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Costs and Benefits of Biodiversity Conservation in China

Contents

1. Introduction

As part of its Country Study on Biological Diversity[1], China conducted an assessment of costs and benefits of biodiversity conservation[2]. The assessment includes estimated costs of conservation and sustainable use, full incremental costs of implementing the Convention's obligations, as well as economic, social and ecological benefits of implementing the Convention.

Biodiversity conservation needs a large amount of capital input. To ensure funding, the State has formulated a series of related policies, and reflected them in the form of rules, standards and programmes. Since the 1980s, the objectives and tasks of environmental protection were listed in national economic and social development plans. Various investments to protect and improve the natural ecosystem have been put into the nation's investment channels, and the steadily increasing financial input has stimulated the development of nature conservation, e.g., investment in biodiversity in 1993 accounted for 0.22% of the State's capital investment.

In recent years, the State has somewhat altered its pattern of investment in biodiversity conservation, step by step, from purely a financial investment by the State to a multi-channelled and multi-modelled investment, to bring into full play the enthusiasm of the ministries and regions for further investment. By this means, the investment is steadily increasing. For instance, with regard to investment in the construction of nature reserves for in situ conservation of biodiversity, besides investments from the planning and financial sectors and some associated ministries, provincial, municipal and county governments and related departments are making investment in nature reserves in many ways such as infrastructural expenses, operating expenses, and special business expense. Nature reserves are also encouraged to raise funds by themselves in various modes as well as striving to obtain opportunities for international multi- or bi-lateral co-operation Due to the opening up of various investment channels, some nature reserves have relatively stable funds for their development and administration.

It has however to be admitted that China is a developing nation with limited financial strength and economic potential. Particularly in order to honour the implementation of the Convention, many new protection measures have to be adopted resulting in this is extra economic expense There exist tremendous gaps in investment although investments will increase with national economic development. According to the Convention financial and technical assistance from developed countries and international funding organizations is imperative.

[1] China (1998). China Biodiversity Country Study (in Chinese), State Environmental Protection Administration, Beijing, 430 pp.

[2] China (1998). China's Biodiversity: A Country Study - Executive summary, Organized by State Environmental Protection Administration of China, http://chinagate.cn/english/2036.htm

2. Estimation of cost in conservation and sustainable use of biodiversity

2.1 Estimation of the existing cost of conservation and sustainable use of biodiversity

Since the 1980's, China has invested funds, manpower and materials in conservation and sustainable use of biodiversity (Table 1), with increasing investment strength and scale.

Table 1. Total investment China has put into the conservation and sustainable use of biodiversity

Item	Total investment		Investment per annum	
	Million yuan	Million USD	Million yuan	Million USD
Construction of nature reserves	1,590	191.6	200	24.1
Other on site conservation	910	109.6	182	22.0
Ex situ conservation	7,362	887.0	572	68.9
Sustainable use of biodiversity components	15,000	1,807.2	1,600	192.8
Survey and cataloguing	312	37.6	13	1.6
Research, monitoring and information	1,035	124.7	120	14.5
Publicity, education and training	1,150	138.6	95	11.4
Technical and scientific co-operation	25	3.0	3	0.4
Others	70	8.4	5	0.6
Total	27,454	3,307.7	2,790	336.1

Note: The exchange rate with the US dollar is based on 1995 figure (1 USD = 8.3 yuan RMB).

(1) Cost of in situ conservation measures

Costs for the construction and management of nature reserves, scenic spots and forest parks are included.

(2) Cost of ex situ conservation measures

Costs for the conservation and administration of rare and endangered animals and plants, such as, zoos, botanical gardens, wild animal domestication and breeding centres, and genetic germplasm banks, are included.

(3) Cost of practising sustainable use of biodiversity

Costs of the sustainable use of biodiversity include a series of forest ecological engineering projects such as the "Triple-North" (or San Bei) shelter forest system, the protection forest system along the upper and middle reaches of the Changjiang River, and the Coastal Windbreak forest system. This is also engineering investment in the sustainable use of grassland, aquatic, and marine resources, and wild animal, plant and eco-agricultural construction.

(4) Cost of scientific research and monitoring of biodiversity

This includes the cost of surveys, inventories, research and the monitoring of biodiversity.

(5) Cost of publicity, education and training for biodiversity

Costs of publicity, education and personnel training in central and local governments are included here.

(6) Cost of technical and scientific co-operation

This includes the costs China has invested in co-operation with multilateral international organisations, such as UNDP, UNEP, FAQ, the World Bank, IUCN, WWF and in bilateral co-operations.

2.2 Estimated funds China needs to honour the Convention on Biological Diversity

The Convention on Biological Diversity has stipulated some obligations for all contracting countries. As a signatory country, China will seriously carry out its obligations. According to the requirements of national capacity-building for biodiversity conservation and sustainable use put forward in the Convention on Biological Diversity and the total future funds China will need to implement the Convention on Biological Diversity in the next 15 years (between 1996 and 2010) has been estimated and includes the following(Table 2).

Table 2. Estimated cost China will need to observe the Convention on Biological Diversity (unit: million Chinese yuan)

Item	Total investment (1996-20l0)		Investment per annum	
	yuan	USD	yuan	USD
Formulation of relevant national strategies and planning	13	1.6	0.9	0.1
Identification and monitoring	1,911	203.2	127.4	15.3
In situ conservation	21,388.5	2,576.9	1,425.9	171.8
Ex situ conservation	13,084	1,576.4	872.7	105.1
Sustainable use of biodiversity components	98,000	11,807.2	6,533.3	787.1
Research, training and public education	4,575	551.2	305	36.7
Information collection, storage and exchange	1,200	144.6	80	9.6
Technical and scientific co-operation	300	36.1	20	2.4
Others	750	90.4	50	6.0
Total	141,211.5	17,014.6	9,413.9	1,134.2

(1) Expenses involved in formulating national strategies, plans, programmes and departmental and trans-departmental programmes

According to Article 6 of the Convention, the China National Biodiversity Strategy and sectoral plans are the near-term tasks.

(2) Expenses of identification and monitoring

According to Article 7 of the Convention, China needs to conduct investigation into germplasm resources such as crops, trees, livestock, forage grasses, green or ornamental animals and plants, aquatic species and Chinese medicinal materials; comprehensively investigate nature reserve resources, finish the compilation of three annals of “China Fauna”, “China Flora” and “China Microbiota”; strengthen the survey of rare and endangered species and the compilation of a red data book; and establish a biodiversity monitoring network system.

(3) Cost of implementing "in situ conservation programmes"

According to Article 8 of the Convention, contracting parties are required to further strengthen in situ biodiversity conservation. To this end, China has compiled the volume "Nature Reserve Development Planning in China" and construction plans for scenic spots and forest parks. Such in situ conservation plans will need investment.

(4) Cost of implementing "ex situ conservation programmes"

Costs involved here are construction and administration of ex situ conservation facilities, such as zoos, botanical gardens, arboretums, aquariums, gene banks, and rare and endangered species conservation centres.

(5) Cost of implementing "programmes for the sustainable use of biodiversity components"

In line with the "National Ecological Environment Construction Programme between 1996—2010 (forestry section)", "Special Programme For Grassland Ecological Construction in 2050", and "Guiding Program for Aquatic Species Conservation in 2050", from 1996 to 2000, large funds will be allocated to afforestation, grassland improvement, fishery resource propagation, breeding of wild animals and plants, eco-agricultural demonstration engineering, technical dissemination.

(6) Cost of "research, training and public education plans"

This estimation is based on the planning objectives for personnel training (science and technology development).

(7) Cost in information collection, storage and exchange

Establishment of a biodiversity information system and collection, storage and exchange of information are one of the action plans for honouring the Convention. In line with related programmes and measures, this cost includes information system development and the construction of administrative institutions, database network construction, applied software development, and the management and operation of information systems.

(8) Cost of technical and scientific cooperation

In order to observe Article 18 of the Convention, extensive technical and scientific cooperation is supposed to be carried out by signatory countries. China will need to strengthen such activities.

2.3 Full incremental costs of implementing the Convention on Biological Diversity

Biodiversity conservation and sustainable use is a strategy to keep the economy of country on the track of sustainable development. China has invested large amounts of funds to strengthen its biodiversity conservation. It is, however, far from the requirements of the Convention. The finances necessary to fully implement the convention will exceed the existing investment scale in China. Therefore, all new

additional expenses should be estimated and considered as the basis for obtaining financial support from sources made available by the Convention.

(1) Full incremental costs of the construction of conservation facilities

On the basis of existing investment, to implement in situ and ex Situ conservation planning, the full incremental costs will reach 1,343. 9 million yuan each year, totalling 20,158.5 million yuan in 15 years.

(2) Full incremental costs of implementing sustainable use planning

Based on planning and the estimated cost of implementing the sustainable use of biodiversity components in China, a total extra cost of 4,933.33 million yuan will be needed between 1996 and 2010, constituting 74.02% of the total additional expenses. The sustainable use of forestry resource has the highest expense needs.

(3) Full incremental costs of scientific research, identification and the monitoring of biodiversity

In the field of scientific research, identification and monitoring of biodiversity and construction of information systems, additional expenses of 174.4 million yuan will be needed each year. The additional expenses will cover programmed investments in basic biodiversity studies, and biotechnology research, construction of a national biodiversity monitoring network and information systems.

(4) Full incremental costs for publicity, education and training

The annual investment required for publicity and training of biodiversity will be as much as 205 million yuan in fifteen years with, yearly, the additional expense being about 110 million yuan.

On the basis of the above estimates, to implement the Convention on Biological Diversity, China needs 6,624 million yuan additional expenses each year in the following 15 years. China will increase its investment in biodiversity conservation and sustainable use with economic development. If at the same speed as the national economic growth rate, the total domestic extra funds will account for 42.7% of the total extra funds required by the Convention. However, another additional expense 3,815 million yuan, should be supplied from international funds.

2.4 Cost of implementing priority projects for biodiversity conservation and sustainable use

This section is mainly based on the priority projects listed in the Annex of China Biodiversity Conservation Action Plan. From 1996 to 2000, total expenses were about 10,904 million yuan, which includes:

(1) In situ conservation: the priority in situ conservation projects will need a total sum of 3,129 million yuan within 5 years.

(2) Ex situ conservation: a total sum of 915 million yuan is needed over the next five years.

(3)Sustainable use demonstration projects: a total cost of 5,675 million yuan is needed within five years.

(4) Comprehensive evaluation of China's biodiversity conservation activities: a total cost of 85 million yuan is needed.

(5) Research, monitoring and public education: a total cost of 1,100 million yuan is needed.

2.5 Fund sources and project application procedure

(1) Fund sources

Along with the development of the economy, investment in biodiversity conservation will be added to every year by China. Nevertheless, the new and additional expense is too big to bear by China itself. It is necessary to obtain international financial support by all means and ways to meet the total extra expenses required to implement the Convention. Biodiversity in China is an important component of global biodiversity, and the sound conservation of its biodiversity will contribute much to world biodiversity conservation. Article 20 of the Convention provided that developed honoring country should supply new and additional funds to for developing countries so that they can carry out their obligations and obtain benefits resulting from articles in the Convention. Consequently, the total incremental costs resulting from the implementation of the Convention will mainly depend on how much funds are supplied by developed countries.

(2) Project application procedure

The cost requirements above were estimated on the basis of former investments. The application and implementation of specific projects should, based on practical conditions, be proceeded with according to routine procedures adopted for State capital construction projects.

3. Benefits of biodiversity conservation

A large investment and conservation measures to implement the Convention on Biological Diversity will generate ecological benefits as well as significant economic and social benefits. It requires a long cycle for biological resources to become rehabilitated and propagated. Under natural conditions, it requires several generations' persistent efforts to restore degraded ecosystems and endangered species. Even under artificial protection, it generally takes 50 years or so for woody plants to be restored and probably much longer for animal resources. As a result, it is difficult to see any significant effect from an input into biodiversity conservation within a short period of time. The evaluation of the benefits obtained from investment in the implementation of the Convention can be conducted by ecological-economic cost/benefit analysis. Economic benefit valuation methods, such as the market valuation method, the substitute market valuation method, and the shadow engineering method, can be employed. The formula is as follows:

$M=f(D, E, P)$

Where, M - Benefits resulting from investment in the components of biodiversity conservation; D - Quantitative value of the components of biodiversity conservation; E - Price coefficient related to this component.

P=(Pi P2, P3, …)

P1, P2, P3 are parameters related to this component of biodiversity;

F - function of M with D, E, P.

Based on the above equation, and by appropriate transformation, economic, ecological and social benefits resulting from an investment in biodiversity conservation can be estimated.

3.1 Analysis of the economic benefits of implementing the Convention

The economic benefits from of the measures taken to implement the Convention appear in the form of an increased use value of the biological resources.

(1) Increases in the value of timber resources

If calculated on the basis of the current average annual growth rate of the nation's forests, newly established forests, as a result of measures taken for conservation and sustainable use of such resources, will increase the standing stock by 69.6 million cubic meters, or 21,090 million yuan, annually by 2010.

(2) The value of grassland management in animal husbandry

The new addition of 58.3 million ha of ameliorated, artificial and rotational grasslands will increase the annual output of animal husbandry by 11,660 million yuan on the basis of 2 more sheep per ha in terms of animal carrying capacity.

(3) Increased value of Chinese medicinal materials and other forestry and animal by-products

Increase in the forest area and improvement of grassland resources can raise not only the output of timber and forage grasses but also the collecting area and output of Chinese medicinal materials, arid promote propagation of wild fibre plants, berries, economic fungi and wildlife. It is expected that by 2010 the annual increment in the output of Chinese medicinal materials and other forestry and animal by-products will be 3,370 million yuan in value.

(4) Economic benefits from the propagation of aquatic resources

The economic benefit of the measures taken for conservation and sustainable use of aquatic resources will show itself in the propagation of such resources, for which, however, there is no reliable and workable calculation. It is, therefore, hard to make an accurate estimation of the overall benefit. By substituting the increment in the off shore marine and freshwater catch for the benefit of aquatic resources conservation, the annual increment in the output of aquatic products will reach 0.89 million t or 4,300 million yuan in economic value. Although this calculation method is not very convincing, the actual benefits are surely higher than above.

(5) Economic benefits from the conservation of genetic resources

The benefits of genetic resource conservation are mostly latent, and will be very significant once it is yielded. For instance, during the period from 1976 to 1993, hybrid rice alone was expanded to an accumulative area of 160 million ha, increasing the output by 240 million t, or about 120,000 million yuan in economic value. In 1985 - 1992 an area of 0.52 million ha of selected fine varieties of Chinese firs were established, increasing the net profit by 500 million yuan. Although the economic benefit resulted from the implementation of the Convention is hard to reckon comprehensively at present, it will undoubtedly be extremely large.

(6) Economic benefits from the conservation of rare and endangered species

It is predicted that by 2010, China's endangered wildlife resources will have been restored, or expanded to various extents, as a result of the adoption of proper conservation measures. The endangeredness of some rare species can be lessened, but not to the extent that the populations of the species are expanded large enough to exploit. Its direct economic benefit is, therefore, very low. Artificial breeding of endangered animals and plants can not only meet the demand for conservation and research, but also provide considerable amounts for direct use. The economic benefits resulting from such activities may amount to 500 million yuan.

(7) Newly increased tourist benefits

During 1996 - 2010, China will set up 1850 new biodiversity conservation facilities (including nature reserves, scenic spots and forest parks), covering a protection area of 66 million ha. The addition of in situ conservation facilities and the restoration of ecosystem will greatly advance the development of ecotourism. It is predicted that by 2010, the newly augmented tourist receiving capacity will have reached 300 million person units, and can create an additional tourist benefit of 14,700 million yuan.

Based on the above calculations, the implementation of the Convention on Biological Diversity will generate extra annual economic benefits of 55,620 million yuan.

3.2 Analysis of the social benefits resulting from implementation of the Convention

The implementation of the Convention will generate social benefits in the form of better natural environmental quality, more agricultural products and by-products for society, higher living standards for the people and more job opportunities.

(1) Better environmental quality

Adoption of the implementation measures of the Convention will not only generate ecological benefits but also improve the nation's environmental quality, creating a better and more comfortable ecological environment for the people to live in. The addition of forest area and standing stock will, especially, increase the CO2 fixation and O2 releasing capacity of the forests, which will not only play an important role in improving the nation's ecological environment but also contribute significantly to the solution of the global greenhouse effect problem.

(2) Higher supply of agricultural, forestry and husbandry products

It is predicted that by 2010, the implementation of the Convention will generate an increased annual supply capacity of agricultural, forestry and husbandry products, i.e., 60 million m^3 of timber, 12.87 million t of grains, 0.7 million t of meat and 0.88 million t of aquatic products. The increase in the fellable stock of timber will help further reduce the short fall in timber supply; and a larger supply of agricultural, and husbandry products can further improve people's lives.

(3) Higher job opportunity

The implementation of the Convention will considerably increase the usable volume of biological resources, which means a corresponding increase in job opportunity. By 2010, the annual increment in economic benefits resulting from the implementation of the Convention will reach 55,620 million yuan, which can provide about 2.78 million jobs if calculated on the basis that one labour unit can create 20, 000 yuan per year. On the other hand, increased biodiversity conservation benefits can stimulate the development of related industries and, thereafter, create more job opportunities.

3.3 Analysis of the ecological benefits of implementing the Convention

The ecological benefits from investment in the implementation of the Convention will mainly be reflected in conserving water sources, controlling soil erosion, fixing sands against wind, and conserving wildlife.

(1) Benefits from conserving water sources

An increase in forest area means an increase in its water conserving capacity. It is expected that by 2010 after adoption of the implementation measures of the Convention, the total forest area will reach 162.7 million ha, of which 29 million ha will be newly established. The increment in water conserving capacity may reach 81,809 million t, which is valued at 54,812 million yuan if calculated on the basis of the unit storage capacity cost of reservoir projects.

(2) Benefits from soil erosion control

Benefits in soil erosion control increased by biodiversity conservation and the sustainable use of biological resources are mainly embodied in the form of increased areas of forest land, soil erosion control of artificial grassland and ameliorated grassland, reduced loss in land and soil nutrient, and reduced loss generated by siltation. It is predicted that as a result of convention implementation activities, the new addition of forest land and grassland will reduce soil erosion by 2,615 million t by the year of 2010, i.e., reducing deserted land by 0.4 million ha, silt retention by 860 million t, siltation by 630 million t, and decreasing the loss of organic matter, readily available N, P and K by 30, 2.62, 0.39 and 1.57 million t, respectively, each year. All the above-said items add up to 16,030 million yuan per annum in benefits.

(3) Benefits from increased agricultural output

It can be expected that by 2010 the total area of forest-netted farmland will have reached 59.05 million ha, of which 25.37 million ha is increased by implementation of the Convention. The yield-increasing

effect of the forest network on farmland is around 10%, or 12.87 million t in terms of grain or 12,865 million yuan in terms of net monetary value.

(4) Benefits from fixing sands against wind

By 2010, the area of harnessed desertified land is expected to have expanded to 11.43 million ha as a result of biodiversity conservation and sustainable use of biological resources. If based on the estimation that the comprehensive benefit of combating desertification is 450 yuan per ha, the total benefit will reach 5,140 million yuan.

(5) Benefits from combating natural disasters

The measures China takes in the field of biodiversity conservation will greatly improve her ecological environment and her capacity to combat natural disasters. By 2010, the annual benefit from reduced losses caused by natural disasters is estimated to have reached 15,000 million yuan, if calculated on the basis that the coefficient of the disaster-reducing capacity is 0.3.

(6) Environmental benefits from O_2 release and CO_2 fixation

By 2010, the new addition of 29 million ha of forests will increase CO_2 fixation by 72.5 million t and O_2 release by 52.78 million t annually. If calculated on the basis of the afforestation cost, the annual increase in environmental benefit will be 19,500 million yuan.

(7) Ecological benefits from species conservation

The ecological benefit of species conservation is mostly reflected in lessened endangeredness of endangered species, increased populations of wildlife, more reasonable community composition and reduced pest and rat damage in agriculture, forestry and animal husbandry. It is, however, rather hard to put a monetary value on the ecological benefit of wild species conservation, and only qualitative methods can be used to describe it.

Based on the above calculation, by 2010, the implementation of the Convention will generate ecological benefits of about 123,350 million yuan.

4 Summary

To summarize the above analyses, it is predicted that by 2010, implementation of the Convention will bring about annual economic benefits of 55,620 million yuan, annual ecological and economic benefits totaling to 178, 970 million yuan, of which the ecological benefits account for 68.92%, or about 2.2 times as much as the economic benefits. Compared with the input into biodiversity conservation, the benefits are obviously higher. The above-mentioned figures do not really reflect the benefits obtained in a single year, rather the mean of many years. The actual benefits in the first year will be below the mean value.

China[3] (1995) systematically and comprehensively identified the scope and content of the capacity building China has to undertake and reinforce then and in the 15 years afterwards. It included not only planned targets, tasks and measures for building national capacity in terms of laws and regulations, institutions, policy, manpower and resources, conservation and sustainable utilization, scientific research, information management, publicity, education and public participation and international co-operation, but also the requirements for construction of basic facilities in the fields of conservation and sustainable utilization, monitoring, information management, publicity and education. Before 2010, the total number of nature reserves would reach 1,200 with a total acreage of 10% of the state's territory. Various components of China's biodiversity would be thoroughly investigated, all volumes of China's Flora, China's Fauna and China's Cryptograms completed, a state-wide biodiversity monitoring network established, data management strengthened and on-lined, and the nation's capacity building for bio-safety strengthened. Based on the capacity building requirements, tasks and measures, the report presented an estimation of the costs needed to implement them. Using the actual investment China made in terms of conservation and sustainable biodiversity utilization since the 1980s as a baseline, the investment required to implement the obligations set out in the Convention over the subsequent 15 years was calculated. The major fields of such an investment would will be: formulation of a national strategy, plans, schemes and departmental programs; identification and monitoring; implementation of medium-and long-term in situ conservation programs; implementation of programmers for the sustainable utilization of biodiversity's components; implementation of research, training and public education; collection, storage and exchange of information; and international technological and scientific co-operation. It was estimated that the total costs required to implement the convention in the subsequent 15 years would be 141.2 billion yuan, or, an annual average of 9.4 billion yuan, i. e., about 1.1 billion USD per annum (1 USD=8.3 yuan RMB in 1995). By deducting the state's regular budget, the remaining 99.4 billion yuan would be the extra cost required in the subsequent 15 years, i. e., an average of 6.624 billion RMB yuan, which is equivalent of US$ 0.798 billion, per annum. This estimate is based on the level of input by China's government on the early 1990s towards biodiversity conservation and sustainable utilization. Along with the development of the national economy, the state would increase its budget for biodiversity protection each year. But, taking inflation into account, the present estimate would still be an underestimate. To sum up, to fulfill the "Convention on Biological Diversity", an amount of US$ 0.4 billion per annum would be required either from GEF or from other forms of foreign aid to cover the extra costs.

The study also calculated the investment required for the priority projects identified in the "China Biodiversity Conservation Action Plan". For the next 5 years, over 20 priority projects would require approximately a total input of 10.9 billion yuan, or about 1.3 billion USD.

[3] China (1998). China's Biodiversity: A Country Study - Executive summary, Organized by State Environmental Protection Administration of China, http://chinagate.cn/english/2036.htm