Water Transport and Its Ecological Aspects
by Jayant Vishnu Narlikar
About the Author

(A) BIOGRAPHICAL INFORMATION

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Married on 21 June 1966

Wife : Mangala Jayant Narlikar (nee' Mangala Sadashiv Rajwade)

Children : three daughters

Geeta (b. 16 March, 1970)
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(B) EDUCATION

School : University Children's School, Banaras Hindu University (1943-53)
Matriculated in 1953, standing First in the University Admission Examination.
College : a) Central Hindu College, Kamachha, Varanasi (1953-55)
Stood First in the Intermediate Science Examination of B.H.U.
b) Science College, B.H.U. (1955-57)
Stood First in the B.Sc. Examination of B.H.U.

University degrees : 1957 B.Sc., Banaras Hindu University, India.
1960 B.A. University of Cambridge, U.K.
1963 Ph.D., " " "
1964 M.A., " " "
1976 Sc.D., " " "

Academic prizes, scholarships etc. :

1957 Munishi Shiva Prasad Medal for Mathematics in the B.Sc. Examination of B.H.U.

1957 J. N. Tata Endowment Scholarship for higher studies at Cambridge.

1958-60 1912 Exhibition at Fitzwilliam House, Cambridge.

1960 Tyson Medal for best performance in Astronomy in the Mathematical Tripos III of University of Cambridge.

1960-61 W.A. Meek Scholarship of the University of Cambridge.

1962 Smith's Prize, University of Cambridge.

1963 Berry Ramsay Fellowship at King's College, Cambridge.

(C) POSITIONS HELD

1962-63 Director of Studies in Mathematics, Fitzwilliam House, Cambridge.

1963-69 Berry Ramsay Fellow, King's College, Cambridge.

Water Transport and Its Ecological Aspects

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YOU may wonder what an astrophysicist has to say on the down-to-earth questions of ecology and environment when his sights are set on heavenly bodies like stars, galaxies, quasars, etc. located millions to billions of light years away.

First of all, it needs to be mentioned that observations of the heavens are carried out mostly from the earth and as such astronomers are just as concerned as any other group of responsible human beings with the conditions of our planet. Let me illustrate my thesis with a historical example.

One of the pioneering telescopes of the twentieth century was the hundred inch instrument on Mount Wilson in Southern California. The dimension "hundred inch" specifies the diameter of the main light collecting mirror of the telescope. Because of its large size, the telescope was able to collect enough light to be able to do photography and spectroscopy of the galaxies situated well beyond our own Milky Way Galaxy. It was largely through this instrument that Edwin Hubble and his colleagues could confirm the important finding that our universe is expanding.

In modern times we have telescopes bigger than the Mount Wilson telescope. However, even telescopes of hundred inch size can still do frontier research with the back-up of sophisticated electronics. Yet, the Mount Wilson telescope had to be shut down. Why? Because, the city of Los Angeles spread and spread and the urban lights made the sky so bright that the telescope could hardly function. To pick up light from a distant star or galaxy one needs a dark sky with very low light background — just as to pick up a whisper from apart the listener must have a noiseless background. So one can say that it is the light pollution that killed the telescope.

Indeed today some of the world's leading telescopes are fighting a losing battle against light pollution from uncontrolled urban sprawl. To see the devasting effect of urban lighting on astronomy compare the darkness of the night sky over Bombay with that over an isolated village.

There is another type of pollution, however, that interests the astronomer positively. This is the pollution in the Milky Way. The Milky Way is normally seen as a white band across the sky. The whiteness is due to the integrated effect of all stars in the Galaxy that happen to be distributed in a disc-like structure. Our Sun iself is a part of this disc.

This galactic disc happens to be polluted! Apart from the shining stars it contains gas and dust. It is the latter that absorbs light. The absorption may be partial or complete. In the latter case it is completely blacks out the background stars. Indeed, before astronomers became aware of the existence of dust they made the mistake of assuming that such apparently dark star-less regions were voids. Today the astrophysicists have turned this disadvantage into an advantage. It is found that the interstellar dust does not absorb or scatter light of all wavelength with equal efficiency. The chemical composition of dust particles, their shapes and sizes determine the extinction profile of light waves. Thus, it is possible to infer the nature of dust grains from the extinction profiles actually observed. Although the process is not fool-proof, it has in the past provided useful clues to the dust composition of the Galaxy in different directions.

But enough of astronomy! Let me come down to the topic of my lecture today, namely, Water Transport in India. Apart from boating on the Ganges near Varanasi, and a steamer journey from Bombay to Goa, I can hardly claim any first hand familiarity of water transport in our country. However, recently I was the non-Expert Chairman of an Expert Group constituted to study the future scope for water transport in India. As a layman I feel I learnt a lot through this exercise. Since water transport has considerable bearing on ecology, I would like to share some of these ideas with you on this occassion.

Normally transport of human beings and goods, cargo, etc. is undertaken by four modes : roads, rail, air and water. The simplest and least sophisticated mode is the last of these. Simply set down a floating object in a river or a stream or on high seas and it moves. Road transport requires wheels and, preferably, road surfaces. Trains need special rails while aircrafts need high technology. Thus one could safely argue that where suitable water routes exist, transport along them is the most natural of all these modes. It is not surprising, therefore, that in the older times human societies congregated on river banks or along the coastline. Of course, in the case of rivers facility for agriculture was an important advantage.

History also tells us about commerce flourishing because of water routes — about sail boats travelling hundreds of miles on the high seas. Even today in terms of energy consumed for transporting a given load, water transport is the most favourable of the four modes of transport. Yet, with a coastline of 5,660 kms. and a length of 14,500 kms. of navigable waterways, water transport in India is largely neglected. Why?

The reasons are many. The principal among these, of course, is speed. My steamer journey from Bombay to London took eighteen days in 1957. Today a jetliner can perform the journey in nine hours, that is, in about two percent of the steamer time. A supersonic plane may take only 4 to 5 hours. In the fast moving society of today, therefore, water transport appears too slow.

A second practical reason is lack of accessibility. Not everyone stays along the coast or on river banks today. Even if water transport is used, it can only serve a partial purpose. One needs to supplement the journey with other modes transport.

There are other difficulties also. A river by itself is not enough. It has to have a deep enough channel in it to allow a river-craft to move. Bridges tend to limit the heights of crafts that can move along the river. Vegetation like water hyacinth can be a problem. Inclement weather in the form of rain or storms tends to restrict the period of sea navigation.

However, a closer examination shows that not all of these difficulties are, insurmountable. Inputs from science and technology can be brought to bear on these problems and water transport can be made a viable alternative even in the modern jet age. In the rest of this talk I shall consider these issues. There are four different aspects in which water transport can make very useful contributions to the country's economy and general welfare :

(a) Coastal transport as well as transport between main land and the groups of islands within the national territory
(a) inland water transport
(c) Urban transport and
(d) Tourism

(a) Coastal/Island/Inter-island transport :

Coastal movement in the 1950's, 60's and 70's comprised mainly general cargo, salt, coal and crude oil and petroleum products. General cargo here means manily food grains, jute, tea, iron and steel products, fertiliser, cement, etc. More recently, however, the coastal trade has generally been limited to coal, crude oil and petroleum products. The general cargo shipment along the coast declined steadily from about 15 lakh ton per year to 1 lakh tons per year over the same period. This has happened because of speed and convenience (door-to-door service) of road transport, high cargo handling costs at ports and the buraucratic delays encountered there.

Since new thermal power stations are being set up at various coastal cities of India such as Visakhapatanam, Pondicherry, etc., it makes sense to ship the coal along the coast and it is expected that coal shipment will indeed increase manytimes. The same may happen for crude oil from Bombay High fields which is now mostly refined at coastal refineries.

From the environmental point of view the coastal alternative has the advantage that our roads, congested and polluted by heavy lorries, do not possess.

The passenger services along the coastine have declined again because of competition from road and rail but placing in turn too much burden on these modes. Faster boats may revive routes like Bombay-Goa, Bombay-Kutch for example. This is where new technology needs to be brought into play.

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The competition from other modes is considerably less for transport between the mainland and the Andaman-Nicobar or the Lakshadweep group of islands. There the alternative to shipping is by air only. Besides, there is also the need to develop the inter-island traffic with motorboats or other faster and light crafts. So far as inter-island cargo transport is concerned, the shallowness of the lagoons near individual islands necessitates the discharge of cargo outside the lagoons. This has resulted in heavy loss of cargo. The problem can be resolved by acquiring low draft cargo vessels.

(b) The inland water transport system :

Because of its low consumption of energy inland water transport is recognised as the most suitable mode for transporting bulk and semi-finished commodities. Additional advantages are low pollution, low cost of operation and negligible use of land in comparison with surface transport. Although the Central Government has been showing a sustained interest by steadily enhancing plan funds from about 33 lakhs in the First Plan to 4,117 lakhs in the Sixth Plan, there is much that remains to be done. In particular, the state governments have not managed, by and large, to spend their quota.

Several case studies have been carried out in Kerala to compare the cost-effectiveness of inland water transport, both goods and passengers, to that of surface transport. Thess usually are break-even points in terms of distances beyond which the former is more economical. These distances are of the order of 100-200 kms.

A problem that needs to be solved is that of assured availability of water. To provide a minimum necessary draught to the boats, water needs to be released from barrages, locks, etc. in the lean season. However, water is needed for irrigation too and it is not always possible to ensure it for water transport. The policy to maintain a minimum flow of water in the river also comes from the need to control pollution and keep the river alive.

For better and balanced management of water, particularly in high flood season, a portion of money from flood control measures could be diverted to conservancy measures to maintain assured channel with sufficient depth.

I may mention a pilot experiment which is being carried out in the Ganga-Yamuna doab region of Uttar Pradesh. The experiment consists of lowering the underground water table by pumping water out of tubewells in the lean season. The table is made up by the flood water seeping in during the rainy season. Thus the experiment uses natural ecology for storing water for agricultural purposes. The underground seepage would reduce the flood-havoc, which is an additional benefit. The preliminary findings of this experiment have been encouraging.

(c) Urban water transport :

Anyone who has lived or moved in the city of Bombay will appreciate the limitations of surface transport in the rail or road mode. With the increasing population of the city both these modes have been stretched beyond limits. In the city of Cochin the inadequacy of roads to deal with commuter movement has long been felt. Indeed, time has come to examine the water mode more seriously in urban areas where it is available.

From the ecological point of view this alternative may help to prevent further deterioration of air quality in our cities. Science and technology can be mobilised to provide suitable launches, sea-buses, commuter platforms to relieve congestion on our roads and bridges. Research and developmental efforts along these lines have already been producing viable water-mobiles in the advanced countries. Can we not think of ferry services along such modern lines linking Bombay to new Bombay, for example? This alternative may be worth considering seriously instead of building bridges that inevitably add to road traffic density.

(d) Tourism :

From the urban necessities of the commuters let me now turn to recreational aspects. Water transport in the form of water cruises and water sports remains largely unexplored in India. A steamer journey along the Rhine a, look at Paris from a cruise boat, a visit to the San Diego Sea-World or surf riding near the Hawaiian coast will convince the skeptic of the potentialities of water transport for attracting tourists.

India has numerous lakes, waterfalls, attractive beaches and coastlines as well as historic towns on river banks to make water-tourism an important generator of industry and foreign exchange.

ECOLOGICAL ISSUES

Let me conclude with the ecological issues arising from the promotion of water transport.

I have already referred to the competition for inland water between transport and irrigation. Increasing water withdrawal for irrigation and lowering of the water table due to adverse environmental conditions caused by indiscriminate deforestation pose a continuous threat to the already critical depth available in the waterways.

Severe erosion along the banks with consequent siltation of channels of the river is another important problem requiring attention. Constant maintenance dredging becomes essential in many reaches of the river to maintain adequate depths for navigation.

In the case of canals, erosion along the banks due to waves generated by ship motion is a major constraint requiring careful attention. The basic nature of soil comprising the bank would need to be examined before suggesting any protection measures. This calls for studies in the laboratory, simulation of movements of vessels and likely wave and current forces on the banks. Experiments like those conducted at IIT, Kharagpur are useful in arriving at suitable measures.

R & D efforts call for interaction between the navigation specialist, the hydraulic engineer and the vessel designers. The wateway has to be designed with the size of the vessel in view, the bends with due consideration for smooth navigation. The problem gets more complicated when one proceeds down the waterway to the reach where interaction of the tidal and fresh water flows begins to be felt. The sedimentation in the navigation channel could become more complex due to the intermixing of salt and fresh water and the occurence of a salt water wedge. The position of this wedge varies depending on the quantum of fresh water flows and tidal discharge. The wedge in turn controls the sediment movement.

The effect of deepening the navigation channel in such cases could completely offset the expected improvement as the salt water wedge could travel further upstream after deepening causing greater sedimentation problems. Likewise, dreging of waterways needs careful planning to avoid not only the problems of reshaoling but also environmental pollution.

Control of aquatic weeds is another major problem. Excessive growth of weeds results in swamp formation, changes in hydrochemistry and reduces fish production. They also endenger swimmers, foul up boat propellers and make certain types of fishing activity impossible. Weeds can choke up large waterways that are customarily used by boats.

Excessive inorganic nutrients (phosphates, nitrate, silicates, etc.) can cause entrophication of lakes and also fertilizing flowing streams with the resultant production of heavy plankton blooms, water hyacinth, water milfoil and water chestnut. These as well as algae, worms, barnacles, etc. can clog waterways, cling to vessels and accelerate corrosion.

To sum up then, water transport in all its different aspect holds out the promise of an alternative mode of transport of both goods and human beings. It is an area that cries out for development. It is relatively cheap, has very few negative effects on environment and can relieve the pressures on other forms of transport. These are many problems that require a solution before water transport can really take off. But with suitable R & D efforts this should not be difficult.