was unaware of the Swiss macro-engineer, H. J. Stauber, whose UK Patent Specification 1224216, 'Method of and means for packaging and utilizing water as a movable packaged supply', was filed during 1968. Stauber detailed an inexpensive gravitational discharge of huge floating packages of any liquid, including freshwater. Staubers' patent has expired.

The International Maritime Organization (organized in 1958, renamed IMO in 1982) estimates that more than 10×10^9 tonnes of ballast water are transferred globally each year, and that more than 3000 species of aquatic flora and fauna may be transported daily by ships[3]. Deoxygenating ballast water is effective in purging all non-indigenous marine species, whether harmful or not[4]. Properly filtered oil tanker ballast water or dedicated freshwater supertankers might become useful to India's coastal-sited farms if drip-irrigation techniques were practiced with careful management by consulting agricultural experts[5]. From the macro-engineering viewpoint, however, large Stauber–Humphrys type seagoing-tug towable plastic pods seem to be a better option economically and technically.

Pure water at 3.98°C consists of H_2O alone with a density of 1.000 [1.000 g/cm^3]; freshwater is rainwater plus the salts—normally 0.2–4‰—dissolved in it. Seawater at 15°C has a density of 1.025 [1.025 g/cm^3] and contains 34.72‰ grams of salt in a kilogram. There is a 2.5% density difference, which means that freshwater floats atop seawater, whether in plastic pods or not. A Stauber–Humphrys plastic pod 200 m long, 33 m wide, with a draft of 7 m could carry 35,000 m^3 of freshwater; equivalent to a 35,000 tonne ship – but significantly cheaper to build and operate for at least a decade – mobilized by a seagoing tug could be delivered from domestic or overseas water suppliers anywhere within, say, 2500 km of the final port of call in India. Pumped loading or gravitational unloading of such fabric pods, at ~100 m^3/s, could take only about 3.5 h. One of the greatest advantages of Stauber–Humphrys ocean-worthy flexible plastic jug-like pods is that they offer end-users (buyers) an inexpensive storage system, which is one of the greatest costs affecting the price of freshwater everywhere[6]. All the bags being used nowadays have flat topsides and are generally ship-shaped lengthwise, with pointy ends. They are also equipped with radar-reflective masts. The Stauber's shape on the other hand, is mentioned here for easy comprehensibility and easy calculation of its volume. Smaller floating plastic bags carrying freshwater shipments have been used for decades in the Mediterranean – especially the Greek islands – and several shipping companies (Alaska and California based) have been testing almost Stauber-size containers. There are a few interesting sites on the internet which deal with these aspects[7]. Their commercialization plan is to harvest freshwater from pristine rivers in those two states (and, maybe, in Canada's British Columbia) for sale to Pacific islands and even to Japan and India!

In the kind of intra-national and international water market envisioned by Stauber and Humphrys in a preliminary manner, the geographically reallocated freshwater's monetary value is entirely independent of the value of land (and improvements thereon) since buyers and sellers participate voluntarily: in the context of each freshwater sale, the price is decided by the buyer and seller only. Of course, the bigger the interaction of Indian customers with overseas sellers in terms of shipped tonnage, the more likely the Government of India will somehow participate directly and, it is to be hoped, as a constructive, economic planning, overmaster. It is obvious that Stauber–Humphrys portable jug-pods would have been very helpful to coastal zone survivors of the 26 December 2004 tsunami affecting India and approximately ten other nation-ecosystems!

Farms in India situated some distance from the seashore, or regional harbours where Stauber–Humphrys pods are temporarily moored, can also receive scheduled freshwater deliveries—distributed by enormous 'self-rolling' plastic bags conveying freshwater to suitable regions of the nation's interior of the type first suggested by Pecero[8]. Such utilitarian conveyances would have little more impact on the land than does the tread of a human foot. These could not produce a crushing steamroller effect. At the very least, India's villages and sprawling city neighbourhoods suffering temporary freshwater shortages, perhaps owing to the delay or weakness of the monsoons, could draw their daily supply in jugs from a regularly delivered ultimate freshwater source[9].

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Open source agricultural biotechnology*

Traditionally, around the world, universities and other public sector research institutions have been the leaders in developing improved crop varieties which were transferred to the field through extension services. This model is currently facing challenges due to privatization and increased intellectual property (IP) protection. Research in agricultural biotechnology (agbiotech) is highly technology intensive and investment oriented with huge market to tap return on that investment. Due to this, globally, private sector is emerging as the major player in agbiotech research. The private sector naturally focuses on crops such as corn and soybeans with large markets in developed countries, which leaves development of subsistence crops important to developing countries to the public sector.

*The views expressed by the author are personal.

This public sector mission is getting crippled due to the intellectual property encumbrances on agricultural inventions including research tools.

Patent laws grant the owner of patents the right to exclude others from making, using, selling, importing or manufacturing the patented invention. The patenting of 'enabling technologies' – the research tools such as *Agrobacterium tumefaciens*-mediated transformation or use of selectable markers which are necessary to introduce changes at the genetic level, affects the development of crops by research institutions, whether private or public. Further, applied agricultural research involves derivative development on existing varieties and with each incremental improvement new IP rights get added resulting in multiple IP holders on innovations. The result is a situation where a single institution will not be able to provide freedom to operate with a particular technology or invention[1]. Large agricultural technology companies have assembled the IP assets needed to develop new crop products by investing in targeted research, licensing of technologies, and strategic mergers and acquisitions.

An Australian scientist, Richard Jefferson, who heads the non-governmental organization Cambia (Centre for the Application of Molecular Biology to International Agriculture), has evolved an innovative open source solution to meet intellectual property constraints in agbiotech[2]. The open source agbiotech is not against patents but uses patents to ensure that research is not hindered yet return on investment is ensured. It advocates patenting of research tools as leaving it in the public domain would enable a patent holder to command control over development of a product.

The Cambia business model allows patenting and obtaining of royalties from commercialization of a product but leaves the patented technology to open access. Access is open to all including private sector enterprises, with an obligation for royalty sharing in the event of commercialization of a research product using the patented technology, provided they do not restrict access to further research and improvement. This is facilitated by distributing the patented research tools along with an open general license incorporating these conditions. For example, a Cambia scientist, Andrzej Kilian invented a technology for genetic analysis which helps fingerprint germplasm. Cambia patented this tool but distributed it with a license which permits everyone to use it so long as they share further innovations using this tool, in a similar way. Recently, Cambia has reported inventing an alternative to *Agrobacterium*-mediated technology, which has also been put in the open source. It exhorts researchers around the world to support this movement by joining BIOS (Biological Innovations for Open Society) initiative[3,4]. The Bios initiative also proposes collaborated problem solving by researchers around the world, particularly by those in developing countries with limited access to resources.

There are examples where academic institutions have successfully used the open source research in agriculture. A small farmer's cooperative society of Hawaii called Hawaiian Papaya Growers Co-operative, in collaboration with scientists at the Cornell University, was able to find a solution to virus problem in papaya using Cambia's open source research tools. The open source technology has also been used by China's leading plant biotechnologist, Zhang Qifa at Huazhong University, to create more than 20,000 unique rice lines for field-testing.

Open source agricultural research enables innovation by myriad small biotechnology companies by promoting open access to technologies. This will enable development of locally suited technologies, reduce dependence on giant agribusiness conglomerates and facilitate research on crops suited for local conditions in the developing countries. Indian agricultural universities and researchers could take part in the open source movement to shape it to benefit our farmers. This open source approach is one which can even be tried out in drug development.

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Bacteria too can get old

When I was doing my graduation in microbiology, one of the favourite questions in the examination was 'Bacteria never die', True or false. We used to have long discussions about the issue and were never able to come up with a conclusive answer. But today, after Stewart *et al.*[1]'s recent discovery, if I were to answer the same question, I will definitely say 'Yes they do age and maybe, eventually die too'.

In the higher organisms, ageing is obvious, but single-celled organisms do not show any visible signs of ageing. Simple unicellular bacteria like *Escherichia coli* reproduce by what is known as binary fission, where one cell divides into two identical halves giving rise to two cells, which in turn divide further to produce an exact copy of the parent and were thus thought to be essentially clonal in nature. As we believed till now, immortal.

A novel approach was used to track down the fate of each cell following division. Though, a very difficult task considering *E. coli* divides once every half hour, pictures were taken of actively dividing *E. coli* cells using an automated fluorescence microscope at predefined time intervals, i.e. every four minutes initially and every two minutes during the later stages of division. The experiment lasted for around 5 h to include the data for nine generations and included little more than 35,000 cells. This data was then analysed using custom-made program for this purpose and the lineage of each cell was traced. At every division, the daughter cells receive one 'new' and one 'old' pole. Computer analysis of cell population helped the investigators to trace the lineage of the 'old' pole through successive generations. Each pole could be assigned the number of divi-