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Ethno-biology: The Science of a Common Man to Explore the Traditional Ecology, Biodiversity and Philosophy of Conservation: A Review

Sachidananda Padhy, Santosh K. Dash and Ratnaprava Mohapatra

Vedic Science Research Centre, Bhaba Nagar-1, Berhampur 760 004, Odisha, India
E-mail: sachi_padhy@rediffmail.com

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ABSTRACT The coining of the term 'Ethno-botany' in the year 1896 is said to be auspicious for the emergence of the science Ethno-biology, with genuine academic and research activities as existing today, to explore the traditional relationship between men and surrounding biota. In Indian scenario, a collaboration work of Indian and Deutsch medicine men during the period 1637 - 1691, reflected as the publication '*Hortus Malabaricus*', was a land mark in the history of biodiversity research, worldwide. In course of time, the subject is now established as ethno-biology with the integration of various branches of science. The subject ethno-botany / ethno-biology is now included in the university curricula as an integrated subject in the post-graduate curriculum of Ecology and Environmental studies; extended to organisation of national level seminars, workshops and international congress along with activities like - All India Coordinated Research projects, initiated by Ministry of Environment and Forests of Central Government. Human relationship with the surrounding biota is as ancient as the evolution of man. The interrelationship between man and surrounding biodiversity is of two types: material and spiritual or cultural which is based on relationship useful to both-man and biota; useful to man, but harmful to biota; useful to biota, but harmful to man and harmful to both man and biota. The techniques of ethno- biological research are twofold: field research and Literature research. Field work is based on survey and collection of information and material. Study of ancient literature and mythology is a new dimension in ethno- biological research which conveys the ancient traditional scientific thoughts, encapsulated in the hymns of Sanskrit or any other language and religious icons in symbolic terms and/or forms respectively. This provides scope to realise that the ancient (Indian) environmental and ethical education deserves a rediscovery and needs an ecological implementation in the present context. Some of the important aspects of literary research are significantly focused in this review.

INTRODUCTION

It was rightly commented that "Biology flourishes as the science of life without attempting to define life" (Wald 1958). Probably to the deeper, man has entered into science, he has lost the foresight of looking to his own environment. In this age of computers and Genetic Engineering, a group of elites look back to the old scriptures, epics, to the tribal and forest people, to the broken archaeological remnants, to the sacred groves, to the folklore and folk medicines to evaluate its scientific basis in them and be enlighten. The attempt to regain this alertness and to resume the exploration of the surrounding biota, is the science of "Ethno-biology". The ethno-biological knowledge has transmitted from generations, lasts through culture, tradition, habit, folklore, scripture, dogmas, tales etc. Often a question rises, when biological science is so much advanced upto gene cloning, why to go back to some ancient knowledge to search the science in it ? In fact, this is because the ethno--biological knowledge is natural which man has gained and documented in thousands of years through his own experiences. It can be compared with the source of energy like coal and petrol which the nature has conserved in millions of years.

The coining of the term 'Ethno-botany' by Harshberger (1896), with a limited scope of the subject to point out the plants used by the aboriginals, is said to be auspicious for the emergence of the science of Ethno-biology with genuine academic research activities as existing today to explore the relationship between men and the surrounding biota, with multidimensional view point. Robins et al. (1916) broadly defined the area of Ethno-botany, which entails the study of all aspects of plants amenable for human consumption. Mostly the earlier studies in Ethno-botany have included Economic Botany

Address for correspondence:
Sachidananda Padhy
Vedic Science Research Centre,
Bhaba Nagar-1, Berhampur 760 004,
Odisha, India
E-mail: sachi_padhy@rediffmail.com

and study of the indigenous knowledge of tribals related to usage of plants in their food habit, medicine, culture, music and life style with a wider sense (Faulks 1958; Richard 1978; Schultas 1941, 1960). In course of time the term Ethno-botany was realised to be with much broader scope, than what it was expected to be. In the present scenario the interdisciplinary nature of the subject (Jain 1987; Maheswari 1987) is well realised, with the interaction of various branches of science (Manilal 1989) such as: (1) Food and Nutrition, (2) Defence and Survival, (3) Sociology and Culture, (4) Religion and Social Customs, (5) Medicine, (6) Art and Literature, (7) Mythology, (8) Archaeology, (9) Anthropology, (10) Forestry and Agriculture, (11) Economics, (12) Wood Science, (13) Language and Linguistics, (14) History and Politics, (15) Ecology and Conservation. In this context some of the important subdisciplines of Ethno-botany can be focussed as follows:

1. **Ethno-taxonomy:** deals with nomenclature and folk classification on plants and animals (Brown 1984) of different human society in their language.
2. **Ethno-mycology:** deals with origin and antiquity of the human use of fungi (Manilal 1981).
3. **Ethno-ecology:** deals with the study of the past and present inter-relationship of human societies and their living and non-living environment (Padhy 2000).
4. **Ethno-pharmacology:** deals with identification, description, observation and experimental investigation of the ingredients used in various recipes and indigenous drugs prepared by aboriginal (Holmstedt and Bruhn 1983).
5. **Ethno-medicine:** deals with study of indigenous folklore herbal charms pharmacopoeia based on medicines derived from plants, animals and minerals (Weiner 1971).
6. **Ethno-toxicology:** deals with various toxic plants used as fish poison, arrow poison etc. (Schultes 1970).
7. **Ethno-musicology:** It deals with music of tribal and aboriginal people (Jain 1987)
8. **Archaeo-ethno-botany:** deals with the study of biology in archaeological scriptures and structures (Jain 1987).
9. **Palaeo-ethno-botany:** deals with the identification of fossilised plant materials correlating the ancient plant economy from palaeo-biological perspectives of crops and the changing pattern of the use of plants by various human cultures (Stewart 1976; Zeven and Zhukovsky 1975).
10. **Ethno-gynaecology:** deals with various diseases among women in tribal societies, related to sterility, conception, abortion etc and the use of abortive (Tarafdar 1983a,b).
11. **Ethno-narcotics:** deals with the use of narcotics, snuffs, hallucinogens etc in primitive societies (Schultes 1970).

Other than the above aspects, ethno-botany has branches like ethno-paediatrics, ethno-agriculture, ethno-silviculture, ethno-etymology, ethno-linguistics etc (Jain 1987). It also lays emphasis on germplasm conservation of biota, study of sacred groves and exploration of knowledge of women society on various use of plants and animals and many other aspects. Moreover, the recently developed branch Astro-Ethno-biology deals with the interaction of planatory and biological world (Padhy et al 2005a,b) is interesting. The division of the above sub-disciplines does not very much distinguished one from another. The source of data may broadly remain the same for all; but the methods of study will vary for each sub-discipline (Jain 1987).

ETHNO-BOTANY TO ETHNO-BIOLOGY IN INDIAN SCENARIO

An enlighten report related to the development of Indian Ethno-botany is presented (Chandra 1996) in the proceedings of 4th International Congress in Ethno-biology held at Lucknow in 1994. However, it is felt as a basic need to rediscuss this aspect pertaining to the context. The earliest possible ethno-botanical work in India was during the period 1637-91, a collaboration work of India and Deutsch medicine man, was published entitled '*Hortus Malabaricus*', which was a land mark in the history of Ethnobotany, worldwide. This work was rediscovered by Manilal (1965) and Nicholson and Saldhana (1976). This project is still in its lively status with its head quarter at Calicut, India. Ethnobiological work during British India was pioneered by Bodding (1940) and Hoffmann and Arthur (1950). But, Indian Ethno-botany as a scientific study, was initiated by E.K. Janakiamal (Jain and Rao 1983) who opened a separate Ethno-botanical Section at the Central Botani-

cal Laboratory, Botanical Survey of India at Allahabad in 1960. That flame of ethno-botanical knowledge lit by her, is now glowing as the science of Ethno-botany throughout India. However, the age of Ethno-botanical studies in India is only half a century old and this time period comparing to the long forward march of science is too short. Precisely, Indian Ethno-botany has crossed its infant stage; yet requires further nourishment.

Dr. S. K. Jain, the founder of the Society of Ethno-botanists (SEB) in 1982 and the founding Editor of its International Journal 'Ethno-botany', is regarded as the Olympian torch bearer of the subject (Chandra 1996). He was honoured with Harshburger Medal at Mexico International Congress of Ethno-biology (ICE) in 1992. He has conducted six International Training Courses in Ethno-botany-cum-Ethno-botanical Workshops throughout India during 1986-1994, which has equipped various thousands of workers with the knowledge of Ethno-botany. Some of his landmark publications in this field includes: *Bibliography of Ethno-botany* (1984), *A World Directory of Ethno-botanists* (1986), *Directory of Indian Folk Medicines and Ethno-botany* (1991), *Notable Plants in Ethno-medicine of India* (1991), *Cross Cultural Ethno-botany of North East India* (1996), *Ethno-biology in Human welfare* (1996), *Dictionary of Ethno-veterinary Plants* (2000) and the latest review on Ethno-botany (Jain 2001).

In course of time many workers have rendered valuable contributions in this field which is documented in different research articles from time to time. The work by N.C. shah and O.P. Viramani in 1982: *Directory of Crude Drugs and Aromatic Plant Dealers*; S.L. Kappor and R. Mitra, (1982): *Herbal Drugs in Indian Pharmaceutical Industries*; R. Mitra, (1985): *Bibliography on Pharmacognosy of Medicinal Plants* (includes 12,000 references) and V. Mitre (1989) and K.S. Saraswati (1993) on Archaeobotanical research are noteworthy. Most of the earlier Ethno-botanical literature are broadly dealt by Mudgal (1987), Rao and Hazra (1987), Manilal (1989), Chandra (1996) and presentation of selected references by Roma Mitra since 1996 as routine publication in the Journal 'Ethno-botany' are significant. Few recent ethno-botanical work, based on the traditional culture of an area needs to be highlighted (Apollo et al. 2006; Das et al. 2003; Dash and Padhy 2006, 2007; Dash et al. 1997; Mohanty et al. 1996, 1997, 1998; Padhy 1999; Padhy and Dash 2003; Padhy et al. 1997)

The annual publications of the Journal 'Ethno-botany' since 1978 have been updating the findings of various Ethno-botanical aspects. Other Journals like Journal of Asiatic Society, Journal of Bombay Natural History Society, Journal of Economic and Taxonomic Botany, Journal of Research in Indian Medicines, Man' in India, Nagarjuna, Indian Folk Lore, Indian Forester, Indian Museum Bulletin, Bulletin of Botanical Survey of India, Bulletin of Medico-Ethno-botanical Research, Bio-Vignyanam, Bulletin of Anthropological Survey of India, Journal of Human Ecology, Ancient Science of Life, Vanyajati, Phytomorphology, Studies on Ethno-Medicine, Journal of Biodiversity, Indian Journal of Traditional Knowledge etc. are some of the leading journals which take care the interest of Ethno-biology in their golden pages. Moreover, the latest review by Jain (2001) entitled "Ethno-botany in Modern India" appears more precise for a clear understanding of the subject.

It is a matter of pride that Ethno-botany / Ethno-biology is included in the University curricula; taken as an integrated subject in the Post Graduate Curriculum of Ecology and Environmental Studies, as implemented in the Indian Institute of Ecology and Environment (IIEE), New Delhi. Moreover, activities through the All India Co-ordinated Research project in Ethnobiology by Ministry of Environment and Forests, Government of India, New Delhi (Pushpangadan 1985); Organisation of the IV-international Congress on Ethno-biology at Lucknow, during November 1994 and foundation of the Institute of Ethno-biology at Lucknow (Jain 1996) elevated the status of the subject Ethno-botany to Ethno-biology at all India level. In this context, the role of Indian Ethno-botanists is much more significant to establish the subject Ethnobiology compared to others. Obviously, the various sub-disciplines mentioned earlier for Ethno-botany are also the deemed sub-disciplines of Ethno-biology at par.

MAN-ENVIRONMENT RELATIONSHIP

Human relationship with the surrounding biota is as ancient as the evolution of man and the growth of Ethno-botanical and Ethno-zoological (combining form - Ethno-Biological) knowledge has occurred in a synchronised form

with the gathering of fruits / tubers or hunting of animals for the purpose of food by the Palaeolithic man on this earth. The subject Ethnobiology is a thrust area of research which brings out Man's relationship with bio-resources, with greater emphasis on cultural, spiritual and social aspects. It is the totality of relationship between cultures and bio-resources. Of course, the cultural relationship of men and bio-resources evolve and change keeping pace with the change of space and time. Moreover, the selective exploration or protection of bio-resources by man, influence their distribution, abundance and availability; in turn the Man-Biotic interrelationship gets influenced and modified or substituted.

The interrelationship between man and surrounding biota is of two types, a) Material and b) Cultural or Spiritual. Such relationship can be further categorised into four sub-groups that is, (i) Relationships useful, both to men and biota (ii) Relationships useful to men; but harmful to biota (iii) Relationships useful to biota; but harmful to men and (iv) Relationships harmful both to men and biota (Jain 2001)

a) Material Relationships

i) The oxygen and carbon-dioxide balance of the ecosystem through photosynthesis and respiration; persuasion of agriculture and forestry for food and other needs; development of improved crop varieties and new animal races; spatial distribution of plants and animals for agriculture and commercial purpose; conservation of biota and all cultural and scientific relationships come under the first category "Useful both to men and biota".

ii) The second category, "Useful for men but harmful to biota" includes the deliberate selection of a system. Manipulation of the population for self-benefit which is exclusively due to agriculture, forestry and animal husbandry; ultimately neglects the other so-called biota irrespective of plants and animals less frequently used by man.

iii) The unusual growth of a plant or animal population and steps taken to eliminate them (to save others) by the use of herbicides, fungicides, insecticides and other chemicals, is certainly useful for a specific biota; but the bio-magnification of the chemicals and the other side effects are harmful to man.

iv) Certain activities of the environment, mostly ethno-ecological, such as causing pollution, de-forestation and shift of agriculture are harmful to both that is, men and biota.

b) Cultural / Spiritual Relationships

This is mostly presumed as useful to both men and biota, through activities like worship, protection and conservation of plants and animals; but the over religious involvement due to wrong interpretation of rituals, fanatic and religion oriented imbalanced human food habit as well, have a negative implication on a specific biotic population.

Thus any knowledge existing in an organised and/or codified form has a primary origin from common man itself. As an outcome from his diversified interrelationship with the surrounding biota, known as empirical knowledge, folk knowledge or ethnic knowledge, have passed from generation to generation through oral information or any other alternative forms. The science of Ethno-biology is committed to explore such biological knowledge restricted to the common men, may seem to be unjustified or scientifically not supported by experimental data; but is traditional and more near to human conception and reality.

In a different classification, the men-biotic relationship can be categorised into two groups on the basis of information as concrete and abstract, similar to material and cultural / spiritual, discussed previously.

Concrete Relationship (Material evidence): deals with the materials used by human beings as food, medicine, house building, agriculture, domestic use, trade and barter, fine arts, painting, carving, house decoration etc.

Abstract Relationship (based on faith and belief): includes faith, good and bad powers of plants and animals, taboos, avoidance, sacred plants and animals, their worship and folklore.

Conversely irrespective of the abstract or concrete relationship, there can be various sources of information which can be broadly divided into four types (Dash 1998); as follows:

Information with People: Folklore, taboo, weather forecast, worship symbols, faith in powers, sacred plants and animals etc.

People's Practice: Religious, agricultural, food, improvement and destruction of biota, hobbies like music, folk art and folk painting and so on.

Specific Field Survey / Study: Observation, collection of materials (Plants / animals / others) through questioner; archaeological remnants, sacred groves, exchange of views.

Study of Ancient Literature: Analysis of ancient / unnoticed and un-established old literatures; Published / unpublished; epic / myths/ legends.

TECHNIQUES IN ETHNO-BIOLOGICAL RESEARCH

The subject Ethno-botany got established as an emerging potential academic and research trend in the second half of the twentieth century, which subsequently developed to Ethno-biology at the international level and now is established as one of the thrust areas of research. It may be focussed here, the various sub-disciplines mentioned earlier for the study of Ethnobotany, are also the deemed sub-disciplines of Ethno—biology. Accordingly, Ethno-biology deals with the study of total natural and traditional relation and interrelation-ship between man and surrounding biota. The interdisciplinary nature of ethno-biology with two major sources of information for research purpose, such as Concrete (material evidences) and Abstract (based on faith and belief) has been narrated earlier. Even though, the research in this line depends on the objective irrespective of methodology, they can be broadly put into two categories, viz. (1) Field research and (2) Literary research.

i) Field Research

Field work is not only applicable to ethnobiological research, rather any faculty which works among traditional communities for observation, interaction and discussion with knowledgeable persons and collection of information and material for further reference, accept this methodology as their main approach to the system. These data may vary depending on location, objective of work, expertise of the researcher and resources like manpower, equipment, funds etc. It also includes reconnaissance surveys, prolonged stay or frequent visit to area of work, interviews, travels in the area with local resource persons, visits to agricultural fields, festivals, markets and burial ground during socio-religious occasions, etc.

All the observations should be recorded through informal discussions followed by collection of material samples, if any. As proposed by Cotton (1996), for proper recording of the data, understanding of the spiritual, social and economic background of the locality (venue of research) are necessary too. It should be kept in mind that the indigenous knowledge is never uniformly distributed among all the people in a community; rather a significant variation can be marked between different age groups, sex and micro locality. Moreover, field research also involves factors like selection of area, choice of ethnic group, time and duration of field work, composition of team, selective involvement of concerned local resource persons and handling with care of data and the material collections. Further, traditional knowledge is changeable being influenced by factors like changes in ecological, social, socio-economical, political, occupational, climatic etc. keeping pace with the space and time. Elaborated literature on field work pertained to ethno-botanical research are presented earlier (Jain 1987, 1989; Jain and Mudgal 1999).

ii) Literary Research

Study of ancient literature and mythology is a new dimension in ethno-biological research (Padhy 1998), as approved earlier (Jain and Rao 1983), which conveys the ancient scientific thoughts, encapsulated in the Sanskrit (or any other language) hymns and religious icons in symbolic terms and/or forms respectively. Attempts to study *Manusmruti* from ethno-biological point of view since 1995 (Dash 1998; Mohapatra 2003; Padhy 2000) and also exposing the science concealed within the religious icons (Padhy et al. 1996, 1999, 2001b; Panigrahy et al. 2002a,b) has provided greater scope to realise that the ancient Indian environmental and ethical education deserves a rediscovery and needs an ecological implementation in the present context (Padhy et al. 2001a). It has been pin pointed that, subjects and topics connected with our culture and tradition are not found to be studied by many ethno-biologist with due importance. In this regard, an introspective review on the Vedic plant *Soma* (Padhy et al. 2001c) is a welcome change.

Most of the previous publications concerned to literature research in India are sporadic. However, these studies are only informative and the

introspective part is neglected. As mentioned earlier, the recent review on "Ethno-botany in modern India" (Jain 2001) has broadly categorised the methods of ethno-botanical research into two: (1) Field research and (2) Literary research. Methods pertained to field research are extensively elaborated in the above cited review, while the literary research is diminished to two sentences followed only by two references. This speaks that the later line of research has suffered a fall on and needs to be properly emphasized. Hence, an attempt has been made in this article to present some of the important aspects of literary research, which are emerged out of experience during different course of investigations and have been realised to overcome the problems concerned as follows (Mohapatra 2003):

- The literature (published / unpublished) under investigation, taken as a tool, should be an authentic one.
- It is essential that the researcher must have expertise on the language of the literature concerned; lest, a befitting alternative should be followed/owned to make the discovery more lively.
- Before establishing any fact or theory out of the survey, a thorough introspective study of the views of different authors is necessary, those who have interpreted the concerned literature earlier, if any.
- If the work is a pioneer study, it suffers from lack of references and there must be proper explanation to the effect.
- The work may also suffer from non-acceptance by most Editorial Boards, the scientific communities in seminars or by most examiners / evaluators of thesis pertains to that; because of the pre-occupied biased thoughts on the facts. The author should have enough patience to overcome such hurdles and short-comings.
- The work should be retrospective in approach and introspective in vision, instead of being informative alone.
- The basic content of the ancient literature should not be super-imposed with the modern scientific thoughts; rather a positive and acceptable corroboration is necessary between the two systems through critical analysis and approach.
- At times, methods adopted in field research, such as collection of opinions from different personals, may be necessary to support the literature survey.
- The outcome of research on ethno-biological literatures should not be considered as theoretical or hypothetical in any way; because of the scientific introspection in it. This can be subjected to verify through the laboratory / field experiments, which is in conformity with a recent attempt at national level (Datta 2002).
- Moreover, literature survey emerges on facts like the mentalities of ancient people (endemic / indigenous) regarding the usage and classification of biota, inquisitiveness for exploration, cross cultural divergence, life pattern, the then environmental status and people's interaction/ reaction to it and many other aspects on ecological ethics. In this context, it may be mentioned that during the study of a particular literature, an inter-coherence between the different chapters and aspects, can not be claimed. Rather, each fact and chapter should be considered independently, may have been brought from different sources.
- Most of the findings from ancient literature study, was of an environmental situation which was existing long ago (quite different from that existing as on today), when the world was free from modern scientific achievements, over industrialisation, over population and hostile attitude of human beings towards nature (Dash and Padhy 1998a). It is essential for the researchers and readers as well, to conceive the literary knowledge keeping in view of the environmental situation and interaction of the then people towards that.

It is worthy to mention here that the modern day environmentalists of world over, have seriously started considering on the diversified aspects of the role of religion, that can; rather must play in saving the natural environment. This view published in the journal "The Ecologist" (Vol. 30(1), January 2000 by Ecosystem Ltd., London) is sufficed to pinpoint the importance of research on ancient literatures, which are mostly religious based.

STUDY OF ANCIENT LITERATURE(S): A CONSTITUTING DIMENSION IN ETHNO-BIOLOGICAL RESEARCH

Ancient noticed or un-noticed, published or unpublished literatures are the important source of ethno-biological information (Jain and Rao 1983) and their proper analysis is a prospective

research field (Padhy 1998). The idea of ancient Indian Science was first revealed by B.N. Seal (1915), the then King George fifth Professor of Philosophy in Calcutta University in his book "*The Positive Science of the Ancient Hindus*". It is interesting to note that ancient scientific studies were topics of presidential address in Indian Science Congress (Choudhury 1932; Haward 1926). The other front liners like Hora 1953; Majumdar 1927; Sircar 1950 have reflected the ancient Hindu scientific thoughts in their works. But the work of Svami Satya Prakash Sarasvati (1965) in his legendary book "*Founders of science in ancient India* (Two Volumes)" is a landmark in such studies which deals with a broad cross section of this subject. Further, the book of Ssaastri (1970), "*Science in the Vedas*" clearly depicts on mathematics, psychology, physics, chemistry, astronomy etc. and the book by Upadhyaya (1996) '*Vedon Ki Vaignyaanika Abadhaaranaa*' is specially devoted for studies in Botany and Zoology, as excepts from The Vedas.

The glimpses of plant science in ancient India is extensively reviewed by Sivaranjan (1991) in his book '*Introduction to the Principles of Plant Taxonomy*. The author has rightly claimed that the Indian knowledge on plant science was not accessible to western scientists because the subject was written in Sanskrit and further no serious attempt was made by modern scholars to highlight on this ancient Indian knowledge. Even though, these scientific concepts are hidden in the Sanskrit terminology, they are comparable with allied modern theories through proper analysis. Epics like (i) *Vrikshaayurveda* by Sarangadhara (deals with soil science, seed biology, the biology of plants, agronomy, plant protection, horticulture), (2) *Vrikshaayurveda* by Parasara, 250-120 B.C. (cell structure - cell wall: outer, inner, apparent idea of translocation and photosynthesis, classification of plants as families, morphology and anatomy of plant organs, nature and properties of soil, description and distribution of forests in the country (Padhy and Dash 2000), (3) *Brihataaranyaka Upanishad* (Anatomy of plants), (4) *Brihat Samhitaa* by Varaha Mihira, 500 A.D. (Plant diseases) (5) *Upasakra* by Sankara Mishra (Natural recuperation of plants after injury) (6) *Suddarssana Samuchaya* (Classification of soil, concept on suction force generated by root pressure, internal consciousness of plants, stages of plant growth, diseases and death), (7) *Kiranaavali* by Uddayana (Latent consciousness in plants and feeling of pleasure and pain) (8) *Charak Samhitaa* and *Sussruta Samhitaa* (Materia Medica - Medicinal literature and technique of surgical operations) (9) *Arthassaastra* by Koutilya (Qualification of agriculture officer and much more (Sen-Sarma 1997) are noteworthy in this context. Moreover, different Sanskrit terminologies used to explain various botanical aspects like habit, habitat, plant morphology, methods of propagation, ecological characters, concept on species and nomenclature etc. can be rediscovered in these epics, which support the scientific attainments of the ancient Indian seer scientists. A review of ancient literatures on plant science along with detailed Sanskrit terminology was presented already in the same context (Dash 1998). Above all, in ancient days, before the proper recognition of medicine, it was thoroughly discussed among the specialists in that field as evident from the proceedings of the seminars conducted by the sages, somewhere in the Himalayas as recorded in *Charak Samhitaa* (Padhy 2014c).

Comparatively, literatures on animal science are meagre. However, the names (about 84) of different animals, birds, cattle, serpents, fishes, insects and worms are available in Vedas, along with rich knowledge on plant world (Mac Donell and Keith 1967) which entails a wide field of research. Similarly about 150 animals are tested for their medicinal properties in Aayurveda and many of them are used for the purpose (Dutta et al. 1996; Ghosh and Maity 1996; Panday 1996; Sharma 1996; Tripathy 1953). Moreover, animals are the pioneer source informer, who enlightens the man from their natural instinct of using herbals as remedy, revealed in Vedas (Hajra 1987).

The most important thing in Hindu Mythology is that many of the animals are depicted as mount (*Vaahana*) of different Gods. The mount is specific for a deity and is nothing other than the deity itself in its animal form. The characteristics of the animals usually express or symbolise the nature of the corresponding specific aspects of the deity. In other words the mount is an expression of the God's personality (Vitasaxis 1977).

There are other binary interpretations for the mounts as the chariot of the deities like eagle, bull, horse, elephant, pigeon, owl, buffalo, (Bera 1996). Moreover, in some of the deities like

Ganesh, *Panchamukhee Hanumaan*; *Hayagreeba*, *Nrusingha*, *Varaaha*, *Matsya* and *Kachchapa*, the various *Avaataras* of *Bhagawaan* Vishnu are described as the animal heads / body associated with the icons. However, the internal theme of animal conservation through this association of the animals with deities in Hindu mythology, can not be ruled out. In this regard no serious (ethno-biological) research has been done upon the Indian popular religious pictures (Basham 1977). A pioneer attempt for the scientific analysis of a myth in *Matsyapuraana* is noteworthy (Padhy et al. 1996) in this context. Further research on ethno-biological analysis of myth to science has revealed out different facts associated with the mythological events and icons in Indian scenario. For example, the deity *Panchamukhee Hannumaan* is an empirical representation of ancient animal classification (Padhy et al. 1999); the event *Samudra Manthana* is a symbolic chronological process for re-establishment of the human ecology (Padhy et a. 2001b); the ten incarnations of *Bhagawaan* Vishnu symbolise the zoological and anthropological evolution (Panigrahy et al. 2002a) and various events of *Kaliyuga* as presented in *Kalki Puraana* support the descending ethical environment of the present age (Panigrahy et al. 2002b). The synchronised theories of Genesis and human endeavour for conservation of biodiversity at the juncture of dissolution, as reflected in epics of the east (*Manusmruti* and *Bhaagawata*) and west (Bible) proves the parallel evolution of ethnic science in two distinct ends of the world (Padhy 2006 b,c). The latest discovery in the series Myth to Science finds the possibility, that biotechnology was known to earlier civilisation of India as evident from the generation of one hundred cloned sons (*Kouravas*) from a mass of tissue as depicted in the epic Mahaabhaarata (Padhy 2015c).

Under the banner of Ethno-botany a significant attempt by Sen Sarma (1989, 1997, 2000) to bring out the plants associated with various *Puranas*, Koutilya's *Arthassaastra* and *Atri Samhitaa* are to be noted. Some sporadic studies on plants of *Raamaayana* (Balapure et at. 1987); *Rama Charit Maanas*, (Rai and Shukla 1989; Sikarwar 1993), Bible (Chandra 1995) are also encouraging. Moreover, a deep study of the original Sanskrit *Ramayana* has revealed that the *Ramasetu* was constructed using twenty one plant species along with massive rocks on a pre-existing mountainous basement. The age of the *Setu* as 17.5 Lakhs of years estimated by NASA, is in conformity with the Indian ethnic time unit calculation, that is, *Yuga* (Padhy and Dash 2008). Chandra in his review (1996) has discussed about a very authoritative publication - *Plants of the Quran*, brought out by Dr. M.I.H. Farooqi. In this context, the work on Vedic *Soma* plant demands special attention (Dash and Padhy 1997a, 1998b; Hillebrandt 1980; Kocher 1996; Mahdi Hassan 1963; Padhy 2004; Padhy and Dash 2002, 2004; Schultes and Holfmann 1979; Wasson 1969) and a review by Padhy et al. 2001c on the topic is more informative and introspective. It is a matter of pride, that the German translation version of a paper on *Soma* by Padhy and Dash (2004), by Edzard Klapp (edzard.klapp@gmx.de), is placed in the German Virtual museum about *Amanita muscaria* (Dash and Padhy 1997a) made by Mr. Niels Hallerbery at Gelsenkirchen. This adds to the extra interest of western people, for the culture and ethno-biology of the east.

In the past two-decade substantial work has been done to explore the ancient science of India in the epic *Manusmruti* (Dash 1998; Mohapatra 2003). Manu was the pioneer to predict the concept of creation, dissolution, geological time period and origin of life in the water medium of the earth (Mohapatro et al. 2001c,d,e). His biological classification is at par with the modern plant and animal classification (Dash and Padhy 1997b; Padhy et al. 2006a). Aspects of environmental factors, ecological food chain, ecological indicators, conservation philosophy of the biodiversity and system of binomial nomenclature are unique presentations in the epic (Dash and Padhy 1998a,c,d; Mohapatra et al. 2001b; Padhy and Dash 2000; Padhy et al. 1997 a,b). The environmental laws were projected for the first time in *Manusmruti* thousands of years ago, that speaks the consciousness of ancient Indians about the science of ecology (Padhy 2000, 2006d; Padhy et al. 1998, 2001a, 2006b). The eugenic concept of Indian *Varna* division as reflected in the compendium finds a place in the modern genetic research at the international level (Bamshad et al. 1996, 1998; Dash and Padhy 1998 e; Mohapatro et al. 2001a; Padhy 2001, 2010).

Manusmruti has prescribed to perform five sacrifices (*Pancha Yajnya*) as a part of routine activity in daily life of a house-holder. These

five sacrifices elaborate one's socio-ecological responsibilities are such as: (1) *Rrushi Yajnya* - (sacrifices for the source of knowledge - teachers), (2) *Pitru Yajnya* (responsibility for the parents, ancestors and self-genetic system), (3) *Deva Yajnya* (protection for the environmental powers as Gods), (4) *Bhoota Yajnya* (care for the protection of biodiversity) and (5) *Nrru Yajnya* (Positive interaction with fellow human beings of the society). Men should be committed to show obligation to the above environmental constituents as their ethical and ecological responsibilities. The analysis of the scientific basis behind the religious events of *Pancha Yajnya*, proves its aim to raise eco-consciousness amongst the human environment. These five sacrifices amounts to be as the highest ethno--ecological philosophy of the world, originated in the Vedic age and still practised today in the Indian social scenario being modified in different turns and tunes. In course of time the philosophy of *Pancha Yajnya* slowly entered into the daily rituals like *Tarpana* (ceremonial offering of water to all concerned), *Bisswadeva Puja* (offering of food) and worshiping of iconic representatives, popularly known as *Pancha Devataa* (Five God powers) of a householder to reiterate his ecological responsibility. The integration of the Vedic age *Pancha Yajnya* philosophy is elaborated in Gita says that: one should work with selfless motive for sacrifice. In the present scenario the theme of *Pancha Yajnya* has turned to a community activity and celebration instead of an individual commitment. Since the origin of the philosophy of *Pancha Yajnya*, in course of thousands of years may have undergone metamorphosis, yet its basic concept remains unaltered and unmutilated, readily acceptable for the present society, amenable worldwide, to raise up eco-consciousness in the human environment. Moreover, a *Yogi* offers his five sacrifices through the practice of Yogo being indifferent and unattached. He honours his environmental responsibility through Yogic achievements (Padhy 2008a-e, 2009, 2011). More to add here, that the negative vibrations generated form the human mind causes thought pollution, which works in obscurity in the ethnic - environment as a great factor (Padhy 2006a) and Yoga contradicts it.

Bhagavad Gita, the holy epic of India spreads knowledge for all concern. Every culture finds nurturing words for its own philosophy in Gita. Srikrishna reveals the secrets of the universal environment based on the awesome nature of the cosmos; the age of the universe - its creation and destruction; as well has fixed the evolution of the biological world since four *Manvantaras* (1045877115 earthly years upto now). Aspects of ecology which are amenable with modern science such as: Ecological Factors, Flow of energy in Ecosystem, Nature's Hydrological Cycle, Ecological Niche and Socio-Ecological Pyramids are discussed in this epic. The practical realization and perception of one imperishable divine existence as undivided and equally present in all individual beings is the only means for the conservation of the biodiversity. The description of the divine personality as *"He has endowed with numerous arms, hands, thighs and feet on all sides; many bellies and heads in all directions with innumerable mouths, teeth, eyes and ears all round, extended in countless forms pervading everywhere"*, stands as the most appropriate representation for the global biosphere as a single unit as per modern ecological science. It is rightly presented *"He is undivided and yet seems to be divided in beings"*, focuses on the whole world as a single giant ecosystem.

Nature and its inhabitants should live together with reciprocity, which has been the prime principle since the beginning of creation as Gita says. The mankind should protect the environment (the *Devataa* factor) with the spirit of *Yajnya* (Sacrifice), from where he gets all sorts of unasked gifts for livelihood. The *Prakruti* (Nature) consists of three essential metaphysical constituents called *Gunas* (quality) named *Sattva, Raajas* and *Taamas* (yet to be accepted by modern science). The existence of *Prakruti* can not be realized in the absence of *Gunas*, as fire without heat. The diversity of the *Prakruti* is a resultant product of interaction between *Gunas*.

The Gita has identified twenty biological character present in diversified form in living beings such as: intellect, wisdom, non-illusion, forgiveness, truth, self- restraint, calmness, happiness, pain, birth, death, fear, fearlessness, non-injury, equanimity, contentment, austerity, charity, fame and obloquy. The seventy-two manifestations of the nature (divine) reflected in Chapter Ten, when arranged systematically can be grouped into nine divisions: 1. Basic theme of life, 2. Sustenance of life, 3. Ecological factors, 4. Prolification of biodiversity, 5. Expansion of hu-

man characters, 6. The source of knowledge, 7. The capitalized sources of knowledge, 8. Specialized divine factors of the nature and 9. The time factor that encapsulates everything. The chronology of the above divisions represents the Biological and Anthropological evolution in course of time. The nature is the glory of the divinity. The abiotic and biotic manifestations once declared 5114 years ago by Srikrishna (Chapter Ten) as pure, prosperous and powerful are now deteriorated to a great extent. The Gita says: "Let the human community protect the environment for their own survival and the biodiversity around" (Padhy 2013a,b,c, 2014a,b, 2015a,b).

In addition to its rich culture, India has many ancient Sanskrit epics in the form of ***Veda*** (*Samhitas, Braahmanas, Aaranyakas, Upanishadas*), ***Upaveda*** (*Aayurveda, Arthaveda, Gaandharva Veda, Dhanurveda*), ***Vedaanga*** (*Ssikshaa, Chhaanda, Vyaakarana, Nirukta, Jyotisha, Kalpa*), ***Upaanga*** (*Nyaaya, Vaisesika, Saamkhya Yoga, Mimaansaa, Vedaanta*) ***Smruti*** (50 ethical law books), ***Tantra*** and ***Puraana*** which are enriched with ancient ethnic science, needs proper exploration. The culture of the society, man's aptitude for knowledge, attitude towards the environment and biodiversity and exploration of nature changes from time to time. The proverb, "History repeats" has suggested a different name for time - *Kaalachakra* (cyclic movement of time). There is no doubt that time passes in a unidirectional flow. There is no end for the ethno--biological investigations, till the existence of human ecology on this earth. The research in ethno-biology will certainly bring back the ancient thoughts in human mind, and there will be a new adventure based on the modified form of the earlier knowledge coupled with the progress of modern science.

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