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GUEST EDITORIAL

Science in the service of a symbiotic society

In *Hind Swaraj*, the book that outlined his social and economic philosophy Mahatma Gandhi unfortunately rejected modern science, technology and industrialization. While he did not follow up the implications of this philosophy in practice, many who raise concerns about the current pattern of development seem to be mired in this philosophical formulation. But J. C. Kumarappa, the Accountant-Economist who worked closely with Gandhi, came up with a different and significant formulation that is very much germane to the current debate (The economy of permanence: a quest for a social order based on non-violence, 1946). Kumarappa, who was inducted by Jawaharlal Nehru to work with the Planning Commission in early years of Indian independence, favoured industrialization, but insisted that its pursuit should not lead to the creation of an economy of violence. He pointed out that the Western Capitalism had elaborated a capital-intensive economy highly wasteful of natural resources because they had successfully accumulated large capital stocks through draining their colonies, and had access to natural resources of whole continents like the Americas, taken over by wiping out the indigenous people. India did not enjoy that kind of access to capital and natural resources, but had to do justice to its huge pool of human resources. This called for prudent use of natural resources, best accomplished by empowering local communities to safeguard and nurture them, and creation of productive employment on a massive scale. Kumarappa, therefore advocated working out an innovative Indian model of a symbiotic, rather than imitating the Western pattern of predatory development.

As the Nobel Laureate Joseph Stiglitz emphasizes, any nation must aim at a harmonious development of its four capital stocks; not just man-made capital that GDP highlights, but natural, human and social capitals as well (*The Price of Inequality*, 2012). But the current dominant philosophy of development focuses on GDP-centric economic growth, ignoring rapid depletion of the country's natural resources, and injustices being meted out to people, accompanied by lawlessness and corruption. It is claimed that the accompanying economic growth will create wealth that will trickle down. As people become more prosperous they will ensure that environment and social justice will be attended to. Ergo, environment and social justice cannot be our priorities today.

But empirical evidence suggests otherwise. We are currently in the midst, not of a trickle-down, but a suck-up

process of economic growth. The vast majority of India's population remains engaged in the natural resource-based, labour-intensive sectors; agriculture, animal husbandry, fishing, forest produce collection, tourism. Even as the resource base of these overcrowded sectors is deteriorating, the organized industries-services sectors are not generating employment at a rate high enough to absorb people from these sectors into productive employment. The rate of growth of jobs in the organized sector has in fact declined even as the rate of growth of GDP has gone up. At the same time, there is no accounting of jobs once existing in the unorganized sector that are destroyed by environmental degradation. For instance, the Chemical Industry hub at Lote in coastal Maharashtra employs 12 thousand people, while 20 thousand members of fishing community have lost their livelihoods due to water pollution. So what we are witnessing is jobless growth that erodes human and social capital. The resultant growing strife in the country, such as the Naxalite violence in India's tribal heartland, suggests that Kumarappa's worst fears of a lop-sided development have been realized.

There is then a compelling case for a change of direction. Of course, India must continue to develop a vibrant modern technology based economy. But, inevitably this will employ only a small proportion of our people. Hence this modern economy must come to assume a symbiotic, and not a predatory role towards the natural resource-based, labour-intensive sector of the economy. Our scientific community ought to play a very positive role in promoting progress towards such a symbiotic pattern. The scientific challenges that this poses are those of dealing with complex systems characterized by tremendous location and time specific variability, systems whose proper specification depends upon a large number of parameters. As the Greek philosopher Heraclitus said, we are dealing with systems in which 'Everything changes and nothing remains still; you cannot step twice into the same stream'. As a consequence, these systems are not amenable to experimental approaches calling for extensive replications. Of course, there are general scientific principles applicable to these systems, but any productive practical interventions still require careful case by case consideration. This entails demanding scientific work, but its results do not have the same level of generality as experimental or theoretical investigations of less complex physical, chemical, biological phenomena. Hence the resultant work may not be readily publishable in high

impact journals; nevertheless, it is such work that will have a truly significant impact on the ground.

There is a tendency not to squarely confront this complexity and either go in for sweeping generalizations or attempt to homogenize the systems by external interventions. An example of the former is the belief of one of our most distinguished biologists of the last century, Salim Ali, that all rural demands on natural ecosystems had negative impacts and the only route to nature conservation was to eliminate them. So he advocated banning grazing at the famous Bharatpur wetland by declaring it as a National Park. It turned out that buffaloes grazing around this wetland for centuries were responsible for controlling growth of water-loving grass *Paspalum*, and when grazing stopped, this grass choked the wetland rendering it a poorer habitat for the waterfowl for which the National Park was designed. Ecologists now advocate that such systems are best managed through an adaptive co-management approach, whereby various possible interventions are implemented on a trial basis, their consequences monitored, and the regime of interventions fine-tuned. This is best achieved by involving local community members in the decision-making and monitoring process since they have a wealth of relevant historical experience and constitute the right agency for continual monitoring of on-going changes. This is a *Citizen Science* approach that is growing by leaps and bounds in the Western societies. There are abundant opportunities for us to adopt this in India. Our democracy has led to provisions such as the 73rd and 74th Amendments to the Constitution and the Biological Diversity Act which assign to local bodies a very constructive role in planning and implementation of developmental activities and management of the natural resources within their jurisdiction. Regrettably, these provisions are being sabotaged and this precious opportunity is being lost. But as the experience of Australian Waterwatch-Victoria programme has demonstrated, this is indeed a very fruitful approach.

I am fortunate enough to be currently engaged in one such endeavour. This has materialized from the successful assignment of Community Forest Resources under the Forest Rights Act over extensive areas of Gadchiroli district in Eastern Maharashtra. This is promoting prudent resource use in the long-term interest of the resource base as well as far greater economic returns to the local community, and I believe this to be the only sane route to combat Naxalism. The people, especially the youth are motivated to assess the resource base carefully, plan its sustainable use and conservation, work out the potential of local level industrial processing and develop appropriate marketing strategies. These constitute major scientific, technological and managerial challenges, and I am greatly enjoying working closely with highly motivated people with a rich store of practical ecological knowledge in a scientific and technological enterprise. To top it all, I am delighted that the communities have spontaneously decided to set apart 10% of the Community Forest Resources areas as strict nature reserves. Regrettably, little

else is happening along these lines. Thus, another major challenge in Gadchiroli is good management of soil and water resources. However, such measures are being undertaken following rigid guidelines developed by the Government machinery, guidelines that are uniform for the entire state of Maharashtra, and utterly inappropriate for prevalent local conditions. Our Agricultural Universities or Engineering Colleges are in no way involved; the only technical experts that are occasionally consulted are foreigners commissioned by Aid Agencies who flit in and out and have no understanding of the ground realities.

Along with sustainably managing natural resources, we need to actively intervene and enhance the biological as well as economic productivity of agricultural, animal husbandry, fishery ecosystems. The on-going attempts at doing so focus almost exclusively on homogenizing the systems by external interventions. It is far more desirable to work with and take intelligent advantage of natural variability. This is what Precision Agriculture aims to do by matching farming practices more closely to crop needs (e.g. fertilizer inputs); by reducing environmental risks and footprint of farming (e.g. limiting leaching of nitrogen); and by boosting competitiveness through more efficient practices (e.g. improved management of fertilizers and other inputs). P. R. Seshagiri Rao of Natural Remedies, Bengaluru has applied this philosophy to the cultivation of medicinal plants under a regime of very low rainfall in the Krishnagiri district of Tamil Nadu. This system is based on a mix of perennial and seasonal crops coupled to building up of a soil moisture bank that would average out short-term fluctuations in precipitation. The deep and extensive root systems of the perennial crops make use of the deep soil water beyond reach of roots of seasonal crops, while reducing runoff and facilitating percolation to deeper soil layers. The crop system adopted is highly diversified to suit the specific soil-topography conditions that vary even within a single farmer's field, as well as to take advantage of newer marketing opportunities. The system has been designed on the basis of extensive compilation and interpretation of a wide range of scientific information. It ends up completely doing away with all chemical and fossil fuel inputs simply on grounds of economic efficiency without taking an ideological stand. This work offers an excellent model of possible approaches to dryland farming, a major challenge before us.

Indian science can and must contribute to sustainable management and enhancement of the productivity of India's diverse ecosystems by working on the ground with the people; such contributions are vital to our endeavours to create a symbiotic society. This is a challenge that we must rise up to.

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