INTERNATIONAL JOURNAL OF APPLIED AND EXPERIMENTAL BIOLOGY
(ISSN PRINT: 2790-6523; ISSN ONLINE: 2790-6531)
2025, Vol. 4, NO.1, 149-154
doi: https://doi.org/10.56612/ijaaeb.v1i1.130
ARK: https://n2t.net/ark:/71142/IJAaEB.v1i1.130
https://eminentscientists.com/

Climate change and global warming effects on agricultural communities: Mitigation through pedagogical content knowledge (PCK) approach

Mina Mahbod[1]

[1]Department of Educational Sciences, Farhangian University, P.O. Box 14665-889, Tehran, Iran.

Abstract

This article examines the effects and changes of climate change and global warming on farming communities and their social life, especially in coastal and arid regions. In the study, the PRISMA approach and the C-I-M-O framework were employed to survey scientific publications in the context of environmental, social, and psychological impacts of climate change and global warming. Resultantly, this paper discusses the opportunities and challenges for adaptation and mitigation, and the strategies and methods for minimizing the impacts of climate change on the farming communities. At the bottom-line, it proposes the need for more research, PCK approach education, awareness, and actions regarding these phenomena, alongside the role of policymakers and institutions in addressing the challenges and implications of climate change. In conclusion, a passive call felt for a multidisciplinary and cooperative response from various stakeholders, such as scientists, practitioners, policymakers, and civil society, to create a more resilient, sustainable, and healthy future for humans and the planet.

ARTICLE TYPE
Systhetic Review (SR)

SECTION
Plant Biology (PB)

HANDLING EDITOR
Ozyigit, I.I. (PB)

ARTICLE HISTORY
Received: 20 Sep, 2024
Accepted: 14 Oct, 2024
Online: 17 Oct, 2024
Published: 06 Jan, 2025

KEYWORDS
Alleviation;
Climate change;
Community challenges;
Impacts;
Sustainable development

Introduction

Climate change and global warming phenomena are closely related, which affect the weather (temperature and precipitation) conditions / patterns on our home planet, the Earth. These phenomena are reinforced by the increasing carbon emissions due to human activities, e.g., industries, transportation, livestock, and agriculture. The global energy consumptions prone to high carbon emissions have significantly increased (British Petroleum, 2022). The consequences and outcomes of climate change and global warming are serious and widespread, especially for the polar regions, arid/semi-arid areas, and coastal areas (Scholes, 2020). The melting of the Earth polar ice caps and the rising of sea levels threaten normal livelihoods and food security (Saleem et al., 2024). This is more important for the coastal communities, which depend on the fertile and productive lands for their social activities, economy, and well-being (Scholes, 2020). Therefore, it is urgent and critical to mitigate the adverse effects of climate change and global warming for coastal human populations and residential areas therein.

Climate change affects inland areas in different ways, which are dissimilar to those of coastal areas, particularly in arid and semi-arid regions (Rubekie et al., 2022). This phenomenon can cause water

***CONTACT** Mina Mahbod, mina.mahbod@cfu.ac.ir, Department of Educational Sciences, Farhangian University, P.O. Box 14665-889, Tehran, Iran.

CITATION (APA): Mahbod, M. (2025). Climate change and global warming effects on agricultural communities: Mitigation through pedagogical content knowledge (PCK) approach. *International Journal of Applied and Experimental Biology* 4(1): 149-154.

scarcity, which harms agricultural production and intensifies environmental salinization (soil and water resources salinization) (Saleem et al., 2024). It also leads to desertification, land degradation, and dust storms, which disrupt food and goods supply chains, increases involuntary migration and disruption in sustainable power supply, increases industrial sustainability and investment risks, increases health problems, and weakens political and economic stability (Agheli and Taghvaee, 2022). These risks and disadvantages have endangered the sustainability of local communities.

The use of databases

To conduct a bibliographic research on the topic, the PRISMA approach was followed and searched the databases of Scopus, Web of Science, and Google Scholar from 1995 to 2023. The search terms included "climate change", "global warming", and "psychological impacts". Only peer-reviewed journals and books were selected for the study. The title and abstract of each article were reviewed to determine their relevance to the study scope. The C-I-M-O (context-intervention-mechanism-outcome) framework was used to choose the most pertinent articles. After reviewing the articles, the snowball sampling was applied to include other relevant articles cited by the selected ones.

Results and Discussion

Climate change poses a severe challenge to communities

Climate change poses a severe challenge to food security and job markets, especially for communities located in coastal and arid regions, such as the MENA (Middle East and North Africa) and southern Europe, which are already facing the negative effects of climate change (**Table 1**).

Table 1. Climate change harmful effects reports

Location	Climate change-induced effects	Reference
Nile Delta, Egypt	Increasing agriculture and tourism pressure	El-Nahry and Doluschitz, 2010
Jordan River Basin	Water scarcity	Al Qatarneh et al., 2018
Maghreb region	Droughts, heat waves, floods, storms, and desertification	Schilling et al., 2020
Lake Urmia, Iran	Urmia lake is consistently diminishing	Schulz et al., 2020
Red Sea coral reefs, Saudi Arabia	Local ecosystem services are threatened by climate change	Hereher, 2016
Mesopotamian marshes, Iraq	Reduced precipitation, increased evaporation, and altered river flows	Albarakat et al., 2018
Indus River Delta, Pakistan	Intensification of water and soil salinization	Jamali et al., 2023
Doha Bay ,Qatar	Sea level rise, storms, coastal flooding, heat stress, and air pollution	Ajjur and Al-Ghamdi, 2022

Global climate change affects communities

Climate change endangers human and their surrounding ecosystem in various aspects, such as food, water, energy, and safety (**Table 2**). However, not all communities and environments are equally affected by climate change. Some are more vulnerable than others. For example, indigenous communities strongly rely on the local natural resources for their livelihoods and culture, but climate change has serious impacts on their food providing systems and lands. Correspondingly, low-income groups, minorities, women, children, and elderly face more risks from extreme weather events, such as floods, droughts, heat waves, and storms. They also have less resources and services to manage climate change effects (Adger et al., 2014).

Table 2. Some climate change harmful effects and challenges

Effects and challenges	References
Forest fires	Aponte.et al., 2016
Hurricanes	Appendini et al., 2019
Droughts	Stewart et al., 2020
Heat waves	Hopke, 2020
Air pollution	Weiand et al., 2019
Food insecurity	Dasgupta and Robinson, 2022
Soil salinization	Okur and Örçen, 2020

Climate change silent movement is the main cause of social and psychological problems

Climate change affects the society's surrounding environment and poses challenges for human health, both physical and mental (**Table 3**). It impacts a large and diverse population, with different kinds of public health threats in different regions (Cianconi et al., 2020). It also has impact on psychological well-being, as caused disasters, such as floods, droughts, heat waves, and storms (Saleem et al., 2024). This phenomenon can put in risk human mental health, and its social relations. Climate anxiety and other related emotional reactions are new risks of healthily life that need clinical attention, but they can also be adaptive or maladaptive (Whitmarsh et al., 2022). Therefore, individual mental health should not overshadow the societal response that is required to tackle climate change (Clayton, 2020). The mental effects of climate change on humans can be different in duration and intensity from direct and immediate to indirect and long-term. Severe events can trigger traumatic stress responses, resulting in common mental disorders. Chronic events can cause delayed or intergenerational effects, such as posttraumatic stress disorders (Cianconi et al., 2020).

Table 3. Some climate change induced social and psychological problems

Effects	References
Climate anxiety in children and young	Hickman et al., 2021
Anger, depression and anxiety	Stanley et al., 2021
Post-traumatic stress disorder, depression, anxiety, psychotic symptoms, suicidal ideation and suicide completion	Burke et al., 2018
Ecological anxiety and grief	Cunsolo et al., 2020

Climate change has serious environmental (air, water and soil) effects (Okur and Örçen, 2020), which lead to health impacts and violate human rights and social justice, especially for low-income societies and poor people in high-income ones. Climate change causes temperature rise, precipitation change, harsh weather, and sea level rise, which could damage agricultural productivity, water quality and quantity, job market, and land degradation (Schilling et al., 2020). Regarding the matter of the facts, it forces many individuals to shift their homelands. Climate change also prompts heat stress, infectious diseases, allergies, malnutrition, violence, and mental disorders (Burke et al., 2018). These impacts affect the rights to life, food, water, health, security, shelter, and culture of vulnerable groups, such as the poor, minorities, women, children, elderly, disabled, sick, and workers (Neira et al., 2023). Moreover, low-income countries emit less greenhouse gases but suffer more from climate change than high-income countries, and have less ability to adapt. Therefore, climate action should protect human rights, promote social justice, and support vulnerable populations (Levy and Patz, 2015; Grundmann, 2016). Short-term changes, especially crucial changes in climate conditions, trigger a significant response in and by human society. The anthropogenic climate changes have a long-time scale effects on societies. Regarding the deep socio-economic impacts of these changes, policy makers should develop optimal adaptation strategies (Stehr and Von Storch, 1995; Neira et al., 2023).

Pedagogical Content Knowledge (PCK) Approaches for Mitigation of Climate Change Effects, and Changes in Communities and Residents' Social Life

Extension/promotion of environmental topics in communities demands proper education of people, youth, and society local leaders. Pedagogical Content Knowledge (PCK) is an educational framework that emphasizes the importance of teachers having a deep understanding of both the contents, in this case climate change and global warming, they are teaching and the pedagogical strategies that are most appropriate to teach mitigation pathway (Cianconi et al., 2020; Favier et al., 2020). Regarding climate change, the environmental education, PCK, involves the ability of teachers to impressively teach related topics by integrating knowledge with suitable teaching methods that are most likely to embrace with students' mindset (Favier et al., 2021).

Application of PCK to environmental topics in teaching methods of educators should involve the emotional and psychological impact of students. Teachers need to navigate these discussions with sensitivity and provide students with the tools to engage in positive actions associated with contributing to environmental stewardship (Teed and Franco, 2014; Van Poeck et al., 2023). The application of PCK in environmental phenomena mitigation education is essential for developing people who can understand complex environmental issues and take part in sustainable training (Teed and Franco, 2014; Favier et al., 2021). PCK can be the core for the mitigation of effects and changes in communities and residents' social life. PCK combines deep knowledge of these environmental issues with an understanding of how to teach effectively, considering student's mindset, misperceptions, and learning challenges. When PCK approach comes to climate change impacts, teachers need to be proficient at communicating the scientific

principles of climate change, social science and psychology in a way that is both culturally and contextually proper.

For the promotion of climate change mitigation and management methods, PCK approaches can involve experiential methods such as project-based learning, where students engage in climate change related communities and social life problem findings and solutions. This hands-on approach facilitates a deeper understanding of the complexities and potential of mitigation methods. Furthermore, incorporating specific cases of successful climate change mitigation projects can make useful educational experiences and inspire student's innovations (Cianconi et al., 2020; Favier et al., 2021). This approach encourages critical thinking and problem-solving skills, empowering students to become informed citizens and innovators capable of addressing climate change problems through mitigation of climate change consequences in communities.

Conclusion

Climate change and global warming are among the most pressing issues of our time, affecting the environment, human well-being, and sustainable development in various ways. These are challenged by coastal and arid regions communities, which are already experiencing the negative impacts of climate change on their social life, natural resources, food security, health, and stability. Therefore, it is imperative and essential to take urgent and effective actions to mitigate and adapt to climate change and global warming, and to support and protect the affected populations and ecosystems. This article has provided a comprehensive overview of the causes and effects of climate change and global warming, the opportunities and challenges for adaptation and mitigation, and the strategies and methods for minimizing the impacts of climate change. It has also highlighted the need for research, the PCK approach in education, awareness, and steady actions in this regard, as well as the role of policymakers and institutions in addressing the human rights and social justice implications of climate change. Climate change and global warming demand a multidisciplinary, mutual, and cooperative movement based on various stakeholders, such as scientists, practitioners, policymakers, NGOs, etc.

Author(s), Editor(s) and Publisher's declarations

Acknowledgement
None declared.

Conflict of interest
The author declares no conflict of interest.

Source of funding
None declared.

Contribution of authors
Conceptualization and designing of the study as well as drafting the whole manuscript: MM.

Supplementary material
No supplementary material is included with this manuscript.

Ethical approval
This study does not involve human/animal subjects, and thus no ethical approval is needed.

Handling of bio-hazardous materials
Since this is a review article, so it does not involve any experimentation or use of any types of materials/chemicals

Declaration of generative AI and AI-assisted technologies in the writing process
It is declared that the authors did not use any AI tools or AI-assisted services in the preparation, analysis, or creation of this manuscript submitted for publication in the International Journal of Applied and Experimental Biology (IJAaEB).

Availability of primary data and materials

As per editorial policy, experimental materials, primary data, or software codes are not submitted to the publisher. These are available with the corresponding author and/or with other author(s) as declared by the corresponding author of this manuscript.

Author's consent

The author has critically read this manuscript and agreed to publish in IJAaEB.

Disclaimer/editors'/publisher's declaration

All claims/results/prototypes included in this manuscript are exclusively those of the author and do not inevitably express those of their affiliated organizations/enterprises, or those of the publisher/journal management, and the editors/reviewers. Any product mentioned in this manuscript, or claim rendered by its manufacturer, is not certified by the publisher/Journal management. The journal management disown responsibility for any injury to organisms including humans, animals and plants or property resulting from any ideas/opinions, protocols/methods, guidelines or products included in the publication. The IJAaEB publisher/Management stays impartial/neutral pertaining to institutional affiliations and jurisdictional claims in maps included in the manuscript.

References

Agheli, L., Taghvaee, V.M. (2022). Political stability effect on environment and weak sustainability in Asian countries. *Sustainability Analytics and Modeling* 2:100007. https://doi.org/10.1016/j.samod.2022.100007.

Ajjur, S.B., Al-Ghamdi, S.G. (2022). Exploring urban growth–climate change–flood risk nexus in fast growing cities. *Scientific Reports* 12(1):12265. https://doi.org/10.1038/s41598-022-16475-x

Al Qatarneh, G.N., Al Smadi, B., Al-Zboon, K., Shatanawi, K.M. (2018). Impact of climate change on water resources in Jordan: a case study of Azraq basin. *Applied Water Science* 8:1-14.

Albarakat, R., Lakshmi, V., Tucker, C.J. (2018). Using satellite remote sensing to study the impact of climate and anthropogenic changes in the Mesopotamian marshlands, Iraq. *Remote Sensing* 10(10):1524. https://doi.org/10.3390/rs1010152

Aponte, C., de Groot, W.J., Wotton, B.M. (2016). Forest fires and climate change: causes, consequences and management options. *International Journal of Wildland Fire* 25(8): i-ii. https://doi.org/10.1071/WFv25n8-FO

Appendini, C.M., Meza-Padilla, R., Abud-Russell, S., Proust, S., Barrios, R.E. et al. (2019). Effect of climate change over landfalling hurricanes at the Yucatan Peninsula. *Climatic Change* 157:469-482.

British Petroleum (BP) (2022). "bp Statistical Review of World Energy 2022", 71st edition.

Burke, M., González, F., Baylis, P., Heft-Neal, S., Baysan, C. et al. (2018). Higher temperatures increase suicide rates in the United States and Mexico. *Nature Climate Change* 8(8):723-729.

Cianconi, P., Betrò, S., Janiri, L. (2020). The impact of climate change on mental health: a systematic descriptive review. *Frontiers in Psychiatry* 11:74. https://doi.org/10.3389/fpsyt.2020.00074

Clayton, S. (2020). Climate anxiety: Psychological responses to climate change. *Journal of Anxiety Disorders* 74:102263. https://doi.org/10.1016/j.janxdis.2020.102263.

Cunsolo, A., Harper, S.L., Minor, K., Hayes, K., Williams, K.G. et al. (2020). Ecological grief and anxiety: the start of a healthy response to climate change?. *The Lancet Planetary Health* 4(7):e261-e263.

Dasgupta, S., Robinson, E.J. (2022). Attributing changes in food insecurity to a changing climate. *Scientific Reports* 12(1):4709. https://doi.org/10.1038/s41598-022-08696-x

El-Nahry, A.H., Doluschitz, R. (2010). Climate change and its impacts on the coastal zone of the Nile Delta, Egypt. *Environmental Earth Sciences* 59:1497-1506.

Favier, T., Van Gorp, B., Cyvin, J.B., Cyvin, J. (2021). Learning to teach climate change: students in teacher training and their progression in pedagogical content knowledge. *Journal of Geography in Higher Education* 45(4):594-620.

Grundmann, R. (2016). Climate change as a wicked social problem. *Nature Geoscience* 9(8):562-563.

Hereher, M.E. (2016). Vulnerability assessment of the Saudi Arabian Red Sea coast to climate change. *Environmental Earth Sciences* 75(1):30. https://doi.org/10.1007/s12665-015-4835-3

Hickman, C., Marks, E., Pihkala, P., Clayton, S., Lewandowski, R.E. et al. (2021). Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. *The Lancet Planetary Health* 5(12):e863-e873.

Hopke, J.E. (2020). Connecting extreme heat events to climate change: Media coverage of heat waves and wildfires. *Environmental Communication* 14(4):492-508.

Jamali, H., Jamali, M., Hayat, S., Iqbal, J. (2023). Indus River Delta: Contested narratives in the climate of change. *Asian Journal of Social Science* 51(4):215-226.

Levy, B.S., Patz, J.A. (2015). Climate change, human rights, and social justice. *Annals of Global Health* 81(3):310-322.

Neira, M., Erguler, K., Ahmady-Birgani, H., Al-Hmoud, N.D., Fears, R. et al. (2023). Climate change and human health in the Eastern Mediterranean and Middle East: Literature review, research priorities and policy suggestions. *Environmental Research* 216(Pt 2):114537. https://doi.org/10.1016/j.envres.2022.114537

Okur, B., Örçen, N. (2020). Soil salinization and climate change. *In* "Climate Change and Soil Interactions" (M.N.V. Prasad, M. Pietrzykowski, eds.), pp. 331-350. Elsevier.

Rubekie, A.P., Pauline, N.M., Kaaya, L.T. (2022). Coastal communities' responses to climate change and variability impacts: a threat to coastal and marine resources? *Climate and Development* 14(9):842–856. https://doi.org/10.1080/17565529.2021.2018984

Saleem, A., Anwar, S., Nawaz, T., Fahad, S., Saud, S. et al. (2024). Securing a sustainable future: the climate change threat to agriculture, food security, and sustainable development goals. *Journal of Umm Al-Qura University for Applied Sciences* (2024). https://doi.org/10.1007/s43994-024-00177-3

Schilling, J., Hertig, E., Tramblay, Y., Scheffran, J. (2020). Climate change vulnerability, water resources and social implications in North Africa. *Regional Environmental Change* 20(15): https://doi.org/10.1007/s10113-020-01597-7

Scholes, R.J. (2020). The future of semi-arid regions: A weak fabric unravels. *Climate* 8:43. https://doi.org/10.3390/cli8030043

Schulz, S., Darehshouri, S., Hassanzadeh, E., Tajrishy, M., Schüth, C. (2020). Climate change or irrigated agriculture–what drives the water level decline of Lake Urmia. *Scientific Reports*10(1):236. https://doi.org/10.1038/s41598-019-57150-y

Stanley, S.K., Hogg, T.L., Leviston, Z., Walker, I. (2021). From anger to action: Differential impacts of eco-anxiety, eco-depression, and eco-anger on climate action and wellbeing. *The Journal of Climate Change and Health* 1:100003. https://doi.org/10.1016/j.joclim.2021.100003.

Stehr, N., Von Storch, H. (1995). The social construct of climate and climate change. *Climate Research* 5(2):99-105.

Stewart, I.T., Rogers, J., Graham, A. (2020). Water security under severe drought and climate change: Disparate impacts of the recent severe drought on environmental flows and water supplies in Central California. *Journal of Hydrology X*, 7:100054. https://doi.org/10.1016/j.hydroa.2020.100054

Teed, R., Franco, S. (2014). Increasing teachers' confidence and pedagogical content knowledge through a workshop and follow-up program on climate change. *Journal of Geoscience Education* 62(4):587-597.

Van Poeck, K., Vandenplas, E., Östman, L. (2023). Teaching action-oriented knowledge on sustainability issues. *Environmental Education Research* 30(3):334–360. https://doi.org/10.1080/13504622.2023.2167939

Weiand, L., Schmitz, S., Becker, S., Niehoff, N., Schwartzbach, F. et al. (2019). Climate change and air pollution: the connection between traffic intervention policies and public acceptance in a local context. *Environmental Research Letters* 14(8):085008. https://doi.org/10.1088/1748-9326/ab299b

Whitmarsh, L., Player, L., Jiongco, A., James, M., Williams, M. et al. (2022). Climate anxiety: What predicts it and how is it related to climate action?, *Journal of Environmental Psychology* 83:101866. https://doi.org/10.1016/j.jenvp.2022.101866.