Carrying capacity of India: How far are we or already exceeded?

The current escalation of food prices in the country, caused by demand – supply mismatch, leading to overall increase in inflation has once again drawn the attention to food – energy – poverty – depleting natural resources – environment and population[1]. The Science summit on world population hosted by the Indian National Science Academy 15 years ago[2] with participation of 58 academies, had drawn attention to 'the intertwined problems of rapid population growth, wasteful resource consumption, environmental degradation, and poverty'. Others have raised the question of feeding the growing population of India[3–5]. The *Atlas of the Sustainability of Food Security*[6] shows that many states in the country are not sustainably food-secure. A large country with a population of a billion plus, adding 11 million each year, ought to have long-term food and nutritional self-sufficiency. Availability of water is the first limiting factor for food production in the country. Water can be augmented with appropriate technologies and energy inputs, the extreme being the use of desalinized sea water. However, at present the country is short of food, energy and water. Current GDP growth of 8–9% and growing prosperity would increase competing demand for all three. Further, population and income growth would accelerate loss of prime cropland to non-agricultural uses, to satisfy the need for housing, transport, recreation and industries. This calls for a science-based estimate of the carrying capacity of India, and its different agro-climatic regions. The key issues of food, water, energy, poverty, environment and population link to the carrying capacity of the land.

Ecologists define the carrying capacity of an ecosystem as the population of humans and animals that can be sustained, based on the primary productivity of plants, with the available resources and services without damaging the resource base – soil, water and the environment. Carrying capacity depends on the resources available, population size, and per capita consumption of food and other resources. Carrying capacity can be enhanced with technological, financial and managerial inputs. Robust science-based estimates of the carrying capacity are essential for evolving sustainable agriculture and other development goals. The Department of Science and Technology/ Planning Commission/science academies may constitute a multidisciplinary team of ecologists, economists, geographers, agronomists, modellers and other subject-area specialists to estimate the carrying capacity for the country and for major agro-climatic zones. Different scenarios, including the anticipated effects of population growth, climate change and depletion/enhancement of water and energy resources can be incorporated in the model. This science-based information may also help in wider social acceptance of the urgent need for stabilizing human and animal population in the country.

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C. R. BHATIA

17 Rohini, Plot 29–30,
Sector 9-A, Vashi,
New Mumbai 400 703, India
e-mail: neil@bom7.vsnl.net.in

Possible transmission of Chikungunya virus through blood transfusion

Chikungunya, an arboviral disease caused by a virus that belongs to the genus *Alphavirus*, family Togaviridae, had an estimated 1.3 million people in India as its victims. There has always been some linguistic confusion regarding the origin of the word 'Chikungunya'. Some authors report it to be derived from Makonde language, while some claim it to be derived from Swahili, and a recent report claimed it to be derived from Bantu language[1]. From the initial reports of Robinson[2] and Lumsden[3], and from the findings of Benjamin[4], we can confirm that the term Chikungunya is indeed derived from Makonde language. Although blood transfusion as a potential source for transmission of various pathogens (HIV, HBV, HCV, malaria, West Nile, etc.) has been established, up to date reports of Chikungunya virus (CHIKV) transmission through blood transfusion have not been reported in the literature, except a case documented in France[5], wherein a nurse got infected after coming in direct contact with a CHIKV patient's blood. In our study of 129 CHIKV suspected patients (Sai Gopal *et al.*, unpublished data), we observed two male patients in the age group of 20–30 years who had fever of one-day duration. The fever subsided on the second day and both of them resumed work as usual without showing any disease symptom. Blood drawn from these patients on the second day showed CHIKV-positive by RT–PCR[6]. It is evident that depending upon the immune status, both of them might have acted as asymptomatic carriers. Blood donated by such patients during the viremic stage will be infectious to some extent and by observing asymptomatic CHIKV patients we cannot underestimate the possibility of such a transmission. In a recent study, Brouard *et al.*[7] observed that the estimated risk of viremic blood donation was high during CHIKV outbreaks. Our present observation in agreement with recent reports, supports the fact that improper blood screening may to some extent help in spread of CHIKV. Although such a mode of transmission might be low, we cannot rule out the possibility and take any chance against

the virus which has created havoc across geographical boundaries and age groups. The Government should take the necessary steps during such outbreaks and a precautionary measure should be implemented for CHIKV screening in blood banks. The impact and feasibility of CHIKV in organ transplantation is yet to be understood. In the absence of a preventive vaccine for CHIKV and to further prevent any such CHIKV epidemics in the near future, establishment of a system for continuous surveillance of the disease seems to be the only possible solution.

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C. V. M. NARESH KUMAR
D. V. R. SAI GOPAL*

Department of Virology,
Sri Venkateswara University,
Tirupati 517 502, India
**e-mail: dvrsaigopal@rediffmail.com*

Indian Gharial (*Gavialis gangeticus*) on the verge of extinction

Reptiles evolved on the earth some 200 million years ago. Fossil records show that they evolved in different ways and were semi-aquatic in habit, with characteristics similar to mammals and birds. Crocodiles find a place in ancient folklore: Egyptians worshipped a god named Sobek, who had a human body and crocodile head.

The Indian Gharial (*Gavialis gangeticus*) is the oldest crocodilian and the sole survivor of an evolutionary line called archosauromorpha. The name 'Gharial' originated from a 'ghara' or earthen pot on their head[1].

The Gharials, once abundant in river systems of the Indian subcontinent with its range extending throughout the Gangetic Plains, Indus river in Pakistan, northern Nepal and Bhutan, East Burma and southern Orissa[2], are reportedly extinct in Burma and Pakistan[3]. The Indian Gharial is now confined to India, Nepal and Bangladesh, in scattered and isolated populations.

The late 1970s saw a drastic decline in the Gharial population and distribution. In 1975, the Crocodile Conservation Project was initiated by the Government of India/UNDP, FAO in Uttar Pradesh, for the conservation of the Gharial. The project involved two phases – captive breeding and rehabilitation. Gharial eggs were collected from the wild, incubated and the resultant hatchlings were released into the wild. At times, 90% of incubation of the eggs was done *in situ* in wild nests and then the eggs were transported to hatcheries at rehabilitation centres for complete incubation.

The National Chambal Sanctuary (25°30′–26°52′N and 76°28′–79°00′E) was founded over Chambal river in 1978–79 under the Crocodile Conservation Project for the protection of Indian Gharial. This is the only wetland sanctuary in India for the conservation and management of crocodiles[4]. An alluvial belt of eroded banks, sandy islets, peninsulas and deep sand banks of Chambal formed an ideal habitat for the Gharials for basking and nesting[5].

Apart from the National Chambal Sanctuary, Orissa also forms a good habitat for the Gharials. In fact, Orissa is the only state in India to have all three species of Indian crocodiles, viz. mugger or marsh crocodile (*Crocodylus palustris*), the saltwater or estuarine crocodile (*Crocodylus porosus*) and Gharial (*Gavialis gangeticus*). But the once abundant Gharial population in three major river systems of Orissa, viz. Mahanadi, Brahmani and Baitarani, showed a steady decline and by 1975 a small population of juvenile and adult Gharials survived only in the Mahanadi.

Many factors, individually or in combination, were responsible for the drastic decline of the Gharial population in the Indian subcontinent. Loss of habitat owing to construction of reservoirs and dams, lack of stringent laws, trapping in fishing nets and erroneous superstitions have made them one of the most vulnerable reptiles. Superstitions are part of the South Asian tradition, but some of them harm wildlife. A common belief of a local tribe called 'Tharu' of Nepal associated with the Gharial is that the 'ghara' kept under the pillow of pregnant women relieved her of her labour pain[6]. Another belief is that incense sticks made of 'ghara' when burnt in fields acted as a pesticide. In addition, the 'Tharu' community believes that Gharial eggs have medicinal value. All these superstitions have led to their decline in Nepal.

Gharials in Nepal were listed as 'Endangered' in the *IUCN Red Data Book* of 1975. The 2007 *IUCN Red Data* list of threatened species places the Indian Gharial in the 'Critically Endangered' category[7]; and if the present rate of decline continues, the Indian Gharial will soon become extinct.

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SUMAN D. GAD

(S. Ramaseshan Fellow),
c/o Vedpal Tari,
D-3/F, Gen. Pool,
Government Quarters,
Altinho-Panaji,
Goa 403 001, India
e-mail: sumangad@rediffmail.com