Water, land and India’s economic expectations

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In an atmosphere of globalization of trade, India is expecting strong economic growth at a steady rate over the foreseeable future. Although such an expectation may be reasonable from a perspective of commerce, an examination of India’s water and land resources suggests that the potential for even a modest rate of steady growth over the next several decades will be severely limited by the finite capacity of the water resource systems, and the vulnerability of the environment and ecosystems to unacceptable degradation.

Six decades after independence, India is looking ahead to a promising economic future. Aided by unprecedented influx of foreign capital over the past decade, India has been experiencing impressive economic growth, with a reported\(^1\) rate of 9.4% for 2006–07. Even if one were to assume a modest annual growth rate of 6%, India’s economy must double in real value every dozen years. Thus, the expectation is that India’s GDP should grow from about one trillion US dollars in 2007 to about 4 trillion US dollars by 2031, and 16 trillion US dollars by 2055.

These expectations involve very large numbers, and their significance is hard to comprehend. Yet, they profoundly affect the life of the common citizen. If so, are there ways to look at these economic forecasts, other than those of commerce and trade? Perhaps there is. One way is to consider economic growth from a perspective that shifts focus from commerce and trade to water and land. The rationale for this is that society has to ultimately depend for its sustenance on natural resources such as water, land, minerals and fuel that are derived from the earth. As these resources are extracted, they become depleted, some permanently, and others at rates faster than what nature can replenish. In addition to depletion, the very act of extraction of natural resources impacts the human and biological habitat, often deleteriously. Reduction in freshwater resources, salinization of soils, encroachment of deserts, loss of ecological habitats and endangerment of species are some examples of deleterious impacts. Therefore, it is pertinent to inquire what the prospects for India’s economic growth are, given that continued economic growth implies a continued increase in the rates at which the earth’s natural resources are extracted.

India’s economic growth entails two major consequences. One is the expectation of enhanced standard of living among all segments of society, and the other is the production of more goods and commodities to satisfy expanding needs of trade. Both these consequences contribute inevitably to increased stresses on an already stressed earth and its water resources. If so, one has to examine the extent to which India’s natural resources systems are currently utilized, and the extent to which they could withstand continued stressing at accelerated rates to facilitate a real doubling of India’s economy every dozen years.

In a technological world, India’s economy depends on a variety of earth resources, including fossil fuels, radioactive minerals, metaliferous ore deposits, water, forests, soils, and building materials. For purposes of gaining insights, we may limit consideration to water and the landscape. India has an average annual rainfall\(^2\) of about 1170 mm, spread over an area of 3.28 million km\(^2\). This translates to an annual input of about 3840 km\(^3\) of water as rainfall. Of this, a significant portion goes back to the atmosphere as evaporation by sun’s heat, and as transpiration by plants, collectively referred to as evapotranspiration. World-wide experience in the field of hydrology indicates that annual evapotranspiration over the continents varies on an average between 60 and 80% or more of the total rainfall. For India, an estimate of 69.5% has been suggested\(^3\). Even the lower value of 60% would suggest that 2300 km\(^3\) of India’s annual rainfall is consumed as evapotranspiration, and is unavailable for human use. The remaining 1540 km\(^3\) constitutes surface run-off in rivers and streams and infiltration into the soil zone and the groundwater reservoir below the water table. Water required for human use (agricultural, industrial, municipal, and domestic) must be derived by diversion from surface run-off and groundwater infiltration. However, plant and animal communities distributed throughout the land depend for their sustenance on the same surface-water run-off and groundwater infiltration. Thus, diversion of water for human use has to be moderated so that plant and animal communities are not unduly deprived of their sustenance because of reduced water availability. For this reason, and for reasons of technological complexities associated with manipulating earth systems, there are definite limits to the portion of the 1540 km\(^3\) that can be diverted for human use. Here again, experience in different parts of the world suggests that perhaps 40–50% of this quantity, or 620–770 km\(^3\) of water may be amenable to extraction for human use. Available estimates\(^4\) suggest that the current rate of water use in India is between 634 and 645 km\(^3\).

Together, these estimates indicate that India’s current rate of water use is close to its full replenishable potential. In other words, India is currently utilizing its water resources close to its full capacity. If India’s economy has to increase fourfold over the next 25 years, then the country’s water use has to increase significantly beyond its estimated full capacity.

We must now go beyound water availability for human use and examine the impact of intense economic development on the integrity of the resources themselves. To simplify comprehension, we may restrict attention to potential impacts of disposal of wastes and extraction of construction materials.

Vigorous economic growth, accompanied by industrial development and urbanization will necessarily lead to phenomenal increase in waste of various kinds, both toxic and non-toxic. Information technology, which fuels India’s economic growth, is also responsible for generating massive quantities of liquid and solid wastes associated with electronic materials. This type of waste was practically unknown a few decades ago. Although no reliable estimates are available on the
magnitude of domestic and industrial wastes generated in India, it is reason-
able to assume that there will be un-
precedented increases in their quantities and toxicities throughout the country as
economy grows rapidly. There is no way
but to dispose these wastes on land, in
landfills and other suitable facilities, where
they will remain for centuries to come.
The hazard associated with landfills is
slow, long-term contamination of pre-
cious groundwater resources. Selection
of sites for safe disposal of wastes has to
be based on geological and hydro-
geological conditions, as well as accep-
tance by local communities. For this
reason, finding suitable waste-disposal
sites is a difficult task.

Continued economic growth also en-
tails increased construction of roads, bridges, buildings and other
civil engineering structures. Construction
in turn has to rely heavily on massive
production of earth materials such as
clay, sand, gravel and limestone. These
materials have to come from river and
stream beds, and sediments and rock
formations. Large-scale quarrying and
mining of these earth materials will in-
evitably contribute to degradation of wa-
ter sheds, soil erosion, and destruction of
fish and wildlife habitats. These envi-
ronmental and ecological hazards severely
limit the extent to which construction
materials can be produced at rates that
can sustain steady economic growth.

The examples of waste disposal and
mining of construction materials provide
a glimpse into the complex ways in which
water resources management, land use
planning, and preservation of ecosystems
are intimately interlinked. Since economic
liberalization in 1991, India has been ex-
periencing explosive growth in construc-
tion associated with industrialization and
urbanization. In an effort to keep pace
with rapid inflow of capital, construction
activities are allowed to proceed at a
phenomenal rate, with very little time
devoted to examining impacts on water
resources, the environment, and ecosys-
tems. There is little evidence to suggest
that this state of uncoordinated rapid de-
velopment will change any time soon.

In essence, India’s economic situation
in relation to its natural resources is that
the country seems to be using its repleni-
shable water resources to full capacity.
But, due to lack of coordinated planning
and lack of a coherent national water
policy, distribution of water resources
among various segments of society is far
from efficient. Even to improve the cur-
rent state of inadequacy in water distri-
bution, India faces formidable challenges
of policy, administration and social atti-
dudes. At the same time, the quantity of
water that nature can provide for human
consumption is finite and fixed, and its
effective availability is progressively
threatened by uncontrolled use, contami-
nation, and destruction of watersheds.
Given these facts, one cannot rationally
expect that India’s water resources will
continuously keep pace with the in-
creased demands of a growing economy.

Clearly, India is capitalizing on sci-
ence and technology for its ambitious
economic growth. If so, how may one
account for India’s lack of attention to
the role that earth-science plays in eco-
nomic growth? One possible explanation
may be the confidence that spectacular
growth in contemporary science and
technology, aided by financial incentives
stemming from competition, world mar-
kets, and rights to intellectual property
will help conquer any obstacles that
come in the way of economic growth.
But, this reliance on technology must be
moderated in dealing with the earth. Al-
though principles of physics and chemis-
try play a vital role in comprehending
the earth, there are aspects of the earth and
its biological systems that transcend
physics and chemistry. The complexities
and interconnections among earth and
biological systems place severe limits on
the extent to which science and technol-
ogy can foresee their behaviour or con-
trol their functioning to suit human
aspirations. Science and technology can-
not increase water availability, which is
dictated by climate and physiography.
Used wisely, science and technology will
help use water efficiently and effectively.
Expectations of steady economic growth
would become even less meaningful if,
because of global warming, low-lying
areas of high population density get
inundated, or if multi-year droughts dra-
tically reduce water input from rainfall.

India’s economic health depends vitally
on its ability to utilize its water and land
resources judiciously and thoughtfully.
At present India is in a water crisis, with
uncontrolled over-production of ground-
water in certain parts of the country, pol-
lution of little protected water bodies,
and rapid land development. Pressures to
solve economic and political problems in
the short-term appear to overwhelm any
desire for thinking about the long term.
There seems to be an underlying con-
ference that water and natural resources
problems will be overcome by techno-
ology and market forces. However, our
current state of knowledge of the earth
tells us that there are no simple solutions
or technological fixes for India’s natural
resource problems. To assure efficient
and equitable distribution of available
water even at the present economic levels,
India has to pay serious attention to the
earth, and formulate policies that, at their
core, recognize the attributes of natural
resource systems. The fact that economic
expectations of steady growth based
simply on human desires are pursued at
all, is indicative of a mindset that vital
national policies can be based entirely on
political and economic aspirations, with
scant regard to the nature of natural ele-
ments that dictate human sustenance.

Despite impressive performance of
India in international business, one finds
a notable lack of balance in Indian think-
ing with regard to understanding the
earth on which society at large has to
sustain, and human values within which
science, technology and wealth have to
function in a civilized society. Without
such balance, the country’s economic
expectations of continued, steady growth
over the coming decades can have no
credibility.

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