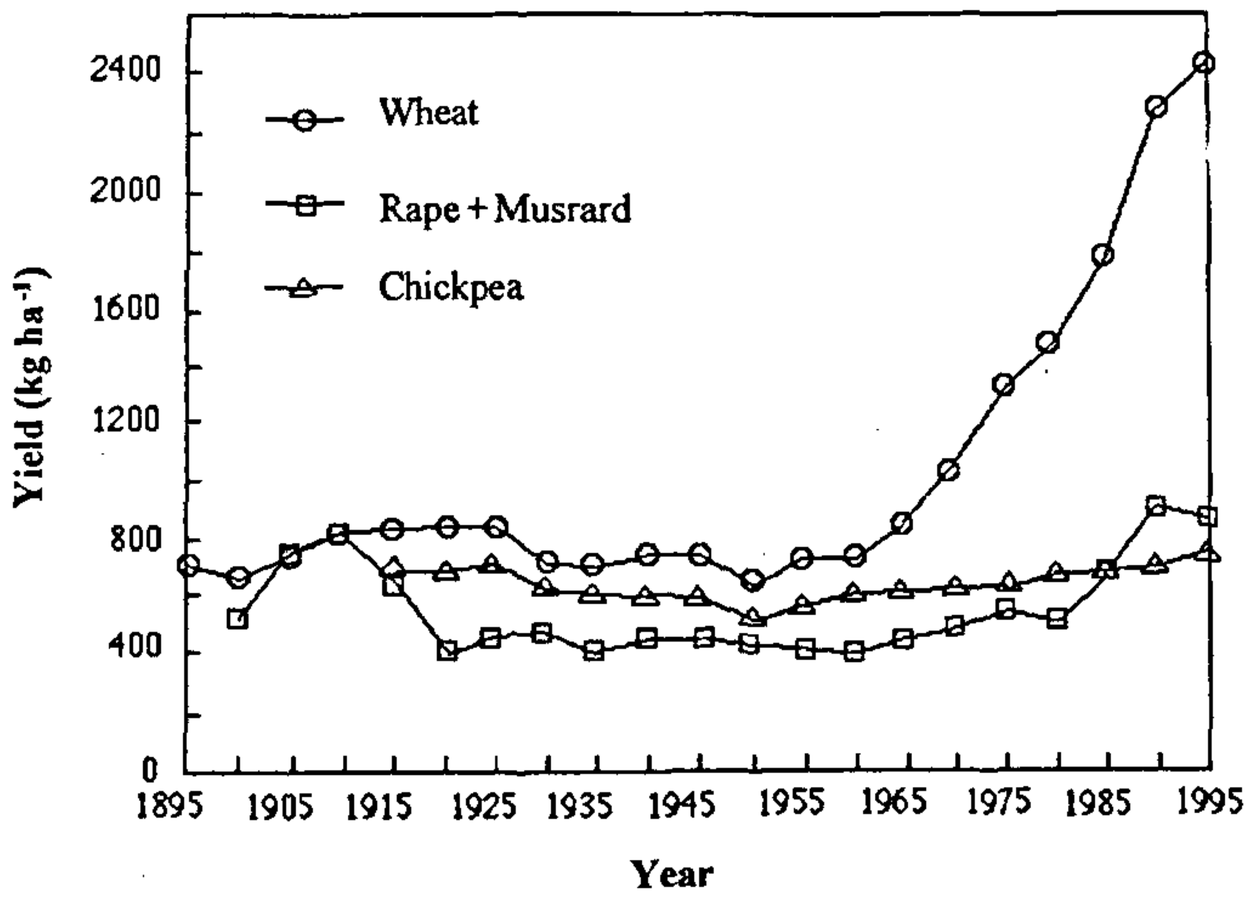

Figure 1. Change in productivity of wheat, rape + mustard and ckickpea in India since 1895 (each point is mean of proceeding 5 years)

farmer's field in the next 5–10 years. Efforts are now on for genetic management of nutrient efficiency. Such technologies help maintain the sustainability of cropping systems. These technologies were not described even in scientific fictions during the times of Malthus.

Future scenario

The future of mankind is still linked with the production and supply of food. The world population is expected to rise from the present 6 billion to 9 billion in the next 50 years. There is already a decline in cultivated area per person and the production of foodgrains per person after stabilization is showing signs of decline. This is because in many parts of the world the actual productivity is far below its potential. Many of these countries do not have access to capital resources and technology to use natural resources for achieving the desired levels of productivity. There are some countries which provide subsidy to farmers to keep land vacant and thus maintain a certain level of production. At the global level there is a possibility to sustain food supply for a regulated population. However, it seems that mankind is moving fast to an era of economic competition and survival of the fittest. Therefore, the question of sustainability has acquired a different perception and meaning to different countries and communities. Malthus talked of ethics and compassion which have been the basic tenets of Indian society, and these would have to be blended with technology to maintain sustainability without imposing segregation.

1. Malthus, T. R., *An Essay on the Principle of Population*, J. M. Dent and Sons, London, 1973.
2. Notestein, F. W., *Three Essays on Population*, Oxford & IBH, Calcutta, 1958.

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OPINION

The rise of the techno-baboo: IT is a brain-sink

Rajesh Kochhar

Computer software is the new pagoda tree which India is shaking vigorously. Earnings from software (SW) exports this year (1998–99) are expected to touch Rs 11,000 cr, up 60% from last year. The rise this year is higher partly due to depreciation of the rupee and the fact that the US has magnanimously agreed to issue entry visas to a larger number of SW professionals than before. One-third of this Rs 11,000 cr comes from a single city, Bangalore, which is home to some 270 firms, big and small, employing more than 80,000 people. The pace of SW growth can be gauged from the fact that barely seven years ago (1991–92), India's SW earnings stood at a paltry Rs 430 cr including Bangalore's Rs 6 cr.

The global SW market is worth $800 bn ($1 bn = Rs 4200 cr), so that India's share of the pie is a minuscule one part in 300. SW exports comprise about 8% of total Indian exports. It is a measure of India's tottering economy that though small as percentage, the SW earnings come as manna from heaven for the beleagured budget-makers.

On the domestic front, the SW effect is discernible in two sectors: motorbike and soft-porn. There has been a spurt in the sale of motorbikes, the entry-level *savari* of the young, ambitious software professionals (that is, the yaspies). This spurt is in sharp contrast to the decline in the sale of scooters, the life-long vehicle of the lower middle class. While the craze for motorbikes is merely a rearrangement within the two-wheeler segment, soft-porn is a new vista. Moneyed but overworked, and away from the loving but intrusive eyes of the fam-

ily, the yaspies seem to be enthusiastic patrons of soft-porn magazines and the colour supplements of newspapers.

Catchphrase

Information technology (IT) is a beautiful catchphrase. Like all good catchphrases, it has the ability to seduce the audience into a mindset of uncriticality. The term technology implies something new or better. The IT India is engaged in is not information technology in the real sense of the term but information tinkering. If IT is equated with designing a new bicycle, India's assignment is no more than fixing tyre punctures.

Big IT companies like Infosys and Satyam have notched up remarkable growth of 100–150% in gross sales and profits over last year. But this growth has been 'almost entirely fuelled by software exports linked to the Y2K [year 2000] syndrome'. When the first generation of computers came up, their memory was extremely small. To save on space, the four digit Gregorian year was abbreviated to the last two digits. Now when the first two digits themselves are going to change, the year must be spelt out in full in all the extant computer programs. It is this glorious donkey work that India has been gainfully employed in.

By definition, the Y2K bonanza would end before the year 2000. India now hopes to turn Europe-wards for lucrative, though more complicated, programming work related to Euro currency conversion. The Indian SW work remains uninspiring and unintellectual. To paraphrase C. V. Raman, recognition (and now money) comes when a proper name becomes an adjective. In Indian SW, no brand names are being built; no value is being added. The profitability of India's SW work does not arise from any intrinsic worth; it comes from the wage differential.

Brain-sink

If we divide Bangalore's export earning of Rs 3500 cr by the 80,000 computerists it is said to employ, we notice that the west is paying $10,000 per Indian professional. In the USA, even a less qualified person would cost at least five times higher. The big Indian SW companies complain how the professionals they send abroad are often lapped up by the companies there. This brings to mind the *mohalla* warfare of yesteryears when the domestic help (comprising mundus and ma'is) was enticed away from one household into another.

In their selfrighteous indignation over brain-drain, the software companies forget that they themselves are acting like a vast national brain-sink. Salaries in the SW market are high; even a fractional dollar salary translates into a tidy rupee packet. And then there is the added attraction of visits and possible employment abroad. The high social value of a programming job more than makes up for its low intellectual worth.

The lucrative but simplistic computer programming contracts that India has been soliciting and executing have trivialized the whole education system. Although there is a mad rush for admission into engineering colleges, the craze for an engineering degree does not mean craze for engineering. Right from the IITs down to institutions run in bicycle sheds, Indian engineering colleges show a wide range in quality. But they all have one thing in common. None of their students wants to work on a shop floor. Everybody wants a ride on the software gravy train.

Recently a student seeking admission into an IIT was matter-of-factly told at the time of counselling not to fuss about the branch he got. In any case he was going to do software. At least a few years ago, IIT Kanpur was planning to close down the aerodynamical engineering. Not because its products were not needed. But because out of the 50 graduates produced, half went abroad, and the remaining went into management/SW. While in the case of the better-quality institutions, the rigorous training is going waste, in the lesser institutions the training itself is being downgraded by the market pulls.

Thanks to the lure of SW, whatever little basic science is offered within engineering colleges is being neglected. There are no takers for the bachelor programmes in basic sciences. For the benefit of students not going to engineering colleges, the degree colleges have started offering courses in computer skills in place of teaching fundamental concepts. We, of our free will, are becoming a nation of techno-baboos. (The old-fashioned spellings are deliberately used to bring to mind the early days of English education in India.)

The techno-baboos now have a new opening, that is, providing remote back-office services to the west. Western airlines, finance companies, hospitals, etc. are setting up offices in India or hiring Indian-based firms to do routine type of semi-manual work. At present, some 25,000 persons are employed in remote services, although the number is expected to go up drastically in coming years. Indian 'data-workers are not rootless part-timers, as their American equivalents may be'. 'Most of those employed in India would be deemed overqualified in the west'.

The colonial science that the British took up in India and in which the natives were employed in a peripheral role was not laboratory science but field science (geography, geology, botany, and even astronomy); it was latitude-driven. More than a century later, the natives are once again being employed by the west. This time their activity is longitude-driven. The working day for the west now lasts a full 24 h, with one difference. The remote office work is got done not by paying overtime, but by one-third the wages.

There are a number of economists and other experts who extol the role of service sector in building up a country's GDP. (Does the burden of the fifth pay commission add to India's GDP?) What is off putting about their analyses is that all the time they are comparing India with Singapore or Hong Kong. India is a country much bigger than either, and far more complex. Also, it is a participative democracy. Its GDP should not only be large but also broad-based. It should cover a vast fraction of the population. This can be achieved only by making the economy knowledge-based.

A handful of people turning in a quick dollar or euro cannot take the economy much further. Bangalore's status as a technopolis does not seem to have done much good to Karnataka as a whole. Perhaps Hyderabad would soon realize this.

For about a century preceding the 1757 battle of Plassey, the British merchants made a lot of money from trade in India. This money went into industrialization of England. The Indian

associates of the British merchants also made a lot of money. But this money went into buying zamindaris and urban properties, and thus became a dead end. In a similar fashion, the SW export earnings are not going into anything progressive; they are simply being frittered away.

India has raised large chunks of loans domestically and internationally. The only way to pay back these loans is to produce wealth vigorously and quickly. The only way to produce wealth is to employ qualified technical people in the task. If these people are placed at the disposal of the industrialized countries at rock-bottom rates in extraneous jobs, who and what would give India strength? It needs to be better known that as far as the unspecified 'non-software electronic exports' are concerned, there was an actual decline of more than 8% in 1997–98 from the previous year, even though the SW exports went up 50%.

There cannot be any objection to India's providing competitive, soiled-collar services to the rest of the world. The trend in fact needs to be encouraged. Globalization, however, does not mean perpetual sunshine in the west and perpetual sunset in India. Globalization means that similarly qualified people anywhere in the world should be more or less similarly employed. Let India's well-regarded manpower take up jobs consistent with its intellect and training. Let the service sector in India flourish on discounted payments but let it not suck in India's trained scientific and technical manpower.

(An earlier version was presented at the UGC-sponsored Seminar on Disturbing Trends in Science Education, Bangalore, 18 February 1999).

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SCIENTIFIC CORRESPONDENCE

Gravity image of India

Regional gravity anomaly maps provide valuable information on the subsurface density distribution, major tectonic and structural lineaments, geodynamic aspects of a plate margin, and structure of the crust and lithosphere, etc. Several papers[1–3] appeared in literature showing the utility of gravity anomaly map of India[4] in geological interpretations. Significance of gravity field in understanding the seismicity and tectonics of the Indian peninsula and the Himalayas[5] and the geodynamic aspects of the Indian plate[6] are also reported. More recently, the importance of gravity anomalies in deciphering the layering of the earth's crust and upper mantle below India[2] is highlighted. Study of gravity trends[3] and synthesis of regional gravity data with available magnetic and seismic information[7] has been done to identify structural provinces[3] and to prepare the tectonic map of the Indian sub-continent[7].

An image of the gravity data digitized earlier[2] is presented in this paper. The purpose is to show the efficacy of geophysical images in displaying the features that cannot be seen readily in a contour map. The colour shaded image of Bouguer gravity anomalies over India is prepared using the GEOSOFT image processing software with both the azimuth and elevation of the sun equal to 45°. However, the commonly available SURFER software or advanced level graphics packages can also be used to create such images. While the basic features of such images would be similar, the application of different graphics packages will normally result in images of different qualities. The image in Figure 1 can be directly correlated with some of the most prominent geological features of India[9]. For example, the Narmada–Son lineament, Godavari and Mahanadi rifts, Aravallis trend and the Eastern Ghats, etc. can be identified by the gravity highs shown by red to yellow colours. The Saurashtra and west Rajasthan block as well as the Shillong plateau are also characterized by high gravity values. Around Mathura (south of Delhi) a gravity high that extends in NE direction as a ridge towards lower Himalayas also appears prominently. A more detailed examination of the map will help to recognize the Cuddapah basin, Vindhyans, and Chattisgarh and Indravati basins – all of them associated with gravity lows shown by green to blue colours.

The features described above provide an obvious correlation with the known geology. A number of interesting features, not reflected in the geological map[9], can be seen in the Dharwar craton. First of all, the Deccan traps, despite being the single largest unit in the geological map of India, do not appear in the gravity image. According to this image map it could be surmised that the Dharwar craton extends northwards up to Tapti river while on the eastern side it is bounded by the Godavari rift. In the northern part of the Dharwar craton there are two strong NW–SE trending parallel gravity high features that run from the western coast to the western margin of the Cuddapah basin. These features might be associated with the rift valleys beneath the Deccan traps reported earlier[10]. Gravity values associated with the trend located in the south also divide the Dharwar craton into northern and southern parts clearly. In the south Dharwar craton, the Clospet granite and the arcuate schist belts in the western part can be identified easily. While the gravity values over the Dharwar craton and the southern granulite terrain show similar magnitudes, a careful examination of the trends clearly shows that the two are separated by the distinct signature of Palghat–Cauvery shear zone.

Among other interesting features, one could recognize two parallel ENE–WSW trends north of Narmada–Son