Better liquid fuels from plants should promise carbon-neutral and water-efficient resource utilization

There is added emphasis towards development of environment-friendly fuel from renewable resources such as plants to cater to the ever-increasing demand vis-à-vis global concern for continued rise in atmospheric carbon emanating from anthropogenic emissions. Traditional methods for making fuels from plant biomass come in two forms – biological and chemical. A newer approach combining the best of both worlds promises the advent of a 'second generation of biofuels – like DMF (2,5-dimethylfuran)'[1]. However, reliance on plant-based fuels will increase the demand for agricultural land at the expense of natural ecosystems[2]. Growing crops for production of raw material for fructose or glucose to produce efficient biofuel, is bound to put pressure on fast-depleting water resources, terrestrial carbon and also enhancing the atmospheric carbon in an already warming world. Therefore, for the success of any technology aimed towards better biofuels from plants, it is desirable that the supply of the raw material is ensured in an ecologically sustainable manner. Model crops that are carbon neutral and could grow under arid conditions/minimum water usage are required to be developed to harness raw material for chemical production of second-generation liquid fuels. Crops like sweet sorghum that assimilate the same amount of carbon as they produce and consume much less water than conventional sweet crops, could be the possible candidates to complement development of eco-friendly liquid biofuel technologies.

Román-Leshkov *et al.*[3], have developed a two-step catalytic strategy that can convert fructose – a carbohydrate obtained directly from biomass or by the isomerization of glucose, into a potentially better liquid biofuel, DMF, thus creating a route for transforming abundant renewable biomass resources into a liquid fuel. DMF, having 40% higher density, 20 K higher boiling point and being insoluble in water could outperform ethanol – a traditional biofuel derived from crops like sugarcane, maize and other plants, and could be easily made from fructose, and in future from glucose derived from the woody parts of plants[3]. The strategy involves the key step of turning a sugar into the intermediate compound 5-hydroxymethylfurfural (HMF), and then reacting this further to make DMF. The HMF-creating step involves dehydrating the sugar, and is catalysed by acid. HMF is turned into DMF through a ruthenium and copper catalyst system that drives the reaction by breaking a carbon–oxygen bond and adding hydrogen. The process strips the sugar of its oxygen, which decreases the water solubility of the molecule and increases its energy density[3]. However, efficient utilization of such technology could be best realized in practice when the supply of raw material promises carbon neutral and water-efficient resource utilization.

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Seismic safety

Jain[1] has rightly pointed out the weakness and possible policy directives to improve seismic safety in India in general, and research to achieve it, in particular. Hope, this will help to develop better strategy for earthquake protection.

Compared to its size and population, India is investing far less on research related to seismic safety issues such as engineering, socio-legal or knowledge dissemination at different levels on risk perception and mitigation. The result is before us. An encouraging fact is that it has taken a big stride in different fronts of seismic safety after the 2001 Bhuj earthquake; however it still needs to go a long way.

India is a unique country which has probably the largest spectrum of building typologies (most primitive to most advanced) and many among these are different than in other parts of the world. As pointed out by Jain[1], the research conducted elsewhere may not be suitable for India because of different building materials, construction practices or affordability. Because of this uniqueness, India needs its own research to understand the seismic behaviour of buildings and ways to improve them without jeopardizing its culture or affordability.

Further research is also needed on the implementation of aseismic provisions in buildings to understand knowledge dissemination and implementation mechanism. Solutions that have worked well in developed countries may not suit in India because of different socio-cultural and techno-legal regime, affordability, knowledge transfer and learning process, and building production mechanism.

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