

REVIEW ARTICLE

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# Dynamics of indigenous community's food and culture in the time of climate change in the Himalayan region

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## Abstract

Global climate change has become the most significant challenge of modern times, confronting the lives and security of vulnerable societies around the world. The anticipated impact of climatic variability will be severe on local communities, particularly those residing near high-risk prone zones such as coastal areas and mountain regions. The indigenous knowledge and locally-held beliefs act as a refuge, which also prompt and prohibit the responsiveness towards climatic instabilities. Subsequently, ensuring food and nutritional security is the primary task of strategy makers. Hence, comprehensive knowledge of the indigenous traditional food habits and cultural values, beliefs, and gendered norms need to be explored on a priority basis to address the adverse impact of environmental changes, emphasizing the urgency of the Himalayan societies. Despite that, the integration of indigenous knowledge is not on the priority list of the researcher. Thus, this article reviews the existing literature on customary food habits to analyze the bidirectional association between climate change and the dietary practice of the indigenous communities for adaptation policy. PRISMA Statement technique is used for a systematic review of Scopus and Web of Science databases identified 24 related studies from 14 countries, with a specific focus on the Himalayan region, which resulted into four themes viz. impact of climatic variability of indigenous societies, the impact of climate change on community's customary food beliefs, the impact of climate change on gender defined norms, climate change adaptation strategies. The findings show that the current literature has failed to include the socio-ecological beliefs of traditional communities associated with dietary habits. Thus, the focus should be given to integrate the locally held beliefs of customary societies for the successful adoption of climate change adaptation and food security programs.

**Keywords:** Systematic review, Socio-cultural approach, Food practice and norms, Local communities, Qualitative approach

## Introduction

Global climate change has become the most significant challenge of modern times, confronting the lives of vulnerable communities around the world. The indigenous dietary habits of the Himalayan regions are changing due to climate change, which is the new norm of the twenty-first century. Both anthropomorphic and natural factors

are responsible for environmental change. Accordingly, the anticipated impact of climatic variability will be severe for vulnerable communities such as those residing near coastal areas and mountain regions [1]. Further, the severity of climate change on the natural ecosystem is estimated to increase the possibility of higher incidence of forest fires, infrequent rainfall, and unpredictable temperature change. Moreover, the environmental change for a more extended period of time would disturb the seasonal precipitation rates, affect the mountain ecosystem, availability of water, and food security [2].

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Furthermore, the ever-increasing importance and global recognition of indigenous people’s knowledge, which suggests an alternative perspective about climate change and nutritional security, is now a primary concern of policymakers [3]. Besides that, the traditional knowledge of the local community acts as a refuge at the time of climate-induced emergency. Even the literatures have emphasized a significant connection between traditional dietary habits, climate change, and socio-cultural belief systems (Fig. 1); despite it, the integration of indigenous knowledge is not on the priority list of the researcher.

The impact of climatic variability varies among different social groups, and the underprivileged communities are the most vulnerable ones. Since most of the Himalayan population lives in rural areas, they lack the proper connectivity with the mainstream world. Hence, food security gets exacerbated at times of unfortunate climatic events. For that reason, comprehensive knowledge of the indigenous traditional food habits and cultural values, beliefs, and norms needs to explore on a priority basis to address the adverse impact of environmental changes, emphasizing the urgency of the Himalayan societies.

Subsequently, climatic variability has created widespread risks for indigenous people’s traditional dietary practices and food security in the Himalayan region. As a result, local cultures have been forced to make significant adjustments in their traditional food choices. To make the policies sustainable and acceptable to the mountainous people, they needed to be investigated, explored, and improved with suitable contributions from socio-cultural and scientific perspectives.

Therefore, this study explores the piece of literature related to the dietary habits of traditional communities during climate-induced emergencies. The systematic review aims to analyze the dynamic of socio-ecology and culturally important indigenous eating practices for sustainable consumption patterns. Secondly, to

suggest climate change adaptation strategies for future research focusing on the Himalayan region (Fig. 2). This section describes the motive of conducting a systematic review, whereas the second section explains the methodology and PRISMA Statement (Preferred Reporting Items for Systematic reviews and Meta-Analyses) approach. The third part systematically reviews and synthesizes the empirical research work to recognize, select and evaluate the existing studies on the importance of culturally-significant dietary beliefs affecting the climate change adaptation and food security of traditional communities, and discovers the perspectives for future research. The last section is the conclusion of this systematic review.

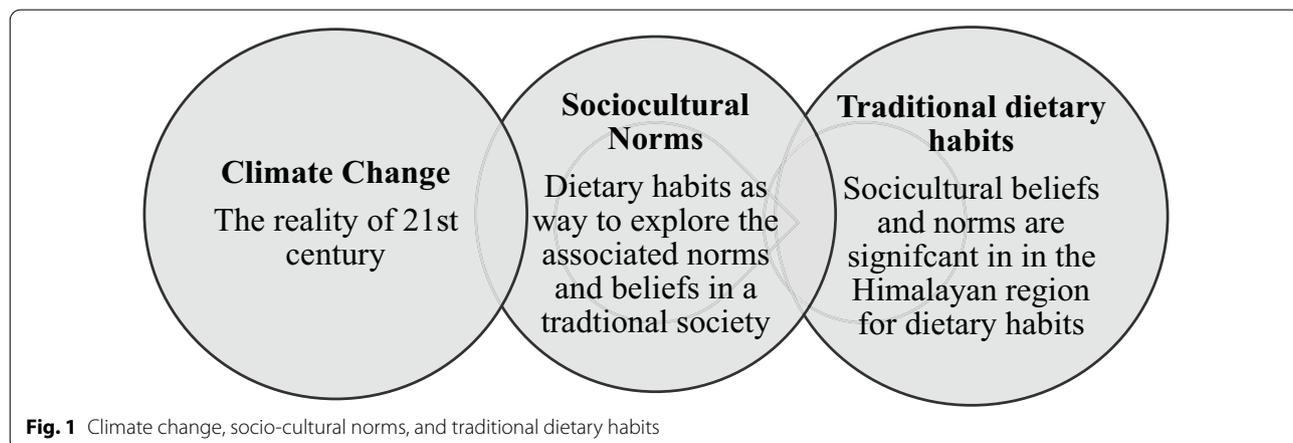
**Methodology**

**PRISMA Statement**

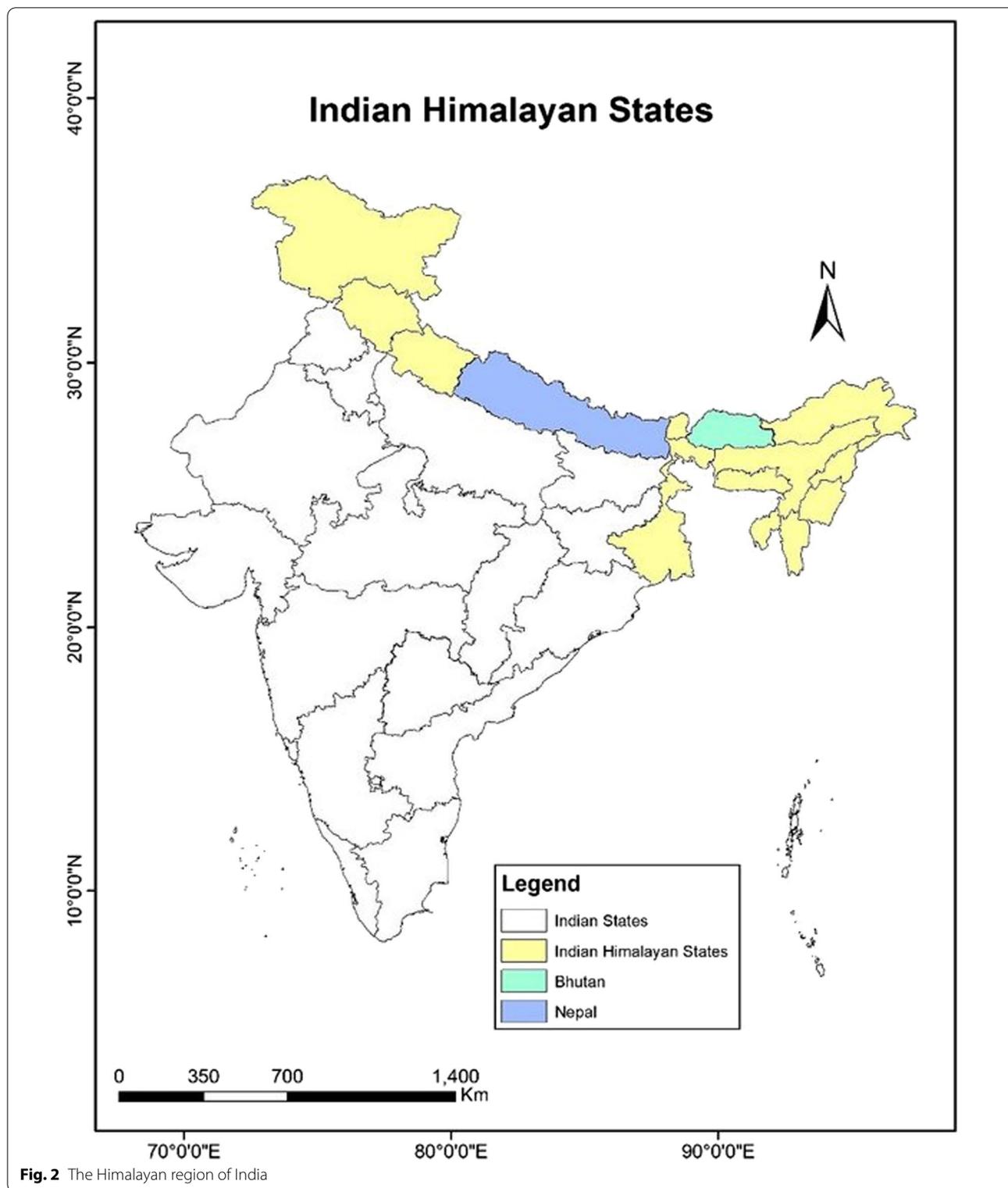
The current review has used the PRISMA statement. The PRISMA method is widely used in socio-ecological studies [4–6]. This approach allows the researchers to define the research objectives with substantial systematic research. Also, it allows the identification of inclusion and exclusion criteria, which further aids in examining a larger database within a defined period [7]. Further, the PRISMA statement permits to search for literature related to multiple dimensions of climatic variabilities, such as the impact on indigenous community’s dietary practices.

**Article collection**

The present article is the systematic review of studies grounded on the analysis of the existing literature presenting the effect of climate change on the traditional dietary habits of the indigenous peoples in the traditional communities. We collected the already published literature in English only. Furthermore, primarily the Google



**Fig. 1** Climate change, socio-cultural norms, and traditional dietary habits



scholar, Scindirect, Web of Science, and Scopus databases were used for data mining, i.e., collecting relevant articles and literature for analysis purposes.

#### Coding and theme generation

Thematic coding is a qualitative analysis that explores and documents sentences or paragraphs having interlinkage

through a common theme or idea. That allows the indexing of the transcript into several groups and establishes a “framework of thematic ideas about it” [8]. Adapting the thematic analysis approach of [9, 10], the subsequent combinations of keywords or codes used are, i.e., climate variability, OR environmental change, OR climate change; AND food choice, OR food practice, OR dietary habits, OR eating patterns, OR traditional food, OR traditional diet, OR dietary shift, OR ethnic food; AND local culture, OR gendered norms, OR indigenous knowledge, OR traditional knowledge.

#### Criteria for inclusion and exclusion of articles

Since climate change started happening rapidly in recent two decades [11], only those articles were selected, published after 2000 for the current review article. Further, to be incorporated in this study, the article needed to report: the impact of climate change on the indigenous population and their perception, the socio-cultural dynamics associated with the customary eating practice, and the gender dimension of dietary habits in traditional societies. Hence, studies published merely from quantitative or only from laboratory trials were not considered for the analysis. The studies presenting only an indication in terms of significance or less significance of the social and cultural aspects of food choices were also excluded. The reports of the research projects focusing primarily on technological solutions were also omitted due to the nature of the current analysis.

#### Selection of studies

Initially, articles were mined to apply the search filters to the titles, keywords, and abstracts. After the search, a second manual filter of complete reading of the titles and abstracts was conducted to improve bibliographic material selection on the returned documents for further systematic review [12].

#### Approach for systematic review

The systematic review was conducted in four stages. The first one was the identification of keywords to be used for relevant literature searches. Based on earlier research studies, the keywords with relevance and similarity with climate change, indigenous community, and traditional belief system (Table 1), duplicate articles were removed accordingly. At the second phase, i.e., the screening stage, out of 275 articles initially found eligible to be reviewed, 198 articles were removed. At the third phase, i.e., eligibility, 53 secondary pieces of literature were removed due to the irrelevance of studies for the current article following exclusion criteria. Finally, 24 articles were used for qualitative analysis (Fig. 3).

#### Data abstraction and analysis

Initially, the data analysis was performed by scrutinizing the code frequency, prevalence, and co-occurrence employing the Atlas-ti 8 software to identify the inter-linkage of codes and defined concepts at the preliminary level. Descriptive statistics were used to evaluate which codes are common and often occur together and follow code prevalence across the articles [37]. Following a three-step thematic analysis, each secondary literature was entered into qualitative data analysis tools [38]. Thematic analysis was conducted with the remaining literature on Atlas-ti version 8 software for qualitative data analysis [39]. The NCT (noticing, collecting, and thinking) approach was employed for data analysis. Consequently, the option of network-building feature, which is the major strength of Atlas-ti software, also aids in the examination of existing association and correlation between the various studies incorporated for the current article [40]. Finally, general themes and sub-themes were defined.

#### Results

A total of 275 articles were collected during the initial search from different databases. Accordingly, after following the exclusion criteria, i.e., articles published before 2000 ( $n=22$ ), lack of focus on socio-cultural dimension ( $n=5$ ), book chapters, book series, review articles, non-English articles ( $n=12$ ), technical reports, lab and experimental reports ( $n=14$ ) (Fig. 3). Thus, only 24 articles were considered for systematic analysis, which met the inclusion criteria. Furthermore, only those studies were incorporated, using the qualitative approach, i.e., interview schedule to describe the respondent's observation. Regarding, year of publication, only those papers were systematically reviewed that were published between 2006 and 2021, viz. six studies between 2006 and 2010, eight studies between 2011 and 2015, eight studies between 2016 and 2020, and one study in 2021. Further, eighteen studies were conducted on local or indigenous people, three studies were a consumer survey, and one was based on an opinion poll.

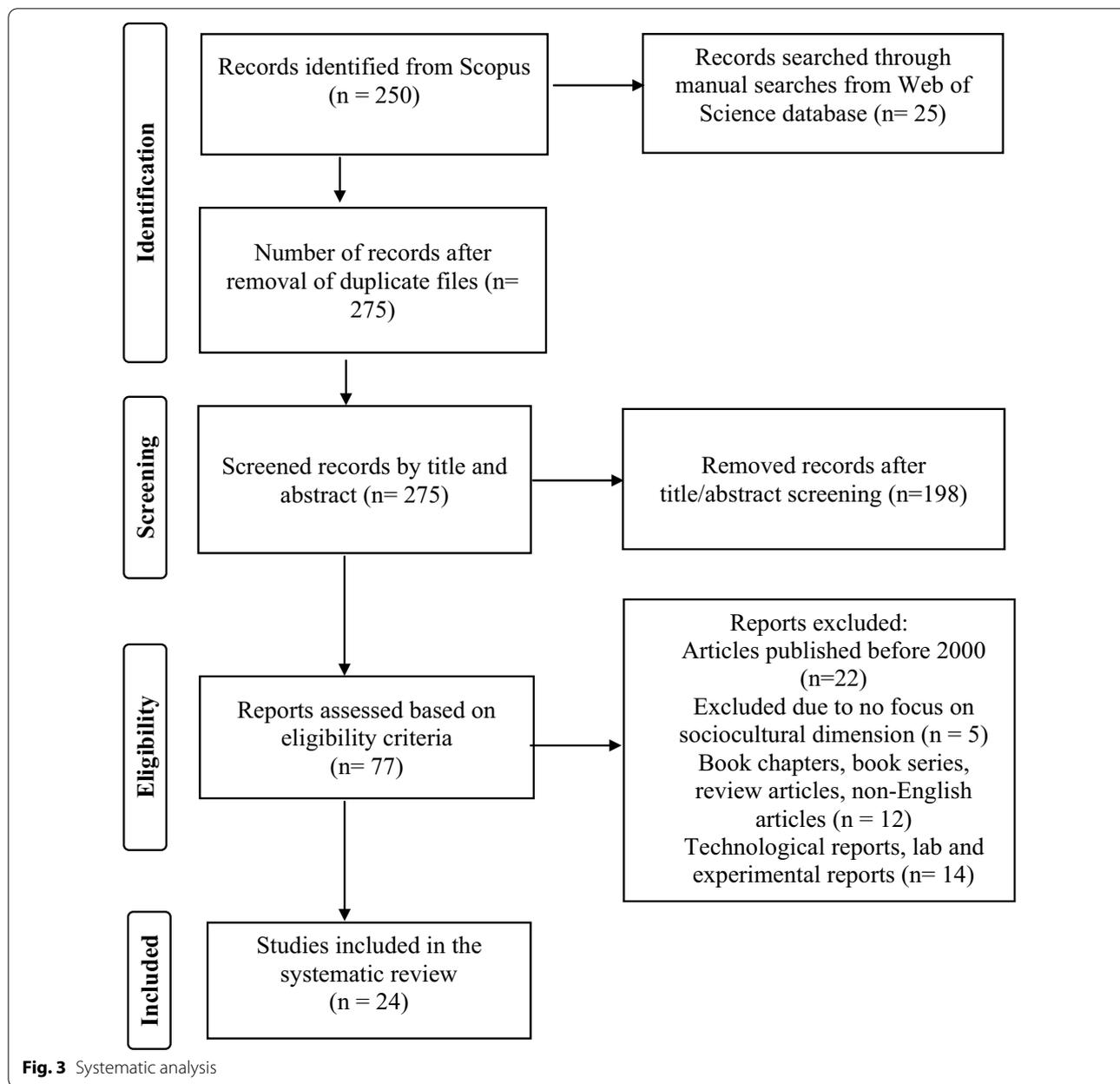
The majority of the research were carried out in the Himalayan region viz. in India [36, 21, 25, 28, 32–35], Nepal [13, 20], India and Nepal [22], China [15, 16], Pakistan [14], Bhutan [23], Myanmar [24], Canada [26, 27], Spain [17], Europe [29], Portland [19], Mexico [30], Joint research in Sweden, US, UK, and Japan [18], Nigeria [31], as shown in Table 1. Studies incorporated for the systematic analysis were based on the traditional community's traditional eating practices and the impact of climate change on indigenous people.

**Table 1** The findings

| Author(s)                   | Country/city              | Sample size   | Methodology   | Key findings  |
|-----------------------------|---------------------------|---|---|---|
| Bhattarai et al. [13]       | Nepal                     | Local farmer (n = 91), Focus Group Discussion (FGD) (n = 4, 10–12 participants) | Case studies, in-depth interviews, FGD, and participant's observation | Gender inequality due to socio-structural norms; undermines the climate change adaptation   |
| Khan et al. [14]            | Pakistan                  | Local communities (n = 120, 87 male and 33 female)                              | In-depth interviews   | Lack of awareness of ethnobotanical plants; results in the careless use of natural resources  |
| Salick et al. [15]          | Tibet, China              | Sample size (Not mentioned)   | Ethnobotanical method and qualitative in-depth interviews             | The severe impact of climatic change on the livelihood, lifestyle, and traditional Tibetan culture of herding of animals                        |
| Byg and Salick [16]         | Tibet, China              | Indigenous communities (n = 90, 45 female and 45 male)                          | Semi-structured interviews  | Localized meaning of climate change based on socio-cultural, spiritual, and moral factors   |
| Gómez-Baggethun et al. [17] | Spain                     | Local people (n = 33), FGD (n = 3, 4–6 individuals)                             | Interviews, FGD, and systematic reviews of historical archives        | Traditional beliefs systems associated with socio-ecological knowledge are crucial for a sustainable long-term solution                         |
| Von Borgstede et al. [18]   | Sweden, US, UK, and Japan | Opinion poll (n = 1500) in 2005 (n = 742) and 2010 (n = 615)                    | The longitudinal survey, opinion poll, close-ended questionnaires     | Climate change is the reality; sustainable environmental friendly consumption choices possible solution   |
| Semenza et al. [19]         | Portland and Houston      | Participants (n = 1202, female = 787 and male = 415)                            | Mixed methodology   | The negligence of socio-structural norms; barriers in climate mitigation efforts  |
| Gentle and Maraseni [20]    | Nepal                     | Local household (n = 485)   | In-depth interviews, FGD, key informants interviews                   | Social inequalities and inequity in resource allocation due to climate change; affecting vulnerable communities                                 |
| Vedwan [21]                 | Himachal Pradesh, India   | Apple growers (n = 58)  | Semi-structured interviews  | Shift in traditional cropping pattern due to climate change in the Himalayan region   |
| Chaudhary and Bawa [22]     | India and Nepal           | Households (n = 225)  | In-depth interviews, focus group discussion                           | The shift in agricultural practices of indigenous communities. For example, apple production has severely been affected                         |
| Katwal et al. [23]          | Bhutan                    | Indigenous farmers (n = 404, male = 237, and female = 167)                      | Survey with close-ended questionnaires                                | The loss of one-third of traditional agrobiodiversity in the region; emphasis on adoption of crops according to different agro-ecological zones |
| Oo et al. [24]              | Myanmar                   | Local farmers (n = 178), FGD (n = 7)  | In-depth interviews, FGD  | Poor socio-economic status negatively affects the adaptation policies in society  |
| Bhadwal et al. [25]         | Sikkim, India             | Local communities FGD (n = 8)   | In-depth interviews, FGD  | Gender norms in traditional communities affect adaptation; due to lack of access to human, financial, and natural capitals                      |
| Guyot et al. [26]           | Canada                    | Aboriginal communities (n = 2)  | In-depth interviews, FGD  | Impact of climate change on traditional dietary practices and consumption   |
| Ford [27]                   | Canada                    | Nunavut community   | In-depth interviews, FGD  | Impact of climate change on traditional dietary practices   |
| Upadhaya et al. [28]        | Meghalaya, India          | Tribal community (n = 2)  | In-depth interviews, FGD  | Traditional agriculture practice could result in sustainable consumption and environment  |

**Table 1** (continued)

| Author(s)                  | Country/city            | Sample size  | Methodology  | Key findings  |
|----------------------------|-------------------------|--|--|---|
| Pieniak et al. [29]        | Europe                  | Consumer survey (n = 4828)                         | Cross-sectional quantitative survey                                | Traditional food consumption depends on familiarity, naturalness, and health benefits         |
| Rojas-Rivas et al. [30]    | Mexico City             | Consumer survey (n = 610)                          | In-depth interviews  | The association of traditional norms positively influence the dietary habits                  |
| Akintan et al. [31]        | Nigeria                 | The household survey (n = 350)                     | Household surveys, semi-structured interviews                      | 'Ethnic-specific' traditional norms and taboos crucial in food choices of traditional society |
| Chakraborty et al. [32]    | Uttarakhand, India      | Local households (n = 62)                          | Household surveys, semi-structured interviews                      | Socio-cultural norms are significant sustainable environment and dietary choices              |
| Malhotra et al. [33]       | Himachal Pradesh, India | Local people (n = 20), FGD (n = 3)                 | In-depth interviews, FGD   | Socio-ecological changes and affected the cultural norms linked to eating practices           |
| Singh et al. [34]          | Kashmir, India          | Native people (n = 113)                            | Household surveys, interviews, semi-structured interviews          | Ethnobotanical knowledge is crucial for novel nutraceutical products                          |
| Nautiyal and Kaechele [35] | India                   | Sample size (not mentioned)                        | Household surveys, semi-structured interviews                      | Traditional mountain farming is sustainable for the environment and indigenous societies      |
| Negi and Maikhuri [36]     | Uttarakhand, India      | Local villages (n = 62, sample size not mentioned) | Household surveys, semi-structured interviews, in-depth interviews | Traditional agro diversity is insurance against disease and extreme climatic fluctuations     |



The present study has systematically reviewed existing studies on climate change and the impact of traditional society’s lifestyle and attached cultural beliefs through dietary practices. Climate change is the reality of the twenty-firstst century, which requires an integrated and holistic approach to address its impact on vulnerable communities. Thus, a rigorous review of the select articles retrieved from two databases resulted in 24 papers related to the significance of socio-cultural practices of traditional communities in climate change adaptation. Accordingly, four themes were generated viz. impact of

climatic variability of indigenous societies, the impact of climate change on community’s customary food beliefs, the impact of climate change on gender defined norms, climate change adaption strategies. The first theme has recognized that the negative impact of environmental change can have severely affected the indigenous lifestyle of native people with seven studies. For example, ethnobotanical species’ declining knowledge has resulted in reckless usage of natural resources [14]. Similarly, the climatic variabilities have also affected their traditional way of living, such as animal herding, a

significant customary practice of herding community for their very existence in the mountain regions [15, 16]. Also, climate change affects the local biodiversity of the regions and impacts the local adaptation strategies [23]. Thus, the traditional ethnobotanical knowledge [34], indigenous method of farming [35], local agrobiodiversity act as insurance against climate-induced emergencies [36].

The second theme emphasizes the impact of environmental change on traditional dietary habits and attached customary practices of the local communities with ten studies. For example, the shift in cropping patterns has led to a dietary shift in recent years, i.e., the productivity of apples has been decreasing due to early budding [21, 22]. Similarly, the shift in customary eating practice has also been observed due to climate change [26, 27]. Further, in a traditional society, dietary habits depend on the familiarity and naturalness of food [29], customary norms [30], and taboos in indigenous communities [31]. Thus, the socio-cultural norms and beliefs system is imperative for environmentally sustainable practice [28, 32, 33].

The third theme explores the impact of changing climate on gender-associated norms on a traditional community, including three studies. Climate change is already widening inequality in society because it affects the vulnerable community the most, but women suffer the most due to defined gender roles. Further, gender disparity leads to inequality in terms of access to financial and natural resources, affecting their food and nutritional security [13, 20]. Thus, the inclusion of gender-defined norms of the traditional society is imperative for an inclusive policy [25].

The last theme documents the policy dynamics with a focus on four studies. Climate change is the reality of modern times. Therefore, sustainable consumption choices must be integrated for a long-term solution [18] since traditional dietary habits are eco-friendly, which have lesser carbon footprints in the environment. Therefore, the ignorance of socio-cultural and socio-ecological dimensions can result in policy failure and hamper climate change adaptation [17]. Hence, besides reducing the economic disparities [24], the urgency of intergenerational of culturally-significant traditional dietary practices arises for viable and inclusive climate change policies [19].

## Discussion

### Impact of climatic variability of indigenous societies

The degree of livelihood and climate change vulnerability differed according to the community's geographical, financial, and social status in a traditional society. Thus, the heavy reliance of indigenous communities on natural

resources in the Himalayan regions gets severely affected due to climatic variability [41]. Therefore, examining and measuring the depth of the awareness and perception related to climate change and its impact on local and indigenous dietary habits are urgent for inclusive and comprehensive strategies. Climate change is anticipated to raise temperatures and precipitation in the Himalayan region, putting pressure on traditional eating practices due to change in agrobiodiversity and cropping patterns. However, the traditional diet is one of the local communities' solutions for adapting to climate change [42].

For example, the early budburst is a recent phenomenon in the mountainous regions due to rapid environmental changes, which have further forced the indigenous communities to change the agriculture pattern. For example, apple production has severely been affected. Also, change in temperature is highly felt at high altitudes compared to lower altitudes [22]. Similarly, the lack of adaptive capacity makes the farmers more vulnerable to climate change, and the issue gets exacerbated due to poor socio-economic status in society [24]. Furthermore, the higher dependence of indigenous communities on forest and forest resources, i.e., about 1.6 billion people rely on natural and forest resources, makes the local perspective inevitable for sustainable solutions [43]. Thus, local people's and farming communities' understanding of rural landscape management and sustainable bioresource use is an effective strategy for dealing with climate change. Hence, local people's indigenous knowledge and climate change perspectives are crucial for adaptation strategies at the local level in the western Himalayan mountain ecosystem [44]. Also, the phenomena of environmental change will have an impact on ecology as well as on societal belief systems. Even one of the primary agenda of the sustainable development goals for adaptation measures is to address the issue of food and nutritional insecurity faced by vulnerable local communities [45].

Besides, the success of any policy directly depends on the acceptance of the same among the local and regional communities, which is only possible if the indigenous community's perspective is integrated into policy documents to address the meaningful context-specific and geography-specific issue [46]. Since the Himalayan region is the typical example of a highly dynamic socio-ecological landscape [47], a comprehensive understanding of traditional society's insights on climate change can be employed in policy formation for ensuring food security and reducing the risk of the Himalayan communities in the western Himalayan regions.

In addition, anthropogenic activities play a decisive role in the severe deterioration of the Himalayan regions, which further increases the vulnerability of locals

towards climatic variabilities [48]. Thus, it is evident for inclusive and responsive climate change actions to understand local socio-cultural beliefs attached to food choices comprehensively. Society's response to every dimension of global climate change is mediated by culture. Thus, the response to climate variabilities is noticed in both physical and natural ecosystems. Still, adaptive and mitigating strategies are developed considering the availability of natural resources on unique and societal scales [49]. The linkage between crop and climate shapes the perception of climate change. Hence, due to climate change, the crop pattern has also shifted from a diversified cropping pattern to a mono-cropping pattern in the Himalayan region, as the study indicates [21].

The local community's livelihoods are impacted by climate change in a variety of ways. Their traditional wisdom influences society's perceptions of climate-related challenges. The study demonstrated a strong association between communities' perceptions of climate change and traditional norms [50]. The participation of the community is crucial for the sustainable development and management of natural resources, which have a special place in local societies important due to the indigenous community's dependence on a favorable climate for their livelihood and financial needs through tourism. The Van Panchayat (Forest Councils) and Village Forest Committees have always been important in making adaptive and mitigative strategies due to their significance in local societies. But, due to globalization and market forces, the importance attached to local councils has deteriorated in the mountain regions. Therefore, the urgent need for traditional community integration arises for constructive and better resilience policy measures [51].

#### **Impact of climate change on community's customary food beliefs**

The environmental change poses an unusual threat to societal imagination. Thus, applying sociological imagination as defined by C.W. Mills, i.e., the ability to shift from one viewpoint to another rational approach, is vital to genuinely recognize the interrelationships between environment and social structure [52]. He reiterated that the scientific community had made a great stride in understanding the climatic variabilities, but the response to changing climate is inadequate despite the remarkable socio-political efforts. Since human beings live in harmony with nature, therefore, acknowledging the relationships between a community's actions, cultural norms, and their impact on the ecological system or vice-versa is inevitable [53]. Further, despite similar physiological needs in humans, food habits are not universal. In the words of sociologists Peter L. Berger and Thomas Luckman (1966), dietary practices are the social construction

of reality, i.e., the subjective meaning and choices are influenced by the cultural and historical experiences of the individual [54].

The social and cultural norms are an integral part of traditional society. Several studies have reported the importance of socio-cultural beliefs in the Himalayan regions. In terms of biodiversity conservation, sacred groves are well-known around the world. In recognition of its role in biodiversity protection, the study recommended the conservation and integration in the strategies to deal with climate change [55]. However, the change in traditional values and norms instigated by environmental change among the indigenous community is still unknown, despite much significance of the traditional beliefs in the western Himalayan mountain regions. For example, as noted by [23] in Bhutan, a study of 404 indigenous farmers found that the loss of one-third of traditional agrobiodiversity in the region. More than ninety percent of farmers agreed that climate change had affected the local agrobiodiversity. Finally, it emphasized the adaptation of crops according to different agro-ecological zones considering the agro-ecological heterogeneity.

People in the Himalayan region have maintained a reasonable living standard despite physiography, climatic, and resource availability challenges. However, the study noted that the climatic change had prompted the local community to shift their traditional dietary habits as a successful adaptation strategy. Hence, indigenous food habits need to be integrated for inclusive adaptation measures [56]. Climatic variability has caused broad threats to indigenous communities' food and nutritional security in the Himalaya region. However, because of the wide range of demographic, social, and economic variables, the extent of the consequences experienced and perceived by local people differs [57].

For example, it was observed in a qualitative and ethnobotanical study in Tibet that the Alpine trees are highly diverse and crucial plants most susceptible to environmental change [15]. But, due to the climatic changes, the livelihood, lifestyle, and traditional Tibetan culture of herding of animals have been vitally affected. Similarly, another study in Tibet, with 90 indigenous people, concluded that climate change significantly varied with geographical factors and livelihood activities [16]. Further, the phenomena of climate change not only depend upon economic factors but also on socio-cultural, spiritual, and moral factors.

Consequently, the area under traditional crops is rapidly shrinking in the region for various reasons. However, many crop varieties are still protected due to their socio-cultural and religious values. For example, the practice of Jhum farming in the northeastern mountain regions of India plays a vital role in ensuring the

traditional communities' food security and nutritional security. Besides, the practice of Jhum cultivation is a ritually sanctioned lifestyle of ethnic communities, which is also a measure of ethnic identity due to associated socio-religious beliefs of the local people. Therefore, integrating traditional knowledge is essential for balancing food security and the conservation of natural resources because indigenous practices lead to high yields without damaging the ecosystem [58]. Additionally, in a longitudinal opinion poll, which was jointly conducted in Sweden, the US, UK, and Japan with 1500 participants, where the respondents significantly agreed that climate change is the reality and nodded that sustainable environmental friendly consumption choices could be the possible solution to environmental change [18].

The local and cultural festivals also contribute to safeguarding the important crop varieties. For example, one of the farm festival celebrations called Harela in Uttarakhand urges people to preserve their indigenous dietary habits [50]. Also, the concept of sacred landscape is recognized by many traditional societies and frequently preserved by cultural and religious values as a manifestation of this relationship. Thus, the Himalayas has a long history of conserving ecological resources through religion and belief and plays an integral part in protecting biodiversity in the Himalayan region [59]. Therefore, exploring and documenting the degree of the possible change in customary beliefs associated with dietary habits among the local communities is inevitable.

In the Himalayan region, agro diversity is a safeguard against illness and extreme climate variations as an adaptive measure at times of climatic uncertainties. Many vulnerable crops have been preserved due to various traditional food as well as socio-cultural and religious rituals. However, these systems and practices in hill agriculture policy are blatantly neglected, emphasizing plain lands [36]. Participation of people has always been a part of development philosophy. However, village communities' control of local natural resources is now universally regarded as an institutional requirement. As a result, it's critical to look at how these institutions function, particularly from the perspective of the poor. Nonetheless, the socio-cultural factors and related changes in norms of the indigenous people are frequently lacking. Therefore, the fundamental reasons linked to traditional eating practices and possible change in societal beliefs due to climatic variabilities need to be explored sensibly for evidence-based policymaking [60].

The specific indigenous crops are considered suitable to particular agro-climatic regions due to their decades-long evolution. They share a significant portion of subsistence farming, food, and the lifestyle of the household and communities. But, such indigenous varieties are

hardly taken into account until some unfortunate natural calamities and anthropogenic incidents happen. For example, the associated benefit of the oak leaf is crucial for the communities because the oak forest is an excellent source of organic farming practice. Still, the local authorities have not recognized or acknowledged the same practice in the mountain regions [61].

Additionally, the indigenous ecological knowledge aids in the cultivation and conservation of soils fertility, helps control pest infestation, maintenance of sustainable biodiversity in the region. For example, "tinni" is a local variety of wild red rice, primarily conserved in the Bhar community by the females in the Northwestern state of Uttar Pradesh, India. The community has created tolerant rice varieties through the above local practice and maintained the aquatic fish biodiversity in the complex aquaculture region [62]. Further, few studies have been mentioned in the table, which interlinks climate change and its impact on traditional dietary habits and socio-cultural practices, as shown in Table 2.

#### **Impact of climate change on gender defined norms**

The notion of food choices and dietary habits has always been associated with gender norms, i.e., societal and cultural principles based on gender identity—for example, the women of the family cook due to defined gender roles. Hence, societal beliefs are prominent in defining the food choices in a traditional community. Thus, the integration of gender dynamics becomes crucial for forming gender-sensitive food policies in the face of climate change [67]. Climate change has a considerable impact on particular demography and communities. For example, in the Himalayan region of Pakistan, in a qualitative study with 120 local farmers, the local communities are well aware of the traditional ethnobotanical knowledge of the species and habitat conservation. Still, due to climate change and scarcity, people unwisely utilize natural resources, further deteriorating the ecosystem [14]. Similarly, climate change has contributed significantly to social inequalities and inequity in resource allocation due to degrading natural resources, which further affects the marginal like women, children, and poor communities the most [20].

Further, gender norms are significant in indigenous mountainous communities. The irregular rainfall and unpredictable seasonal variations have affected the accessibility and availability of natural resources, water, food, and forest produce. For example, the existing socio-structural norms strengthen gender inequality, further undermining the adaptation process to the climatic variability [13]. Furthermore, the environmental change has affected the socio-cultural aspects of the local communities in India's western Himalayas due to their significant dependence on nature and natural resources for food and

**Table 2** Climatic variabilities and cultural changes

| Climatic risks              | Impact on diets   | Cultural impacts   |
|-----------------------------|---|--|
| Drought                     | The practice of rotational cropping and the cultivation of various types of livestock for maintaining the different grazing habits that reduce the chances of disease to cattle are under threat [36] | The indigenous nomadic communities consider pastoralism was an integral part of their socio-cultural norms. Since climate change makes it difficult to follow the traditional way of cattle rearing, the cultural concept of pastoralism is vanishing due to shifts in social structures as the younger generation exit from shepherding   |
| Rising temperature          | The shift in the apple belt towards higher elevations results from global climatic change and local environmental change in the Himalayan regions [63]  | The psychological and spiritual emotions attached to the fruits have significantly affected  |
| Erratic rainfall            | Erratic rainfall patterns have affected the fish spawn availability in river Ganga [64]   | The climatic variability impacts fish availability, which has led to a decline of ecological and socio-cultural importance attached to local fisheries in the Gangetic plains  |
| Melting of ice              | Narwhal, ringed seals, arctic char, and caribou are the mainstays of the wildlife harvest in Arctic Bay, but climate change has affected the consumption and availability of traditional food [65]    | The difficulty of inaccessibility has resulted in modifying the consumption of traditionally significant food among the indigenous community. Since local food has importance in socio-cultural and economic activities in a traditional society thus, hunting seals is not only the means of food but also a way of life. Therefore, the change in seal-hunting has an impact on the culture of the traditional Inuit communities |
| Extreme climatic conditions | The traditional dietary practices have changed, such as consumptions of locally produce pluses like <i>Madua</i> and <i>Kala bharr</i> have shifted in the Himalayan region [66]                      | On special occasions like marriage and birth ceremonies, rituals are followed, where unique cuisines are prepared. Still, the ritual ceremonies and festival ceremonies have also been affected due to the lesser availability of traditional food   |

other basic needs such as water, wood, etc. Also, climate change is threatening the dietary habits of local communities in gender-specific ways [68].

Similarly, environmental change has a differential impact on men and women regarding their respective vulnerability factors. Hence, gender perspective should be integrated to adapt against changing climate [69]. However, only a few studies have been emphasized the role of gender and the impact of natural calamities on nutritional security in a customary society. But, the focus is on food security from the lens of gender approach, without exploring the potential change in gender and cultural norms of dietary practices due to climatic variabilities [70].

The current paper has focussed on the comprehensive understanding of the significance of the traditional community's perspective and knowledge in tackling climate change through the lens of dietary habits. It recognized the studies and local models where the customary knowledge of the indigenous societies was critical during natural calamities and unfortunate climatic variabilities. The analysis showed a greater sense of awareness about the environment among the indigenous communities, which further assisted in creating resilience against unforeseen situations in a traditional society.

#### Climate change adaption strategies

Ensuring the accessibility and affordability of food with the changing climate requires inclusive climate action. Since the eating habits and food choices of society and individuals are affected by various factors, the socio-cultural and socio-structural norms and values are the most influential in traditional indigenous communities of the Himalayan regions. Further, climate change has altered the ecosystem, not in India and neighbouring countries like China, Nepal, Bhutan, Pakistan, and Myanmar but also worldwide. The thematic analysis with the help of Atlas-ti version 8 software shows that climate change is the reality of the twenty-first century. Interestingly, due to the shift in traditional dietary habits, the socio-cultural norms associated with food practices also change due to climate change.

Further, the food and nutritional security of the women get severely affected during natural calamities and extreme weather conditions. In addition, the issue gets exacerbated due to the prevalent social and cultural norms of the communities. Therefore, following the is the direction for future research and climate change adaptation policies:

1. *Significance of traditional beliefs*: globally, the research on indigenous knowledge related to ecology, social and cultural factors affecting the food change

due to climate change is limited in numbers [71]. Thus, the local community's participation is inevitable, besides technological and scientific solutions for conserving natural resources in addressing the impact of climate change.

2. *Integration of gender-targeted policies*: the influence of societal and cultural factors is evident for gender-defined roles in decision-making regarding food habits in traditional communities related to adaptive measures to tackle the climate change dietary habits. Thus, based on the observations in the Himalayan regions and northern part of India, the study emphasized the certainty of gender-sensitive policy for adaptive policies against changing climate.
3. *Inclusion of customary practices*: traditional agricultural practices, identification of indigenous sustainable biodiversity for their nutritional value should be given due importance to ensure and food and nutritional security during climatic instabilities in the local communities.

#### Conclusion

This article has reviewed the existing literature on customary food habits to analyze the bidirectional association between climate change and the dietary practice of the indigenous communities for adaptation policy. PRISMA Statement technique is used for the systematic review of Scopus and Web of Science databases identified 24 related studies from 14 countries, with a specific focus on the Himalayan region, which resulted into four themes viz. impact of climatic variability of indigenous societies, the impact of climate change on community's customary food beliefs, the impact of climate change on gender defined norms, climate change adaption strategies. The findings show that the current literature has failed to include the socio-ecological beliefs of traditional communities associated with dietary habits. Climate change is heavily mediated by anthropogenic activity, where cultural beliefs are paramount. Still, at the same time, there is marginal research, which has incorporated the cultural aspect of the community and its influence in the development of climate change adaptation strategies. The exploration socio-cultural dimension would aid in a comprehensive knowledge of the underlying issues such as customary norms, gender-defines roles, and understanding the indigenous context of climate change. Further, the insights generated from this study will help better understand the response of customary societies to environmental change and formulate sustainable adaptation policy.

The indigenous practices acquired and approved by the traditional communities are competent to respond

against climatic variabilities. The traditional knowledge is inclusive, i.e., among the traditional communities, the family and societies' social structure is prominent besides socio-political development. Thus, the experience of traditional societies could be the starting point for the successful adaptive measure, but at the same, i.e., the socio-cultural dynamic of indigenous knowledge rarely gets recognized at the times of policy formation. A multi-dimensional approach would be imperative to effectively tackle the climate-induced emergency rather than emphasizing a single issue as vulnerability itself is multi-dimensional. Hence, the urgency of an integrated and holistic approach arises to ensure food security and climate change adaptation.

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The author declares no potential conflict of interest with respect to the research, authorship, and publication of the study.

#### Authors' contributions

Mr. Suraj Das developed the idea for the current research paper, reviewed the relevant literature, analyzed and wrote the manuscript. Dr. A.J. Mishra helped in every step from the formatting, proofreading to the finalization of the draft. All authors read and approved the final manuscript.

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