

Climate Stress, Behavioral Adaptation and Subjective Well Being in Coastal Cities of India

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Received October 24, 2013; Revised January 03, 2014; Accepted February 08, 2014

Abstract India has been identified as one amongst 27 countries which are most vulnerable to the impacts of global warming related accelerated SLR (UNEP,1989). There is a perceived potential threat to coastal India owing to the vast sea-side development and huge populations in the vicinity of the coast. Therefore, there is a pressing need to address issues related to climate stress, adaptation, vulnerability and coping in coastal cities of India, especially from the psychological perspective. Climate change in coastal areas is associated much with flooding, SLR, land inundation, storms, cyclones etc. Coping with and adapting to climate stress are therefore issues of concern for experts worldwide. If environmental stressors persist chronically, they may lead to inner conflicts that can be psychologically disturbing for individuals and may even give rise to physiological, emotional, cognitive and behavioral changes. The established fact that anthropogenic factors account for one of the major contributors to climate change makes it necessary to probe into behavioral facets as in spite of the best possible efforts around the globe to combat climate change, it is felt that people are still not as seriously aware/ alarmed of the expected future risk as they should be. In view of above background, the present behavioral study to assess the cognitive understanding of climate change, climate stress and actions and reactions of coastal people with a special focus on behavioral adaptation and subjective well being was undertaken. The study was conducted on a sample of 150 males and female respondents mainly in four coastal cities of India namely Mumbai, Chennai, Daman and Pondicherry keeping in mind the coastal hazards and vulnerability issues associated with Indian coastal cities (TERI,1996). Especially designed Climate change perception Inventory (CCPI) based on a four-point Likert type rating scale format was used to assess the respondents' Climate Change Awareness (CCA), Climate Stress and Emotional Concern (CSEC), Coping/Adaptation, Institutional Accountability (IA), and Coastal Subjective Well Being (CSWB). Results indicated a good level of CCA and subjective well being among coastal people. Respondents were found to be experiencing a moderate amount of climate stress and were unable to fully cope with it. They expected more efforts on the part of government and environmental institutions for adapting with climate change in coastal cities and suggested various adaptive strategies in this regard. Results were interpreted in line with article 6 of New Delhi Work Program of UNFCCC (2007) in which special effort to foster psychological/behavioral change has been stressed through public awareness.

Keywords: climate change, SLR, climate stress, behavioral adaptation, coping, subjective well being

Cite This Article: Parul Rishi, and Ruchi Mudaliar, "Climate Stress, Behavioral Adaptation and Subjective Well Being in Coastal Cities of India." *American Journal of Applied Psychology*, vol. 2, no. 1 (2014): 13-21. doi: 10.12691/ajap-2-1-3.

1. Introduction

Climate change and associated sea level rise (SLR) is one of the major environmental concerns of today. Coastal cities will face great challenges in managing the significant growth in exposure that will come about from both human and environmental influences, including climate change (Nicholls et.al, 2008). The threat of rise in sea-levels as a result of changing climate makes the coastal resources, coastal infrastructure and population living in the coastal areas highly vulnerable.

1.1. Global Coastal Scenario

A major consequence of climate change is global SLR that could cause serious impacts around the world's coast (Nicholls et. al, 2000). Human-induced global climate change and associated SLR can have major adverse consequences for coastal ecosystems and societies (Hinkel and Klein,2003). Population and economic density in the coastal zone is greater than other areas of the earth's surface (Nicholls,2010). Due to climate change and SLR, livelihood security of 170 million people from 22 coast lying countries would be affected (Middleton, 1999). The IPCC in its various reports has established a clear link among global warming, climate change, SLR and coastal livelihood security. The third assessment report of the IPCC (2001) has projected a SLR as high as 88 cm by the

end of this century even though it has lowered that limit to 59 cm in its fourth assessment report (IPCC,2007). SLR can have a range of impacts on coastal areas including (1) increased storm damage, flooding and submergence, (2) increased erosion, (3) ecosystem changes such as coastal wetland loss and change, and (4) surface and groundwater salinization (Nicholls, 2010). It is quite evident that such a climate change induced global SLR is going to impose major challenges before the coastal zones which are already facing tremendous pressures because of human development and expansion activities leading to problems of land use change, over fishing, environmental pollution etc.

1.2. Indian Coastal Scenario

Out of the several projected impacts of climate change in India, coastal zones are apprehended to suffer the most devastating effects. India has been identified as one amongst 27 countries which are most vulnerable to the impacts of global warming related accelerated SLR (UNEP, 1989). The high degree of vulnerability of Indian coasts can be mainly attributed to extensive low-lying coastal area, high population density, frequent occurrence of cyclones and storms, high rate of coastal environmental degradation on account of pollution and non-sustainable development. Observations suggest that the sea level has risen at a rate of 2.5 mm year⁻¹ along the Indian coastline since 1950s. A mean SLR of between 15 and 38 cm is projected by the mid- 21st century along India's coast. Added to this, a 15% projected increase in intensity of tropical cyclones would significantly enhance the vulnerability of populations living in cyclone prone coastal regions of India. Other sectors vulnerable to the climate change include freshwater resources, industry, agriculture, fisheries, tourism and human settlements. Given that many climate change impacts on India's coastal zone feature irreversible effects, the appropriate national policy response should enhance the resilience and adaptation potential of these areas.¹

Nicholls et al. (2008) conducted a global screening study which made a first estimate of the exposure of the world's large port cities to coastal flooding due to storm surge and damage due to high winds. The study suggested top 10 cities in terms of population exposure to coastal flooding by the 2070s, which include Indian coastal cities of Kolkata and Mumbai besides cities of Dhaka, Guangzhou, Ho Chi Minh City, Shanghai, Bangkok, Rangoon, Miami and Hai Phŭng.

The study led to the inference that given the heavy concentration of people and assets in port city locations, and the importance in global trade, failure to develop effective adaptation strategies would inevitably have not just local but also national or even wider economic consequences. Cities with greatest population exposure to extreme sea levels also tend to be those with greatest exposure to wind damage from tropical and extra-tropical cyclones. The main conclusion was that these cities may experience combined perils of growing storm surges and more intense winds, and therefore must incorporate both perils into their adaptation and risk management strategies.

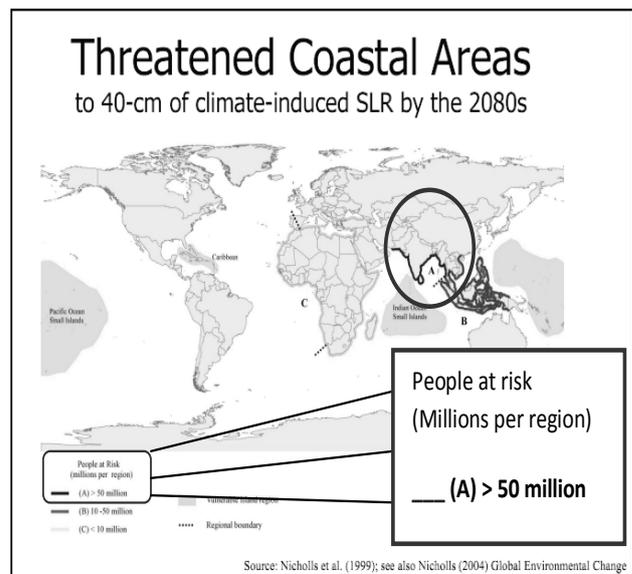


Figure 1. India's Coastal Vulnerability on a Global Scale (Source: Nicholls et. al (1999); see also Nicholls et. al (2004) Global environmental change)

1.3. Climate Stress

Climate stress has been found to be generated by *changes* in the environment, as opposed to the regular stresses caused by *activities* within that environment. Climate stressors are typically not evident in day to day life but do have indirect impacts upon one's physical and mental capacities. Studies on the effects of climate stressors indicate that they do have impacts upon one's behavior, moods, lifestyle, cognitive function, physical health and/or psychological well being. Climate change in coastal areas is associated much with flooding, SLR, land inundation, storms, cyclones etc. In present times, Indian coasts are confronted with problems of increasing human pressures which is causing overexploitation of coastal resources. Human activities such as dumping of industrial and toxic wastes, oil spills and leaks have all caused substantial damage to coastal ecosystems of many of the Indian coastal zones. Coping with and adapting to climate stress are therefore issues of concern for experts worldwide.

1.4. Behavioral Adaptation

Behavioral adaptation is an adjustment in individual, group and institutional behavior in order to reduce society's vulnerabilities to climate (Pielke, 1998). It involves adjustments to decrease the vulnerability of communities, regions, and nations to climate variability and change and in promoting sustainable development (IPCC 2001). As a result of anthropogenic/Socio-economic factors, Indian Coastal population is currently facing great pressure in the form of cumulative environment degradation driven by population expansion, urbanization, industrial development, environmental unfriendly life style, attitudinal changes and unsustainable growth. Coastal population can better deal with such a situation by way of behavioral adaptation which would enable them to bring certain changes in processes, practices and structures so as to moderate potential damages or to benefit from opportunities associated with climate change.

¹ Coastline accessed at http://www.southasianmedia.net/profile/india/geography_coastline.cfm

1.5. Subjective Well Being

SWB is 'a broad category of phenomena that includes people's emotional responses, domain satisfactions, and global judgments of life satisfaction' (Diener et al., 1999). Specifically, reported SWB consists of two distinctive components (Diener, 1994): an affective part, which refers to both the presence of positive affect (PA) and the absence of negative affect (NA), and a cognitive part. The affective part is a hedonic evaluation guided by emotions and feelings, while the cognitive part is an information-based appraisal of one's life for which people judge the extent to which their life so far measures up to their expectations and resembles their envisioned 'ideal' life. Climate change induced coastal stress ought to have negative impacts on the SWB of people in view of the present ongoing changes taking place along with the perceived threats in future. As a result, this would definitely alter the affective and cognitive dimensions of one's personality. There is much probability that the positive affect gets replaced with negative affect. The cognitive part too can not remain unaltered in changing climate scenario. People's information processing with regard to climate change gets influenced with the numerous information they encounter through internet, books, media and so on. As a result, it is a matter to be studied that how the subjective well being gets altered and in what ways when confronted to climate change issues.

1.6. Climate Change and Human Behavior

There is predominant evidence that causes of global climate change are anthropogenic: the result of human behavior. However, it is less widely recognized that the solutions are also rooted in human behavior. Effective solutions must draw on a broader understanding of social systems and human behavior (Karen Ehrhardt-Martinez, 2007). Human behavior (B) and his interaction with environment (E) can best be explained by the following equation (Lewin, 1951): $B = f(P \times E)$. The equation suggests that behavior is a function of person, environment and interaction between the two. Hence, any change in the environment brings changes in a person's behavior as well. Albrecht et. al (2007) predicts that physical and mental illness related to the environment will increase dramatically.

Previous global studies have tended to either consider (i) the potential impacts of SLR (e.g. number of people affected) (Hoozemans et al. 1993; Nicholls 2004) or (ii) the economic implications of SLR (e.g. impact and adaptation costs) (Fankhauser 1994; Tol 2004). A workshop convened on 12 November 2004 at Princeton University was motivated by the notion that environmental policies that target human behavior should incorporate insights about behavioral change and decision-making, topics central in behavioral sciences. The objective of the workshop was to inform climate scientists about the current state of understanding of how people think about global warming and, hopefully, initiate a collaborative dialogue between climate and behavioral scientists. As a part of amended New Delhi work program (2007) to implement article 6 of the convention, under public awareness, a special effort to foster psychological/behavioral change has been stressed. Keeping in view that

most of the work, if not all, on climate change focuses on the technicalities of the subject, this study is purported to address the psychological aspects underlying or concerned with climate change as psychological assessment of human-climate interface, behavioral adaptation and subjective well being of people residing particularly in Indian coastal cities are crucial topics of concern.

2. Methodology

2.1. Study Sites

The study was conducted mainly in four coastal cities of India namely Mumbai, Chennai, Daman and Pondicherry. The coastal metropolitan cities of Mumbai and Chennai have been specifically chosen as the study sites for this purpose since these cities are listed under vulnerable categories and also keeping in view the coastal hazards and vulnerability issues associated with climate change in these cities (TERI, 1996).

2.2. Sampling

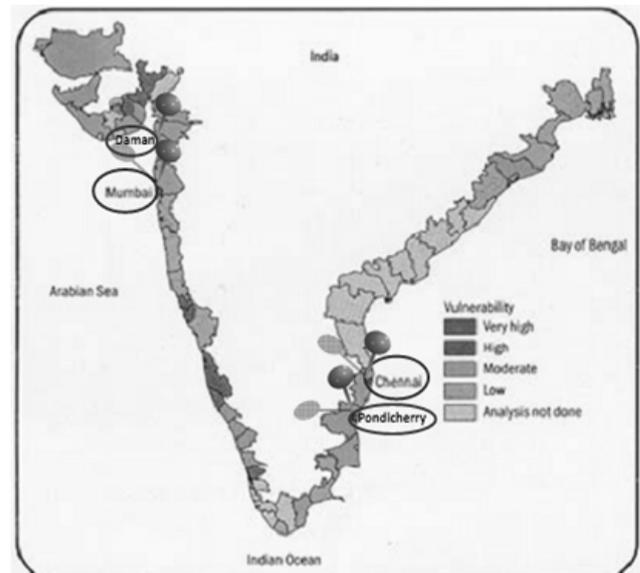


Figure 2. Vulnerability to One Meter Sea Level Rise (Source: TERI, 1996)

Multistage sampling technique was used for selecting the sample from selected coastal cities of India. In the first stage, coastal metropolitan cities of Mumbai and Chennai and small coastal cities of Daman and Pondicherry were purposively selected based on their high vulnerability index to SLR (TERI, 1996) to represent the coastal population of South-East and West zone of India. In the second stage, from the selected cities, institutions (educational, corporate, govt. and others) falling within the distance of 2 km from the coast were listed based on Google earth imagery. Out of the generated list of 45 institutes, using systematic sampling technique 30 institutes were selected for the study. Based on the sampling frame of list of employees/students, 150 adult respondents (Male=74; Female=76) were systematically selected for the study. Those residing in the city since less than 2 years were excluded from the sample.

Following table describes the demographic features of the sample:

Table 1. Demographic Profile of Respondents

Sr. No.	Categorical variable	Description	Percentage distribution in sample
1	Age group	Young adult (18-24 years)	33%
		Adult (25-45 years)	56%
		Senior adult (> 45 years)	11%
2	Sex	Male	49%
		Female	51%
3	Educational qualification	Graduate	37%
		Post Graduate	47%
		Other	16%
4	Living in the city	2-5 years	31%
		>5 years	69%
5	Family size	1-5 Members	87%
		> 5 Members	13%
6	Distance of coast from home	Less than 2 kms	38%
		Between 2-5 kms	32%
		More than 5 kms	30%

2.3. Tools and Techniques

CCPI was especially designed to assess CCA, CSEC, coping/adaptation, IA and CSWB of the sample. CCPI was divided in five sections as above to obtain information on 5 point Likert type rating scale. The section wise details are as below:

Table 2. Reliability of Responses Measuring Climate Variables

Section	Variable	No. of indicators	Chronbach's Alpha
I	Climate change awareness	13	0.72
II	Climate stress and emotional concern	18	0.79
III	Coping/Adaptation	13	0.81
IV	Institutional Accountability	4	0.75
V	Coastal Subjective Well Being	4	0.85

Besides rating scale format, there were some open ended questions too, which were included to obtain qualitative information, thus adopting the multiple response format including nominal, ordinal and ratio scales. Principal Component Analysis (PCA) using SPSS was conducted for factor analysis of CCA, CSEC and coping/adaptation. Based on rotated component matrix, the elicited component factors under the study variables and their Eigen values are tabulated as under:

Table 3. Eigen Values Calculated Through Principal Component Analysis (PCA)

Study variables	Component	Eigen values
Climate change awareness	Tacit knowledge	1.866
	Climate change impact	1.049
Climate stress and emotional concern	Emotional anxiety	4.094
	Dissatisfaction	1.978
	Resource stress and climate variability	1.277
Coping/Adaptation	Group/institutional coping	1.900
	Individual level coping	1.500
	Adaptation effort	1.159

2.4. Research Design

A correlational research design was adopted to study the inter-relationship between categorical variables (age, gender and distance from coast) and other discrete variables (CCA, CSEC, Coping/Adaptation, IA and CSWB).

3. Results

In the context of coping and adaptation against the impact of climate change, it is immensely important for the coastal habitants to have knowledge and awareness about possible climate change impacts.

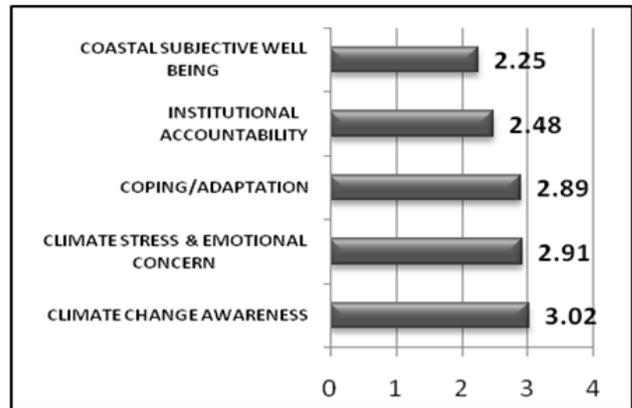


Figure 3. Section Wise Scale Average

3.1. Climate Change Awareness

Level of CCA was assessed using 13 item rating scale as a part of CCPI. On the basis of Principal Component Analysis (PCA), CCA was indicated by two components viz. tacit knowledge and awareness about climate change impacts. Tacit knowledge was significantly higher when the distance from coast of the sample's residence was less than 2 km (F = 4.16, significant at .017 level). Inter-correlations revealed Negative correlation between distance from coast and tacit knowledge which justifies that the near coast population had higher tacit knowledge about changing climate and its impacts being more vulnerable to the potential adverse impacts of SLR. As the distance from coast was increasing, the tacit knowledge was decreasing as populations were less concerned about the direct effect of SLR or changing climate on their lives. However, the individual coping and subjective well being were not affected by it as being in the coastal city, coping at the individual level is indispensable to some extent.

Significant positive correlation (r = .503) was found between tacit knowledge and emotional anxiety which indicated that the more respondents gain knowledge and awareness regarding climate change, the greater are the chances of their becoming more emotionally anxious about the situation. Some scholars have indicated the need for access to information as a means to enhance people's climate awareness which in turn help them to adapt(Phillips 2003; Kurita et al. 2006; Collins/Kapucu 2008; Leal Filho 2009; Leal Filho/Mannke 2009; Saroar/Routray 2010). Significant positive correlation was also found between tacit knowledge and IA (r = .289) which meant that role of institutions and their

accountability are more recognized by people when their tacit knowledge increases. In other words, people expect the institutions to play more effective roles and also believe in their capabilities of bringing about positive change in dealing with climate change when they become more aware about climate change aspects.

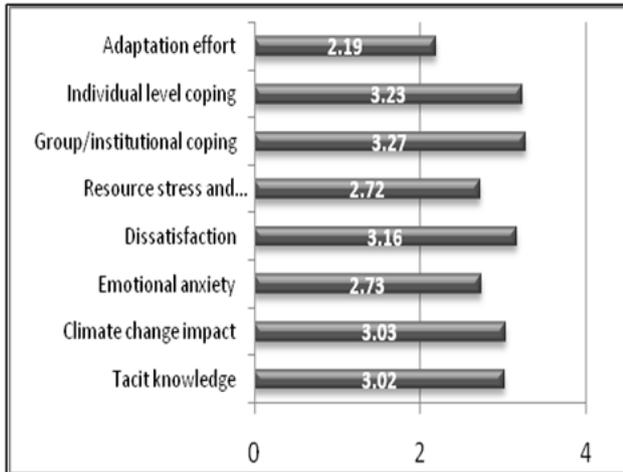


Figure 4. Component Wise Scale Average

Major impact of SLR was perceived to be loss of life and property (M = 1.85), followed by flooding (M = 1.82) and loss of coastal resources (M = 1.81) on a 3-point rating scale as shown in Figure 5 below:

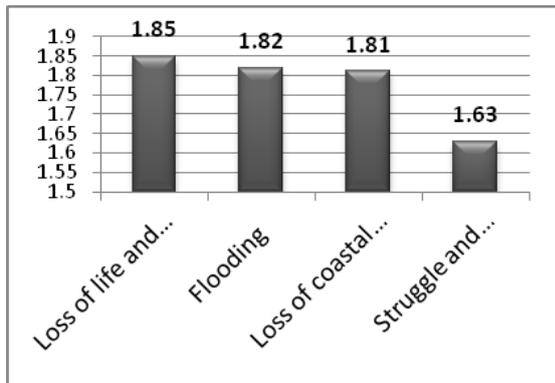


Figure 5. Major Perceived Impacts of SLR

The prime perceived factors determining vulnerability of coastal population to coastal disasters were insufficient financial and physical resources to cope effectively (M = 1.56) followed by forced choice to live near the coast (M = 1.46) and inefficient disaster management system (M = 1.42).

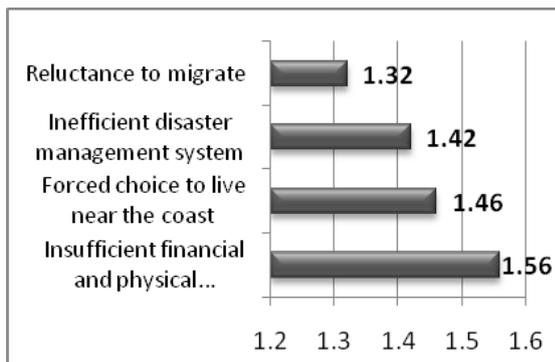


Figure 6. Perceived Reasons for the Coastal Population being Vulnerable to Coastal Disasters

3.2. Climate Stress and Emotional Concern

Climate stress was assessed using 18 item rating scale classified in emotional anxiety, dissatisfaction and resource stress/ climate variability based on PCA. A moderate level of climate induced emotional anxiety and resource stress was reported (M = 2.73 and 2.72).

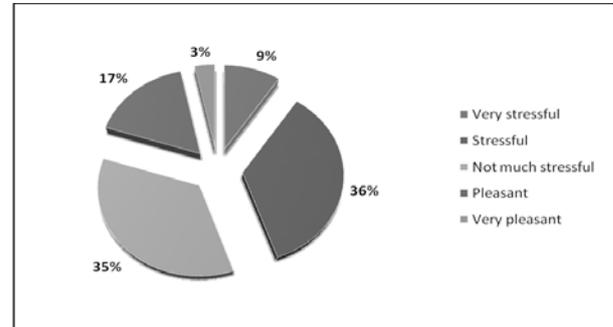


Figure 7. Perception of Coastal Environment of Cities by the Respondents

However, dissatisfaction with the luxurious lifestyle of developed nations, industrial and domestic pollution and improper management of coastal zones possibly causing climatic adversities was expressed through frustration and anger (M = 3.16) and the need for more stringent environmental laws was expressed. Significant gender differences were found with females reporting higher emotional anxiety than males (F = 8.81 significant at .003 level). In a study by Sundblad et. al (2007), it was found that cognitive risk judgments (of probability) of serious negative consequences and affective risk judgments (worry) were predicted by knowledge of causes and knowledge of consequences of climate change, in particular health consequences. The study also found that women were more worried than men but did not differ from men with respect to the cognitive risk judgments. About 45% of the respondents reported the coastal environment/condition in their city to be stressful while 35% regarded it as not to be much stressful (See Figure 7).

3.3. Coping and Adaptation

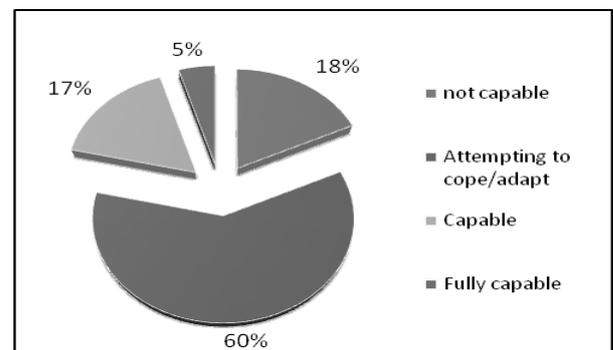


Figure 8. Respondents' Coping/Adapting Capacities to Climate Change Related Coastal Adversities

Perceived coping and adaptation was assessed through a 12-item perceived coping scale which was further clustered in Individual coping, Group/institutional coping and general adaptation effort based on factor analysis (PCA). Group/institutional coping was found to be highest (M = 3.27) followed by individual coping (M = 3.23) and

adaptation effort (M=2.19). No significant age differences were found in this section.

Females were found to be putting greater adaptation effort in terms of keeping the food stock for adverse coastal scenario managing coastal upheaval by migration or other possible options (F=22.66 significant at .000 level). It is justifiable by the Indian familial system where females play a dominant role in managing the household and family in case of any coastal or other disaster. The significantly positive correlation (r = .406) indicates that with the increased adaptation effort from people, expectation for IA also increases. It is justifiable with the fact that if coastal populations are exerting effort to adapt with the climate variability and associated adversities, it cannot be successful in isolation if local institutional system is not supplementing their efforts by playing a responsible proactive role in macro level adaptation. Only then the adaptive efficacy of the city to changing climate can increase.

Overall, about 5% of sample was fully capable and 17% capable to cope/adapt to climate change. Adaptive response to a large extent depends on three important elements. These are timely recognition of the need to adapt, an incentive to adapt, and ability to adapt (Fankhauser et. al, 1999; Adger et. al, 2005; Perry, 2007). Smit et al., (2001) maintains that the impacts of climate change are not evenly distributed — the people who will be exposed to the worst of the impacts are the ones least able to cope with the associated risks. This implies that the coastal population has to look for effective ways of increasing their coping capacities.

3.4. Institutional Accountability

It was indicated by perceived efficacy of coastal disaster management system and role of government/NGOs and media in creating awareness and environmentally healthy lifestyle. A moderate level of IA was found (M = 2.48). The reason for respondents not acknowledging high accountability of institutions could be because in India coastal planning and management are constrained largely by a lack of information, data and analysis about the interaction between development activities and the coastal environment. India does not have a specific coastal focus for its development policies. It has on the one hand, policies and plans for sectorial development and on the other, environmental policies and legislation to protect the environment from such development. Some of these are incompatible. So coastal development occurs with no or little management. (Noronha et. al 2003). However, the study registered significant gender differences with females reporting higher level of IA than males (F=3.829 significant at .052 level). Around 48.7% of the sample reported moderate level of IA while 36% reported high level of IA in their coastal city.

3.5. Coastal Subjective Well Being

CSWB, indicated by 4 items, was found to be low moderate (M = 2.25). A trend of gender differences was found with females having a slightly better feeling of CSWB than males. While men and women show little comparative difference in average subjective well-being, more women than men live at the extreme ends of well-

being scales (Diener et. al 1999). People living near the coast were having a significantly higher CSWB (F= 3.31 significant at .03 level) and as the distance from the coast was increasing, the CSWB was decreasing (r = -.189 significant at .05 level). The reason may be the pleasant landscape of the sea and its surroundings which gives people a sense of contentment and they feel good living near the coast, especially if they have not personally experienced any coastal disaster in the past. It is further enhanced by the IA as if local management system and institutions are responsive and accountable, it further enhances the CSWB (r = .406 significant at .01 level). Similarly adaptation efficacy increases with the increase of distance of settlement from the coast. People staying more distant from the coastline, possess more adaptation efficacy than those who are staying close to the coast (Saroar and Routray,2009). This finding conforms to the existing body of knowledge of resilient coastal community (Adger et. al, 2007).

3.6. Analysis and Interpretation of Regression

Linear regression analysis was calculated to make the predictions of possible relationship between dependent variables of CSWB, Group/institutional coping, individual level coping and adaptation effort and independent variables like CCA and Climate stress. Unstandardized Coefficients (B) suggest that for one unit increase in emotional anxiety, the CSWB will increase by 2.393 units. It means that emotional anxiety to climate change, though appears to be just opposite to well being, can be attributed to higher CSWB in this case. In spite of being emotionally anxious, respondents are likely to have SWB as an individual defense mechanism to curb the negativity associated with anxiety. On the other hand, for one unit increase in Resource stress and climate variability, SWB will decrease by 0.311. This means adverse impact of climate variability in terms of increasing temperature and humidity, coastal risk and resource stress specifically associated with water shortage can be attributed to reduced level of coastal SWB. However, IA accounts for the increase of 0.392 per unit to coastal SWB. The responsive attitude of coastal management institutions and media contributes to positive increase in SWB.

Table 4. Multiple Regression Model of Effects of Factors on Dependent Variables

Dependent variable	Independent variable	Unstanda- - dized Coefficients β	Std. Error	Sig.
CSWB	Emotional anxiety	2.393	0.489	.000
	Resource stress & climate variability	-0.311	0.129	0.017
	IA	0.392	0.087	.000
Group / institutional coping	Dissatisfaction	0.346	0.095	.000
Individual level coping	climate change impact	0.153	0.083	0.068
Adaptation effort	Emotional Anxiety	0.175	0.086	0.043
	Dissatisfaction	-0.227	0.102	0.027
	IA	0.302	0.08	.000
	climate change impact	-0.173	0.085	0.045

The factor of dissatisfaction emerged to be positively contributing to the coping efforts of groups/institutions. This was suggested by per unit increase in dissatisfaction leading to increase in group/institutional coping efforts by .346 units. It means that the greater the dissatisfaction among general population with regard to wasteful energy consumption patterns of big/developed nations, less stringent environmental laws, coastal pollution aspects and inefficient coastal zone management, the more groups/institutions would gear up their efforts at coping with climate stress. In one of the six conclusions of a review by Agrawal (2008), it is suggested that External interventions in the form of new information and technology aimed at improving coping capacities, institutional coordination for better articulation (connections among institutions) and improved access (connections of institutions with social groups), and inflows of finances support for local leadership will be critical to strengthen local institutional capacities.

4. Discussion

The study was purported at assessing the CCA of respondents together with understanding the climate stress and coping/adaptation of people in Indian coastal cities. Attention was also directed towards knowing behavioral adaptation and subjective well being aspects of respondents. Results have been interpreted in line with article 6 of New Delhi Work Program of UNFCCC (2007) in which special effort to foster psychological/behavioral change have been stressed through public awareness. The respondents were found to possess a good level of CCA though awareness about climate change impact was moderate. This indicated that respondents were much benefitted by the role played by newspapers/magazines, visual media i.e. television, and internet in spreading awareness about climate change as these were the major reported sources of information about climate change and global warming by the respondents. However, this meant that respondents were exposed to only one half side of the coin which was awareness about climate change while they were still a little less informed about the other half side regarding the real climate change impacts. Various factors influences climate adaptation efficacy including climate awareness. Climate awareness is manifested through perception of, familiarity with, and knowledge about climatic events (Saroar and Routray,2009). Development and implementation of educational and public awareness programs on climate change and its impacts can go a long way in raising public understanding of information on climate change and its impacts leading to general awareness about climate change issues and anthropogenic contributions.

The study also indicated a good level of subjective well being among coastal people living near the coast and as the distance from the coast was increasing, the CSWB was decreasing. This was in contrast to our assumption that climate change induced coastal stress ought to have negative impacts on the SWB of people in view of the present ongoing changes taking place along with the perceived threats in future. It has been found that people who experience high levels of well-being on average tend to have more trusting, co-operative, and pro-peace attitudes, more confidence in the government, stronger

support for democracy, and lower levels of intolerance for immigrants and racial groups (Tov & Diener, 2008; Diener & Tov, 2007).

Climate change in coastal areas is associated much with flooding, SLR, land inundation, storms, cyclones etc. People who are vulnerable to SLR can follow any of the three methods of adaptation. These are protection, accommodation and retreat (Klein et. al, 2001). Studies on the effects of climate stressors indicate that they do have impacts upon one's behavior, moods, lifestyle, cognitive function, physical health and/or psychological well being. A moderate amount of climate stress was experienced by the respondents who were unable to fully cope with it. They expected more efforts on the part of government and environmental institutions for adapting with climate change in coastal cities and suggested various adaptive strategies in this regard. Agrawal (2008) suggests that institutions influence adaptation and climate vulnerability in three critical ways: a) they structure impacts and vulnerability, b) they mediate between individual and collective responses to climate impacts and thereby shape outcomes of adaptation, and c) they act as the means of delivery of external resources to facilitate adaptation, and thus govern access to such resources.

Effective adaptation is essential for managing risks against the background of developing cities and the changing climate (Nicholls, 2008). While there are many available coastal adaptation options, the most effective adaptation policy options include a combination of (1) upgraded protection, (2) managing subsidence (in susceptible cities), (3) land use planning, focusing new development away from the floodplain, and (4) selective relocation away from existing city areas (Klein et. al, 2001). Because adaptation to climate change is local, it is critically important to understand better the role of local institutions in shaping adaptation and improving capacities of the most vulnerable social groups.² Recognizing the ever-increasing vulnerability of coastal urban cities in Asia due to climate change impacts and variability and also due to fast-growing urban development, a study focusing on climate disaster resilience was conducted by Shaw (2009) in order to measure the existing level of climate disaster resilience of the targeted areas using a Climate Disaster Resilience Index. The index was developed based on five resilience-based dimensions: natural, physical, social, economic and institutional. The scope of this study was limited to climate-induced disasters, such as cyclone, flood, heat wave, drought and heavy rainfall induced landslide. For each individual city case, resilience information was presented as overall resilience, and separate physical, social, economic and institutional resilience. Indian city of Mumbai was found to have a relatively low overall climate-disaster resilience. Policy recommendations for Mumbai suggested that local institutions responsible for city development have good external network, but needed to effectively address climate-disaster issues by wider and broader cooperation with other institutions and also by mainstreaming disaster risk reduction in the development agenda.

²http://siteresources.worldbank.org/EXTSOCIALDEVELOPMENT/Resources/244362-1164107274725/3182370-1164201144397/Local_Institutions-Climate_Change_Adaptation_note113.pdf

5. Conclusions and Policy Implications

A good level of CCA in terms of tacit knowledge and climate change impacts was found in the coastal people. At the same time, they were quite dissatisfied with the way developed nations were exploiting the common resources for their luxurious lifestyle, causing resource and environmental stress for the whole planet and were emotionally anxious in this regard. As far as perceived coping was concerned, people expressed their ability to cope at individual, group and institutional level but adaptation effort was found to be limited. Overall, climate stress was found to be more pronounced in the young adult age group than the adult and senior adult respondents. A moderate level of IA and CSWB was found. Linear regression analysis predicted that though people were anxious at the emotional level in view of the possible climate adversities, the self report of CSWB was increasing as a defense mechanism to camouflage the inner anxiety. Besides CSWB, adaptation efforts were also increasing with the increase in emotional anxiety and respondents wanted institutions to be more accountable to climate change and associated adversities. A special role of media and coastal disaster management institutes was projected in this regard.

The study has strong implications for coastal institutions and media for a proactive and responsive approach for generating awareness and in managing the climate change related issues in the coastal areas. A need for more stringent environmental laws was felt for effective planning and management of coastal areas. It also justifies the role of fear appeal generated through climate stress and associated emotional anxiety which is a useful mode of promoting environmentally healthy attitudes.

To conclude, development and implementation of educational and public awareness programs on climate change and its impacts have a very pertinent role in generating and raising public understanding of information on climate change, its impacts and anthropogenic contributions. Involvement of media and local communities in adaptation efforts is very important in this regard. More so, future interventions must incorporate the socio-psychological dimensions of climate change to enhance the awareness and adaptation efforts of coastal communities.

Acknowledgements

This paper is a part of an outcome of an IIFM sponsored project titled A Behavioral Study of Climate Stress and Coping in Coastal Cities of India. The authors acknowledge the funding support received by Indian Institute of Forest Management, Bhopal for the above study. Also a sincere note of thanks is extended towards the technical support in statistical analysis provided by Dr. B.K. Upadhyaya (Asstt. Professor, IIFM) and Dr. Swati Moghe (Project Consultant, IIFM).

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