ECO-SECURITY TASK FORCE REPORT

Strategies for Controlling Invasive Alien Species in China

BEIJING 2002

Foreword

Since UNCED in Rio de Janeiro in 1992, biodiversity conservation or bio-security has been concerned more and more by international societies. One of the focuses is the issue of invasive alien species (IAS) and bio-security. People become aware of the ecological damage and economic loss resulted by IAS, either actual or potential, cannot be underestimated. Internationally, IAS has been listed the second largest threats of the loss of biodiversity after habitat deterioration.

Meeting the requirement of CCICED and the need of biodiversity conservation, the Eco-security Task Force was established with the approval of CCICED on the basis of the work of biodiversity working group. In about 2 years, evaluation and research of IAS and bio-security will be focused on in order to put forward pertinent recommendations to the government.

Due to the short duration since the Task Force established with official approval, as well as our international members being heavily involved in Johannesburg Summit Conference, it has been unable to hold a formal meeting of ETF dealing with the ETF mission. This report is therefore formulated on the basis of the study on IAS issue carried out by the former BWG and especially a recently held Workshop on China's Eco-security and IAS Control Strategies and Action. The participants include EFT Chinese members, one ETF international member and one of ETF member's representative, as well as invited experts from relative governmental sectors and international organizations. The Secretary General and members of the CCICED secretariat also presented part of the workshop. Therefore, the report is the result of collective efforts by experts in various fields to a certain degree. We appreciate their contributions to EFT and expect their further support and cooperation in the following years.

Strategies for Controlling Invasive Alien Species in China

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Executive Summary

The following recommendations emerged from the BWG/ETF's work on IAS as well as the Workshop on Invasive Alien Species held on 23-24 October, 2002, in Beijing.

Background:

- *Problems experienced by Invasive Alien Species (IAS) affect many production and health sectors as well as posing threats to native species, habitats and ecosystem functions.*

- *Globally, IUCN now rated IAS as the second greatest threat to global biodiversity after habitat loss.*

- *Some sectors in China are well aware of the problems and are applying good practices for combating the threats, especially in areas of health and production agencies whose productivity is directly affected by IAS. Less awareness and less activity is evident with respect to the invasion of natural and semi-natural habitats, where production losses are not noticed and the degradation caused by IAS is gradual and less spectacular.*

- *China is particularly vulnerable to Alien Invasive attack because its territory is so large and habitats so diverse that almost any species can find a home here; native habitats are damaged and degraded; and China is emerging as a major global trading nation with large-scale imports of grain seed, timber, wildlife and human visitors.*

- *Already several hundred Invasive Alien Species have been recognized in China and some case studies highlighted in the booklet produced by the task force indicate that these are causing great hardships and economic losses.*

- *In USA the total damage from these problems is estimated at more than $137 billion per year and there is no reason to imagine the figure for China would be much less.*

1.2 Recommendations:

- *China needs to develop a national IAS strategy and embark on a comprehensive programme to combat the threats of Invasive Alien Species.*

- *It is recommended that SEPA as the national agency responsible for Convention on Biological Diversity (CBD) affairs and overall coordinating agency on environment should form a special IAS committee to develop this strategy, review relevant legislation and supervise the overall programme.*

- *Many aspects of the programme would be undertaken independently by the concerned responsible sectors, but there are areas of overlap and synergy that warrant a comprehensive approach. Moreover, solution to IAS problems requires the cooperation of many sectors such as aviation, tourism, trade, shipping etc. that are not themselves feeling losses due to IAS.*

- *The nature of the problem is essentially international and requires close links to a number of relevant international programmes (GISP, IPPC, CITES, CBD etc.) and databases as well as direct collaboration with neighbouring countries and major trade partners.*

- *Although GMOs are very distinct from natural IAS, they pose similar problems with regard to threats to native species and ecosystems. It is important to apply similar risk assessments, and field trials before permitting field releases and IAS should be screened just as vigorously as GMOs in this aspect.*

- *Prevention of IAS entering the country is better than cure and early response is cheaper than waiting for major problems to develop. The focus of a national IAS programme should be prevention, early detection and warning system, rapid response and fast sharing of information and experiences.*

- *Any introduction of alien species into China should be subject to strict risk assessment. The level of risk acceptable should be determined in relation to the level of benefit expected from the introduction but systems of suitable risk assessment still need to be developed for some sectors (forestry and natural environment).*

- *Tightening up on the screening of species crossing national borders will have a secondary benefit of reducing vulnerability to deliberate import of malicious organisms for bio-terrorism purposes.*

- *Consideration of IAS risks should be built into all types of Environment Impact Assessment. In particular, the problems of unintended introduction of IAS should be covered.*

- *Due to the wide biogeographic variation across China, internal eco-region boundaries may need to be manned with checkpoints to prevent internal transfers of unwanted species.*

- *Considerable research and capacity development will be required and local IAS units will need to be established and equipped. This will require new public expenditure.*

- *The following guiding principles are recommended for the national programme :- User pays; full social cost pricing; precautionary principle; protection of the public interest and subsidiarity.*

- *A review of existing laws and regulations needs to be undertaken. New regulations are needed to cover gaps and loopholes in existing legislation. A new comprehensive law covering all aspects of IAS should eventually be drafted. The law should refer to dynamic lists of prohibited species, species allowed for introduction and species requiring different levels of risk assessment and testing. These lists will need constant revision and should not be embodied within the law itself but maintained by authorized expert committees.*

Strategies for Controlling Invasive Alien Species in China

Eco-security Task Force/CCICED

Introduction

"**Alien species**" (non-native, non-indigenous, foreign, exotic) means a species, subspecies, or lower taxon occurring outside of its natural range (past or present) and dispersal potential (i.e. outside the range it occupies naturally or could occupy without direct or indirect introduction or care by humans) and includes any part, gamete or propagule of such species that might survive and subsequently reproduce. "**Invasive alien species**" means an alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity.

China is the world's third largest country and one of the richest in terms of biodiversity. Its vast territory stretches 5,200 km from east to west, spans 50 degrees of latitude, and covers five climatic zones: cold-temperate, temperate, warm-temperate, subtropical, and tropical. Consequently, it has many types of ecosystems. A wide range of habitats and environmental conditions makes China especially vulnerable to the establishment of invasive species of foreign origin. Potential invasive alien–species from most parts of the world may find suitable habitat somewhere in China.

China's rapid economic development in the twentieth century, including explosive growth in trade and transportation systems, and especially becoming a member of the WTO, is increasing the pathways for the introduction and spread of invasive species within China and the introduction of new invasive species to China from other countries. Since many invasive species have long lag times from initial establishment until the appearance of a full-blown invasion, the full effects of recently arrived invasive species in China may not be felt until well into the 21st century. In the United States, the globalization of travel and trade has facilitated introductions of invasive species since the early days of the Industrial Revolution in the nineteenth century. Many species that were first introduced decades ago have only recently begun to spread rapidly in ecosystems. There has been an upward trend in the establishment of non-indigenous species, and large numbers of invasive species have been documented. In view of the ecogeographic similarities between the United States and China, the U.S. situation may be a good indication of future trends in China as China's world trade and domestic development continues to expand.

For many years, Chinese government departments responsible for agriculture, forestry, and animal husbandry, as well as customs authorities, have recognised the potential threat posed by a small number of alien species, leading to the quarantine of alien diseases and pests. However, it was

only a few years ago that the concept of invasive species was introduced into China and the potential threats to China's natural heritage are still not widely recognized. This contrasts with the situation in a growing number of countries where invasive species have become an important environmental issue.

There have already been many studies and publications, mostly from developed countries, on alien mammals, plants, weeds, fishes, mollusks, crustaceans, herpetofauna and wildlife diseases, including general discussions of pathways, vectors, the role of natural and human-caused disturbances (physical, chemical, climatic, *etc.*), and the economic and environmental impacts of invasions. The World Conservation Union (IUCN) has also established the Invasive Species Specialist Group (ISSG) to address problems of invasive species. The Convention on Biological Diversity (CBD), to which China and 177 other countries are Party, calls on governments to "prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species" (Article 8h).

However, in China, except for the attention given those species that have created great economic loss and damage to human health, little research on, or management of, invasive alien species and their impacts on natural ecosystems had been conducted. In 1999, several projects were initiated to remedy this situation. Statistics and educational material on the status of alien species in China and their potential to create harm have been collated and disseminated, and control measures directed at alien species implemented. Websites, such as www.chinabiodiversity.com and www.bioinvasion.org have been developed to improve public awareness. Current research estimates that there are already 600 naturalized plants species, in which the number of actual invasives is unknown, and far more than 60 animals species that have become invasive in China. The number of alien invasive micro-organisms and diseases has not been well enumerated but is probably high. . Except for a few fish species that are invasive across regions within China, these figures only count species that have come from foreign countries,. The situation of invasive species across regions within China is much more complicated and has been insufficiently studied.

Alien species occur in each of China's 34 provinces, municipalities and autonomous regions. They occur widely in both urban and rural landscapes, and also inside protected areas. Alien plants have been reported everywhere, except in a few remote reserves in the Qinghai-Tibet Plateau, Hengduan Mountains, Xinjiang and Inner Mongolia. Alien species occur in almost every watershed and ecosystem, including forests, wetlands, grasslands, and croplands. They are from many taxonomic groups, including mammals, birds, reptiles, amphibians, fish; arthropods and crustaceans; algae, ferns and seed plants; fungi, viruses, bacteria, and other micro-organisms. These AIS have already caused great damage in China. Since China stopped logging and is restoring vegetation in many places, IAS have become the most important cause of ecosystem degradation and biodiversity loss. Especially in freshwater systems and south tropical and sub-tropical regions, IAS have been considered as the primary threat to biodiversity loss. The damage caused by these species includes the replacement of local species, endangerment and extinction of endemic species (It has been recognized that introduction of alien fish was the first factor to endanger local fishes in Yunnan), the simplification and degradation of the ecosystem,

interference with the normal functioning of ecosystems, change and destruction of the local landscape and pollution of the local genetic pool. IAS have threatened human health and caused economic loss to China's agriculture, forestry, and fishery industries. A conservative estimate is that IAS cause many 100 billion RMB worth of damage each year in China (for details please refer to Appendix 1).

Invasive alien species in China published by the Eco-security Task Force of CCICED has introduced the status, and impacts of AIS, and the reasons they pose such a threat to the economy, environment, biodiversity and human health in China. It describes the taxonomy, identification, biology, current distribution, original distribution, reasons for introduction, impacts and control measures of 128 IAS in China. The book and the website created by ETF/CCICED at www.chinabiodiversity.com, provide essential information on the current status of IAS in China. This report is generated from these studies, and focuses on developing a strategy for dealing with the IAS issue in China.

China's people and government are now facing the great challenge of controlling AIS, minimizing the losses caused by IAS them and restoring a degraded ecosystem. Since 1999 the Eco-security Task Force/CCICED (former Biodiversity Working Group) has engaged in a comprehensive study and impact evaluation of invasive alien species invasive alien species . Based on these studies, ETF/CCICED compiled the booklet *Invasive alien species in China*, which is the first publication to comprehensively address the IAS issue. This work has drawn the attention of the government and public, and has created the scientific basis for further studies and monitoring of invasive species. IAS is an issue which relates to many sectors, such as legislation/enforcement, import/export administration, forestry, agriculture, husbandry, fishery, oceanography, environmental protection, research and education. Understanding and cooperation among these sectors on the AIS issue is key to the successful control of AIS.

Based on these concerns, ETF/CCICED held a multi-sectoral workshop to pursue a combined control strategy for IAS from 23~24 Oct. 2002 in Beijing. Management sectors attended the workshop were the State Environment Protection Agency (SEPA), State Forestry Administration (SFA), Ministry of Agriculture (MOA), Fishery Bureau of MOA, General Administration of Quality Supervision , Inspection and Quarantine of the People's Republic of China (AQSIQ), Ministry of Health (MOH), State Oceanography Administration (SOA) and State Endangered Species Import and Export Management Office (SESIEMO). Research institutions attending were the Insitute of Zoology and Institute of Botany of the Chinese Academy of Sciences (CAS), College of Life Sciences of Fudan University, Institute of Biological Control of the Chinese Academy of Agriculture Sciences (CAAS) and the Institute of Viral Disease of the Chinese Disease Control Center. ETF/CCICED made presentations on the overall status of IAS in China and international control strategies. Representatives from management agencies gave presentations on the problems and various control strategies existing in relevant departments. These presentations conveyed a favourable impression of current IAS control in China. Then participants had an enthusiastic discussion on how to strengthen management. The following report on "Strategies on Controlling IAS in China" was generated based on these studies and the subsequent workshop.

Guiding Principles on the Management of AIS

User pays: Make those responsible for the introduction of economically harmful invasive species liable for the costs they impose. Importers could be required to take out insurance to cover such liabilities. The government could apply commodity taxes to cover risks incurred by the importation of alien species.

Full social cost pricing: Ensure that the prices of goods and services whose production or consumption exacerbates the damage of invasive species reflects their true cost to society.

Precautionary principle: Precautionary measures should be taken wherever there is a perceived risk even in the absence of complete proof. A risk should be assumed to exist until proved otherwise.

Protection of the public interest: Since the measures to limit damages from invasive alien species invasive alien species are implemented mainly to protect public interests, public funds should be used to support such programmes.

Sharing of information: Agencies holding information about IAS risks liable to be faced by other agencies are required to allow free access to such information and are encouraged to maintain relevant information on open web sites.

Right of redress: Persons or agencies facing threats or damages as a result of IAS have the right to seek compensation from the responsible importers.

Grassroots management: Operate policies and management at the lowest level of government that can effectively deal with the problem.

Holistic approach: Coordinated programmes should involve all relevant stakeholders including NGOs and the general public.

Timely action: Prevention is better than cure and early response is cheaper than delay.

Facilitating coordination and cooperation between relevant agencies

The IAS issue relates to many agencies including those responsible for legislation/enforcement, import/export administration, agriculture, forestry, animal husbandry, fisheries management, marine resources, environmental protection, customs, quarantine, health, research and education. Other agencies involved include the departments of tourism, civil aviation, transport and shipping, army, trade, zoos, botanic gardens, wildlife breeders, food importers, universities and normal colleges. Understanding and cooperation among these sectors on the IAS issue is the key to the successful control of AIS. The number of different agencies involved has resulted in serious overlap and duplication of effort, management gaps and a sometimes unscientific approach to IAS

issues. Moreover, there is far from enough communication and exchange of information among these sectors. Each sector usually considers the IAS issue soley from its own perspective and fails to recognise the potential damage to other sectors, especially the environment and ecosystems. This often results in inadequate or no management measures being taken.

Actions suggested:

- **Establish a "National Invasive alien species Commission" with sufficient authority.** Like the State Environment Protection Commission which serves as a comprehensive coordination mechanism for different government agencies on environment protection programmes, there is a need to establish a National Invasive alien species Commission. Legislation is required to empower such a commission. The commission would exert these rights in the name of the State Council. The rights should include the power to: 1) draft and revise relevant laws and regulations; 2) coordinate relevant sectors/make decision on control strategies; 3) determine permit systems on the importation of AIS, such as revising lists of species to be controlled; 4) draw up and approve terms/definition to standardize terms. Staff and tasks of the commission should be relatively stable.
- **Establish an "Invasive Alien Species Expert Committee".** This will strengthen cooperation and have a supervisory role with respect to scientific research. Legislation is required to give the committee the power to evaluate, supervise and guide scientific research. The committee will manage species lists to be managed. It will also have the function of coordinating different sectors.
- **Hold multiple-sector workshops.** Hosted by the National Invasive Alien Species Commission, the Invasive Alien Species Expert Committee should hold at least two workshops each year which national and international experts and relevant sectors should attend. These workshops will prepare proposals on strategies, actions and programmes and apply and coordinate national and international funds. Each sector should be requested to devote a necessary proportion of its working plan to addressing the issue of AIS.
- **Strengthen information sharing among management sectors.** A Biological Diversity Convention (CBD) Implementation Office has been established under the framework of the CBD. This has initiated the development of a Biodiversity Information Clearing House. The Clearing House should be greatly expanded to promote itself as an important tool of integrating information from different sectors, promoting information exchange both vertically from the grass-roots to central government as well as horizontally between agencies. The Eco-security Task Force of CCICED could be involved in facilitating coordination and help with development of this Clearing House.
- **Strengthen cooperation with research institutions.** Both national and international cooperation and management of IAS should have a solid scientific base. Cooperation between management sectors and ecological societies should be achieved at all levels. In order to deal with the IAS issue more effectively, before and during management operations, ecological specialists should be contacted and consulted to develop specific management plans, steps and approaches. Inappropriate management can exacerbate an invasion or the ecological damage caused by AIS.
- **Strengthen communication and cooperation with local communities.** The IAS issue is

closely related to the life style of every person. Control measures are often implemented in areas with high levels of human activity. In inhabited areas, the IAS issue is closely related to the interests of local communities and the control of IAS will have a direct impact on such communities. Therefore, effective control of IAS requires broad base local participation. Local communities should be encouraged to work cooperatively with IAS government agencies to deal with IAS issues. Local people should be invited to contribute to management plans and it should be recognized that their support is the key to the success of these plans. Use rural spare labor, or, during the fallow season, promote grass-roots control measures. Regional and small scale IAS control or eradication programmes should mostly rely on local people supported by subsidies from the government. Recruit volunteers to promote management of AIS, establish and improve the IAS investigation systems, reporting and response IAS at the community level. Local people should become the front line in dealing with IAS and protecting ecosystems. Education to combat the blind introduction of IAS and destruction of ecosystems is another urgent requirement. Strategies to encourage local people to become involved in this work should be developed.

Strengthening legislation

Existing laws or regulations already address to some degree the control of AIS. These laws or regulations are the People's Republic of China (PRC) Animal and Plant Quarantine Law, PRC Import and Export Goods Inspection Law , PRC Health Quarantine Law, PRC Plant Quarantine Regulations, PRC Animal Epidemic Prevention Law, PRC Livestock and Fowls Prevention Regulation, Agriculture GMO Safety Management Regulation, PRC Wildlife Protection Law, PRC Oceanic Environment Protection Law, PRC Food Hygeine Law, and PRC Plant Introduction Law (for details please refer to Appendix 2). The major agencies resposible for implementing these laws are: the Bureau of Import and Export Animal and Plant Quarantine, Agricultural Techniques Popularizing Center and Plant Protection Stations of MOA which distributed nationwide, the Forest Protection (Quarantine) Stations of SFA, and branches of SEPA and MOA. However, the legislation and agencies mentioned mainly focus on plant diseases, insect pests and weed quarantine. No attention has been paid to invasive organisms that may not cause serious economic losses in the short term but threaten ecosystems and biodiversity. China has a vast territory containing many kinds of ecosystems. Not enough attention has been paid to control of species movements across ecosystems within China, and there is no regulatory mechansim to manage regional AIS. At the same time, although China has taken some measures to control the risk of introductions through national ports, a complete set of IAS control systems is far from established. Little emphasis has been placed on early prediction, supervision, control and rapid response systems to manage invasive species risks. Thus, there is an urgent need to develop legislation to control IAS in order to protect ecosystems and biodiversity.

Actions suggested:

- **Improve existing legislations relevant to AIS.** There is a need to evaluate and improve existing legislation, so that it can adapt to the situation after China has entered the WTO, and to protect both our industries and environment. Add sections on AIS. Strengthen management

of each sector especially aspects pertaining to ecological and environment impacts from AIS. For example, the Plant Quarantine Regulation should be upgraded to a Plant Quarantine Law to strengthen plant quarantine within China. Development of legislation and control plans should be done in consultation with scientists and lawyers.

- **Develop Invasive Alien Species Management Regulation.** Having reviewed existing legislation, the Task Force has agreed that the system is not able to wholly minimize the damage to ecosystems or economic and human health caused by AIS. Consequently it is necessary to begin drafting Invasive Alien Species Management Regulations, which can be upgraded into a law when appropriate. The regulations should address the IAS problem in different regions within China (such as among provinces) and should improve the species introduction permit system.
- **Increase the scientific content of legislation.** Develop managed species lists and risk assessment methodology based on plenary scientific studies and information gathering. These scientific results should be listed as appendices to laws or regulations and serve as references for the implementation of legislation. Laws should be stable for a relatively long period, but the appendices should be updated regularly to keep abreast of advances in scientific knowledge and changing conditions.

Creating Awareness

In the past 50 years, environmental education has helped the public realize the impact of human civilization on the natural environment. There have already been many measures implemented to protect the environment such as measures for the prevention forest fires, reducing chemical and waste pollution, recycling, etc. The new environmental ethic has already effectively changed people's behaviour and IAS education has become a new field in environmental protection. As we know, IAS is closely related to human activities. Human transportation is the key channel for the spread of IAS , therefore peoples' habits and lifestyles are an integral part of the IAS issue. Today, most people know that they should not do activities which will cause chemical or physical pollution. However, most people remain ignorant of the environmental risk posed by carrying or introducing AIS, and the casual release of alien animals remains a major problem in some parts of the world. People should be educated to notice, report and tackle IAS problems. Awareness of the nature and scale of the problem and the respective responsibilities of many sectors of society needs to be increased by a widely ranging programme consisting of the following elements.

Actions suggested:

- ***Establish a new biosafety prevention ethic.*** Widely increase public awareness of the risks posed by IAS and the importance of maintaining biosafety, so that everybody will be conscious of the potential of spreading IAS through their own activities. Each sector and individual should recognise they have a responsibility to control IAS and establish a new ethic which will help prevent the unintentional introduction of AIS. Try to use local species wherever possible. Develop a National Invasive Alien Species Information System to provide information and technological assistance through a network or other channels. Mobilize the public to help the early detection of new alien species and reporting any such recent invaders

to the relevant institutions.

- ***Make IAS education part of the school and university curriculum.*** Build an education base by promoting relevant education in primary and middle schools. Knowledge on controlling IAS should be added to courses on the natural sciences in primary and middle schools throughout China to increase public awareness. Various activities could be encouraged. For example, "Biosafety week" or "Biosafety interest groups" could be established in addition to training workshops, field studies of typical invasive species, writing short scientific papers, collecting alien species specimens and so on. There are already ecosystem and environment relevant specialist courses in universities and colleges. These institutions should regard the training of specialists to deal with IAS issues as a long-term task. Normal universities should set bio-security education as a basic course. Academies should take in graduate students and Ph.D candidates to major in IAS studies, and send scholars to overseas institutions study IAS problems and management. Faculties of environment protection, nature resources, economic trade, legislation and administration, should also include relevant aspects of IAS management in their own training courses.
- ***Fully utilize mass media:*** The mass media are the most efficient means of promoting public awareness. Radio, television, films, newspapers, magazines, electronic publications, websites etc. can all be used to increase public awareness. Government agencies and NGOs should organize various activities and use the media effectively to publicize these. Use public, easily accessed and attractive approaches, such as education courses or public display boards. Establish education stations in ecologically vulnerable sites, provide various education materials, and make sure that every family is aware about the IAS risk at these sites. Take advantage of World Environment Day, Earth Day, International Biodiversity Day and other relevant commemorative days and important conferences to conduct intensive education programmes. In urban areas, establish long term education IAS display panels in scenic spots, zoos, wildlife parks, botanic gardens, and aquariums. Various protected areas including nature reserves, world heritage sites, and scenic spots should include IAS public awareness as one of their long-term tasks. Ecologists and biologists should also be actively involved in disseminating information and educating the public about AIS.
- ***Conduct high-profile media events to stimulate public interest:*** conduct well publicised, attention-grabbing projects and action programmes to draw the attention of the public. Mobilize artists and scientists to work together, and present the IAS issue in media-friendly ways. Create a strong public voice in society and increase public pressure on those responsible for IAS management, especially the relevant officials at various levels of government. Refer to positive and negative case examples to improving public awareness of how IAS threats should and should not be managed. Strengthen media and public scrutiny of IAS management, praise best practices and expose illegal behavior. The objective of public education is to make society aware that the IAS issue is a basic component of bio-safety, and that managing the IAS threat depends on the vigilance and voluntary cooperation of the entire community.
- ***Hold various training courses.*** Ecological research and education institutions should be in charge of providing training materials; conservation and management experts should be engaged in preparing training plans and teaching materials. Training methods must be enjoyable and flexible to suit different situations. Course contents should be both specific and

practical. If possible, training should be conducted locally, and integrated with the local situation. Relevant local people should be heavily involved. There should be special in-service training courses for local government planners and officials.

- ***Public access to information.*** Since the public has the right to obtain relevant information it is necessary to establish channels to effectively disseminate such information. These could include an IAS telephone "hot-line", research institutes, and public web sites. Bulletins should be active and on time.
- ***Shared experience:*** international exchanges of experience, information and expertise
- ***Promote NGO's role on education.***

Strengthen International Cooperation

The IAS issue is a global issue that transcends national borders. Therefore, controlling IAS inevitably involves international trade, customs, quarantine, etc., all of which will have impacts on the economy and international relations. Control techniques (for example, the introduction of natural enemies of AIS) will require international cooperation and research. It is necessary to share information and cooperate with neighboring countries, especially in Southeastern Asia. Some species (Crofton Weed (*Eupatorium adenophorum*)) entered China either naturally or through human activity from Southeastern Asia. Many IAS in southern China are also spreading into Southern Asia. Therefore, it is necessary to maintain clear lines of communication with these countries to ensure information sharing and coordinate management of IAS threats.

Action suggested:

- China should fully participate in relevant international initiatives. These include: the Convention of Biological Diversity, Cartagena Protocol on Biosafety, United Nations Convention on the Law of the Sea, Ramsar Convention (Wetlands of International Importance), Convention on Migratory Species of Wild Animals (Bonn), International Plant Protection Convention, Plant Protection Agreement for the Asia and Pacific Region, Agreement on the Application of Sanitary and Phytosanitary Measures, International Health Regulations, Agenda 21, Code of Practice on the Introductions and Transfers of Marine Organisms, Code of Conduct for Responsible Fisheries, Code of Conduct for the import and release of exotic control agents, Prevention of the Introduction of Invasive Alien Species resolution of the International Civil Aviation Organisation, Convention on International Trade in Endangered Species of Wild Fauna and Flora, Global Invasive Species Programme, and etc. (for details please refer to Appendix 3)
- China should enter into special cooperation agreements with its many land neighbours and nearest marine neighbours. ASEAN countries are currently developing an ASEAN Regional Strategy on Invasive Alien Species and are keen to include what they term ASEAN plus 3 (China, Korea, Japan).
- Strengthen cooperation with trade inter-transfer ports, such as Hong Kong, Macao and Taiwan.

- Invite involvement of IAS international experts in drafting relevant law.
- International experts should be invited to assist with training relevant staff and to exchange information and experiences

Develop Research Capacity

Greater research effort should be diverted to solve several urgent IAS problems:

Action suggested:

- Improve facilities and establish technical bases for controlling AIS. Develop national alien species information and data collecting nodes and an information sharing mechanism. Gather information and fill gaps where basic information is lacking. Develop an Invasive alien species Information System and form the base for management decision-making. Establish an alien species identification center, setup required equipment and form academic groups focused on dealing with the IAS threat. Develop research institutes and mechanisms for cooperating on the IAS issue.
- **Strengthen fundamental studies.** Basic scientific studies form the foundation for controlling AIS. For example, *Flora of China* and *Fauna of China* should be revised, and amended by inclusion of material on AIS. Promote greater taxonomic skills particularly parataxonomy at local levels so that people can spot IAS or notice the appearance of new species in their environment. Conduct systematic surveys, region by region and sector by sector to get a comprehensive understanding of the IAS situation IAS in China. Build basic information interfaces and initiate monitoring. Conduct further studies on the impacts of IAS on ecosystems and the environment. Conduct studies on the relationships between human activity, climate, land-use and the spread of alien invasive species. Identify key habitats and localities that require special protection from the threat of alien invasives. Identify key zoogeographic barriers where intra-national controls on the movement of species should be applied.
- **Strengthen studies on relevant methodologies, criteria and guidelines.** Develop standards of IAS management, incorporate international technical criteria appropriate to the Chinese situation, and develop national or sector criteria for investigation, monitoring, evaluation and management. Develop suitable risk assessment methodologies for respective sectors. Develop sound field trial methods and criteria for different taxa. Develop suitable field monitoring and reporting methodologies for different sectors. Develop and test appropriate technologies for the containment, eradication and control of different invasive species. Develop specific safety tests for GMO's. Develop methodologies for habitat restoration. Develop better screening procedures to exclude alien species from packing materials, ballast water, ships' hulls, luggage etc.

Develop Management Capacity

Control and management of IAS requires high quality, efficient and progressive personel. Therefore, there is an urgent need to improve the quality of managers at all levels, and establish

management teams qualified to deal with AIS.

Action suggested:

- **Strengthen institutional and system development.** Form cross-sector working teams and committees at different levels. Establishing IAS specialist positions in natural resource management agencies. Develop monitoring and reporting as part of an early warning system. Develop rapid response mechanisms appropriate to different sectors**.**
- **Provide Traing.** Training in parataxonomy is needed so that field teams can undertake monitoring of indicator species and detect alien species in local environments. This should include: the training of customs and quarantine staff in recognition of potentially dangerous or banned species, design and introduction of new materials into education and training programmes, training of local teams in environmental restoration techniques, inclusion of IAS aspects in Environmental Impact Assessments, training in risk assessment and field trials, improved data management and information access and familiarisation with international programmes, initiatives, terminology and standards.
- Management capacity requires urgent strengthening in several sectors especially at the local level.

Develop IAS risk assessment system

The degree of risk posed by an alien species needs to be estimated by conducting risk assessment prior to authorizing release. Consequently, an invasive risk assessment system is urgently needed. This system should be based on characteristics of alien species and determine the risk of a given species establishing itself in the wild. The risk assessment system can be part of the introduction permit system, but should also be used by local management departments to manage local alien species, detect potential IAS threats, identify species that require monitoring, develop control strategies and promote awareness. Risk Assessment forms the basis for granting or not granting permission to import, introduce or release alien species or undertake activities considered to have a risk of accidentally introducing or inviting alien species invasion.

Risk Assessment has several components – health risks; threats to productivity; threats to local wildlife and biodiversity; risks of causing environmental damage or loss of the ecological services of ecosystems. This may require different kinds of screening and assessment by different concerned sectors but two major components will generally be: ‘What is the likelihood of this species becoming invasive in the environment?’ and ‘What type of damage or loss could such a species cause?’. Being found to be a low risk to one sector does not imply that a species has no risk to other sectors, and being found to be of low risk in one region does not imply that the species will also be low risk in different regions or ecosystems.

Currently, some relevant departments have established Risk Assessment Systems. The SQCA has conducted Pest Risk Analysis (PRA) since 1980, and its plant PRA work is in the ahead of the global plant quarantine field. It has developed qualitative and quantitative risk assessment procedures incorporating GIS software, and has created technical bases for quarantine

management agencies. The MOA has organized an agriculture research institute and academies and SFA has also organized the Chinese Academy of Forestry and other research institutes to conduct risk assessment. SEPA has organized the Nanjing University and other environmental protection research institutes to establish a risk assessment system. The ETF/CCICED has also draft a risk assessment system (Appendix 4: Alien Species Invasion Risk Index System). The participants agree that the system should primarily "assess the risk of alien species becoming established in the wild" instead of focusing on the potential "economic damage" caused by alien species. This makes the system more ecologically relevant, but at the same time creates a need for more detailed information.There willl inevitably be situations where the risk of an alien species becoming established in the wild will be unknown due to a lack of information. The appropriate response in such situations requires further consideration.

Action suggested:

- **Establish a species introduction permit system.** Based on the precautionary principle, establish a "Species Introduction Permit System". This would require any individual or organisation who want to introduce alien species from foreign countries or different ecosystems within China to apply for a permit. The permit cannot be issued until it has been proved that the proposed introduction will not cause damage to national or regional ecosystems, the environment, human health or economic development. As China is so huge, this requires regional screening. A species found to be safe in one part of China cannot be assumed to be safe in other regions. Each province should issue its own licenses for importation.
- **Revise the organism list:** Some import and export quarantine species lists have been developed in China but are far from complete. Updated potentially invasive species lists are needed. Th introduction of species on those lists should be prohibited or restricted according to the degree of perceived risk. Dynamic lists are recommended. Lists should have 3 categories: 1. Black List. Species known to be invasive and so destructive that their introduction should be prohibited; 2. White List. Shows species that stringent testing has shown to have such a low probability of invasion that they can be introduced; 3. Grey List. Shows species of uncertain risk that require further risk assessment. The Grey List includes all species not listed in the black and white lists.
- **Develop an Alien Species Invasive Risk Assessment System.** Organize a cross sector team, including experts from the State Quality Checking Agency, MOA, SFA, SEPA, SOA and CAS, to develop an Alien Species Invasive Risk Assessment System. The team could work as a Task Force. The system should consider the impacts of IAS on the economy, environment and society, placing particular emphasis on long term ecological impacts.

Field Release Trials

Action suggested:

In many cases field release trials under controlled and reversible conditions may be a necessary component of risk analysis prior to giving permission for more widespread releases. This is

particularly relevant to the release of GMO's.

One particular problem in this respect is the long lag time invasive alien species invasive alien species between the time of a species first establishment and the time when its invasive nature becomes evident. Because of this, it is prudent to apply the precautionary principle and assume a high risk for any alien species that shows it is capable of establishing itself in the natural environment without further human assistance. By simply occupying space, the species is already competing with some local species.

Information Sharing

The sharing of information is one of the cornerstones of the national programme for combating alien invasive species. It is essential that everyone involved in the programme have access to the best possible information.

Action suggested:

- **Compile information on AIS.** This information will include both the identification of AIS and the risks associated with given species. This information can be organized into coded lists. For instance a Black List showing species known to be invasive and so destructive that their introduction should be prohibited; a White List showing species that stringent testing has shown to have such a low probability of invasion that they can be introduced; a Grey List showing species of uncertain risk that require further risk assessment. Knowledge about species movements – source, pathway and destination of species - is required including the movement patterns of migratory species. The main requirement is information on the natural ecology of species such as: details of natural enemies, diseases or controlling agencies of species; details of the documented continuing spread of invasive species, preferably in point plot map format; case studies of the impact, damage or health hazards associated with particular species; access to best practice methods for eradicating or controlling different species. Details of international protocols, standards and practices are also required, such as, details of land cover, land-use, major development plans and scenarios of climate change.
- **Manage information by using databases.** Such data need to be maintained in easily accessible databases, preferably on open web sites. Databases should be maintained and regularly updated by data custodians familiar with the nature of the data, i.e. experts in the particular taxa or sector concerned, but also need to be linked into an efficient network for wide access. The network will itself need to be networked to regional and global databases due to the transfrontier nature of the datasets involved. A network is more efficient than a centralised database because data can be managed by specialists and can be updated without downloading or multiple editing of the same files or records. There is some sense in having a central website at the hub of the network which can generate news, highlight developments and serve as a search engine to direct the data seeker to the most appropriate database. Databases need to be dynamic and responsive. Interactive databases should be able to receive raw data quickly from the field but such data requires screening and verifying before being uploaded onto public sites.

Strengthen Monitoring：

Field monitoring is the basis for the early detection and rapid response to the establishment of new alien species; evaluating the effectiveness or success of control prescriptions; reporting to database systems and information sharing. High levels of public participation are required.

Actions suggested:

- **Improve IAS surveys.** Conduct surveys at the level of province or county to determine the status of local IAS and their impacts on local ecosystems. Then conduct regular surveys each year to monitor changes. Strengthen specific survey and monitoring of particularly harmful IAS and in critical areas (such as seriously impacted areas, ecological vulnerable areas and ecological nature reserves)
- **Strengthen information management system development.** Gather and manage information on AIS, especially data from field surveys and monitoring. Develop database and GIS records, map impact situation at county level. Using a website, compile monitoring information from various sectors and develop it into dynamic database that can be updated frequently. Develop an identification expert database, so that experts can be easily located to help identify potential AIS.
- **Develop monitoring procedures and criteria.** The details of monitoring will differ from sector to sector. The agriculture sector would monitor weeds, pests and other agricultural problems, fisheries would monitor catch size, species composition, species size and condition; foresters would monitor weeds and pests in forests and plantations whilst conservationists would note the appearance of new species in the natural environment; health agencies would monitor the spread and movement of diseases and disease vectors, trade agencies monitor patterns of demand, supply, consumption and customs and quarantine monitor species and their condition at ports, borders and other checkpoints. Suitable monitoring procedures still need to be developed by different sectors and staff trained to implement these procedures.
- **Develop reporting and bulletin system.** A regular reporting system will gather information on time which will assist in making reports to management sectors and timely management. The government agencies responsible should publish prevention lists, impacts and relevant control measures.
- **Develop monitoring responsibility system.** Organisations or individuals that seek to introduce new species should be required to contribute to the monitoring of such species to avoid the risk of invasion. If an introduced species becomes invasive, the introducer should be responsible for its eradication, and face legal or economic liabilities.
- **Strengthen monitoring capacity training.** In some cases there will need to be an improvement in the staff's abilities to recognize different species; this could be assisted by the production of specific keys or identification guides. Such guides could also be made in easily to use electronic formats – web, palm computers etc.

Develop an early detection system

Even the best standards of quarantine and controlled introduction systems cannot totally prevent

the invasion of alien species; it's inevitable that some alien species will intentionally or unintentionally be introduced into a new ecosystem and that some of these will become invasive. For example hundreds of varieties of grass are currently being introduced into China as part of the growing turf industry. If a new invasion is not detected and control measures are not taken in time, serious damage will probably occur. Early detection and timely control measures are essential since: A) The cost of control is extremely high and artificial removal is often impossible. B) Many invasions cannot be controlled. China already has some early detection systems. SQCA has a report system on port interceptions that requires making daily reports and developing a database. MOA, SFA, and SOA have their own epidemic reporting systems. These departments also have an epidemic monitoring system. However, these systems are only applied to a very limited number of quarantined species and there is no monitoring and early detection system for species that may impact on the environment and ecosystems.

Action suggested:

- **Establish a National Early Detection System.** As a matter of fact, to establish a national prediction system of invasive alien species is to develop a coordination mechanism between local and central governments. Governments should establish multimedia networks (websites, publications, CD, etc.) to provide information on invasive alien species, help evaluate the risks posed by them, predict potential influence and offer recommendations on management measures. At the same time, all sections should report new records and current status of invasive alien species to the responsible authorities through the appropriate channels. This early prediction system supplements introduction control measures. The two measures can work together to better combat the economic and environmental losses resulting from invasive species.
- **Develop an early warning system at the provincial level.** As important as the monitoring itself is the swift transfer of data to databases that can collate and analyze it at different levels. This forms the basis for an early warning system. Data should be reviewed by specialists, probably at provincial level so that early alarm can be given whenever new invaders are noticed or established alien species show signs of becoming invasive. These provincial agencies should have the capacity to make spot checks to verify incoming reports, verify species identification or propose revision or intensification of monitoring procedures. It is recommended that such agencies are based in provincial offices of SEPA but have the ability to call on provincial experts in other agencies or academic institutes. In consultation with national and other provincial agencies, provincial units should decide on the most appropriate response to new threats and launch appropriate actions within the appropriate time-frame.

Develop quick response system

Strict monitoring is needed for established IAS alien species that have high invasive risk. Once there is any sign of invasion or reinvasion, control measures should be put in place as quickly as possible. To avoid outbreaks of AIS, an efficient quick response system should developed. Currently SFA has some quick response systems, such as aerial control. MOA has a quick response system to deal with a serious epidemic situation, and SQCA has a relevant emergency

action plan. However, these existing quick response systems do not consider the problems facing the environment and ecosystems. There is an urgent need to develop quick response systems to deal with full-scale, especially environment and ecosystem, invasions. When the actions to be applied in response to new threats are determined, these should be transmitted to grassroots agencies at the county, or even village, level for action. The effectiveness of the rapid response mechanism will depend on the efficiency of the entire communication network and the preparedness of the local agencies to undertake the prescribed actions. This in turn will depend on manpower, budgets, availability of suitable tools or equipment, training and skills. Creating such capacity will be the role of the management capacity development programme.

Actions suggested:

- **Train staff in bio-emergency response techniques and prepare equipment and resources.** Very different types of training and readiness will be required in different sectors, but actions could include: manual weeding of invasive plants, applications of herbicides and pesticides; erection of animal fences; capture and destruction of dangerous animals; taking of samples or specimens for further analysis; inoculation programmes; erection of checkpoints; destruction of poultry or animal herds; restriction of access to critical areas; halting of ongoing construction projects etc.
- **Establish emergency fund for controlling AIS.** Ensure that there are enough funds for quick response. This fund should be able to cover costs for hiring experts to conduct identification and research, field surveys, eradication operations and subsequent monitoring.
- **Develop vulnerable area system.** Classify vulnerable areas according to their degree of risk. Set up buffer zones to strengthen quarantine and control introduction channels to stop bioinvasion to vulnerable areas.
- **Improve quick response capacity.** Strengthen education and training on known high risk species, so that problems can be identified as quickly as possible and timely action taken. The species listed in *Invasive alien species in China* can be a good reference.

Develop a system of economic responsibility and appropriate penalties

At present, most people are ignorant of scale of economic losses resulting from AIS. Invasion is usually is a slow process with limited initial impact and unclear economic loss. At this stage, it is difficult to prove that a given species is invasive, therefore such species receive little attention until an irruption causes great economic loss. When people intentionally or unintentionally introduce some species to new habitats, they are usually not aware of the risks. Moreover, in most cases, these risks do not threaten their own interests. Before an IAS causes great damage, people can hardly monitor them, take early control measures or accept economic responsibility for the subsequent impacts of such species. When damage finally occurs, all economic costs are carried by others or future generations, rather than those who permitted or imported these pests. This is neither fair nor reasonable.

It is a ridiculous situation that China, which has probably has more native species of grass than any other country, has never developed any of these species commercially. 95% of all grass planted in China is alien seed. The risk introduced by such practices could easily be avoided by

using native plant resources in preference to exotic plants.

Action suggested:

- **Include IAS control as one of the ecological conservation measures in the national financial budget.** Ecological conservation is a basic task for all levels of government. Government responsibilities should include the quarantine and control of AIS, which should also be included in the ecological conservation plans of different levels of government, including the national basic plans and budget. Central and local governments should arrange funds accordingly. Within the national budget, basic construction investment, agriculture support funds, ecological restoration and environment integrated renovation funds, unemployment benefit funds, poverty alieviation funds, environment conservation funds, integrated agricultural development funds, plus all industry and enterprise fees, should regard IAS management as an important component of their annual plans and increase the amount allocated for this yearly.
- **Develop a risk fund.** Since the impacts of IAS may only become apparent after several decades it is possible that the agency responsible for the importation of a species that subsequently becomes and invasive pest may no longer exist. Therefore, all importers should be required to pay into a risk fund according to the estimated degree of the risk posed by the organism they import, or establish a risk sharing system to transfer some of the economic risk of IAS to the private sector or commercial insurance companies.
- **Develop measures to compensate for losses caused by AIS.** In addition to legal punishment for people or agencies who who illegally import AIS, these parties should also be required to pay compensation to those who suffer economic or other harm as a result of their actions. Victims of economic or other damage caused by IAS should also be able to apply for compensation from the National Government. There is also a need to scientifically evaluate the risk posed by species currently listed in introduction duty fee policies**.**
- **Develop economic penalties.** Appropriate government agencies should develop and implement regulations for applying economic penalties to agencies or individuals responsible for ecological damage and economic loss. If an imported alien species is no longer required due to changes in market prices, the agencies or individuals who introduced it should either properly dispose of it, or pay for its proper disposal.
- **Improve cost-benefit budget methodology.** Effective control of invasive alien species requires clearly defined responsibilities. Especially in international or national trade, the cost of potential risks by introducing IAS should be factored into trade costs. A fair and reasonable mechanism to define the economic responsibilities of introducers of potential IAS should be developed. The introducers should evaluate the risk of given introduced organism, undertake field trials, monitoring and control measures, and accept responsibility for compensation if the IAS organism causes damage. If introducing an alien organism carries an economic cost proportional to the risk it poses to the environment introducers will consider such introductions more carefully.
- **Promote the use of local species.** Encourage local governments to promote the use of local species. Develop policies to promote public use of local species. Strengthen scientific studies on local species to build a scientific basis for their utilization. A proposed introduction of an

alien organism should only be considered if it has been proven safe to human health and the environment and if there isn't a suitable local equivalent.

Prevention Measures

The best way to reduce the risk of invasive alien species invasive alien species is to prevent their entry into the country or area of interest.

Prevention has several components:
Legal: regulations to prohibit or control the import or movement of high risk species
Permits: to control import, export and movement of potentially risky species
Quarantine: to reduce the risk of accidental entry of species
Customs: to check for illegal movement of species and verify details of permitted movements of species

Actions suggested:

- All these mechanisms are already in place in the health sector and as part of the CITES agreement to which China is a signatory. All that is required is an expansion of the lists of species requiring different types of permits.
- Under CITES an exporter from another country must acquire both an export permit from the country of origin and an import permit into the destination country before shipment is possible. In this way unwanted shipments are prevented at point of origin, not halted at the gates of the destination country. Such a system should be extended to all species imports.
- Customs officers would require training to identify high risk species.

Eradication programmes

Where border control measures have been breached and a new alien species has become established and detected through the 'early warning system', a quick decision should be taken as to whether eradication should be attempted. Similarly, a permitted introduction may result in an unexpected invasive situation in which case there must be the capacity to quickly withdraw the permit. Another possibility is that a species which has not been permitted for release, but has been permitted for captive confinement, escapes from its cage. In this case an eradication programme needs to be initiated as soon as possible. Such a programme should be supervised by specialists. Techniques will vary from case to case. A disease may be controlled through inoculation. Escaped vertebrates may be trapped, hunted, or poisoned. Weeds can be physically removed or killed with herbicides. Biological control agents can be introduced to prey on or parasitize the pest species. In the case of insect pests, sterile animals can be introduced into the feral population to reduce its fecundity.

Action suggested:

- **Develop effective eradication capacity before taking action.** Eradication and control have very different objectives. Control operations attempt to limit the impact of an IAS by restricting its population size or range IAS , while eradication attempts to entirely exterminate an invasive species from a given region. Obviously eradication is preferable since it eliminates the pest and obviates the cost of long-term control. However, eradication is usually more difficult than control and may not always be feasible. Effective eradication operations require careful evaluation and planning and adequate resources. These include: 1) A sound scientific base that must be carefully reviewed by authorising agencies before the operation is launched; 2) Effective monitoring methods to ensure that the pest is, in fact, eradicated; 3) The support of the local community and all relevant stakeholders; 4) The support of relevant legislation and institutions; 5) Adequate funding; 6) Effective, cost-effective techniques; 7) Measures to prevent any further introduction or invasion. It is important to ensure that eradication techniques and approaches are environmentally sound, ethical and socially acceptable. Methods should only affect the target species and do minimal damage to local biodiversity and the environment. There should be provision to undertake any necessary ecosystem restoration measures after eradication.

- **Developing suitable methods of response** forms part of the research capacity programme, learning successful techniques through the information sharing system will be very important and training in the application of such techniques will form a major part of the management capacity programme.

Control programmes

Total elimination of pest species is usually difficult and is virtually impossible unless the pathway of invasion can be terminated. An interim stage that is easier to achieve is, control ; the containment of an IAS within a prescribed geographical area. It is usually only possible to apply control programmes to prevent the further spread of IAS and minimise their ecological impact.

Actions suggested:

- In managing control programmes it is necessary to carefully monitor expenditure against perceived damage mitigation. Sometimes the costs of control are too high relative to the benefits achieved. But there are many cases where the savings from control programmes are hundreds or thousands of times greater than the cost.
- Again, the same caveats apply to control programmes as elimination programmes.

Critical Site protection measures

Where invasive alien species invasive alien species are already well established inside the country and eradication is deemed impossible, it becomes important to reduce their impact on local biodiversity by ensuring security for precious and endemic species at key sites. Such sites include

the national system of protected areas and other geographically critical areas such as areas of local endemism, isolated lakes, mountains, mangroves, islands etc.

Actions suggested:

- Special management or protection measures should be considered for such sites. These should include: Strict prohibition of any alien introductions within the site or a surrounding buffer zone; Careful planning of surrounding land-use adjacent to the critical site; Vigorous monitoring of the site and surrounding areas; Aggressive control and eradication programmes for alien species found in site or surrounding areas; Protection of key species on isolated islands that can be more effectively protected from alien invasion.
- Protected areas should not be used as release sights for confiscated wildlife that have not been screened for diseases and are of unknown origin. Only healthy local species should be released into protected areas.

GMO issue

China is gradually becoming a big producer and importer of transgenic organisms and products. The impacts of these organisms on ecosystems and the environment should be evaluated. GMOs are a kind of alien species. The GMO issue in China has the following features: 1) The geographical scale is large. A main GMO crop is transgenic cotton which has been planted over 1.5 m hectares. There are also another 4 kinds of crops including corn, soya, tomato, and Petunias that have been commercialized. In addition, each year there are 15 m tons of soya beans imported from the USA most of which are transgenic. 2) The public lacks awareness of the issue. There may be advantages in having some GMO foods on Chinese markets, however without labeling consumers' rights have been violated. 3) Legislation is not complete. Although the Ministry of Science and Technology, MOA and MOH have issued some regulations, inconsistency among these complicates management.

Actions suggested:

- **Strictly limit the scope of GMO technology.** One of the transgenic crops developed is a Petunia which has been genetically modified to have a different colour. It is surely not worth risking environmental damage simply to improve a plant's beauty. Traditional selection & hybridization are quite adequate technology for developing such novel ornamental varieties. The only justification for GMO's is to improve the production, quality and safety of food, to reduce environmental damage (e.g. herbicides) or to benefit human health through the development of new therapies or reducing the cost of medicines..
- **Improve coordination among government sectors.** Improve management cooperation among different government agencies, and establish a GMO bio-safety expert group. Improve legislation through cooperation and sharing information. GMO crops are closely related to commercial interests and patent issues, legal experts should be involved in dealing with these issues.
- **Use precautionary principles in GMO management.** As with other AIS, GMOs should be

presumed to be a bio-security risk and be required to be proven safe before introduction. Since most introductions of GMOs are intentional, there is a need to strengthen the permit system for their introduction and environment release. Management of GMO should also consider the particular local uses of such crops in and across China. For example, although trials of commercialized GMO cotton in the USA focused on detecting adverse skin reactions from wearing cloth made from this material,,in China oil made from cotton seed is a widely consumed food. Therefore, blind acceptance of safety certification from other countries is inappropriate and could well be disastrous. At the same time, the health and environment responsibilities pertaining to introduced GMOs should be shifted to the introducers.

- **Strengthen ecological risk evaluation and environment release trials and monitoring.** China is rich in biodiversity and is the place of origin of many commercially important crops. Since there are wild or related varieties of these crops which can easily become genetically polluted by closely related GMOs there is considerable risk in the incautious release of such organisms. It is necessary to conduct ecological risk evaluation and environment release trials and monitoring, and research the impact of GMOs on native biodiversity. Particular attention should be paid to high risk species such as transgenic fishes. Hybridization and gene movement in such organisms will be difficult to manage and monitor. Once damage occurs it may be irreversible.
- **Improve public access to information.** There is need to increase public awareness. Since GMO foods are now on the market, there should be improved labeling to facilitate tracking, monitoring and management.
- **Separate management and industry, and ensure the neutrality of departments responsible for evaluating and management.** Neutral departments that have no vested interest in the importation of alien species or organisms will have more objective judgment and management concerning IAS issues. Regulations must consider not only the environment, biodiversity, human health and animal welfare, but also national security and social equity. As a developing country with rich resources, China has to ensure the safety of the ecosystem, environment and genetic resources, and avoid becoming a testing ground for the GMOs of other countries. There are considerable social implications in the widespread use of GMOs (see Appendix 5).
- **Develop a strategy for the management of GMOs.** GMOs are a special group of IAS that pose a clear potential threat to the environment. Since their assessment and management is similar to that of other AIS the strategies that have been developed in the report for IAS can be also used to manage GMOs. However, the GMO issue is more complicated, and there are additional risks due to the inherent genetic instability of these organisms that have additional health, food safety, political and economic implications. Further evaluation should be conducted and a separate strategy for managing GMOs should be developed.

Appendix 1: Expenses for control and loss from alien invasive species

Species	Economic variable	Time	Influence (RMB)	Place
Eupatorium adenophorum	Econ. Loss of animal husbandry	Every year	Several 10 million yuan	Liangshan Prefecture, Sichuan Prov.
Eupatorium adenophorum	Control	Several years in 90s,2000	150 thousand yuan	Liangshan Prefecture, Sichuan Prov.
Eupatorium adenophorum	Control	Several years in 90s,2000,every year	800 thousand yuan	Liangshan Prefecture, Sichuan Prov.
Eichhornia crassipes	Artificial eradication	1999	5 million yuan	Putian, Fujian Prov.
Eichhornia crassipes	Artificial eradication	1999	10 million yuan	Wenzhou City, Zhejiang Prov.
Eichhornia crassipes	Artificial eradication	1999	> 0.1 billion yuan	Whole country
Ambrosia artemisiifolia	Pollen allergic	Every year	> 1 million yuan	Whole country
Alternanthera philoxeroides	Economic loss	Every year	0.6 billion yuan	Whole country
Liriomyza sativae	Economic loss	1995	24 million yuan	Sichuan Prov.
Liriomyza sativae	Economic loss	1995	110 million yuan	Shandong Prov.
Liriomyza sativae	Control	Every year	0.45 billiion yuan	Whole country
Nutria	Economic loss	1994-1996	20 275 yuan	14 peasant families, Hubing township, Gutian county, Fujian Prov.
Pinewood nematode	Economic loss		0.5 billion yuan	Anhui & Zhejiang Provs.
Pinewood nematode	Only reduce 4000 ha	One year	60 million yuan	Guangdong Prov.
Spartina alterniflora	1 year loss of aquaculture	1990	> 10 million yuan	Around Dongwuyang, Ningde City, Fujian Prov.
Spartina alterniflora	1 year loss of aquaculture	Every year	Peasant income decreased by several hundreds million yuan	6 counties of Fujian Prov.
Fowl influenza	Living fowl burned, compensating loss	1997	0.14 billion H.K.D	Hong Kong
Several main IAS	Economic loss	Every year	57.4 billion yuan	Whole country
All IAS	Economic loss	Every year	Several hundreds billion yuan	Whole country

Appendix 2:

Chinese major laws and regulations pertaining to IAS management

Laws and regulations	Species/ Ecosystem involved	List
People's Republic of China (PRC) Animal and Plant Quarantine Law, 1992 Implementing Details on People's Republic of China (PRC) Animal and Plant Quarantine Law, 1997	Animal infection, verminosis and dangerous diseases, pests, weeds and other organisms threatening plants	1. A quarantine list of dangerous diseases, pests and weeds (1997). 84 quarantined pests, diseases and weeds 2. A list of first and second class epidemic and parasitic diseases of imported animals (1992). 97 imported animals listed as requiring quarantine including 15 first class and 82 second class diseases 3. A list of animals, animal products and other quarantine goods which are forbidden to be carried or mailed into the PRC 4. A list of forbidden imported plant quarantine objects
PRC Health Quarantine Law 1986，1992 Implementing Details on Health Quarantine Law 1989, 1997	Infection	
PRC Plant Quarantine Regulations, 1983, 1992 Implementing Details on Plant Quarantine Regulations (Agricultural part) 1983, 1995 Implementing Details on Plant Quarantine Law (Forestry part) 1984, 1994	Dangerous diseases, pests and weeds threatening plants	1. A list of plant quarantine objects and plants and plant products to be quarantined (1995). 32 quarantine objects including 12 diseases, 17 pests and 3 weeds. 2. A list of forest plant quarantine objects and forest plants and their products to be quarantined (1996) lists 35 domestic forest plant quarantine objects
The PRC Animal Epidemic Prevention Law, 1998	Animal epidemic and verminosis	
PRC Livestock and Fowls Prevention Regulation, 1985 Implementing Details on PRC Livestock and Fowls Prevention Regulation, 1985, 1992	Livestock and fowl epidemic (including verminosis)	A list of first, second and third class livestock and fowl epidemic diseases (1992), 51 livestock and fowl epidemic (including verminosis)
Agriculture GMO Safety Management Regulation, 2001	Agriculture GMOs	
PRC Wildlife Protection Law, 1989 Implementation Regulations on	Captive wild animals. Requires that appropriate measures be taken to prevent their escape to the wild. Return of such animals to the wild	

Protecting Terrestrial Wild Animals, 1992	requires scientific reasoning and submission of a report to the Forestry Authority of the State Council for approval.	
PRC Oceanic Environment Protection Law. 1982, 1999	Before introducing marine animals, there should be scientific evaluation to avoid ecological damage.	

Appendix 3: International and regional legal instruments and institutions pertaining to invasive alien species

Instrument/Institution	Relevant Provisions/Decisions/Resolutions
1. Convention on Biological Diversity (Nairobi, 1992) http://www.biodiv.org	Article 8(h). Parties to "prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species".
2. United Nations Convention on the Law of the Sea (Montego Bay, 1982) http://www.un.org/Depts/los/losconv1.htm	Article 196. States to take all measures necessary to prevent, reduce and control the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment, which may cause significant and harmful changes.
3. The Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, 1971) http://www.ramsar.org	COP7—Resolution VII.14 on Invasive Species and Wetlands
4. Convention on Migratory Species of Wild Animals (Bonn, 1979) http://www.wcmc.org.uk/cms/	Range State Parties of Endangered Migratory Species (Annex 1) to prevent, reduce or control factors that are endangering or likely to further endanger the species, including exotic species. (Article III (4)(c)). Agreements for Annex II Migratory Species to provide for strict control of the introduction of, or control of already introduced exotic species detrimental to the migratory species (Article V (5)(e)).
5. Convention on the Law of Non-navigational Uses of International Watercourses (New York, 1997) http://www.un.org/	Watercourse States shall take all necessary measures to prevent the introduction of species, alien or new, into an international watercourse. (Article 22).
6. International Plant Protection Convention (Rome, 1951, as amended in 1997) http://www.fao.org/legal/treaties	Creates an international regime to prevent spread and introduction of plants and plant products through the use of sanitary and phytosanitary measures by Contracting Parties. Parties establish national plant protection organizations and agree to cooperate on information exchange and on the development of International Standards for Phytosanitary Measures. Regional agreements for Europe and the Mediterranean, the Asia-Pacific, Near East, Pacific, Caribbean, North American, South American, South America and Africa.
7. Plant Protection Agreement for the Asia and Pacific Region (Rome, 1956) http://www.fao.org/legal/treaties	Contracting Governments to prevent the introduction into and spread within the South East Asia and Pacific Region of plant diseases and pests. A supplementary agreement under Article III of the IPPC.
8. Agreement on the Application of Sanitary and Phytosanitary Measures（Marakech，1995） http://www.wto.org/english/tratop_e/sps_e/spsagr.htm	A supplementary agreement to the WTO Agreement. Applicable to all sanitary and phytosanitary measures directly or indirectly affecting international trade.
9. International Health Regulations (Geneva, 1982) (adopted by the 22nd World Health Assembly in 1969 and amended by the 26th World Health	To ensure maximum security against the international spread of diseases with a minimum interference with world traffic. Regulations

Assembly in 1973, and the 34th World Health Assembly in 1981) http://www.who.int/emc/IHR/int_regs.html	strengthen the use of epidemiological principles as applied internationally, to detect, reduce or eliminate the sources from which infection spreads, to improve sanitation in and around ports and airports, to prevent the dissemination of vectors and to encourage epidemiological activities on the national level.
10. IUCN-Guidelines for the Prevention of Biodiversity Loss Caused by Invasive alien species (2000) http://www.chinabiodiversity.com/shwdyx/ruq/ruq-index-cn.htm	Guidelines designed to increase awareness and understanding of the impact of alien species. Provides guidance for the prevention of introduction, re-introduction, and control and eradication of invasive alien species.
11. Guidelines for the Control and Management of ships' Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens. (Resolution A.868 (29)1997, International Maritime Organisation) http://www.imo.org	Provides guidance and strategies to minimize the risk of unwanted organisms and pathogens from ballast water and sediment discharge. Revokes the "Guidelines for preventing the Introduction of Unwanted Organisms and Pathogens from Ships' Ballast Water and Sediment Discharges" (IMO Resolution A. 774 (18) 1991).
12. Agenda 21—United Nations Conference on Environment and Development (Rio, 1992)	Calls for increasing protection of forests from disease and uncontrolled introduction of exotic plant and animal species 11.14); acknowledgement that inappropriate introduction of foreign plants and animals has contributed to biodiversity loss (15.3); appropriate rules on ballast water discharge to prevent spread of non-indigenous organisms. 17.30(vi); controlling noxious aquatic species that may destroy other aquatic species (chap. 18-40(e)(iv)).
13. Code of Practice on the Introductions and Transfers of Marine Organisms (ICES/EIFAC 1994)	Recommends practices and procedures to diminish risks of detrimental effects from marine organism introduction and transfer, including those genetically modified. Requires ICES members to submit a prospectus to regulators, including a detailed analysis of potential environmental impacts to the aquatic ecosystem.
14. Code of Conduct for Responsible Fisheries (FAO, 1995) http://www.fao.org/fi/agreem/codecond/ficonde.asp	Encourages legal and administrative frameworks to facilitate responsible aquaculture. Including pre-introduction discussion with neighbouring states when non-indigenous stocks are to be introduced into transboundary aquatic ecosystems. Harmful effects of non-indigenous and genetically altered stocks to be minimized especially where significant potential exists for spread into other states or country of origin. Adverse genetic and disease effects to wild stock from genetic improvement and non-indigenous species to be minimized.
15. Code of Conduct for the import and release of exotic biological control agents（FAO，1995） http://www.fao.org	Aims to facilitate the safe import, export and release of such agents by introducing procedures of an internationally acceptable level for all public and private entities involved, particularly where national legislation to regulate their use does not exist or is inadequate. Outlines specific responsibilities for authorities of an exporting country, who should ensure that relevant regulations of the importing country are followed in exports of biological control agents.
16. Preventing the Introduction of Invasive Alien Species. Resolution A-32-9, International Civil Aviation Organisation (ICAO) (1998). http://www.icao.int/icao/end/res/a32_9.htm	Urges all Contracting States to use their civil aviation authorities to assist in reducing the risk of introducing, through civil air transportation, potentially invasive species to areas outside their natural range. Requests the ICAO Council to work with other United Nations organizations to identify approaches that the ICAO might take in assisting to reduce the risk of introducing potential invasive species.
17. Global Programme of Action for the Protection	Introduction of Alien Species acknowledged to

of the Marine Environment from Land-based Activities (UNEP, 1995) http://www.unep.org/unep/gpa/pol2a.htm	have serious effects upon ecosystem integrity.

Appendix 4: Scoring system for assessing the level of risk posed by alien species

Questions		**Risk scoring**			
		Low	**Medium**	**High**	**Unacceptable**
		0	**2**	**5**	**20**
I Reproduction &Dispersal mechanisms	1. Can the species be established in nature?	No	Yes		
	2. What is the minimum generative time?	>=4 years	2-3 years	1 year	
	3. Is the species able to reproduce asexually (or vegetatively)?	No		Yes	
	4. Can reproductive parts be dispersed by wind, water, or animals such as mammals, insects and birds?	No	Yes	very far	
	5. Is the species able to disperse fast in nature?	Not at all	Slow	Medium	Fast
	6. Is it likely to be dispersed unintentionally?	No	Yes	Easy	
	7. Is it likely to be dispersed intentionally by people?	No	Yes		
II Hereditary traits	1. Is the species genetically stable over 10 generations?	Yes			No
	2. Are there related local weed species or pest species?	No		Yes	
	3. Are there closely related highly valued biodiversity species?	No	Yes		
	4. Is cross pollination or breeding possible with local domestic or wild species?	No	Possible		Proven
III Undesirable traits	1. Is any part of the species (the seed, roots, stem, flower, fruit, and pollen, secretion, excretion, flesh or skin etc.) found to be toxic to wildlife, domestic animals or humans?	No		Yes	
	2. Does the species have any inhibitive effects on other plants, eg. Phytotoxins?	No	Yes		
	3. Is the species parasitic? Are there any potential hosts in China?	No		Yes	
	4. Is the plant known to have negative effects on the environment? (soil, watershed, water table, air, microclimate etc.) ?	No	Unkown	Yes	
	5. Is it able to occur at high density?	No	Yes		
	6. Are there local species with similar feeding methods and food resources? Is the introduced species likely to become the competitor of these species?	No	Yes		

IV Adaptability	1. Is it suited to any local climate?	No	Yes	Highly suitable	
	2. Has it broad climate suitability?	Narrow	Medium	Broad	
	3. Is it able to survive in degraded environments (for instance is it able to endure direct sunshine or polluted environments or grow on infertile soils)?	No	Yes		
	4. Is it able to survive adverse conditions and reproduce rapidly when these become more favourable?	No	Yes		
V Species type	1. Can it survive in water?	No		Yes	
	2. Is it a grass?	No	Yes		
	3. Can it fly?	No		Yes	
	4. Is it micro-organism or virus?	No		Yes	
VI Ease of Control	1. Can the species/plant be easily eradicated by artificial means?	Yes		No	
	2. Are there effective natural enemies locally?	Many	Yes	Not at all	
VII Invasive history	1. Are any close relatives of the species known to be alien invasives?	No	Unknown	Yes	

The score of every single item reflects different aspects of risk posed by the organism in question and collectively indicate its potential to become an invasive pest. If the total score is more than 20 the organism should not to be introduced or released into the wild. If a species has 1 Unacceptable, 4 high, or 10 medium risks, its total score will reach 20 and it should not be introduced. Such species should go on the black list. Those species with a total score of less than 5 can be introduced (white list) and species with scores of 5~10 (grey list) should be restricted with regards to the objective of introduction, region, quantity and time. Those with total scores of 10~20 should, in addition, and be controlled and supervised after introduction and released only after successfully completing field release trials.

Appendix 5: Statement of Risks and Concerns on GMOs

(Institute of Science in Society. 2000. Open Letter from World Scientists to All Governments Concerning Genetically Modified Organisms (GMOs). www.i-sis.org.)

1 Patents on life-forms and living processes should be banned because they threaten food security, sanction biopiracy of indigenous knowledge and genetic resources, violate basic human rights and dignity, compromise healthcare, impede medical and scientific research and are against the welfare of animals. Life-forms such as organisms, seeds, cell lines and genes are discoveries and hence not patentable. Current GM techniques which exploit living processes are unreliable, uncontrollable and unpredictable, and do not qualify as inventions. Furthermore, those techniques are inherently unsafe, as are many GM organisms and products.

2. It is becoming increasingly clear that current GM crops are neither needed nor beneficial. They are a dangerous diversion preventing the essential shift to sustainable agricultural practices that can provide food security and health around the world.

3. Two simple characteristics account for the nearly 40 million hectares of GM crops planted in 1999. The majority (71%) are tolerant to broad-spectrum herbicides, with companies engineering plants to be tolerant to their own brand of herbicide, while most of the rest are engineered with bt-toxins to kill insect pests. A university-based survey of 8200 field trials of the most widely grown GM crops, herbicide-tolerant soya beans - revealed that they yield 6.7% less and required two to five times more herbicides than non-GM varieties. This has been confirmed by a more recent study in the University of Nebraska. Yet other problems have been identified: erratic performance, disease susceptibility, fruit abortion and poor economic returns to farmers.

4. According to the UN food programme, there is enough food to feed the world one and a half times over. While world population has grown 90% in the past 40 years, the amount of food per capita has increased by 25%, yet one billion are hungry. A new FAO report confirms that there will be enough or more than enough food to meet global demands without taking into account any yield improvements that might result from GM crops well into 2030. It is on account of an increasing corporate monopoly operating under the globalised economy that the poor are getting poorer and hungrier. Family farmers around the world have been driven to destitution and suicide, and for the same reasons. Between 1993 and 1997 the number of mid-sized farms in the US dropped by 74,440, and farmers are now receiving below the average cost of production for their produce. The farming population in France and Germany fell by 50% since 1978. In the UK, 20 000 farming jobs were lost in the past year alone, and the Prime Minister has announced a £200m aid package. Four corporations control 85% of the world trade in cereals at the end of 1999. Mergers and acquisitions are continuing.

5. The new patents on seeds intensify corporate monopoly by preventing farmers from saving and replanting seeds, which is what most farmers still do in the Third World. In order to protect their patents, corporations are continuing to develop terminator technologies that genetically engineer harvested seeds not to germinate, despite worldwide opposition from farmers and civil society at large.

6. Christian Aid, a major charity working with the Third World, concluded that GM crops will cause unemployment, exacerbate Third World debt, threaten sustainable farming systems and damage the environment. It predicts famine for the poorest countries. African Governments condemned Monsanto's claim that GMOs are needed to feed the hungry of the world: "We…strongly object that the image of the poor and hungry from our countries is being used by giant multinational corporations to push a technology that is neither safe, environmentally friendly, nor economically beneficial to us… we believe it will destroy the diversity, the local knowledge and the sustainable agricultural systems that our farmers have developed for millennia and …undermine our capacity to feed ourselves." A message from the Peasant movement of the Philippines to the Organization for Economic Cooperation and Development (OECD) of the industrialized countries stated, "The entry of GMOs will certainly intensify landlessness, hunger and injustice."

7. A coalition of family farming groups in the US has issued a comprehensive list of demands, including a ban on ownership of all life-forms; suspension of sales, environmental releases and further approvals of all GM crops and products pending an independent, comprehensive assessment of the social, environmental, health and economic impacts; and for corporations to be made liable for all damages arising from GM crops and products to livestock, human beings and the environment. They also demand a moratorium on all corporate mergers and acquisitions, on farm closures, and an end to policies that serve big agribusiness interests at the expense of family farmers, taxpayers and the environment. They have mounted a lawsuit against Monsanto and nine other corporations for monopolistic practices and for foisting GM crops on farmers without adequate safety and environmental impact assessments.

8. Some of the hazards of GM crops are openly acknowledged by the UK and US Governments. UK Ministry of Agriculture, Fisheries and Food (MAFF) has admitted that the transfer of GM crops and pollen beyond the planted fields is unavoidable, and this has already resulted in herbicide-tolerant weeds. An interim report on UK Government-sponsored field trials confirmed hybridisation between adjacent plots of different herbicide tolerant GM oilseed rape varieties, which gave rise to hybrids tolerant to multiple herbicides. In addition, GM oilseed rape and their hybrids have been found in subsequent wheat and barley crops, which had to be controlled by standard herbicides. Bt-resistant insect pests have evolved in response to the continuous presence of these toxins in GM plants throughout the growing season, and the US Environment Protection Agency is recommending farmers to plant up to 40% non-GM crops in order to create refugia for non-resistant insect pests.

9. The threats to biodiversity from major GM crops that are already commercialized are becoming increasingly clear. The broad-spectrum herbicides used with herbicide-tolerant GM crops decimate wild plant species indiscriminately, they are also toxic to animals. Glufosinate causes birth defects in mammals and glyphosate is linked to non-Hodgkin lymphoma. GM crops with bt-toxins kill beneficial insects such as bees and lacewings, and pollen from bt-corn is found to be lethal to monarch butterflies as well as swallowtails. Bt-toxin is exuded from roots of bt-plants in the rhizosphere, where it rapidly binds to soil particles and becomes protected from degradation. As the toxin is present in an activated, non-selective form, both target and non-target species in the soil will be affected, with knock on effects for species above ground.

10. Products resulting from genetically modified organisms can also be hazardous. For example, a batch of tryptophan produced by GM microorganisms was associated with at least 37 deaths and 1500 serious illnesses. Genetically modified Bovine Growth Hormone, injected into cows in order to increase milk yield, not only causes excessive suffering and illnesses for the cows but increased IGF-1 in the milk, a substance linked to breast and prostate cancers in humans. It is vital for the public to be protected from all GM products, and not only those containing transgenic DNA or protein. That is because the process of genetic modification itself, at least in the form currently practiced, is inherently unsafe.

11. A secret memoranda of US Food and Drug Administration revealed that it ignored the warnings of its own scientists that genetic engineering is a new departure and introduces new risks. Furthermore, the first GM crop to be commercialized - the Flavr Savr tomato - did not pass the

required toxicological tests. Since then, no comprehensive scientific safety testing had been done until Dr. Arpad Pusztai and his collaborators in the UK raised serious concerns over the safety of the GM potatoes they were testing. They concluded that a significant part of the toxic effect may be due to the "[gene] construct or the genetic transformation (or both)" used in making the GM plants.

12. The safety of GM foods was openly disputed by Professor Bevan Moseley, molecular geneticist and current Chair of the Working Group on Novel Foods in the European Union's Scientific Committee on Food. He drew attention to unforseen effects inherent to the technology, emphasizing that the next generation of GM foods - the so-called 'neutraceuticals' or 'functional foods', such as vitamin A 'enriched' rice - will pose even greater health risks because of the increased complexity of the gene constructs.

13. Genetic engineering introduces new genes and new combinations of genetic material constructed in the laboratory into crops, livestock and microorganisms. The artificial constructs are derived from the genetic material of pathogenic viruses and other genetic parasites, as well as bacteria and other organisms, and include genes coding for antibiotic resistance. The constructs are designed to break down species barriers and to overcome mechanisms that prevent foreign genetic material from inserting into genomes. Most of them have never existed in nature in the course of billions of years of evolution.

14. These constructs are introduced into cells by invasive methods that lead to random insertion of the foreign genes into the genomes (the totality of all the genetic material of a cell or organism). This gives rise to unpredictable, random effects, including gross abnormalities in animals and unexpected toxins and allergens in food crops.

15. One construct common to practically all GM crops already commercialized or undergoing field trials involves a gene-switch (promoter) from the cauliflower mosaic virus (CaMV) spliced next to the foreign gene (transgene) to make it over-express continuously. This CaMV promoter is active in all plants, in yeast, algae and E. coli. We recently discovered that it is even active in amphibian egg and human cell extracts. It has a modular structure, and is interchangeable, in part, or in whole with promoters of other viruses to produce infectious viruses. It also has a 'recombination hotspot' where it is prone to break and join up with other genetic material.

16. For these and other reasons, transgenic DNA - the totality of artificial constructs transferred into the GMO - may be more unstable and prone to transfer again to unrelated species; potentially to all species interacting with the GMO.

17. The instability of transgenic DNA in GM plants is well-known(45). GM genes are often silenced, but loss of part or all of the transgenic DNA also occurs, even during later generations of propagation(46). We are aware of no published evidence for the long term stability of GM inserts in terms of structure or location in the plant genome in any of the GM lines already commercialized or undergoing field trials.

18. The potential hazards of horizontal transfer of GM genes include the spread of antibiotic resistance genes to pathogens, the generation of new viruses and bacteria that cause disease and

mutations due to the random insertion of foreign DNA, some of which may lead to cancer in mammalian cells. The ability of the CaMV promoter to function in all species including human beings is particularly relevant to the potential hazards of horizontal gene transfer.

19. The possibility for naked or free DNA to be taken up by mammalian cells is explicitly mentioned in the US Food and Drug Administration (FDA) draft guidance to industry on antibiotic resistance marker genes. In commenting on the FDA's document, the UK MAFF pointed out that transgenic DNA may be transferred not just by ingestion, but by contact with plant dust and air-borne pollen during farm work and food processing. This warning is all the more significant with the recent report from Jena University in Germany that field experiments indicated GM genes may have transferred via GM pollen to the bacteria and yeasts in the gut of bee larvae.

20. Plant DNA is not readily degraded during most commercial food processing. Procedures such as grinding and milling left grain DNA largely intact, as did heat-treatment at 90deg.C. Plants placed in silage showed little degradation of DNA, and a special UK MAFF report advises against using GM plants or plant waste in animal feed.

21. The human mouth contains bacteria that have been shown to take up and express naked DNA containing antibiotic resistance genes, and similar transformable bacteria are present in the respiratory tracts.

22. Antibiotic resistance marker genes from GM plants have been found to transfer horizontally to soil bacteria and fungi in the laboratory. Field monitoring revealed that GM sugar beet DNA persisted in the soil for up to two years after the GM crop was planted. And there is evidence suggesting that parts of transgenic DNA have transferred horizontally to bacteria in the soil.

23. Recent research in gene therapy and nucleic acid (both DNA and RNA) vaccines leaves little doubt that naked/free nucleic acids can be taken up, and in some cases, incorporated into the genome of all mammalian cells including those of human beings. Adverse effects already observed include acute toxic shock, delayed immunological reactions and autoimmune reactions.

24. The British Medical Association, in their interim report (published May, 1999), called for an indefinite moratorium on the releases of GMOs pending further research on new allergies, the spread of antibiotic resistance genes and the effects of transgenic DNA.

25. In the Cartegena Biosafety Protocol successfully negotiated in Montreal in January, 2000, more than 130 governments have agreed to implement the precautionary principle, and to ensure that biosafety legislations at the national and international levels take precedence over trade and financial agreements at the WTO. Similarly, delegates to the Codex Alimentarius Commission Conference in Chiba Japan, March 2000, have agreed to prepare stringent regulatory procedures for GM foods that include pre-market evaluation, long-term monitoring for health impacts, tests for genetic stability, toxins, allergens and other unintended effects. The Cartegena Biosafety Protocol has now been signed by 68 Governments in Nairobi in May, 2000.

26. We urge all Governments to take proper account of the now substantial scientific evidence of actual and suspected hazards arising from GM technology and many of its products, and to impose an immediate moratorium on further environmental releases, including open field trials, in accordance with the precautionary principle as well as sound science.

27. Successive studies have documented the productivity and sustainability of family farming in the Third World as well as in the North. Evidence from both North and South indicates that small farms are more productive, more efficient and contribute more to economic development than large farms. Small farmers also tend to make better stewards of natural resources, conserving biodiversity and safeguarding the sustainability of agricultural production. Cuba responded to the economic crisis precipitated by the break up of the Soviet Bloc in 1989 by converting from conventional large scale, high input monoculture to small organic and semi-organic farming, thereby doubling food production with half the previous input.

28. Agroecological approaches hold great promise for sustainable agriculture in developing countries, in combining local farming knowledge and techniques adjusted to local conditions with contemporary western scientific knowledge. The yields have doubled and tripled and are still increasing. An estimated 12.5 million hectares worldwide are already successfully farmed in this way. It is environmentally sound and affordable for small farmers. It recovers farming land marginalized by conventional intensive agriculture. It offers the only practical way of restoring agricultural land degraded by conventional agronomic practices. Most of all, it empowers small family farmers to combat poverty and hunger.

29. We urge all Governments to reject GM crops on grounds that they are both hazardous and contrary to ecologically sustainable use of resources. Instead they should support research and development of sustainable agricultural methods that can truly benefit family farmers the world over.

Appendix 6: Definition of terms

SSC/IUCN. 2000. IUCN Guidelines for the prevention of biodiversity loss caused by alien invasive species. Gland Switzerland.

English version*: http://iucn.org/themes/ssc/pubs/policy/invasivesEng.htm*

Chinese version*: http://www.chinabiodiversity.com/shwdyx/ruq/ruq-index-cn.htm*

"**Alien invasive species**" means an alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity.

"**Alien species**" (non-native, non-indigenous, foreign, exotic) means a species, subspecies, or lower taxon occurring outside of its natural range (past or present) and dispersal potential (*i.e.* outside the range it occupies naturally or could not occupy without direct or indirect introduction or care by humans) and includes any part, gametes or propagule of such species that might survive and subsequently reproduce.

"**Biological diversity**" (Biodiversity) means 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 a part; this includes diversity within species, between species and of ecosystems.

"**Biosecurity threats**" means those matters or activities which, individually or collectively, may constitute a biological risk to the ecological welfare or to the well-being of humans, animals or plants of a country.

"**Intentional introduction**" means an introduction made deliberately by humans, involving the purposeful movement of a species outside of its natural range and dispersal potential. (Such introductions may be authorised or unauthorised.)

"**Introduction**" means the movement, by human agency, of a species, subspecies, or lower taxon (including any part, gametes or propagule that might survive and subsequently reproduce) outside its natural range (past or present). This movement can be either within a country or between countries.

"**Unintentional introduction**" means an unintended introduction made as a result of a species utilising humans or human delivery systems as vectors for dispersal outside its natural range.

"**Native species**"(indigenous) means a species, subspecies, or lower taxon, occurring within its natural range (past or present) and dispersal potential (i.e. within the range it occupies naturally or could occupy without direct or indirect introduction or care by humans.)

"**Natural ecosystem**" means an ecosystem not perceptibly altered by humans.

"**Semi-natural ecosystem**" means an ecosystem which has been altered by human actions, but which retains significant native elements.

Appendix 7: Activities of the Eco-security Task Force

1 Preparation of Awareness Booklet on Invasive Alien Species in China

A special booklet documenting the threat of Invasive Alien Species in China has been prepared by task force members and printed to promote awareness and attention to this urgent problem. Copies of the booklet are available in Chinese for CCICED members. Only a quick English translation is available for the interest of international members.

2 Preparation of Booklet *Restoration of Natural Vegetation in China*

A special booklet, in Chinese, on restoration of natural vegetation has been prepared and published as a follow up to work completed in 2001 by the Biodiversity Working Group of CCICED. The booklet remains highly relevant to the work of the new task force especially in relation to the re-greening efforts under the Great Western Development programme. Copies are available to Chinese members of CCICED.

3 Holding of 2-day Workshop on Invasive Alien Species

A two day workshop was held at Xiangshan Hotel, Beijing on 23 and 24 October, 2002. The meeting was attended by more than 30 persons comprising members of the task force and invited experts from departments of health, agriculture, fisheries, oceanography, quarantine, SEPA and academic institutes.

The schedule of the meeting is attached as Annex 1 to this report. A number of presentations were made by international visitors and relevant departments. These gave rise to considerable lively debate and discussion.

The participants broke up into three Chinese and one international work groups to draft recommendations to the Chinese Government. These recommendations were amalgamated by the taskforce and are appended to this report as Annexe 2. A summary of conclusions and recommendations is given above.

4 First Meeting of the Eco-security Task Force

The members of the task force met in Xiangshan Hotel on 25th October, 2002 following the conclusion of the two day workshop on Invasive Alien Species.

The Chinese chair of the taskforce welcomed the members and explained the background and history of the first 2 phases of CCICED and the plans for Phase 3.

The members reviewed, revised and prioritised the workplan of the taskforce. The proposed revision is presented above (item 4).

The members discussed the conclusions and recommendations of the Alien Invasive workshop, amalgamated the various recommendations and prepared the summary conclusions and recommendations presented above (item 1).

The members made plans for the next meeting of the working group.

5 Work plans of the Eco-security Task Force

- It is planned to hold the next meeting of the task force in Yunnan during the third week of January 2003. The focus of the meeting will be to examine IAS problems in the field and examine biodiversity threats associated with the Great Western Development Programme.
- Select around 100 serious IAS, and study their origin, reason for introduction, and analysis that if we could find any method to stop their invasion to China. Based on these analysis, we may be able to find some suitable methods to stop invasion.
- Develop a national strategy for the setting up of adequate control mechanisms including training needs for China to deal with the problem.
- Undertake studies on risk assessment methodology, and draft an operational methodology for various sectors. Establish a process for scoring risk category of likelihood of becoming alien

invasive pests. Study on impact of IAS to ecosystem and conduct evaluation from aspect of ecosystem conservation.

- Review the current status of regulations controls and general awareness of GMO threats. Prepare and publish a "*Primer on GMO's*" to educate the public and governmental officials.
- Prepare specific TOR for testing efforts on local environment to be included in risk assessment regulations.
- Evaluate and study on legislation of controlling IAS.
- Expand the Alien Invasive Species Database to include all non-native organisms known to be wild in China. Study on national ecosystem evaluation to map out areas thought to have the highest risks of invasion by GMOs or alien invasives.
- 10-Year Review and Perspective of Biodiversity Conservation
- Best use the chance of Green Olympics to improve public awareness on biodiversity.

6. Revision of the Ongoing BWG/ETF Work Programmes

There are a couple of ongoing projects started in late Phase II of BWG/CCICED which should be continued and completed. The progress of those projects are hereby briefed as follows:

- **China's Red List of Endangered Species** With the support from NORAD and CI, the project is now entering into the final review process of the evaluation of the status of wild fauna and flora. All the wild species of vertebrates and higher plants and selected major groups of invertebrates have been evaluated by using the new IUCN Criteria 2000. A Red List of Endangered Species of China will be formulated by early 2003 for releasing which will be the basis in terms of China's biodiversity conservation.

- **Dujiangyan BSAP** A county level Biodiversity Strategy & Action Plan for Dujiangyan area, Sichuan Province, a new World Heritage site, is coming to the final review which is planned to hold a Final Review Workshop in the upcoming December.

- **China Species Information System (CSIS)** Further development and maintaining of the CSIS is undergoing which can be accessed by the web-site: www.chinabiodiversity.com. Existing information and data on vertebrates are presented, including taxonomic information, distribution, habitats, status and threats, categories of endangerness, conservation measures taken and to be taken, literatures, together with pictures and maps. It can be of reference for conservation actions and legislation, EIA, research priority setting, education and public awareness. It is also functioning for species data and information exchange and communication domestically and internationally.

- **Biodiversity Web-site** A bilingual web-site of "Conserving China's Biodiversity" in Chinese and English www.chinabiodiversity.com was developed during the CCICED Phase II and is now still updating regularly. All the annual reports of BWG together with technical reports resulted from activities by BWG can be accessed on the web-site. In addition, the China Species Information System is also available on the site.

- **China Mammal Guide** Since the ***Field Guide to the Birds of China*** (English and Chinese versions) published in 2000, BWG-ETF has started the compilation of the ***Field Guide to the Mammals of China*** (English and Chinese) especially for those conservation staff based in reserves and national parks, as well as for public education.

7. Pulbications

- ***Invasive Alien Species in China,*** 2002, China Forestry Press, Beijing (Chinese), 230 pages.
- ***Restoration of Natural Vegetation,*** 2002, China Forestry Press, Beijing (Chinese), 58 pages.
- ***World Conservation Information,*** A Chinese Newsletter. Nos. 15/16; 17/18 (Chinese)
- ***China Human Development Report,*** 2002**.** UNDP. (Chinese and English; for "Biodiversity")

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ETF/CCICED IAS Report

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