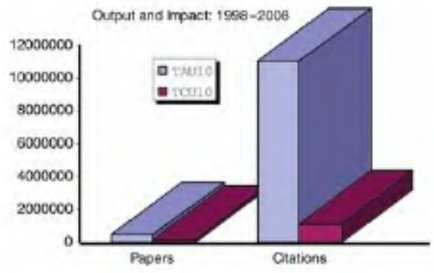

Figure 1. Output and impact of TAU10 and TCU10 during 1998–2008.

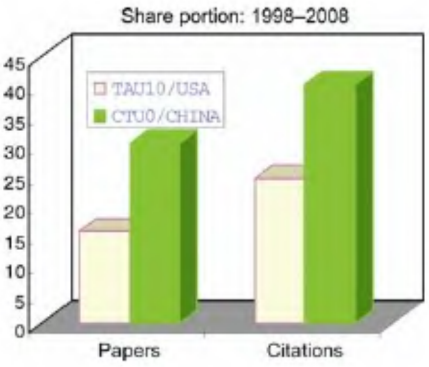

Figure 2. The share portion of TAU10 and TCU10 in USA and China during 1998–2008.

TCU10 are public institutions, including three in Hong Kong.

Although not entirely determined by them, scientific innovation can be partly measured by publication output and citation impact[3–5]. These data can be obtained from the ISI–ESI (Institute of Scientific Information–Essential Science Information) database via ISI Web of Knowledge and subsequently analysed for proof that top universities lead scientific innovation. The results are shown in Figures 1 and 2 whereas the data are given in Tables 1 and 2.

There are approximately 3000 universities in the US, but according to the data, the TAU10 accounts for nearly one-sixth of the total publications and one-fourth of total citations. Likewise, there are about 2000 universities in China, but 30% of publications and 40% of citations originated from the TCU10. Top universities contribute a disproportionately high percentage of original scientific research by the publications and citations in both US and China. These universities occupy a core position in their respective national science systems, providing crucial building blocks for both scientific research output and impact. The role of top universities in spurring scientific innovation is more evident in China, a developing country; further research could be pursued in this direction to determine if this generally holds true.

Discussions of national scientific policy should proceed with this knowledge, stimulating new ideas about how to maximize scientific discovery and development at the national level. It is worth considering the benefits of placing greater emphasis on scientific research in top universities, which may be the key to worldwide scientific innovation. Moreover, the Matthew effect in scientific publishing and R&D investing will lead to even greater attention and more interest in scientific research in top universities.

Universities are engines that drive scientific research and innovation, and top universities set the tone of their nations' scientific development through their disproportionate contributions, which may affect the national scientific policy.

Table 1. Data of TAU10 and TCU10, USA and China in ISI–ESI Database (1998–2008)

Group	Papers	Citations	CPP
TAU10	475,849	11,047,517	23.2164
TCU10	183,095	1,175,040	6.41765
USA	3,048,247	45,149,821	14.8117
China	604,041	2,920,922	4.83564

Source: http://esi.isiknowledge.com/home.cgi, 1 January 1998 to 31 December 2008.

Table 2. Portion of TAU10 and TCU10 in USA and China (%)

Portion	Papers	Citations
TAU10/USA	15.61058	24.46857
TCU10/China	30.31168	40.22839

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Need for conservation of wetlands in arid Kachchh region

Kachchh, the second largest district in the country (45,652 sq. km), is located in the north-western region of Gujarat and stretches between 22°41′11″–24°41′47″N lat. and 68°09′46″–71°54′47″E long. The district shares its international boundary in the north and north-west with Pakistan; and the Arabian Sea lies in the west and south-west. The land area on the southern side is limited by the Gulf of Kachchh. Rajkot shares its eastern boundary, while Bananskantha, Mehsana and Rajasthan form a part of the north-eastern boundary. Administratively, this district encompasses 10 taluks with 1062 villages. Kachchh, owing to its unique ecological and geographical setting is classified under biotic province '3 A' (Kachchh desert) of biogeographic zone[1] experiencing tropical arid climate. It experiences extremes of weather conditions, characterized by three distinct seasons: winter, summer and monsoon. Kachchh receives much of its rainfall from the south-west monsoon (end of June to August). The estimated average annual rainfall from 1996 to 2006 in this

district is 350 mm, ranging from 252 (Bhuj) to 451 mm (Rapar). The region averaging 13 days of rain in a year experiences high evapotranspiration rate, illustrating the stress on surface water resources, especially wetlands in the region. In spite of being arid, Kachchh district has 80.21% of the total wetlands area in Gujarat[2] (21.77 lakh ha). There are as many as 231 major and minor reservoirs built to cater to the irrigational and drinking water needs of the region.

Most of the wetlands in this arid region are man-made, probably to maximize efficiency in harvesting the scarce water resources and the natural wetlands are highly seasonal; however, they play a vital role in the very sustenance of this arid ecosystem. A recent study by GUIDE[3] highlights the rich biodiversity potential of select wetlands in this arid region. In total, 202 floral species were reported in the vicinity of these wetlands, of which 13 are rare species. 117 species of herbs, aquatic herbs, grasses and sedges were recorded close to the water line, an estimate higher than that reported from Nal Sarovar wetland (74 macrophytes)[4], which receives higher annual rainfall (550 mm) than the Kachchh region (350 mm). These wetlands harbour 169 species of phytoplanktons, 66 species of zooplanktons and 23 species of benthic invertebrates[3]. The study also revealed that the Kachchh wetlands support 118 species of birds. This includes 17 threatened species of which seven come under near-threatened category, two were conservation dependent – Graylag Goose (*Anser anser*) and Dalmatian Pelican (*Pelecanus crispus*) as per *Birdlife International*. Three species – Fulvous Whistling Duck (*Dendrocygna bicolor*), Osprey (*Pandion haliaetus*) and Eurasian Spoonbill (*Platalea leucorodia*) are under the endangered category as per Indian Wildlife Protection Act (1972).

Wetlands in this region, mostly rainfed, are put to several uses and the prominent among them are irrigation, drinking, fishing, industrial use, livestock use, ecotourism, etc. In some wetlands, herbaceous vegetation and in certain cases, trees constitute essential grazing resources for stock farming. Once resources are exhausted elsewhere, stock farmers graze their herds in wetland areas, which are otherwise supposed to be left untouched. Because this region receives very low and erratic rainfall and frequent dry spells and droughts, livestock farming is the backbone of the rural economy. During drought period, most of the wetlands act as natural fodder banks generally in Kachchh and especially in Banni region. Rising livestock population and resultant overgrazing in and around the wetlands is expected to cause soil erosion and sedimentation in the wetlands. In addition, aridity, limited water resources, rising human population and associated developments, specifically urbanization and increasing agriculture are likely to have severe impacts on the wetlands of Kachchh region in the form of draining of wetland for intensive agriculture and increase in pollution load due to fertilizer application and domestic sewage. It is often claimed that wetlands can play an important role in recharging aquifers, but there is little scientific evidence to support any such roles in Kachchh, because wetland types here vary enormously. Large scale changes in the form of mineral sourcing and other industrial development add to the land degradation augmenting pressure on water resources. It is inevitable that the industrial developments in this district will pollute the wetlands located close by. Major industries operating in the area are lignite mines, limestone mines, thermal power plants and cement plants. The former two induce landscape level changes, whereas the latter two require precious water resources for their operation, both leading to a variety of irreversible changes in the natural environment. The geological settings of the region are basically of sandstone and hence, are expected to help in recharging aquifers. However, looking into the ongoing changes and their consequences, the recharge role of the existing wetlands apparently has been decreasing at a fast rate. Sedimentation in the wetlands results in a hike in toxic elements such as Cu, Pb, and Cd in the area, as indicated by studies conducted elsewhere by the author and others.

Although not documented, the wetlands of Kachchh region must be providing, if not tangible benefits as other tropical wetlands do, intangible goods. However, it seems we are still in the dark and understanding the ecological role of wetlands in this arid region is imperative for sustainably managing the natural resources. The future of wetlands of arid regions of Kachchh depends largely on documenting the ecological benefits they offer explicitly or implicitly, sustainable use of these resources and appropriate management interventions. Transformation of wetland ecosystems through draining, dredging and infilling to meet the demand of the growing population, although their apparent fate[5] does not suit the path of ecologically sustainable development. Possibly, this is likely to create an ecological disaster, as wetland beds often act as repository for seeds (vegetation and fish) and nutrients, the major drivers of the ecosystem[6]. In view of these specifics, an exhaustive and holistic management approach for an all round sustainable development of wetlands of this arid region is immediately required so that it may provide an opportunity to conserve them in the region's ecosocial gradient.

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