Environmental flow estimation under climate change

Dhanya and Arun Kumar[1] have presented a schematic of interlinking of factors influencing estimation of environmental flow (Eflow), wherein the Eflow is computed first accounting for the water quality and quantity issues and finally, the minimum flow is computed based on the current and future scenarios of water quantity and quality. This schematic reveals that minimum flow is equal to the dilution factor times E-flow, and is not the same as the E-flow, which has to be prescribed to maintain the river water quality standards. However, in their study, the terminologies 'minimum flow' and 'Eflow' are used interchangeably. Based on our past experience, particularly with the estimation of Eflows for some of the hydropower projects in India, it is argued that there is a significant difference between these two terminologies.

The concept of minimum flow in rivers came into practice during 1970s, which explains a threshold flow value below which the health of the river degrades significantly if more and more water is withdrawn. Subsequently, many studies realized the importance of river flow regime, such as high, medium and low flows, and flood pulses for maintaining healthy river habitat, and aquatic flora and fauna. Our experience shows that these multiple flows or natural flows are not only paramount for habitat maintenance but also for fish migration, feeding and breeding physiology during different seasons. Fish migration and reproduction are dependent on the seasonal flows; for example, the hill-stream fish species, *Schizothorax* sp. and *Tor* sp. migrate upstream of the river reach during the early monsoon period for their breeding activities. Hence, only the minimum flow, which is estimated using the hydrological analysis, does not satisfy the sustainable water requirement of the aquatic organisms. According to the Brisbane Declaration-2007, Eflows are the quantity, timing, duration, frequency and quality of flow required to sustain freshwater, estuarine, and near-shore ecosystems, and the human livelihoods and well-being that depend on them.

With the anthropogenic activities causing floodplain encroachment in many of the river stretches in India, the natural purification capacity of the rivers has reduced significantly. Hence, only dilution factor may not help maintain the instream water quality; and there is a need of flood pulses to clean up the floodplain. Moreover, the riparian zone, which is one of the major biodiversities of the river ecosystem, is not served by computing the Eflow as a percentage of dependable flow using the flow-duration curve analysis. Using these concepts, we estimated the Eflow requirement for the proposed Etalin hydropower project on the Dri and Tangon rivers in Arunachal Pradesh[2]. Based on this study on seasonal flow requirement for the fish and the river ecosystem, members of the Expert Appraisal Committee, River Valley Projects, Ministry of Environment, Forest and Climate Change (MoEFC), Government of India realized the importance of mimicking seasonal/natural river flow regimes for estimating the Eflows. Now the MoEFC is convinced that only hydrological modelling will not suffice for estimating the Eflows. There is a need to estimate the natural flows in the river using the multidisciplinary concepts of ecology, hydrology, hydraulics, geomorphology and sociology. During Eflow estimation, water requirement for all the sectors must be accounted for to maintain a balance between the health of the river ecosystem and the societal development. Since the main objective of estimating the 'Eflow' for a river is to maintain a sustainable fluvial ecosystem, to obtain this decision variable, apart from considering the water quantity and quality issues, those of biodiversity, biological cycle of the major aquatic organisms, dynamism of riparian vegetation, and sedimentation of the hyporheic zone must be addressed. In light of this argument, we summarize that the minimum flow is not ecologically sustainable but hydrological motivated, and hence cannot be equated with the Eflow which is majorly hydro-ecologically sustainable.

1. Dhanya, C. T. and Arun Kumar, *Curr. Sci.*, 2015, **109**(6), 1019–1020.
2. Central Inland Fisheries Research Institute, Assessment of environmental flows for Etalin hydro-electric project in the river Dri and Tangon, Dibang Valley District, Arunachal Pradesh, Barrackpore (West Bengal), Report, Kolkata, 2015, p. 93.

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Afforestation/Reforestation-Clean Development Mechanism and Indian farmers

Clean Development Mechanism (CDM) is one of the most flexible mechanisms under the Kyoto Protocol (KP) for project-based emission reduction activities in developing countries that aim to generate certified emission reductions (CERs). Although Afforestation/Reforestation – Clean Development Mechanism (A/R-CDM) is a small part of the overall CDM, such projects have helped in the sustainable development of degraded and unproductive land. In most cases the benefits from these projects have flown to the participating communities. After the successful completion of the first commitment period of the KP, India has managed to register 7 A/R-CDM projects between 2008 and 2012 and currently holds 18% of the share in the international carbon market (ICM)[1]. Now with the commencement of the second commitment period, and with India having ample scope for carbon mitigation options through the land use, land use change and forestry (LULUCF) activities, our farmers should seriously think of using this mechanism as a tool to gain financial benefits apart from the role in carbon offsetting. The opportunities in the ICM should be seriously tapped by such farmer groups whose lands are not giving sufficient dividends to them.

As a matter of fact, the agricultural sector in India has been badly hit for the past few decades, due to faulty Government policies, lack of implementation of Government schemes and continuous negligence of the agriculture sector resulting into farmer suicides. Moreover, the land acquisition bill recently pushed by the Central Government for acquiring farmers' lands for developmental purposes without their consent makes the situation even more grim for the farmer community across India.

There is ample scope for farmers to contribute to the A/R-CDM mechanism, generating carbon credits that can be sold in ICM, thus achieving environmental, economic, financial and social benefits. One of the most recent examples of financial benefits being flown to the participating farmer communities can be cited from Himachal Pradesh, India where reforestation under A/R-CDM was carried out in 3204 ha of degraded lands by the Himachal Pradesh State Forest Department. These lands were owned by farmer communities. After the acceptance of the verification report for the first cycle was completed in November 2014, the Government of Spain through the World Bank has agreed to release the first installment of INR 1.93 crores against a stored and verified 65,582 CERs. The financial incentives are expected to percolate down to farmers scattered in 10 districts, including 602 villages.

As the concept is not so popular among farmers, awareness should be spread at the grass-roots level about such practices by organizing awareness programmes in villages all across the country. The Government should also play a proactive role and provide technical inputs through its highly trained team of experts. Thus, it can be concluded that A/R-CDM projects could be a better alternative for Indian farmers facing a complexity of problems and successful implementation of more such projects in the second commitment period could find solutions to problems of the farmers.

1. Tripathi, S. *et al.*, *A Guidebook on Afforestation and Reforestation CDM Projects in India*, 2012.

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Citation peaks in modern science: 1900–2010

The references in an article indicate that the author believes they are of importance to the article, in that they support, illustrate, or elaborate on or are related to what the author has to say[1]. Citations have been considered as relating to authoritativeness[2], intellectual influence[3] and high quality[4], and it is hence normally assumed that greater the number of citations that a paper receives, greater is the impact (or influence, importance, authoritativeness, etc.) of that paper within its particular research community.

As the largest citation database, Thomson Reuters' *Web of Science* (*WoS*) provides data for citation analysis research. It contains citations of publications in over 10,000 of the world's most important academic journals dating back to 1900. Using the data of *WoS*-indexed journals, Thomson Reuters' *Essential Science Indicators* (*ESI*) reports the most cited papers in each field, including the rankings of highly cited papers (last ten years) and hot papers (last two years). However, these rankings are limited to a certain time period (recent ten or two years). Here, based on *WoS*, we have collected historical data to show the most highly cited papers in modern science. We first retrieve the top 100 highly cited papers in 1900–2010 by ranking the citations of all the *WoS* indexed papers in descending order. Then, we retrieve all the annual papers in the *WoS* by each year, and arrange them by citations in descending order. Last, we download these two sets of most highly cited papers (i.e. citation peak), which constitute the basic dataset in the present study. Because articles need time to be highly cited publications, we do not consider the recent ones.

By counting citations to all the *WoS*-indexed papers in 1900–2010, Figure 1 shows 100 stars indicating the top 100 highly cited papers in history. Clearly, papers published during and before 1950 rarely take up 6% of the top 100; those during and after 2001 account for only 2%, and the remaining 92% was published during the period 1951–2000. The histogram in Figure 1 reveals that 24 out of the top 100 papers were published during the decade 1981–1990, significantly higher than the numbers in other decades. The most productive three countries/territories are USA (43), Germany (7) and England (5), together contributing 55% of the highly cited papers to the total. According to the 22 broad categories listed in the *WoS*, the three most active fields are biochemistry and molecular biology (39), physics (11) and chemistry (10). The distribution of the highly cited papers among journals is not as concentrated as countries/territories or research fields, since the most dedicated three journals contribute 23% to the top 100 papers; they are *Journal of Biological Chemistry* (10), *Nucleic Acids Research* (7) and *Analytical Biochemistry* (6).

It is generally believed that review articles are cited more frequently than typical research articles because they often serve as surrogates for earlier literature, especially in journals that discourage extensive bibliographies. Unexpectedly here, 91 of the top 100 papers are research articles, with only 5 notes and 4 reviews, including a software review.

Total citations of publications tend to grow over time. In theory, it weighs heavily against newly published papers to compare them with highly cited papers. It is clear from Figure 2 *a* that citations of the most highly cited papers