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Harnessing S & T: The Political-Economies of Technology and the Sciences in India's Policymaking

By

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Abstract

The traverse of ideas, rooted in the natural sciences, from brains-to-bazaars, or the spread of their ubiquity, or their application in the service of a societal need, is far from a linear process. The instruments of State policy that influence the speed and direction of the processes at play are only sometimes proximate to, but are often remote from, the identifiable connections between technological activity, economic performance or social consequence. Although this perspective was explicitly so articulated in India's policy-making by the National Committee on Science and Technology (NCST) as far back as 1973, only recently has it been recognised more widely. This lecture ia an attempt to disaggregate the issues that still struggle to find effective expression in the design and wielding of instruments of policy nominally directed towards, or supportive of, the harnessing of S&T to economic and social ends.

1. The baselines

Of all the post-colonial countries – bar none -- India has the largest and densest array of scientific and technological institution[1] It is for us to use this asset for purposes we can decide, and in ways that we can fashion; liberties that other post-colonial countries cannot – and mostly dare not – contemplate, much less take.

In recent years, about half of these have emerged in the private sector, although each such unit is quite small by the number of qualified scientists and engineers employed, and their annual throughput of money

One factoid that gets repeated is that India has the "third largest number of the world's scientific and technical personnel". This is wholly incorrect. The actual rank on this account is in the teens; the actual number depending on definitions. And the toll is now being felt of the ignored warnings

[1] For a *tour-de horizon* of the post-colonial/post-Independence evolution of science and technology in India, see::Siddhartha. *V.,* at 36.5 *The Evolution of Science and Technology in India since Independence.,* Pp.744-746. in UNESCO: History of humanity : scientific and cultural development. Vol. VII, The twentieth century, ISBN 978–0–415–09311–8 (Routledge)

over the past decade-and-a half. Of the consequences of mindless mis-application of engineering talent to near-routine key-boarding

The second baseline is annual expenditure on S&T of the Central and State Governments, plus the expenditure of enterprises in both the public and private sectors on "R&D" (Of this, about half is accounted for by the strategic mission agencies of Atomic Energy, Space and Defence Research). While the total has never exceeded 0.9 % of GDP in any year in the last quarter century, the spend has been increasing monotonically – so, the availability of money, *per se*, has not been a significant constraint on the nation's conduct of scientific and technological activities -- so that non-constraint will not form any part of the rest of this lecture.

And that rest is explicitly *not* about those mission agencies.

2. Webs of contention: The tightening interconnectedness in our well-being

In a short but telling article, Dilip Hiro notes: "The emphasis of the WTO and the IMF on export-led growth encouraged cultivators to switch from food crops to fertilizer-intensive cash crops like cotton, coffee, sugarcane, groundnuts, pepper and vanilla. As a consequence, the daily per capita availability of food grains declined from 510 grams in 1991 to 422 grams in 2005. The general lack of rural development and neglect of poverty alleviation has meant continuing malnutrition. A 2009 study by the official National Nutrition Monitoring Bureau showed 35 percent of Indians suffering from chronic hunger as measured by body mass index. During the first post-N(ew)E(conomic)P(policy) decade indebted farm households nearly doubled, from 26 percent to 48.6 percent. The ratio of debt to assets rose from 1.6 to 2.4, an increase of 50 percent. The trend has continued, with an increasing number of indebted farmers committing suicide."

The point for this discourse of the above quote is that the human condition that is masked by the statistic is not an inevitable effect of a hidden gene lurking unnoticed in agricultural technology. That condition is the result of explicit choices made for the middle class, by the middle class, but paid for in real terms by the farmer -- in life more than in relief by self-inflicted death. Or, as the NCST of 1973 noted: "…remote from the identifiable connection between technological activity and economic performance".

Within their lifetimes, the children of the this audience, will experience the proximity of fellow Indians who will number some 1.3 -1.5 billion, give or take half the total numbers of their parents and grandparents, or about half the ageing population of Europe.

Also within their lifetimes, but possibly without their realisation, the resilience in food chains and ecosystems accorded by bio-diversity will have dropped by the actions and inactions of us, their parents. So even modest changes in environmental circumstances brought about by climate

change will have large effects on our children and their – the felt non-linearity common in complex, interconnected webs, well known to systems science.

By way of elucidation of what I call the 'webs of contention', Mayukh Hajra notes recently in a long blog on the Goals of Sustainable Development, and their achievement:

"…, an increase in agricultural production and therefore food security (linked to Goal 2) can well be a result of conversion of forest land to agricultural use, over-extraction of ground water resources or introduction of GMOs which would impinge respectively on the protective management of forests (linked to Goal 15), water security (linked to Goal 6) and maintenance of biodiversity (Goal 15). The negative feedback of all of this would, in the long term hinder the sustainability of the enhanced production achieved. The experience of the green revolution in Punjab is just one of the well documented cases that serves to illustrate the dangers of having a narrow focus on the achievement of one goal without being sensitive to its wider and long term repercussions" [2]

What is not so well appreciated is that the ingredient that binds these 'webs of contention' is technology. Incipient or mature; in the public domain or privately owned; producing energy or requiring it; sparsely available or ubiquitous; expensive of capital or not; requiring special skill to use or not; with a light or heavy impact on the environment; using of labour or displacing of it, inherently safe or dangerous; polluting of air and water, or relatively clean. How technology that may be so characterised is harnessed directly to public purpose , or to private purpose with public effect – or is prevented from doing so [43] -- is self-evidently a matter of political economy.

By way of examples, to two such technology groups I now turn. The first is the creation of work places for productive employment. The second is an enabling technology; one that can communicate essential information without excessive demands made on ability to read and write. In the NCST exercises, MS Swaminathan called this "Techniracy" – particularly amongst women -- the ability to benefit from technical "show-how" with no more than the ability to write one's own name in one's mother tongue – the UN definition of literacy.

3. State-catalysed innovation for productive employment

Regardless of the whys and hows of the unfolding demographic nightmare - remember, there is no dividend if there is no 'equity'! -- The question remains: How does one create off-farm jobs for several tens of millions (hundreds of?) of youths who are unskilled (and undernourished), and who are coming-off fragmenting farms, particularly in the BIMARU states? The answer has to

[2] http://devalt.org/newsletter/jun16/june16.htm, accessed also on 15 July, 2016. Merits a full read.

3 In Karnataka, a successful demonstration of the use of solar water heating for the silk-industry iwas prevented by the fire-wood lobby from wide adoption.

be a policy-goal in itself; not the use of labour as a 'factor of production' in wider economic policy, amenable to the economics of trading in labour markets, even if legally mandated minimum wages in off-farm employment were enforceable.[4]

And likewise, the sidewise jump we can make – if we choose to – in manufacturing is to plan and execute a programme in additive manufacturing. Although that sounds esoteric and "hi-tech", imparting training in this manufacturing art is readily accomplished in Industrial Training Institutes -- including those established specially for women -- using equipment designed, built and sold in India.

Rather than wastefully removing material from a stock of raw-material by machining, a part or component is built layer-by-layer by adding material in a pre-designed pattern -- entire buildings have been constructed using this technology; it can be used, for example, to build rapidly banks of toilet blocks. The machines are amenable to the use of modest amounts of decentralised energy per work place, for producing goods for mostly localised markets. The machines that are designed, made and sold in India. (Would it help to point out that Daimler in Germany is now adopting this technology for making automobile components?)

4. The design of content in 'show-how' information networks.[5]

Growth in mobile phone usage has exploded from less than 37 million subscriptions in 2001 to crossing the one billion mark last year. But their use is linguistically circumscribed to the language of communication in the networks of use. However younger people in even non-Hindi speaking states do know, besides their mother tongue, some Bollywood Hindi, and sms dialects that mix their mother tongue with English nouns and descriptors in common use in their nearest town.

A portfolio of brand-supplied messages, and representational icons, are available on our mobile phones.

In Karnataka, a pilot scheme (funded by the State Council for S&T) has been tried for communicating essential farming information through language-independent, custom-evolved, field-tested iconic representation. Obviously such 'show-how' information networks can be used only for communication, and good-practice instruction. They cannot be used for ideation, nor are they meant to be.

[4] And therefore far-removed in reality from models of the "Harris-Todaro" type. See, for e.g. https://udayanrathore.wordpress.com/2009/10/21/harris-todaro-model-how-close-to-reality/ accessed also on July 15 2016

[5] I am indebted to a recent conversation in Bengaluru with Dr V.S. Ramamurthy, the former Director of NIAS, for engaging me on this topic

If such is do-able in one state, it must be doable in another. But for that an eco-system must exist in other states that can catch and replicate this specific innovation

If it is not happening, it is not for want of knowledge of this pilot or its do-ability (every State has its own State Council for S&T which exchanges information about its programmes with the others); not for want of opportunity or need; nor for want of money (farmer's co-operatives in states like Maharashtra have enough money to support a pilot scheme). The reason has to do with the blocking influence of matters remote from the demonstrated benefits of the innovation and its widespread adoption.

5. The special place of the bio-sciences in India's policy-making

For the purposes of this lecture, there are four reasons why the bio-sciences have a special place in India's policy-making.

The first is that the Green Revolution was brought about by the application of the bio-science of plant-breeding; the elimination of the scourges of small-pox and polio has been brought about the mass-application of the bio-science of vaccines. Only the grand-parents of the present tweet generation know that these are no ordinary achievements.

The second reason is that there is nothing in bio-science, or the technology of the delivery of science-based health-care, that requires their embodiments to be marketable commodities. If it has been made so, it is by choice in a particularly contentious arena of political economy

The third reason is that, alone of the post-colonial countries, and almost unique amongst the others, India has a full-ledged executive, Department of Biotechnology in its Central Government. Its existence and its programmes of innovation support in the bio-technology industry have been more than instrumental in the growth of that industry in India, and its export performance.

The fourth is that the sub-Himalayan regions, the North East and the Western Ghats are bio-diverse and bio-fragile. These have been mapped by survey organisations that have been in existence since before Independence. In almost every case of damage to those fragile eco-systems, with adverse effects on the lives and subsistence of whole communities that are integral to those eco-systems, the damage – even catastrophic -- has been the result of the political economy that drove the ignoring of science-based predictions of the likely effects of those decisions.

6. Is there anything to learn from other Asian countries?

State-catalysed and supported industrial innovation in very many OECD countries has been, and remains, a standard feature of their innovation-support policies. The leading Asian members of the OECD, Japan and South Korea have been, and remain, fine practitioners of the art -- Japan

through its famed MITI in the 70s, and subsequently South Korea. Within the circumstances and goals of their own, very far from 'free' market political economies, these Asian countries have state-subsidised the traverse from brain (usually foreign) -to-bazaars (local and foreign). They have state-chaperoned products and capital goods through the agency of dominant industry groups and conglomerates – Zaibatsu in the case of Japan, and the Chaebols in South Korea.

Through what is known as 'Ithakuhi' and 'Hojokin' state co-funding, Japan has supported (and continues to support, albeit in *sub rosa* ways) industrial innovation through industry-located and performed R&D on the 'supply side'; and on the 'demand side' , by public procurement and market protection, as also through several other means at the edge of legality in intellectual property law and international trade commitments.

7. Next steps in employment-generating technology funding

We too in India, have schemes of the above-type. Schemes of supporting – for e.g. through the Technology Development Board (see: http://tdb.gov.in/about-us/) – innovation executed by existing industry and potential entrepreneurs, backed by the expertise in academic institutions and national laboratories. Without any legislative effort, these schemes can, and should, be re-directed towards the development and field-demonstration of employment-generating and sustaining schemes. These should be designed to be executed at District and Taluk levels, through the ITIs and local industry, by the local development of saleable prototypes of manpower-using equipment and techniques for local use to fulfil a variety of asset-creating Central and State employment schemes – such as MGREGS. Once demonstrated as being *politically* viable at the local level, one can rely on the political-economy of the State to arrange for the proliferation of the products and processes to the rest of the State, indeed in the country. For example, a new technology initiative supported by the DST under its composites mission, has resulted in bamboo-reinforced composite roofing material -- that is *ab-initio* rain proof -- developed by a Manipur entrepreneur that has found a market as far-away as Bengaluru

What is required, therefore, is executive re-direction of existing schemes -- no *extra money is required for demonstration programmes* -- that can be then taken further by the States themselves, with some subvention by the Centre in such states as those of the North East, where both the near-unique agro-climatic conditions and the need to upgrade local skills may call for such subvention.

These schemes can, and should, be then adopted by the States, and geared almost wholly to an overwhelming and urgent goal of public policy – the creation of productive work places. It is not difficult to devise tangible incentive schemes for corporates to engage in such schemes as part of their Corporate Social Responsibility (CSR) commitments.

All of the above will take imaginative programming and administrative acumen – both, we must admit, in very short supply. So, these schemes and the means of their execution will need to made an integral part of the curriculum of the IAS and State administrative cadre training Schools, with inter-state field trips to demonstrate what can, and has, been done – even if only on pilot scale.

8. A few last words on technical education

The majority of our massively large, poor communities are born into. Networks of inter-relations that form the fabric of social circumstances and physical environment that they live on, or somehow negotiate to live by.

Our demographics and agrarian political economy will require productive work-places for millions of youth in off-farm employment, some permanent, some seasonal -- which seasons will also likely alter their cycles with inevitable climate change.

To create those work-places and innovate for adaptation to climate change will call for legions of young people with the technical knowledge, imagination and mental agility necessary to craft-to-purpose the applicable science. And to follow that through into use – preferably as entrepreneurs themselves -- of technological means, embodied in tools and affordable machines that use modest amounts of decentralised energy per work place, for producing goods for mostly localised markets.

Now, if you wholly commodify higher technical education ("IITs should be self-financing by 2030") then for sure our Of The Middle Class, By The Middle Class export-oriented IITs (the curriculum, and instruction, *orientation* is for export, although – contrary to popular belief – most IIT graduates stay in the country) will not train young people with those needed skills and knowledge. Indeed, from this perspective, the 'up-gradation' of the Regional Engineering Colleges to IITs was a counter-productive move. But that is another subject, possibly for another evening.

Thank you for your patience.