VISION ON BIORESOURCE RECOGNITION AND BIORESOURCE MANAGEMENT: BANGLADESH PERSPECTIVES

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INTRODUCTION

According to the need of time or for the sake of ourselves, we motivate ourselves towards urbanization due to demand for upgrading life; change ourselves in the name of social development; suite ourselves to adapt for survival in nature. Unfortunately, it is obvious that we deliver our efforts till our last limits to get a better life. But, we forget our nature to where we survive, our environment in which we breath, our biodiversity to which we belong as a part.

Plants and animals in combination constitute the bioresource. All components of a bioresource are the derivatives of the plants and animals. It means that the principal ethos of the bioresources is the interactive mass of byproducts of the flora and fauna in a certain ecosystem. Maintenance and safeguarding of the interactions between plants and animals or among the organisms through functional characterization is the bioresource management (Bashar 2004). “If we want to know animals we should go to plants and if we like to know plants we should go animals (especially insects)” (Feeny 1976). In the era of Feeny, conception on biodiversity and recognition of bioresources were in ambiguous intellectual forays by saying that intellectual forays into the field of ‘bioresources and bioresource management’ resemble the explorations of an amoeba which extends pseudopodia in many directions simultaneously, follows some, retracts others, seemingly does not know where to it is going, but nevertheless makes progress (Dethier 1986). But at the present time (since the World Summit of 1992 at Rio de Jenairo), the concept of the above subjects (viz. biodiversity, bioresources, bioresource management) came into a clear cut shape within a frame of definition.

Conservation of biodiversity needs to understand how we can go for defining biodiversity, bioresources, recognition of bioresources, use of bioresources and bioresource management. And in doing so, we seriously need practice to establishing some spokesman for the subject of bioresources and their management. Through this spokesman dissemination of knowledge in the field is to be maintained.

Requirements of bioresource recognition and its uses are very important and vital, but at the same time preparation of a manuscript for the subject is critical for a researcher in the line. It requires a standard journal or spokesman as a carrying media in written form. Maintenance of a standard journal in the line, we should have gone through identification of forays of techniques to be followed and materialized.

BIORESOURCE DEFINITION AND AREAS

There are many definitions of bioresources. Different authors working in this line have defined the term bioresource, but they could not go beyond their professional biasness. There are evidences of professional biasness in their defined statements.

Biological resources are life generated materials and processes which are naturally and sustainably renewable and biodegradable (Knowledge-Based Bio-Economy, KBBE). As such, biological resources fulfill man's essential, fundamental needs: food, feed, bioactive molecules, fuel, shelter, fiber, bio-remediation etc. They play a key role in present and future socio-economic evolutions. Bioresources are raw materials, such as minerals, biomass and biological resources; environmental media, such as air, water and soil; flow resources, such as wind, geothermal, tidal and solar energy; and space as land area. Natural resources consist of "the materials stores that can be found in their natural environment which are both rare and economically useful either at a raw state or after a minimum transformation" (World Trade Report 2010). Bioresources are defined as biological samples with associated data (medical/epidemiological, social), and databases independent of physical samples, and other bio-molecular and bioinformatics research tools.

Biological resources include agriculture, forestry, and biologically-derived waste, and there are many other renewable bioresource examples. One of the scientific terms used to denote renewable bioresources is lignocellulose. Lignocellulosic tissues are biologically-derived natural resources containing some of the main constituents of the natural world. 1) Holocellulose is the carbohydrate fraction of lignocellulose that includes cellulose, a common building block made of sugar (glucose) that is the most abundant biopolymer, as well as hemicelluloses. 2) Lignin is the second most abundant biopolymer. Cellulose and lignin are two of the primary natural polymers used by plants to store energy as well as to give strength, as is the case in woody plant tissues. Other energy storage chemicals in plants include oils, waxes, fats etc., and because these other plant compounds have distinct properties, they offer potential for a host of different bioproducts. CBD specifies "the genetic resources are organisms or parts of them, populations or any other biotic element of ecosystems having an effective or potential use or value for mankind" (CBD 1992). The EC communication « Roadmap to a resource efficient Europe » defines natural resources as « raw materials, energy, water, air, land and soil, biodiversity, stable climate and ecosystem services ». For WTO, natural resources consist of "the materials stores that can be found in their natural environment which are both rare and economically useful either at a raw state or after a minimum transformation" (World Trade Report 2010).

TERMS USED IN BIORESOURCES

To bring bioresources into its application, management, dissemination and materialization it needs some terms to be used properly and appropriately. These terms are: ***Bioresource engineering***; ***Biocapacity***; ***Carrying capacity***; ***Ecosystem***; ***Ecological footprint***; ***Ecological deficit*****;** ***Ecological reserve***; ***Ecosystem services***; ***Natural Capital***; ***Resilience and Sustainability.***

Bioresource engineering

Bioresource Engineering is an interdisciplinary program that integrates engineering, design and biological sciences. It is a unique profession that applies engineering principles to the enhancement and sustainability of the world's natural resources. Bioresource Engineers seek solutions to the problems that involve plants, animals and the environment. Bioresource engineering is similar to biological engineering, except that it is based on biological and/or agricultural feedstocks. Bioresource engineering is more general and encompasses a wider range of technologies and various elements, such as biomass, biological waste treatment, bioenergy, biotransfromations and bioresource systems analysis, and technologies associated with thermochemical conversion technologies, such as combustion, pyrolysis, gasification, catalysis, etc. Bioresource engineering also contains biochemical conversion technologies, such as aerobic methods, anaerobic digestion, microbial growth processes, enzymatic methods, and composting. Products include fibre, fuels, feedstocks, fertilisers, building materials, polymers and other industrial products, and management products, e.g. modelling, systems analysis, decisions, and support systems.

Biocapacity (Biological capacity)

Biocapacity is the capacity of ecosystems to produce useful biological materials and to absorb waste materials generated by humans, using current management schemes and extraction technologies. The capacity of a given territory reflects its specific natural potential in terms of available resources under given management skills, expressed in hectares per capita. Degradation of biocapacity generates high level of social and environmental vulnerability (also see carrying capacity and resilience) (WWF Living Planet Report 2010).

Carrying capacity

Carrying capacity is the capacity of a biological species in a given environment; it is the maximum population size of this species that the environment can sustain indefinitely, giving food, habitat, water and other necessities available. If the population size of the species is over its carrying capacity, the environment will be degraded more or less quickly and consequently, it will not sustain the population which in turn will decrease and tend to go for extinction until the environment retains to bioresources. Moreover, if the environment itself has its resources decreasing in reason of an abiotic cause (viz. cyclone, earthquake, Tsunami etc.), the carrying capacity of the population will also decrease accordingly.

Ecosystem

It is a system or phenomenon of interaction between abiotic and biotic factors in a certain area of the biosphere. The biosphere may be divided into smaller ecological units each of which is termed as an ecosystem. This is a term first used by Tansley in 1935 to describe a natural unit that consists living and non-living parts, interacting to form a stable system. The ecosystem may then defined as a unit of the biosphere consisting of organisms and their physical and chemical environment tuned in a machine-like organization and driven by an external energy source, the solar radiations. So long as the system receives energy, it is self-sustaining. Fundamental concepts include the flow of energy via food chains and food webs and the cycling of nutrient biogeochemically. Ecosystem principles can be applied at all scales — thus the principles may be applied equally to a lake or an ocean, or the whole planet when these will be considered as ecosystem locally or globally (Bashar 2013).

Ecological footprint

Ecological footprint is a measure of how much biologically productive land and water an individual, population or activity requires to produce all the resources it consumes and to absorb the waste it generates using prevailing technology and resource management practices. Today humanity uses the equivalent of 1.5 planets to provide the resources we use and absorb our waste.

Ecological deficit

It is the difference between the biocapacity and ecological footprint of a region or country. An ecological deficit occurs when the footprint of a population exceeds the biocapacity of the area available to that population.

Ecological reserve

An ecological reserve exists when the biocapacity of a region exceeds its population's footprint. Also, similar terms may be considered as biodiversity buffer/ecosystem buffer; these indicate the amount of biocapacity set aside to maintain representative ecosystem types and viable populations of species (related to resilience of ecosystems).

Ecosystem services (Life support systems)

Ecosystem services are the services from which the people obtain benefits from ecosystems. Resources and processes are supplied by natural ecosystems (including clean drinking water, decomposition of waste). Ecosystem services are divided into 4 types: *provisioning*, such as the production of food and water; *regulating*, such as the control of climate and disease; *supporting*, such as nutrient cycles and crop pollination; and *cultural*, such as spiritual and recreational benefits. Some of the services provided by ecosystems include the components used in fabricating food, clothing, medicine, and energy production. Recreation and passive ecosystem services are significant as well. These include fishing, hunting, hiking, birding, camping, water filtration/purification, climate moderation, flood mitigation, erosion prevention, and pest management.

Natural Capital

Natural capital is a stock of natural ecosystems yielding a flow of valuable ecosystem goods or services into the future; the key is the function of the whole system.

Resilience

The return time to the equilibrium or carrying capacity level in a perturbed system; the shorter the return time, the more stable is the system (Pimm 1977).

Sustainability

Sustainability implies the use of (bio) resources at the rates that do not exceed the capacity of the Earth to replace them. In other words, maintaining ecosystem services and biodiversity while feeding the world implies limiting the deleterious impacts of conventional agriculture through the proper and intensive use of the natural functions and services the ecosystems provide. This is called sustainable intensification, i.e. "producing more food from the same area of land while reducing the environmental impacts" (21st Century Vision and Action Plan for the Ecological Society of America, Godfray *et al*. 2010, Griffon 2006, Palmer *et al.* 2004, Koshel and McAllister 2008, Sciences 2004).

BIORESOURCE CATEGORIES

Conventional bioproducts and emerging bioproducts are two broad categories. The examples of conventional bio-based products include building materials, pulp and paper, and forest products; whereas the examples of emerging bioproducts or biobased products include biofuels, bioenergy, starch-based and cellulose-based ethanol, bio-based adhesives, biochemicals, bioplastics, etc. the emerging bioproducts are active subjects of research and development, and these efforts have developed significantly since the turn of the 20/21st century, in part driven by the price of traditional petroleum-based products, by the environmental impact of petroleum use, and by an interest in many countries to become independent from foreign sources of oil. The bioproducts derived from bioresources can replace much of the fuels, chemicals, plastics etc. that are currently derived from petroleum.
Bioresources are the nonfossil biogenic resources which can be used by humans for multiple purposes, for instance to produce food, substantial products, and/or energy carriers. Scientists have categorized bioresources into following categories (BioResource Innovation):

Primary bioresources

Primary bioresources are generated for a specific application-oriented purpose in forestry, agri- or aquaculture to enable the production of food, substantial products, or eventually energy. Examples are *wood, grain, potato, bamboo, algae.* The virgin primary bioresources are grown plants or animals mainly. To virgin primary bioresources count the whole harvested nonprocessed plant or the slaughtered animal. Processed primary bioresources are the removed most value-added parts of the virgin primary bioresource needed to produce the "core product". For example: *spruce tree → stemwood → pulp for paper.*

Secondary bioresources

Secondary bioresources may be generated during primary processing, in further industrial processing as by-products or residues, but also during maintenance of large green areas. Typical characteristics are as follows: they accrue genuine from virgin materials; they contain mainly a low amount of impurities; and they are produced in large quantities. As processing outcomes they consist of parts from the primary bioresource. Mechanical, but also biological, chemical, or physical processes could be used for separations. As maintenance residues they are harvested on large green areas, such as parks, lawns, sport places, and dikes as genuine fractions in significant amounts under controlled conditions in ample quality in terms of purity and freshness.

Tertiary bioresources

Tertiary bioresources are also parts from virgin materials, which were separated along the processing chain. But, compared to secondary bioresources they are residues which occur rather in small amounts at the generation place. Also uncontrolled modifications, e.g. degradation during storage, may have taken place. They have generally a lower value than secondary bioresources. Examples may be taken from “waste algae mixed with refuse from coastal clearing” as: 1. In large-scale processing during harvesting, post-harvesting, primary processing, and storage activities; during industrial processing, packaging, and distribution up to the retail sector. 2. At consumer level in small commerce (e.g., restaurants, canteens), and in private kitchens at household level. Especially in this category it is important to distinguish between avoidable and not avoidable fractions. 3. In maintenance of green areas, such as gardens, other green areas, and special installations with vegetation. The plant residues are not genuine and/or often partly degraded before they arrive in a utilization facility.

Quaternary bioresources

Quaternary bioresources occur after a product is used. They can be distinguished regarding the time frames of their generation after the start of utilization into short-, mid-, and long-term categories. In short-term after the begin of product use they are generated in all cases of food and feed consumption in the form of human feces and urine, and as animal excrements. Such bioresources are generated with short delay after food or feed consumption at a time scale of hours. With a mid-term delay the quaternary bioresources appear in days to months after the begin of utilization. For example, packaging materials are only in use for the period of transport, newsprints for one time readings. The time frame for the long-term after use group can reach from years to centuries. For example, wood construction materials, integrated in houses may last decades to centuries until they become waste wood. Materials used for furniture construction commonly have a life-time ranging from years to decades.

BIORESOURCE QUALITY RESEARCH

Quality research

In the present days it stands essential to identify bioresource and to quantify bioresource. These processes are necessary both for the stakeholders of bioresource and for bioresource researchers. Researchers on bioresources, bioresource-trading policy-makers and bioresource stakeholder’s involvement should come together to prepare sophisticated framework for bioresource research impact factor. The researchers should work in a form of group to publishing a “research spokesman” to go for assessing bioresources and their management. And that should be a proper journal or strong bulletin which will bear documents of the results of researchers in various frontiers of bioresources, bioresource conservation and bioresources management.

Requirements of bioresource uses and recognition are vital. At the same time preparation of a research manuscript by a researcher for publishing in a standard journal stands essential. On the other hand, through such a journal on bioresources, bioresource researchers will be able to exercise their access to share the bioresource ideas and uses. In this regard, some vital points are to be considered as: *Bioresource research impact factors*; *bioresource recognition*; *bioresource uses and sharing*; *bioresource stake-holders and bioresource management*.

Bioresource research impact factors

In analyzing bioresource recognition, we need to analyze first what is meant by the 'Bioresource Research Impact Factor (BRIF)'. The idea of the concept of the BRIF was first initiated by Cambon-Thomsen (2003). His ideas were modified and developed by his works in 2004 under the heading of "The social and ethical issues of post-genomic human biobanks; and also under the heading of "The role of a bioresource research impact factor as an incentive to share human bioresources" by Cambon-Thomsen *et al.* (2011). In the modifications and developments, the BRIF initiative was set up to construct an adequate framework and provide a set of tools that will allow an objective measure of the actual research utilization of bioresources as a significant component for establishing their reliability and sustainability. An international working group was established to develop the BRIF, consisting of 134 members from 22 countries, most of them are European (86), North-American (31) and the rest from other countries. This group was further divided into five relevant thematic sub-groups: i) the BRIF and digital identifiers, ii) the BRIF parameters, iii) the BRIF in sharing policies, iv) the BRIF and journal editors and v) the BRIF dissemination. The working group completed some workshops out of which, two might be reported below as: (a) Constructing a quantitative tool to evaluate the impact of a bioresource on research; and (b) Stakeholders in bioresources sharing.

(a) Constructing a quantitative tool to evaluate the impact of a bioresource on research: According to the suggestion of Garfield (2006), the BRIF would be modeled, to some degree, on the Journal Impact Factor (JIF), and would provide guidance and methodology for optimizing recognition of bioresources, their use and their sharing at an international level. Such a tool could be used much more systematically than "reputation" for evaluating the activity of a bioresource over time. When taken into account in assessing 'researchers/contributors' scientific contribution, this should increase the use and sharing of bioresources, wherein a virtuous circle would occur: the highest is the quality, the most frequent will be the solicitations; the more one shares, the more one's impact increases, and the more one is inclined to share. Although this concept can be valid for any kind of bioresource, we focus first on bioresources of human origin.

(b) Stake-holders in bioresources sharing: The BRIF aims to be a quantitative indicator filling a gap in the complex environment of scientific production assessment. Its implementation thus depends on its ability to meet the requirements of multiple stakeholders and to integrate with an already existing system of practices and parameters. The BRIF could effectively enable traceability, thus being useful for all actors involved in the complex world of bioresources, from the initial collector(s) or initiator(s) to the scientific primary or secondary user(s) on the one hand; to funding bodies, the general public, scientific readers, industry and editors on the other hand. Stakeholders would benefit from the BRIF through the recognition it will generate or through the information it will offer about the bioresource, its use and the research results based on it.

The above authors (Cambon-Thomsen 2003; Cambon-Thomsen *et al.* 2011; Garfield 2006) together with other initiators in the line of bioresource researches concluded on the essentiality of quantifying the use of bioresources for promoting their sharing in scientific research. They highlighted the perspectives on '*current endeavours for practical development and implementation of BRIF*' as stated as follows:

"To allow bioresource recognition to become rapidly entrenched in everyday research practices, it is essential to test the feasibility of the various aspects of the BRIF through several small-sized pilot studies each focusing on specific issues, such as the citation modalities, especially exploring the feasibility of a specific field for bioresources in electronic submission systems, the identifier entity, the authors compliance. This is being initiated with the help of volunteer consortiums and being open to external proposals. The international outreach of the initiative is presently limited as an unbalanced geopolitical representation that has been mobilized so far in the BRIF working group. A dissemination and open access policy to the participation in this initiative is thus necessary and this paper aims to encourage this. Better geographical representation, contact with other networks and initiatives that could produce synergetic actions, and solicitation of international journal editors committees and institutional scientific evaluation boards involved in producing incentives and guidance towards researchers and authors may each contribute to better tailor the BRIF tool as required. Once a solid framework for bioresource research impact has been secured, the next step will be the actual production of a set of metrics and software to mine articles and bioresource information metadata in order to test which ones are best performing. More sophisticated factors would consider some measurements of bioresource quality and value, including origin of samples and their rareness that could also be further devised and integrated into the indexing system. To address the need to incentivize the development, maintenance and sharing of bioresources, a set of principles, tools and guidelines is required. We conceptualized and formalized a framework for bioresources management, use and referencing on which the medical and scientific community could rely for their research practice. It can draw on technologies already in use for tracking and evaluation of impact in other science referencing areas. This article provides the foundations for the creation of the BRIF as an adequate instrument. It hopes to trigger discussion among relevant stakeholders and incite the scientific community to embark in this endeavour."

BIORESOURCE RECOGNITION: BANGLADESH PERSPECTIVE

Though there are arguments on the definition of bioresource, but the resources that take their origin biologically are known as bioresources; and they are renewable resources. These resources are inexhaustible and at the same time, they are environmentally sound in utilization for humans. When an area of the biosphere (politically known as a "state") is rich in species biodiversity and has many suitable ecological conditions for biodiversity sustenance, then this area becomes rich in bioresources. Sound volume and high significant biomass production are found in such unit area. Bangladesh is one of such best places in the world. And Bangladesh bioresources have distinct characteristics because the three components of biodiversity are very strongly interlinked in the country. These components are ecosystem biodiversity, species biodiversity and genetic biodiversity. Ecosystem biodiversity is functional and fruitful both in aquatic and terrestrial conditions. In terrestrial conditions, every season of the six seasons of the country of the year has got its respective biomass, produces its own identity and provides new supply of vegetables, fruits, consumable crops and cash-crops. This is unique in the history of the world. In aquatic ecological conditions, we have marine ecosystem, riverine ecosystem, Haor-baor ecosystem, estuarine ecosystem, wetland ecosystem and mangrove ecosystem. In all the ecosystems, not only fish populations are highly diversified but all other aquatic animals both vertebrates and invertebrates are providing adequate biomass. Genetic biodiversity is very characteristic having two sides of features: firstly species richness is very high; secondly population per species is very small. These two characters of species diversity are contradictory but highly optimistic in one sense and pessimistic in other sense. We have many species which are producing bioresources, but because of a few number of individuals per species it risks that if these individuals per species become extinct we shall have to lose the bioresource diversity through the extinction of that species. On the other hand, from now on if we can take care with high attention to increase the population of the species with low density that are at risk stage, we shall have the optimum possibilities of having a good supply of bioresources.

Genetic resources are very rich in Bangladesh and it goes without saying that this is because of having high genetical variations in our country. The varied genetic resources are existed in wild and domesticated species both for the flora and fauna. Examples are many; in animals, tigers, deer, wild boar, fishes (both marine and freshwater), birds, reptiles and amphibians, bees, earthworms, echinoderms, butterflies, prawns and shrimps, various molluscs and corals. In many cases, these genetic resources are thought to be sensitive to extinction. Anthropogenic activities and negative pressures are very significant agents for the depletion and destruction of our genetic resources. Very recently such happening occurred in the Sundarbans, but very little attention had been given to the fact by the authorities. There are several examples of bioresource-recognition, uses and bioresource management. In Bangladesh perspective, the Sundarbans-ecosystem itself is the best example of the statement. It means that the Sundarban maintains all the above three aspects (bioresource-recognition, uses and management) together. The analysis on the fact could be made by putting an explanation of some interactivenesses of biotic-biotic factors in the mangrove ecosystem as stated below.

Honey bee-plant interactions: a case study

In the Sundarbans ecosystem, honey and wax production is a major seasonal activity. About 2000 honey collectors locally known as ‘mawallis’, are engaged in collecting about 200 tones of honey and about 50 tones of bee wax annually which constitute about 50% of the total honey and bee wax production in Bangladesh. As far as available information is concerned, there is no country in the world which has got 50% of its national honey production coming from a single natural resource system. Apiculture or colonization of bees by man provides honey production in other countries of the world. But only Bangladesh has got the natural privilege and mangrove ecosystem’s gift in different status.

It is to be remembered that biodiversity comprises of three components like species diversity, genetic diversity and ecosystem diversity. The first two components (species and genetic diversities) interact with each other. This means that interrelationships between biotic and biotic factors enhance and establish these relations (i.e. interaction between genetic diversity and species diversity) in nature. This interaction in connection with ecosystem diversity makes a structural formation of biodiversity. And that is why healthiness of biodiversity in an area is a prerequisite for establishing environmental balance in the natural system.

In the Sundarbans mangrove ecosystem, it is found that about 35 wild and forest plant species are related with honey bees' activities. Out of the 35 plant species, 9 to 11 plants and their reproductive stages (flowering stages) are associated with honey production periodicity (the seasonality of honey collection), forest-plant gene-flow functionality, sustenance of forest healthiness, maintenance of general equilibrium position (GEP) of bee population in the forest, maintenance of bee progeny system (in in-situ condition) and finally the maintenance of bee-caste system. These facts are externalities of the interactions and depend on the synchronization of coincidences between the phenological stages of the related plants and the life stages (especially different castes) of the honey bees. This coincidence occurs during the time-period of the reproductive stages of the related plants. It needs to be examined what is going on in the Sundarbans mangrove ecosystem regarding the question of reproductive stages (flowering) of the plants and the normal activities of the bees in the ecosystem. It is to be realized now "how gene-flow in the plant population of a forest like the Sundarbans is hampered by anthropogenic activities which causes depletion of biodiversity as whole in the ecosystem".

In the Sundarbans, the closely related plants with the so called 'honey-collection' by 'mawallis' during the time period from April to June in the year are very much important regarding the appearance of flowers on them. These plants are khulshi (*Aegiceras cornuculatum*), baen (*Avicennia officinalis*), kankra (*Bruguiera gymnorrhiza*), goran (*Ceriops decandra*), gewa (*Excoecaria agallocha*), jhana/garzon (*Rhizophora mucronata*), keora (*Sonneratia apetala* and *S. acida*), passur (*Xylocarpus mekongenesis*) and hargoza (*Acanthus ilicifolius*). In addition to these, many other plants are also related but their flowering periods are not synchronizing associated with the temporal facts of time and honey collection in the ecosystem. Of the major plants, khulshi flowering period continues for the period of March-April; baen flowers remain functional for the period from May to June; kankra gives lower during the month of April; goran flowering continues from the month of April to the end of May; jhana/garzan is provided with appearance of flowers for the period of March and April; keora species gives flower at the end of April and continues up to the end of May; passur flowering lasts during the months of March and April; and hargoza maintains flowering for the duration of the months of May and June. In the plant kingdom (especially for the case of flowering plants), flowering period is the most vital time for successful gene-flow, for population maintenance, for successful fruitification, and for healthiness of the ecosystem where they are living or/and propagating their generations. These functionalities in the plants are dependent (especially in the forest ecosystem) on the animals' life cycle and are associated with synchronization of coincidences between the 'flowering' of the plants and the 'life stages' of the animals concerned, especially with bees in majority cases. What marvelous fact of nature's playing is prevailing in the Sundarbans ecosystem has to be dealt with.

In the traditional system of honey collection, it is clearly reported by the forest department that, the honey from the Sundarbans is collected for a period of two months of the year commencing usually in April. The honey collectors have to collect the honey during the daylight hours and as such are subject to strong colony defense. Honey collectors are also the victims of many other unusual situations like tiger attacks. In combination of all these, the techniques of collecting honey are faulty and rudimentary for the honey collectors. But for the honey bees the techniques are brutal and for the forest and mangrove ecosystem the techniques are devastating both in micro and macro-levels (for plants' gene-flow and plant population sustenance). All the bee colonies that are encountered by the mawallis are harvested without knowing whether honey is ripe or not. The bee colonies are often destroyed brutally during the collecting process. Collection of honey from the wild honey bee colonies of '*Apis dorsata*' is a unique process in the world. '*A. dorsata'* build a single large and unique comb in an open place on the branches of a large tree. This type of comb preparation and honey building process is highly coincidental between the appearance of reproductive stage (flowering period) of some plants species (as stated above) and the progeny maintenance capacity of honey bee (*A. dorsata*). This is a naturally sustained unique process responsible for maintaining large mangrove forest ecosystem in the world. The natural-sustain system is being practiced naturally for the mechanization of plant gene-flow. The gene-flow mechanization is carried out by bees as the pollens of the above mentioned plants are entomophilous means the pollination of the plants is by means of insects and mainly by wild bees. It is to be seriously considered that the major plants, those are responsible for providing nectars for preparing honey by the bees are with flowering stage during the months from April to June. On the other hand, the wild bees are dependent on the pollens and nectars for the maintenance of their progeny and the strong wilderness. This type of unique forest ecosystem is a suitable natural process for the maintenance of the forest's healthiness. If the honey collection takes place in the immature stage of the honey comb and the maintenance of caste system in honey bees is destroyed so brutally, the healthiness of the plants in the forest definitely stands vulnerable because the floral reproductive activities remained under unusual passage. Obviously, the plants in the forest will be at risk of having attacked by various diseases easily. Ultimately forest status will be threatened and declined continuously.

Very recently the UN officials expressed alarm at a huge decline in bee colonies under multiple constraints. International efforts have been urged to save the pollinators that are vital both for cultivated and wild plants. The UN environmental agency has pointed out that besides all other causes, the loss of flowering plants stands vital reason of bee population decline. One of the UNEP executives said that "The way humanity manages or mismanages its nature-based assets, including pollinators, will in part define our collective future in the 21st century". In spite of the wild plant populations, "The fact is that of the 100 crop species that provide 90 per cent of the world's food, over 70 are pollinated by the bees". Honey bee colony declines in the recent years reached up to 85% in some of the areas of the world, and that is very alarming. This is an overall situation of the world, but the situation in the Sundarbans ecosystem is rather more serious as because not only the question of honey production and bee population is concerned, but the whole ecosystem is interlocked with the fact of gene-flow in plant kingdom and the status of successive trophic levels (animal populations and their status) in the forest ecology.

Improper and unscientific collection of honey in the Sundarbans causes desynchronization of coincidences between reproductive stages of major plants (those that give flower in the period from March to June) and the vital life stages of the honey bees (the key agent for maintaining 'general equilibrium position–GEP' in the plant population). The question is that maintenance of the bee population's GEP is the natural security of the sustenance of reproductive stages of the forest-plants. If the plant population is hampered, there will be a big gap in the synchronization of trophic supply to the all animals living in the forest. Because, presence of high species composition in an ecosystem is interacted with abiotic factors over there; and the combined situation makes there a suitable environmental conditions for sustenance of animal populations. This situation provides the best habitat for biodiversity as a whole. It is to be noted that the large animals are very poor to maintain the secret activities and functionings of the forest ecosystem at atomic and molecular levels, but the smaller animals like insects can do this. These smaller insects must not be touched and must not be denormalized. Their life stage-synchronization is very much related with the protection of the plant population in the ecosystem at molecular level. If once the synchronization is broken up, the entire ecosystem will stand scattered and unstable. Consequences will be must for the question of biodiversity loss; and this is the main situation prevailing in the Sundarbans mangrove ecosystem for the cause of improper and immature honey collection in the largest mangrove forest in the world.

A large colony of *Apis dorsata* with a tall mangrove tree in the Sundarbans (Photo-EBBL: 2013).

Here in the Sundabans bioresource story is related to a species of the honey bee, it stands that honey bee is a bioresource; the plants providing nectar to the bees is bioresource; pollens of the bee-related plants together is a bioresource; and dynamism of relationships between two biotic aspects (plants and bees) is a bioresource. Assemblage of all the above four bioresources together in an ecosystem (like in the Sundarbans ecosystem) is a natural phenomenon of recognizing the bioresources. And then it needs to be recognized characteristically as the best and most sound environmental habitat. This habitat (ecosystem) can provide the best services to humans both economically and environmentally. Its management stands as the best example of bioresource management.

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