Niraj Kumar

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The sustenance and renewal of life in an ecosystem depends mainly on two factors, energy cycling and nutrient flow. Nitrogen cycle and nitrogen fixation are perhaps the best examples of nutrient cycling. Nutrient cycling involves elements moving to/from biotic and abiotic factors in the ecosystem. Energy movement through food chain in biotic factors is an important example of energy flow. Energy is either transformed or conserved.

Plants and some other organisms convert solar energy to chemical energy via photosynthesis which occurs in two parts: light-dependent reactions and dark reactions. The light-dependent reaction happens when solar energy is captured to make adenosine triphosphate (ATP). The dark reaction happens when the ATP is used to make glucose (the Calvin Cycle). Chlorophyll on irradiation with sun light forms antenna complexes which transfer light energy to one of two types of photochemical reaction centers: P_{700}, which is part of Photo-system I, or P_{680}, which is part of Photo-system II. Excited electrons are transferred to electron acceptors, leaving the reaction center in an oxidised state.

The role played by an organism in its environment is defined as “Niche” in Ecological Biology. A niche may also encompass how the organism interacts with other living things or biotic factors, and also with the non-living, or abiotic parts of the environment as well. All living organisms have a fundamental niche. This is all of the possibilities available for the organism to take advantage of. All possible sources of food, all open roles in the environment, and any suitable habitat is included in a fundamental niche. Any organism does not use all the available resources at the same time. Rather it uses in a very narrow range. This more specific role is called the organism’s realised niche. Abiotic factors, such as water availability, climate, weather, and in the case of plants, soil types, and amount of sunlight can also narrow a fundamental niche to a realised niche. An organism can somewhat adapt to its environment, but the basic needs must be met first in order for them to have time to find their niche.

Abiotic disorders can influence biotic disorders and vice versa. Biotic and abiotic factors are closely linked in an ecosystem. The environment affects the human health in a big way. People tend to be most susceptible to illness when physically or mentally stressed. Stress, energy and immunity form a closely knit network.
The author in the present book has brought out this intricate concept of inter-
dependence of biotic (living) and abiotic (non-living) factors in an ecosystem,
resulting in an impact on human health, in an explicitly marvelous manner. As a
result a new word “Biogeogens” has been coined, “bio” for living (biotic), “geo”
for non-living (abiotic/geographical/climatic/environment) and “gens” for the
interactive proceeds of the two. For the ambience embedded with clarity with
which the author has explained the flow of energy cycle through these two
important factors, “biotic” and “abiotic” and how it influences human health is
praiseworthy. I congratulate the author for this Herculean task and hope that
readers will find the book useful and interesting.

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Preface

The WHO data on the burden of diseases suggest that approximately 80% health problems in rural parts of India are due to communicable diseases like diarrhea, typhoid, cholera and infective hepatitis etc. Only diarrhea kills approx. 6 lakhs children in India every year. Morbidity and mortality due to malaria are the major public health concerns with around two million cases reported annually; Filaria, T.B., Measles, Flu and worm infestations add further burden. The 50% of health budget is spent in tackling health impact of disease related to water pollution as vector of communicable diseases in India. Therefore, preventive and promotive health care mechanisms are must to improve the situation.

Realising this very fact, the Institute of Applied Sciences, Allahabad, India, actively involved in the application of scientific know how for the betterment of society has undertaken many research projects to evaluate the geography of health of suburban and rural population in and around Allahabad. The guiding principles to conduct these projects were mainly inspired by the studies of Prof. Rais Akhtar, a noted medical geographer and an eminent scientist of this country. But, the author further analysed several other factors affecting human health, based on his participatory observations done to evaluate the nutritional requirements, water intake, food habits and associated taboos, disease condition and health status of the population under study. Finally, on the basis of the years of strenuous and methodological studies done under the guidance of the author and involving the researchers Prasanna Ghosh and Vartika, a Dogma of Biogeogens has been postulated by the author—which could be helpful for the future scope of research in this field as well as to cast out many doubts in effective management of human health.

From Author’s Pen
Acknowledgments

I deem it to be my proud privilege to take this opportunity to pay my deepest regards and gratitude to the past Presidents of the National Academy of Sciences, India (Hon’ble Prof. A. K. Sharma and Prof. Manju Sharma) and the present President (Hon’ble Dr. K. Kasturirangan) of the Academy; and the Institute of Applied Sciences, Allahabad (Dr. B. P. Agrawal), for their continuous support, inspiration and encouragement that has made this work possible.

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It is my genuine abiding desire and great pleasure to express my most sincere thanks to my colleagues Dr. K. P. Singh, Vice-President of IASc, Allahabad, and Dr. Ashwani Kumar, IFS, Former Director, Forest Research Institute, U.P., for their kind support throughout the period of the work.

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In the end, my sincere thanks to Dr. Mamta Kapila and Sri Aninda; and all my love, affection and good wishes to my heartiest friends and family members for their helpful and cooperative nature and attitude, especially to my lovely better half and three kids—Aashu, Apaarna and Twinkle.

With all my best regards to my parents (Mother—Smt. Dharmashila Srivastava and Father—Late Shri K. P. Srivastava).

From Author’s Heart
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Biogeogens and Human Health

Introducing the Concept of Biogeogens

The world mainly depends on the transformation and conservation of energy from one form to the other. Energy is transformed and conserved in terms of its channelisation in the biotic and abiotic resources, which could be explained by certain phenomena based on the principle of \( E = mc^2 \).

Energy is neither created nor destroyed. Meaning simply that energy is either transformed or conserved. It is also defined that energy is the ability to do work. This cause and effect relation is directly linked with all the biotic and abiotic factors and phenomenon. They could be made understandable in terms of energy, its flow, loss, transformation and conservation. A living system gets energy in the chemical form; some machines also get their energy in chemical form, i.e. from fuels like gasoline or diesel. A plant has chemical energy stored in its leaves, which happens due to a complex phenomenon/process, i.e., photosynthesis.

Photosynthesis is the process that supports life on earth. Plants use the sun’s energy to transform \( \text{CO}_2 \) and water into a sugar called glucose.

\[
6\text{CO}_2 + 12\text{H}_2\text{O} = \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O} + 6\text{O}_2
\]

The process of photosynthesis starts with an advent of light on the leaves of plants. The sun’s energy is transferred to plants by means of photons hitting the chlorophyll.
Diagrammatic representation of electron release on incident of light on the chlorophyll [chart made by Ms Fatmatuz Zohra, Vigyan Sancharak Fellow (VSF), DST, New Delhi under the mentorship of the author in Institute of Applied Sciences (IASc), Allahabad]

This stored energy can be released if the chemical makeup of the plant changes, for example if it is eaten by an animal/human being or burn to produce heat and light. That is how the energy stored in the form of chemical/food energy is transferred to other living organisms, i.e., from producers to consumers through different trophic levels; in each step, a sufficient amount of energy is consumed in other processes before transfer. This consumption/transfer of energy from one process/system to another involves many phenomena and factors, which interact with each other in an orderly manner leaving an impact on many processes of life, thus:
• The living and nonliving are interwoven on the matrix of energy dynamics, in terms of either electron flow or photon flow.
• The cycle of food chain starts with the transfer of energy from photons to electrons and goes on to the extent of conservation/transformation of energy from one form to other (e.g., from food/chemical energy to heat energy and so on).
• Further availability of this food energy decides the fate of an ecosystem, correlating the phenomenon of biogeochemical cycle with the food web.
• Finally, the pray–predator and its population dynamics play a pivotal role in deciding the pyramid of energy, (as seen in the photograph- courtesy: VSF, IASc, Allahabad).

Thus biotic and abiotic factors interact with each other; and selection pressure decides the directional flow of the energy-economic dynamics. All this creates a multidimensional impact on the biotic and abiotic systems. That is how the two components are linked together in an ecosystem.

As per the United Nations Environmental Programme (1992) for planet protection, “All constituents of the environment of our planet ultimately exert an
influence on human health and well-being”. Further, if one has to define all the constituents (abiotic and biotic) in an environment in terms of their relation to each other, as described above, and their impact on human health, biotic may be abbreviated as bio while abiotic (non-living/geographical/climatic) as geo; and all those proceeds which are supposed to arise from the processes taking place in these two may be termed together as Biogeogens. Now, the question is what are these in real terms, which could affect human health and how?

Before discussing these factors, it is necessary to define first human health; only then would it be possible to understand the effect of biogeogens on it. Human health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (as defined by World Health Organisation). The essential requisites of “human health” include the following:

- achievement of optimal growth and development as per genetic make-up,
- maintenance of the structural and functional efficiency of body organs/tissues necessary for an active and productive life,
- mental alertness and well-being,
- ability to withstand the inevitable process of ageing with minimal deformity/disability and functional impairment, and
- ability to tolerate and combat diseases.

Till about three decades ago, the importance of nutrition as a major determinant of health had been widely recognised only with respect to the first two of the requisites listed above. But now, it is a well-established fact that nutrition plays a major role in negating the effects of toxins and pollutants [1]. One major prerequisite for the maintenance of health is that there be an optimal dietary intake of a number of nutrients; the chief of these are vitamins, certain amino acids, certain fatty acids, various minerals, and water [2, 3]. Each of these aspects has a deep influence on health and which in turn influences all these aspects.

Thus, nutrition is a major process taking place in the human body giving rise to several free radicals, antioxidants, etc.; all these could be considered as biogens (the proceeds of the processes taking place in a biotic component), which interact with the geogens (radiations, pesticide and other chemicals, etc., i.e., the proceeds of the processes taking place in an abiotic component), determining finally the status of human health.

From the above, one can understand simply the connotation of biogeogens; however, assessment of its impact on human health is not easy as the adaptive interactions of biogeogens further give rise to several other complications making the dynamics more and more complex, necessary to be deciphered for regulating the human health, which will be discussed in detail to fix-up their role in determining the well-being of humans.
References

Dogma of Biogeogens

Biogeogens arise together as an aftermath of interplay of the proceeds of the processes taking place under the influence of the following dimensions:

- **Population Dimension**
  - Genetical Factors
  - Immunological Factors
  - Nutritional Factors
  - Demographic Composition
  - Psychological Factors

- **Environmental Dimension**
  - Physical Factors
  - Chemical Factors
  - Availability of Health Care Services

- **Cultural Dimension**
  - Food Taboos
  - Dietary Habits & Practices
  - House type
  - Clothing
  - Conceptual Mind
  - Health Education

Each and every dimension has its own significance, and is further categorised into several components:
Thus, all the above factors are considered necessary to assess the status of health; the health problems of any community are influenced by an interplay of all these factors [1]. The common beliefs, customs and practices related to health and
disease in turn influence the health-seeking behaviour of the community [2]. It has been shown in different studies that various socioeconomic, mental and other factors affect the nutritional status of infants/children [3–5]. In other studies also, it has been well established that the nutritional status of a person is a function of his/her socioeconomic condition [6–9].

Further, widespread poverty, illiteracy, malnutrition, absence of safe drinking water and sanitary living conditions, poor maternal and child health care services and ineffective coverage of national health and nutritional programmes/services have been traced out in several studies as possible contributing factors to dismal health conditions prevailing among the rural/tribal population in India [10–21]. Hence, a comprehensive approach in the light of the concept of biogeogens is needed to reach any definite conclusion regarding the health status of an individual/community.

References

2. Indian Council of Medical Research (1998) Health of Tribal population in India; result of some ICMR studies. Indian Council of Medical Research, New Delhi
Establishing the Concept of Biogeogens

Our Studies on Rural/Tribal Populations

The poor health status of any population is manifested not only in terms of morbidity and mortality rates but also in the capacity of individuals of a community to develop their human potentialities and meaningful productive life. Recognition of health as an essential component of socio-economic development has led to the review and reorientation of health statistical services. Though healthcare facilities are overwhelmingly concentrated in rural areas of India, the ‘socio-economic distance’ prevents access for the rural poor. These socio-economic barriers include cost of health care, social factors, such as the lack of culturally appropriate services, language/ethnic barriers, and prejudices on the part of providers. Thus, there is a general belief that the rural/tribal populations in India are deprived of many facilities/healthcare services; and their nutritional status is also very low, in turn making them vulnerable to several diseases.

Now, the problem is how to prove this? While supervising the projects/thesis work [1–6] of the researchers in the Institute of Applied Sciences, Allahabad, several facts were revealed during our studies on health and nutritional status of the rural/tribal population of Shankargarh area, near Allahabad; which became the backbone of the concept of “Biogeogens.”

Study area: Shankargarh block is situated in the Vindhyan region of India. The Vindhyan range is a low mountain range of Central India, extending in east–west direction from Varanasi to Gujarat State for a distance of 1,100 km. (700 miles). The range separates the drainage basin of the river Ganga in the north from the Deccan Plateau in the south. Elevations range from 450 to 500 m (1,500–3,000 ft.) and reach a maximum of 1,113 m (3,651 ft.). It includes South of Allahabad, Vindhyanchal, Mirzapur, Manigaon, Chakghat, Shahdol, Rewa, Panna, Satna, Umaria, Sidhi and adjoining areas. In 1948 Baghel Khand and Bundel Khand merged into Vindhya Pradesh, which, with several former enclaves of southern Uttar Pradesh, merged with Madhya Pradesh in 1956. The Vindhyan range is also known for its great potential for medicinal herbs.
In fact, our attention was earlier focused on studies on medicinal plants only; and as per earlier survey conducted by our researchers several plants were identified in the Vindhyan region, such as *Andrgraphis paniculata* (Fam. Acanthaceae), *Catharanthus roseus* (Apocynaceae), *Matthiola incana* (Fam. Brassicaceae), *Lagerstroemia speciosa* (Fam. Lythraceae), *Althaea rosea* and *Sida cordifolia* (Fam. Malvaceae), *Butea monosperma* and *Tephrosia purpurea* (Fam. Papilionaceae), *Receda odorato* (Fam. Resedaceae), *Ruta graveolens* (Fam. Rutaceae), etc. However, gradually our attention shifted toward nutritional and health studies, as we came across several amazing facts, which finally forced to correlate our findings with other hidden realities unearthed during the extensive studies on the target population, leading to establishment of the Biogeogen concept.