Press Release **May 18, 2007**

19% of India's Global Warming emissions from Large Dams

Myth of large hydro being clean shattered (again)

India's dams largest methane emitters among the world's dams

Latest scientific estimates show that Large dams in India are responsible for about a fifth of the countries' total global warming impact. The estimates also reveal that Indian dams are the largest global warming contributors compared to all other nations. This estimate by Ivan Lima and colleagues from Brazil's National Institute for Space Research (INPE) was recently published in a peer-reviewed journal.

Methane emission from Indian Large Dams This study estimates that total methane emissions from India's large dams could be 33.5 million tonnes (MT) per annum, including emissions from reservoirs (1.1 MT), spillways (13.2 MT) and turbines of hydropower dams (19.2 MT). Total generation of methane from India's reservoirs could be 45.8 MT. The difference between the figures of methane generation and emission is due to the oxidation of methane as it rises from the bottom of a reservoir to its surface.

The study estimates that emission of methane from all the reservoirs of the world could be 120 MT per annum. This means that of the total global emissions of methane due to all human activities, contribution from large dams alone could be 24%. The study does not include the emission of nitrous oxide and carbon dioxide from large dams. If all these are included, the global warming impact of large reservoirs would go up further.

The methane emission from India's dams is estimated at 27.86 % of the methane emission from all the large dams of the world, which is more than the share of any other country of the world. Brazil comes second with the emission of methane from Brazil's reservoirs being 21.8 MT per annum, which is 18.13% of the global figure.

"It is unfortunate that Lima's study has come too late to be included in the recent reports from the Intergovernmental Panel on Climate Change (IPCC)," says Patrick McCully, Director of the International Rivers Network. "Climate policy-makers have largely overlooked the importance of dam-generated methane. The IPCC urgently needs to address this issue."

These latest round of studies should further help shatter the myth that power from large hydropower projects is clean. Indian hydropower projects are already known for their serious social and environmental impacts on the communities and environment. The fact that these projects also emit global warming gases in such significant proportion should further destroy the myth.

Looking at the available figures for dams in India, total emission of methane from Indian dams may be somewhat over estimated, but it is still likely to be around 17 MT per annum. Even this more conservative figure means that India's dams emit about 425 CO2 equivalent MT (considering that global warming potential over 100 years of a T of methane is equivalent to GWP of 25 T of CO2, as per the latest estimates of IPCC). This, when compared to India's official emission of 1849 CO2e MT in year 2000 (which does not include emission from large dams), the contribution of methane emission from large dams is 18.7% of the total CO2 emission from India.

What needs to be done Indian government has been blind to this issue so far, even though it has been known for more than a decade now that reservoirs in tropical climate are significant source of global warming gases. Neither Central Water Commission, nor Central Electricity Authority, both premier institutes of Govt of India, have assessed the global warming impact of India's large dams and implications there of. The minimum the government can do is:

- To urgently institute a credible independent scientific study of global warming impact of dams in India, in light of findings elsewhere. The study should include actual measurement of methane and other GHG emission from a sample of reservoirs.

- While making this assessment, it should also be assess as to what extent methane emitted from reservoirs and hydropower projects can be recovered for beneficial use, in the process also reducing the global warming impact of the reservoirs.
- While assessing power and water resources development options, the Green house gas emission potential of dams should be assessed, as part of the cost benefit analysis and as part of environment impact assessment.
- The IPCC should initiate an independent study to assess the GHG potential of reservoirs in different parts of the world, including India. Emission of CO2 from reservoirs is already part of the mandatory reporting formats of IPCC. Reporting of methane emissions is suggested, but not mandated. The IPCC should make reporting of emission of methane from large dams mandatory.

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Brief Backgrounder

Assumptions The study had to make a number of assumptions in arriving at these estimates, as no measurements of the methane concentration or emission have been made for reservoirs in India. (Most measurements of methane emission from reservoirs have been done in Canada, Brazil and French Guyana.) Secondly, the data about the release of water from turbines and spillways of India's dams were not adequate; hence the estimates involved some further assumptions.

The Science Large dams have been known to be emitters of greenhouse gases like methane, carbon dioxide and nitrous oxide for over a decade now. The "fuel" for these gases is the rotting of the vegetation and soils flooded by reservoirs, and of the organic matter (plants, plankton, algae, etc.) that flows into. Methane is produced at the bottom of the reservoirs in the anaerobic conditions prevailing there, over the lifespan of the reservoirs. The gases are released at the reservoir surface, at turbines (of hydropower projects) and spillways, and downstream of the dam.

The latest estimates reveal that the biggest global warming impact of large dams could be coming from methane emissions from turbines of large hydropower projects and spillways of dams. Methane is produced at the reservoir bottom. As it rises toward the surface part of the methane is oxidized in the water to carbon dioxide, a much less powerful greenhouse gas. But when methane-rich deep water is released at the turbines and spillways (generally from below the surface of the reservoirs), the pressure acting upon the gas due to the water column above it suddenly drops and most of the dissolved methane is released directly into the atmosphere. This degassing is a similar process to the fizzing of a newly opened bottle of Soda or cold drink. Researchers from INPE estimate that 95% of dam methane emissions are from spillways, turbines and downstream.

China and USA have more large dams than India. However, Indian dams, being situated in tropical climate, could be such big contributors to global warming, since Methane emissions are one or more orders of magnitude higher in tropical (in areas between 30 degree latitude on both sides of equator) climate than those from reservoirs elsewhere. Some of the large hydropower reservoirs in Brazil (also in tropical climate zone) have been estimated to have a higher global warming impact per kilowatt-hour electricity generated than fossil fuels, including coal, according to the study.

It is true that the calculation of the warming impact of reservoirs should be based upon net emissions, which is additional emissions due to reservoirs, compared to situation without the reservoirs. Net carbon dioxide emissions from reservoirs may be significantly smaller than gross emissions. However the difference between net and gross methane emissions is not likely to be significant.

Lima and his co-authors propose capturing methane in reservoirs and using it to fuel power plants. Lima says, "If we can generate electricity from the huge amounts of methane produced by existing tropical dams we can avoid the need to build new dams with their associated human and environmental costs."

ICOLD data base A large dam is defined by the International Commission on Large Dams (ICOLD)—the dam industry's primary business association—as one that is over 15 meters tall from the deepest foundation. The ICOLD database used by the INPE researchers counts some 33,071 registered large dams. The actual number of large dams is likely to be closer to 52,000. The total number of Indian large dams in the ICOLD register is 4005, but actual number of completed large dams in India is likely to be closer to 4500. According to 2002 Central Water Commission Register of dams, India had 4525 large dams, including 475 under construction dams. However, that Register is not exhaustive.

More information

- Ivan B.T. Lima et al. (2007) "Methane Emissions from Large Dams as Renewable Energy Resources: A Developing Nation Perspective,"Mitigation and Adaptation Strategies for Global Change, published on-line March 2007. http://tinyurl.com/2bzawj
- "FAQ: Greenhouse Gas Emissions from Dams." http://www.irn.org/pdf/greenhouse/GlobalResGHGsFAQ.pdf
- IRN web pages on reservoir emissions. http://www.irn.org/programs/greenhouse/index.php?id=resemissions.html
- www.dams.org