National Biodiversity Authority
Government of India

BIODIVERSITY VALUATION:
ACCESS TO RESOURCES AND BENEFIT SHARING

A BRIEF CONTEXTUAL NOTE

1. Biodiversity and Need for Economic Valuation

Biological diversity (biodiversity) represents the variety of life on earth; which include species diversity (the numbers and kinds of living organism), genetic diversity (genetic variations within species) and ecosystem diversity (the variety of habitats, biological communities and ecological process). Biodiversity is the foundation of life on earth. It is crucial for the functioning of ecosystems, which provide us products and services without which we can't imagine our life. Oxygen, fresh water, fertile soil, food, medicines, shelter, protection from storms and floods, stable climate, recreation etc. are sourced from nature or healthy ecosystems. The earth's biological resources are vital to economic and social development. In brief, biological diversity is a global asset with tremendous value to present and future generations. However, recently the species and ecosystem are under threat than before, primarily due to human activities.

In this respect arresting the decline of biodiversity (species and ecosystems) is a major objective of environmental policy at global to local. Under the umbrella of CBD different nations strengthened their biodiversity management policies primarily through institutional and legal initiatives. However, through market (economic instruments such as economic incentives and disincentives) too biodiversity can manage efficiently. Recognising this fact the OECD Environment Ministers meeting stressed the need for incentive measures to protect biodiversity and identified that creation and use of markets for biodiversity products and services, is an option (OECD, 2003).

2. ABS and Valuation Linkage

Access and benefit-sharing (ABS) framework provides guidance for the way in which genetic resources are accessed, and the way benefits are shared between people or countries using the resources (users) and the people or countries that provide them (providers). Providers of genetic resources can be governments or civil society bodies, which can include private land owners and communities within a country, who are entitled to provide access, negotiate the benefits resulting from their use.

The rapid development of modern biotechnology over the past decades has enabled us to use genetic resources in more scientific manner for improving human well-being. It has also improved conservation methods that help safeguard global biodiversity. ABS principles ensure that the physical access to genetic resources is facilitated and that the benefits obtained from their use are shared equitably with the providers. Such ABS regimes also need to consider valuable traditional knowledge associated with the resources.

The benefits to be shared can be monetary, or non-monetary. It is vital that both users and providers understand and respect legal, administrative and policy frameworks at national and local levels as well as in those outlined in the Convention of Biological Diversity (CBD) and the Nagoya Protocol on ABS. ABS is based on prior informed consent (PIC) being granted by a provider to a user and negotiations between both parties that result in mutually agreed terms (MAT) including provision for fair and equitable benefit sharing.

The process of prospecting biological and / or genetic resources involves a large number of actors and stakeholders ranging from local communities to multi-national companies. Thus there is a need to establish appropriate user provider chain when dealing into ABS issues. The negotiation between a provider and a user of resources can never be entirely based on the nature and quality of resources to be used. Both user and provider need to know the true value of the resources that is in discussion to meaningfully arrive at a conclusion on the quantum of benefits that can be generated and subsequently shared.

However, many times, the economic potential of biological resources is hardly understood by the providers as well as users in exact economic terms. This becomes a fundamental problem in arriving at suitable ABS agreements. In general, the provider (either the local community and indigenous group or the country) believe that they obtain a meagre share of the real resource value since they don't have a proper base value to bargain or negotiate the benefits.

In this context the examination for market failure in the context of biodiversity and its reasons are significant to follow a proactive approach

3. Market Distortion and Biodiversity Loss

Biodiversity and its underlying resources have economic value and always been important for economic activity. Unfortunately this link is not well understood. All societies depend on biodiversity and biological resources either directly or indirectly and used markets to commercialise products ever since humankind learned the benefits of trading. However, most of the biodiversity values are implicit rather than explicit, and thus are often not captured by markets. For biodiversity and many other biological resources, the absence of apparent values combined with their "public good" characteristics in the absence of well-defined property rights, have created problems of over-exploitation and unregulated use. Moreover, increasing development pressures have led to what many believe is an unprecedented rate of biodiversity loss.

An important first step in the process of biodiversity conservation is to quantify its economic values. Valuation helps us to identify the potential or probable market value of biodiversity. Once biodiversity goods and services valued, it will become a part of the rational decision process that facilitates its sustainable use and conservation.

> *"The direct relevance of ensuring that economic values for non-market ecosystem effects are recorded lies in the judgement… that most diversity loss is due to land use change. In turn, land use change is primarily driven by the respective rates of return to the different land uses. A forest converted to agriculture appears to have a higher economic value than as a conserved forest. 'Green belt' land in richer countries appears to have low conservation value relative to the value of the land for housing developments, and so on. While economic values may not capture by any means all of the 'value' residing in diversity, the importance of economic value derives from its role in altering the accounting balance sheet for land conversion. The higher non-market economic values are, the less likely it is that land conversion that damages biodiversity will be justified. The corollary is that simply measuring non-market values is not enough: they have to be 'captured' through some process that converts non-market values into real financial or resource flows" (OECD, 2003)*

However, marketing of biodiversity is not always possible: some goods and services are better suited for markets. Hence it is important to first identify the products and services of biodiversity that are most marketable. To undertake such an exercise, it is essential to understand biodiversity in light of its private or public good characteristics.

A **private** good is both rival in consumption (one person's consumption depletes the availability of the good to others) and excludable (it is feasible to exclude people – e.g. by charging a price – from consuming that good).

Public goods and services are those that fail to display (reveal) either rivalry or excludability. They are non-rival and non-excludable. When they display neither characteristic, they are termed "pure public goods" – as the case for biodiversity.

Often, however, the characteristics of rivalry and excludability are applicable in varying degrees for biodiversity, rather than as simple binary attributes. Biodiversity goods and services can thus be arranged on a spectrum ranging from "completely private" to "pure public" goods. The policy relevance of these designations is that the more a good or service displays either non-excludability or non-rivalry, the less likely it is that private provision via markets will materialise. Society would often be better off through private provision (less overuse would occur).

In brief, at the present situation most of the bio-products, which are involved in trading and transactions, are highly under-priced. But this is something historically happening. Apart from the public good nature of biodiversity, certain other factors are also influencing in the market distortion, and the basic reasons are summarized below:

- Bio-products are generally considered the free gifts of nature (manufactured by nature with its unique and intrinsic ability). It is not like any other manufactured commodity, where the cost of factors of production plays a significant role in price fixation.
- Bio-products are broadly public goods (either pure or in-pure public goods) hence non-excludable and non-rivalry in character. In most of the core

biodiversity spots (such as: forests, wetlands, marine and coastal zones) the property rights are not well defined.

- The non-excludability character of open access resources like biodiversity (bio-products) will often make a market price close to zero, when the actual value is quite large.
- Since the bio-products are non-rivalry in character, there is no (not much) competition of these resources, hence the market price will be inaccurate.
- Non-excludable and non-rivalry characters of biodiversity reflects the "off-site effects" and the resources often flow to wider communities to different provinces and countries skewing the well below market prices than the actual value.

The valuation exercise, currently undertaken in India with the framework of UNEP-GEF-ABS project is an attempt to understand or measure the real / true value of biological resources (goods), which enable appropriate fixation of benefit sharing components.

4. Markets and Pricing for Biodiversity and Biological Resources

Biological resources have been commercialised ever since humankind created markets and even before the invention of money. During the "barter system" most of the transactions were on natural resources/goods. According to CBD biological resources are: "…genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity." Therefor biological resources should be considered as a subset of biological diversity or biodiversity, defined by the CBD as: "…the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems." (CBD, 2000). In brief, one can interpret biodiversity is a 'stock' and biological resources are 'flow' from it. Hence, both biological resources and biodiversity have value and accounting or capturing the total value of biodiversity is significant.

Markets often fail to incorporate the values associated with biodiversity, resulting in (a) unsustainable harvesting practices, (b) discouraging long-term investments in

natural resources, and (c) inadequate attentions towards alternative land uses which are less harmful to the biodiversity. This reviles the economic characteristics associated with biodiversity. For example, many products and services linked to biodiversity are either non-excludable (it is generally not possible to exclude people from their benefits) or non-rival in consumption (the derived benefits are not depleted by the additional user). In addition, property rights on biodiversity are often unclear and markets fail to indicate their true value. If property rights were clearly defined, enforced, and traded, an important characteristic of environmental problems – the market failure – would be mitigated. Unfortunately, this is usually not the case. Here designing and implementation of methodologies to assess biodiversity is a critical task.

In *'biodiversity economy*', the Producers, consumers, traders, investors and other market participants are finding that creating and using markets to promote biodiversity conservation and sustainable use may at least in part fulfil their economic, financial and environmental goals. In certain cases, **even regulators are finding that markets may assist in achieving regulatory standards in an efficient manner** (OECD, 2003). In a sense, therefore, the market can assist in the correction of the market failures and put a true value on biological resources and biodiversity, which facilitates in conservation and sustainable use of biodiversity.

However, examples or experiences scattered throughout the world show that creating and using markets for biodiversity conservation and sustainable use is still at an early stage, with reliable policy lessons in many instances still too premature to be drawn.

Even if eco-system and bio-products are inter linked for economic valuation, particularly in ABS perspectives, one should examine this separately with different methodologies.

An ecosystem is defined as "a community of plants, animals and smaller organisms that live, feed, reproduce and interact in the same area or environment". Ecosystems are providing innumerable services which are the core aspect behind the existence of human life. Broadly, ecosystem services are the service people obtain from the environment. "Ecosystem services are the transformation of natural assets (soil,

plants and animals, air and water) into things that we value. They can be viewed as provisioning such as food and water; regulating, for example, flood and disease control; cultural such as spiritual, recreational, and cultural benefits; or supporting like nutrient cycling that maintain the conditions for life on Earth.

Ecosystem services also include, "ecosystem goods" such as food, medicinal plants, construction materials, tourism and recreation, and wild genes for domestic plants and animals. From an ABS perspective, use value - particularly direct use values - in the forms of goods / products which are tangible or visible is significant. Majority of these products are currently marketed in different local or traditional manner, where the real value of the product is not reflected in the form of medium of exchange or price.

In this context valuation of ecosystem or biodiversity is more in site specific (forests, mangroves, wetlands etc.) with the Total Economic value (TEV) approach (Fig 1).

Fig. 1 Total Economic Value of Biodiversity

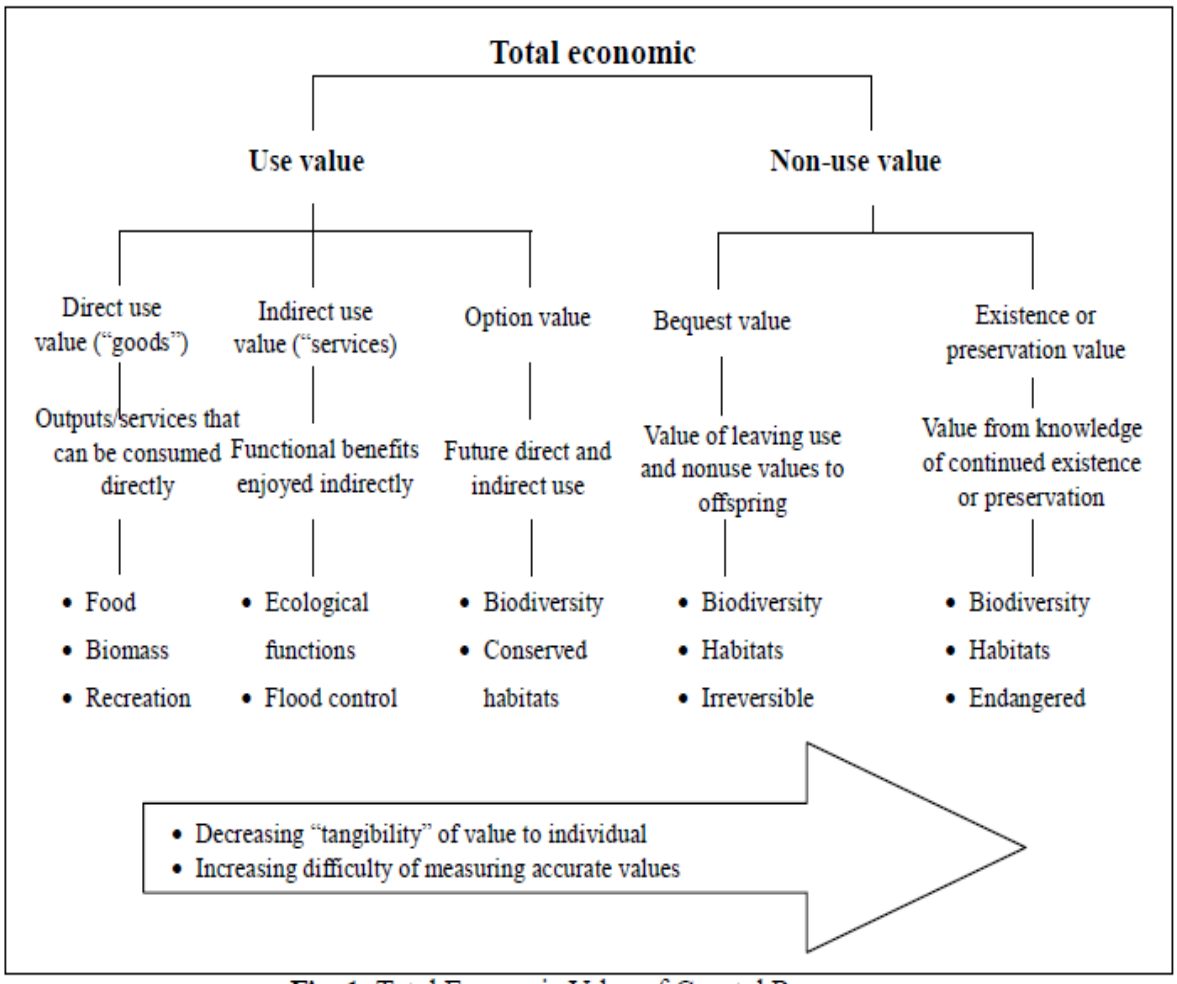

Fig. 1 Total Economic Value of Coastal Resources

Source; Jin et al (2003)

The components of Total Economic Value (TEV) of an ecosystem consist of use and non-use values.

Use value means many goods and services provided by ecosystems, which could be consumed or used directly or indirectly. Use value consists of: (a) direct use values, (b) indirect use values and (c) option values.

Direct use value can be classified as "good", which measures the consumptive value of tangible resources such as fish, timber, honey etc.

Indirect use values, which can be classified as "services", measures non-consumptive ecological and recreational uses of ecosystem or biodiversity or bio- resources such as, swimming, boating, hunting and picnicking.

Option value (which could be direct or indirect) is the willingness to pay to maintain the weighted by the probability that the resource will be used at some future date

Non-use values are those values, which are independent of an individual's present or future direct or indirect use. Traditionally these components have not been quantified in monetary terms, which have led to biodiversity or bio-resource being undervalued.

Bequest value: The willingness to pay for conservation and preservation of biodiversity or bio-resource, to avoid irreversible changes specifically for the benefit of future generations is known as the bequest value. (gift, inheritance value)

Existence value: Besides the bequest value, people may gain satisfaction from the knowledge that certain biodiversity or bio-resource exists and therefore may be willing to pay for their continued existence. This is known as the existence value. Existence value arises from the notion that individuals who make no use of a particular biodiversity or bio-resource may gain utility from the mere existence of the resource, even if there is no intention to use the resource in the future.

Even if valuation of ecosystems has highly debated, last two decades economists are involved in developing valuation methodologies with consider its increasing role in natural resources management and policies. However there are constrains (resources and data) in applying methods and some of them work better for certain services. Ecosystem valuation methods can broadly be classified into 6 categories.

5. Components of Valuation Methods

Group	Method	Summary
Direct Market Price	i. Market prices	i. Observe market prices
Market Alternative	I. Replacement costs ii. Damage cost avoided iii. Production function	i. Finding a man-made solution as an alternative to the ecosystem service. ii. How much spending was avoided because of the ecosystem service provided? iii. How much is the value-added by the ecosystem service based on its input to production processes?
Surrogate markets	i. Hedonic Price Method ii. Travel Cost Method	i. Consider housing market and the extra amount paid for higher environmental quality ii. Cost of visiting a site: travel costs (fares, car use etc.) and also value of leisure time expended
Stated preference	i. Contingent valuation method ii. Choice experiments	i. How much is the survey respondent willing-to-pay to have more of a particular ecosystem service? ii. Given a 'menu' of options with differing levels of ecosystem services and differing costs, which is preferred?
Participatory	i. Participatory environmental valuation	i. Asking members of a community to determine the importance of a non-marketed ecosystem service relative to goods or services that are marketed
Benefits transfer	i. Benefits transfer (mean value, adjusted mean value, benefit function)	i. 'Borrowing' or transferring a value from an existing study to provide a ballpark estimate for current decision

Source: TEEB, 2010

Certain ecosystem goods and services have a market. For example: timber, fish, and vegetables have economic values that can be calculated with little statistical analysis. Markets for tangible ecosystem services are also emerging. However, most ecosystem goods and services do not have readily observable market prices.

When market prices are available for bio-product and genetic resources, they may be *either undervalued or distorted*. Distortions in the market (subsidies, price regulations, taxes) may produce incorrect values which must be accounted for in an effective valuation analysis, which is the prime objective of the 'valuation of biodiversity' component in ABS project. When the market is weak or not exists for certain ecosystem services, valuation methods like market alternatives and other non-market valuation methods are used for obtain the real value of the goods and services.

In brief, through valuation, the value of ecosystem goods and services can placed in decision making and action. A careful application of valuation does not only seek out the 'right numbers' to input; but also sensitive to peoples' cultural and spiritual values. Generally, the 'purpose of valuation' determines which method is most appropriate. However consider the options such as: (a) who the end-users of the analysis will be, (b) who the affected stakeholders are, and (c) what resources are available, before design a valuation exercise.

6. Valuation of Three Ecosystems

The on-going ABS Project attempts to value selected ecosystems such as: forests, wetlands and agriculture in the project implementing states in India (Andhra Pradesh, West Bengal, Sikkim, Himachal Pradesh and Gujarat).

6.1 *Forests*

Forests are important renewable ecosystems capable of providing a wide range of benefits (environmental, economic, social and cultural) to the society. Forests provide raw-materials for food, fuel and shelter. In forests, ecosystem components such as microorganisms, soil and vegetative cover interact to purify air and water, regulate climate and recycle nutrients and wastes. Hence forest attributes significantly in global life support system, economic growth and the environmental conditions of the country. The values associated with conventional forest products

such as timber, pulp, paper etc. pass directly through to markets. On the other hand, many other services of forests (regulating weather patterns, recreational services, controlling soil erosion and hydrological cycle etc.) are not marketable. Therefore, it is becoming increasingly important to identify and evaluate these non-market benefits of forests with the help of appropriate methodology for deriving the total economic value of the forest.

6.2 ***Wetlands***

Wetlands are one of the most productive ecosystems in the earth. Wetland includes: (a) estuaries – where rivers meet the sea and salinity is intermediate between salt and freshwater (e.g., deltas, mudflats, salt marshes), (b) marine – not influenced by river flows (e.g., shorelines and coral reefs), (c) riverine – land periodically inundated by river overtopping (e.g., water meadows, flooded forests, oxbow lakes), (d) palustrine – where there is more or less permanent water (e.g., papyrus swamp, marshes, fen) and (e) lacustrine – areas of permanent water with little flow (e.g., ponds, kettle lakes, volcanic crater lakes) The major components of a wetland includes biotic (plants and animals) and non-biotic (soil and water). The interactions between the components make wetland as functions, including nutrient cycling and exchange of water between the surface and the groundwater and the surface and the atmosphere (hydrological cycle). The system also has attributes, such as the diversity of species.

Wetland ecosystem provides direct as well as indirect services to the humanity. People use wetland soils for agriculture, they catch wetland fish to eat, they cut wetland trees for timber, fuel-wood, to make mats and to thatch roofs, collect plants for manufacturing medicines and other commercial products. Further wetlands also used for recreation (bird watching or sailing) and scientific research purpose. The indirect services of wetlands includes: flood control, regulating the atmospheric conditions and climate and protect the communities from natural calamities (as mangrove wetlands protect coastal communities).

6.3 ***Agriculture***

Agricultural biodiversity is an essential component for global food production, livelihood security and sustainable agricultural development. The plant, animal and microbial organisms influenced on food and agriculture must be conserved and used sustainably for universal food security. Agricultural biodiversity of all food species is highly threatened during globalisation induced unsustainable industrial food production. It is the first link in the food chain, developed and safeguarded by farmers, herders and fishers throughout the world. Agricultural biodiversity includes: harvested crop varieties, livestock breeds, fish species and nondomesticated ('wild') resources within field, forest, rangeland and in aquatic ecosystems; (b) non-harvested species within production ecosystems that support food provision, including soil micro-biota, pollinators and so on; and (c) non-harvested species in the wider environment that support food production ecosystems (agricultural, pastoral, forest and aquatic ecosystems).

Agricultural biodiversity emerged from the interaction between the environment, genetic resources and the management systems and practices used by culturally diverse peoples resulting in the different ways land and water resources are used for production. It thus encompasses the variety and variability of animals, plants and microorganisms which are necessary to sustain key functions of the agro-ecosystem. In brief, agricultural biodiversity is essentially the interaction of knowledge and genetic resources used for food, biological support or ecological services.

7. Primary goods and services provided by ecosystems

The following table provide comprehensive information about the primary goods and services provided by different ecosystems.

Primary goods and services provided by ecosystems

Ecosystem	Goods	Services
Agro ecosystems	1. Food crops 2. Fibre crops 3. Crop genetic resources 4. Other crops (energy, fodder, etc) 5. Cultural resources	1. Maintain limited watershed functions 2. Provide habitat for humans, birds, pollinators, soil organisms important to agriculture, maintain biodiversity and cycle nutrients. 3. Sequester atmospheric carbon 4. Provide employment 5. Contribute to aesthetic beauty and provide recreation
Coastal ecosystems	6. Fish and shellfish 7. Fish meal (animal feed) 8. Seaweeds (for food and industrial use) 9. Salt 10. Genetic resources 11. Cultural resources	6. Moderate Storm Impacts (mangroves; barrier islands) 7. Provide wildlife (marine and terrestrial habitat) 8. Maintain biodiversity 9. Dilute and treat wastes 10. Provide harbour and transportation roots 11. Provide human and wildlife habitat 12. Provide employment 13. Contribute to aesthetic beauty and provide recreation
Forest ecosystems	12. Timber 13. Fuel wood 14. Drinking and irrigation water 15. Fodder 16. Non timber forest products 17. Food (honey, mushrooms, fruit, and other edible plants; game) 18. Genetic resources 19. Cultural resources	14. Remove air pollutants, emit oxygen 15. Cycle nutrients 16. Maintain array of watershed functions (infiltration, purification, flow control, soil stabilization) 17. Maintain biodiversity 18. Sequester atmospheric carbon 19. Moderate weather extremes and impacts 20. Generate soil 21. Provide employment 22. Provide human, wildlife, and beneficial insect habitat 23. Contribute to aesthetic beauty and provide recreation
		Cont …. Next page

Freshwater ecosystems	20. Drinking and irrigation water 21. Fish 22. Hydroelectricity 23. Genetic Resources 24. Cultural Resources	24. Buffer Water flow (control of timing and volume) 25. Dilute and carry away wastes 26. Cycle nutrients 27. Maintain biodiversity 28. Provide aquatic habitat 29. Provide Transportation corridor 30. Provide employment 31. Contribute to aesthetic beauty and provide recreation
Grassland ecosystems	25. Livestock (food, game, hides, fiber) 26. Drinking and irrigation water 27. Genetic resources 28. Cultural resources	32. Maintain array of watershed functions (infiltration, purification, flow control, soil stabilization) 33. Cycle nutrients 34. Remove air pollutants, emit oxygen 35. Maintain biodiversity 36. Generate soil 37. Sequester atmospheric carbon 38. Provide employment 39. Provide human and wildlife habitat 40. Contribute to aesthetic beauty and provide recreation

Source: OECD, 2003

8. Ecosystem Goods / Bio-products / Bio-resources and their Valuation

Bio-resources are playing a significant role in manufacturing different consumer goods, which provide utility to the consumers and enhancing human welfare, but in a different perspective. Even these resources are having markets (may be weak) and price (may be lower). This indicates that the market for bio-resources is imperfect or inefficient.

Inefficient market is a market where prices do not always reflect available information as accurately as possible. Inefficient markets may result from a lag in information transferring to one place to another, deliberate withholding of information by an insider, or other reasons. Inefficient markets give rise to arbitrage opportunities. Most analysts believe that no market is perfectly efficient and that some inefficiency is inevitable. However in the case of biodiversity or bio-resources market is highly inefficient.

- Certain goods obtained from ecosystem (for example honey) can directly use by the consumers without any intermediate process. Hence value addition is basically through the movement of movement or transaction. For example in the case of honey, the collection price at forest gate is Rs. 119 per Kg. at the forest gate, the sale price of the federation is Rs. 133 and final consumer price is Rs. 200. Here the price spread is Rs. 81 (119 to 200) and its percentage of collection price is 59.5% (Shylajan and Mythili, 2007). Here the value addition is basically through the transaction cost.
- Certain bio-products may act as basic raw material for manufacturing a final product like. The *Jeevani* an immuno-modulatory product (ayurvedic medicine) is manufactured from the plant known as *Arogyapacha* (Suneetha and Chandrakanth …). However the *Arogyapacha* is an unavoidable input, but not an exclusive one. There are many other products and knowledge / skill (research and development) also attributed in the arrival of the final product. Here the *amortised pricing* technique is relevant to estimate the raw material price and determining the proper benefit sharing ratio. In this case the value chain is complex, since many factors including the services are attributing in the value chain/addition.
- Certain bio-products may act as a supplementary raw material or resources in manufacturing specific products.
- Genetic resources case its segregation; storage and further application are significant. For identifying and locating these resources, the traditional knowledge plays a significant role. Most of the genetic resources more international market, hence ABS is much more significant.

9. Conclusion

Valuation of biodiversity goods and ecosystem services is a fundamental step towards realizing the goal and objectives of ABS framework. With 193 countries around the world agreeing on an international protocol related to ABS – the Nagoya Protocol on ABS – under the Convention on Biological Diversity (CBD), time has come for environmental economists, planners and governments to understand and apply principles of Environmental Economics to real on the ground action to achive the objectives of ABS.

With India chairing the CBD and ABS process at global level as COP President, the National Biodiversity Authority currently working to develop a workable model to address un-ambiguous valuation methods biodiversity, goods through a Global Environment Facility supported project in 3 ecosystems (forest, agriculture, and wetlands) at 5 states (Andhra Pradesh, Gujarat, Himachal Pradesh, Sikkim, and West Bengal).

References

Jin Wang, Shenghong Ran and Caixing Yun (2003) "Study on Coastal resources Evaluation: Theories and Methods" Paper presented in International Conference on Estuaries and Coasts"", November 9-11, 2003, Hangzhou, China.

OECD (Organisation for Economic Co-Operation and Development), "(2003) "Harnessing Markets for Biodiversity; Towards Conservation and Sustainable Use

Shylajan C. S. and G. Mythili (2007) "Community Dependence on Non-timber Forest Products: A Household Analysis and its Implication for Forest Conservation", Working Paper (WP-2007-005), Indira Gandhi Institute of Development Research, Mumbai, March 2007.

Suneetha M S and Chandrakanth M G (----) "Cashing in on the Sacred: Are benefit sharing exercises equitable? - Economic Analysis of three benefit sharing case studies", Unpublished paper University of Agricultural Sciences, Bangalore, Karnataka, India

TEEB (2010), "The Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers

---

For more information contact: Dr. Prakash Nelliyat (paecogef@nbaindia.in) and or Chairman, NBA (chairman@nbaindia.in).