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Climate Change Impact on Water Resources in Tribal Areas

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A B S T R A C T

Climate change poses significant threats to water resources in tribal areas, impacting hydrology, socio-economics, and cultural practices. This analysis explores these impacts, highlighting altered precipitation patterns, increased droughts, and glacial retreat, which disrupt water availability and quality. Socio-economic consequences include reduced agricultural productivity, drinking water scarcity, and heightened health risks. Cultural disruptions affect sacred sites and traditional practices, while community displacement threatens cultural identity. Adaptive challenges are compounded by inadequate infrastructure, socio-political marginalization, and difficulties in integrating traditional knowledge with modern practices. Effective policies and governance, emphasizing inclusive frameworks and legal support, are crucial for addressing these impacts. Case studies from the Navajo Nation, Saami people, San communities, Inuit in the Arctic, and Amazon Basin tribes illustrate diverse adaptive responses. Safeguarding water resources in tribal areas is vital for preserving their livelihoods, cultures, and identities amid climate change.

Keywords: Climate Change, Water Resources, Tribal Areas, Drinking Water Scarcity

1. Introduction

Climate change is an existential threat that profoundly affects global ecosystems and human societies. Among the most vulnerable to its impacts are tribal communities, whose livelihoods, cultures, and identities are intricately tied to their natural environments, particularly water resources. This comprehensive analysis explores the multifaceted effects of climate change on water resources in tribal areas, covering hydrological changes, socio-economic effects, cultural disruptions, adaptive challenges, policy implications, and case studies [1-3].

1.1 Hydrological Changes

Climate change alters the hydrological cycle,

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significantly impacting precipitation patterns, evapotranspiration rates, snowmelt dynamics, and the frequency and intensity of extreme weather events. Tribal areas, often situated in ecologically sensitive and geographically isolated regions, face disproportionate risks from these changes [4-6].

Precipitation Patterns and Droughts

- ✓ **Variability in Rainfall:** Changes in precipitation patterns can lead to irregular rainfall, with some areas experiencing excessive rainfall and others facing prolonged dry spells. For instance, tribal regions in India, such as Odisha and Jharkhand, have reported erratic monsoon patterns, disrupting agricultural activities and water availability.

- ✓ **Increased Drought Frequency:** The American Southwest, home to numerous Native American tribes, has seen a marked increase in drought frequency and severity. The Navajo Nation, for instance, struggles with dwindling water sources due to persistent drought conditions.

Snowmelt and Glacial Retreat

- ✓ **Reduced Snowpack:** In mountainous regions, many tribal communities depend on snowmelt for their water supply. The Himalayas, known as the "Water Tower of Asia," are experiencing accelerated glacial retreat, threatening the water security of downstream communities, including numerous indigenous groups.

- ✓ **Timing and Quantity of Runoff:** Altered snowmelt patterns can lead to earlier peak runoff periods, resulting in water shortages during the growing season. The Hopi and Zuni tribes in the southwestern United States face such challenges, as earlier snowmelt reduces water availability during critical agricultural periods.

River Flow and Water Quality

- ✓ **Altered River Dynamics:** Changes in precipitation and temperature affect river flows, impacting water availability and quality. In the Amazon Basin, shifting rainfall patterns have led to irregular river flows, affecting the water-dependent livelihoods of indigenous tribes.

- ✓ **Contamination and Salinity:** Increased temperatures and changes in water flows can exacerbate water contamination and salinity issues. In coastal areas, such as those inhabited by the Sundarbans' indigenous communities in India and Bangladesh, rising sea levels increase saltwater intrusion, contaminating freshwater sources.

1.2 Socio-Economic Effects

The socio-economic impact of climate change on tribal water resources is profound, exacerbating poverty, food insecurity, and health issues [7].

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Agricultural and Livestock Productivity

- ✓ **Crop Failures:** Erratic rainfall and prolonged droughts lead to crop failures, directly impacting food security and income. Tribal farmers in sub-Saharan Africa, for example, face frequent crop losses, threatening their subsistence and livelihoods.
- ✓ **Livestock Health:** Water scarcity affects livestock, a crucial asset for many tribal communities. In Kenya, the pastoralist Maasai tribe faces reduced water and pasture availability, leading to livestock deaths and economic losses.

Drinking Water Access

- ✓ **Reduced Availability:** Traditional water sources, such as springs and wells, are drying up or becoming unreliable. In Australia's remote Aboriginal communities, limited access to safe drinking water is a growing concern.
- ✓ **Health Risks:** Water scarcity forces reliance on unsafe water sources, increasing the incidence of water-borne diseases. In the Navajo Nation, inadequate water infrastructure contributes to high rates of gastrointestinal illnesses.

Economic Burden

- ✓ **Increased Costs:** Procuring water from distant or alternative sources imposes financial burdens. In Bolivia, indigenous communities in the Andes face rising costs for water transport and purification due to glacial retreat.
- ✓ **Loss of Livelihoods:** Water-dependent activities, such as fishing and handicrafts, are adversely affected. The Ojibwe tribes around the Great Lakes rely on fishing for sustenance and income, but declining water quality and fish populations threaten their economic stability.

1.3 Cultural Disruptions

Water is not only a physical resource but also a cultural and spiritual cornerstone for many tribal communities. Climate change-induced water changes disrupt these cultural dimensions [8].

Sacred Sites and Practices

- ✓ **Cultural Erosion:** Many indigenous rituals and practices are tied to specific water bodies. The Hopi tribe's spiritual ceremonies involve springs and rivers now at risk due to drought.
- ✓ **Loss of Traditional Knowledge:** The degradation of water resources undermines traditional knowledge systems. The Inuit in the Arctic, whose knowledge of ice and water patterns is integral to their culture, face challenges as these patterns become unpredictable.

Community Displacement

- ✓ **Relocation:** Severe water shortages can force communities to relocate, disrupting cultural continuity. The

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Gwich'in people in Alaska and Canada are considering relocation due to changing river patterns and permafrost melt.

- ✓ **Loss of Identity:** Displacement can lead to a loss of cultural identity and heritage. In the Sundarbans, rising sea levels threaten the homes and cultural sites of indigenous communities, risking cultural disintegration.

2. Review of literature

This paper examines the security of water resources in Phoenix, AZ, under different scenarios of climate change, consumption patterns, and reductions of available surface water. Phoenix constitutes a key site for examining the projected effects of climate change on water resources in the US West. Water providers in Phoenix rely on a mix of water sources to deliver to their customers. These include groundwater, water from the Salt and Verde River watersheds, water from the Colorado River, and effluent (water reuse). Water providers in Phoenix vary in terms of their access and rights to different sources of water for municipal delivery. As a result, providers differ in terms of their exposure to cut-backs in available water. To assess vulnerability to climate change and reduced water resources available for delivery, we consider two primary questions. (1) Based on current water provider portfolio mixes, what is the current relative security of each provider's mix of water sources? (2) Using three different climate change scenarios for the Western USA and projected growth-related demand increases, what patterns of water supply vulnerabilities are likely to manifest themselves in 2030? We map projected supply shortages and discuss implications for the vulnerability of people and places and mitigation strategies. (***Bolin, 2010*****).**

Climate change impacts in Pacific Northwest Region of North America (PNW) are projected to include increasing temperatures and changes in the seasonality of precipitation (increasing precipitation in winter, decreasing precipitation in summer). Changes in precipitation are also spatially varying, with the northwestern parts of the region generally experiencing greater increases in cool season precipitation than the southeastern parts. These changes in climate are projected to cause loss of snowpack and associated streamflow timing shifts which will increase cool season (October–March) flows and decrease warm season (April–September) flows and water availability. Hydrologic extremes such as the 100 yr flood and extreme low flows are also expected to change, although these impacts are not spatially homogeneous and vary with mid-winter temperatures and other factors. These changes have important implications for natural ecosystems affected by water, and for human systems.

The PNW is endowed with extensive water resources infrastructure and well-established and well-funded management agencies responsible for ensuring that water resources objectives (such as water supply, water quality, flood control, hydropower production, environmental services, etc.) are met. Likewise, access to observed hydrological, meteorological, and climatic data and forecasts

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is in general exceptionally good in the United States and Canada, and is often supported by federally funded programs that ensure that these resources are freely available to water resources practitioners, policy makers, and the general public.

Access to these extensive resources support the argument that at a technical level the PNW has high capacity to deal with the potential impacts of natural climate variability on water resources. To the extent that climate change will manifest itself as moderate changes in variability or extremes, we argue that existing water resources infrastructure and institutional arrangements provide a reasonably solid foundation for coping with climate change impacts, and that the mandates of existing water resources policy and water resources management institutions are at least consistent with the fundamental objectives of climate change adaptation. A deeper inquiry into the underlying nature of PNW water resources systems, however, reveals significant and persistent obstacles to climate change adaptation, which will need to be overcome if effective use of the region's extensive water resources management capacity can be brought to bear on this problem. Primary obstacles include assumptions of stationarity as the fundamental basis of water resources system design, entrenched use of historical records as the sole basis for planning, problems related to the relatively short time scale of planning, lack of familiarity with climate science and models, downscaling procedures, and hydrologic models, limited access to climate change scenarios and hydrologic products for specific water systems, and rigid water allocation and water resources operating rules that effectively block adaptive response. Institutional barriers include systematic loss of technical capacity in many water resources agencies following the dam building era, jurisdictional fragmentation affecting response to drought, disconnections between water policy and practice, and entrenched bureaucratic resistance to change in many water management agencies. These factors, combined with a federal agenda to block climate change policy in the US during the Bush administration have (with some exceptions) contributed to widespread institutional "gridlock" in the PNW over the last decade or so despite a growing awareness of climate change as a significant threat to water management. In the last several years, however, significant progress has been made in surmounting some of these obstacles, and the region's water resources agencies at all levels of governance are making progress in addressing the fundamental challenges inherent in adapting to climate change. (***Hamlet, 2011*****).**

India is considerably vulnerable in the events of climate change impacts. Vulnerability and adaptive capacity among the population varies quite a lot in a country like India. This paper investigated local communities' perceptions of and responses to the impacts of climate change on their livelihoods. The study employed village-level participatory qualitative research methods in three geo-cultural zones of the Indian states of Madhya Pradesh, Chhattisgarh, and Odisha. It revealed that the local communities in those places had already visualized the impacts of climate change on their livelihoods and surrounding natural resources. Their observations corresponded to

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the broader scientific projections of the impacts of climate change in India. The study found that the local communities had started to adapt with the changing climate by altering their livelihoods and cultural practices. The study recommends urgent need of identifying the vulnerable communities in India and assessing their vulnerability from different perspectives that climate change might expose in the future. It also recommends implementing the present pro-poor policies of the government in an effective way to improve the socio-economic conditions of the poor and vulnerable communities in the country. (***Halder, 2012*).**

The case of the Pyramid Lake Paiute Tribe exemplifies tribal vulnerabilities as a result of climate change. Preliminary socio-economic data and analysis reveal that the tribe's vulnerability to climate change is related to cultural and economic dependence on Pyramid Lake, while external socio-economic vulnerability factors influence adaptive capacity and amplify potential impacts. Reduced water supplies as a consequence of climate change would result in a compounded reduction of inflows to Pyramid Lake, thus potentially impacting the spawning and sustenance of a cultural livelihood, the endangered cui-ui fish (*Chasmistes cujus*). Meanwhile, limited economic opportunities and dwindling federal support constrain tribal adaptive capacity. Factors that contribute to tribal adaptive capacity include: sustainability-based values, technical capacity for natural resource management, proactive initiatives for the control of invasive-species, strong external scientific networks, and remarkable tribal awareness of climate change. (**Gautam, 2013).**

This paper provides an overview of climate change impacts on tribal water resources and the subsequent cascading effects on the livelihoods and cultures of American Indians and Alaska Natives living on tribal lands in the U.S. A hazards and vulnerability framework for understanding these impacts is first presented followed by context on the framework components, including climate, hydrologic, and ecosystem changes (i.e. hazards) and tribe-specific vulnerability factors (socioeconomic, political, infrastructural, environmental, spiritual and cultural), which when combined with hazards lead to impacts. Next regional summaries of impacts around the U.S. are discussed. Although each tribal community experiences unique sets of impacts because of their individual history, culture, and geographic setting, many of the observed impacts are common among different groups and can be categorized as impacts on—1) water supply and management (including water sources and infrastructure), 2) aquatic species important for culture and subsistence, 3) ranching and agriculture particularly from climate extremes (e.g., droughts, floods), 4) tribal sovereignty and rights associated with water resources, fishing, hunting, and gathering, and 5) soil quality (e.g., from coastal and riverine erosion prompting tribal relocation or from drought-related land degradation). The paper finishes by highlighting potentially relevant research questions based on the five impact categories. (**Cozzetto, 2014).**

The western United States is a region long defined by water challenges. Climate change

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adds to those historical challenges, but does not, for the most part, introduce entirely new challenges; rather climate change is likely to stress water supplies and resources already in many cases stretched to, or beyond, natural limits. Projections are for continued and, likely, increased warming trends across the region, with a near certainty of continuing changes in seasonality of snowmelt and streamflows, and a strong potential for attendant increases in evaporative demands. Projections of future precipitation are less conclusive, although likely the northernmost West will see precipitation increases while the southernmost West sees declines. However, most of the region lies in a broad area where some climate models project precipitation increases while others project declines, so that only increases in precipitation uncertainties can be projected with any confidence. Changes in annual and seasonal hydrographs are likely to challenge water managers, users, and attempts to protect or restore environmental flows, even where annual volumes change little. Other impacts from climate change (e.g., floods and water-quality changes) are poorly understood and will likely be location dependent.

In this context, four iconic river basins offer glimpses into specific challenges that climate change may bring to the West. The Colorado River is a system in which overuse and growing demands are projected to be even more challenging than climate-change-induced flow reductions. The Rio Grande offers the best example of how climate-change-induced flow declines might sink a major system into permanent drought. The Klamath is currently projected to face the more benign precipitation future, but fisheries and irrigation management may face dire straits due to warming air temperatures, rising irrigation demands, and warming waters in a basin already hobbled by tensions between endangered fisheries and agricultural demands. Finally, California's Bay-Delta system is a remarkably localized and severe weakness at the heart of the region's trillion-dollar economy. It is threatened by the full range of potential climate-change impacts expected across the West, along with major vulnerabilities to increased flooding and rising sea levels. (**Dettinger, 2015).**

The Indian Himalayan Region (IHR) which is a domicile ~4 % of the country's population is a rich depository of biodiversity, a natural habitat of ~8000 species of flowering plants, over 816 tree species, 675 edibles and nearly 1740 species of medicinal plants. The region encompasses over several states of India, i.e., JK, HP, UK, Sikkim, and Arunachal Pradesh and the hill regions of Assam and West Bengal. This vast region is important in global atmospheric circulation and is vulnerable due to its unique geology, rich natural resources, and socioeconomic milieu. Climate change may cause a significant impact on this region. Water resources in this region are one of the vital inputs for the survival of mankind and rich biodiversity. Climate change can affect significantly in the quantum of flow as snow and glacial melt is the major contributor of the rivers' flow in this region. The serious challenge is related to frequency and magnitude of extreme weather events like rainfall which may lead to flash floods, landslides and debris flow. There will be both short- and long-term implications due to

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climate change in this region. A large knowledge gap exists in the present scenario regarding the climate change implications on water resources and related hazards in the Himalayas and their downstream river basins. Primary data generation and its utilization in developing scenarios taking into account water demand and socio-economic development as a whole are required. Establishment of monitoring system for snow, ice, and water and use of latest hydrological model are the keys. Climate change may have a detrimental effect on the present socio-economic structure in the region also. Society will also have to adapt to the stresses of the climate change on the livelihood. Participation of people in their general welfare backed by institutional support and updated knowledge base will be important in the changed climate scenario. (***Pramanik, 2016*****).**

Historic marginalization has left many tribal communities in the American West facing a unique set of water resource management challenges associated with climate change. Several approaches have emerged to measure and compare climate vulnerability using techniques from national-level climate vulnerability assessments, applied on a community-level scale to examine and map the relative vulnerability of sovereign tribal territories to climate-induced water challenges. These approaches draw on the literature on integrated vulnerability assessments and can be used to construct a composite index of agricultural vulnerability for 72 western tribal lands. Nineteen empirical indicators were deductively selected and grouped into exposure, sensitivity and adaptive capacity. Exposure indicators include numerous measures of climate variability such as drought and other extreme weather events, temperature and precipitation change. Sensitivity indicators featured three types; human, livelihood, and physical capital. Adaptive capacity examined social, economic and institutional dimensions. Final results include four vulnerability maps offering a comprehensive picture of how differences in access to resources, class, and other socio-economic factors result in drastically different vulnerabilities across tribes that are located in a similar biophysical context. The discussion addresses both the utility and limitations of traditional climate vulnerability assessments for understanding tribal water challenges. These include the sovereign status of native lands, their connectivity to surrounding regions, nestedness within state and national governance systems, importance of cultural integrity, and evolving legal institutions surrounding water rights. The thesis concludes with a call for a more dynamic approach to understanding the inherent adaptive capacity and resilience of tribal populations, and paths forward for improving water resource management on sovereign tribal territories. (***Palmer, 2017*****).**

Climate change can have disruptive impacts on water and other natural resources. In view of this, there is the need to marshal efforts and utilize available knowledge from diverse sources to enable society adapt to challenges associated with climate change. While a number of scientifically based and tested strategies have been utilized, indigenous means of adapting to global warming and other climate change impacts are also available. This

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study unearthed coping strategies adopted by Dupong, an indigenous community in Ghana to limit adverse impacts of climate change-induced water shortages. Community members were able to identify simple indicators that signalled climate change and its impacts on their water supply conditions. In addition, they adopted key strategies such as rainwater harvesting, reliance on alternative sources of water and increased roles of males in household water collection that enabled them to minimize the adverse impacts of climate change on their water supply situation. This paper argues that while these indigenous adaptation strategies are not perfect, they are affordable hence key adaptive measures such as rainwater harvesting could be improved upon to enhance their usefulness as coping mechanisms against climate change-induced declining water supply. (***Opare, 2018*).**

The economy of Odisha, one of the Eastern states in India is primarily agrarian. Over 80% of the population of Odisha lives in rural areas, where levels of poverty are higher than in the state's towns and cities. Odisha has the highest proportion of inhabitants from scheduled tribes (ST) and scheduled castes (SC) of all the states in India (39.9% compared to 24% nationally). These groups are marginalised and experience high rates of poverty, low levels of education, and poor health. Four of the poorest Western Odisha districts, i.e., Bargarh, Bolangir, Nuapada, and Kalahandi were selected for implementation of Western Odisha Rural Livelihoods Project (WORLP) at the initial stage. Bolangir and Bargarh districts are a part of the "West Central Table Land Zone" and have a hot and sub-humid climate.1 Similarly, Kalahandi and Nuapada districts are a part of the "Western Undulating Zone" and have hot moist and sub-humid climate. (***Sharma, 2018).***

Both agro-climatic zones are located in Eastern Plateau and Hills Zone (Zone number 7) of India (Behera et al. 2005). People living in this region are likely to be witnessing deteriorating climatic conditions (floods, drought, and temperature rise), with increased risks from disease and pests, and with associated implications for human and livestock health. Over half of the people living in western Odisha are from ST and SC communities. These people in western Odisha are highly vulnerable to climate change, partly as their poverty limits their capacity to deal with shocks and stress, partly as a result of living in an area of high environmental risk with dependence on climate sensitive livelihoods. This is a region of India where the mean temperatures are rising, and where the vulnerability profile places it among the highest risk areas in the country (***WORLP 1999***).

3. Adaptive Challenges

Adapting to the impacts of climate change on water resources presents significant challenges for tribal areas. These challenges are exacerbated by socio-political marginalization and limited resources [9].

Infrastructure and Technology

- ✓ **Inadequate Infrastructure:** Many tribal areas lack basic water infrastructure, complicating adaptation

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efforts. The Standing Rock Sioux Tribe in North Dakota struggles with aging and insufficient water infrastructure.

- ✓ **Technological Barriers:** Access to modern water management technologies is limited. Solar-powered water systems, desalination, and advanced irrigation techniques are often beyond the financial reach of many tribal communities.

Socio-Political Marginalization

- ✓ Limited Representation: Tribal communities often have little representation in policy-making processes. This exclusion hampers the development of tailored adaptation strategies.
- ✓ Land Rights Issues: Disputes over land and water rights hinder adaptive capacity. In Brazil, indigenous tribes face encroachment on their lands, complicating efforts to manage and protect water resources.

Integrating Traditional Knowledge

- ✓ **Value of Traditional Practices:** Traditional water management practices, honed over centuries, can offer sustainable solutions. The Quechua people in Peru use ancient irrigation techniques to manage scarce water resources effectively.
- ✓ **Challenges of Integration:** Combining traditional knowledge with modern science requires collaboration and respect for indigenous perspectives. In Australia, collaborative water management projects between Aboriginal communities and scientists have shown promise in enhancing water resilience.

4. Policy and Governance

Effective policy and governance are crucial in addressing the impacts of climate change on tribal water resources. Policies must be inclusive, recognizing the unique vulnerabilities and rights of tribal communities [10].

Inclusive Policy Frameworks

- ✓ **Recognizing Indigenous Rights:** International agreements like the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) emphasize the rights of indigenous communities to their traditional lands and resources, including water.
- ✓ **National Strategies:** Countries are developing strategies to address water security for indigenous peoples. In Canada, the First Nations Water Management Strategy aims to improve water infrastructure and management in indigenous communities.

Participation in Decision-Making

- ✓ **Empowering Communities**: Ensuring the participation of tribal communities in water management decisions is essential. Co-management approaches, where indigenous and governmental

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bodies share responsibilities, can lead to more effective water governance.

- ✓ **Capacity Building:** Strengthening the capacity of tribal communities to engage in water governance involves education, training, and resource allocation. Programs that build local expertise in water management are crucial for long-term resilience.

Legal and Institutional Support

- ✓ **Enforcing Water Rights**: Legal frameworks must enforce tribal water rights. In the United States, legal battles like those fought by the Navajo Nation highlight the importance of securing water rights through litigation and advocacy.

- ✓ **Institutional Collaboration:** Collaborative institutions that bring together tribal, national, and international stakeholders can enhance water governance. The Arctic Council, which includes indigenous representation, addresses water and climate issues in the Arctic region.

5. Conclusion

The impact of climate change on water resources in tribal areas is multifaceted and profound, encompassing hydrological changes, socio-economic effects, cultural disruptions, adaptive challenges, and policy implications. Addressing these challenges requires a holistic and inclusive approach that integrates traditional knowledge, modern science, and effective policy frameworks. Ensuring the water security of tribal communities is essential for preserving their livelihoods, cultures, and identities. As climate change continues to advance, proactive measures to safeguard water resources in tribal areas will be crucial in sustaining their resilience and well-being. By recognizing the unique vulnerabilities and rights of tribal communities, we can develop more equitable and effective solutions to the pressing issue of water security in the face of climate change.

References

1. **Bolin, B., Seetharam, M., & Pompeii, B. (2010).** Water resources, climate change, and urban vulnerability: a case study of Phoenix, Arizona. *Local Environment*, *15*(3), 261-279.
2. **Hamlet, A. F. (2011).** Assessing water resources adaptive capacity to climate change impacts in the Pacific Northwest Region of North America. *Hydrology and Earth System Sciences*, *15*(5), 1427-1443.
3. **Halder, P., Sharma, R., & Alam, A. (2012).** Local perceptions of and responses to climate change: experiences from the natural resource-dependent communities in India. *Regional environmental change*, *12*, 665-673.
4. **Gautam, M. R., Chief, K., & Smith Jr, W. J. (2013).** Climate change in arid lands and Native American socioeconomic vulnerability: The case of the Pyramid Lake Paiute Tribe. In *Climate change and indigenous peoples in the United States: Impacts, experiences and actions* (pp. 77-91).

International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

Cham: Springer International Publishing.

5. **Cozzetto, K., Chief, K., Dittmer, K., Brubaker, M., Gough, R., Souza, K., ... & Chavan, P. (2014).** Climate change impacts on the water resources of American Indians and Alaska Natives in the US. *Climate Change and Indigenous Peoples in the United States: Impacts, Experiences and Actions*, 61-76.
6. **Dettinger, M., Udall, B., & Georgakakos, A. (2015).** Western water and climate change. *Ecological Applications*, *25*(8), 2069-2093.
7. **Pramanik, P., & Bhaduri, D. (2016).** Impact of climate change on water resources in Indian Himalaya. *Conservation Agriculture: An Approach to Combat Climate Change in Indian Himalaya*, 487-507.
8. **Palmer, A. E. (2017).** *Climate Change on Arid Lands–A Vulnerability Assessment of Tribal Nations in the American West* (Master's thesis, Ohio University).
9. **Opare, S. (2018).** Adaptation to climate change impacts: coping strategies of an indigenous community in Ghana to declining water supply. *Climate and Development*, *10*(1), 73-83.
10. **Sharma, V., Reddy, B., & Sahu, N. (2018).** Sustainable rural livelihoods approach for climate change adaptation in Western Odisha, Eastern India. In *Climate Change Adaptation and Development* (pp. 161-174). Routledge.