and Trademarks Office shows that from 1969 to 1994, CSIR had only 47 patents to its credit[3] (coinciding with the time India recognized only process patents and not product patents, especially in pharmaceuticals, food and agrochemicals). With CSIR rising to proactively propagate the importance of patents in India, a multi-pronged approach is required to spread knowledge about intellectual property and patents. Universities, industry and government will have to take proactive steps to take proactive steps to ensure that the nation is literate in terms of patents in the coming years.

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Is *Kappaphycus alvarezii* heading towards marine bioinvasion?

Pereira and Verlecar[1] have stated that an exotic marine algal species, *Kappaphycus alvarezii*, is on the verge of becoming invasive in southern India. They have further stated that scientist-divers have reported that this alga has started spreading in the Gulf of Mannar region and may affect other marine flora. There is a fear that it may propagate through spores which could lead to a bioinvasion. Another concern, according to them, is that the seaweed absorbs high amounts of nutrients from sea water.

The Central Salt and Marine Chemicals Research Institute (CSMCRI), Bhavnagar procured a few fragments of the above alga more than a decade ago, observing all protocols of introduction and quarantine. After acclimatization and laboratory culture, the alga was introduced in the sea in confined conditions – employing a novel bag technology – initially in the Gujarat coast and later in Mandapam, Tamil Nadu[2]. Although the alga introduced by CSMCRI was of foreign origin, it was cited subsequently on the Andaman coast by Rao and Umamaheshwar Rao[3]. However, drifted *K. alvarezii* was reported from Okha coast as early as 1970 by Krishnamurthy and Joshi[4].

Mairh *et al.*[5] observed liberation of tetraspores and carpospores from the above alga, but the germlings from these spores did not survive beyond 1–4 days in the majority of cases. Tetraspores were also reported by Paula *et al.*[6], but these authors too have confirmed the mass mortality of spores in germination experiments. The above observations may help explain why no trace of the alga was found in the open waters during all the years of its cultivation in confined bags in the Mandapam area. After initiating *K. alvarezii* cultivation in unconfined conditions, i.e. in net bags and monoline, in 2000, as part of a DBT-sponsored project to make the cultivation practically viable, an EIA study was carried out by CSMCRI. No significant adverse effect on the ecosystem was observed except for depletion of nutrients in the immediate vicinity of cultivation due to its uptake by the seaweed[7]. Bioinvasion of *K. alvarezii* is evidently not a facile process since there is no reported natural stock anywhere in the world, and the alga has become available in large scale only through cultivation, in countries such as Philippines and Indonesia. According to Pereira and Verlecar although a few seaweeds have been listed as invasive, *K. alvarezii* is not one of them.

Regarding the issue of reduction in nutrient levels in sea water, the sea has a large pool of nutrients and, even though there may be temporary decline in the nutrient level as a result of cultivation, this has no adverse impact. No significant effect was found on daily growth rate of *K. alvarezii*, even though it needs nutrients from sea water to grow. Grazing of the plants by fish was a menace that had to be tackled, but this was a good indicator of the health of the water. In fact, fishing near the cultivation site is becoming a popular activity. It will be appreciated that seaweeds help oxygenate waters through photosynthesis and this could help alleviate the anoxic condition of Indian coastal waters reported recently[8].

The successful development of *K. alvarezii* cultivation technology in Indian waters, and the unprecedented interest in seaweed cultivation witnessed since transfer of the knowhow, is important for several reasons: (i) declining fish catch that has made it imperative to look for ways of supplementing incomes of the coastal population, (ii) invention of a novel technology that yields large volumes of seaweed sap rich in plant growth promoters and potash from freshly harvested alga, in addition to *k*-carrageenan-containing residue[9], (iii) environmental gains through CO_2 sequestration and O_2 generation through photosynthesis, and (iv) introduction of a new sustainable cultivation that requires no arable land, no irrigation water and no fertilizer. Availability of indigenous *k*-carrageenan will also open up the possibility of producing animal gelatin substitutes and biodegradable plastic, apart from its conventional uses[10]. All aspects of the work undertaken with the alga so far were debated at the symposium organized by Aquaculture Foundation of India at Mandapam[11]. It was recommended that cultivation of the alga is safe and promising. Cultivation has also been recommended by the National Academy of Agriculture[12].

As a responsible national laboratory that introduced *K. alvarezii* in India, we are duty bound to continuously monitor the environmental impact of large-scale cultivation, while taking pride in the socio-economic gains that are beginning to emerge.

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Response:

In our article, we had raised apprehensions about the possible spread of the algae *Kappaphycus alvarezii* in the waters of the Gulf of Mannar. In this connection it was suggested to introduce regular surveillance mechanism in the Gulf waters to keep in check the rate of encroachment of *K. alvarezii* over other native flora, so as to avoid any threat of future bioinvasion by this algae.

Tewari *et al.* have clearly indicated that they are aware of the problem and necessary surveillance mechanisms are in use for monitoring the environmental impact of large-scale cultivation of *K. alvarezii*. It appears that the institutions involved in this programme are taking adequate measures for the safety of the biosphere reserve in the Gulf of Mannar region, which needs appreciation.

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The 2005 eruption on Barren Island, Andaman Sea

The Barren volcano, the lone active volcano of the Indian subcontinent, has erupted time and again since the pre-historic period (Ravishankar *et al.*[1] and references therein). Yet the eruption is poorly documented in scientific literature. The Indian Coast Guard, Port Blair reported emission of smoke from the volcano on 28 May 2005. On 13 June, a team of geologists from the Geological Survey of India studied the nature and style of eruption and sampled the lava fragments. The activity was a continuous ejection of huge volume of juvenile gas, ash and discrete instantaneous outburst of incandescent coarser fragments of basaltic composition from a subaerial open vent. The explosion has been interpreted as mild Strombolian eruption inferred to have been triggered by the fragmentation of moderately fluid, volatile-rich, frothy magma in the upper part of the conduit but below the surface.

Barren and Narcondum on the west Andaman Sea are two volcanic islands that fall within a chain of active and quaternary volcanoes extending from Myanmar to Sumatra (Figure 1). The Barren is active while Narcondum is possibly dormant. The Barren Island exposes interstratified pre-historic lava and fragmental pyroclastics and an active volcano (Figure 2 *a*). Hobday and Mallet[2], who first prepared the topographical cum geological map of Barren Island, described 'a symmetrical central volcanic cone in the midst of an amphitheater, a summit with a height of ca. 1000 ft above msl, truncated summit marks the presence of a crater, emission of a thin column of smoke rises into the air and basaltic lavas flowing into the sea through breach on the west-

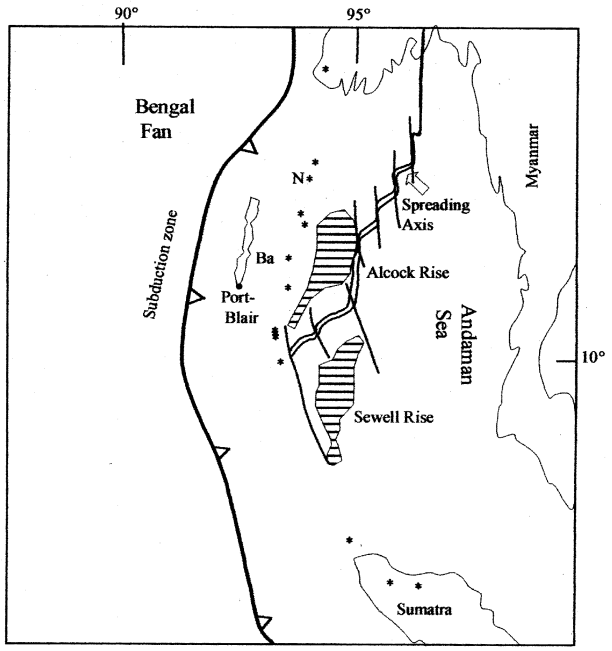

Figure 1. Location of Barren (Ba) and Narcondum (N) Islands, seamounts, spreading axis, Andaman Islands and volcanoes (asterisk) (modified after Curry[11]).