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Climate Change: Implications for the Indian Navy

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"Climate Change is a Global Emergency. The world is in danger of going into cardiac arrest, yet we behave as if we've caught a common cold".

Mohammed Nasheed, President of Maldives[1]
March 15, 2009

Climate trends and scientific metrics continue to suggest, in an increasingly compelling way, that the global environment is changing. The UN Climate Change Report 2007 mentions that out of the 20 warmest years on record, 19 have occurred since 1980. This singular example is enough to portend the climatic future. Given such trends, a global debate is underway on the political and security implications of climate change, which until the last decade was thought to be a purely geophysical phenomena, far removed from traditional preoccupations of international security. Hard headed military and intelligence analysts around the world now agree that climate change has transformed from an environmental concern to a first order national security concern. What is the reason behind this shift? There exists sufficient scientific data to conclude that the magnitude, and more importantly speed, of climate change, poses a daunting challenge to issues pertaining to food and water scarcity, heightened energy insecurity, infectious diseases, more frequent and severe natural disasters, rising sea levels, maritime boundaries and environmental refugees – all of which pose fundamental questions for both human security and international geo politics. Consequently, all these dynamics

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will impact the Armed Forces across the world, in a multifaceted and unforeseeable manner. This paper seeks to explore the possible impacts of climate change on the Indian Navy and elucidate potential coping strategies.

Introduction

The importance of climate change as an 'issue' has never been in doubt. Sadly, the civilisational threat that it poses to humanity and the magnitude of the challenge still invites scepticism. In the first decade of the 21st century, there is ample evidence to suggest that today's environmental crisis is of an unprecedented scale and one that could threaten the very existence of life on our planet.

Addressing global warming during an international meet in 2009, the President of Maldives, Mohammed Nasheed stated that the phenomenon is

> "*more serious threat to the international order than Islamic radicalism, piracy or sharing of resources*".

Sir John Houghton, Chief Climate Change Adviser to the British Prime Minister believes that climate change is

> "*a weapon of mass destruction and at least as dangerous as international terrorism*".[2]

At the African Union Summit in 2007, the Ugandan President, Yoweri Museveni called global warming

> "*an act of aggression by the rich against the poor*".[3]

These statements are indicative of the extent of concern about the potential fallout of climate change. There is a wide consensus on the belief that climate change could be a threat multiplier, which could erode the socio-economic fabric of nation states and hence their stability. India is no exception. It is anticipated that our security dynamics will be impacted in a multitude of ways by this emerging phenomenon.

This paper aims to look at various aspects of climate change that impinge on India's maritime security and on the operations of the Indian Navy. It concludes with a section highlighting the specific issues that could impact on the Indian Navy.

Background

Historical Perspective

There are many historical examples of climatic shifts or extreme weather triggering conflict and even contributing to the rise and fall of civilisations. Growing aridity and frigid temperatures from a prolonged cold snap caused Huns and German tribes to surge across the Volga and Rhine rivers into the Roman Empire during the 4th and 5th centuries, eventually leading to the overthrow of the Romans.[4] Muslim expansion into the Mediterranean and southern Europe was driven to some extent by persistent drought in the present Middle East region. The Viking community in Greenland perished in the 15th century partly because of a sudden lowering of temperatures across northern Europe, also known as the "little ice age". Similarly, the changing climate may have been responsible for the disappearance of the Mayan world in Central America more than a thousand years ago.[5]

As of 2010, climate trends and scientific metrics continue to suggest, in an increasingly compelling way, that the global environment is changing. As per the United Nations (UN) Climate Change Report 2007, out of the 20 warmest years on record, 19 have occurred since 1980. This is indicative of the climate for the future.

Given such trends, in 2007, the UN Security Council (UNSC) deliberated on the security implications of climate change, which until then had been considered an environmental issue far removed from international security. Security and defence analysts around the world now agree that climate change has grown from an environmental concern to an important national security concern.

Sufficient scientific data exists to conclude that the magnitude and, more importantly, the speed of climate change pose a frightening challenge to issues pertaining to food and water scarcity, heightened energy insecurity, infectious diseases, more frequent and severe natural disasters, rising sea levels and environmental refugees – all of which pose fundamental questions regarding the future of human security and survival.

Across the globe, a series of studies are presently underway to deepen the understanding of the relationship between climate change and national security. In September 2009, the United States (US) Central Intelligence Agency (CIA) established a Center on Climate Change and National Security as the focal point for its work on the subject. This institution is led by senior specialists from the Directorate of Intelligence

and the Directorate of Science and Technology.[6] Its charter is to look not only at the science of climate change per se but also on the national security consequences of phenomena such as rising sea levels, population shifts and heightened competition for natural resources.[7]

The national security consequences of climate change for a developing country like India are bound to be grave. In the larger canvas of security, maritime security is a central issue.

At first glance, climate change appears irrelevant to traditional notions of maritime security. However, in the present era, traditional concepts of security are being rapidly revaluated. In the 20th century, maritime security was considered, in the classical military sense, as protection of the homeland and national trade from conventional seaborne military attack. However, as of 2010, the concept of maritime security has been transformed and can also be thought of as the safety of life and assets at sea. The threats could be natural, man-made, traditional or non-traditional. Therefore, maritime security can be broadly defined to include the protection of all of the nation's interest on the seas. Climate change clearly is a crucial factor in all this.

Though defining what is and what is not in the maritime security domain is an ongoing debate, it is opined that climate change may well be the critical issue of maritime security by 2025.

Sea Level Rise

A brief look at the history of sea levels reveals that over the last 140,000 years the sea level has varied over 120 m. The most recent major change involved an increase of more than 120 m as the last ice age ended. Thereafter, the sea level stabilised in the last few thousand years and there was little change between about 1 AD and 1800 AD. Sea level began to rise again in the 19th century and accelerated again in the early 20th century.[8] Satellite altimeter measurements show that since the early 1990s the sea level has risen at a rate of 3 mm per year. Thermal expansion is producing about half of this annual increase in global sea levels. The contribution of this factor has increased from around 0.5 mm per year over the second half of the 20th century to around 1.6 mm per year over the last 12-14 years.

Another major contribution to the recent sea level rise has come from the melting of glaciers, polar ice cap and the ice sheets in Greenland and the Antarctic. This is

believed to cause about one-third or more of the current 3 mm per year increase in the global sea level. The complete melting of the Greenland ice sheet alone could increase global mean sea levels by around 7 m. Though this would probably take about 1,000 years but it is believed that Greenland's melting ice could still contribute significantly to sea level rise over the next 50-100 years.[10] Global warming is also resulting in an atmosphere containing more water vapour, which enhances greenhouse effects and leads to more warming and melting in a self-reinforcing cycle.

How deleterious the impact of sea level rise on the Indian coast can be, is evident in Orissa. Sea level rise in the Bay of Bengal has progressively inundated the coastal village of Satabahya in Orissa's Kendrapa district. The village has been forced to move inland thrice in the last 20 years. Two decades ago, the sea was a scenic 2 km walk from the village. Today, the original village location is somewhere 1 km inside the sea. This hamlet symbolises the dangers of sea level rise, which could lead to a multitude of detrimental factors.

One problem is forced migration. Of the 200 families that once lived in Satabahya and its neighbouring Kanhapur village, only 32 remain. In response, the state government has gradually shrunk the revenue map of the area. Increased soil salinity is another problem. A few hundred metres away from Satabahya village are lush paddy fields and forests, but villagers fear they may not remain fertile any longer. Saline water is seeping under their fields and into sand covering the earth, shrivelling their crops. Further, sea level rise will increase salinity in surrounding coastal areas dramatically reducing yields from food crops and jeopardising drinking water supplies.

There is worldwide recognition of the fact that the force, gravity and frequency of natural disasters would rise with the warming of the planet. Evidence is growing of a strong correlation between a steady rise in ocean temperatures and the increase in frequency and intensity of coastal storms. Typically, large storms require ocean temperatures of above 27°C. Such conditions are now occurring more regularly as tropical waters heat up. The increased occurrence of higher category storms is understood to be a direct consequence of warmer ocean temperatures. Storm surges taking place on higher mean sea levels in the future will cause inundation and destructive waves would advance further inland increasing flooding and erosion. This, in turn, would have a damaging effect on infrastructure and natural ecosystems.

The possibility of climate change and natural disasters working together to cause massive coastal destruction is a major concern. The cascading effect of the death,

destruction and stress that ensues, may further lead to political and economic crises. The Bay of Bengal typhoon of 1970 is a case in point. It is well known that the residual anger of typhoon victims contributed to the commencement of Civil War in 1971 in erstwhile East Pakistan. The majority of Asia's population and economic centres – especially in India and China, as well as in Bangladesh, Pakistan, Thailand, Indonesia and the Philippines – are located close to the coastal areas. Intra-national migration towards these urban centres is likely to continue, increasing their vulnerability to climate induced maritime disasters.

A higher sea level means that the gradient of rivers at the point of discharge into the sea will be reduced, resulting in slower drainage and probable flooding upstream. Increased sea levels would result in saline intrusion further upstream in river systems.

The rise in sea levels is also bound to complicate maritime boundary disputes. Maritime boundaries are determined by baseline or low water mark. Any shift in baseline points would alter boundaries significantly and become a source of contention. Almost any change in sea level could have very remarkable effects on certain baselines; these, in turn, could have potentially dramatic consequences on maritime boundaries. Rise in sea levels in particular geographic situations is likely to result in significant shifts in the outer boundaries of the oceanic zones claimed by coastal states. Even submergence of small atolls, rocks, and low lying islands could have implications for maritime claims. This phenomenon has the potential to aggravate the already existing complications in maritime issues between neighbouring states.

Defence forces bear the brunt of emergency and humanitarian crises as they are usually the only organisations with the resources and discipline capable of responding rapidly. In the Indian Ocean Region (IOR), the impact of climate change and violent weather phenomena will increase the pressure on naval and coast guard forces. They will have to participate in a growing number of humanitarian assistance, disaster relief and evacuation operations. This was the case during major recent disasters including cyclones *Sidr* (Bangladesh, 2008) and *Nargis* (Myanmar, 2008). The December 2004 Asian Tsunami, though not induced by climate change, required the deployment of all available platforms of the Indian Navy for disaster relief. Rising sea levels imply that waters of a similar Tsunami in the future will be carried further inshore, inflicting greater destruction. Moreover, the increasing commitment of the defence forces to disaster relief may prove to be advantageous for hostile sea borne non-state actors (like the 26/11 perpetrators).

Apart from rising sea levels, rise in temperatures would also lead to severe deterioration of the maritime environment. Climate change induced changes in the strength and seasonality of ocean currents is likely to cause fish species to migrate and disrupt breeding grounds. The movement of deep water fish may become unpredictable, compounding the problem of over fishing, thus, impacting livelihoods. This could lead to a rise in unlawful activities, thereby becoming a challenge to law and order. The rich Somali fishing grounds have for many years been callously exploited by foreign fishing fleets and used for dumping of toxic wastes originating in Europe. Diminishing fish catch off Somalia is one of the reasons that have led to deprived local fishermen taking to piracy as the more lucrative option.

Each year the oceans absorb the equivalent of about one-third of human emissions of carbon dioxide (CO_2), transferring most of it to the deep ocean. Over the past 200 years, increasing CO_2 emissions from fossil fuel combustion have led to an exponential increase in the net amount of CO_2 being dissolved in the ocean. Dissolved CO_2 creates carbonic acid, which reduces the ocean pH level, making it more acidic. The greatest impact of ocean acidification will be on marine ecosystems.[11] A decrease in ocean pH affects marine life by lowering the amount of calcium carbonate, which is used by most marine organisms (including coral, shellfish, crustaceans, and mollusks) to build their shells. If oceanic pH drops by the anticipated 0.5 during this century, the resulting effect would be a 60 per cent drop in available calcium carbonate.[12] Hence, unchecked acidification of the ocean, which is inevitable given the global carbon emissions, is very likely to substantially impact future fish stocks and, hence, coastal livelihoods.

It has been established that temperature and humidity levels must be sufficient for certain disease-carrying vectors to thrive. Climate change could push temperature and humidity levels towards creating optimum conditions for the survival rate of these vectors. As per the World Health Organisation reports, high-density populations in coastal regions are at high health risk. Climate-sensitive health outcomes of concern in small islands and coastal areas include malaria, dengue, diarrheal diseases, heat stress, skin diseases and acute respiratory infections.[13]

Vulnerabilities in the Indian Maritime Neighbourhood

Most nations that are highly vulnerable to sea level rise do not have the resources to prepare for it. In South Asia, India, Bangladesh, Pakistan and Sri Lanka have large

populations living in 'at-risk' coastal areas. Small island nations such as the Maldives are at severe risk because they do not have enough land at higher elevations to support displaced coastal populations.[14] Another challenge for coastal populations is the danger of losing their fresh-water supplies as rising sea levels push saltwater into their aquifers. For these reasons, those living on several small island nations like the Maldives could be forced to evacuate during this century itself.

Bangladesh is the world's third most vulnerable country with regard to sea-level rise in terms of the number of people at risk and in the top 10 in terms of percentage of population living in low-lying coastal zones.[15] Currently, around 40 million people live in its coastal areas. Loss of coastal land to the sea in this vulnerable zone – currently predicted to touch 3 per cent by 2030, 6 per cent by 2050 and 13 per cent by 2080 – is likely to generate a steady flow of displaced people.[16] Owing to sealing of the land border with India, a large population, thus displaced, could resort to the sea route for illegal migration.

Maldives holds the record for being the lowest country in the world with a maximum natural ground level of only 2.3 m above sea level (asl) and an average height of only 1.5 m asl. In November 2008, President Nasheed announced plans to consider purchasing land in India, Sri Lanka, and Australia, due to concerns about global warming and the possibility of much of his nation's islands being inundated by rising sea levels. The purchase of land is intended to be made from a fund generated by tourism. Some reports suggest that Islamic fundamentalism is finding its way into this Muslim nation, albeit on a small scale. Some years down the line, a scenario is very likely wherein forced relocation of population and loss of economic opportunities in tandem with religious fundamentalism could create a national security crisis in the Maldives, which would then have an adverse impact on India's maritime security.

India's Lakshadweep group of islands has problems similar to that of the Maldives, insofar as terrain and vulnerability are concerned. The consequences of climate change in the Maldives would be replicated in these islands.

The British Indian Ocean territory of Diego Garcia is a critical staging facility for US and British naval and air forces operating in the Middle East and Central Asia. It sits just a few feet above sea-level at its highest point. According to a 2007 US think-tank report prepared by an eminent panel of 11 retired US Admirals and Generals, the Diego Garcia base – because of its low average elevation of 1.3 m asl – is considered the prime example of a "losing place" in the face of global sea level rise over the next

three to four decades.[17] Thus, the search for alternate bases may be one of the underlying causes for the growing interest of US Navy in the IOR.

Implications of the Melting Arctic

One of the most immediate and dramatic effect of climate change is the possibility of seasonal melting of the perpetual Arctic ice cap. The results of global warming in the Arctic are far more dramatic than elsewhere due to the sharper angle at which the Sun's rays strike the polar regions during summer and because the retreating sea ice plate is turning into open water, which absorbs far more solar radiation. This dynamic is creating a self-reinforcing melting cycle.

However, estimates vary as to when the Arctic is likely to be ice free during summers. Earlier estimates suggested a seasonally ice-free Arctic by 2060, while more current research suggests the date could be as early as 2013.[18] The two most important implications of the Arctic opening are potentially shorter shipping routes and the likely improved access to vast energy and mineral resources.

The prospect of seasonal and permanently open shipping routes in the Arctic could significantly cut the distances that need to be traversed, for instance, between various global shipping destinations. It has been suggested that, if navigable, the Northwest passage would offer a 7,000 km saving on the route between Asia and the East Coast of the US as compared to the route via the Panama Canal. The Northern Sea route would entail a 40 per cent distance savings on the transit between northern Europe and Northeast Asia as compared to a route via the Suez Canal.[19] With regard to the trans-polar route, the figures are even more dramatic, with a voyage between Hamburg, Germany and Kobe, Japan being 11,225 nautical miles via the traditional route through the Suez Canal compared with just around 5,000 nautical miles over the North Pole.[20]

While these significantly reduced distances represent an attractive prospect for the international shipping industry, distance alone does not tell the whole story. Such savings may be somewhat illusory, as the reduced distances may not necessarily translate to equivalent savings in terms of the transit times and navigational costs. Although sea ice may have thinned or melted enough to enable transit through these routes, ice will remain a major feature of the high northern latitudes, presenting a significant latent risk to navigation and, thus, necessitating cautious and unhurried navigation.

Despite these constrains over the near-term, over the long-term, taking into account canal fees, fuel costs, and other variables that determine freight rates, these shortcuts could cut expenditure, saving the shipping business billions of dollars every year. The savings would be bigger for the megaships that are unable to fit through the Panama and Suez Canals and so presently sail around the Cape of Good Hope and Cape Horn. Moreover, these Arctic routes would also allow commercial and military vessels to avoid sailing through politically unstable Middle Eastern waters and the pirate-infested Horn of Africa and South China Sea. Therefore, the use of arctic waters for navigation and international trade, in the coming decades, appears inevitable.

The great Arctic melt could yield more of the very commodities that precipitated it – fossil fuels. According to the US Geological Survey's (USGS) 2000 estimate, the Arctic may hold as much as 25 per cent of the world's undiscovered energy resources.[21] Though the technology to exploit oil from the heart of the Arctic region may not be available in the immediate future, the potential profits and advantages are already evident to the US, Canada, Russia, Denmark, and Norway, as demonstrated by the emergence of competing territorial claims, such as between Russia and Norway, and Canada and Denmark. Such issues may result in the diversion of naval forces of concerned countries to the Arctic with consequent diminishing presence in other parts of the globe, including the IOR.

The combination of new shipping routes coupled with trillions of dollars in possible oil and gas resources, will have far reaching geo-political implications. The omnipresent threat of piracy in the Gulf of Aden and the Strait of Malacca provides additional reasons for shipping lanes from Europe to Asia shifting to the Arctic. Therefore, melting of the Arctic will impact the density of traffic that traverses South of India. Consequently, revenues of maritime hubs like Singapore may also be impacted. If massive sources of oil are discovered under a melting Arctic, as predicted, then over the long-term the geo-political importance of the Middle East may also lessen.

As China is vitally dependent on the Strait of Malacca for most of its energy supplies, it would be inclined in promoting this emerging alternative route. It is already looking North and engaging with Iceland,[22] which is strategically located on the Atlantic-Arctic route to China. This route assumes more importance in light of China's fast accelerating dependence on oil from countries on Africa's West Coast – most notably Angola, Nigeria, Gabon and Equatorial Guinea. China is also showing increasing interest in the Arctic Council, and has applied for Observer status in the

organisation.[23] At a 2009 meeting in Tromso, however, the Arctic Council denied permanent membership to China.[24]

The melting of the Arctic, at first glance, appears to be a phenomenon that is too distant to have an impact on the Indian Navy. However, a deeper study suggests that this climate change induced development has the potential for an indirect, but substantial, impact on Asian geopolitics and, hence, on the Indian Navy.

Impact on the Indian Navy

The International Maritime Organisation (IMO), a specialised UN agency for the maritime sector, in its 2007 study estimated that total CO_2 emissions from international shipping during 2007 were 843 million tonnes or 2.7 per cent of global CO_2 emissions. This figure is likely to increase by over 30 per cent by 2020.[25] The shipping sector will face increasing demands to address the issue of greenhouse gas (GHG) emissions control.[26] Navies across the world, too, are likely to be placed under scrutiny regarding their carbon footprints.

The issue of marine GHG emissions being placed under an international regulatory regime would have significant implications for the Indian Navy. Currently, military ships and shore assets are exempt from environmental considerations and emission standards. However, in the decades to come, growing political and economic pressures from governments to implement energy efficient technologies and methods could impact the Indian Navy and compel it to implement a radical shift in its operational procedure. Curtailing carbon footprint and increasing use of carbon free fuels could also become mandatory in the future. The Navy, thus, needs to remain aware of such possibilities in order to successfully manage them in the future.

Climate change could also affect the Indian Navy in several other ways. It would be pertinent to touch upon some of these issues, including challenges related to Indian naval operational tasking, force structures, energy efficiency and technological changes.

As higher mean sea levels would increasingly result in coastal inundation and soil salinity, this, in all likelihood, would lead to a large scale sea-borne migration. Therefore, the growing risk of natural disasters and crisis situations arising from climate change, especially in India's maritime zone, will increase the pressure on its naval forces to undertake regular disaster relief and humanitarian aid operations. The Navy was extensively deployed for relief operations following the havoc unleashed by the

unprecedented flooding of Mumbai city in July 2005, which was caused by a combination of incessant rain and high tide. If the high tide levels became 'permanent' (due to rising sea levels), the impact on Mumbai during monsoons could be catastrophic. The Navy would have to consider such dynamics in determining its future operational tasking. Further, in the coming decades, the ingress of illegal migrants from Bangladesh and the Maldives via the sea could become a security concern and directly involve the Navy and the Coast Guard.

To carry out relief missions at short notice, the Navy would have to build capacity to carry large volumes of supplies as well as move and deploy resources rapidly. It may, thus, have to consider acquiring more shallow draught ships capable of landing in disaster prone areas and heavy-lift helicopters. The induction of air cushion vehicles and hovercrafts could become an unavoidable requirement. There could be an additional need to create onboard storage space for supplies needed for disaster relief, such as construction and sanitation gear, fuel storage equipment, medical supplies and shore based power generation equipment. Disaster relief specific or dual-purpose equipment will become an important consideration in ship design and outfitting.

The Indian Navy may need a fundamental rethink to carry humanitarian and civil relief workers more frequently, requiring a shift in manning principles and including them in regular training missions in non-crisis periods. Similarly, an increase in the frequency of conducting disaster relief operations could drive changes in the training doctrine of the Navy towards increasing emphasis on humanitarian missions in training programmes and exercises. Until now, training and exercises are focused largely on conventional naval warfare, with humanitarian aspects covered largely in classroom instructions. Training people to operate effectively in humanitarian missions would require integration of such missions in full-scale functional excises.

The Navy would also need to carry out vulnerability assessments of its bases and coastal installations against degradation due to extreme weather and rising sea levels. A close watch will have to be maintained on naval detachments in Kavarati and Minicoy.

The construction of new jetties, dry docks and infrastructure close to sea will require accounting for the rate of sea level rise. Further, in view of the fact that urban accommodation is a major source of GHGs and is likely to come under the scanner in the coming decades, the Indian Navy will need to go 'green' in planning future buildings and family accommodation in naval areas. These 'green' measures will add to costs, but they can be recovered over the long term by decreased operating costs.

The load on the Navy's health care infrastructure would increase with every passing decade, given the vulnerability of populations in coastal areas to climate change induced health risks. This dynamic will have to be kept in mind whilst planning future medical amenities and manpower induction into the Navy's medical branch.

Ocean data viz., temperature, salinity, pressure profiles, and ocean circulation patterns (especially of the upper layers of the ocean) govern submarine operations and performance of underwater sensors, communications and weapons firing. If oceanographic parameters are undergoing change at an accelerated rate, research is needed to ascertain appropriate changes in the design of sensors and change in tactics, as the case may be.

In the decades to come, growing political and economic pressure from shipping regulatory agencies to implement clean and energy efficient technology may influence the future propulsion choices of the Navy.

The Indian Navy has for long adhered to environmental norms, most notably being the controlled discharge of sewage overboard and pumping of fuel from bilges. Further, in this era of global warming, cutting emissions of afloat or shore-based assets is not only the environmentally right thing to do but also helps organisations project a positive self image. Increased use of simulators in training is a novel way to reduce the carbon footprint. The Navy can become an "environmental frontrunner" by adopting 'green' policies and practices and showcasing these achievements in its media campaigns.

Combating Climate Change

In order to combat this challenge, it is instructive to look at measures taken by navies of other developed countries. The US Navy, for instance has created a Task Force Climate Change (TFCC), headed by a Two Star Admiral, to understand and evaluate the implications of climate change and to assess the Navy's preparedness. The Task Force makes recommendations to the naval leadership regarding policy, strategy, force structure and investments relating to climate change. The US Navy Secretary Ray Mabus has set 'green' targets for the Navy. This includes evolving a system of awarding contracts that consider the lifetime energy cost of a system – creating a "Green Strike Group" by 2012 composed of ships powered by biofuels and deploying that fleet by 2016; reducing petroleum use by 2015 in its 50,000 commercial vehicle fleet through phased increases in the use of hybrid fuel and electric vehicles; producing at least half of the shore-based energy requirements from renewable sources; and by 2020, ensuring

at least 40 per cent of the Navy's total energy consumption comes from alternative sources.[27]

The Centre for Naval Analysis (CNA), USA in its report of 2007 assessed the direct impact of climate change on military systems and concluded, *inter-alia*, that abnormal stress on systems or equipment caused by higher temperatures would result in significant maintenance costs. The shortening of hours sailors could endure on deck would place restrictions on take-offs and landings on aircraft carriers.[28] In November 2009, during a major conference on the issue at CNA, a gaming exercise was conducted to highlight the challenges that nations may face in the future, given a scenario of increased climate related crises, and allow forecasting and preparedness for the challenges ahead.[29]

In September 2009, the Royal Navy appointed Rear Admiral Neil Morisetti as UK's climate and energy security envoy to lead a campaign that aims to broaden and deepen the debate on security implications of climate change. This was done to ensure increased understanding and sharing of best practices within security and defence communities, including benefits for the military in reducing its own carbon 'bootprint'.[30]

Conclusion

Most narratives dealing with the issue have come to similar conclusions that climate change is likely to be a threat multiplier, which has the potential to wear down a nation's socio-economic foundations and state institutions, thereby threatening its very stability. This explains the current transformation of climate change from an environmental issue to a first order national security concern. Thus, military analysts are increasingly becoming aware of and evaluating its security implications. The impact of climate change on Indian maritime security will be substantial given that the country's maritime neighbourhood is among the most vulnerable in the world and already subject to stresses associated with developing countries.

Keeping such dynamics in mind, the Indian Navy planners need to study and ascertain the likely effect of climate change in great depth. This will have to include, *inter-alia*, areas such as future force structures, operational philosophies, infrastructure development and propulsion choices. Increasing awareness among the future generation is, therefore, imperative and one method to achieve this could be incorporation of climate change as part of the syllabi for professional exams and as a research topic for

officers undergoing Staff College or Higher Command Courses. Further, the efforts of other advanced navies in combating this non-traditional challenge may also provide guidance on how maritime military forces could meet the challenge.

The need of the hour is for the Indian Navy to stay intellectually engaged with this issue for it to anticipate the emerging linkages between climate change and itself.

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