

Bengal Delta not sinking at a very high rate

A pragmatic assessment based on archaeological monuments

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DURING the last couple of years, several research and studies have been carried out on the Bengal delta, which suggest that it is subsiding at a very high rate from one to two centimeters per year (cm/yr). In many cases, however, this phenomenon includes subsidence plus Global Sea Level Rise (GSLR), which is generally known as Relative Sea Level Rise (RSLR). Syvitski and his co-researchers published an article in the *Nature Geo-science* in 2009 where they estimated the rate of RSLR for the different deltas in the world using high resolution satellite images, Shuttle Radar Topography Mission (SRTM) and historical maps.

Syvitski et al. (2009) claimed that due to human interventions, such as groundwater extraction and carbon mining, many of the deltas are sinking at a very high rate. Through their analyses, they assigned a range of 8 to 18 millimeters/yr RSLR for the Ganges-Brahmaputra delta, but did not use any ground truthing information. In our delta, especially in the southern part, which is very much vulnerable to climate change, there is almost no groundwater or carbon mining, which suggests that this RSLR might be a part of a long-term natural sinking process.

Two studies were carried out recently in Bangladesh for two projects in the Ganges-Brahmaputra delta area funded by the World Bank. The studies, however, referred the study by Syvitski et al. (2009) as supporting evidence. One study is on the Sunderbans, carried out by an Expatriate Professor where he showed that the southwest part of the delta was subsiding at the rate of 20 mm/yr. According to him, GSLR is not required to sink the delta; subsidence alone can make it happen within a timeframe of a few decades. Another study, carried out by the Coastal Embankment Improvement Project (CEIP) estimated the rate of subsidence as one cm/yr referring to the recent research carried out through a joint collaboration between Dhaka University and Colorado University, US.

The Geological Department of Dhaka University with the help of their expatriate partners established earth observatory stations at different locations in Bangladesh. They are using stationary GPS (Global Positioning System) reading for calculating both horizontal and vertical earth surface movements. Results from their observations suggest that local subsidence is about 10 mm/yr in Khulna and Patuakhali, although the period of observation is short. More research is being carried out on the same issue from US based universities. The preliminary findings of such research also suggest that the annual sedimentation rate in the Sunderbans is within a centi-

meter per year, which is also synonymous to RSLR.

The results of such research have long-term implications for Bangladesh. It has become crucial for local people, local investors, decision makers and also the donors in decision making, to find out whether the inhabitants will be encouraged to migrate to other places from the disaster prone delta area or invest huge money to rescue the delta.

Many of the researches are based on remotely sensed data such as satellite images or GPS, or data of the shorter time-scale (one to two years sedimentation rate). The observations from the shorter period may be biased by short-term perturbation and may not be representative of the prevailing decade or century scale processes. It is very difficult to measure the RSLR directly and there are several ways to do so



Doyamoyee Kali Mondir

indirectly. Every type of measurement has its limitations. We selected the archaeological monuments in the tidal plains for assessing the rate of RSLR, which can provide a very good indication about the range of subsidence for quite a longer period than reflecting short-term perturbations.

In the tidal plain, land formation occurs by sediment dispersal through tide. The surface level of land is deter-

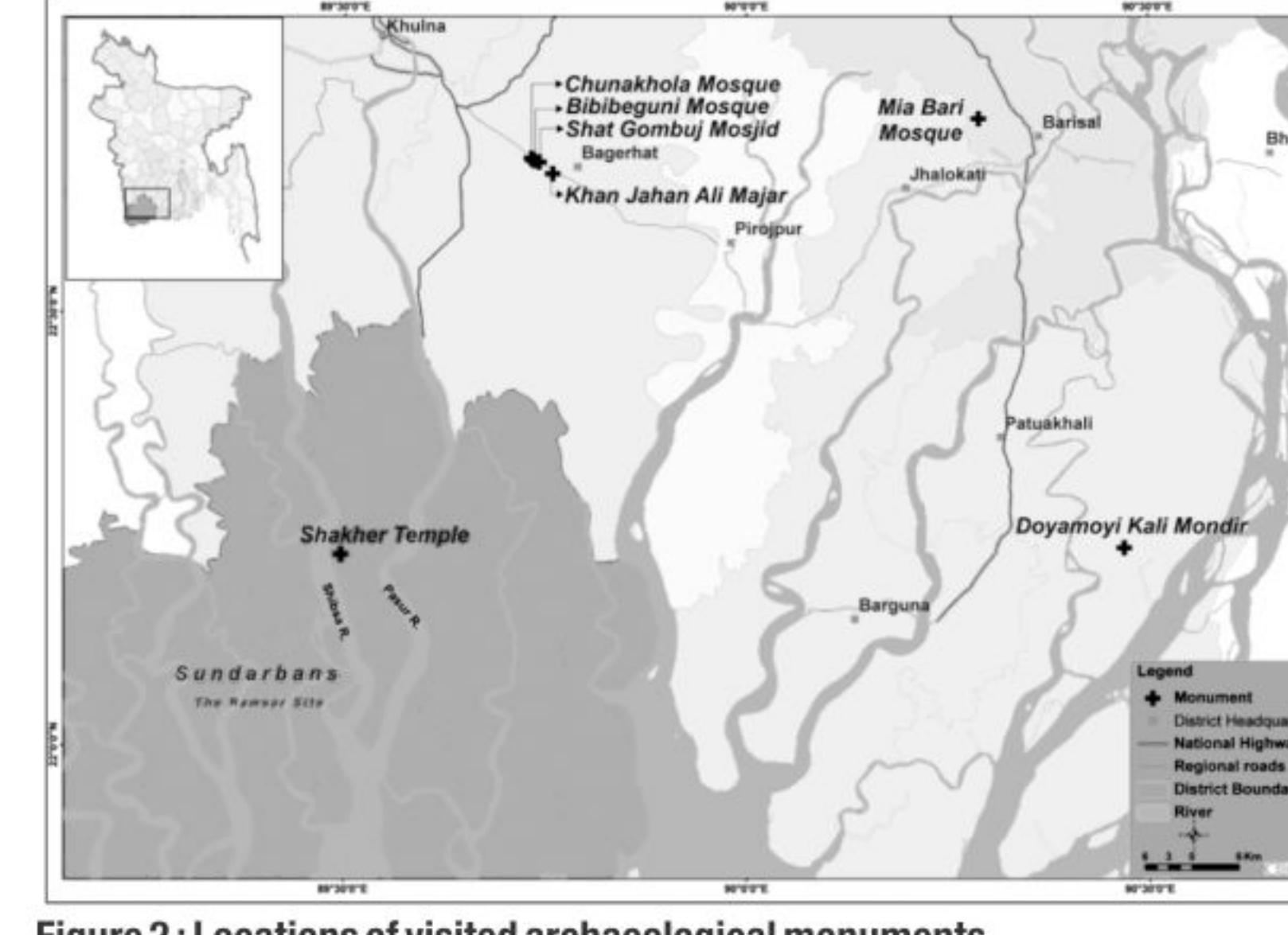


Figure 2: Locations of visited archaeological monuments

mined by the high tide level, availability of sediment and proximity of tidal rivers/creeks. In natural condition, as in the Sunderbans, most of the land surface is above the average high tide level during neap tide (NHWL) and below the average high tide level during spring tide (SHWL), i.e. land surface level is largely determined by the Mean Sea Level (MSL) and tidal amplitudes. The Global Sea Level is not constant, rather it is changing continuously. Several researches have estimated the Global Sea Level Rise of last 130 years at about



Chunakhola Mosque

0.2 m. There are no reliable measurements for the past and thus we assumed 0.25 m GSLR for the past few centuries.

Generally there are common practices in building houses or any other structure in tidal plains. Homestead platform is built a few decimeters above the tidal plain, which should be very close to the SHWL, so that the platform is seldom inundated by tidal flooding. The height of the plinth of the houses

generally varies from 0.5 to 0.8 m from the house platform level. A simplified diagram is shown in Figure 1 to demonstrate the relation between the tide, tidal plain, homestead platform and plinth levels.

Thus $PLS - TPL = 1.2 \text{ to } 1.8 \text{ m}$

RSLR is calculated for lower and higher limits.

Lower RSLR = $TPL + 1.2 \text{ PLE}$ and

Higher RSLR = $TPL + 1.8 \text{ PLE}$

Here SHWL = Spring Tide High Water Level, NHWL = Neap Tide High Water Level, TPL = Tidal Plain Level, HPL = Homestead Platform Level, PLS = Plinth Level Standard, PLE = Plinth Level Existing. Subsidence is calculated after deducting 0.25 m from the calculated RSLR.

Recently, a team from CEGIS visited several archaeological monuments in the southwest region of Bangladesh, the locations of which are shown in Figure 2. The objectives of the visits were to inspect the conditions of different archaeological monuments and to measure the existing plinth heights of the old structures from the tidal plain, homestead platform, or from other reference levels. Information on monuments such as Doyamoyee Mondir, Chunakhola Mosque and Bibi Beguni Mosque and Shakher Temple in the Sunderbans, was used for calculating the rate of subsidence in the Bengal Delta. The Shat Gombuj Mosque and the tomb of Khan Jahan Ali at Bagerhat

Matrix

| Observed plinth level, rate of subsidence, and predicted plinth levels of different monuments | Present plinth | Estimated rate of subsidence (mm/yr) | Monument plinth level | |
|---|------------------|--------------------------------------|--------------------------|--------------------------|
| | | | For 10 mm subsidence | For 20 mm subsidence |
| Doyamoyee Mondir | 0.70 m above TPL | 1.25 | 0.7 m below TPL | 2.7 m below TPL |
| Chunakhola Mosque | 0.30 m above TPL | 1.3 to 2.5 | 3.5 m below TPL | 8.5 m below TPL |
| Bibi Beguni Mosque | 0.40 m below HPL | 1.3 to 2.5 | 3.5 m below TPL | 8.5 m below TPL |
| Shakher Temple | 1.2 m above TPL | -0.6 to 0.88 | 2.5 m below forest floor | 6.5 m below forest floor |

were not considered as they are constructed on land artificially raised by earth excavated from a huge adjacent pond (dighi).

Brief descriptions based on the Internet and records from the Archaeological Department of Bangladesh are given below. The plinth levels of these monuments were measured from information on tidal plains, homesteads, or from any other references. In cases of high subsidence like 10 or 20 mm per year, probable elevations of the plinth of those monuments

were estimated and compared with the present conditions.

Doyamoyee Kali Mondir: The Doyamoyee Mondir was built in the year 1208 of the Bengali calendar. It is a temple of the god Shiva and the goddess Kali of the Hindu religion, and is an ancient structure and archaeological heritage. It is located at the side of a tidal creek called Kamlakanto Khal at Galachipa upazila under Patuakhali district. The structure is under the threat of riverbank erosion and a part of the structure has been eroded by the river. It is located on the tidal plain and is free from the effects of poldering. The plinth level of the structure is about 0.7 m above the existing ground/homestead level and 0.5 m below the polder embankment level. During the last 200 years, GSLR has been about 0.25 m and thus the subsidence has been 0.5 to 0.25 m = 0.25 m. The annual rate of subsidence has not been more than 1.25 mm/yr. If the RSLR was 10 mm or 20

The level of the original plinth was estimated by comparing the door heights, which are 0.40 m below the homestead level. Thus, the RSLR is within 0.9 to 1.5 m and subsequent subsidence is within the range of 0.65 to 1.25 m. The equivalent rate for the age of 500 years is 1.3 to 2.5 mm/yr, almost the same as that of the Chunakhola Mosque.

Shakher Temple: The only standing ancient structure in the Sundarbans is located in Shakher Tek, about one kilometer away from the east bank of the Sibsa River. In the early 17th century, Raja Paratapaditya had established a township and a fort there during his reign in order to fend off Arakanese and Portuguese pirates. The temple itself was built by the Pratapaditya settlers. It is a temple for the goddess Kali of the Hindu religion.

It is the place where the forest floor

Bibi Beguni Mosque

mm per year, the plinth level would have been 0.5 m or 2.5 m below the TPL respectively, which is far from the reality.

Chunakhola Mosque: Built in the 15th century, the Chunakhola Mosque is located in the village of Chuna Khola in Bagerhat, and is an archaeological heritage. It has a hemispherical dome with frontal arches. The brick walls were repaired in the 1980s. The plinth level of the mosque is about 0.3 m above the TPL. Thus, the RSLR value during the last 500 years would have been within the range of 0.9 to 1.5 m and hence subsidence would have been 0.65 to 1.25 m. Therefore, the rate of subsidence would have been 1.3 to 2.5 mm/yr. In this subsidence, settlement due to the massive brick walls with 2.08 m thickness is included. For 10 to 20 mm RSLR,

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Bibi Beguni Mosque: The single domed Bibi Beguni Mosque was also built in the 15th century and is situated in the west of the Shat Gombuj Mosque. It is square in shape at its outer side.

There are three arched doorways in its eastern wall and one each on the north and the south. The plinth is raised, for which the main door height is found to be lower than the Chunakhola Mosque.

the plinth would have been 3.5 m to 8.5 m below the TPL, which cannot be imagined even for any archaeological monument in our tidal plain.

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The writers are with Center for Environmental and Geographic Information Services (CEGIS). They acknowledge the contribution of Anika Tahsin, Mizanur Rahman, Mohammad Razu Ahmed and several other CEGIS colleagues for making their field investigation to the archaeological monuments including Sunderbans successful.

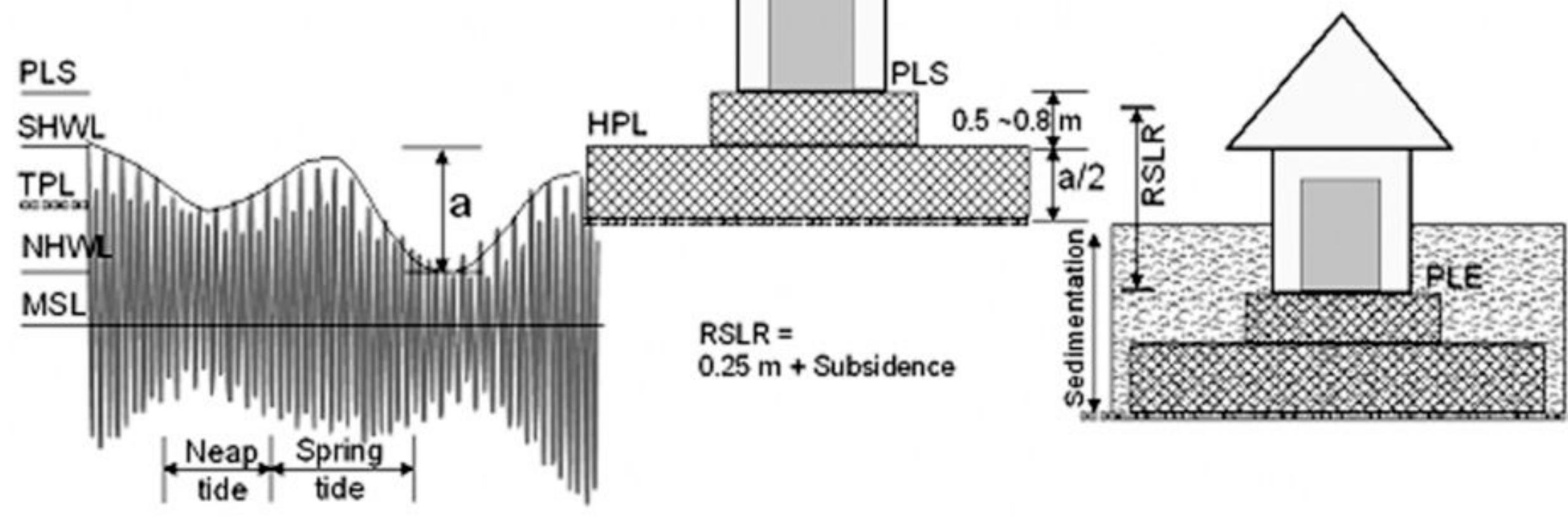


Figure 1: Schematic diagram showing the methodology of calculating RSLR using the plinth height of archaeological monuments

Gender and climate negotiation: Time to celebrate!

FARAH KABIR

DOHA COP18 will go down in history as the COP that incorporated Gender in the main negotiation text. The draft circulated co chairs of SBI Agenda 21, which was prepared with contributions from many, especially Mary Robinson, and circulated by EU, was opened for consultation on 29th of November. After two days of consultations among delegates from participating countries a draft text was submitted for consideration in SBI with the suggestions that it go to COP.

Notwithstanding that there wasn't sufficient time to discuss at length the text, and after initial discussions over certain language and concepts proposed by delegates from the parties present an agreement was reached in the greater interest of gender balance. For me it was about the women leaving under the climate change disasters now, and for those who were under the threat in the future for no doing of theirs.

Bangladesh had proposed that a measurable target with timeline, i.e., 50% by 2020, be incorporated for achieving gender balance in COP bodies, structures and related institutions. It was about inclusion, representation, effective contribution. Some countries present, did not agree to set this target and timeline. The disagreement may be attributed to varying reasons, countries not confident that they had the capacity within their country and region, thus the target within

the stipulated time to having a 50/50 balance was not feasible; while another country objected as they would have to lose a few women in an all women delegation so as to include men in the delegation! Thus a longer duration to be able to achieve this target was needed. The main thinking among the party representatives was that once the text is adopted, there were ways to amend the agreement. If invested there could be concerted efforts to develop the capacity in the meantime.

In the preamble it has been recognized that there is a need to achieve greater participation from the developing countries. India proposed disaggregated data of women's representation from developed and developing countries be made available so as to work to achieve balance.

In probably the shortest possible time all those present came to an agreement on the draft text as we all had a common agenda...

Incorporate gender balance in COP and negotiations process. We could not afford to miss the opportunity

Friday 7th December 2012, may be the day to celebrate the inclusion of gender balance in the text of COP!

Surprisingly it was possible to agree on this text when there is no movement on any of the other fronts: Finance, Loss and Damage, nor any of the more contentious issues.

And... there is gender, women and climate change. So is it 'add on'?



Woman and girl child tackle flood situation

Why does Gender matter?

In the course of development, where the world stands today, women have contributed just as much as men have, may be even more. But where is the recognition? It is about the perspective of 50% of the population and it is about the impact on their lives yet not organically integrated.

Women were initially part of neither international negotiations nor policy formulations a scene which is equally true at national levels. I am not raising this as a matter of representation of women only. It is much deeper and fundamental issue: it is about the conceptualization and understanding that women are impacted differently and they suffer the impacts of climate

change disproportionately. Thus, it is important to get their perspective on board to propose or make any change that may be brought to the table as part of adaptation or mitigation measures.

A need to change the structural dynamics of the negotiations was how Mary Robinson, president of MRFCI thought the change towards gender inclusion could be achieved. She opined that women are intergenerational and practical. I therefore would like to ask, do we bring in their knowledge and wisdom on board or leave it, as we often have in endless global processes and policies before? We have to catalyse the structural change within climate change negotiations to create an opportunity.

It, for me, flows from the principles of accountability, transparency and democracy. There is the need to ensure deliverables which are critical for a right based governance and equitable society. It becomes imperative to challenge the existing power dynamics and relationships. It calls for the change of mindset of both men and women.

National policies must facilitate the process of equitable development opportunities. At ground level, increasing broad-based economic development by promoting female education, employment and economic and political empowerment. It is most likely to prove as one of the most promising strategies for climate change

adaptation, with women as key agents. A broad-based development approach requires gender-sensitive growth strategies that invest in women and empower them to more effectively contribute to economic development. All regions will require greater recognition that women need to be supported in their dual roles as care-givers and active economic agents. This will involve lightening their care burden through access to improved household technologies, extended public social protection systems, and through strategies that increase women's bargaining power. The success of a post-MDG development framework depends on formulating policies and translating existing policy promises on gender equality and women's empowerment into concrete actions.

Other issues such as migration and its impact have to be central to thinking for any policy or programmatic intervention we may propose. There is need for ensuring the environment for gender analysis and women's participation in policy formulation and decision making without any further loss of time.

Women need to think of themselves as 'power up group' and more men have to actually join in and believe in moving from the support role to an active role for inclusion. Otherwise an equitable and just society call will be no more than rhetoric!

The writer is Country Director, ActionAid Bangladesh