

Extreme Weather Events and Climate Change Impact on Construction Small Medium Enterprises (SME's): Imbibing Indigenous Responses for Sustainability of SME's

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Abstract

Purpose: India has a rich tradition of cultural practices and a textual heritage that dates back to several hundreds of years. The intellectual achievements of Indian thought are found across several fields of study in ancient Indian texts ranging from the Vedas and the Upanishads to a whole range of scriptural, philosophical, scientific, technical and artistic sources, which advocates environmentalism. However as the globalization took roots in India in late 80's and to withstand the competition face from global markets Indian Small Medium Enterprises ignored the environmental safety and as results of this pollution is now crossing critical limits in metro cities. Delhi experienced a number of Extreme Weather Events (EWEs) during recent years and a significant number of businesses were affected including the construction sector, which is a major employment driver, being the second largest employer in the country, next only to agriculture. However, little research work has been undertaken on how construction industry is at the risk due to the EWEs. The paper profoundly aims at exploring various such EMEs and their impact on the construction businesses. And finally suggests the ways through which it could be tackled.

Research design/methodology/approach: A mix and match research design was adopted to elicit information from construction industry, involving a questionnaire survey and interviews to obtain responses from construction practitioners. Mean was used to establish the average scores for analysis and conclusion. Direct and Indirect impacts from extreme weather events on logistics, people premises, process, markets and finance are discussed in detail

Findings/conclusions: Direct and indirect impacts from climate change include damage to products and tools from higher temperatures and increased rainfall, with consequent delays and increased costs to projects. The predominance of outdoor workers in this sector leaves its employees at higher risk from increased direct-heat stress, mostly dehydration all leading to severe effect on people.

Keywords: Indigenous knowledge; India; Extreme weather events; SMEs; Sustainability; Construction industry

Introduction

A brief about knowledge traditions and practices of India

India has a rich tradition of cultural practices and a textual heritage that dates back to several hundreds of years. It had a magnificently advanced knowledge base, which gave birth to rich traditions and ingenious practices during the medieval era. The intellectual achievements of Indian thought are found across several fields of study in ancient Indian texts ranging from the Vedas and the Upanishads to a whole range of scriptural, philosophical, scientific, technical and artistic sources. In many parts of India, communities have inherited the rich tradition of love and reverence for nature through ages. Religious preaching, traditions and customs have played a big role in this regard: Indian religions have generally been the advocates of environmentalism. India has witnessed the great environmental movements in past.

The four Vedas - Rigveda, Samaveda, Yajurveda and Atharvaveda - are full of hymns dedicated to the supremacy of various natural entities. The Rigvedic hymns refer to many gods and goddesses identified with sun, moon, thunder, lightening, snow, rain, water, rivers, trees etc. They have been glorified and worshipped as givers of health, wealth and prosperity. *The rain -god Indra* has the largest number of hymns attached to him. *Sun worship* is of vital importance in Vedic worship; the sun was worshipped in the form of gods like Surya, Martanda, Usa, Pusan, Rudra, etc because solar energy is the ultimate source of energy that regulates the energy flow through the food-chain, drives various nutrient cycles and thus controls the entire ecosystem all over the earth, but it was probably well understood and realized by the ancient

people as well. Holy book "*Guru Granth Sahib*" states, '*Air is the guru (Teacher), water is the father, and earth is the great Mother of all.*'

A brief about flora and fauna wealth of India

Trees and plants were considered as animate beings and to harm them was regarded as a sacrilege. The Atharva-Veda glorifies the medicinal value of various herbs with mythical powers. Three major factors are responsible for the origin of the tree-cult in India:

Their wood leaves, fruits, etc. were useful to humans; it was believed that trees were possessed by spirits who guided humans in their distress; and humans developed respect for trees which often provided them with an alternative for medicinal plants.

The pipal (*Ficus religiosa*) tree (Figure 1), which is considered sacred among Indian masses, continuously releases oxygen in the atmosphere, and therefore, our ancestors must have put such knowledge into

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Figure 1: The pipal (*Ficus religiosa*) tree.

spiritual form. Epics like *Meghaduta*, *Abhijnanasakuntalam*, etc. They provide colourful portrayal of trees, creepers, animals and birds conversing with people and sharing their joys and sorrows, which shows that people believed in harmony between man and nature. According to Kautilya (Figure 2), cutting trees or its branches is an offence and he prescribed various punishments for it. Watering the plants is considered as greatly rewarding in the *dharmaśāstra* texts.

Many gods and goddess have Bird as their vehicles or *vahana*. These include lion, tiger, elephant, bull, horse, peacock, swan, owl, vulture, ox, mouse, etc. The association of wild animals with peoples' religious beliefs played a significant role in their preservation since long period in India, until the colonial rule indulged in intensive hunting of wild animals.

The case of Sacred Grooves

A sacred groove (Figure 3) consists of a bunch of old trees, generally at the outskirts of a village, which were left, untouched when the original settlers cleared the forest to establish the village. Such groves were regarded as the abodes of gods and goddesses or spirits and hence protected with utmost care. The cutting of trees was prohibited in these areas and nobody dared to disobey the injunction, partly because of religious faith and partly due to the fear of facing the wrath of the gods, goddesses and spirits.

Conservation teachings in Jainism and Buddhism

Buddhism and Jainism, the two most popular heterodox sects of ancient times also advocated nature conservation. Buddhism believes in tolerance, love, compassion, forgiveness and non-violence to all. Jainism advocates complete non-violence or Ahimsa; it treats every creature on earth including the smallest insects or microbes as of equal importance and forbids their killing by all means. This perception went a long way towards preserving biodiversity.

Environmental movements in India-and tradition of resistance

The love for trees was so greatly infused in the minds and souls of the Bishnois (A farming community of Rajasthan and its adjoining states) that in Khejrli village of Rajasthan about 363 young and old men and women embraced the *khejri* trees (*Prosopiscineraria*) to protect them from being felled by the king's men. The local ruler had ordered the cutting of *khejri* trees to use them for his limekilns as fuel;

the Bishnois hugged them and many were killed in the episode. Later, a temple was built in honour of the Bishnoi martyrs. One of the leading women of the movement was Amrita Devi Bishnoi. The repentant king later issued an edict protecting trees and animals in Bishnoi-controlled lands.

Chipko movement: The first movement against indiscriminate tree felling was started in India in 1730. It was fought against indiscriminate tree felling in Jodhpur, a city in Rajasthan province of India. Amrita Devi, a village woman, collected 362 other women from her village and marched to forest nearby. They declared that the forest trees could be cut down only over their dead bodies. "Chipko" means "hug". And each woman clung to a tree and stood motionless when timber contractors came. All the 362 women were axed to death by the tree fellers. This heart-rending incident compelled the then king of Jodhpur to ban tree felling in forest. The movement soon became famous all over the world. Environmentalists from France, Germany, Sweden, etc. came India to learn about unique Chipko movement. Then there was the *Baliyapal Movement*. This was against the taking over of the thickly populated village of Baliyapal village's fertile land for testing Missiles.

Later on some other persons have also been involved in this movement and have given it proper direction. Mr Sunderlal Bahuguna, a Gandhian activist and philosopher, whose appeal to Mrs Indira Gandhi, the then Prime Minister of India, resulted in the green-felling ban. Mr Bahuguna coined the Chipko slogan: '*ecology is permanent*



Figure 2: Chanakya is traditionally identified as Kautilya or Vishnu Gupta, who authored the ancient Indian political treatise called Arthaśāstra. As such, he is considered as the pioneer of the field of economics and political science in India, and his work is thought of as an important precursor to Classical Economics.



Figure 3: A sacred groove.

economy'. Mr Ghanasyam Raturi, the Chipko poet, whose songs echo throughout the Himalayas of Uttar Pradesh, wrote a poem describing the method of embracing the trees to save them from felling:

Embrace the trees and

Save them from being felled;

The property of our hills,

Save them from being looted.'

SME's in India and Effect of Globalization and Liberalization

Small and Medium Enterprises (SMEs) are considered as the backbone of economic growth in all countries because they account for 80 percent of global economic growth. In the newly developing or Newly Industrialized Countries (NICs), SMEs generally employ the largest percentage of the workforce and are responsible for income generation opportunities. The initiation of economic reforms through industrial and trade liberalization in 1991-1992 marked the beginning of a new era for industry in India. The measures included industrial de-licensing, the removal of threshold limits on the assets of large enterprises, the implementation of a liberal policy to facilitate Foreign Direct Investment (FDI), the expansion of the Open General License (OGL) list, reductions in customs duties and similar actions. Global competition confronts the majority of purely domestic SMEs, whose products and sales are extremely localized and/or segmented. Trade liberalization increases the capacity of well-established foreign manufacturers and retailers to penetrate both remote and underdeveloped markets. Against this development, local SMEs find it increasingly difficult to survive or even maintain their current business position in their respective markets. Most of the entrepreneurs think that Environmental regulations damages competitiveness and it is the reason that SMEs account for 70% of total industrial pollution.

Construction industry/construction sector SMEs

The construction industry is the second largest industry of the country after agriculture accounting for 11 percent of India's GDP. Indian construction industry employs 32 million people and its total market size is estimated at Rs. 2, 48,000 crores (35,640 million €) (Source: www.marketresearchindia.in). The activities of the construction industry include working on new structures as well as additions, alterations, and repairs to existing ones. SMEs account for a significant proportion of the construction sector.

Problems faced by Indian construction industry

- Construction industry suffers from capacity constraints.
- Lack of trained manpower and managerial skills with performance much below international level.
- Small and medium contractors do not have the wherewithal to upgrade their capability.
- Quality, safety, environment and social aspects are also not being addressed appropriately.

Also, Due to the nature of their operations, businesses operating in the construction sector have always been considered significantly vulnerable to weather extremes. Indeed, Mills [1] identified the construction sector as one of the most vulnerable to climate change and EWEs. Therefore there is a need to increase the understanding the risk associated with it. And thus greater research has to be undertaken

on how construction SMEs responds to the risk of EWEs and build resilience.

EWE and construction industry

Basically, the climate of India is dominated by the summer monsoon (June to September). The entire year is, however, divided into four seasons: (i) Winter (December and January) (ii) Pre-monsoon or Hot Weather season (March - May) (iii) Southwest or Summer Monsoon season (June - September) (iv) Post monsoon season (October - November). Year to year deviations in the weather and occurrence of climatic anomalies / extremes in respect of these four seasons are:

- Cold wave, Fog, Snow storms
- Hailstorm, Thunderstorm and Dust storms
- Heat wave
- Floods, Heavy rain

These are all related to the meteorological factors. Whereas earthquakes, volcanoes and tsunamis are other geo physically triggered disasters and not discussed in the present research paper.

EWEs can have both direct and indirect effects on the construction sector and those associated with it.

Direct effects include disruption to site works as a consequence of the extreme weather event itself (e.g. the site might be flooded); indirect effects include disruption to site works as a consequence of the secondary effects of an extreme weather event (e.g. disruptions to deliveries and utility supplies through the supply chain) [2]. Many authors have found that: there is a lack of forward planning; lack of capital for recovery; ineffectual interactions with national agencies; infra-structure problems [3]; individual attitudes and organizational culture; access to expertise; perceived exposure to risk [4]; and the relatively low importance assigned to climate change and EWEs by the construction sector [5], all contribute to a general inertia amongst organizations to consider resilience to EWEs.

Research Methodology Adopted for Study

The methodology adopted in this research work is given below

- Study of literature related to impact of extreme weather events in construction business.
- Preparation of Questionnaire.
- Site visit to major construction project sites.
- Questionnaire survey and personnel interviews with in-charges and managers and collection of data from site.

Questionnaire design

The six identified impact areas and 29 factors formed a questionnaire used as survey tool. Respondents were asked to express the degree of impact EWE is likely to have on their businesses on a five-point Likert scale. After interviewing professionals and different academicians the questionnaire was finalized and was distributed among 60 clients. While interviewing the professionals they were asked to quote their responses based on their experiences in the past. No incentives to participation in the survey were offered. Questionnaires were posted in the months of January - February, 2013. Out of 60 questionnaires only 20 fully filled questionnaires were received i.e. a response rate of 30%. The mean score (out of 5) of each factor under a given parameter was calculated

indicating the relative importance of each factor. Significance of the score 1 - Very Low Impact, 2 - Low Impact, 3 - Moderate Impact, 4 - High Impact and 5 - Very High impact. A descriptive figure of research methodology has been depicted in the flow chart below (Figure 4).

Results and Discussion

The entire respondent said that they had been affected by extreme weather events in the last 2 years. By far the most common extreme weather event recalled by the sample was High Temperatures (4.517), Rainfall (4.312) and Drought/Water restrictions (4.116) followed by low temperature (3.47) and winds (2.34) which is not surprising given the fact that the India has been affected by a number of Extreme Weather Events (EWEs) in the recent past (Table 1). The 2003, 2012 heat waves, 2005 flood, and 2004, 2005 heavy winter, 2013 drought, 1988 hailstorm are some examples. Such weather extremes have lead to significant economic as well as societal costs.

Identified impact areas are mentioned below:

Logistics - for example vulnerability of supply chain, utilities and transport arrangements

Premises - for example impacts on maintenance, facilities management or building design and construction

People - for example implications for workforce or customers

Process - for example impacts on concreting works and other construction works.

Finance - for example implications for investment, insurance and stakeholder reputation

Markets - for example changing demand for goods and services

As shown, in Table 2, Industries were most likely to be affected by the severe weather causing implications in terms of logistics (4.843) and people (4.719), process (4.173). A smaller proportion also mentioned that the weather had affected premises (3.129), finance (2.207) and markets (1.302).

Most of the respondent mentioned impact on workers health/ Employee Productivity (4.452) with also staff/key personnel not being able to get access to work or, simply access to work (3.167). Problems caused by staff not getting into work were most pronounced in the times of Heat waves and cold waves, possibly due to a larger number of financially weaker labourers in this area who can't cope up with changing weather conditions

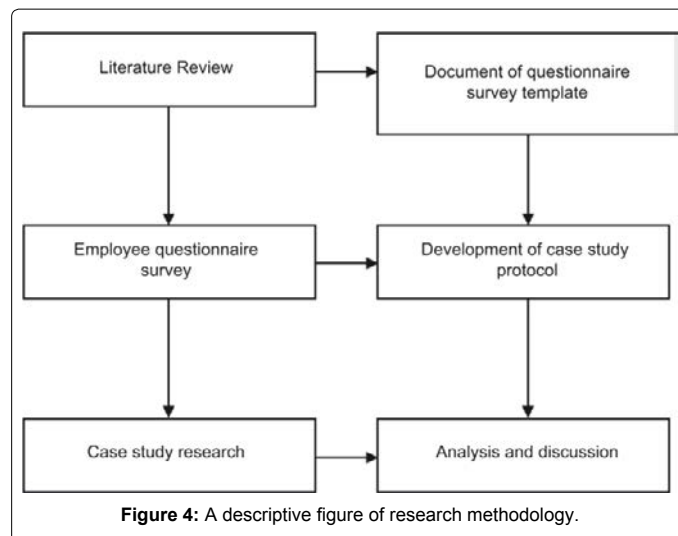
The fact that the customers could not get to the business because of extreme weather (2.389) and daily workers wage loss (2.868) was also mentioned by respondents (Table 3).

“Employees could not get to work.” “Our staff had to clear the Water and Mud.” “Our customers were not satisfied because project was late.” “We were without staff for 2-3 days.” “People were sent home because there was no electricity after the flooding.”

When asked to specify the greatest proportion of businesses who said extreme weather had impacted logistics mentioned supply of resources affected (3.87) because of disruptions to either transport or access (3.465) also causing delayed and delayed/failed deliveries (3.111) (Table 4).

ICT related problems and somewhat impact on schedule control were also notable issues with 2.698 as the mean.

As shown in the Table 5, it is site logistics that suffered mostly due



Dimensions	MEAN
Low Temperatures	3.472
Rain/ flooding	4.312
Winds	2.347
High Temperatures	4.517
Drought / Water restrictions	4.116
Snowfall	0

Source: Self Study through questionnaire

Table 1: EWEs which impacts most in Delhi-NCR region.

Dimensions	Mean
People	4.719
Logistics	4.843
Process	4.173
Premises	3.129
Markets	1.302
Finance	2.207

Source: Self Study through questionnaire

Table 2: Impact of EWE on Construction Industry.

Dimensions	Mean
Impact on workers health/ Employee Productivity	4.452
Customers couldn't get to the business/site visits etc.	2.389
Access to work of key personnel	3.167
Daily workers wage loss (payee side)	2.868

Source: Self Study through questionnaire

Table 3: Impacts of Extreme Weather Events on "People".

to extreme weather events with increased difficulty in material storage, processing and handling difficulty (4.342) followed by problems in coordination of material flows on the building site (3.878). When EWE is sudden rainfall, Loss of resources (like CCTV cameras) (2.749) and disposal of waste (3.217) is an also problem due to marshy surface. Most of the comments were (Table 5):

“Deliveries were held up - materials coming into the business and outgoing to customers. Staff also couldn't get into work.”

Dimensions	Mean
Supply logistics	
Supply of resources affected	3.871
Delayed / failed deliveries	3.111
Transport disrupt/ access	3.465
Others like ICT related problems and Impact on schedule control	2.698

Source: Self Study through questionnaire

Table 4: Impact of EWEs on supply Logistics.

Dimensions	Mean
Site logistics	
Material storage, processing and handling difficulty	4.342
Coordination of material flow on construction site.	3.878
Loss of resources	2.749
Disposal of waste	3.217

Source: Self Study through questionnaire

Table 5: Impact of EWEs on Site Logistics.

“The fog affected everything. The roads were inaccessible this meant that deliveries inbound and outbound to customers was affected.”

“We had trouble moving goods.” “Production was slowed down because there were no staffs.”

All the construction processes were significantly affected during extreme weather events except that of painting-flooring and tiling process (Table 6). Major problem is of mobility on premises (3.9854) during the rainfall and low temperatures at the time of dense fog. Structural damage (3.374) was also frequently occurring problem for businesses whose premises had been affected by extreme weather. Freezing and leaks (2.585), floodwater loggings (3.274) and even water scarcity (3.161) were also mentioned by respondents (Table 7).

In total, respondent stated that the market they operate in had been slightly affected by the impact of severe weather in the last 2 years. Some respondents also pointed out that extreme weather had affected their customers in some ways (2.341) and brought demand fluctuations (2.109) while there was very less impact on decrease in sales (1.676) (Table 8). Most of the respondents agreed with increase in marginal costs during EWEs (4.141) leading to income or revenue loss (3.983) (Table 9).

“We supply more sweaters, coolers, fans, etc. to site for our staff at the times of heat and cold waves.”

“Demand increase as parts break more often.”

“We still had to pay the staff even though they were not at work.” “Our turnover and profitability dropped.”

Following results were obtained on when respondents were asked about how much they are concerned about extreme weather events on their businesses (Figure 5).

Almost all respondents who were somewhat concerned about impact of EWEs were treating it same as traditional risks problems and taking simple steps like distributing sweaters and providing more facilities like liquid stamina drinks to the workers at the time of heat waves.

The respondents who marked “Very Concerned” have started incorporating new risk assessment methods including policy level changes and insurance related changes.

On asking about factors that enable them to initiate action on

Dimensions	Mean
Excavation-Foundation-Reinforcement placing	4.129
Shuttering/ framework	4.097
Concreting- Brickwork-Curing	4.129
Plastering (internal/external)	3.023
Plaster of Paris	2.112
Painting-Doors-windows-Flooring - Tiling	1.076

Source: Self Study through questionnaire

Table 6: Impacts of EWEs on processes at site.

Dimensions	Mean
Damages to land/ structural damages/	3.374
Mobility on premises	3.985
Floods water loggings	3.274
Water scarcity	3.161
If Other. Then please specify? Leaks / freezing	2.585

Source: Self Study through questionnaire

Table 7: Impacts of EWEs on premises.

Dimensions	Mean
Client's / vendor's affected	2.341
Demand fluctuations	2.109
Decrease in Sales	1.676

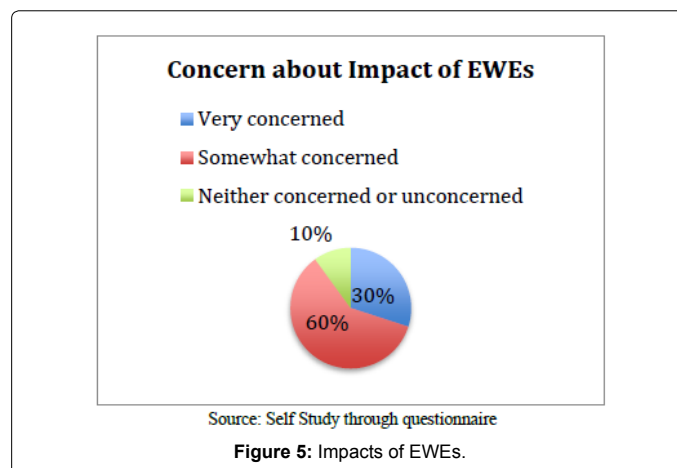
Source: Self Study through questionnaire

Table 8: Impacts of EWEs on Markets.

Dimensions	Mean
Increase in Marginal costs during EWEs	4.141
Income/ Revenue loss	3.983
Slow/ lost business	1.211

Source: Self Study through questionnaire

Table 9: Impacts of EWEs on Finance.



Climate change and EWEs and build resilience most of them rated cost savings (3.376) as the important factor followed by improved competitiveness (3.376) and customer demands (3.423) (Table 10).

Conclusion

Construction SMEs do not see EWEs as out of the ordinary as weather has always affected the construction industry at the project level.

The severity of the events that the SMEs have experienced was not significant enough to cause a major disruption to the business. Therefore, SMEs may tend to consider EWEs more as an annoyance than a threat to the future of the company. Consequently, this might have directed them not to consider implementing coping strategies. However, now the SMEs are more concerned about the risk of EWEs and have identified several coping strategies, as they have experienced significant impacts of EWEs recently.

Also, where the SMEs developed new coping strategies, these were an extension of their existing approaches for risk management/transfer rather than radical approaches to minimize the impacts of future EWEs.

Recommendations

Community engagement

Local communities often have a fund of knowledge and expertise that is extremely valuable in project planning and implementation. Local people have specific interests in the impacts that the project might have on them. Local communities have a sense of self-identity that is an important aspect to be preserved. For these and many other reasons, it is important to ensure that local communities are intimately involved as stakeholders in project development when that project has a direct or indirect effect on them. An emphasis on traditional values can help to predict and mitigate the effects of cultures that have different value systems including the treatment of women, conflict resolution style, and acceptable norms of behaviour.

Include indigenous knowledge and peoples from the very beginning

While a project is still in the thinking stages, it is a wise decision to include the indigenous peoples and their knowledge to assist in determining the feasibility of the project. Bringing the indigenous peoples in after the decision has been made to carry out the project is not respectful of the integrity and autonomy of the indigenous peoples.

Build on the strengths of indigenous knowledge

Indigenous knowledge is intensely local and of long duration. It uses indirect indicators to predict events. These are complementary aspects to the strengths of the scientific basis of development projects. Traditional knowledge of the area can significantly reduce the effort to acquire this knowledge if it is included in the survey. The development of large scale detailed maps, catalogues, and even Geographical

Dimensions	Mean
Cost savings	4.137
Improved PR as a result	2.147
Improved competitiveness as a result	3.376
Customer demand	3.423

Source: Self Study through questionnaire

Table 10: Factors that enable construction industry to build resilience.

Name of species	Significance with respect to climate change
<i>Ficus</i> species	Flowering and generation of new leaves indicates near rainfall onset.
Butterfly	Appearance of many butterflies indicate early rainfall onset and also gives a prospect of good season
Corn field ant, <i>Fanghmir</i> (<i>Lasius alienus</i>)	When there are a number of ants moving along a path carrying their food items with them, a heavy rain is expected on the same day, or within one or two days.
Common Frog, <i>Uchang</i> (<i>Rana temporaria</i>):	If the frogs croak in a water body in the afternoon until sunset, rain will be coming soon, even during winter and spring season.
Sukarvar <i>ribadri, rahishanicharjay e, barsabinanajaya</i> (proverb)	It means that if clouds form on Friday and remain till Saturday then they will not go without rain, such indications predict rains.
<i>Nada tankan, baladbikavan. matbajetu, adhesaawan</i> (proverb)	It means that in mid monsoon if South east wind blow then farmer of marwar region cries because it indicates famine in the particular region
Height of bird's nest	Floods are predicted from the height of bird's nests near rivers.
Moths	Moths decreasing numbers can predict drought.
Position of the sun or the cry of a specific bird on trees near rivers	Indicators such as the position of the sun or the cry of a specific bird on trees near rivers help people to predict the onset of the rainy season.
Bamboo Partridge, <i>Vahlah</i> (<i>Bambusicola fytchii</i>):	If male bamboo partridges roar frequently during spring and summer in the morning after sunrise, rain is expected in the immediate future. Similarly, when it rains in the morning, the roaring of the bamboo partridge at this time indicates that the rain will soon stop for that day in that location.
Field cricket, <i>Perhpawng</i> (<i>Gryllus pennsylvanicus</i>):	If a cricket brings new soil particles out of its hole during the dry season, it is thought that rain is coming soon (Figure 6). If the same activity occurs during the rainy season, a heavy rain is expected during the season.
Winged termite, <i>Phingphihlip</i> (<i>Reticulitermes</i> sp.)	When these insects come out of the soil in a group after a rainfall occurs, it is believed that rain will not come again for some time. (If there was no rain in the previous day or week but the insects are coming out of the soil, rain is expected to come soon.
Bird/Hen and cock, <i>Arpui/arpa</i> [<i>Circus cyaneus</i>]	If local domestic chickens search for food even during the rain, it is commonly thought that the rain will last for the whole day. But if the birds stop searching for food when it is raining and take shelter (in the morning or afternoon), the rain is expected to cease soon and to be minimal.
Location, pattern of clouds (blackish colour), Chhumdum:	When the clouds are thick and black in colour, and are arranged perpendicular to the orbit of the sun in the morning, it is said that rain is approaching.
A person having sciatica problem	Nowadays, a patient suffering from sciatica is said to be able to foretell weather phenomena according to their body temperature and the pain in the affected body part (One man, Mr. Ngawihkhonang (L) (1945- 2006) was known to forecast weather (humidity, temperature and rainfall) three or four days ahead, through the temperature of his body part (foot, leg, ear or forehead) affected by sciatica. The people of Ngailzawl village were dependent on his weather forecasting ability.

Bug species (brown in colour, medium size, living both at the edge of the river and in the forest according to the weather conditions), Tiauhmi (consumed as curry)	If this particular bug is found under a stone on the bank of the river after the monsoon season, it is said that the autumn season is over and winter is beginning. If this bug species is found in the forest during summer, it is expected that rainfall and flooding are about to begin.
Dried ripen chilli (<i>Solanum frutescence</i>) and dried tobacco leaves (Hmarcharep)	If dried chillies become moist except during the rainy season, it indicates high humidity and imminent rain.
Flowering pattern of peach species, <i>Theite par. (Prunus sp.)</i> :	If peach or plum flowers grow from the basal region to the terminal of the tree in flowering season, it is predicted that there will be a good rain and higher crop production than in other years. This indicator has been accurate until today.
Soil moisture and ground water level	During the spring and summer seasons, the villagers might turn over any stone or border stone near a river or a hillside in an open space and or clearing within the tree canopy. If the soil under the rock or under the surface is moist it is thought that summer rain is approaching.
Water bubble formation, <i>Puakkau (Paihte dialect)</i> :	If water bubbles forms at any place on the surface of a flowing or stagnant water body, particularly during a morning rain shower, it is thought that the rain will last for whole day. My experience confirmed that this indicator was applicable.
Cloud colour, time, direction and location of appearance in the sky:	If reddish colour cloud is seen at sunset one western horizon (Figure 6), rain is predicted to come within two to four days. If there is thick cloud toward the south or north, the rain will be more on that side within the region. If the sky is full of reddish coloured clouds appearing after a long rainfall, it is a sign that the rain will not come again in that particular season.
General Duration of hot days	If the first 10-15 of the month May-June are very hot a good rainfall is predicted.
Dragon fly swarm	If Dragon fly swarm in a large group over water surface a dry weather is predicted, if they swarm over open dry lands then early rainfall is predicted.
Centipedes	If centipedes emerge from their holes carrying their eggs in swarms an early rainfall is predicted.
Sun and Moon	Presence of visible spectrum with a greater diameter around the sun than around the moon indicates rainfall after a day or two.

Annexure: List of traditional indicators for climate change and use of traditional knowledge in daily life.

Information Systems of traditional information by some indigenous associations will vastly speed the process of transfer of information. Because these are being compiled by indigenous peoples for indigenous peoples, the means used to collect the information will have been done inside their own cultural system.

Time schedule of construction project

Develop a time schedule with culture and nature-based indicators of when tasks should be completed, or when certain milestones will be met. Indigenous peoples who live on the land are tied to the rhythm of the land, its seasons, and the movement of wildlife. For many people, hunt or gathering occurs at a particular time of year, or it does not happen. Failure to meet these cyclic imperatives can be dangerous for indigenous peoples. Plan the schedule for a project with indigenous peoples and their knowledge to develop a flexible schedule based on their seasonal and cultural requirements. This should be worked out in advance with the local people.

All parties can agree that at certain stages a milestone should be met. Problems usually arise when the agreed- on milestone is missed. Project work schedule are defined by time frames, but these are often not effective for indigenous peoples who have their own internal needs and schedules that are not easily adjusted. Instead of time scales, it is sometimes better to use indicators based on their traditions.

It has become abundantly clear to informed practitioners that including traditional knowledge (whether indigenous or not) is an important and helpful approach to modern project planning and implementation when traditional peoples are directly or indirectly affected.

Integrated strategy

Co-management agreements where traditional knowledge and technological knowledge are used together can significantly improve the management of resources.

The people best equipped to discover these subtle potential changes are often the holders of traditional knowledge of the area. When traditional knowledge is used in its original context, and in partnership with other knowledge systems, the combination is often a powerful tool.

Research Implications and Future Research Ahead

Mostly responses were obtained from SMEs in construction industry due to their easy approachability while MNCs in construction sectors were not considered. Hence research can be generalized for only SMEs and since research was done in Delhi, results may also vary for location-to-location and developing to developed nations.

Further work is necessary to refine the survey tool to ensure that it does contain all climate change issues and factors affecting construction business. Furthermore a much larger sample of clients is required to validate the relative importance of variables and to permit analysis on how the influence of factors may change over time and/or in relation to type of extreme weather events taking place.

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