

Local Knowledge and Climate Change: A Case Study of Bangladesh

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Abstract: *Climate changes are posing as a major threat to sustainable development in developing countries and this is anticipated to be most vulnerable because of low adaptive capacity and high dependency on climate sensitive resources such as water resources and ecological systems. Local knowledge by its nature include the idea of coping with and adapting to changeable and changing environment. These involve the local population exclusively setting their own view of and approaches to solve the problems and evaluating the results. Consequently, these approaches imply for the context of the countries of the south that external institution should participate in the activities of the local actors concerned instead of vice versa. The paper covers the idea of local knowledge in context of Bangladesh. The methodologies include: collecting information from available literature, reports, media sources on the issue of Local Knowledge, Adaptation strategies and Climate Change in Bangladesh which briefly highlights ground adaptation practices from available sources. The information gathered is used to examine and document the societal impacts and vulnerability of Bangladesh to floods specially reflecting on coping strategies.*

Keywords: Climate change, Local Knowledge, Adaptation, flooding, Regional governance

1. Introduction

Climate changes are posing as a major threat to sustainable development in developing countries and this is anticipated to be most vulnerable because of low adaptive capacity and high dependency on climate sensitive resources such as water resources and ecological systems. A common theme in climate change literature is the idea that countries, region, economic sectors and social groups differ in their degree of vulnerability to climate change. (Bohel et al. 1993) Climate change is becoming increasingly fickle and unpredictable with the most disastrous consequences. Local knowledge by its nature include the idea of coping with and adapting to changeable and changing environment. The knowledge system provides considerable assets in the form of social capital and natural capital demonstrating people's modus operandi. Local knowledge consisting of factual knowledge, skills, capabilities most of which have some empirical grounding. It is culturally situated and best understood as a social product. It is rooted in local or regional culture and ecology. It does include dynamic processes of innovation, adaptation and respectively failures. In a broader usage, local knowledge seems to be adequate to approach to the needs and requirements of local communities. This was put in the slogan, most concisely, "Putting People First" (Cernea 1991). This encompasses taking into account the local environment, participation in development measures, harnessing existing local technical solutions and putting efforts to make visible and articulate for the first-time problems experienced by indigenous communities, women and other disadvantage groups. (Antweiler, 1998)

2. Why Local knowledge

The local approaches most closely in line with the concept of making local knowledge available and applicable, are geared to local self-reliance, decentralization of decision making and fair access to natural resources. These involve the local population exclusively setting their own view of and approaches to solve the problems and evaluating the

results. Consequently, these approaches imply for the context of the countries of the south that external institution should participate in the activities of the local actors concerned instead of vice versa. These approaches seem rather idealistic and politically perhaps not acceptable in their entirety countries. In many countries of the world, political decisions have been taken to empower local institutions, but not necessarily local communities but districts, provinces and other administrative units. The momentum of decentralization of power and local access to natural resources should correspond with the building of local capacity and competence. It seems unchallenged that the basic for local capacity and competence is the best local knowledge. It is to define to which extent external knowledge system as a constructive contribution to the local adaptation to a changing environment.

On one hand, 'local knowledge' comprises fixed and structured subject matter. On the other hand, may be virtue of its combination with the performance of actions involve a more fluid process of 'knowing'. Hence this involve empirical practices, that forms base of knowledge. Further this knowledge can be analytically distinguished are factual knowledge and capabilities related to specific theme. This emphasis about local knowledge having both dimension of practical and social significance. The social significance of local knowledge amount as being 'social product' because it usually geared to real life practices. It can only be understood with reference or the context to the situation in which it is to be applied.

As factual knowledge with focused skills and capabilities are making this expertise local to the extent that they are acquired and applied by people with respect to local objectives, situation and problems.

Local Knowledge and climate change

A common theme in the climate change literature emphasize the idea that countries, region, economic sectors and social sectors differ in their degree of vulnerability to climate change. (Bohel et al, 1993). It means that differential

vulnerabilities exist (Bohel et al, 1994). The UNFCC (United Nation Framework Convention on Climate Change) highlights two fundamental response strategies: Adaptation and Mitigation. While mitigation seeks to limit climate change by reducing emission of CHG (Greenhouse Gases) and by enhancing 'Sink' opportunities, adaptation aims to alleviate the adverse impacts through a wide range of systematic actions (Fussel and Klein, 2002). IPCC (2001:15) recognizes that "even within regions, impacts, adaptive capacity and vulnerability will vary".

The significance of climate variation depends on the degree of change and the characteristics of society exposed to it. These characteristics determine the level of vulnerability of a system. Poor developing countries are more exposed to vulnerabilities due to socio-economic preconditions which include: overpopulation debilitated ecological base, dependency on climate sensitive sectors, level of economic growth, inequities in terms of resource availability, weaker socio-economic settings, technological bottlenecks, poor pre-existing health conditions. Reducing vulnerabilities involves reducing exposures through specific measures, or increasing adaptive capacity through activities that are closely aligned with local expertise and knowledge, having developmental priorities.

It has been argued that local knowledge often treated as a source of inputs to conventional planning processes and science framework rather than as knowledge system in its own right. (12-16) As its not open to change, sometimes. As it lacks wholesomeness, a broader perspective which also make exclusively applicable.

Adaptation as a response measure to Climate Change

Traditionally, mitigation has received greater amount of attention than the adaptation in research area both from a scientific and policy perspective. Adaptation to climate change is continuous process as its emphasis practical and social significance for long term policy formulation.

The convincing arguments for consideration of adaptation as a response measure:

- A certain degree of climate change is inevitable due to historical emission and the inertia of climate system. (IPCC, 2001)
- The effect of mitigation may take several decades to manifest; most adaptation activities take effect almost immediately.
- Such measures can be applied on a regional or local scale and their effectiveness is less dependent on the action of others.
- Adaptation besides addressing risks associated with changes in the climate in future typically reduces risks associated with current climate variability.

Adaptation refers to "*adjustment in ecological social or economic system in response to actual or expected stimuli and their effects or 'impacts'. This refers to changes in process, practices and structure to moderate potential damage or to benefit from opportunities associated with climate change*". (IPCC, 2001)

Adaptation needs vary across geographical and temporal scales, must be addressed within complex and uncertain conditions. Adaptation to climate change is continuous process. It is important to consider adaptation as transitional permanent and long-term process; an adaptation plan of a few years being one step in this process. (de Perthuis et al, 2010)

3. Methods and approaches

The general approach for the current synthesis is to highlights the role of local knowledge and adaptation strategies dealing with climate change on spatial scale, to understand nature of local knowledge, its contextualization particularly in case of developing country and assess available effective strategies.

The methodologies include: collecting information from available literature, reports, media sources on the issue of Local Knowledge, Adaptation strategies and Climate Change in Bangladesh which briefly highlights ground adaptation practices from available sources. The information gathered is used to examine and document the societal impacts and vulnerability of Bangladesh to floods specially reflecting on coping strategies

Bangladesh: Case Study

Climate change is happening and posing major threat to sustainable development and this fact stand with proper evidences provided by scientific communities. These climate events are frequently taking place and intensifying changes around the globe. These events are marking major damages to the peculiar geographical locations like Bangladesh. This country has been facing regular onslaughts of divulge for the last couple of decades¹. Bangladesh is a country of 310² rivers and tributaries, having an area about 144, 000 sq. Km. the major portion of environment and livelihood are based on the rivers and its resources. There are 230 rivers which occupies near about 14% of the area. The most common water-related natural hazard in a deltaic floodplain such as Bangladesh is flood.³ Through three main occurrences are the Brahmaputra, Ganges and Meghna river basins, there are several factors such as rainfall, location, elevation and many more that also has prominent influences in causing flood in different region of Bangladesh⁴.

¹Khalil Ghazi Md., "Floods in Bangladesh: Questions of disciplining the rivers" *Natural Hazards*, December 1990, Volume 3, Issue 4, pp 379-401, Feb, 2019. <https://link.springer.com/article/10.1007/BF00124395>

² Follow the link <https://www.adrc.asia/nationinformation.php?NationCode=50&Mode=country>

³Ahmed Ahsan Udin, " Bangladesh- Climate change Impacts and Vulnerability: A Synthesis", https://www.preventionweb.net/files/574_10370.pdf

⁴Kozi Kasim Raihana, " Identifying Flood Prone regions in Bangladesh by Clustering" *IEEE Xplore/ACIS 17th International Conference*, Singapore. <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8466533>

Flooding in Bangladesh is the result of a complex series of factors. These include a huge inflow of water from upstream catchment areas coinciding with heavy monsoon rainfall in the country, a low floodplain gradient, congested drainage channels, the major rivers converging inside Bangladesh, tides and storm surges in coastal areas, and polders that increase the intensity of floodwater outside protected areas. Different combinations of these various factors give rise to different types of flooding (Ahmed and Mirza, 2000).

According to the location of Bangladesh, it has tropical climate which entails a monsoon season that typically lasts for five months. Heavy winds and territorial rain often turn rivers into overflowing, i.e. flooding.

Human Causes of Flooding in Bangladesh

Bangladesh flooding further jeopardized by human activities, on the global scale, scientist overwhelmingly agree that humans are causing global warming. The consensus position is articulated by Intergovernmental Panel on Climate Change (IPCC) statement that 'human influences has been the dominant cause of observed warming since the mid- 20th century (Qin *et al*, P.17)'.

The earth warming has intensified the natural cause of flooding in Bangladesh, for example: Precipitation occurs at faster rate, snow melts in Himalayan region at rapid pace and there is uneven amount of rainfall at various place, and in case of Bangladesh it is in greater amount. Socio-economic backwardness has also intensified the flooding situation. One is major concern is lack of proper infrastructure, as being improvised state, Bangladesh is not able to afford a flood defense mechanism or services. This makes flooding a more life-threatening event. This issue is aggravated by even more in terms of growing population. Bangladesh is densely populated country which means more people need a greater deal of housing complexes and infrastructure. Urbanization in Bangladesh's drainage basin areas increases the risks of flooding, as water cannot be infiltrated impermeable surface like pavements. This increases the chances of flooding as surface runoff is increased hence, infiltration decreased and it can cause heavy rainfall to collect and remain without being soaked up or drained.

As the population of Bangladesh is increasing, it does need fresh water to survive then more amount of water would need to be supplied in densely populated areas. Due to rising demand of water a greater number of wells have been constructed in Bangladesh, near about 100, 000 by means of boring and drilling into the earth to access the groundwater, which resulted in lowering down of groundwater level. This is making more risk of flooding.

Deforestation has also increased the risk of flooding, as less evapotranspiration can take place. After deforestation, no roots are remained to protect the soil. Roots are essential to store and absorb water. Most ecologists state the forests in habitable environment should make up at least 25% of the total land but in case of Bangladesh, only 16% area is made of forested cover, and every year nearly 2600 hectares of land are deforested, which is alarming. Irrigation is another man-made impact that is intensifying the risk of flooding.

Flooding: A Transnational Affair

Recent studies have shown that due to the effect of sea level rise the densely populated coastal zone of Bangladesh is getting highly vulnerable to coastal flood⁵. It is known that the South Asia Geography is making it more vulnerable to natural hazardous and disaster. The Global Risk Reports 2018 have estimated that sea level rise can lead to increased salination of soil and of water sources used for irrigation, particularly in delta region of Bangladesh, the world bank estimate salination could cause a 15.6% decline in rise yield⁶. In 2017, 18.8 million people were newly displaced by whether related causes, including floods and coastal storms⁷. The intensifying impact of coastal cities and plains will render an increasing amount of land uninhabitable or economically unviable⁸.

In case of Bangladesh and India, delta regions are vulnerable to future climate change and sea level rise with the potential for extensive flooding due to enhanced cyclone activity and increased river flows or extended droughts with changes in monsoon rainfall⁹. The Ganges, Brahmaputra and Meghna rivers are key drivers of change in this delta system and determine water discharge into the region¹⁰. The GBM river system drains the area of 1.612 million Km. and is one of the largest, trans-boundary river basins in the world, providing environmental services for the population of 670 million people¹¹. Due to population increase in the GBM catchment has resulted in diversified, extensive usage like agricultural expansion, urbanization and early stage of industrialization, change in water supply.

Migration trends in the delta mirror well established global trends, with a general increase in urban populations due to

5 Tanvir H. Dewan, "Societal Impacts and Vulnerability to floods in Bangladesh and Nepal" *Weather and Climate Extremes*, Vol.7, March 2015, pp.36-42, Accessed on March 2019.

<https://doi.org/10.1016/j.wace.2014.11.001>

6 Norwegian Institute of Bioeconomy Research (NIBIO). 2017. "Food Security Threatened by Sea-Level Rise". Phys.org. 18 January 2017. <https://phys.org/news/2017-01-food-threatened-sea-level.html>

7 Internal Displacement Monitoring Centre (IDMC). 2018. "Global Report on Internal Displacement" *Geneva: Internal Displacement Monitoring Centre and Norwegian Refugee Council*. <http://www.internal-displacement.org/global-report/grid2018/downloads/report/2018-GRID-region-south-asia.pdf>

8 See this http://www3.weforum.org/docs/WEF_Global_Risks_Report_2019.pdf

9 R. J. Nicholls and S. L. Goodbred, "Towards Integrated Assessment of the Ganges–Brahmaputra Delta", *Proceedings of 5th International Conference on Asian Marine Geology, and 1st Annual Meeting of IGCP475 DeltaMAP and APN Mega-Deltas, 2004*

10 <https://pubs.rsc.org/en/content/articlehtml/2015/em/c4em00619d#cit1>

11 See this <https://pubs.rsc.org/en/content/articlehtml/2015/em/c4em00619d#cit1>

migration in coastal cities (de Sherbini et al. 2011; Seto 2011). The rural to urban transition sits alongside episodes of involuntary out-migration as both direct and indirect consequences of environmental risks such as salinization and cyclonic storm surges (Black et al. 2011; Gray and Muller 2012; Martin et al. 2014).

Impacts of flooding

Bangladesh being majorly situated on deltaic region, entail socioeconomic preconditions which are making this region prone to climate change and hence, vulnerabilities and jeopardize living conditions for inhabitants. A historical account of flooded area suggest that the only minor and very high intensity floods have been occurring during the past three decades (Agarwal et al., 2003). The high distribution in inter-annual variability of flooded areas. Depending on rainfall variability within the country and in the GSM catchment area, the location and timing of flooding vary from one part of the country to another. Four natural type of flood occurs in Bangladesh: flashflood, river floods, rainwater floods and coastal floods induced by storm surges (Ahmed et al., 1994; Ahmed et al., 2000). Floods of high intensity occur when huge rate of discharge of the Bangladesh river is grossly fall behind the rate of accumulation of water. Discharge is often impeded because of low river gradients unplanned infrastructure and strong backwater effect at the confluence of large rivers, the latter being induced by high oceanic stage. The confluence between the Brahmaputra and the Ganges and the between the Meghna, and the combined flow of the earlier two river (called Padma) become two huge pools during the peak season and causes high intensity flooding, particularly in central part of the country. Riverbank erosion, sedimentation, droughts and salinity near coastal zone affecting the country for decades.

Bangladesh is listed in Least Developed Countries¹² which exhibit lower socio economical indicators, lowest human development ranking all around the world. These preconditions aggravate further impacts of climate change and flooding. This vulnerable system establishes prolonged impacts on community's adaptive capacities to climate change. Lack of proper infrastructure and finances are major hurdles while dealing with climate change. This lowers capacity of system to deal with any kind of disaster whether it is human made or natural. Climate change is halting livelihood of local, inducing major changes through. Being deltaic region, it considered as the most fertile land, where inhabitants are highly dependent on agriculture. In South Asia, agriculture is primarily based on the monsoon condition which is uncertain. Methods used in agriculture are labor intensive; hence a major part of population is based on agriculture for their livelihood. Global warming and resultant climate change could have profound effect on the water resource of the country (both surface and the ground water), the areas become highly susceptible to: 1. Increased flooding in both in terms of extent and frequency, 2. Increased moisture stress during dry periods. 3. Increased salinity intrusion during low flow conditions- which affects crop agriculture, livestock production, aquaculture, coastal

shrimp production, forest and vegetation. Due to changes in temperature and humidity, human health will also be affected. The high susceptibility of water based natural hazards will affect settlement of the population and also physical immobile infrastructure. Vulnerable system also leads to reversal state of development through a series of spiral orders of influences or conditions, occurring due to climate change. (Nazmul Haq et al, 2015) this obstruct the process of development in a region.

Usage of local Knowledge

When it comes to planning for future climate change impacts, adaptation actions always need to be locally contextualized and often customized to local and regional socio-cultural and institutional factors. (M. Glaser et al., 2014) Bangladesh is different in its geographical location which needs to be assessed as per availability of proper resources. Creation of flood defence along the major rivers has been recommended by several authors (Alam et al., 1998; Mahtab 1989, Faruque and Ali, 2005)

The human challenges arising from climate change develop in a complex interaction between nature, technology and society, and it is clear that a changing climate, among changes to biophysical parameters in the natural environment, also drives demand for changes to social and institutional processes (Glover 2017; IPCC 2014; Granberg and Glover 2014; Bauer et al. 2012). While human and societal action in the face of environmental change is not a new phenomenon per se, contemporary climatic change, through "its speed and scale of impact, combined with the invisibility of causal linkages in everyday life" (Pelling 2011, p. 13) this challenges human cognitive abilities to devise solutions in new ways and threatens the survival of whole socio-ecological systems.

Resilience has many possible interpretations but most commonly refers to a system's ability "to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" (UNISDR 2009, p. 24) when exposed to hazards. Government of Bangladesh (GOB) has established an inter-ministerial committee on climate change headed by Minister for Environment and Forest (MoEF) and with representation from relevant government ministries and department as well as Non-governmental organization (NGOs) and research institutions. The Department of Environment (DoE) under the MoEF has also setup a Climate Change related programme within the government to mitigate the effects of flood and other disasters.

In addition to constructing 5695 km of embankments including 3931km long coastal embankments to protect coastal land from inundation, GO Bhasdug 4774 km of drainage channels for proper flow of flood water. They have also constructed 200 flood shelters for evacuation of people threatened by floods (NAPA2005). In Bangladesh, people along with their domestic animal usually take shelter in schools, colleges, Union-Council complex, and even on the embankments of the rivers. GOB and different NGOs have taken initiatives to build brick latrine with proper septic

¹² See this https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/ldc_list.pdf

tanks to minimize water contamination. In the last decade, Bangladesh Government and NGOs have organized different relief programs e.g. Gratuitous Relief (GR) in Bangladesh, Vulnerable Group Feeding (VGF) to help the flood victims (Ninno et al., 2001).

In Bangladesh, authorities have been constantly building awareness among the farmers to adapt their farming systems to “normal floods” that typically inundate about a quarter of the country every year. For instance, farmers are encouraged to switch to high-yielding rice crops instead of low-yielding deep-water rice. A special type of rain fed rice; “Aman” grown in Bangladesh is highly susceptible to river floods and has been affected in all years of flooding (Baky et al., 2012). The Bangladesh Agriculture Research Institute (BARI) and Bangladesh Rice Research Institute (BRRI) have developed salinity tolerant species to mitigate the flood impact on crops (Mondal, 2010).

The local government climate change alliances seek to shape and manage a range of practices and navigate the complexities of doing so across jurisdictional, organisational and institutional boundaries. It is clear that there is no ‘one-size-fits-all’ approach to local climate change adaptation. Traditional practices in Bangladesh movement of people for commuting in rural and semi-urban is to build “Vela” a float made of either Bamboor Banana tree, and/or using small hand rowed boats. In recent years a few motor driven boats are seen in flood season, but due to the high cost and non-availability of fuel, traditional “Vela” and small hand rowed boats during floods are still in practice in both the countries. To shelter flood victims, flood shelters are organized by the government, although often it is not enough to accommodate all the flood victims. Conversely, the traditional practice, to create “Matcha”, elevated surface made out of bamboo or woods or use of “Vela” to live on during flood are still valuable. In both the countries, despite governments organize relief including food, cloth, money and health care services, these usually do not reach the victims in time due to transportation problem; however, people in flood prone areas to re puff rice (Muri), flat rice (Chira) and jiggery as immediate food supply during the flooding period to protect them from starvation and these dry foods are safe and hygienic. Traditional practices show that green coconut water is consumed in Bangladesh to rehydrate the victims of waterborne diseases like diarrhoea, cholera and dysentery (Dewanetal, inpress). Duetoits mineral and electrolyte content green coconut water is unmatched to any modern-day sore hydrate substitute and has proven 97% recovery rate of dehydration- related diseases: such as cholera and influenza (Fife, 2007).

A growing number of cities are stepping up to the challenge of sea-level rise. Most of them literally have no choice. Alongside mitigating their carbon footprints though reducing emissions, they are basically three ways taking steps. First, they are fielding hard engineering projects like sea walls, surge barriers, water pumps and overflow chambers to keep water out. Second, they are adopting environmental approaches involving land recovery and the restoration of mangroves and wetlands to help cities cope with floodwater inundation. The third strategy involves people-oriented measures including urban design, building

resilience and retreating after all other options have been exhausted.

The good news is that coastal cities are not starting from scratch – most of them have deep stores of knowledge and expertise. For centuries, cities bordering oceans and waterways have had to contend with local sea-level fluctuations and periodic storms. Many coastal cities have experimented with a combination of all three types of measures for hundreds of years. But past successes do not necessarily guarantee future safety. Today’s cities are different from their predecessors. Many of them are of an unprecedented size and complexity. Complicating matters, sea levels are rising more rapidly than in the past, in some cases overwhelming local capacities to respond.

Regional Governance

In case of least developed countries (LDCs), National Adaptation Programs of Action to Climate Change (NAPAs) provide a starting point for identifying national priorities for adaptation to CC. However, they rarely identify the need to work closely with local institutions in implementing priority actions on Climate Change. In addition, all countries signatory to the United Nations Framework Convention on Climate Change (UNFCCC) produce periodic “National Communications” on CC which increasingly draw together both mitigation and adaptations issues, but again are not specific in terms of the role of local authorities.

Disaster management in Bangladesh: the role of local government

Bangladesh’s draft National Plan for Disaster Management 2008–2015 recognizes that ‘climate change adds a new dimension to community risk and vulnerability. Although the magnitude of these changes may appear to be small, they could substantially increase the frequency and intensity of existing climatic events (floods, droughts, cyclones etc). Current indications are that not only will flood and cyclones become more severe; they will also start to occur outside of their “established seasons”. Events, such as drought, may not have previously occurred in some areas and may now be experienced’

(Government of the People’s Republic of Bangladesh 2008, p.12).

The Plan calls for the establishment of Disaster Management Committees at all sub-national levels (Districts, Upazilas, UPs, Pourashavas and City Corporations), charged with developing Disaster Management Plans (DMPs) for their respective jurisdictions. DMPs are expected to include provisions for: (i) reducing and mitigating disasters; (ii) disaster response; (iii) post-disaster recovery; and (iv) costings for each. The nested hierarchy of DMPs is intended to use local knowledge to build a bottom-up approach to disaster mitigation and response and to ensure higher levels of overall coordination at the local levels.

Source: Government of the People’s Republic of Bangladesh (2008).

4. Conclusion

Studying local climate action in a setting confronted with significant social tensions is valuable, and accordingly, this case study makes an important understanding to our knowledge around creating climate resilience in a complex social setting. Striving for climate resilience in a developing country with social and economic tensions necessitates a focus on equity and consideration of those areas and communities most vulnerable. Equity goals need to be integrated into planning policies and processes and not treated as separate to other development goals. The transformative potential of local climate change action is highly contingent and susceptible to wider changes at regional, national and global scales. Despite the ongoing dynamic and uncertain context within which local actors come together to respond to climate change, Climate change affects this region differently than the rest of the world due to vulnerable system, produces prolonged impacts on community's adaptive capacities to deal with climate change. As Bangladesh's case entails various geographical and political reasons which are aggravating this situation further. Local expertise or adaptive capacities are something need to be noted while dealing with multilevel governance and policymaking efforts. This system requires bottom-up approach to deal with communities during disasters and further needed an important step to build resilience among vulnerable communities.

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Some Useful links:

- [14] <https://www.iucn.org/content/climate-change-induced-migration-bangladesh>
- [15] <https://data.humdata.org/dataset/bangladesh-floods-august-2017-vulnerability-population-density>
- [16] <https://www.dhakatribune.com/bangladesh/2017/08/28/flood-situation-shows-signs-improvement/>
- [17] http://www.mcrg.ac.in/5thCSC/5thCSC_Paper/Haimanti_Pakrashi.pdf
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