.

Materials and Methods

A systematic review (SR) is an important tool to filter and analyze a lot of researches (Flood et al., 2018). This study used the PRISM framework to obtain past research data (*Figure 1*). Using this procedure, 187 articles were identified through systematic database searches between 2006 and 2020. The SCOPUS database were searched using the following keywords: climate change adaptation, and engagement. Filtered articles were revised and open access articles published in English. This review discussed 14 studies from 13 journals published between 2013 and 2020 (*Table 1*).

Table 1. *Overview of all included studies.*

Authors	Year	Country	Method	Subject area	Sample	Citation
Saptutyningsih, Diswandi, & Jaung.	2020	Indonesia	Quantitative	Farmers' willingness to participate in the process of climate change adaptation.	Farm households, n = 286	7
Terorotua, Duvat, Maspataud, & Ouriqua.	2020	French Polynesia	Qualitative	Perception of public authorities and designing coastal climate services toward climate change adaptation.	Administrative divisions directly or indirectly involved in climate change issues, and a workshop dedicated to discussing needs in terms of CCS, n=23	
Wamsler, Alkan-Olsson, Björn, Falck, Hanson, Oskarsson, Simonsson, & Zelmerlow.	2020	Sweden	Qualitative	Citizen engagement in nature-based solutions and climate change adaptation.	Case-specific workshops, n=7, Field visits to the case study areas, n=5, Municipal staff, n= 12.	1
Harcourt, Bruine de Bruin, Dessai, & Taylor.	2019	United Kingdom	Qualitative	Individuals interpretation toward impacts and adaptation with a diverse set of climate change views	The initial set of interviews, n = 15 The second set, n = 7	
Mitter, Larcher, Schönhart, Stöttinger, & Schmid.	2019	Austria	Qualitative	Farmer perception and adaptation toward climate change	Farmers, n = 29	10
Lorencová, Loučková, & Vačkářů.	2019	Czech Republic	Quantitative	Individual Perception of Climate Change Risk and Adaptation	Czech general citizen (aged 18–65), n = 1024	1
Brink & Wamsler.	2019	sweden	Quantitative	Citizen engagement in climate adaptation	Household, n = 600	9
Robinson, Bardsley, Raymond, Underwood,	2018	Australia	Mix method	Farmer Adapting to Climate Change	Interviews Farmers, n = 30 Focus groups farm advisors, n = 50 Household, n = 797	2
Buckley, Pinnegar, Painting, Terry, Chilvers, Lorenzoni, Gelcich, & Duarte.	2017	Pan-European	Quantitative	European Citizens levels of awareness, concern, and trust towards climate change.	European citizens in 10 countries, n = 10,000	9
Cvitanovic, Crimp, Fleming, Bell,	2016	Pacific Island	Qualitative	Impediments engagement of Pacific Island communities toward adaptations needed to safeguard	Participant, n = 24	21

Howden, Hobday, Taylor, & Cunningham.				food security.	Logistical constraints, n = 16	
Arbuckle, Hobbs, Loy, Morton, Prokopy, & Tyndall.	2014	US	Quantitative	Understanding Corn Belt farmer perspectives and engagement toward adaptation and mitigation on climate change	Farmers US Corn Belt, n = 4,778	41
Ortega-Egea, García-de-Frutos, & Antolín-López.	2014	Croatia, Turkey, Macedonia and Turkish Cypriot.	Quantitative	European Citizen behavior in response to climate change	Participant, n = 30,170	32
Knapp, Stuart Chapin, Kofinas, Fresco, Carothers, & Craver.	2014	USA	Quantitative	Multistakeholder engagement in adaptation toward climate change	Community members, N=39, Tour bus drivers, n = 8, NPS employees/scientists, n = 18	13
Opondo.	2013	Kenya	Mix method	Local perceptions, experience and adaptation towards floods event.	Household N = 400. Three focus group discussions: n = 25 women, men and youth, In-depth interviews household: n = 4	16

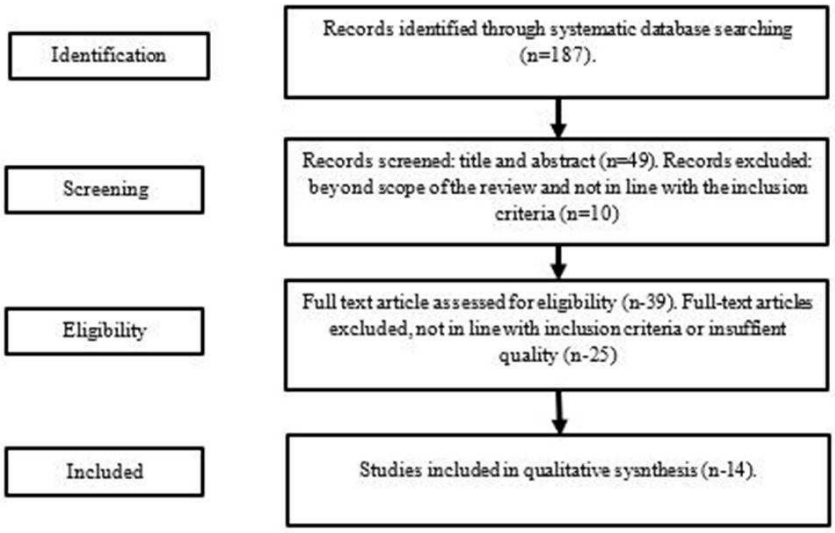

Figure 1. *PRISMA flowchart of article search.*

Results and Discussion

Descriptive analysis

The entire study is described in *Table 1*. In most articles, the method used was quantitative method with seven articles, followed by qualitative method with five articles and mixed-method with two articles. Due to the limitation on the conducted research, each study focused on a specific scope. Overall, there were researchers who studied engagement towards climate change adaptation among farmers (Saptutyningsih et al., 2020; Mitter et al., 2019; Hernandez et al., 2018; Cvitanovic et al., 2016). In addition to that, there were other study samples, such as public, community, or citizens in an area (Terorotua et al., 2020; Wamsler et al., 2020; Brink and Wamsler, 2019; Harcourt et al., 2019; Lorencová et al., 2019; Buckley et al., 2017; Arbuckle et al., 2014; Knapp et al., 2014) and stakeholders involved in addressing climate change issues (Ortega-Egea et al., 2014).

All studies were characterized by the research method. Therefore, the diversity of the total sample or population for all studies could be observed. Studies using quantitative methods showed the number of samples between 30 and 286 while studies that used qualitative methods showed a sample between 22 and 40. The impact of the study produced can be seen through the citations by other researchers. Therefore, based on the overall study reviewed, Cvitanovic et al. (2016) had the highest number of citations of 41, followed by Arbuckle et al. (2014) with 32 citations and Buckley et al. (2017) with 21 citations. There were two studies that showed citations between 11 and 20 citations, seven studies between one and ten citations, and two studies that have not cited by other researchers. However, this citation was only recorded until the date when the database was extracted from the SCOPUS web: October 24, 2020.

Thematic overview

Table 2 shows the thematic overview of the perceived outcomes of engagement towards climate change adaptation. This description would elaborate on the domains and themes used by all researchers to study this issue. Based on the review, three

domains were used by the researchers: climate change risk, adaptation, and mitigation. It has been stated that studies on climate change issues outlined in the UNFCCC involve adaptation and mitigation studies. The study on the engagement towards climate change adaptation showed that many themes were used to understand and measure the domain of the study. In the domain of adaptation, several themes were identified: engagement, perception, understanding, behavior, interpretation, awareness, concern, trust or belief, experience, willingness, motivation, intention, knowledge, and altitude.

Table 2. *Thematic overview of the perceived outcomes of engaging climate change adaptation.*

Domain	Theme	Authors
Adaptation	Engagement	Saptutyningsih, Diswandi, & Jaung (2020); Wamsler et al (2020); Brink & Wamsler (2019); Mitter et al (2019); Cvitanovic et al (2016); Arbuckle et al (2014); Knapp et al (2014); Opondo (2013)
	Perception	Terorotua et al (2020); Mitter et al (2019); Lorencová, Loučková, & Vačkářů (2019); Opondo (2013)
	Understanding	Arbuckle et al (2014)
	Behaviour	Ortega-Egea, García-de-Frutos, & Antolín-López. (2014)
	Interpretation	Harcourt et al (2019)
	Awareness	Buckley et al (2017)
	Concern	Buckley et al (2017)
	Trust/Belief	Robinson et al (2018); Lorencová, Loučková, & Vačkářů (2019)
	Experiance	Harcourt et al (2019); Lorencová, Loučková, & Vačkářů (2019); Robinson et al (2018); Opondo (2013)
	Willingness	Saptutyningsih, Diswandi, & Jaung (2020)
	Motivation	Brink & Wamsler (2019); Ortega-Egea, García-de-Frutos, & Antolín-López (2014)
	Intention	Mitter et al (2019)
	Knowledge	Robinson et al (2018); Cvitanovic et al (2016); Ortega-Egea, García-de-Frutos, & Antolín-López. (2014)
	Attitude	Ortega-Egea, García-de-Frutos, & Antolín-López. (2014)
	Understanding	Ortega-Egea, García-de-Frutos, & Antolín-López. (2014)
Mitigation	Engagement	Arbuckle et al (2014)
	Behaviour	Ortega-Egea, García-de-Frutos, & Antolín-López. (2014)
Climate change risk	Perception	Lorencová, Loučková, & Vačkářů (2019)

Eight articles used the engagement theme to study climate change adaptation. In engagement theme, there were several indicators that calculated the level of the theme, including observations of change, impacts on people's lives, potential adaptations (Opondo, 2013); barriers to community engagement, the importance of trust (Arbuckle et al., 2014); general perceptions, awareness and concern, awareness of magnitude and

rates of change, information sources and trust, policy actions (Cvitanovic et al., 2016); adaptation actions, motivation for future adaptation, hazard experience, public support, beliefs, values, emotions (Brink and Wamsler, 2019); adaptation intentions, appraise adaptation, integrative adaptors (Mitter et al., 2019); citizen involvement versus sustainability outcomes, drivers and barriers (Wamsler et al., 2020); and social capital and technology adoption in response to climate change (Saptutyningsih et al., 2020). Overall, the indicator of engagement theme has also used the theme for adaptation.

In the domain of mitigation, there were understanding, engagement, and behavior themes while the climate change risk domain had a perception theme. Based on the theme of behavior, the indicators used by researchers were climate change belief, experienced hazard, perceived risk, and efficacy (Ortega-Egea et al., 2014). The theme of perception for climate change risk also had indicators, such as general attitudes towards climate change, the role of gender, previous experience with extreme events, and adaptation and mitigation actions (Lorencová et al., 2019). The study of perceptions in climate change risk is more about measuring risk perception.

Contribution of knowledge and gap/future research from article

The contribution of knowledge was focused on the major findings in the selected articles, indicating that the study has successfully demonstrated the relationship between the selected study themes. Meanwhile, the gap discussed suggestions made by the researchers to improve the studies related to engagement towards climate change adaptation. *Table 3* shows the contribution of knowledge and gap from the selected articles.

Table 3. *Contribution of knowledge and gap from article.*

Authors	Major finding	Gap/future research
Saptutyningsih, Diswandi, & Jaung (2020)	1. Participation showed a significant relationship between high social capital, consisting of high trust, community involvement, and personal relationships with people in other villages.	1. Future research needs to examine the role of social capital on farmers' support to adapt to climate change elsewhere in Indonesia, as well as other countries as the results may differ in different social and cultural contexts.
Terorotua et al (2020)	1. Respondents did not identify climate change as a current major issue in French Polynesia; they showed greater concern for economic growth, pollution, land acquisition, and land use planning. 2. However, they were concerned about the impact of rising sea levels, warming and acidification of the sea in the future, citing its adverse effects on marine ecosystems, coastal position, economy (especially agriculture and blue economy), and freshwater resources.	1. Disaster risk perceptions in Oceania indicate a gap between the perceptions of risk and the actual risk being measured. 2. It is recommended to focus on bottom-up and educational approaches, which can be done with strong political will and good governance practices.
Wamsler et al (2020)	1. The results of the interviews showen that in the current situation, the involvement of citizens often hindersed sustainable results. 2. Current structures and mechanisms to prioritize environmental and climate considerations into sectoral planning were limited and, further, neglected citizen involvement. In addition, there was a blind spot with respect to personal transformation space towards sustainability regarding citizens, state officials, and decision makers.	1. Seeking environmental-related solutions to improve governance of climate adaptation, we need targeted human and human resources, and greater capacity to overcome current constraints and support all stages and phases of mainstream, especially planning, implementation, monitoring, and learning.
Harcourt et al (2019)	1. Those interviewed expressed a lack of clarity about the expected impact of climate change, which did not prevent them from saying that they were already experiencing the effects of climate change. Furthermore, threats to cultural norms and values were considered serious and emotional. Adaptation was often combined with mitigation, and the responsibility to adapt was often disputed.	1. Future research should provide a more comprehensive study of how impact and adaptation are narrated in all sectors of general discourse
Mitter et al	1. Adaptation intentions are formed only if farmers knew	1. Questionnaires should be designed to include

(2019)	the effective adaptation measures, accepted personal responsibility for their farms, and evaluated the costs of adaptation positively (i.e. adaptation evaluation). Farmers 'climate change assessments as well as farm and regional characteristics were also considered relevant to farmers' adaptation decisions but did not appear to be less important than adaptation assessments.	cognitive elements as well as socio-environmental context factors as expressed by our results, e.g. belief in climate change, perceptions of climate change as risks or opportunities, knowledge and evaluation of adaptive measures and self-responsibility.
Lorencová, Loučková, & Vačkářů (2019)	1. Respondents with previous experience with extreme weather events were more likely to perform adaptive and mitigation actions than inexperienced respondents.	1. Further research is needed to explore the relationship between the types and intensities of extreme weather event experiences and their impact on climate change beliefs, concerns and readiness to adapt.
Brink & Wamsler (2019)	1. Although high levels of citizen action were often associated with past dangerous experiences, the motivation to adapt went beyond the idea of acting out of rational self-interest.	1. This study supports the development of theories linking climate change adaptation to risk, environmental and behavioral studies (e.g., for what theories drive people's motivation and actions).
Robinson et al (2017)	1. Actions taken by individuals to reduce and / or adapt to climate change were related to the nature of the environmental values held (or ecological worldview) and the places involved. 2. Individuals who had a strong place attachment to the study area (Adelaide Hills), and who had knowledge and / or belief in climate change would most likely take action to reduce it. This was also linked to previous major forest fire risk experiences.	-
Buckley et al (2016)	1. European citizens living near the coast were more concerned and informed about the problem of marine climate change, compared to those living in the village. 2. Women were more concerned - but expressed themselves less knowledgeable than men. 3. Concerns with trust increased with increasing age. 4. Eighteen to twenty-four-year olds were the biggest users of the internet, movies and social networking sites as a source of information but usually tended not to trust these sources.	-
Cvitanovic et al (2014)	1. Key barriers included cultural differences between western science and cultural knowledge, lack of trust among local communities and outside scientists, inappropriate governance structures, and lack of political and technical support. We identified the importance of adaptive science, local social networks, key actors (i.e. influential and trusted individuals), and relevant forms of knowledge exchange as important to overcome these barriers.	-
Arbuckle et al (2014)	1. Strategies with specific reference to climate change might be most effective in involving subpopulation of farmers who believed climate change was occurring and threatening, but the use of cost-free terms such as weather variability was likely to be more effective with wider farmers. 2. Using terms such as "weather variability" instead of more burdensome terms such as "climate change" was more likely to be effective with a wider audience of farmers.	1. Involving farmers in creative adaptation with their experience (e.g., increased weather variability) rather than its cause (climate change) would be a more effective path to resilience.
Ortega-Egea, García-de-Frutos, & Antolín-López (2014)	1. Regression analysis highlighteds the importance of environmental psychography (i.e., attitudes, motivation, and knowledge of climate change) and socio-demographics (especially national-level variables) in understanding additional mitigation behaviors. 2. By looking at data through segmentation lenses, significant heterogeneity was found in the relationship of attitudes and knowledge of climate change - but not in motivational or socio-demographic relationships - with additional mitigation behaviors in response to climate change, in two groups of active respondents from the environment	1. National and regional heterogeneity in environmental policy and legislation also tends to take into account national differences in community mitigation behavior. Multi-level analysis seems to be best suited for environmental research questions involving variables from different levels - for example, the influence of individual and national levels on climate-motivated behavior.
Knapp et al (2014)	1. These findings suggested that involving various stakeholder groups interacting with the park in different ways addeds a lot of information provided by Denali staff and scientists and offereds a broader basis for adaptation planning. This also suggesteds that the paradigm of traditional protected areas failing to learn	-

	and encouraging the involvement of appropriate people may not be appropriate in the context of climate change.	
Opondo (2013)	1. Periodic river floods have a devastating social and economic impact on poor households in Kenya's low and western coastal areas. The results showed that many coping measures used by people could erode, as they had a negative long-term effect on the sustainability of household life.	-

From the overall results of the study, the article reviewed reported that the engagement between study subjects (farmer/household/public/citizen) and climate change adaptation (including climate risk/environment/flood) showed various significant relationships between study themes. Among those that influenced study subjects to adapt to climate change were belief in the existence of climate change (Saptutyningsih et al., 2020); adaptive intentions that were formed when there was knowledge of climate change (Mitter et al., 2019), experience on the risks/impacts of climate change that helped study subjects to better adapt (Wamsler et al., 2020; Harcourt et al., 2019; Lorencová et al., 2019; Robinson et al., 2018; Buckley et al., 2017; Knapp et al., 2014); and clear knowledge of the impact of climate change that prompted study subjects to adapt to climate change (Cvitanovic et al., 2016; Arbuckle et al., 2014; Ortega-Egea et al., 2014).

Of all the reviewed articles, only eight articles clearly provided future research suggestions and explained the gap in their study. The proposed future research related to the engagement towards climate change is as stated by Terorotua et al. (2020) in a study that focuses on bottom-up approach and education. Further studies need to be done at all levels because different levels of knowledge, experience and others are different in each area (Saptutyningsih et al., 2020; Wamsler et al., 2020; Harcourt et al., 2019; Ortega-Egea et al., 2014). Previous studies such as by Terorotua et al. (2020) explained that there was a gap between risk perception and actual measured risk. Brink and Wamsler (2019) supported the development of theories that linked climate change adaptation to risk, environmental and behavioral studies (for example, which theories influence people's motivation and actions) that can be applied to future studies.

This systematic literature review aimed to synthesize the available empirical studies on the individual/public/citizen engagement towards climate change adaptation and mitigation. It is undeniable that the challenge of creating a united nation based on the SDGs is the ability to create equality and social justice such as on biodiversity, ecosystems, and the environment, and they need to be addressed as “whole individuals” (Ravera et al., 2016). This study identified 14 publications that met the criteria for inclusion. Each of these publications studies the engagement of climate change adaptation. All these studies help us to better understand the use of domain and theme as a construct in such research.

Confuion of the use of terms adaptation and mitigation

These two domains, adaptation and mitigation, are among the ways to address the issue of climate change. However, the studies involving individual/public/citizen engagement normally includes adaptation. Under certain circumstances, people tend to engage in solving environmental-related problems such as climate adaptation (Wamsler et al., 2020). However, the two are interrelated because the government generally has two options in dealing with climate change by implementing both mitigation and adaptation policies. As explained by Klein et al. (2005), mitigation encompasses all

human activities aimed at reducing emissions or increasing the absorption of GHG such as carbon dioxide, methane, and nitric oxide. Adaptation in the context of climate change refers to adaptations that occur in the natural or human system in response to the effects of actual or expected climate change, aimed at reducing hazards or taking advantage of beneficial opportunities.

Confuion to indicate engagement toward climate change adaptation

The explained indicators showed that there was an indicator to the theme of engagement towards climate change adaptation. Therefore, the engagement indicator was inconsistent based on the indicators used, and the indicator might be used as a theme to measure climate change adaptation. Themes that could be identified together and had significant relationships in the context of the study on the engagement of climate change adaptation were;

Perception; knowledge; experience and altitude

The theme can be interpreted as people shaping their perceptions based on their personal experiences, knowledge, and character. However, the theme can also be an independent or dependent variable or construct. It depends on what they want to measure in their study. Terorotua et al. (2020), who studied perceptions observed that setting the status quo was an important stage in the process of implementing appropriate actions to adapt to climate change. Mitter et al. (2019) showed that there was a relationship between farmers' beliefs and perceptions of climate change, forming an assessment of risks and opportunities, possibly through a motivated reasoning process. Although the risks and perceptions of opportunities associated with climate change (i.e. climate change assessment) supported the formation of agricultural adaptation intentions, the empirical data showed that farmers' adaptation assessments strongly determined their intention to adapt to climate change. Lorencová et al. (2019) corroborated, proving the discovery of a strong relationship between perceptions of climate change and willingness to take individual action. Previous experience with extreme weather events also critically influences individual actions. Cvitanovic et al. (2016) explained that using social capital would help to ensure that scientific messages were tailored to society's perceptions and attitudes.

Understanding, awareness and experiance

Comprehension is nurtured by awareness, and awareness is achieved by increasing understanding. With the growing understanding of the importance of ecosystem services, there is increasing awareness of the interactions between social and ecological systems, and between humans and nature; and importance of ecosystem services as a component of the natural capital from which we ensure our well-being and build our wealth (Eyþórsdóttir, 2015; Costanza et al., 2014). Lorencová et al. (2019) also showed that understanding individual experience would be more sensitive to future risks and responsive to the implemented adaptation policies.

Behaviour, intention, understanding and motivation

Behavior as an organism's activity that can be observed or measured (Idris et al., 2019). Carlton et al. (2016) emphasized the importance of individual behavior: climate change cannot be effectively addressed without exploring its impacts on human well-being, the public perception, and the influential factors on mitigation and adaptive

behavior. Meanwhile, the Theory of Planned Behavior (TPB) explains intention as one of the constructs to behavior testing. Meanwhile, the Protection Motivation Theory (PMT) considers that the individuals' decisions to participate in a risk prevention behavior are based on their motivation to protect themselves from threats, such as natural disasters, global climate change, and nuclear explosions.

Therefore, researchers argue that behavior, intention, and motivation themes can be used together to test engagement towards climate change adaptation. Ortega-Egea et al. (2014) observed that heterogeneity in associations involved variables of attitudes and knowledge whereas homogeneity existed in motivational and socio-demographic relationships with additional mitigation behaviors. Wamsler et al. (2020) also support other studies that emphasize to provide a comprehensive understanding of the risks and systemic causes for alternative behaviors. Brink and Wamsler (2019) supported the development of theories linking climate change adaptation to risks, environmental studies, and motivational and action-driven behaviors.

Therefore, the use of themes depends on the aspects that need to be measured in a society or a study sample. However, this should be accompanied by research on the use of the research framework and research theory in order to help researchers better understand the constructs they want to measure in their study. This debate requires a more in-depth study, such as the relevance of the research theory used.

The importance of studies related to engagement toward climate change adaptation

Policy decision-makers

Based on the articles referenced, almost all studies showed the importance of research on the development and policymakers in the issue of climate change adaptation. For example, Terorotua et al. (2020) explained that the level of awareness among institutional actors in French Polynesia not only contributed knowledge in the study of climate change and its effects, but also played a role in addressing issues in increasing vulnerability of coastal zones. Consequently, the authorities are encouraged to provide guidelines to the local communities according to the conditions of the place. Lorencová et al. (2019) also demonstrated that their results could support decision-making on adaptation policy and individual adaptation actions as well as directing strategies to communicate climate change problems to society.

According to Brink and Wamsler (2019), community support and risk-sensitive communication of views and worldviews are essential to include, motivate and address different populations in adapting and supporting more collaborative risk governance. Buckley et al. (2017) asserted that younger participants tended to prioritize actions associated with reduced carbon emissions whereas older age groups tended to prioritize increased coastal defenses, demonstrating successful adaptive actions that provided knowledge of the effects of climate change and that required public involvement, and support for policy decisions. Cuthbertson et al. (2019) also supported by recommending a focus on bottom-up and educational approaches, which can be executed with a strong political will and good governance practices.

Contribution of knowledge in the research about engagement towards climate change adaptation

Previous studies are important to show the gaps between the studies that have been done. In the issue of engagement towards climate change adaptation, the results showed the development of knowledge produced by researchers. Cvitanovic et al. (2016)

reported that “gatekeeper” communities would be critical to disseminate key scientific messages across their social networks in ways that increase the likelihood of knowledge being received and used to leverage and build adaptability. Making field transformations require civil servants and decision makers to develop new capabilities (Wamsler et al., 2020). Reliable sources of information are crucial to transfer up-to-date and comprehensive information that drives actions in the climate change adaptation group (Mitter et al., 2019).

The final discussion is to focus on the appropriate methodology used in studies related to the engagement towards climate change adaption. Both quantitative and qualitative methods have their own advantages to answer the questions and objectives of the conducted studies. For example, based on the study by Mitter et al. (2019), in the Austrian farming community, the results of the qualitative analysis were highly relevant for farmers, agricultural experts and adapters, agricultural knowledge brokers, and policy makers and decision makers in Austria. Yet, in a scientific context, they argued that there was also a need for quantitative research. In fact, they agreed that if they were able to create a mixed method, standard quantitative surveys could be conducted to confirm the groups of farmers what they already knew and analyze their distribution in the total population of Austrian farmers.

Conclusion

In conclusion, the studies involving the engagement of climate change adaptation show that it is necessary to include social elements related to their experience and knowledge to find the direction for community involvement on climate change issues. The measured themes are able to help stakeholders or decision-makers to create guidelines or programs that can realize the willingness of the community or individual to adapt to climate change. This review shows the development of the themes used and scenarios portrayed in previous studies that discuss the engagement towards climate change adaptation. This review can be used as a reference for researchers to determine the appropriate theme for their study. In addition to that, this article shows the contribution of knowledge and gap based on the referenced articles. Based on the discussions, the research related to engagement towards climate change adaptation produced important results, such as policy maker decision and knowledge. Apart from that, the results of this SLR also indicated the need to mix quantitative and qualitative methods in related studies to compare approaches collectively.

Upcoming studies are proposed to clarify the research theories used by previous researchers in the issue of engagement towards climate change adaptation. In a recent survey, there was a need for researchers to make relevant studies of how societal enggagement towards climate change adaptation. Meanwhile, in conference the Rio Declaration in 1992 at the United Nations Conference on Environment and Development (UNCED) included the explicit purpose of community participation and involvement in climate action (Principle 10). The responsibility is given specifically to the Nation State to facilitate this by ensuring that the public has access to information and opportunities to participate in the decision -making process. Since then, there has been a need for communities to participate in responding to climate change (Hügel and Davies, 2020).

Acknowledgement

This research is self-funded.

Conflict of interest

There are no conflict of interest involve with any parties in this research study.

REFERENCES

[1] Arbuckle, J.G.J., Morton L.W., Hobbs, J. (2015): Understanding Farmer Perspectives on Climate Change Adaptation and Mitigation: The Roles of Trust in Sources of Climate Information, Climate Change Beliefs, and Perceived Risk. – Environment and Behavior 47(2): 205-234.

[2] Arbuckle, J.G., Hobbs, J., Loy, A., Morton, L.W., Prokopy, L.S., Tyndall, J. (2014): Understanding Corn Belt farmer perspectives on climate change to inform engagement strategies for adaptation and mitigation. – Journal of Soil and Water Conservation 69(6): 505-516.

[3] Asadieh, B., Works, A. (2015): Global trends in extreme precipitation: climate models versus observations Global trends in extreme precipitation. – Hydrology and Earth System Science 19(2): 877-891.

[4] Brink, E., Wamsler, C. (2019): Citizen engagement in climate adaptation surveyed: The role of values, worldviews, gender and place. – Journal of Cleaner Production 209: 1342-1353.

[5] Brooks, N., Grist, N., Brown, K. (2009): Development futures in the context of climate change: Challenging the present and learning from the past. – Development Policy Review 27(6): 741-765.

[6] Buckley, P.J., Pinnegar, J.K., Painting, S.J., Terry, G., Chilvers, J., Lorenzoni, I., Gelcich, S., Duarte, C.M. (2017): Ten thousand voices on marine climate change in Europe: Different perceptions among demographic groups and nationalities. – Frontiers in Marine Science 4: 1-17.

[7] Carlton, J.S., Mase, A.S., Knutson, C.L., Lemos, M.C., Haigh, T., Todey, D.P., Prokopy, L.S. (2016): The effects of extreme drought on climate change beliefs, risk perceptions, and adaptation attitudes. – Climatic Change 135(2): 211-226.

[8] Costanza, R., De Groot, R., Sutton, P., Van Der Ploeg, S., Anderson, S.J., Kubiszewski, I., Turner, R.K. (2014): Changes in the global value of ecosystem services. – Global Environmental Change 26: 152-158.

[9] Cuthbertson, J., Rodriguez-Llanes, J.M., Robertson, A., Archer, F. (2019): Current and emerging disaster risks perceptions in oceania: key stakeholders recommendations for disaster management and resilience building. – International Journal Environmental Research and Public Health 16: 460p.

[10] Cvitanovic, C., Crimp, S., Fleming, A., Bell, J., Howden, M., Hobday, A.J., Taylor, M., Cunningham, R. (2016): Linking adaptation science to action to build food secure Pacific Island communities. – Climate Risk Management 11: 53-62.

[11] Daud, Z.M., Mohamed, N., Abas, N. (2015): Public knowledge of climate change: Malaysia's perspective. – The 2nd International Conference on Human Capital and Knowledge Management 7p.

[12] Environics Research Group (2015): Climate change mitigation messaging research. Prepared for the Alberta Energy Efficiency Alliance and the Cities of Calgary and Edmonton. – Environics Research Group 96p.

[13] Eyþórsdóttir, K.S. (2015): Mapping the use of urban green space with regards to ecosystem resilience. – University of Iceland 94p.

[14] Harcourt, R., Bruine de Bruin, W., Dessai, S., Taylor, A. (2019): Investing in a good pair of wellies: how do non-experts interpret the expert terminology of climate change impacts and adaptation? – Climatic Change 155(2): 257-272.
[15] Hassan, S., Ghias, W., Fatima, T. (2018): Climate Change Risk Perception and Youth Mainstreaming: Challenges and Climate Change Risk Perception and Youth Mainstreaming: Challenges and Policy Recommendations. – Earth Systems and Environment 2(3): 515-523.
[16] Hernandez, Y., Barbosa, P., Corral, S., Rivas, S. (2018): An institutional analysis to address climate change adaptation in Tenerife (Canary Islands). – Environmental Science and Policy 89: 184-191.
[17] Hügel S., Davies A.R. (2020): Public participation, engagement, and climate change adaptation: A review of the research literature. – Wiley Interdisciplinary Reviews: Climate Change e645p.
[18] Idris, F., Muda, K., Mastor, K.A. (2019): Pembentukan Model Toleransi Beragama Belia Pelbagai Etnik di Malaysia (The Development of Religious Tolerance Model Among Multiethnic Youth in Malaysia). – Akademika 89(2): 33-42.
[19] Intergovernmental Panel on Climate Change (IPCC) (2014): Climate Change 2014 Synthesis Report: Foreword, Preface and Dedication. – IPCC Geneva, Switzerland 151p.
[20] Intergovernmental Panel on Climate Change (IPCC) (2007): Contribution to the Fourth Assessment Report of the IPCC Intergovernmental Panel on Climate Change. – Working Group II Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report 987p.
[21] Jung, Y.S. (2019): Analysis of the Relationship Among Personal Factors, Risk Perception, and Behavioral Responses Related to Climate Change in South Korea. – University of Colorado 242p.
[22] Klein, R.J.T., Schipper, E.L.F., Dessai, S. (2005): Integrating mitigation and adaptation into climate and development policy: Three research questions. – Environmental Science and Policy 8(6): 579-588.
[23] Knapp, C.N., Stuart Chapin, F., Kofinas, G.P., Fresco, N., Carothers, C., Craver, A. (2014): Parks, people, and change: The importance of multistakeholder engagement in adaptation planning for conserved areas. – Ecology and Society 19(4): 15p.
[24] Lorencová, E.K., Loučková, B., Vačkářů, D. (2019): Perception of climate change risk and adaptation in the Czech Republic. – Climate 7(5): 61p.
[25] Manuel-Navarrete, D. (2010): Power, realism, and the ideal of human emancipation in a climate of change. – Wiley Interdisciplinary Reviews: Climate Change 1: 781–785.
[26] Mitter, H., Larcher, M., Schönhart, M., Stöttinger, M., Schmid, E. (2019): Exploring Farmers' Climate Change Perceptions and Adaptation Intentions: Empirical Evidence from Austria. – Environmental Management 63(6): 804-821.
[27] Opondo, D.O. (2013): Erosive coping after the 2011 floods in Kenya. – International Journal of Global Warming 5(4): 452-466.
[28] Ortega-Egea, J. M., García-de-Frutos, N., Antolín-López, R. (2014): Why do some people do "more" to mitigate climate change than others? Exploring heterogeneity in psycho-social associations. – PLoS ONE 9(9): e106645p.
[29] Owusu, P.A., Asumadu-Sarkodie, S. (2016): A review of renewable energy sources, sustainability issues and climate change mitigation. – Cogent Engineering 3(1): 1-14.
[30] Rahman, H.A. (2018): Climate Change Scenarios in Malaysia: Engaging the Public. – International Journal of Malay-Nusantara Studies 1(2): 55-77.
[31] Ravera, F., Iniesta-arandia, I., Pascual, U., Bose, P., Martı, B. (2016): Gender perspectives in resilience, vulnerability and adaptation to global environmental change. – Ambio 45(3): 235-247.
[32] Robinson, G.M., Bardsley, D.K., Raymond, C.M., Underwood, T., Moskwa, E., Weber, D., Waschl, N., Bardsley, A.M. (2018): Adapting to climate change: Lessons from farmers and peri-urban fringe residents in South Australia. – Environments 5(3): 1-16.

[33] Saad, S., Fazliyanna, T., Kamarudin, T., Awang, A.H. (2018): Pengetahuan dan sokongan belia terhadap dasar kerajaan mengenai perubahan iklim. – Malaysian Journal of Society and Space 14(1): 130-141.

[34] Saptutyningsih, E., Diswandi, D., Jaung, W. (2020): Does social capital matter in climate change adaptation? A lesson from agricultural sector in Yogyakarta, Indonesia. – Land Use Policy 95: 104189p.

[35] Stocker, T.F., Qin, D., Plattner, G.K., Alexander, L.V., Allen, S.K., Bindoff, N.L., Bréon, F.M., Church, J.A., Cubasch, U., Emori, S., Forster, P., Friedlingstein, P., Gillett, N., Gregory, J.M., Hartmann, D.L., Jansen, E., Kirtman, B., Knutti, R., Krishna Kumar, K., Lemke, P., Marotzke, J., Masson-Delmotte, V., Meehl, G.A., Mokhov, I.I., Piao, S., Ramaswamy, V., Randall, D., Rhein, M., Rojas, M., Sabine, C., Shindell, D., Talley, L.D., Vaughan, D.G., Xie, S.P. (2013): Technical summary. In: Stocker, T.F., Qin, D., Plattner, G.K., Tignor, M., Allen, S.K., Boschung, J., Nauels, A., Xia, Y., Bex, V., Midgley, P.M. (Eds.) Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. – Cambridge University Press, Cambridge, United Kingdom and New York, USA 1585p.

[36] Terorotua, H., Duvat, V.K.E., Maspataud, A., Ouriqua, J. (2020): Assessing Perception of Climate Change by Representatives of Public Authorities and Designing Coastal Climate Services: Lessons Learnt from French Polynesia. – Frontiers in Marine Science 7: 1-16.

[37] Wamsler, C., Alkan-Olsson, J., Björn, H., Falck, H., Hanson, H., Oskarsson, T., Simonsson, E., Zelmerlow, F. (2020): Beyond participation: when citizen engagement leads to undesirable outcomes for nature-based solutions and climate change adaptation. – Climatic Change 158(2): 235-254.

[38] Daud, Z.M., Mohamed, N., Abas, N. (2015): Public knowledge of climate change: Malaysia's perspective. – In International Conference on Human Capital and Knowledge Management 7p.