Biofuels for energy security

Ever since Rudolf Diesel (inventor of the diesel engine) successfully operated a mechanical engine with peanut oil in 1893, it was predicted that vegetable oil will replace fossil fuels. However, availability of cheap and surplus fossil fuels had hindered research on vegetable oils (biofuels), and fossil fuels have continued to be the single most important source of energy. In India, diesel alone meets an estimated 73% of transportation fuel demand. However, domestic production caters to only 22% of the demand, the rest is imported and the amount of imports is increasing with every passing year, from 189.4 million tonnes (mt) in 2014–15 to 202.1 mt of crude oil in 2015–16. Continued dependence on fossil fuels, in addition to a huge strain on the government exchequer, has led to environmental pollution, and global warming, besides several health problems.

Against this background, promotion of biofuels presents a win-win situation, because on the one hand, they are derived from organic raw materials and are renewable in nature, while on the other, they can provide additional income to poor rural households. Technology for conventional biofuels (i.e. first-generation biofuels such as sugar and starch-based ethanol, oil crop-based biodiesel, biogas through anaerobic digestion) is well-established and widely used. However, technologies for second and/or third generation biofuels (based on lignocellulosic biomass as feedstock) are still in the research and development or demonstration stage.

India began its biofuels promotion programme with a 5% ethanol blending pilot programme in 2001. The National Policy on Biofuels, 2009, opting for non-edible feedstock only, proposed a non-mandatory blending target of 20% for both biodiesel and ethanol by 2017.

Among the 400 non-edible oilseed crops found in India, *Jatropha* was selected for the programme, because of its high oil content (40% by weight) and low gestation period compared to other crops, thus avoiding a possible conflict of fuel versus food security. At 20% blending, our current demand for biodiesel/ethanol is estimated at about 23,000 million litres and it would require about 19.5 million hectare *Jatropha* plantations to produce the same. The demand for biodiesel is estimated to escalate to 31,150 million litres by 2020. However, the present total commercial production and marketing of *Jatropha*-based biodiesel in India is small, with estimates varying from 140 to 300 million litres per year and mostly consumed in the unorganized sector (irrigation pumps, mobile towers, kilns, agricultural usage, diesel generators, etc.). Thus, there is a need for developing a strong biofuel industry to tackle the challenges of energy security and fuel self-sufficiency.

At this juncture, the Karnataka model may be considered for boosting biodiesel production. Karnataka, deviating from sole dependence on *Jatropha* as in majority of the Indian states, has adopted multi-species (*Pongamia* species as well) and farmer-centric approach (cultivation of non-edible oil plants on field bunds and wastelands as a subsidiary occupation). Further, Demonstration and Information Centres, with a facility to generate 100 l of fuel, serving as catalyst for biofuel production and consumption have been established in each district for promotion of production and use of biodiesel. This model may be introduced across the country as well.

However, as previous two decades of experience suggests, ethanol and/or biodiesels alone cannot meet the ever-growing need for biofuels. Substantial research thrust is necessary for development of second- and third-generation feedstocks as well, to address the ever-growing future energy needs of the country. Such development would not only provide better energy security, but several environmental, social and economic benefits as well.

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CWUR Subject Rankings 2017

The Center for World University Rankings (CWUR) lists the top 1000 out of 27,000+ degree-granting institutions of higher education worldwide[1]. Arguably this is the the largest academic rankings of global universities. It assesses the quality of education, alumni employment, research quality and innovation, without relying on surveys and university data submissions.

An interesting offering that CWUR makes is the Subject Rankings[2]. These rank the world's leading universities in 227 subject categories, based on the number of research articles in top-tier journals. Data are obtained from Clarivate Analytics (previously the Intellectual Property and Science business of Thomson Reuters). The methodology is non-trivial and is described in detail in their portal[3], and will not be discussed here.

Table 1 is a summary list of the 61 countries that contribute to the top 1000 universities. It is also possible to determine that only universities from 36 countries have at least one unit of assessment in the top 10 in one of the 227 subject categories. Altogether, the 1000 universities contributed 2293 units of assessment. In some subjects, due to ties at rank 9 or rank 10, more than 10 universities are found in the top 10. The 225 universities of USA appear at 1047 places in the top 10 in the 227 subjects. Harvard University appears 112 times, and is ranked first in 72 subject areas. From India only one university appears in the top 10 – Annamalai University is ranked third in spectroscopy. No other university from India appears in any of the remaining 226 subject categories.

Table 1. Sixty-one countries which contributed to the top 1000 universities and universities from 36 countries having at least one unit of assessment in the CWUR top 10 in one of the 227 subject categories

Rank	Country	Universities in the top 1000	Units of assessment in the top 10 in subject rankings	Rank	Country	Universities in the top 1000	Units of assessment in the top 10 in subject rankings
1	USA	225	1047	32	New Zealand	6	1
2	China	97	300	33	Turkey	10	1
3	United Kingdom	65	239	34	Russia	5	1
4	Canada	32	109	35	Czech Republic	4	1
5	The Netherlands	13	88	36	India	15	1
6	Australia	27	72	37	Ireland	8	0
7	Japan	71	49	38	Greece	7	0
8	Singapore	2	47	39	Poland	7	0
9	France	44	46	40	Hungary	6	0
10	Hong Kong	6	28	41	Chile	4	0
11	Germany	57	33	42	Egypt	4	0
12	Switzerland	9	29	43	Argentina	3	0
13	Taiwan	20	26	44	Saudi Arabia	3	0
14	Sweden	11	23	45	Colombia	2	0
15	Denmark	5	22	46	Romania	2	0
16	Spain	40	18	47	Slovenia	2	0
17	Belgium	10	18	48	Bulgaria	1	0
18	South Korea	36	16	49	Croatia	1	0
19	Italy	48	15	50	Cyprus	1	0
20	Portugal	6	12	51	Estonia	1	0
21	Brazil	18	11	52	Iceland	1	0
22	Norway	5	9	53	Lebanon	1	0
23	Israel	7	6	54	Lithuania	1	0
24	South Africa	6	5	55	Pakistan	1	0
25	Iran	8	4	56	Puerto Rico	1	0
26	Austria	12	4	57	Serbia	1	0
27	Finland	9	3	58	Slovak Republic	1	0
28	Malaysia	3	3	59	Uganda	1	0
29	Thailand	3	3	60	United Arab Emirates	1	0
30	Mexico	2	2	61	Uruguay	1	0
31	Macau	1	1		Total	1000	2293

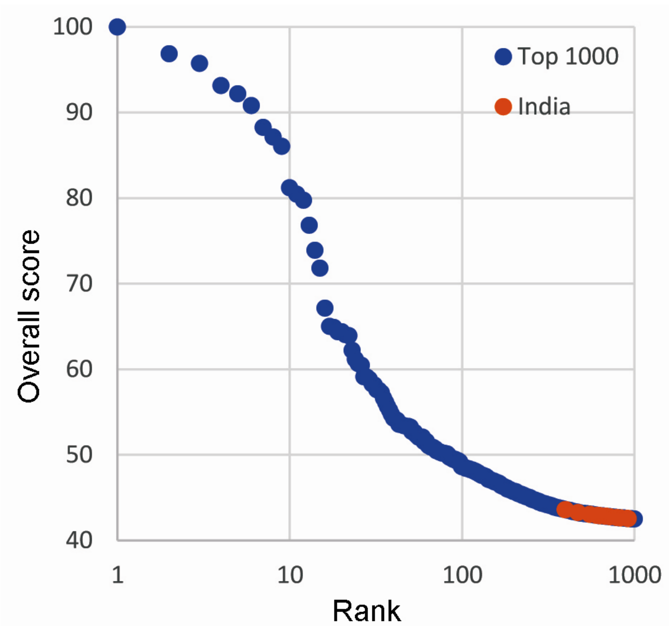

Figure 1. The overall score to rank dispersion for the CWUR top 1000 universities and 15 universities from India.

Table 2. List of 15 universities from India that made it to the CWUR top 1000 in 2017

Rank	University	Overall score
397	University of Delhi	43.61
399	Indian Institute of Technology Delhi	43.60
470	Indian Institute of Science	43.27
550	Panjab University	43.06
607	Indian Institute of Technology Madras	42.93
616	Indian Institute of Technology Kharagpur	42.92
617	Indian Institute of Technology Roorkee	42.92
631	Tata Institute of Fundamental Research	42.90
673	Banaras Hindu University	42.83
683	Indian Institute of Technology Bombay	42.82
722	Jawaharlal Nehru Centre for Advanced Scientific Research	42.76
790	All India Institute of Medical Sciences, New Delhi	42.68
831	Indian Institute of Technology Kanpur	42.64
907	Jadavpur University	42.57
922	University of Calcutta	42.55

Table 2 is the list of 15 universities from India that make it to the CWUR top 1000 in 2017. A less than 1% change can alter the rank from 397 to 922. This is usually the case when the protocol for developing a single overall score telescopes a vast range into a very narrow band. The overall score–rank dispersion in Figure 1 reflects the same.

The picture portrayed by the CWUR Subject Rankings has important lessons for our policy makers. The government has recently announced its intention to provide Rs 10,000 crores to 20 universities, 10 private and 10 government, to make them 'world class'. It seems possible that even if this goal is achieved, there is no assurance that in any of the 226 remaining subject areas, we will have an institution that figures in the top 10 globally. So far, for reasons to be understood, only Annamalai University has made the cut. Hence it may be meaningful to precision target funding by choosing subject areas in universities most likely to be able to make it to the top 10 in that category. Singapore seems to have achieved precisely this (its two universities appear 47 times in the top 10 in subject categories).

1. http://cwur.org/about.php (accessed between 25 and 29 December 2017).
2. http://cwur.org/2017/subjects.php (accessed between 25 and 29 December 2017).
3. http://cwur.org/methodology/subject-rankings.php

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Emerging trend of pharmacoeconomics and health outcomes research in India

Pharmacoeconomics and health outcomes research is an emerging field in India. Pharmacoeconomics is a part of healthcare economics which identifies, measures and compares the cost and consequences of pharmaceutical product and service provision[1]. This field gives significant information about healthcare coverage and access decisions. Research in this field provides evidence to policy makers and healthcare providers to make decisions that help patients in terms of affordability and rational use of drugs[2].

Research in this area is still at a budding stage in India. However, in the last five years significant contributions have been made by Indian researchers in this challenging area of healthcare sector. International collaborations with foreign authors in pharmacoeconomics and health outcomes studies are also on the rise.

The aim of the present study was to evaluate the trend of pharmacoeconomics and health outcomes studies in India. Further, research area of pharmacoeconomics and health outcomes is elaborated in brief. In order to meet the objective, the required information was collected through the scientific presentations database of the International Society for Pharmacoeconomics and Outcomes Research (ISPOR). This is an international, multi-disciplinary, professional membership society. The society aims to advance the policy, science and practice of health economics and outcomes research focusing on patient-centred outcomes[3]. The scientific presentations database was searched with keyword 'India'. The website includes presentations from all ISPOR international meetings since 1998. The abstracts published till 2016 were included in this study. The inclusion criteria were taken as study specific for India[4].

Figure 1 shows the total number of abstracts published by Indian authors and international collaborative research work contributed by Indian authors in the ISPOR international meetings. There were 493 publications during the study period (1998–2016). It can been seen from the figure that the number of papers published has increased steadily over the last five years. The highest number of papers published was during 2016, with a total of 153 abstracts.

International collaboration is becoming more significant in this era of globalization. It is encouraging to note that the number of collaborative research papers with foreign authors has also been increasing over the last five years. There were 150 publications during the study period (1998–2016). The highest number of papers published was during 2016, with a total of 42 abstracts.

Figure 2 shows different areas of research in pharmacoeconomics and health outcomes studies. Some significant and promising areas include cost studies,