to the top 10% most frequently cited. It therefore has a normalizing effect across fields, publication year and document type. The ratio $q = PP$ (top 10%)/10, allows one to fractionalize this proxy, such that a value of 1.00 is the expected global norm.

If we consider q to be the quality indicator, and P to be the zeroth-order indicator of performance, then it is possible to combine this to obtain a first-order indicator of performance qP and a second-order indicator of performance $X = q^2P$ (ref. 2). In this manner, the quantity term (P) and the quality term (q) can be integrated into a single composite term that serves as the best size-dependent proxy for total performance in research context.

Table 1 lists the top ten universities derived from the second-order indicator $X = q^2P$ for all sciences taken together. They are entirely from 'both sides of the pond'. Harvard is twice as big as the next in line and four times bigger than the others in the list. Figure 1 shows the performance trajectories of these universities in a quality–quantity space as we move from the 2006–2009 to the 2013–2016 window. Since the global norm for q is 1, all the universities perform above global norm. Harvard's trajectory is flat. The three entries from the United Kingdom, i.e. University of Oxford, University College London and University of Cambridge show the most promising trajectories, where rapid growth in size of output does not compromise quality as measured by the q indicator.

A unique feature of the Leiden ranking is that it allows anyone to build a multidimensional perspective on university performance from the size-dependent and size-independent indicators which are available for download. This feature is exploited here to visualize how the top 10 world universities can be identified depending on the choice of primary indicators.

1. Prathap, G., *Curr. Sci*., 2014, **106**, 1467–1468.
2. Prathap, G., *Scientometrics*, 2011, **87**(3), 515–524.

GANGAN PRATHAP

Vidya Academy of Science and Technology, Thrissur 680 501, India and A. P. J. Abdul Kalam Technological University, Thiruvananthapuram 695 016, India
e-mail: gangan@vidyaacademy.ac.in

Agrobio-cultural diversity of alder based shifting cultivation practiced by Angami tribes in Khonoma village, Kohima, Nagaland

North East India is one of the culturally diverse regions in the world inhabited by more than 200 tribes in eight states. Also, the region is one of the biodiversity hot spots of the world. The region is endowed with rich floral, faunal and socio-cultural diversity. These tribes have originated from the ethnic groups of Tibeto-Burmese and Indo-Mongoloids[1]. The tribal communities of this region live in hilly areas and depend on forest resources for their livelihood. Shifting cultivation is the major agricultural land use system in undulating hilly terrains of this region. Shifting cultivation (jhum cultivation) by these communities is practised in a cyclic manner of slash and burn, crop cultivation followed by abandoning of the land and subsequent shift from one place to another. The previously abandoned land is revisited for crop cultivation after 15–20 years of jhum cycle or 3–5 years in the current scenario of short jhum cycles. Shifting cultivation practice in North East (NE) India is profoundly linked to the socio-economic and cultural customs of these tribes. The agro-biodiversity of jhum cultivation is as high as the cultural diversity of the region[2]. Different tribes celebrate cultural festivals before growing and after harvesting the crops in their own customary manner. This tradition in NE India has conserved rich cultural diversity since time immemorial. However, continuous slash and burn of forest land has resulted in significant loss of rich natural biodiversity, soil erosion and land degradation[3].

Khonoma, the first Green Village of Asia, is located about 20 km from the state capital of Nagaland and the name is derived from Khwunoria (the Angami name of *Gaultheria fragrantissima*, the Indian wintergreen). The village is estimated to be around 700 years old and spread over an area of 123 km^2. The total population of the village is about 3000, settled in 600 households[4]. Khonoma village is well known for its forests and a unique form of agriculture, including oldest wet terrace cultivation in the region. The village is well known for *Alnus nepalensis* (Himalayan alder)-based shifting cultivation which is an

Figure 1. Preparation of land for crop cultivation (Courtesy: Mr Kedocakho, Khonoma Village).

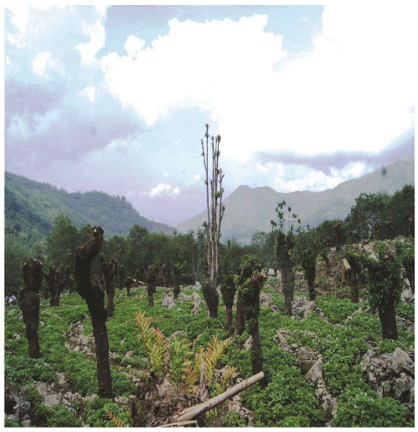

Figure 2. Potato cultivation in alder grown jhum fields (Photograph: Dr Krishna Giri).

actinorhizal tree which fixes atmospheric nitrogen in symbiotic association with actinomycetes called *Frankia*. The Angami tribe of this village has maintained about 100-year-old alder trees in their farm lands for crop cultivation in a sustainable manner without any destruction to natural biodiversity of the surrounding forest areas. Alder trees grown in the farm lands of this village are pollarded above 2–3 m from the ground and leaves are burnt in the field. After burning of leaves the fields are prepared for cultivation of vegetables (Figures 1 and 2), legume pulses and millets. The woody portions of the pollarded trees are used for firewood, furniture and other household related requirements. The land is used for crop cultivation for 2–3 years and left fallow for the next 5–7 years. During this fallow period the farmers shift to other sites for crop cultivation and allow the pollarded alder trees for emergence of new branches. The leaf litter that fall in fallow periods enrich the organic carbon and organic matter in the soil; the tree roots enrich the soil nitrogen as a result of symbiotic nitrogen fixation in association with *Frankia*. This unique jhum cultivation practice is a cultural heritage of Khonoma village, practised since the origin of the village and confined to only this geographic location.

A study was carried out to investigate the soil nutrient status and microbial diversity of alder-based agriculture system of Khonoma Village. The experimental results revealed that the soil under alder-based jhum fields is highly rich in nutrients and harbour very high active microbial population. The soil contained 3.11% soil organic carbon, 5.36% organic matter, 670 ± 2.31 kg h^{-1} available nitrogen, 83.44 ± 1.03 kg h^{-1} available phosphorus and 326 ± 3.21 kg h^{-1} exchangeable potassium. 109×10^6 colony forming units of bacteria per gram soil were recorded in alder based jhum land soil samples. Gene copy numbers quantified using real time PCR (qPCR) revealed 9.59×10^{12} copy numbers of bacterial genes present per gram of soil. One copy number of gene, considered as one bacterial genus, shows very high microbial diversity which make the soil more productive. The major crops/vegetables grown in alder-based jhum fields are potato, tomato, chilli, cabbage, cauliflower, squash, cucumber, ginger, French bean, soybean, pea, millets (Job's tear) and maize. The study observed that alder based jhum cultivation system practiced by Angami tribe of Khonoma, Nagaland is a unique traditional farming system in Eastern Himalaya which has sustained the productivity of the jhum field based on their indigenous traditional knowledge and conserved the rich biodiversity of the surrounding forests. This sustainable jhum cultivation practice has absolutely led to no dependency of the villagers on forest resources for their livelihood requirements.

1. https://www.quora.com/in/How-many-tribes-are-there-in-Northeast-India (retrieved on 30 April 2018 at 09.06 am).
2. Talukdar, N. C. and Thakuria, D., *ENVIS Newsletter on Himalayan Ecology*. 2015, **12**(4), 5.
3. Rathore, S. S., Karunakaran, K. and Prakash, B., *Ind. J. Trad. Know.*, 2010, **9**(4), 677–680.
4. http://northeasttourism.gov.in/khonoma.html #sthash.cFZTYDjL.dpbs (retrieved on 30 April 2018 at 09.10 am).

KRISHNA GIRI*
GAURAV MISHRA
R. S. C. JAYARAJ
RAJESH KUMAR

Rain Forest Research Institute,
Jorhat 785 001, India
**e-mail: krishna.goswami87@gmail.com*