Global Biofuel Alliance at G20

Land vs Water vs Food Security
Has the government addressed the trade-offs?

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Global Biofuel Alliance (GBA):

India has launched a Global Biofuel Alliance (GBA) at the recent G20 meeting in Delhi. The official declaration of it, as reported, reads as follows:

"The Alliance intends to expedite the global uptake of biofuel through facilitating technology advancements, intensifying utilisation of sustainable biofuels, shaping robust standard setting and certification through the participation of a wide spectrum of stakeholders. The alliance will also act as a central repository of knowledge and an export hub. GBA aims to serve as a catalytic platform, fostering global collaboration for the advancement and widespread adoption of biofuels"

While the initiative is welcome, as it seeks to facilitate energy transition from imported hydrocarbons to indigenously available bioresources, it has wider implications in terms of trade-offs via-a-vis land, water, food security etc. Have India's planners analysed those trade-offs adequately to be able to address them in a consistent manner? From the information available in the public domain and an approximate analysis as follows, it appears that the said tinter-sectoral trade-offs have not been adequately addressed.

The declaration aims at "*facilitating technology advancements*". Has India put together a robust R&D strategy to justify it? The answer to it is perhaps "No".

Efforts to use biofuels since 1948:

The Power Alcohol Act of 1948 provided for blending petrol with ethanol to reduce dependence on oil imports. Section 6 of the Act specifically empowered the Central government to direct use of

power alcohol for motive power. Ever since then, the oil companies have been making efforts to substitute oil products such as motor spirit (petrol) and diesel with biofuels.

More recently, in January 2003, the Government of India launched the Ethanol Blended Petrol Programme (EBPP) in nine States and four Union Territories promoting the use of ethanol from molasses for blending with gasoline and the use of biodiesel from non-edible oils for blending with diesel (5% blending in either case). In April 2003, the National Mission on Biodiesel launched by the Government identified *Jatropha curcas* as the most suitable tree-borne oilseed for biodiesel production. Due to ethanol shortage during 2004-05, the blending mandate was made optional in October 2004, and resumed in October 2006 in 20 States and 7 Union Territories in the second phase of EBPP (https://oar.icrisat.org/6520/1/WPS_34.pdf)

In April 2006, the Integrated Energy Policy (IPE) document of the erstwhile Planning Commission proposed that a 3-fold biofuel mission be launched to produce (i) biodiesel from non-edible oils like Jatropha and Karanja, (ii) biofuel from cellulosic ethanol and (iii) raise energy plantations.

In December 2009, the Government came out with a comprehensive National Policy on Biofuels formulated by the Ministry of New and Renewable Energy (MNRE), calling for blending at least 20% biofuels with diesel and petrol by 2017, a highly ambitious goal by any stretch of logic.

The Ministry of Petroleum & Natural Gas (MPNG) notified a national biofuel policy in 2018 aiming to achieve 20% blending of ethanol in petrol by 2030, later advanced to 2025. It is doubtful whether the Ministry can reach anywhere near that goal.

NITI Ayog released a report on ‘Roadmap for Ethanol Blending in India 2020-25’ in June 2021. The report estimated that India’s requirement of ethanol for petrol blending would increase from 173 crore litres in 2019-20 to 1,016 crore litres in 2025-26. To meet this demand, the ethanol production capacity will have to be increased from 684 crore litres in 2019-20 to 1,500 crore litres in 2025-26. This includes a production capacity of: (i) 740 crore litres of grain-based ethanol, and (ii) 760 crores of sugar-based ethanol. The report recommended that the Ministry of Petroleum and Natural Gas should notify a plan for the availability of E10 fuel (blend of 10% ethanol and 90% petrol) by April 2022. Further, the Ministry was asked to notify a plan for continued availability of the fuel for older vehicles. The Ministry was advised that it should aim at making available fuel blended with 20% ethanol (E20) for the transport sector in a phased manner from April 2023 to ensure the availability of E20 by 2025. The roll out of higher ethanol blends may be done in phased manner, starting with the States with surplus production of ethanol.

Niti Ayog's report indicates that one litre of ethanol from sugar requires about 2,860 litres of water. In view of the need for water conservation, the report rightly recommended that suitable incentives should be used to (i) source ethanol from less water-intensive crops, and (ii) promote production from maize and second-generation sources. This is easier said than done. It is not clear whether Niti Ayog's estimates are based on realistic assumptions.

The efforts made by oil companies and other agencies to propagate biofuels over the years did not gain the expected momentum for one reason or another, even when the oil prices touched astronomical levels in 2008.

Despite the special steps taken by the government to divert cereals for biofuels, currently, the average ethanol blending percentage in petrol is around 2.0% and the biodiesel blending percentage in diesel is less than 0.1%.

Ethanol from sugar cane, rice, maize and other grains:

Production of ethanol from rice, sugar cane, maize and other grains involves significant changes in land use and cropping patterns. Rice and sugar cane are highly water-intensive and any steep increase in dependence on them for ethanol will not only necessitate significant changes in land-use patterns but also impose a severe stress on water. Either diversion of rice for ethanol production or diversion of land under rice for sugar cane and other energy crops will affect food security. These are critical trade-offs that cannot be lightly brushed aside.

Indirectly, if the farming community is persuaded to shift from conventional crops to energy crops, the demand for which may not be steady, they are likely to get exposed to undue risks.

Food security:

The National Biofuel Policy notified by the Ministry of Petroleum on June 4, 2018 (amended later without any significant change in the approach) envisages "*allowing conversion of surplus quantities of food grains to ethanol.*" It is doubtful whether India, with its rapidly increasing population, can hope to have “surplus” food grains in the foreseeable future, which can be made available with certainty for ethanol production. A paramount requirement for the biofuel policy to succeed is to ensure a steady supply of ethanol, as otherwise it will erode consumer confidence and cause a setback.

A 2011 ADB study, "*Food Security, Energy Security, and Inclusive Growth in India The Role of Biofuels*" (https://www.adb.org/publications/food-security-energy-security-and-inclusive-growth-india-role-biofuels) indicated that a goal to achieve a 20% ethanol blend in fuel will necessitate 63.8 million ha of additional land to be brought under sugar cane. The requirement will be much more today, as fuel needs of the transport sector have further increased.

Land availability being severely limited in India, with landless households cultivating almost the entire extent of the so-called "wasteland" for raising food crops to sustain themselves, it is doubtful whether any significant extent of additional land would be available at all, either for sugar cane or any other energy crop.

As a result of the increasing population, the demand for food grains and consequently the demand for agricultural land, including irrigated land, will continually increase. However, the total extent of agricultural land in the country has stagnated around 180 million hectares (MHA). Out of it, the extent of irrigated land has fluctuated around 100-112 MHA.

In terms of demand for food grains, what really matters is the per capita consumption.

Though the production of food grains in the country increased marginally, the per capita availability (kg per year) of food grains has stagnated as follows:

(kg/year)

Item	2004	2014	2022
Rice	71.3	72.3	69.6
Wheat	59.2	66.8	68.8
Other cereals	25.3	22.6	29.8

Therefore, bringing an additional extent of even 63.8 MHA of land under sugar cane, as estimated in 2011 by in the above-cited ADB report, will involve a corresponding extent of diversion of land from food grains, adversely affecting the country's food security. Sugar cane is water-intensive. Therefore, such a large scale diversion of land to sugar cane will also impose a stress on scarce water resources, as explained below.

Water scarcity:

As stated earlier, the total irrigated area in the country has been fluctuating around 100-112 MHA. In many regions of India, ground water aquifers stand overexploited.

A recent official report (https://pib.gov.in/PressReleasePage.aspx?PRID=1881845) corroborates this situation. The annual per-capita water availability of less than 1700 cubic meters is considered a water-stressed condition. Based on the 2019 study undertaken by the CWC of "*Reassessment of Water Availability in India using Space Inputs*", the average annual per capita water availability for the year 2031 has been assessed as 1367 cubic meters. As per Dynamic Ground Water Resource Assessment 2022, out of the total 7089 assessment units (Block/Taluks/ Mandals/watersheds/Firkas) in the country, 1006 units in 16 States/UTs have been categorised as 'Over-exploited' where the Annual Ground Water Extraction is more than the Annual Extractable Ground Water Resource. 260 units have been categorised as 'Critical', 885 units as 'Semi-critical', 4780 units as 'Safe' and 158 units as 'Saline'.

This shows that policy options that tend to increase dependence on water, as in the case of shifting to ethanol produced from rice or sugar cane, will accentuate the country's water stress and will eventually fail to take off.

Rice for ethanol:

As an interim measure, the government has allowed the use of rice for ethanol production. FCI sold 1.3 millions tonnes of rice for ethanol from December 2022 till end of June 2023, as against a total annual procurement level of 56 million tonnes (https://economictimes.indiatimes.com/industry/renewables/fci-sells-13-05-lakh-tn-rice-worth-rs-2610-cr-for-ethanol-production-till-july-10-in-2022-23-dec-nov/articleshow/102147585.cms?from=mdr). If rice is to be diverted for ethanol on a much large scale, it will evidently hurt food security, in addition to the fact that rice itself is a water guzzling crop. Converting rice into ethanol would imply a corresponding increase in the water intensity of ethanol. Food security is a right conferred on the citizen by the Constitution and that right cannot be compromised.

Sugar cane:

According to one conservative estimate, meeting E20 with ethanol produced from molasses by 2030 would require an additional 1320 million tons of sugarcane, 348 billion cubic meters of water, and 19 million hectares of land in India (https://iopscience.iop.org/article/10.1088/1748-9326/ab9925/meta) In other words, production of ethanol from sugar will increase stress on both

scarce land resources and scarce water resources and it will give rise to both land and water conflicts.

Maize and other cereals:

Considering an ethanol yield of 380 litres/ tonne as suggested by the NITI Ayog, meeting the maize requirement for ethanol production will require an additional 4.82 MHA of land under maize, more than half of the present 10 MHA under maize cultivation. A policy based on producing ethanol from maize will thus involve major land-use changes. (https://www.orfonline.org/research/the-implications-of-indias-revised-roadmap-for-biofuels/)

Land being a scarce resource, its use for alternate purposes needs to be evaluated carefully. For example, one estimate (https://ieefa.org/wp-content/uploads/2022/03/Indias-Ethanol-Roadmap-Off-Course_March-2022.pdf) shows that the annual travel distance of electric vehicles recharged from 1hectare of solar insolation will be equivalent to ethanol produced from cultivating maize over 187 hectares. Full implementation of Niti Ayog's road map for ethanol from maize may require as much as 30,000 additional sq. km to come under cultivation of maize.

Brazil's ethanol programme:

Brazil's sugarcane ethanol programme is perhaps the most successful biofuel program in the world so far. Brazil is the world's largest producer of fuel ethanol. In addition to providing 40% of its gasoline market with ethanol, Brazil exports a significant quantity of ethanol to Europe, Japan, and the United States. However, as reported in a research article in the Journal of the Institute of Physics (*https://iopscience.iop.org/article/10.1088/1748-9326/1/1/011002/pdf),* a successful biofuel programme calls for a steady supply of ethanol, as otherwise, the consumers of biofuel will shift back to oil products, which the biofuels are expected to replace. In Brazil, there have been significant fluctuations in ethanol production from year to year, which eroded consumer confidence in its steady availability. There have also been public concerns about Brazil's sugarcane ethanol programme causing soil erosion, biodiversity problems as a result of land-use changes, local air pollution problems caused by burning of sugarcane plantations before harvest and so on.

India's planners should study the case of Brazil and see how ethanol blending can be implemented in the Indian conditions, without leading to inter-sectoral conflicts.

Environmental implications:

The national biofuel policy as notified by MPNG in line with Niti Ayog's roadmap will not only involve major shifts in the land-use patterns and increased demand for water with its associated direct impacts on the environment but also call for abridging the existing environment laws and procedures that may compound the increasing problems of pollution.

There is research literature to suggest that the environment implications of biofuels are far more worrisome than usually thought. For example, a recent research publication (https://doi.org/10.1073/pnas.2101084119) on "Environmental outcomes of the US Renewable Fuel Standard", the the world's largest existing biofuel program of corn-based ethanol in the United States states as follows:

"*the RFS (Renewable Fuel Standard) increased corn prices by 30% and the prices of other crops by 20%, which, in turn, expanded US corn cultivation by 2.8 Mha (8.7%) and total cropland by 2.1 Mha (2.4%) in the years following policy enactment (2008 to 2016). These changes increased annual nationwide fertilizer use by 3 to 8%, increased water quality degradants by 3 to 5%, and caused enough domestic land use change emissions such that the carbon intensity of corn ethanol produced under the RFS is no less than gasoline and likely at least 24% higher. These tradeoffs must be weighed alongside the benefits of biofuels as decision-makers consider the future of renewable energy policies and the potential for fuels like corn ethanol to meet climate mitigation goals*"

R&D effort in India:

While Niti Ayog's ambitious roadmap for energy transition from hydrocarbons to biofuels is commendable, unless it rests on a sound R&D foundation, it will not go far.

Considering that the mission to promote ethanol as a fuel started decades ago, by now, India ought to have set up a vast network of research facilities aimed at developing technologies for producing biofuels, which place minimal stress on land, water and other natural resources.

One of the major problems that India faces today is dealing with the rapidly worsening problem of disposal of urban waste. The per capita daily urban waste generation in India is around 330-550 grams. This adds up to roughly 50 million tonnes of waste per year, which will increase to 125 million MT a year by 2031 (https://www.niti.gov.in/sites/default/files/2021-12/Waste-Wise-Cities.pdf). What portion of this can be tapped for conversion to energy? Can the conversion efficiencies be enhanced and adverse

environmental impacts mitigated? There are other wastes generated in the economy, both organic and inorganic. Can they be converted to energy and can the conversion efficiencies enhanced? In some States, agricultural wastes are being burnt causing air pollution. Can such wastes be processed into biofuels? (https://www.siliconrepublic.com/innovation/mit-biofuels-biotech-greenhouse-gas) Can water and land intensities of biofuels be reduced? These are the areas which India's R&D work needs to address. What we need urgently are R&D studies aimed at finding solutions relevant to India. Is there a cogent R&D strategy put in place, supporting the national biofuel policy? The answer to it is in the negative.

India's overall R&D expenditure in proportion to GDP has plummeted from 0.8% in 2009 to 0.64% at present, indicating the low priority given to it by the planners. It is among the lowest in the world. The proportion of that earmarked for biofuels is miniscule.

Though the mission to replace hydrocarbons with biofuels started decades ago, no tangible steps have been taken to build a network of research facilities for biofuels till date. While DST's Clean Fuel Research Institute and IOC's R&D centre have been active, their efforts have been half-hearted, constrained by budget allocations. Had the government been serious about increasing investment in R&D on biofuels, it could have allocated sufficient funds for it from the Oil Industry Development Cess.

According to the CAG (https://cag.gov.in/uploads/download_audit_report/2021/Report%20No.%207%20of%202021_English_(12-7-2021)-061a4c5a0ceebc7.43031638.pdf), the government collected Rs 1,28,461 Crores from this cess during the ten-year time frame from 2010-11 to 2020-21, but failed to transfer any amount to the Oil Industry Development Board (OIDB). Even out of the net proceeds of Rs 72,384 Crores transferred to OIDB, only Rs 15,506 Crores were spent on its activities, the proportion of it going for R&D in biofuels being marginal. This shows the low priority accorded by the government to R&D activity for enhancing oil use efficiencies in general and for R&D work on biofuels in particular.

Conclusion:

It is clear that the Global Biofuel Alliance (GBA) announced at the recent G20 meeting, though a positive initiative, is not supported adequately by an analysis of the inter-sectoral trade-offs it involves and it does not rest on a matching R&D strategy. It fails to take advantage of the possibility of producing biofuels from urban and other wastes, the disposal of which has posed a serious problem. One can only hope that those who have planned this initiative wake up to these

concerns and take corrective measures urgently.