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Wise use of wetlands in China

Integral approach to assess and evaluate opportunities and risks of biodiversity in wetlands in a socio-economic context

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ABSTRACT

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A selection of instruments are described that may help to seek solutions for wise use of wetlands. Following instruments are discussed: (1) The DPSIR framework to pinpoint the main drivers that cause the biodiversity loss. (2) The Contingent Valuation Methods to assess the economic value of non marketable ecosystem services. (3) The LEDESS model to visualize the ecologic consequences of land-use scenarios. (4) Different participatory approaches to evaluate the sociological aspects of land-use scenario's of wetlands.
Based on the described methods a workshop was held with the aim to select potential wetland sites in China where the methods could be used to develop a wise use of wetlands plan. Three sites were selected.

Keywords: Wetlands, wise use, DPSIR, Cost benefit analysis, LEDESS, participatory approaches, RAMSAR

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Summary

Economic development poses a strong pressure on biodiversity in wetlands in China. Today China still has 65.94 million ha of wetlands. However, some 50% of coastal wetlands have already been lost and nearly 1000 lakes have disappeared, whereas in the parts of China where economy development was strong over the last decades, like the Northeast of China, over 90% of the vast wetland plains have been drained and converted to farmlands. Unwise use of wetlands has caused biodiversity to decrease significantly. Conservation and management of wetland resources have received inadequate attention for a long period. The approach in China has been fragmented with many departments responsible for conserving wetlands. Marshes have continued to decrease and are used for cultivation, fish or shrimp ponds. Wildlife species have been killed, and wetland ecosystems have deteriorated due to poor planning and management, as well as other reasons. Wetlands are particularly susceptible to threats from a range of activities carried out not only inside the reserve but also elsewhere in the water catchment which affect the quality and quantity of water flows and by it the quality of the wetland ecosystem.

Obviously sustainable conservation of biodiversity cannot longer been achieved in isolation from socio economic aspects. To be viable on the long term measures must be both economically sustainable and socially acceptable. This often implies that choices must be made where and to what extend human activities can take place in a protected area. Wise use of wetlands implies seeking land-use solutions that are sustainable such that both the protected biodiversity and local communities are viable on the long term.
In this report a selection of instruments are described that may help to seek solutions for wise use of wetlands. These instruments can be used to:

- pinpoint the main drivers that cause the biodiversity loss
- assess the economic value of non marketable ecosystem services
- visualize the ecologic consequences of land-use scenarios
- increase the involvement of local communities to enhance social acceptance

To pinpoint the drivers of biodiversity loss in wetlands the DPSIR framework is discussed. This framework is particularly useful because of its ability to represent cause-effect relationships between interacting components of complex social, economic and environmental systems and to organize the flow of information between their parts. It provides a conceptual model that gives the assessor an overview of the problem. This framework is presented and an application used in China discussed.

To value ecosystem services of wetlands economically, Contigent Valuation Method (CVM) are discussed. Next to ecosystem services as food production (e.g. shrimp farming) wetlands also provide a lot of ecosystem services that have aesthetic value, biodiversity value and recreational value. The first category of ecosystem services belongs to the marketable values, for which good economic evaluation instruments are available. The second category exists of nonmarketable goods, which are more difficult to value in economic terms. Currently CVM are the best instruments to

value non marketable goods. In this report CVM is discussed in the context of ecosystem services of wetlands and an example case in which CVM was applied in China is presented.

To evaluate the ecologic aspects of land-use scenarios in wetlands the LEDESS model is discussed. This model is a space explicit model GIS based, structured by ecotopes. The abiotic conditions and management of a site determines its vegetation. The size of vegetation patches and their spatial structure determine the potency of animal species to maintain viable populations. LEDESS major strength is that it is very useful to visualize the ecological consequences of different scenarios of land-use at all levels of decision making.

To evaluate the sociological aspects of land-use scenario's of wetlands, participatory approaches are discussed. Participatory approaches are increasingly advocated by international conservation organizations. Participatory approaches facilitate the inclusion of stakeholders, assist in making explicit conflicting strategies and use of conservation areas, and help the stakeholders in negotiating trade offs. Participatory approaches are therefore important in the planning, implementation and evaluation phase of scenario development. Three example cases in which different instruments are used in China are discussed.

Based on the above described methods a workshop was held in China in 2008 with the aim to select potential wetland sites in China where the methods could be used to develop a wise use of wetlands plan. Three sites were selected and their location and site description is given.

Since the application of the methods presented were applied in China only separately in the different project as illustrated in this report, this methodological study aims as next step to apply the methods in an integrated way. For this purpose one of the three selected sites will be chosen as case study. The financial resources needed for the execution of the case study will be the main concern to be explored on short term.

1 Introduction

(Chris Klok)

China is currently undergoing a rapid economic development which is expected to have a large impact on the countries environment and biodiversity. Recently, the Government of China has been developing an innovative partnership of Chinese and international governmental and non-governmental agencies, with the overall goal of ensuring the conservation and sustainable use of biodiversity. This **China Biodiversity Partnership Framework** is still under development but has tentatively identified four strategic, inter-connected themes: (1) strengthening the overall enabling environment for biodiversity conservation; (2) mainstreaming biodiversity conservation into socio-economic sectors and development; (3) protecting biodiversity inside protected areas, and (4) protecting and sustainably utilizing biodiversity lying outside protected areas. The **EU-China Biodiversity Programme** (ECBP) is to pave the way for and contributes to that overall Partnership.

Economic development has posed a high risk on biodiversity in wetlands. Still China has 65.94 million ha of wetlands. However, some 50% of coastal wetlands have already been lost and nearly 1000 lakes have disappeared. Whereas in the parts of China where economy has been blooming like the Northeast of China, over 90% of the vast wetland plains have been drained and converted to farmlands. Unwise use of wetlands has caused biodiversity to decrease significantly.

Wetlands are often multidimensional, cross-boundary resources. They provide a range of interrelated environmental functions and socio-economic benefits for different stakeholders. Wetlands are critical resources at the catchment level, providing hydrological benefits for downstream communities and their related socio-economic activities. At higher decision making levels, wetlands provide provinces and national governments with opportunities for ecotourism and timber production. Because of the range of 'wetland use' strategies and beneficiaries at the different decision making levels, there are different, often conflicting demands, placed upon wetlands. For instance, recently in the Yancheng Nature Reserve, which is one of China's largest coastal wetland reserve, local communities preferred the planting of trees and the conversion of farms from irrigated rice to cotton and other crops. This change in the farming system poses threats to the overall wetland cover and suitability for passage of migratory and wintering birds.

The focus of this report is on wetlands where next to biodiversity conservation the wetland has also socio-economic benefits for different stakeholders.

Obviously conservation of biodiversity cannot longer been achieved in isolation from socio economic aspects. To be viable on the long term measures must be both economically sustainable and socially acceptable. This often implies that choices must be made where and to what extend human activities can take place in a protected area. Wise use of wetlands implies seeking land-use solutions that are sustainable

such that both the protected biodiversity and local communities are viable on the long term.
In this report a selection of instruments are described that may help to seek solutions for wise use of wetlands. These instruments can be used to

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In Chapter 1 the current situation and the added value of wise use of wetland management for China are discussed.
Chapter 2 focuses on methods applicable to develop wise use plan

- DPSIR approach,
- Economic valuation methods,
- Ecologic consequences visualized by LEDESS
- Participatory approaches

Chapter 3 reports on a workshop held in China in early 2008 which was used to present and discuss methods and develop criteria to select wetlands in China in which these methods can be applied. Based on the selected criteria three potential wetlands are described.
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1.1 Background on wetland management in China
(Bert Harms)

At present, conservation and sustainable utilization of wetland resources have raised world wide attention. The Convention on Wetlands of International lmportance Especially as Waterfowl Habitat came into force in Ramsar, Iran in 1971. It aims to save wetlands as the environment of human being and other species.

China has the largest areas of wetlands in Asia. Amongst these are many with international importance as waterfowl habitat. There are various types and large areas of wetlands in China. These include marshes, meadow, shallow lakes, salt lakes in the plateau, salt marshes and coastal wetlands.

Wetlands exist mainly as:
(i) marshes in "Sanjiang" catchments in northeast China;
(ii) salt marshes in the Gobi Desert of the Inner Mongolia;
(iii) numerous lakes in lower reaches of the Yellow River and of Yangtzi River;
(iv) coastal marshes of north of Yangtzi River;
(v) coastal marshes and mangroves of south of Yangtzi River;
(vi) meadow in the plateau of Yunnan, Guizhou and Sichuan Provinces;
(vii) huge salt lakes in the desert of the Uyger Autonomous Region;
(viii) alpine lakes in the northern Tianshan Mountains; and
(ix) alpine lakes and bogs in the Qinghai-Tibet Plateau.

Since 1980, the Chinese government has paid attention to conservation of rare and precious waterfowl and animals such as Red-crowned Crane (*Grus japonensis*), Crest lbis (*Nipponia nippon*), Swan (*Cygnus spec.*) and Chinese Alligator(*Alligator sinensis*). Wetland nature reserves have been established to protect biodiversity.

According to the State Forestry Administration (SFA) statistics in 2004, China had a total 38.48 million hectares of wetlands, calculating only those with an area exceeding 100 hectares. This figure includes 36.2 million hectares of natural wetlands and 2.28 million artificially formed ones. Nowadays, 473 wetland nature reserves have been established, helping protect 45 percent of the country's natural wetlands. In China 30 wetlands have been included in the Ramsar List of Wetlands of International Importance, with a surface area of 2,937,481 hectares. The Convention on Wetlands came into force for China on 31 July 1992.

However, conservation and management of wetland resources have received inadequate attention for a long period. The approach has been fragmented with many departments responsible for conserving wetlands. Marshes have continued to decrease and are used for cultivation, fish or shrimp ponds. Wildlife species have been killed, and wetland ecosystems have deteriorated due to poor planning and management, as well as other reasons. Wetlands are particularly susceptible to threats from a range of activities carried out not only inside the reserve but also elsewhere in the water catchment which affect the quality and quantity of water flows and by it the quality of the wetland ecosystem.
In order to tackle those threats the several Conventions have been formulated specific commitments. For instance, in the United Nations Convention on Biological Diversity (CBD), which came into force 18 years after Ramsar and has been ratified by China in 1993, the objectives are:

The conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

In the Ramsar Convention a definition of "wise use" was already adopted in 1987:

The Wise use of wetlands is their sustainable utilization for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem.

Since the adoption of the "wise use" definition in the Ramsar Convention, the language of environmental conservation has evolved and changed, with new terminologies such as in the Brundtland Commission report on sustainable development, and the Millennium Ecosystem Assessment's (MA) definitions and descriptions of the characteristics of ecosystems and of "ecosystem services". In order to update the Ramsar definition of "wise use" in line with the current definitions set by other Conventions, a new definition has been adopted by the last meeting of the Conference of Contracting Parties (COP9) in 2005. The new definition of "wise use" is by now:

Wise use of wetlands is the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development.

At the same meeting a Conceptual Framework for the wise use of wetlands has been adopted. This Conceptual Framework, developed by the Millennium Ecosystem Assessment (MA) for the maintenance of ecosystem services for human well-being and poverty reduction, provides a multi-scalar approach which indicates how and where policy and management interventions and decision making can be made (see fig 1.1). Under this MA framework, "wise use" equates to the maintenance of ecosystems benefits/services to ensure long term maintenance of biodiversity as well as human well-being and poverty alleviation.

It is the aim of this study to contribute to the elaboration of this conceptual framework into a workable methodology for the wise use of wetlands in China.

In 2002, the China Government approved the National Wetland Conservation Action Plan, which identified priority actions to guide the conservation, use, and management of wetlands. The methodology presented in this study has to be considered as a contribution how to implement the priority actions in this Action Plan as well.

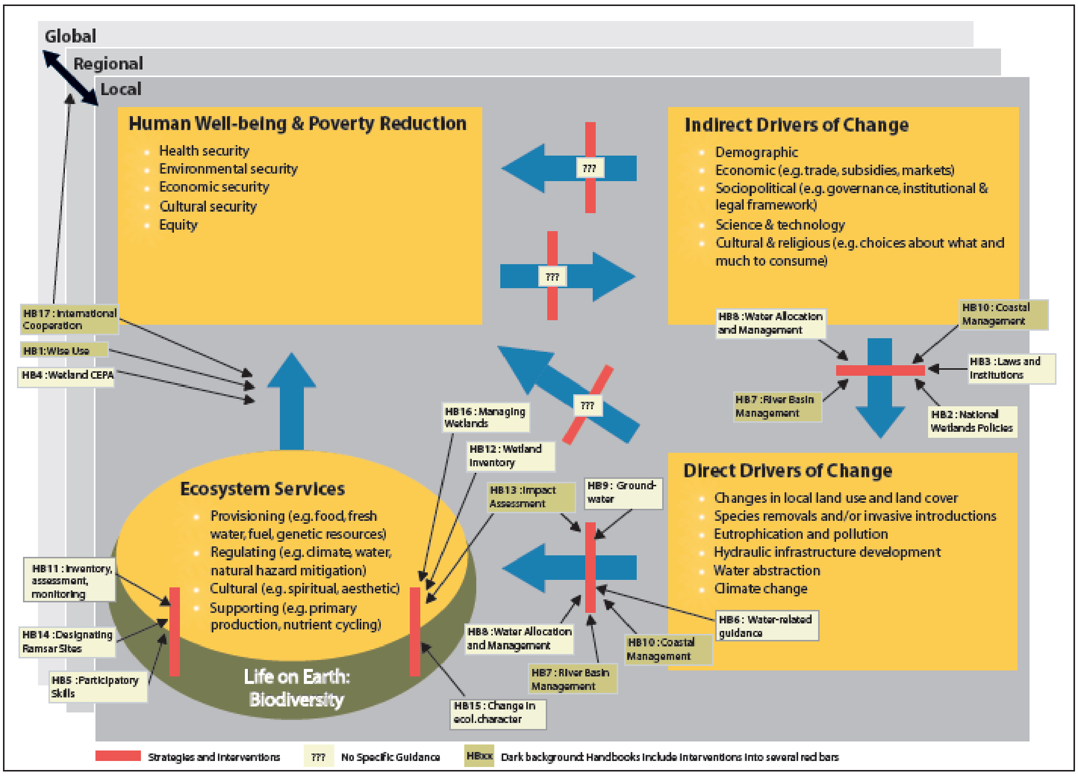


Fig 1.1.: Conceptual Framework for the Wise Use of Wetlands (Wise Use Handbooks 3rd, 2006)

2 Approaches to develop a wise use of wetlands plan

In this report a selection of instruments are described that may help to seek solutions for wise use of wetlands. These instruments can be used to:

- pinpoint the main drivers that cause the biodiversity loss (par. 2.1)
- assess the economic value of non marketable ecosystem services (par. 2.2)
- visualize the ecologic consequences of land-use scenarios (par. 2.3)
- increase the involvement of local communities to enhance social acceptance (par 2.4)

2.1 Driver, Pressure, State, Impact, Response (DPSIR, an approach to visualize causes of biodiversity loss.

(Chris Klok)

The current rate of species extinction by far exceeds historical or background ones (Pimm *et al.,* 1995), and suggests that we are on the brink of a major biodiversity crisis (Thomas *et al.,* 2004). To mitigate further biodiversity loss, a range of biodiversity targets have been set by the UN Convention on Biological Diversity (CBD, 2002), the 6th Environment Action Programme (CEC, 2002), the European Union Strategy for Sustainable Development (CEC, 2001) and the Kiev Resolution on Biodiversity (Fifth Ministerial Conference Environment for Europe, 2003). A global decision was taken at the UN Summit in Johannesburg 2002 to 'significantly reduce the loss of biodiversity by 2010' and the EU calls for a halt in biodiversity decline by 2010 (SSD, 2001).

But how can we realize reduction of biodiversity loss? Biodiversity is a complex issue and changes in biodiversity cannot always be easily related to causes, since many causes also indirectly change biodiversity.

The DPSIR approach makes it possible to visualize different factors responsible for biodiversity change and the possibility to mitigate this change by responses. This framework facilitates the analysis such that issues can be covered in a comprehensive way and all important aspects are analyzed. The widely used DPSIR framework implies the integration of socio-economic and ecological processes to understand the forces that drive patterns of biodiversity change.

Figure 2.1.1 presents a conceptual model that is a simplified version of a DPSIR framework to illustrate how socio-economic and biophysical drivers of change are brought together to understand biodiversity changes. In this conceptual model, socio-economic drivers (demographic, economic, or political) or biophysical forces (e.g. physical geography or climatic conditions) cause the emergence of observable patterns. These patterns relate to the spatial and temporal distributions of socio-economic or biophysical drivers. Additionally, the interactions among the drivers set in motion processes that affect ecological conditions, which in turn cause changes not only in biodiversity but also socio-economic circumstances (human welfare) which finally affect the main drivers themselves. Hence the process can be seen as an iterative cycle.

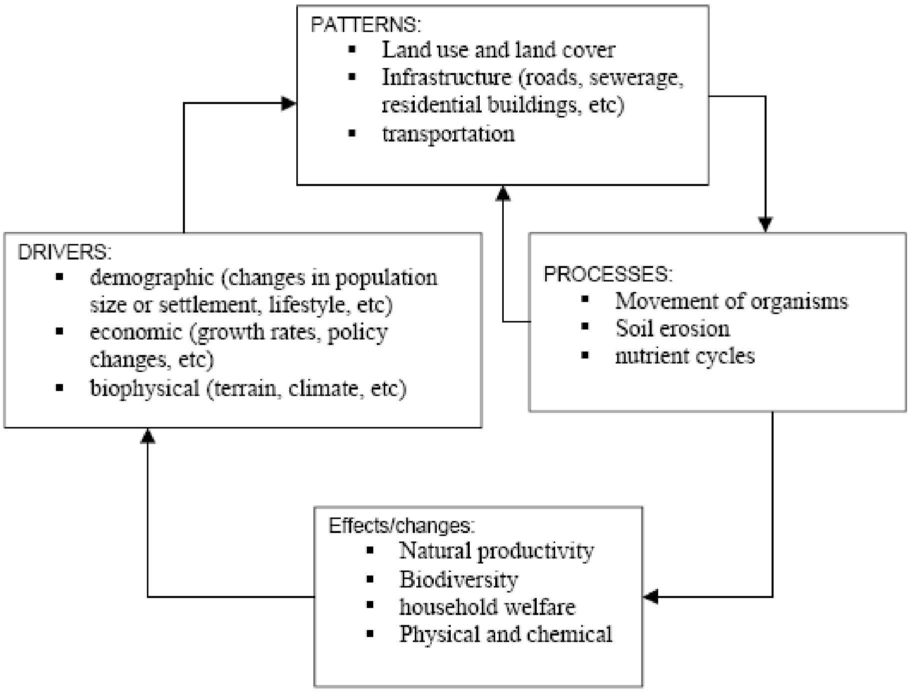


Figure 2.1.1: A conceptual model for modelling biodiversity changes Source: adapted from The Impact of Urban Patterns on Ecosystem Dynamics, http://www.urbaneco.washington.edu/

The DPSIR framework is derived from the pressure-state-response framework. This pressure-state-response framework, first developed and adopted by The Organisation for Economic Cooperation and Development (OECD) offers an appropriate structure for an analysis of biodiversity loss (Petite et al. 2001). It divides information on the *pressures* acting on the environment, the *state* of individual environmental compartments and the human (political or management) *responses* to check and control environmental degradation. The more recently developed DPSIR framework extends the pressure-state-response framework by assuming a chain of causal links starting with *driving forces* (economic activities such as transport or agriculture) through *pressures* (e.g. emissions of pollutants, land-use change) that affect the *states* of sensitive environmental receptors (such as soil pH or hydrology). The changes in these states, i.e. the *impacts* on the environment, such as increase in pH or species loss, eventually stimulate political or technological *responses*, such as limits to air pollution, or the promotion of new drainage systems. The extended framework was originally developed by the European Environmental Agency (EEA) for environmental reporting purposes and structuring of the description of the environmental problems, by formalising the relationships between various sectors of human activity and the environment as causal chains of links. The EEA (within the legal basis for European Union Environmental Policy, Arts 95, 174, 175 and 176 of the consolidated version of the Treaty on European Union and under the auspices of the European Commission) proposed the DPSIR framework in a bid to introduce environmental issues into their development agenda, and to meet the challenges of Agenda 21 (EEA, 1999). Each indicator conveys its own distinctive meaning and application.

- *Driving forces* are social and economic factors and activities that cause either the increase or mitigation of pressures on the environment.
- *Pressures* or proximate causes are represented by direct anthropogenic pressures and impacts on the environment, such as pollutant emissions or the consumption of natural resources.
- *State* relates to the current state and trends of the environment that determine the extent and magnitude of degradation.
- *Impacts* are the effects that the environmental changes have on human and non-human health status.
- *Responses* are what the society perceives should be done, improved or mitigated to realise a better environment (Pierce, 1998; EEA, 1999).

The DPSIR is particularly useful because of its ability to represent cause-effect relationships between interacting components of complex social, economic and environmental systems and to organise the flow of information between their parts. It provides a conceptual model that gives the assessor an overview of the problem. It hence structures the assessor's thinking, helping to provide a good understanding of the system's dynamics.

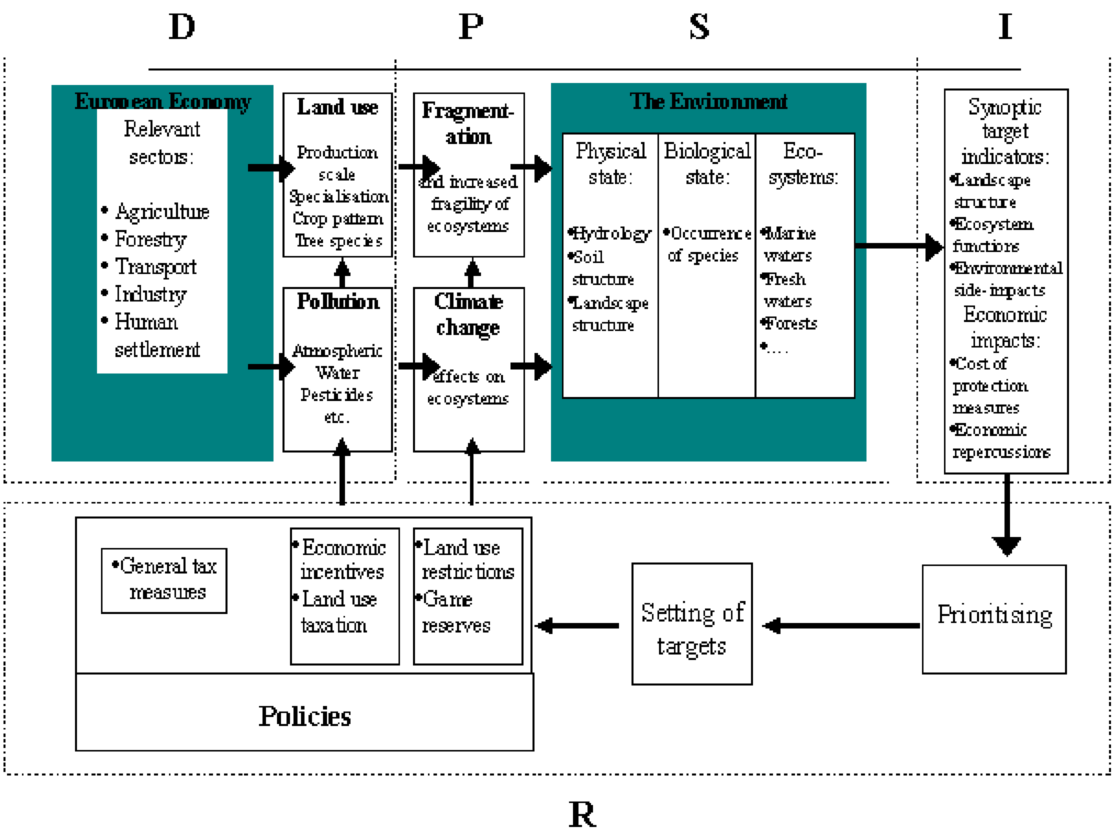


Figure 2.1.2. EEA, 1996

The DPSIR is particularly useful because of its ability to represent cause-effect relationships between interacting components of complex social, economic and environmental systems and to organise the flow of information between their parts. It provides a conceptual model that gives the assessor an overview of the problem. It hence structures the assessor's thinking, helping to provide a good understanding of the system's dynamics.

The great strength of DPSIR is that it provides a standardized methodology to describe the evolution of environmental pressures and their ecological impacts, even when the quality of the available information is not uniform (Petit, 2001). Moreover, there is no *a priori* ideal geographical scale at which to apply the framework. The choice is dictated by the availability of consistent data on driving forces and pressures, by the spatial resolution at which pressure and state interact and by the likely scale at which political responses might operate.

2.1.1 Applications of DPSIR approach in China

Wong and Wong (2004) used the DPSIR approach to raise environmental awareness on the impacts of industrialization and economic growth in the Pearl River delta region. The Pearl River delta changed in a relative short period from an area with high biodiversity where traditional farming took place in an industrialized area with low biodiversity. The number of inhabitants increased form 9.62 million in 1982 to 21.2 in 1996, mainly due to immigrant laborers attracted by development of industry in the region. Industrialization and the pressure inflicted by urban development resulted in a strong increase in water pollution; the estimated discharge of industrial effluent equaled 2 billion t and that of domestic waste 560 million to annually (Chen 1994 in Wong and Wong 2004). This high load of effluents polluted the river resulting in frequent algal blooms in the river up into the costal zone and contamination of water resources. The economic loss due to the environmental degradation was estimated to amount US$11 billion in the region.

Wang et al. (2006) state that current and expected pressures on Lake Taihu Basin cannot be mitigated with the existing environmental management system, since traditionally management operates in a sector-fragmented way and overlapping responsibilities and inadequate policy coordination lacking public involvement which is not very well tailored to respond efficiently to existing and future pressures. The Lake Taihu Basin is densely populated (928 persons per km^2 compared to 130 on average in China), the highest pressure on the environment results form the discharge of untreated wastewater by industry and urban areas in the lake, moreover, also point sources form agriculture in the rural area inflict eutrophication of the lake. Wang et al. (2006) advocate a new management system based on the ideas of integrated environmental management, where institutional cooperation, public participation and environmental externalities play an important role. They suggest the DPSIR approach as a holistic approach is useful to understand the interrelationships between different factors that may have direct or indirect impacts on the environment.

2.2 Economic methods and instruments to assess the cost/benefits of changes in use of wetlands

(Shi Xiaoping, Ou Weixin)

To assess the cost/benefits of changes in use of wetlands, the Cost Benefits Analysis (CBA) is always the preferred method. The key work of CBA is to identify the costs and benefits, which are associated with the wetland services & functions. The process involves monetary value of initial and ongoing expenses vs. expected return. Constructing plausible measures of the costs and benefits of specific actions is often very difficult. In practice, analysts try to estimate costs and benefits either by using survey methods (market valuation method) or by non-market valuation methods drawing inferences from market behaviour. This section will introduce the economic methods and instruments to assess the cost/benefits of changes in use of wetland, which include CBA, the market and non-market valuation methods (for identifying the costs and benefits associated with the wetland services and functions).

2.2.1 The Cost-Benefit Analysis (CBA)

2.2.1.1 Introduction

Cost Benefit Analysis is typically used by governments to evaluate the desirability of a given intervention in markets. The aim is to gauge the efficiency of the intervention relative to the status quo. The costs and benefits of the impacts of an intervention are evaluated in terms of the public's willingness to pay for them (benefits) or willingness to pay to avoid them (costs). Inputs are typically measured in terms of opportunity costs - the value in their best alternative use.

2.2.1.2 Process of CBA

To simplify, we now consider a situation where development is 'all or nothing' in the sense that either economic activities occurs and drives wetland amenity benefits to zero, or development does not occur.

We assume time is divided into two periods, 1 being 'now' and 2 'future'. The decision maker has complete knowledge of all relevant conditions in period 1. At the start of period 1, period 2 outcomes can be listed with probabilities attached to them. A decision involving irreversible consequences must be taken at the start of period 1. At the end of period 1, complete knowledge about period 2 will become available to the decision maker.

The options are shown in the following table. Where, D is for development, P is for preservation, and period 2 costs and benefits are to be understood as discounted present value. R_i is the return associated with the ith option, B_{pt} is preservation benefits which provided by environmental functions & services and also by eco-tourism; C_{Pt} is preservation costs for support installation for eco- tourism; B_{dt} is development benefits, C_d, is development costs, which are treated as arising only in the period in which the development project is undertaken, and as before we do not explicitly distinguish preservation costs.

Table 2.1.1 Two-period development/ preservation options

Option	Period 1	Period 2	Return
1	P	D	$R_1=B_{P1}+B_{D2}-C_{D2}$
2	P	P	$R_2=B_{P1}+B_{P2}-C_{P2}$

Note: In both option, the P in period 1 just keeps the current situation, the profits result from eco-environmental functions and services without any costs.

The return of the decision taken at the start of period 1 to preserve equals either R_1 or R_2, depending on whether or not development is initiated at the start of period 2 given the information then available. If $B_{D2}-C_{D2} > B_{P2}-C_{P2}$, the wetland will be developed. On the contrary, if $B_{P2}-C_{P2} > B_{D2}-C_{D2}$, preservation will be undertaken at the start of period 2. We can express this as

$$R = B_{P1}+ \mathrm{Max}\{(B_{P2}-C_{P2}), (B_{D2}-C_{D2})\} \quad (2.2.1)$$

Now, a decision has to be taken at the start of period 1, and the decision maker does not then have the information that will become available at the start of period 2. But, by assumption, the decision maker does at the start of period 1 know what the informational possibilities are and the probabilities to attach to outcomes in that respect. So, he or she could use the decision rule: go ahead with development at the start of period 2 if

$$E[B_{D2}-C_{D2}]-E[\mathrm{Max}\{(B_{D2}-C_{D2}),(B_{P2}-C_{P2})\}] > 0 \quad (2.2.2)$$

Go ahead with preservation at the start of the period 2 if

$$E[B_{P2}-C_{P2}]-E[\mathrm{Max}\{(B_{D2}-C_{D2}),(B_{P2}-C_{P2})\}] > 0 \quad (2.2.3)$$

where E[..] indicates expected.
Using this model, maybe we can give some information to the decision maker, based on it he or she will make a decision which option is a more wise way for the wetland resource.

2.2.2 Market valuation methods

The values of some ecosystem goods or services can be measured using market prices. Some ecosystem products, such as fish or wood, are traded in markets. Thus, their values can be estimated by estimating consumer and producer surplus, as with any other market good. Other ecosystem services, such as clean water, are used as inputs in production, and their value may be measured by their contribution to the profits made from the final good.

Some ecosystem or environmental services, like aesthetic views or many recreational experiences, may not be directly bought and sold in markets. However, the prices people are willing to pay in markets for related goods can be used to estimate their values. For example, people often pay a higher price for a home with a view of the ocean, or will take the time to travel to a special spot for fishing or bird watching. These kinds of expenditures can be used to place a lower bound on the value of the view or the recreational experience.

These methods include Market Price Method, Productivity Method and Travel Cost Method.

2.2.2.1 Market Price Method

Introduction

The market price method estimates the economic value of ecosystem products or services that are bought and sold in commercial markets. The market price method can be used to value changes in either the quantity or quality of a good or service. It uses standard economic techniques for measuring the economic benefits from marketed goods, based on the quantity people purchase at different prices, and the quantity supplied at different prices.

The standard method for measuring the use value of resources traded in the marketplace is the estimation of consumer surplus and producer surplus using market price and quantity data. The total net economic benefit, or economic surplus, is the sum of consumer surplus and producer surplus.

Methodology

Hypothetical Situation: Water pollution has caused the closure of a commercial fishing area, and agency staff wants to evaluate the benefits of cleanup.

Step 1: The first step is to use market data to estimate the market demand function and consumer surplus for the fish before the closure.

Step 2: The second step is to estimate the market demand function and consumer surplus for the fish after the closure.

Step 3: The third step is to estimate the loss in economic benefits to consumers, by subtracting benefits after the closure, from benefits before the closure.

Step 4: Because this is a marketed good, the researcher must also consider the losses to producers, in this case the commercial fishermen. This is measured by the loss in producer surplus. As with consumer surplus, the researcher must measure the producer surplus before and after the closure and calculate the difference.

Step 5: Next, the researcher would measure the producer surplus after the closure.

Step 6: The next step is to calculate the loss in producer surplus due to the closure.

Step 7: The final step is to calculate the total economic losses due to the closure—the sum of lost consumer surplus and lost producer surplus.

2.2.2.2 Productivity Method

Introduction
The productivity method, also referred to as the net factor income or derived value method, is used to estimate the economic value of ecosystem products or services that contribute to the production of commercially marketed goods. It is applied in cases where the products or services of an ecosystem are used, along with other inputs, to produce a marketed good.

For example, water quality affects the productivity of irrigated agricultural crops, or the costs of purifying municipal drinking water. Thus, the economic benefits of improved water quality can be measured by the increased revenues from greater agricultural productivity, or the decreased costs of providing clean drinking water.

Methodology
Step 1: The first step is to specify the production function for purified drinking water. This is the functional relationship between the inputs—water of a particular quality from the reservoir, chemicals, and filtration, and the output—pure drinking water.

Step 2: The second step is to estimate how the cost of purification changes when reservoir water quality changes, using the production function estimated in the first step. The researcher would calculate the quantities of purification chemicals and filters needed for different levels of reservoir water quality, by plugging different levels of water quality into the production function. These quantities would then be multiplied by their costs.

Step 3: The final step is to estimate the economic benefits of protecting the reservoir from runoff, in terms of reduced purification costs. For example, if all runoff is eliminated, the reservoir water will need very little treatment and the purification costs for drinking water will be minimal. This can be compared to the cost of purifying water where runoff is not controlled. The difference in purification costs is an estimate of the benefits of eliminating runoff. Similarly, the benefits for different levels of runoff reduction can be estimated. This step requires information about the projected success of actions to reduce runoff, in terms of the decrease in runoff and the resulting changes in reservoir water quality.

2.2.2.3 Travel Cost Method

Introduction
The travel cost method is used to estimate economic use values associated with ecosystems or sites that are used for recreation.

The method can be used to estimate the economic benefits or costs resulting from:

- changes in access costs for a recreational site
- elimination of an existing recreational site
- addition of a new recreational site
- changes in environmental quality at a recreational site

The basic premise of the travel cost method is that the time and travel cost expenses that people incur to visit a site represent the "price" of access to the site. Thus, peoples' willingness to pay to visit the site can be estimated based on the number of trips that they make at different travel costs. This is analogous to estimating peoples' willingness to pay for a marketed good based on the quantity demanded at different prices.

Methodology
The zonal travel cost method is the simplest and least expensive approach. It will estimate a value for recreational services of the site as a whole. It cannot easily be used to value a change in quality of recreation for a site, and may not consider some of the factors that may be important determinants of value.

The zonal travel cost method is applied by collecting information on the number of visits to the site from different distances. Because the travel and time costs will increase with distance, this information allows the researcher to calculate the number of visits "purchased" at different "prices." This information is used to construct the demand function for the site, and estimate the consumer surplus, or economic benefits, for the recreational services of the site.

Step 1: The first step is to define a set of zones surrounding the site. These may be defined by concentric circles around the site, or by geographic divisions that make sense, such as metropolitan areas or counties surrounding the site at different distances.

Step 2: The second step is to collect information on the number of visitors from each zone, and the number of visits made in the last year.

Step 3: The third step is to calculate the visitation rates per 1000 population in each zone. This is simply the total visits per year from the zone, divided by the zone's population in thousands.

Step 4: The fourth step is to calculate the average round-trip travel distance and travel time to the site for each zone. Assume that people in Zone 0 have zero travel distance and time. Each other zone will have an increasing travel time and distance. Next, using average cost per mile and per hour of travel time, the researcher can calculate the travel cost per trip. A standard cost per mile for operating an automobile is readily available from tourism agency or other sources.

Step 5: The fifth step is to estimate, using regression analysis, the equation that relates visits per capita to travel costs and other important variables. From this, the researcher can estimate the demand function for the average visitor. In this simple model, the analysis might include demographic variables, such as age, income, gender, and education levels, using the average values for each zone. To maintain the simplest possible model, calculating the equation with only the travel cost and visits/1000 (Travel Cost).

Step 6: The sixth step is to construct the demand function for visits to the site, using the results of the regression analysis. The first point on the demand curve is the total visitors to the site at current access costs (assuming there is no entry fee for the site). The other points are found by estimating the number of visitors with different hypothetical entrance fees (assuming that an entrance fee is viewed in the same way as travel costs).

Step 7: The final step is to estimate the total economic benefit of the site to visitors by calculating the consumer surplus, or the area under the demand curve.

2.2.3 Non-market valuation methods

Some ecosystem or environmental services, like existence value, biodiversity value, may not be bought and sold in markets and have no market price. In this situation, we can use Contigent Valuation Method (CVM) to value the ecosystem services.

2.2.3.1 Introduction

Contingent Valuation (CV) is a method of estimating the economic value of non-market environmental goods (and public goods in general) through survey questions than elicit individuals' preferences regarding such goods. Respondents express their preferences in terms of willing to pay to purchase or restore that good, or alternatively, what they would be willing to accept to no longer be able to purchase or fully utilize that good. To elicit these values, individuals are presented with a hypothetical market for the good, thus the resulting "willingness to pay" and "willingness to accept" values are contingent on the interviewer's description of the hypothetical market, and the approach became CV methods. Because Contingent valuation asks consumers to directly state their values within a hypothetical market rather than inferring values from an actual market behavior, it is perhaps the most controversial of all methods used to value non-market environmental goods. In fact, Contingent valuation is not the only methods that uses data from surveys; many large data sets commonly used by economists consist of survey data, i.e. census surveys, consumer expenditure surveys. But, Contingent valuation survey differ from traditional data surveys in that the respondents are asked to make a hypothetical value trade- off rather than simply report their own characteristics or actual expenditures. The hypothetical nature of Contingent valuation introduces unique challenges when respondents do not correctly understand the good or service being valued, or when they cannot accurately state their willingness to pay in monetary terms. Nonetheless, as known, Contingent valuation is the only economic method available for measuring non- use values associated with nature.

2.2.3.2 Methodology

Consider an individual utility function:

$u(x,z)$

where x is a vector of market goods and z is a vector of non-market environmental goods, characterized as public goods. The individual maximizes utility by choosing which quantities of the available market goods to consume. Expenditures for these consumption choices are constrained by available income,

$y=px$,

where p is a vector of market prices at which the market goods are purchased. Thus, the basic model of consumption can be expressed as:

max $u(x,z)$ subject to $px = y$.

Implicating in this simple characterization of consumer behavior is the important distinction between private and public goods. Individuals can choose different quantities of private goods for consumption, but must use exactly the same quantity of the public good. Given the public good nature of environment goods, the individual does not choose the quantity of environmental goods to enjoy. Moreover, because the environmental goods do not have a corresponding market price, no income must be expended to enjoy the benefits of these goods.

Constrained optimization yields the following demand function for market goods:

$x_i = h_i\,(p,z,y) \quad i = 1, \ldots, n$

where i indexes the ith market good. Here, the demand for a market good depends on its price and the price of all other market goods, the vector of environmental goods, and the individual's level of income. From the demand curve, the indirect utility function is derived:

$v\,(p,z,y) = u\,[h(p,z,y), z]$

where utility is represented as a function of prices for the market goods, income, and the environmental goods. Now suppose that, within the vector of environmental goods z , one particular environmental good, z^i is increased, all other condition remaining unchanged, then ,

$z^1 > z^0$ and $u^1 = v(p,z^1,y) > u^0 = v(p,z^0,y)$.

here the superscripts 0 and 1 indicate states before and after the increase, respectively. The willingness-to-pay that a Contingent valuation survey attempts to elicit from a respondent is based on the difference between utility before and after the increase in z^i. One method of measuring this difference is the compensating variation , that is , the amount of income that the individual would need to give up after the change from z^0 to z^1, be as well off as before the change. The compensating variation measure of change in utility can be written as:

$u^1 = v(p,z^1,y\text{-}c) = u^0 = v(p,z^0,y)$,

where c represent the compensating variation. The reduction in income by c exactly offsets the benefits of the increased environmental amenity, leaving the individual indifferent between u^1 and u^0. Consequently, c can be viewed as the maximum amount the individual would be willing to pay for the increase in the environmental goods. Thus, it is the compensating variation, c , that most contingent valuation questions attempt to elicit. Since we have defined environmental goods as public goods, the total willingness-to-pay for the increase in z^i is given by summing the compensating variations of all n individuals. With the same simple model it is also possible to examine the willingness-to-pay measure of value placed on a given environmental amenity.

2.2.3.3 Survey Techniques

Three broad survey techniques are available for carrying out contingent valuation surveys: in-person interviews, telephone interviews, and mail surveys.

In-person interviews are the preferred method of conducting contingent valuation surveys because they allow for the use of visual aids and close control of the pace of the interview, and be easy to present the complex scenarios involved in Contingent valuation studies of environmental goods services. And it also can be useful in motivating respondents to exercise a greater effort than in other survey responses to generate an accurate willingness to pay value for the good in question. However, in-person interviews are far more expensive than telephone or mail surveys. The drawback of telephone interviews, however, is that without any visual aids (e.g. videos and pictures) and visual cues from the respondent, it is much more difficult to communicate a Contingent valuation scenario. So telephone interviews are only suitable for very short and simple Contingent valuation scenarios. Mail surveys allow the use of visual aids, but suffer from many other drawbacks. A large number of respondents may not posses the reading ability to accurately read and understand complex text. Furthermore, it is not possible to employ follow-up questions tailored to the respondent's answers, and it is not possible to prevent respondents from browsing the entire questionnaire before filling it out or control the order in which the survey questions are completed.

2.2.3.4 Survey

A typical Contingent valuation survey designed to elicit willingness to pay for a particular hypothetical good or service includes three components.

The first component provides a detailed description of the policy or program that the respondent is being asked to value, making it as plausible and understandable as possible. The questionnaire must carefully describe:

- The environmental good or service itself
- The expected effects of the proposed policy
- The method and structure of provision
- The probability of success
- The expected outcome if no action is taken
- The range of substitutes for the good or service being valued, and
- The method of payment

Possible methods of payment include a user fee, a donation, an increase in taxes, or an increase in the prices of other related goods, and may vary in applicability depending on the environmental good being valued. Describing the method of payment also requires setting a time period over which payments are collected.

The second component elicits the values from the respondents and can be achieved in a variety of question formats.

Open questions: ask the respondent to “fill in the blank” regarding how much they would be willing to pay or accept for the good of service in question. It provides a direct estimate of willingness-to-pay, but is prone to certain bias.
Closed question ask the respondent to select from a menu of responses, and include such formats as: payment card, referendum and bidding game formats. The payment card elicitation format keeps response values within a reasonable range by handing the interviewees a card with a list of cost options and asking them to choose what they would be willing to pay or accept. Referendum formats ask the respondent whether they would vote for a government policy, given that it would cost them a certain amount, usually as part of their tax bill. Bidding games are an extension of the referendum format. If the respondent gives a positive response, the interviewer asks if he or she would be willing to pay a higher price; or a negative response for a lower price.

Closed question formats avoid a number of potential pitfalls and are more commonly used than open questions. And it can eliminate “protest responses” where the respondent gives a extremely high of low response. And closed question surveys are also more straightforward and thus, tend to have higher response rates.

The third component of the survey is follow-up questions designed to determine the socioeconomic characteristics of sample and ascertain the effectiveness of the survey. The respondents’ socioeconomic characteristics, preferences relevant to the good or service being valued, and the use history of the good or service are elicited for use in regression estimates. This information is used as explanatory variables in willingness to pay function estimates. The effectiveness of the survey can be explored through questions that determine respondents’ understanding of the information and the credibility of the scenario, and if they took the interview seriously. Additionally, the Contingent valuation interview might include verbal protocol analysis, a method that helps determine how respondents establish their willingness to pay. Individuals are asked to “think aloud” as they are being questioned. Then the interviews are recorded and the transcripts coded and studied to discover patterns in the considerations and bias of the respondents reply.

Given that the survey is well designed and pre-tested, and the survey sample is appropriately developed, the results of the interviews can be used to derive an estimate of the benefits (e.g. in dollars) associated with the environmental amenity in questions.

2.2.3.5 Process

Hypothetical Scenario: A remote site on public land provides important habitat for several species of wildlife. The management agency in charge of the area must decide whether to issue a lease for mining at the site. Thus, they must weight the value of the mining lease against the wildlife habitat benefits that may be lost if the site is developed. Because the area is remote, few people actually visit it, or view the animals that rely on it for habitat. Therefore, non-use values are the largest component of the values for preserving the site.

Step 1: The first step is to define the valuation problem. This would include determining exactly what services are being valued, and who the relevant population (stakeholders) is. In this case, the resource to be valued is a specific site and the services it provides – primarily wildlife habitat. Because it is federally owned public land, the relevant population would be all citizens of the country.

Step 2: The second step is to make preliminary decisions about the survey itself, including whether it will be conducted by mail, phone or in person, how large the sample size will be, who will be surveyed, and other related questions. The answers will depend, among other things, on the importance of the valuation issue, the complexity of the question being asked, and the size of the budget.

In-person interviews are generally the most effective for complex questions, because it is often easier to explain the required background information to respondents in person, and people are more likely to complete a long survey when they are interviewed in person. In some cases, visual aids such as videos or color photographs may be presented to help respondents understand the conditions of the scenario that they are being asked to value.

In-person interviews are generally the most expensive type of survey. However, mail surveys that follow procedures that aim to obtain high response rates can also be quite expensive. Mail and telephone surveys must be kept fairly short, or response rates are likely to drop dramatically. Telephone surveys may be less expensive, but it is often difficult to ask contingent valuation questions over the telephone, because of the amount of background information required.

In this hypothetical case, the researchers have decided to conduct a mail survey, because they want to survey a large sample, over a large geographical area, and are asking questions about a specific site and its benefits, which should be relatively easy to describe in writing in a relatively short survey.

Step 3: The next step is the actual survey design. This is the most important and difficult part of the process, and may take six months or more to complete. It is accomplished in several steps. The survey design process usually starts with initial interviews and/or focus groups with the types of people who will be receiving the final survey, in this case the general public. In the initial focus groups, the researchers would ask general questions, including questions about peoples' understanding of the issues related to the site, whether they are familiar with the site and its wildlife, whether and how they value this site and the habitat services it provides.

In later focus groups, the questions would get more detailed and specific, to help develop specific questions for the survey, as well as decide what kind of background information is needed and how to present it. For example, people might need information on the location and characteristics of the site, the uniqueness of species that have important habitat there, and whether there are any substitute sites that provide similar habitat. The researchers would also want to learn about peoples' knowledge of mining and its impacts, and whether mining is a controversial use of the site. If people are opposed to mining, they may answer the valuation questions with this in mind, rather than expressing their value for the services of the site. At this stage, test different approaches to the valuation question and different payment mechanisms would be tested. Questions that can identify any "protest" bids or other answers that do not reveal peoples' values for the services of interest would also be developed and tested at this stage.

After a number of focus groups have been conducted, and the researchers have reached a point where they have an idea of how to provide background information, describe the hypothetical scenario, and ask the valuation question, they will start pre-testing the survey. Because the survey will be conducted by mail, it should be pretested with as little interaction with the researchers as possible. People would be asked to assume that they've received the survey in the mail and to fill it out. Then the researchers would ask respondents about how they filled it out, and let them ask questions about anything they found confusing. Eventually, a mail pretest might be conducted. The researchers continue this process until they've developed a survey that people seem to understand and answer in a way that makes sense and reveals their values for the services of the site.

Step 4: The next step is the actual survey implementation. The first task is to select the survey sample. Ideally, the sample should be a randomly selected sample of the relevant population, using standard statistical sampling methods. In the case of a mail survey, the researchers must obtain a mailing list of randomly sampled U.S. citizens. They would then use a standard repeat-mailing and reminder method, in order to get the greatest possible response rate for the survey. Telephone surveys are carried out in a similar way, with a certain number of calls to try to reach the selected respondents. In-person surveys may be conducted with random samples of respondents, or may use "convenience" samples – asking people in public places to fill out the survey.

Step 5: The final step is to compile, analyze and report the results. The data must be entered and analyzed using statistical techniques appropriate for the type of question. In the data analysis, the researchers also attempt to identify any responses that may not express the respondent's value for the services of the site. In addition, they can deal with possible non-response bias in a number of ways. The most conservative way is to assume that those who did not respond have zero value.

2.2.4 Other valuation methods: Damage Cost Avoided, Replacement Cost, and Substitute Cost Methods

2.2.4.1 Introduction

The damage cost avoided, replacement cost, and substitute cost methods are related methods that estimate values of ecosystem services based on either the costs of avoiding damages due to lost services, the cost of replacing ecosystem services, or the cost of providing substitute services. These methods do not provide strict measures of economic values, which are based on peoples' willingness to pay for a product or service. Instead, they assume that the costs of avoiding damages or replacing ecosystems or their services provide useful estimates of the value of these ecosystems or services. This is based on the assumption that, if people incur costs to avoid damages caused by lost ecosystem services, or to replace the services of ecosystems, then those services must be worth at least what people paid to replace them. Thus, the methods are most appropriately applied in cases where damage avoidance or replacement expenditures have actually been, or will actually be, made.

Some examples of cases where these methods might be applied include:

- Valuing improved water quality by measuring the cost of controlling effluent emissions.
- Valuing erosion protection services of a forest or wetland by measuring the cost of removing eroded sediment from downstream areas.
- Valuing the water purification services of a wetland by measuring the cost of filtering and chemically treating water.
- Valuing storm protection services of coastal wetlands by measuring the cost of building retaining walls.
- Valuing fish habitat and nursery services by measuring the cost of fish breeding and stocking programs.

2.2.4.2 Methodology

Hypothetical Situation: An agency is considering restoring some degraded wetlands in order to improve their ability to protect the surrounding area from flooding. The agency wants to value the benefits of improved flood protection.

Step 1: The first step is to conduct an ecological assessment of the flood protection services provided by the wetlands. This assessment would determine the current level of flood protection, and the expected level of protection if the wetlands were fully restored.

Step 2: This step depends on the specific method chosen. The Damage Cost Avoided method might be applied using two different approaches. One approach is to use the information on flood protection obtained in the first step to estimate potential damages to property if flooding were to occur. In this case, the researcher would estimate, in dollars, the probable damages to property if the wetlands are not restored. A second approach would be to determine whether nearby property owners have spent money to protect their property from the possibility of flood damage, for example by purchasing additional insurance or by reinforcing their basements. These avoidance expenditures would be summed over all affected properties to provide an estimate of the benefits from increased flood protection. However, one would not expect the two approaches to produce the same estimate. One might expect that, if avoidance costs are expected to be less than the possible damages, people would pay to avoid those damages.

The replacement cost method is applied by estimating the costs of replacing the affected ecosystem services. In this case, flood protection services cannot be directly replaced, so this method would not be useful.

The substitute cost method is applied by estimating the costs of providing a substitute for the affected services. For example, in this case a retaining wall or a levee might be built to protect nearby properties from flooding. The researcher would thus estimate the cost of building and maintaining such a wall or levee. The researcher must also determine whether people would be willing to accept the wall or levee in place of a restored wetland.

2.3 Ecological methods and instruments to assess the biodiversity loss of changes in use of wetlands

(Bianca Nijhof, Michiel van Eupen)

2.3.1 Introduction

2.3.1.1 Concepts in strategies of nature restoration

To understand the basic strategies in nature restoration, it is necessary to examine existing plans and schemes in order to reveal and clarify underlying concepts. Two questions are crucial here: what is the ecological objective, and what is the spatial strategy?

The first question is related to the level of the ecosystem. With different types of nature management, different ecosystems can develop at the same site. Nature policy decides which system is to be developed. The second question is related to the landscape as a whole, the spatial pattern of ecosystems. It is taken into account that other activities, such as farming, recreation, water supply and quarrying, also require space. Nature restoration cannot be considered independently from those activities. Therefore, a spatial strategy is required to combine all land use functions. To find an optimal balance between the two questions, different nature restoration scenarios are developed.

The next step in these scenarios: are the alternatives realistic, feasible and what are the ecological benefits of each plan? This means a validation at the most basic level of knowledge, i.e. the individual species. Since the stages are not completed consecutively but may alternate cyclically, the results of an evaluation can be used as input for a new planning cycle where the scenarios are adapted and re-evaluated. Ultimately, a more comprehensive plan will be the result.

2.3.1.2 General Background of Decision Support Systems

The environment surrounding us is subject to a continuous evolution in development plans. This may be planning at the expense of nature or in favor of nature development. Planners wonder what the consequences of their scenarios for nature are or what kind of nature might develop. Interesting is to know which of the different scenarios made is the most favorable one for nature. Evaluating these scenarios on a qualitative level is common. However, a more spatial presentation is very time consuming. A good comparison has to be done in the same consequent way. Models made to do this are the so-called Decision Support Systems (DSS). They help planners and policy makers to make choices in spatial arrangement.

The use of a DSS also facilitates the evaluation of certain measures and enables experimenting with slightly different measures and/or planning targets. This is the so-called cyclic planning. Furthermore, the DSS is applicable on different scales, varying from the larger policy-making level (e.g. 1:100,000) to the small design level (e.g. 1:10,000).

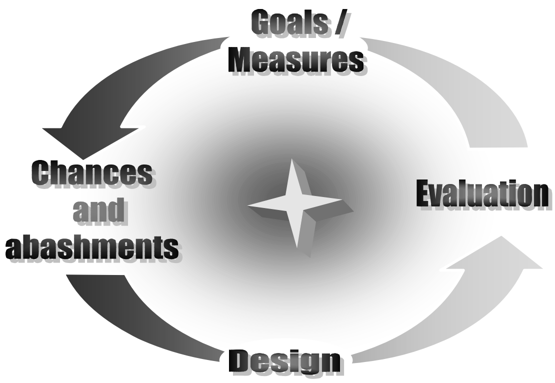


Figure 2.3.1 Cyclic planning procedure: the base for a DSS

2.3.1.3 The LEDESS model; analyzing impact of scenarios for wetlands

In the past, several different models (COR, Gelderse Poort-model, SCN; Harms et al., 1991, 1994, 1995) have been developed to simulate and evaluate nature. In 1996 LEDESS (Landscape Ecological Decision & Evaluation Support System) was developed and used in several projects (Van Eupen et al, 2003).

LEDESS is a GIS based expert system. It is a computer model used to assess and evaluate the effects of land use changes on nature. LEDESS works by confronting

GIS maps of the existing landscapes with proposed measures and ecological know-how. The results are GIS maps and tables of the expected vegetation and fauna distribution patterns.

LEDESS evaluates scenarios to see if they are possible from an ecological point of view and determines their consequences for nature and/or their economic effects. This way, choices can be made on what kind of nature or land use type is desired. The modeled nature types are basic input for evaluating the economic profitability, as well as fauna suitability characteristics of a scenario. The model can be applied on different scale levels (local to international) and for types of ecosystems and species.

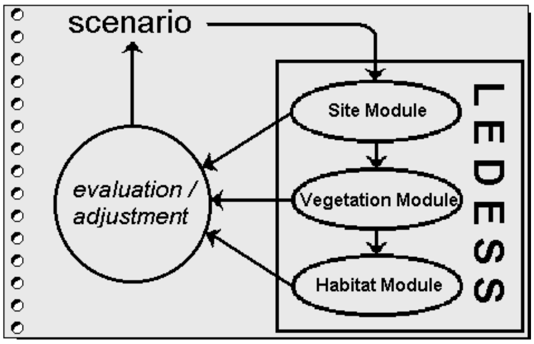


Figure 2.3.2 The role of LEDESS in cyclic planning

2.3.2 Method

The structure of the LEDESS model is based on the concept of ecotopes. When this concept will be build upon characteristics of a wetland it is possible to define a conceptual ecotope typology for the specific wetland.

To create a working model of the wetland ecosystem this ecotope typology has to be defined in terms of (eco-)system attributes and their relations. A further step in conceptual modeling is the approach to define these (eco-)system attributes in a spatial way. The ecosystem typology then has to be defined in terms of GIS-data and spatial calculation rules. The OSIRIS software (Verweij, 2004) is able to structure this kind of system attributes and combine them with spatial (GIS-)data and knowledge sources in a calculation scheme to calculate spatial scenarios. With a model developed with this approach, it is possible to calculate dynamic ecotope maps of the wetland sensitive for morpho-, hydro-, and vegetation-dynamics.

2.3.2.1 Basic Structure of the LEDESS Model
Three components: Site, Vegetation and Habitat

LEDESS evaluates scenarios to see if they are possible from an ecological viewpoint and determines their consequences for nature and/or their economic effects. This way, choices can be made on what kind of nature type is desired and the suitability of the location as well as the economic profitability. The landscape-ecological modeling in LEDESS is based on a simplified view of ecosystems. Four components are considered, namely landscape, physiotope, vegetation and fauna, furthermore their interactions are taken into account. The relations are topological (vertical) and chorological (horizontal). Processes are present as a derivation from the different ecosystems, in other words they are not explicitly present.

Within LEDESS for three of the four components separate components are designed:

SITE:
The SITE module checks the ecological consistency of a nature target plan by comparing the needed abiotic site conditions with the present abiotic site conditions. For areas which are not suitable, measures can be applied by the user to modify the present situation into suitable site conditions (e.g. by excavation or raising the groundwater level).

VEGETATION:
The VEGETATION development can be simulated. Based on abiotic conditions and management, the user defines the number of years that the vegetation is allowed to develop and which nature target plan is used. A second, simpler option is the snapshot development: a nature target plan is directly translated into an end-vegetation structure.

HABITAT:
Suitable habitats are calculated, based on vegetation and physiotopes (abiotic conditions). Additionally, disturbance buffers may be placed around e.g. roads and cities. Finally, the size of the habitat clusters can be calculated to show how many animals can live in a cluster.

Every module results in a map and generates data for the next module. With the results a (nature development) plan can be adjusted or a choice can be made between different scenarios.

Knowledge tables
A system of knowledge tables and typologies connects these components.
The LEDESS-input consists of geographical data and knowledge tables. The present situation (vegetation structures, physiotopes etc.) and scenario data are stored as geographical data. By combining different geographical data layers new (geographical) data can be calculated from relevant knowledge matrices. The link between the maps and classifications is made with knowledge tables. A knowledge table consists of a matrix of the two factors on the X- and Y-axis. Every combination of those two results in a third factor. So, a knowledge matrix represents a set of rules-of-thumb describing a new condition resulting from two existing conditions (expert knowledge).

E.g., if we have two geographical datasets representing conditions A and B, all classes from A are defined as columns in the knowledge matrix, and all classes from B as rows. A new dataset representing condition C can then be derived by looking up the existing combinations of A and B in the matrix (Figure 2.3.3).

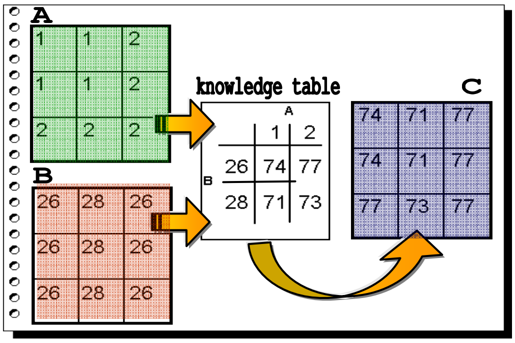


Figure 2.3.3 Mechanism of LEDESS knowledge tables

The accuracy of the output of the model LEDESS is dependent on the accuracy of the data provided by the user. For every module specific information is necessary.

2.3.2.2 Modeling Concept: Dynamic Ecotopes of wetlands

Clear definitions are necessary when trying to put nature into a model. What are its characteristics? What processes a model wants to make clear? A model is always a simplification of (processes in) the real world. To make calculations possible a model schematization has to be made, defining the conceptual model principles. These principles are describing which aspects will be put into the model, the model characteristics, and where it is positioned (spatial en temporal).

These conceptual model characteristics can be described in system attributes to define the abstract model. For actual model calculation, a typology for al the attributes has to be defined and combined with data and calculation rules. These can be related in a calculation scheme to analyze scenarios.

2.3.2.3 Applying the LEDESS concept in wetlands

The landscape-ecological modeling in LEDESS is based on a simplified view of ecosystems. Four components are considered, namely:

1. A landscape consisting of several homogeneous units: ecotopes
2. Homogeneous units concerning the abiotic circumstances: physiotope
3. Homogeneous units defining the vegetation structure types
4. Fauna habitat characteristics of the location (relating ecotopes with the species characteristics .

In addition, the interactions between the components have been taken into account. The relations are topological (vertical) and chorological (horizontal). Processes are present as a derivation from the different ecosystems, in other words they are not explicitly present in the model. To define these relations, a system of knowledge tables, decision trees and typologies connects the components.

1. Ecotope concept
The concept of the ecotope originates from landscape ecology. An ecotope is here defined as "a physically limited ecological unit, whose composition and development are determined by abiotic, biotic and anthropogenic aspects together". Ecotopes are more or less homogeneous units on the scale of the landscape, identifiable by their similarities and differences in geomorphologic and hydrological characteristics, vegetative structure and land use. Within the model, ecotopes are unique combinations of vegetation structures and physiotopes at the used scale.

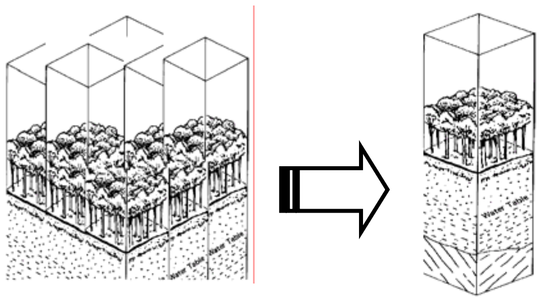

Landscape consisting of several homogeneous units

Figure 2.3.4 The ecotope concept, used in the LEDESS-model: Landscape consisting of several homogeneous units at the used scale

2.Physiotope
The spatial element defined as homogeneous concerning the abiotic circumstances, relevant for vegetation development, is called physiotope. Differentiating characteristics are the abiotic processes, ground water levels and substrates. In other words, if management and stage of development are the same, then the physiotope and ecotope are the same physical unit.

3. Vegetation structure type
For vegetation development, a difference can be made between vegetation structures, ecotopes and vegetation types. Vegetation structures are areas, at a specific scale, with a homogeneous vertical and horizontal vegetation structure and intensity of management. Floristically and abiotically, they can be heterogeneous. Vegetation types are the sociological translation of one or more ecotopes.

The development of the vegetation structure can be simulated in the model based on abiotic conditions, management and the number of years that the vegetation is allowed to develop. A second, simpler option is the snapshot development: the vegetation development is directly translated into a climax or end-vegetation structure.

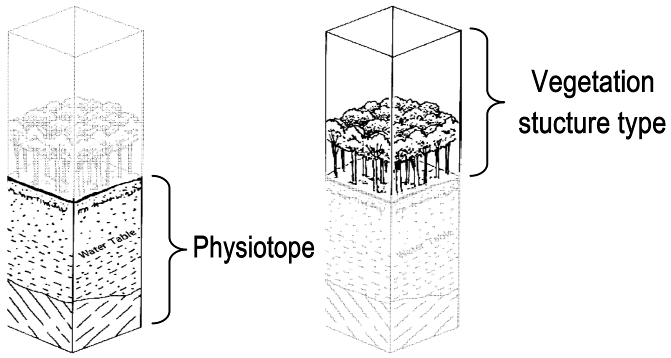
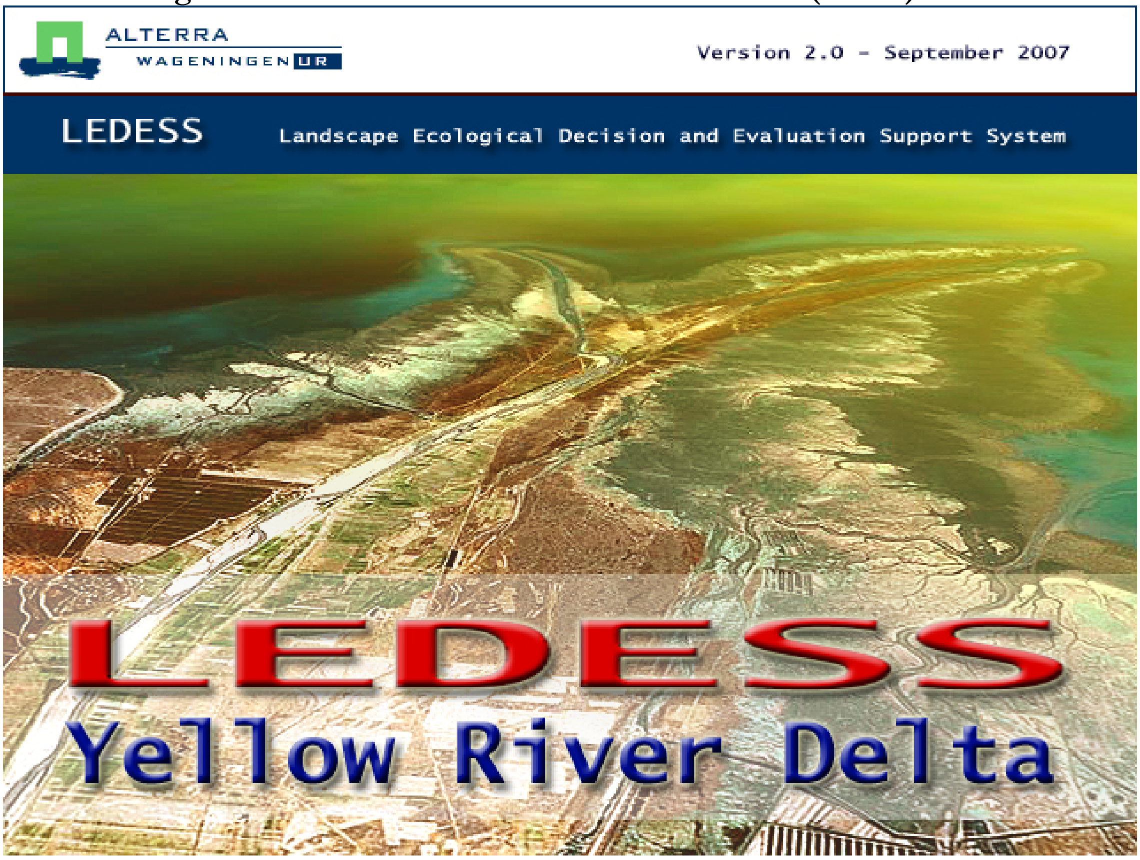


Figure 2.3.5 Ecotopes consisting of Physiotopes and Vegetation structure types

4.Ecotopes as habitat for fauna
Ecotopes are input for the LEDESS Habitat modeling. The (changed) ecotopes in the scenarios result in changes in the amount and configuration of habitat. The effect of these changes on the population size of species can be assessed.

Habitat is a species-specific spatial unity within which all demands of the animal species are met. In LEDESS, it is defined as a spatial collection of ecotopes fulfilling the minimal surface-demands of a species. The suitability of ecotopes for fauna is expressed in carrying capacity per ecotope, or if possible, in density. Areas with a suitable habitat are called *living areas* if no division can be made in functional areas. The most important *functional areas* are *breeding, foraging* and *resting areas*. The surface of connected living or functional areas can be expressed in suitability for (the amount of) animals and the carrying capacity, possibly divided into amount-classes.

2.3.3 Example: Evaluating the effect of wetland management scenarios on vegetation and fauna in the Yellow River Delta (China)



2.3.3.1 General characteristics of YRD ecotopes

With the help of the spatial modeling environment OSIRIS (Verwey, 2004) the model structure for the dynamic ecotope model of the Yellow River Delta (YRD) in China was created, the LEDESS-YRD model. The model should evaluate ecological effects of variations in the flooding regime within the whole YRD. These spatial scenarios can be based for instance on economical driving factors, or nature conservation aspects.

The typology for the YRD ecotopes is based on:

- The conditional characteristics of natural processes in dynamic water systems, controlled by means of landscaping and management.

This dynamic water system is spatial located on the delta of the Yellow River.
Based on these principles the final ecotopes are classified based on three general characteristics, affecting physiotopes, vegetation and fauna:
Morphodynamics: Mechanical forces exercised by water and sediment (erosion, transport and deposit of sediment, flow of water and surge). The morphodynamics for the YRD have been taken into account by assuming a maximum sedimentation

scenario for the sedimentation spread at the mouth of the river delta in the next 10 years.
Hydrodynamics: Physiological and chemical effects of water (duration, depth and time of flooding, as well as the type of the water). In the LEDESS-YRD model duration has been specified by the use of the SOBEK and MODFLOW model (www.visual-modflow.com)The type of water (rain, flooding or groundwater) has been modeled and combined from several models and data sources.
Land use / vegetation dynamics: Effects of mainly by human intervention i.e. conscious landscaping and management (from (natural) grazing or rough pasture management to intensive agricultural use). In addition, the developing from pioneer vegetation to forest or reed marsh after natural set back of vegetation is part of this factor. For the YRD, SPOT satellite data has been combined with expert knowledge and existing vegetation maps to model current vegetation, as well as the change of vegetation type under scenario conditions.

2.3.3.2 Scenarios, SOBEK, Land Use and Management

A scenario is called the total of external settings in a case. A scenario is based on a case. To calculate a scenario, you have to connect ESRI grid sources (Parameter data) to the necessary attributes which are not yet connected.
The LEDESS model is very suited for comparing the effects that can be expected in different scenarios. These scenarios should be described in terms of the determining factors of the ecotopes that are modeled and data that can be taken into account in the modeling, e.g. map of barriers. The scenario parameters of LEDESS-YRD (unconnected system attributes) are: SOBEK (and the related Modflow input), the changes in Land Use (e.g. a newer SPOT image) and a map of the Management measures to reduce the fragmentation of habitat by reducing disturbance (mainly closing roads).

In this study, the determining factors for ecotopes and available data were listed in close cooperation with field and vegetation experts in a scenario workshop. The scenarios assessed were defined by together with Yellow River Conservancy Commission (YRCC), based on the following aspects:

- The (coarseness of the) modeled expert knowledge on ecotopes,
- the available digital spatial data of the study area,
- the effective measures for influencing the flooding regime in the area,
- autonomous developments in the area that can influence the biodiversity.
- For the scenario development, a time horizon of 5 and 10 years can be used. In a few years, major changes in the study area can occur.

2.3.4 Scenario development

The scenarios that are assessed with LEDESS are formulated, taking into account the following information (see Table 2.3.1 and Figure 2.3.6).

Table 2.3.1 The final scenarios in LEDESS YRD

SCENARIO Code	Scenarios name	SOBEK & MODFLOW (Spatial in fig 23)	SPOT image used	Management to reduce fragmentation	Vegetation development based on water given in	Vegetation development (Years)
CSexp	Current situation based on Expert knowledge	none	none	none	none	Current
StopW	Stop water to Wetlands 5years	No water	2007	No	No water given	5
StopWF	*Stop water to Wetlands 5years+ fed. fragm.*	No water	2007	*Yes*	No water given	*5*
CS	**Current sit. (Some water) = Reference Situation**	**SPOT**	**2007**	**No**	**SPOT image**	**5**
CSF	*Current sit. (Some water)+ fed. fragm.*	SPOT	2007	*Yes*	Growing Season	*5*
1	(NS+SS) + Compartments	2.78?	2007	No	Growing Season	5
1F	*(NS+SS) + Compartments+ fed. fragm.*	*2.78?*	2007	*Yes*	Growing Season	*5*
2	(N+NS+SS) + Compartments	2.78?	2007	No	Growing Season	5
2F	*(N+NS+SS) + Compartments+ fed. fragm.*	*2.78?*	2007	*Yes*	Growing Season	*5*
A	(NS; 20 cm)	2.78?	2007	No	Growing Season	5
AF	*(NS; 20 cm)+ fed. fragm.*	*2.78?*	2007	*Yes*	Growing Season	*5*
B	(SS; 20 cm)	2.78?	2007	No	Growing Season	5
BF	*(SS; 20 cm)+ fed. fragm.*	*2.78?*	2007	*Yes*	Growing Season	*5*
C	(NS+SS; 20 cm)	2.78?	2007	No	Growing Season	5
CF	*NS+SS; 20 cm)+ fed. fragm.*	*2.78?*	2007	*Yes*	Growing Season	*5*
D	(N+NS+SS; 20cm)	2.78	2007	No	Growing Season	5
DF	*(N+NS+SS; 20cm)+ fed. fragm.*	*2.78*	2007	*Yes*	Growing Season	*5*
E	(N+NS+SS; 40cm)	3.49	2007	No	Growing Season	5
EF	*(N+NS+SS; 40cm)+ fed. fragm.*	*3.49*	2007	*Yes*	Growing Season	*5*
F	(N+NS+SS; 80cm)	4.17	2007	No	Growing Season	5
FF	*(N+NS+SS; 80cm)+ fed. fragm.*	*4.17*	2007	*Yes*	Growing Season	*5*

Figure 2.3.6 SOBEK & MODFLOW Scenario Design. Shown are the areas and the amount of days the surface is flooded (> 20cm above surface in the growing season (Week 9 to Week 41).Ecotope maps

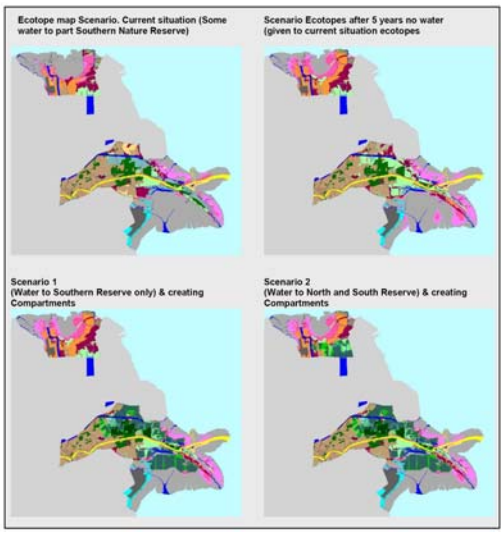


Figure 2.3.7 Spatial distribution of ecotopes; Scenarios D, E & F

In Figure 2.3.8 the overview of the ecotope distribution per scenario is given for evaluation purpose of the outcome of the different scenarios.

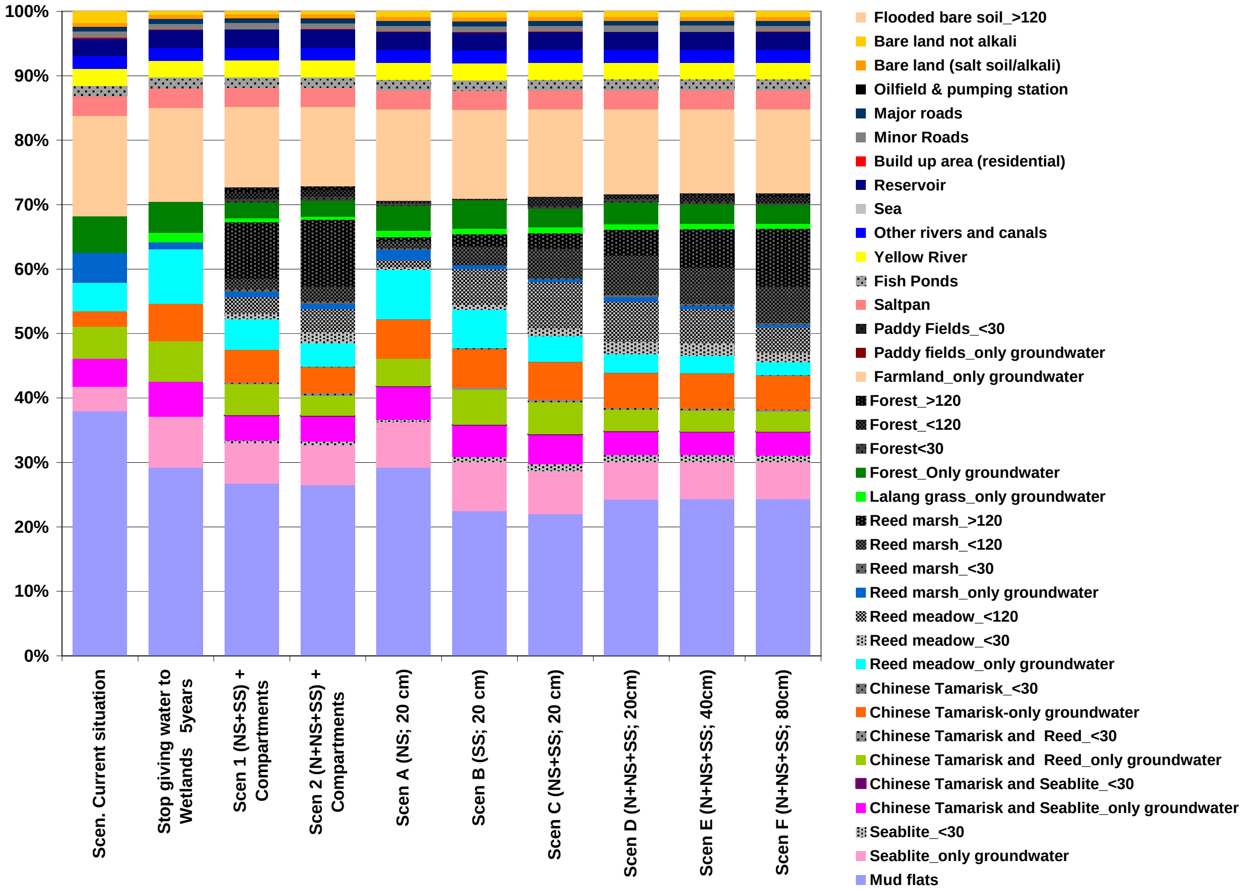


Figure 2.3.8 Relative abundance of ecotopes per scenario.

From Figure 2.3.8 it is clear that in all scenarios where wetland restoration is planned the main ecotope change is the change of the mudflats into reed meadow and reed march vegetation. The relative percentage of farmland in the YRD stays more or less the same in all scenarios. Only in scenario 2 there are larger parts of farmland reclaimed for wetland development.

In principle, based on the distribution of ecotopes for the development of freshwater wetland, the following conclusions can be drawn:

- Making available more water results in more freshwater wetland,
- Stopping water provision to the wetland (or to part of the currently recharged areas) is reducing almost all reed areas to very small amounts. The area of dry land reed meadow will increase considerably;
- The amount of Chinese tamarisk land as ecotope and in combination with reed meadow seems to increase in all scenarios.

Looking at the spatial distribution of the ecotopes in the different scenarios it is clear that these changes mainly take place in the northern nature reserve. Only in the scenarios 2, D, E and F (where fresh water is diverted to the north) the increase of Chinese tamarisk land is not so big. Scenario 2, where the largest area in the north is recharged, is showing the smallest area of Chinese tamarisk.

But also:

- Providing almost twice as much water will not result in a double amount of fresh water reed, since large areas first have to fill up deeper before areas with an higher elevation will be flooded (Scenario D, E, F).
- Especially in the south-south nature reserve (Dawenliu nature reserve) the proposed freshwater wetland is only completely flooded during longer periods of time when very high water depths are accepted (up to more than 3 meters). It is questionable if these water depths are possible and desirable.
- With compartments the distribution of the water seems to be distributed in a more efficient way to get a better " value-for-money" (in this case…water). To look to this in detail the cost for dyke development and management should be compared in more detail with the more efficient water use (which was beyond the scope of this study).

2.3.4.1 Habitat module

The selection of species that are modeled in a study is an important choice in the process. The species that should be selected should obligatory comply with the criteria listed. The species should:
Represent a range of species with similar dispersal capacities and area requirements for viable populations (the species should not have very exceptional characteristics)
Be associated with a specific type of habitat, that responds to expected changes in inundation (i.e. (dis)appearing of forest, different allocation of wetlands)

And preferably:

- Is a protected species
- Is an appealing species
- Represents different kinds of functional groups (birds, mammals etc.)

With a well-chosen set of species, the effects of changes in a landscape can be expressed in the effects on the viability of different kind of species (biodiversity).

Selected species for modeling
For the YRD the first species selection was carried out during the habitat workshops with specialists in Zhengzhou. This selection was for the largest part based on the availability of expert and field knowledge of the species. At the same workshop estimations were given for the required spatial characteristics and the carrying capacity of the ecotopes for these species (Figure 10 and 11). From this selection those species are selected that illustrate the relevant effects on biodiversity best and that showed the most reliable modeling results (Table 2.3.2).

Table 2.3.2 Used species characteristics to calculate habitat size of populations

Great Bustard	Maximum Homerange Distance km	2.0
	Maximum Dispersal distance km	2000
	Max 2006 YRD Density km2	0.3
Oriental Stork	Maximum Homerange Distance km	1.0
	Maximum Dispersal distance km	4000
	Max 2006 YRD Density km2	2
Red Crowned Crane	Maximum Homerange Distance km	1.0
	Maximum Dispersal distance km	3000
	Max 2006 YRD Density km2	0.22
Saunders Gull	Maximum Homerange Distance km	1.0
	Maximum Dispersal distance km	1000
	Max 2006 YRD Density km2	2.1
Siberian Crane	Maximum Homerange Distance km	1.0
	Maximum Dispersal distance km	5000
	Max 2006 YRD Density km2	0.3
Tundra Swan	Maximum Homerange Distance km	1.0
	Maximum Dispersal distance km	2000
	Max 2006 YRD Density km2	10

Species can need more types of habitat to complete their life cycle, for example foraging habitat, breeding habitat and resting habitat. When modeling a species, we model the most limiting habitat type (often breeding habitat). We then assume that other habitat types are sufficiently available and accessible in the near surrounding area.

In cases that two different habitat types are required for breeding and foraging and it is unclear which type of habitat is limiting, it is possible to take more types of habitat into account in the model. This also means that in the Habitat suitability input of both the foraging habitat and the breeding habitat should be defined.

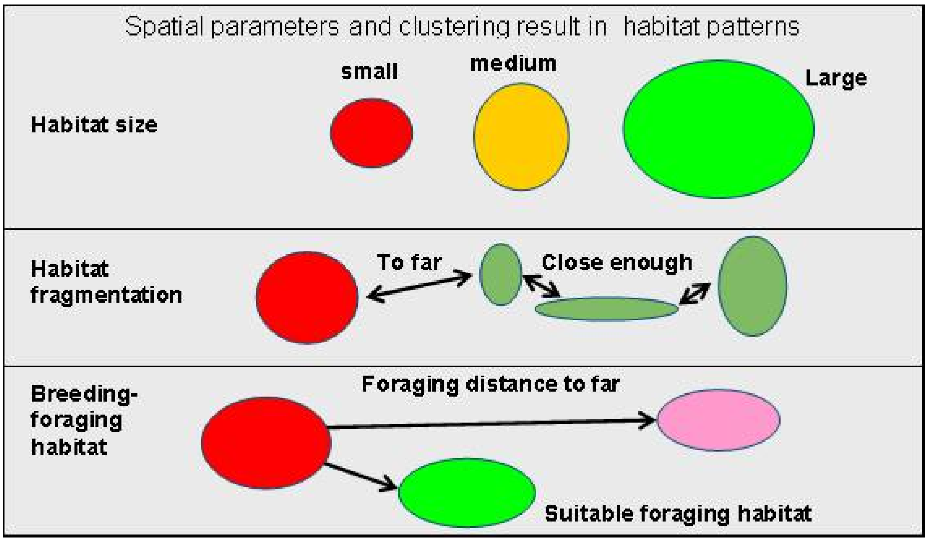


Figure 2.3.9 Habitat Size and Fragmentation of Habitat patches, and the distance to foraging areas are aspects to take into account when modeling the size of populations.

2.3.4.2 Evaluation of scenarios on selected species

Evaluating the different scenarios point wise the following conclusions can be drawn: Stop providing water to the wetland will reduce the amount of species tremendously in 5 years time. For all species involved this seems not a preferred scenario. This means also that doing nothing in the northern reserve will reduce the habitat quality there further too. This is visible in the scenarios A, B and C where it is very clear that taking too few measures in the south only will decrease the amount of individuals for both crane species, since measures taken in the south are not compensating for the loss of habitat in the current reed march areas. In scenarios 2, D, E & F the overall habitat quality of the YRD will increase more. Even to keep the current overall habitat, more water is needed than currently available.

For some species the development of the scenarios at first sight seems to have no or a negative effect. The two species for which this is most obvious are Saunders' gull and the Great Bustard.

For Saunders Gull large areas of possible habitat (mudflats) are converted into wetlands. The more this is happening (Scenario 2, D, E, F) the lower the estimated population size is. But, on the other hand the mudflats are not optimal breeding habitat and in all scenarios the amount of seablite vegetation is growing compared with the current situation. So it is defendable to say that for the Saunders Gull improving habitat quality should be the main focus of the scenarios, instead of increasing the quantity. For such an endangered species, it is difficult to estimate if this is a sufficient solution. Developing a specific scenario for improving Saunders Gull habitat quality is desirable.

For the great Bustard it is clear that 'water' is not a determining factor in improving habitat quality. The Great Bustard has declined because of reclamation of land for agriculture and the fragmentation of habitat through disturbance. Scenarios with measures to reduce this fragmentation show an increase of Great Bustard individuals, but the numbers are far below the larger numbers of 20-25 years ago. Other scenarios will have to be developed to preserve this species in the YRD, but this is mainly out of the scope of the YRCC[1].

It is impossible and not desirable to ignore the effect of increasing fragmentation which has been taken place since the reference situation in the beginning of the '90's. As shown by Huang Chong (CAS, pers.com) in figure 2.3.10, the amount of fragmentation of potential habitat due to disturbance has been increased massively over the past 15 years. As shown in figure 2.3.11, the location of these new disturbed areas are exactly located on (formerly) very good quality habitat areas. For some species like the Great Bustard and the Siberian Crane the disturbed areas can be very large due to their large disturbance distances. A combination of a 'water' scenario and a 'reducing fragmentation' scenario can be giving better results than a scenario with even more water (E.g. compare "Scen. D - with measures" with "Scen. E - without measures"). You could say that in Scen. E compared to D the YRCC is paying the cost for neutralizing the disturbance effect though a provision of a larger a mount of

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[1] The interest of the YRCC could lay in the fact that lowering the amount of irrigated farmland in favor a areas for the great bustard could reduce the amount of water needed for agriculture, which (in theory) could be used then for wetland restoration in the YRD. Discussion about reducing these amounts lays outside the scope of this study.

water. Finding a solution is only possible when all stakeholders involved are trying to look for an integrated solution of this increasing problem in the Yellow River Delta.

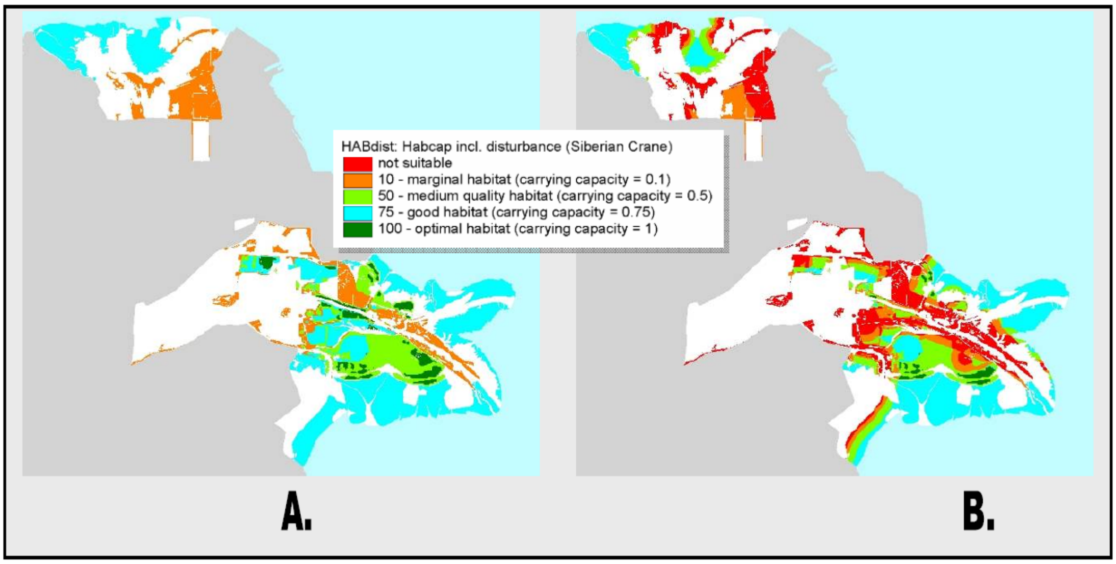


Figure 2.3.10 Visualizing the effect of taking into account the fragmentation of potential habitat due to disturbance. A. Potential habitat of the Siberian Crane, B. Potential habitat of the Siberian Crane after calculation of the disturbance of roads, build up area and oilfields.

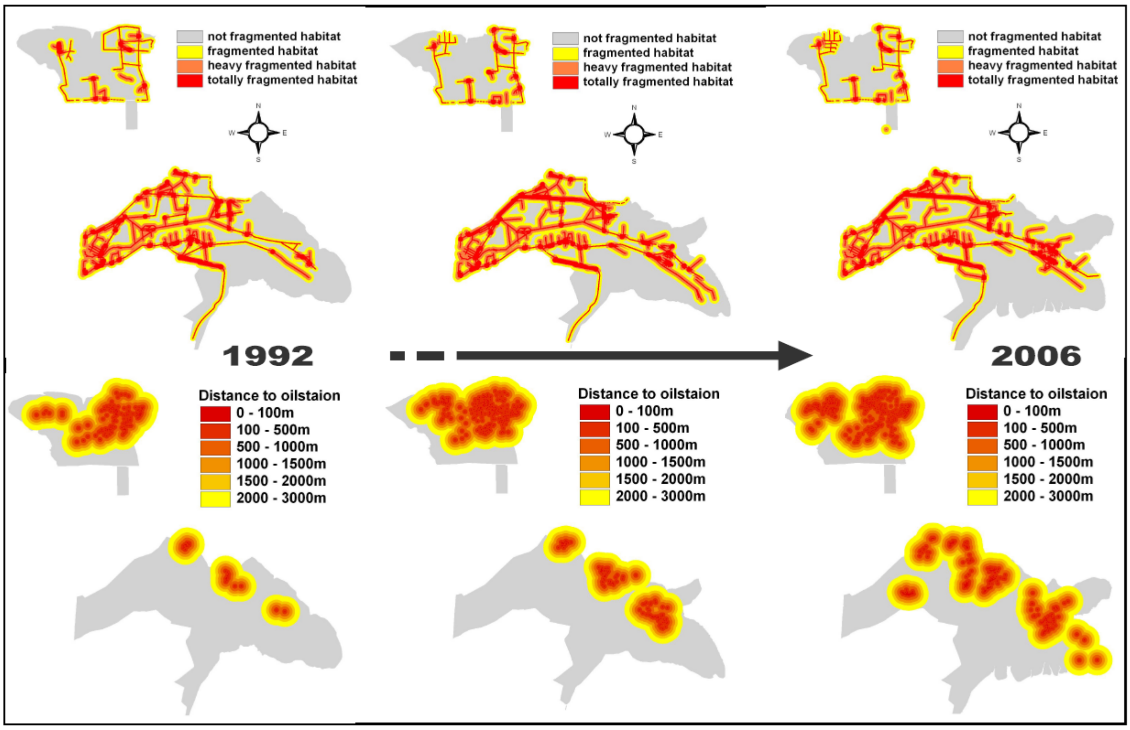


Figure 2.3.11 Visualizing the effect of increasing fragmentation since the reference situation in the beginning of the '90's (Huang Chong (CAS) pers. com.)

2.4 Participatory approaches to wetland management

(Annemarie Groot with contributions of Madeleine van Mansfeld and Jelleke de Nooy (DNY-consult, Wageningen))

2.4.1 Introduction

Participatory approaches to wetland management are increasingly advocated by international wetland organisations such as Wetlands International and the Ramsar Bureau. In 2002, Wetlands International published 'Strategies for Wise Use of Wetlands: Best Practices in Participatory Management'. In addition, the theme of 7th Meeting of Contracting Parties to the Ramsar Convention held in 1999 was 'People and Wetlands: The Vital Link'. Also in China participatory approaches are increasingly being used for the purpose of sustainable wetland management (e.g., Sanjiang Plain Wetlands Protection project and Jiangsu Yancheng Wetlands Protection Project).

This chapter addresses the reasons behind the emerging call for participatory approaches to wetland management and discusses the concept of participation. This chapter also highlights the participatory practice by describing various methodologies and methods that can be used in different phases in participatory wetlands management. An illustration of the use of two participatory methodologies in Chinese context will be provided as well.

2.4.2 Rational behind participatory approaches to wetland management

Participatory approaches to wetland management are advocated because of their potentials to address the issue of multiple claims placed upon the resource.
Wetlands are usually multidimensional, cross-boundary resources. They provide a range of interrelated environmental functions and socio-economic benefits for different stakeholders. At the catchment level, wetlands provide hydrological benefits for downstream communities and their related socio-economic activities. At higher decision making levels, wetlands offer provinces and national governments opportunities for ecotourism and timber production. Because of the range of 'wetland use' strategies and beneficiaries at the different decision making levels, there are different, often conflicting demands, placed upon wetlands. For instance, recently in the Yancheng Nature Reserve, which is one of China's largest coastal wetland reserve, local communities preferred the planting of trees and the conversion of farms from irrigated rice to cotton and other crops. Such a change in the farming system poses threats to the overall wetland cover and suitability for passage of migratory and wintering birds which is the concern of Jiangsu province, and in particular, Yancheng municipality that aims to develop ecotourism. This type of tension could occur more often in future as ecotourism is becoming an increasingly important sector in China. Participatory approaches assist in making explicit conflicting goals and strategies and help to engage the stakeholders in negotiating trade offs.

A second reason behind the use of participatory approaches relates to the main stream sectoral approach to wetland management. Such a sectoral approach makes it difficult to address the multidimensional character of the resource. The sectoral approach is grounded by the way the responsibilities for wetland management are usually divided. Oftentimes the managerial tasks are allocated amongst different sectoral agencies. Weak linkages between these agencies prohibit to use of a more integrated approach to wetland management. Participatory approaches, however, facilitate the inclusion of stakeholders, who represent relevant sectors (i.e., agriculture, forestry, tourism, fisheries), in wetland management. A participatory process facilitates these stakeholders to bring their different types of sectoral knowledge into an integral decision making process.

For these mentioned reasons, world wide it is increasingly acknowledged that in order to plan and implement wetland management which is environmentally, economically and socially sustainable, there is a need to engage all relevant stakeholders in (management) discussions and decisions through means of participatory approaches.

The arguments in favour of participatory approaches to sustainable wetland development can be classified as *pragmatic* and *normative* arguments (Johnson & Wilson, 2000). The pragmatic arguments deal with *effectiveness* and *efficiency*. It is claimed that participation leads to *e*ffective interventions because in such inclusive processes all relevant stakeholders can indeed take a positive stake in their success. Through participation and negotiation in planning, implementation and, monitoring and evaluation, stakeholders are more likely to arrive at win-win solutions and to agree with, and support proposed interventions. Moreover, participation will improve cost-effectiveness as it brings on board stakeholders, who add resources in terms of knowledge, networks, labour, and/or land. Professionals, who use such pragmatic arguments, consider participation as a means.

People who use *normative* arguments claim that participation can lead to empowerment of disadvantaged individuals, communities and organisations, through increasing their capacity to make decisions that affect their lives as well as changing the power relationships between dominant and disadvantaged stakeholders. Moreover, they believe that participation increases the legitimacy of decisions. People who are using normative arguments for participation consider it a basic *human* and *democratic right*. In this perspective, participation is seen as a goal in itself.

In China, like in many other countries supporting the Ramsar convention (see box 2.4.1), participation in wetland management is mainly advocated for pragmatic reasons.
Before discussing some practical experiences with participatory approaches and methodologies in a Chinese context, more clarification on participation terminology is needed.

Box 2.4.1: When is participatory wetland management advisable? (Source: Ramsar Convention on Wetlands, 1999. Resolution VII.8)

Experience has shown that it is advisable to involve local people and indigenous knowledge and practices in a management partnership when:

- The active commitment and collaboration of stakeholders are essential for the management of a wetland (e.g., when the wetland is inhabited or privately owned);
- Access to the natural resources within the wetland is essential for local livelihood, security and cultural heritage, and
- Local people and communities express a strong interest in being involved in management.

The case for local and indigenous people's involvement is even stronger when:

- Local stakeholders have historically enjoyed customary/legal rights over the wetland;
- Local interests are strongly affected by the way in which the wetland is managed;
- Decisions to be taken are complex or controversial (e.g., different values need to be harmonized or there is disagreement on the ownership status of the land or natural resources);
- The existing management regime has failed to produce wise use;
- Stakeholders are ready to collaborate and request to do so, and
- There is sufficient time to negotiate among stakeholders before management decisions are being made.

Different types of participation

The term participation has different meanings to different people. It has been used to devolve decision making from external agencies, but also to justify external decisions. It has been used for data collection, but also for interactive analysis. There are basically seven ways that organisations use the term participation, ranging from *passive* participation, where people are involved merely by being told what is to happen, to *self mobilisation,* where people take initiative independently of external institutions. Each type of participation serves a particular purpose. However, if the objective is to achieve sustainable development, then nothing less than functional participation will suffice (Pretty et al,1995).

Table 2.4.1: "Different degrees of participation can be distinguished Pretty et al, 1995)

Self- mobilization	People participate by taking initiatives independent of external institutions to change systems.
Interactive participation	People participate in joint analysis, which can lead to a shared vision, strategy or action plans.
Functional participation	People participate by forming groups to meet predetermined objectives related to the project, which can involve the development or promotion of externally initiated social organization.
Participation for material incentives	People participate by providing resources, for example labor, in return for food, cash or other material incentives.
Participation by consultation	People participate by being consulted, and external agents listen to views. These external agents define both problems and solutions, and may modify these in the light of people's responses.
Participation in information- giving	People participate by answering questions posed by extractive researchers and project managers using questionnaire surveys or similar approaches.
Passive participation	People participate by being told what is going to happen or what has already happened.

Wetland management practices also show varying degrees of participation. Consultation of stakeholders is becoming increasingly common. Oftentimes stakeholders are informed of proposals for development in wetlands and asked to submit comments. In some countries, local stakeholders are assisting with wetlands management in return for stipends or other incentives i.e., in Trinidad & Tobago where community members are engaged in monitoring activities at the Nariva Swamp (Canari, 2006). Deeper involvement in decision-making is also facilitated through multi-stakeholder National Wetlands Committees and/or Local Wetlands Committees (*ibid*). Several multi-stakeholder committees exist in Jamaica, such as the National Ramsar Committee and the National Integrated Watershed Management Council. In Saint Lucia, there is experience with the granting of co-management agreements to local community organisations designated as Local Fisheries Management Authorities which is contributing to shared ownership and collaborative management of wetlands (*ibid).*

2.4.3 Examples of participatory tools

In wetlands management a wide range of participatory methodologies and tools are applied to enable stakeholders to share and analyse their knowledge of life and conditions in order to vision, plan and act. Each methodology or tool involves a specific procedure for undertaking a particular task, or set of tasks, such as an 'environmental assessment', 'stakeholder analysis', 'action planning' or an 'evaluation'. Some of the tasks are more process oriented such as 'developing participants' engagement' or 'building shared ownership'. Professionals who facilitate participatory wetland management need to have the competence to select the right methodology and methods to accomplish a given task. The large variety of participatory methodologies that are currently in use does not facilitate the choice for the right participatory tool. To help professionals, participatory methodologies can be classified according to the phases of a project or management cycle (see figure 2.4.1). For each of the four iterative phases, i.e., 'getting started', 'planning', 'acting' and 'reviewing' , specific participatory methodologies and tools can be selected.

Figure 2.4.1: Participatory wetland management cycle involving four iterative phases

Table 2.4.2 provides examples of methodologies and tools that can be applied in a specific phase of a participatory wetland management process. However, it is important to realise that some participatory methodologies and tools are specific to a particular phase and others are more general in their use and fit more phases. The use of participatory methodologies brings about qualitative information.

In the following section an illustration of the use of two participatory approaches in Chinese context is provided. The *design approach* is described as an example of a methodology supporting participatory planning. The design approach was applied in the development of the Master plan 'Greenport Shanghai Agropark'. The *sustainability matrix* is presented as an evaluation methodology that will be used to evaluate future developments in the Greenport Shanghai Agropark. Unfortunately, there was no Chinese experience with the use of participatory methodologies in the context of wetland management available to the author of this chapter. Noteworthy, the stakeholders analysis described in 2.2.5 used in the design of scenarios for productive green zones in the urban fringe of Nanjing can also be considered a participatory methodology.

Table 2.4.2: Examples of participatory methodologies and tools in wetland management

Phases in participatory wetland management	Description / relevant questions to address	Examples of participatory methodologies/tools to use
Getting started	• First identification of stakeholders , i.e. those individuals, groups or organisations involved with wetlands either through their livelihood strategies or through their responsibility in an institutional context • Examining why various stakeholders want to or should be engaged in participatory wetland management (What drives people?) • Start building contact with stakeholders • Clarifying reasons and objectives for participatory wetland management	• Stakeholder analysis • Secondary data collection • Rich picture
Planning (designing)	• Building stakeholders understanding of each other's values, concerns and interests • Generating visions for the future • Situation analysis and identifying issues and opportunities. Typical themes to deal with include: • Spatial and temporal changes in wetland use • Environmental characteristics and dynamics of wetlands, • Socio-economic characteristics of wetland users, • Stakeholders' knowledge of wetlands, • Gender divisions in wetland use and management • Institutional arrangements • Policy issues in wetland use • Negotiation and prioritization of issues and opportunities • Exploring future scenarios and designing feasible options • Negotiation/agreeing on objectives, actions, timeframes and responsibilities	• Participatory Rural Appraisal (PRA) techniques such a resource maps, seasonal diagrams, Venn diagrams, semi structured interviews, group discussions • Stakeholder analysis • Gender analysis • Strengths, weakness, opportunities and threads (SWOT) analysis • Participatory GIS • Societal Cost Benefit analysis • Scenario's • Logical framework
Acting (implementation & managing)	• Develop integrated initiatives and detailed action plans • Develop capacities of stakeholders • Establish management structures	• 5 W's and 1 H (What, Why, When, Who, Where and How) • Knowledge management
Reviewing (learning and adapting)	• Creating a learning culture and environment • (jointly) define success criteria (performance questions and indicators) • Review and evaluate progress and identify lessons • Feed lessons learned back into strategies and implementation procedures	• Critical incident method • Semi-structured interviews

2.4.3.1 The Design approach supporting participatory planning

The Design approach was applied in the participatory development of the Master plan 'Greenport Shanghai Agropark' in China. In this section first the design approach will be described in terms of principles. Then, the Chinese –Dutch assignment concerning the Master plan 'Greenport Shanghai Agropark' will be introduced in order to understand the context in which the Design approach was applied. Finally, the use of the design approach in the development of the Master plan will be discussed in terms of process and methods.

Principles of the design approach

The design approach is in use all over the world to shape and organise processes in the field of regional planning, landscape planning and the development of agribusiness parks (Smeets et al, 2007; Groot & van Mansfeld, 2004). The Design approach is driven by a number of principles such as:

- *Active participation* of (representatives) of government services, knowledge institutes, private sector and NGO's;
- *Building coalitions* between the stakeholders;
- *Innovation* is looked for through the integration of various disciplinary knowledge with informal or tacit knowledge of user groups;
- *Process planning as planning mode*: Goals serve as driving forces rather than that they function like a straightjacket. Process planning requires flexibility, continous reorientation and adaptation;

The process design consists of multiple iterative phases: *Innovation, building support* and *implementation of plans*. These three phases can be distinguished but not separated. Each phase is put into practice through participatory methodologies and methods. Some of these methods are specific to a particular phase. Others are more general in use. The so called creative methods are very useful for the development of innovative ideas. The stakeholder analysis, however, is used at different moments throughout the entire process.

Comparing the Design approach with approaches such as 'stakeholder analysis', 'environmental analysis', 'scenario-development' or the 'logical framework' , the design approach is unique were it come to its focus on innovation through the integration of different types of knowledge of people 'representing' four different stakeholder groups i.e., government services, knowledge institutes, the private sector and NGO's.

The design approach applied in Chinese context: The development of the Masterplan Greenport Shanghai Agropark

Agroparks respond to China's vital need for new forms of intensive agricultural production in which food is produced near the centres of urbanization, without causing serious environmental impact. In this context in July 2006, an international Chinese-Dutch combination initiated the Greenport Shanghai Agropark planning and development process. The Shanghai Industrial Investment Company, TransForum Agro & Groen and Alterra, Wageningen University and Research (both located in the Netherlands) worked together in a general strategic alliance, to develop an Agropark in this front garden of Shanghai, on Chongming Dao. The Master plan for this agropark was built upon five features: 1) Integrated network design answering to the needs of production, processing, demonstration, trade and recreation, 2) Modern metropolitan agriculture, 3) High tech infrastructure, 4) Sustainable development and 5) Profit.

The design process of the Masterplan was based on a *multi stakeholder*, *multi level*, *multi disciplinary* and *multi cultural approach*. Cooperation took place between Chinese and Dutch government officials, Dutch Agro-entrepreneurs and international team of 15 Dutch key specialists and Chinese researchers from different disciplines. The design process resulted in the 27km^2 Master plan Greenport Shanghai Agropark (Smeets et al, 2007). At this moment, the process of detailed elaboration and implementation of the Master plan has just started. The opening of the Greenport Shanghai Agropark is planned for in 2010.

The design approach for master planning Greenport Shanghai Agropark: Activities, methodologies and tools used in a work atelier

Since July 2006, many efforts have been undertaken in the light of the design of the Master plan Greenport Shanghai Agropark. So far, the *'Work atelier Masterplan Greenport Shanghai Agropark Dongtan* (25-31 March, 2007), in which the master plan was framed, can be considered one of the highlights of the process till now. The next section, describes the design approach in terms of activities, methodologies and tools applied during the 'Work atelier' and its preparation.

Preparation of the Work atelier: Activities and tools used

As part of the preparation of the Work atelier a *stakeholder analysis* methodology was used in order to find out which people to invite to the 'Work atelier' Masterplan Greenport Shanghai Agropark Dongtan (25-31March, 2007) (see 2.2.5 for a description of stakeholder analysis). Then, *a script* was developed showing in detail the activities that would take place during the 'work atelier', the timing of these activities, the responsible persons and the methods to use. Such a script is an important tool in the design approach. Firstly, it is a planning tool to be used in a flexible way. For instance, in case in the course of the process there is need for change, the script should be adapted accordingly. Secondly, a script serves as an important communication tool. It forces to make explicit facilitators' (implicit) ideas to clients and other participants. As such this tool assists in communication about the process to follow.

Implementation of the Work atelier: Activities and tools used

In the Work atelier 'Masterplan Greenport Shanghai Agropark Dongtan (25-31 March, 2007) CChinese and Dutch government officials, Dutch Agro-entrepreneurs and an international team of 15 Dutch key specialists and Chinese researchers, from different disciplines jointly developed the Master plan. In three task forces, the participants elaborated a *hardware plan* (i.e., infrastructure), *orgwareplan* (i.e., frame for business plan) and a *software plan* (i.e., communication and knowledge management). These three plans together form the basis of the Master plan Greenport Shanghai

Agropark. In the facilitation of the 'Work atelier' various participatory methods were used. The following description highlights only a few.

Creative methods for developing a safe and fruitful working environment

The 'Work atelier' started with an extensive introduction of the participants for which creative methods were used. *Metaphors* were applied in the introduction to encourage the participants to start thinking beyond their daily routine. Usually, workshop participants introduce themselves by presenting their name and professional back ground. However, a participant who explains he would like to function in the project as a captain of a big boat watching over the process, tells much more about himself than in case he would have presenting his name and function only. Moreover, several excursions were organised to become acquainted with the area, the assignment and with each other. The use of these methods contributed to the creation of a safe and creative working environment in which innovative ideas could emerge.

SWOT analysis

After the introduction part, a participatory SWOT analysis was carried out. A **S**WOT Analysis is a strategic planning tool used to identify, explore and assess the **S**trengths, **W**eaknesses, **O**pportunities, and **T**hreats involved in a project or a business venture. It involves specifying the goal of a project and identifying the internal and external factors that are favorable and unfavorable to achieving it. *Strengths* are the attributes that are helpful to achieve a formulated goal. Strengths are aspects people are proud to talk about. *Weaknesses* are attributes of the organization/ area that are harmful to achieving the goal: those things that have not worked so well. *Opportunities* are external conditions that are helpful in achieving the goal. *Threats* are external conditions that are harmful to reaching the stated goal. There is not one fixed procedure for implementing a SWOT analysis. A SWOT analysis is usually done in a relatively quick brainstorming session in which strengths, weaknesses, opportunities, and threats involved in a project are identified. This identification is then concluded upon in terms of strategies to undertake. A SWOT analysis can also be carried out in a more quantitative way when strengths, weaknesses, opportunities, and threats are systematically pair wise compared and ranked. In the context of the Master planning, the objective of the SWOT was to develop a common understanding about the factors and actors favourable and unfavourable to the development of the Greenport Shanghai Agropark. Meanwhile, the SWOT analysis assisted in formulating a joint strategy for the development of the Master plan (Smeets et al, 2007).

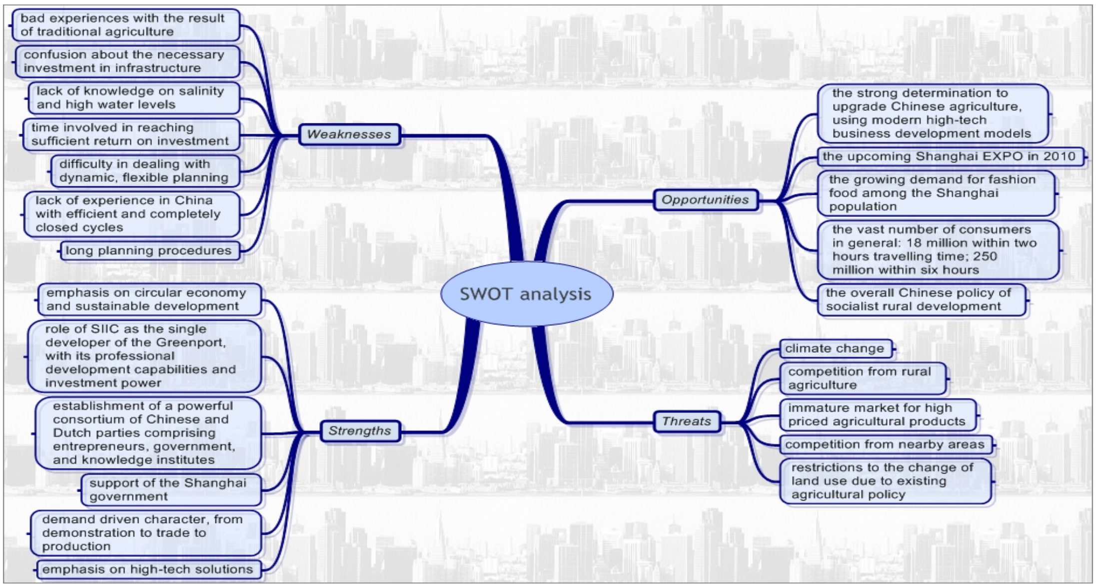


Figure 2.4.2: SWOT analysis showing the weaknesses, strengths, opportunities and threats involved in the development of the Greenport Shanghai Agropark

Joint fact finding: Discussions and the use of creative brainstorming techniques in task groups

The next step in the process dealt with the so called *joint fact finding* which was organised around the three dimensions of the Master plan i.e., 'hardware', 'software' and 'orgware '. The joint fact finding covered two steps. First, each task force was given a problem diagnoses and an assignment. The members were asked discuss this given problem diagnoses and to reformulate the assignment according to their own perceptions and interest (see box 2.4.2 for an example of the given problem diagnosis and assignment).

The rationale behind this part of the 'joint fact finding' was to create a common understanding on the challenges the task forces were to take on and to ensure the relevance of the assignments for the participants.

Box 2.4.2: Joint fact finding - Task force Orgware (Smeets et al, 2007)

Problem diagnoses

- Attracting investors (entrepreneurial, political and knowledge) to Dongtan agro park is one of the most important issues in Dongtan agro park development. Therefore it is important that SIIC presents the many beneficial conditions to potential investors and business possibilities and the required information to its investors to come to a business plan preparation. The information basically informs its investors on market information and how Dongtan agro park can offer significant economic benefits and other services to them.
- The successful operation of Dongtan agro park is critical to the investors as well as to the reputation of the agro park. The internal management of the agro park administration and the management assistance provided to the agro businesses in the agro park are important aspects to be known in advance.

Assignment: The orgware group will work on the subjects

- Building the integrated network China –Netherlands on the level of entrepreneurs, political and civil serveant level, knowledge institutes and relevant Ngo's
- Built the framework of joint business planning in close cooperation with SIIC and entrepreneurs and the Dutch development body LIOF
- Data collection and "research "(interviews and discussion) on feasibilities to operationalise the joint approach to the GPS commercial business for the three parts of the agropoark
- Task description of Agro park agriculture and its coordination in to the Shanghai (Lower basin Yangtse) food chain and of agro park management in the phase of implementation and operationalisation and how it serves the investors,
- Agro park's opportunities in the international setting.
- Commitment and support from the national, regional and local level in China als well as in the Netherlands
- Costs – Benefits analysis and risk analysis based on draft design

Second, as part of the joint fact finding, the three task forces visited different stakeholders and infrastructural sites. The members of the task forces had many intensive discussions through which they generated and shared ideas for the hardware, software or orgware plans. The hardware task force used *creative brainstorming techniques* to generate more than 100 innovative ideas for the spatial design of the agropark. A example of such a creative brainstorm technique is the 'my hero'. Through responding to the question what infrastructure would my hero think of for the agropark new innovative ideas emerged. The most innovative ideas were finally used for designs of the 'water system', 'the landscape ecological system', 'infrastructure'and the 'string of hot spots' of the Greenport Shanghai Agropark (i.e., see figure 2.4.3)).

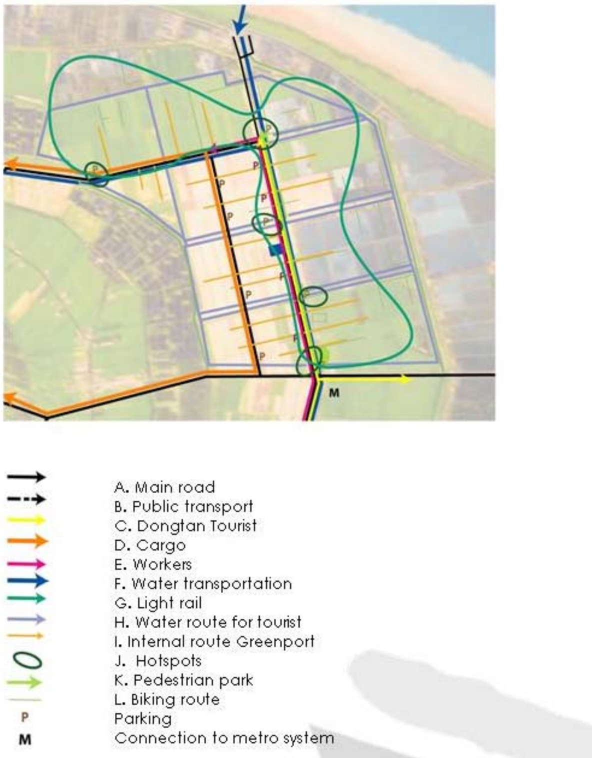


Figure 2.4.3: Spatial design 'The 'string of hot spots' of the Greenport Shanghai Agropark

The design process was enriched by *visualizations* made by participating landscape architects. The drawings supported the intercultural communication process and helped the participants to stretch out their thinking at the same time.
They used *expert consultations* (by phone) and talked with entrepreneurs and potential investors and tried to build their commitment.

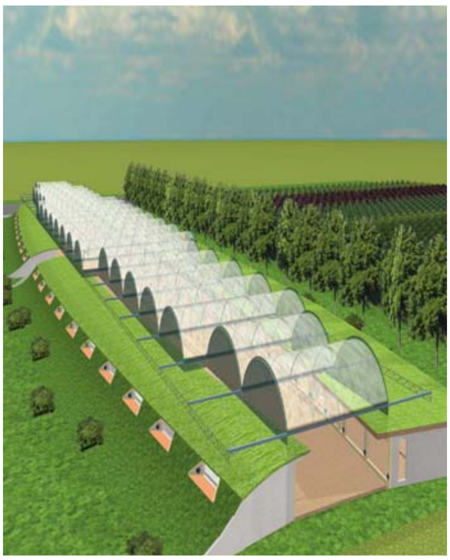


Figure2.4.4: A green roofed semi closed chicken stables fitted carefully into the context of the landscape. The drawing is designed during the discussing amongst stakeholders

During the entire process, sessions were regularly facilitated in which the task forces presented preliminary ideas and draft designs. These ideas and designs were enriched with comments of colleague participants and a cross fertilisation and integration between ideas and plans took place. Gradually, the Master plan Greenport Shanghai was shaped. Three core elements of the park i.e., the Demonstration Park, the Trade Park and the Central Processing Unit were elaborated in the form of possible scenarios (Smeets et al., 2007).

At this moment, details of the Master plan are still being worked out in line with a strategic and an industrial plan. So far, considering the participatory design process, the participating stakeholders concluded that the approach has been very valuable as it consists of an innovative design of the Greenport Shanghai Agropark in which hardware aspects are integrated with strategies towards knowledge development and - valorization as well as with organizational/political developments. In addition, the participatory way of working throughout the Master planning process has resulted in a network in which the Fudan University, Jiaotong University, Nanjing Agriculture University, Tongji University, Wageningen University and Research Centre, TransForum, SIIC and several governmental and business representatives participate. This international knowledge network, which will grow every day, will be very important in future in order to be able to respond quickly to new questions on the knowledge agenda of the Greenport Shanghai Agropark.

The design approach has proven to be useful for the planning and design phase of projects. In the same master planning process a tool for participatory evaluation has been developed. The tool is referred to as the sustainability matrix.

2.4.3.2. Sustainability matrix for a participatory evaluation

The *sustainability matrix for evaluation of sustainable agriculture* is developed in the context of the Greenport Shanghai Agropark. Before providing a description of the tool, a few principles of participatory evaluation are discussed hereafter.

Participatory evaluation: Principles
Evaluation is often seen as a systematic assessment of the relevance, performance, efficiency, impact and sustainability of a project, programme or policy in the context of its stated objectives (Guijt, 2008). There are different types of evaluation depending on the subject of evaluation and on who is responsible for the evaluation. Evaluations that are shaped and implemented by stakeholders are referred to as 'participatory evaluations'. There is a growing interest in participatory evaluation for different reasons (Guijt, 2008). One of the reasons is the aim to ensure the relevance and use of the evaluation outcomes by stakeholders who are directly involved in the project. Participatory evaluations recognize that both formal and tacit knowledge of the stakeholders are important in the assessment. In a participatory evaluation all relevant stakeholders should be given the opportunity to provide feedback on

activities at any time during wetland assessment and management activities, but particularly on their completion. Even simple consultations and discussions can provide valuable feedback on the strengths and weaknesses of particular activities and changes that have occurred. More specifically, in a participatory evaluation stakeholders can participate in:

- Deciding on the subject(s) of evaluation (evaluation criteria and indicators); and/or
- In the data collection and analysis; and/or
- The drawing of evaluation conclusions and the lessons learnt.

Sustainability matrix for evaluation of sustainable agriculture in the context of the Greenport Shanghai Agropark

In the planning process of the Master plan Greenport Shanghai Agropark, a framework for a participatory evaluation was developed. The participants of the master planning i.e., Chinese and Dutch government officials, Dutch Agro-entrepreneurs and international team of 15 Dutch key specialists and Chinese researchers from different disciplines jointly decided on the sustainability matrix as a guiding framework for the evaluation of agricultural developments in the Agropark (Smeets et al, 2007). Sustainable development was used as a key principle in the design of the Master plan and is consequently at the heart of the sustainability matrix as well.

In the development of criteria for the evaluation of sustainable development in the Agropark Greenport Shanghai Agropark the participants decided to focus on three integrated dimensions: people, planet and profit, referring to the social, environmental and economic spheres (Smeets et al, 2007). For each dimension, criteria are identified that are considered relevant to the evaluation of the performance of the Greenport Shanghai Agropark (Smeets, 2007). Table 2.4.4 shows the evaluation criteria and indicators identified for the 'people dimension'. The indicators will be as yardstick to assess future performance and establish thresholds and critical values.

Table 2.4.3: Evaluation criteria for sustainable development of Agriculture in the Greenport Shanghai Agropark (Smeets et al, 2007)

Criteria for People	**Indicator**	**Value/Scale/ Improvement level**	**Remarks**
Employment	Number of employees per ha	Higher than rural mean, up to industrial level	The Agropark should contribute in creation of urban jobs for rural people
Wage and Benefits	Minimum wage earned and Shanghai government standard set for employee benefits	Higher than rural mean (to those still holding rural residency status)	Agropark must improve living conditions
Transferred people	Number of local residents unwilling to leave and not working at the Agropark	Zero	No people should be re-allocated against their will
Working conditions	Quality of working environment	All working environment should meet international standards of International Labour Organisation	
Residential quality	Quality of housing and dormitories Quality of public space Quality public services	Values defined by the Dongtan Ecocity concept	Dongtan Ecocity standards exceed normal Shanghai standards
Residential safety	Safety measures against typhoons & flooding	Equal to Shanghai standard	

2.4.3.3. Stakeholder analysis, Rapid Diagnostic Appraisal and SWOT analysis and illustration of their use for an example case study in Nanjing 2 (Zhu Lina, Shi Xiaoping and Zhu Peixin)

This part will briefly introduce the methods of Stakeholders Analysis, RDA (Rapid Diagnostic Appraisal) and SWOT (Strengths, Weaknesses, Opportunities, and Threats) Analysis[3], and then set the case of Suoshi village in Nanjing as an example to indicate the practical use of these methods in a relevant case. Finally, we introduce the Scenario Analysis with the information collected by the methods introduced above for Suoshi village in Nanjing. It is to show how to develop different scenarios for the rapid development of Suoshi village under the great pressure of urbanization in Nanjing.

[2] Suoshi village was chosen as one of case study village in Nanjing for SEARUSYN project, which is EU financed fifth framework project and Agricultural Economics Research institute (LEI in The Hague), Nanjing Agricultural University and other institutes are involved from 2002 to 2005. More detail information bout the project and project documents can be found at website: www.Searusyn.org.

[3] All the methods introduced in 2.2 are based on the documents from SEARUSYN project. They are number of researchers who contributed to those documents. Those documents can be found at www.Searusyn.org.

Stakeholders Analysis
Stakeholder analysis is a way of understanding a system through its stakeholders. It attempts to deal with stakeholders' multiple and often conflicting views, interests and objectives. By understanding the system, it is possible to facilitate changes.

A conception we should know is who the stakeholders are. Stakeholders are those who have an interest in a particular decision, either as individuals or as representatives of a group, including people who influence a decision, or can influence it, as well as those affected by it. In order to be able to build a shared vision on the issues and solution, the stakeholders are required to:
- Follow the research process actively,
- Create the momentum and keep the process rolling,
- Bring important issues into the project from their own organization/ background,
- Report back to their own organization about what ideas exist and are developed in the platform, which progress is being made, what new information or change of view occurs, and which (possibly) consequent changes are to be dealt with in their own organization,
- Develop a shared and more integrated view on the whole process; which sometimes means to bring cohesion between disciplines.

Hence, through the stakeholder analysis, we can form a social interaction that enable individuals and groups to enter into dialogue, negotiation, learning, decision making and collective actions. In other words, it could get government staffs, policy makers, community representatives, scientists, business people, and NGO representatives to think and work together.

Process of Stakeholder Analysis
When we do a stakeholder analysis, firstly is to find the stakeholders of the concerning issues. The basic process of identifying stakeholders involves thinking about the questions as below:
- Who should be involved in the issues?
- At what scale? Such as numbers (equilibrium), administrative levels and geographic areas.
- For what reasons they will be stakeholders?
- Using what mechanisms?

After finding out the stakeholders, we need to analyze relations and linkages between stakeholders. And then build a stakeholder platform on which an ongoing dialogue between the scientists/researchers and the project stakeholders will be organized. Usually, the dialogue will be organized along two ways. One way is by 'theme groups' of researchers and stakeholders involved in a certain theme or issue. And another one is through a 'stakeholder's platform', in which a scientist represents the research group. If follow the former method to build the dialogue, it is needed to identify, select and invite the representatives for every theme group which consists of a core team of key stakeholders.

In addition to do that, there are feed back mechanisms (arrows) between stakeholders and the organizations they represent.

Two Methods of Stakeholder Analysis—DFID model and PAM (Put in A Matrix)

The DFID model is a popular method to analyze the influence and importance of possible stakeholders. Along the Y-axis (Figure 2.4.5), we show the relative interests / importance of stakeholders; and along the X-axis, we show the relative influence of stakeholders on a successful outcome of the project. The stakeholders in group-A are important stakeholders with less influence, and accordingly the strategy will be used to help some of them to enhance their influence. Group D consists of influential stakeholders with no interests to solve the problems we defined, and then corresponsive the strategy for them will be to convince some of the stakeholders in this group to realize the importance of the problem we want to solve, to make them interested in solving the problem. For the stakeholders of group B are important ones with a lot of influence on process. They are key stakeholders, and can be used to fulfill our process. With regard to the stakeholders of group C, they are often not needed in the process (more in detail see Guo et al., 2005).

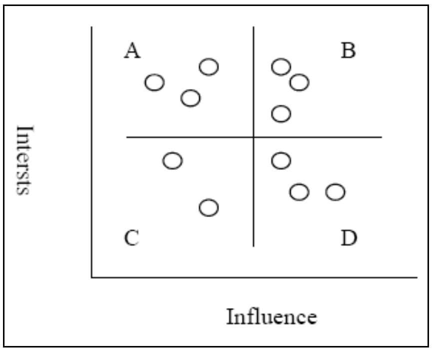


Figure 2.4.5 the DFID model

The following participatory analysis matrix (PAM) (Table 2.4.5) can be used to identify the contributions that each stakeholder can do, define the problems the stakeholder meet, even the possible actions we can take.

Table 2.4.4. the participatory analysis matrix

Stakeholders	What can they contribute?	Problems they meet…	Actions
…	…	…	…
…	…	…	…

This table not only offers us basic analysis tools to analyse the causes and effects relationship of this problem, but also analyse the motivations and behaviors of the stakeholders. What is more important is that this method can be used to design and identify the action to problem. So it is a trans-disciplinary method when it is used as a problem-solving approach to a problem.

Rapid Diagnostic Appraisal (RDA)
Rapid diagnostic appraisal (RDA) is a survey tool to gain as much information as possible in a limited time schedule. Though for different projects, the context of RDA is more or less different. Generally, RDA consists of: collecting relevant information on a pilot area via a review of secondary literature, policies, documents and maps; identifying and becoming acquainted with relevant stakeholders; and starting consultations with relevant stakeholders. And it indeed is a step in starting a dialogue between different stakeholders. Also it gives some feedback information to stakeholder analysis.
Process of RDA
When the researchers implement RDA as study method for a project, there are several steps. For one thing is to form the multi-disciplinary research teams for whom some training courses can be needed. Then according to the objectives of a project to select appropriate pilot areas where the RDA would take place. After that, identify the topics which could be discussed during the RDA (always there will be several topic themes), and link the topics with the tools (see next part).
Before field work, some activities should be carried out already, such as basic information on the selected pilot areas, municipality maps with selected and comparable areas, appointments for meetings and so on. At the end, the RDA is concluded with a feedback meeting to the stakeholders.

Relevant Methods for RDA
Dialogical Analysis is used to assess social changes through interviews, discussions, oral histories and narratives. The most common use is semi-structured interviews, including Open groups, Focus groups and Key informants interviews through which researchers can know local criteria, perceptions, priorities, problems, achievements regarding research theme and existence, performance and interactions of local and external organizations and so on.

Temporal Analysis is used to assess change over time - historical, seasonal, daily patterns. Timelines is a popular method which can gain history of social and environmental change at local levels, impact of external interventions and local responses and initiatives, history of economic and environmental shocks and stresses and links between policies and practices, perceived ‘effects’ and their causes.

Spatial Analysis is a helpful way to assess change over space. And map is the most common tool. Besides there are some other methods to assess socio-economic changes, such as Institutional Analysis, Well-being Analysis, Preference Analysis（van Wijk and Thompson, 2002）.

SWOT Analysis
SWOT analysis stands for Strengths, Weaknesses, Opportunities, and Threats, and is a simple and powerful way to analyze surrounding situations or to assess of an activity, a combination of activities, an industry or even a person in its surrounding. The SWOT framework was described in the late 1960’s. Because it concentrates on issues that potentially have the most impact, the SWOT analysis is useful when a very

limited amount of time is available to address a complex strategic situation (Homewood, IL: Irwin, 1969, c.f. Heimberg, 2006) .

But the SWOT framework has a tendency to oversimplify the situation by classifying the issue's environmental factors into categories in which they may not always fit. The classification of SWOT is somewhat arbitrary. Perhaps what are more important than the superficial classification of these factors is the awareness of them and its development of a strategic plan to use them to its advantage.
Process of SWOT Analysis
A SWOT analysis consists of an internal analysis of the Strengths and Weaknesses of a subject, and an external analysis of the Opportunities and Threats. When the analysis has been completed, a SWOT profile can be generated and used as the basis of goal setting, strategy formulation, and implementation. And different strategies will lead to different scenarios and different actions.

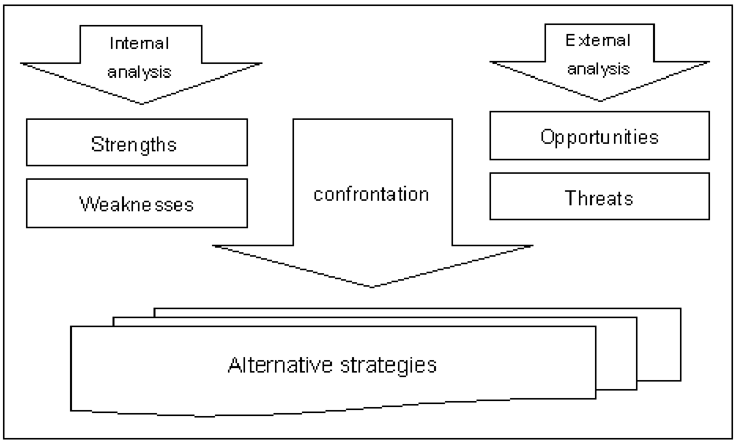


Figure 2.4.6. Process of SWOT Analysis

Internal Analysis: Examine the capabilities of your organization. This can be done by analyzing your organization's strengths and weaknesses. External Analysis: Look at the main points in the environmental analysis, and identify those points that pose opportunities for your organization, and those that pose threats or obstacles to performance. By understanding these four aspects of its situation, we can better leverage its strengths, correct its weakness, capitalize on golden opportunities, and deter potentially devastating threats. And the quality of the analysis will be improved greatly if interviews are held with a spectrum of stakeholders.

One method to formulate strategy is to understand the interaction of the areas in the SWOT profile.

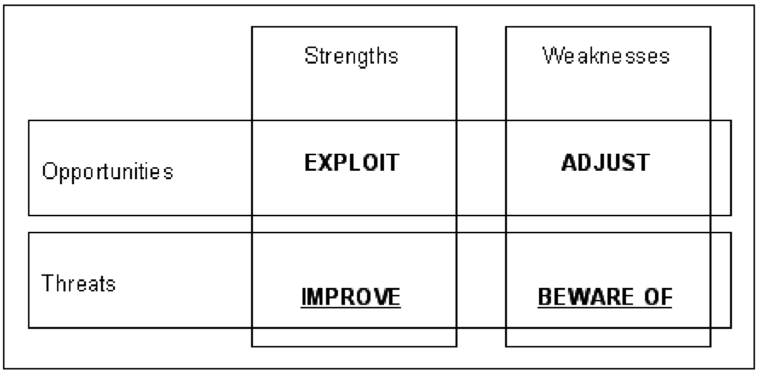


Figure 2.4.7 SWOT Profile

Different superposition means different action to the issue. For example, the area that the strengths overlap the opportunities is aspects we could exploit, while the strengths and the treats area is aspects we need to improve. And the area that the weaknesses overlap the opportunities is somewhat we should adjust; the last area is worst one that we must beware of both threats and weaknesses.

And there is another method to find out strategy as the figure below:

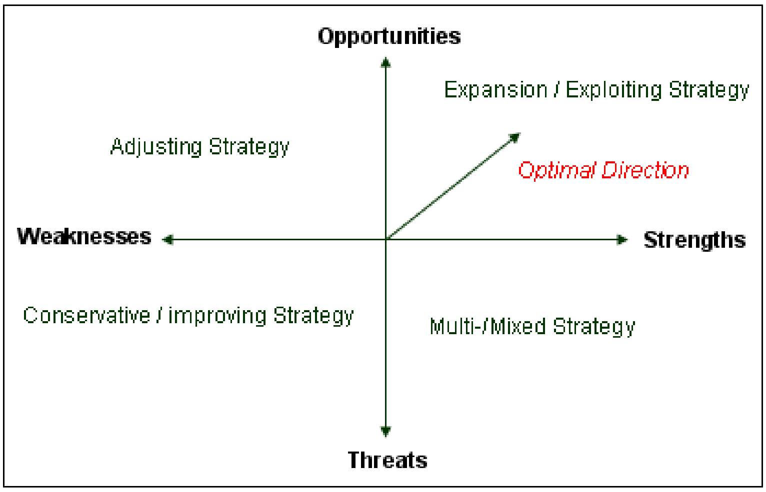


Figure 2.4.8. SWOT Quadrant

The direction between opportunities and strengths is the optimal direction we'd better follow.

Scenario Analysis: A case study for Suoshi village in Nanjing
In the case study of the Suoshi village we apply all three methods discussed above: Stakeholder analysis, RDA and SWOT analysis. The three methods all can be used for socio-economic research issues in different research phase for diverse levels.

Stakeholder analysis remains an important lead and for that reason the multi-stakeholder process has been a major activity throughout the entire duration of the research project. There will be a much more diversified process of communication and involvement of the various stakeholders in the project activities. And towards the end of the project, most of the stakeholders involved in the project, from local and municipality levels as well, will meet at the policy seminars or feedback meetings.

In the first phase the stakeholders analyses provided a wealth of information on research issues, next the research shifted towards local levels which started with a Rapid Diagnostic Appraisal (RDA) in number of villages. In the case of SEARUSN project, three villages were explored in detail and 14 villages are surveyed by using questionnaires. RDA is a tool to get up-to-date information on the current situations and the developments in the recent past. Also it will get feedback information to the stakeholder analysis.

In the third phase the research focused on the interview with farm households in the village and a SWOT analyses was carried out as starting point for strategy development of farm households. Finally the results of the various research activities and consultations have been used for designing different scenarios.

Scenario Analysis

Scenarios are used as descriptions of alternative futures, not as forecasts or predictions. The scenario analysis is a special study technique which analyze on one specific issue or the macroscopical environment of the issues. And it helps to improve decision-making by allowing more complete consideration of outcomes and their implications.

The process of a scenario analysis is to identify the influencing factors of an issue firstly by studying on external environment, and then to simulate the possible multi-scenarios, at last to analyze and predict the alternative futures (Figure 2.4.9).

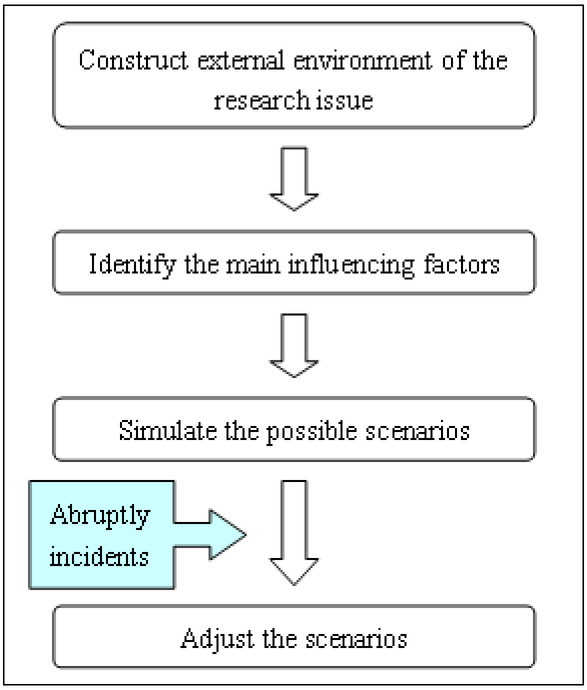


Figure 2.4.9. Process of Scenario Analysis

Compared with other assessment frameworks, scenario analysis offers several advantages, including the ability to intentionally investigate several "futures" or different points of view at one time. It relates primarily to the potential benefits of evaluating all aspects of the decision-making processes. Additionally, for policymakers, scenarios can be used to test current policy in terms of public perceptions. Scenario analysis thus is useful in decision-making processes. In practical use scenario analysis pays attention to continuity of development, relations among factors and all kinds of probabilities and realities (Kepner et al., 2004).

In the case of SEARUSYN project, based on the information collected, three scenarios were developed for Suoshi village in Nanjing. The scenarios developed in Suoshi village were not the final purposes of the SEARUSYN project, but instead it worked as a new discussion platform for policy makers from municipality to village and household levels. It provided the opportunities for policy makers at different levels and stakeholders at local levels to re-think about the development strategies in the case areas.

A Case for Suoshi Village in Nanjing

Background of Suoshi Case Study

Urban growth in East and Southeast Asia is often faster than what governments and city planners can manage. Consequently, developments in the urban fringe are hard to control, resulting in chaotic patterns of land use. Spatial and agro-ecological motivations hardly play a role in decision-making about the form and the direction of urban expansion. To improve this situation an integrated approach is needed which brings researchers, policymakers and other stakeholders in city planning, waste management, food production, food safety and marketing together. For that purpose, a consortium of research institutions from the Netherlands, Portugal, China and Vietnam started in November 2002 a project with the title: "Seeking Synergy between Urban Growth, Horticulture and Environment in Asian Metropolises" (SEARUSYN).

The objective of the project is: to contribute to the synergy between urban growth and agricultural development in the urban fringes of Hanoi and Nanjing, to improve the welfare of rural and urban communities.

Among the selection of villages in the Rapid diagnostic appraisal process, Suoshi Village in Qilin town administrative area, a village under immediate urbanisation pressure, was selected as the final pilot area . A corresponding case study village was chosen in Vietnam, and a comparison between the two villages can be found in report by Van den Berg et al., (2006). Suoshi village in Nanjing, the only village were a scenario analysis was conducted, was set as a sample case to present to the policy makers in final seminar.

Research Process and results of Suoshi Case Study in Nanjing
The case study intends to find a solution to harmonise the contradiction between urbanisation, horticulture and environment, which can be accepted by all the stakeholders. And there are three main themes of the project which are Agriculture Development, Land Use Planning and Urban Development and Environment Issue and Safe Horticulture Production.

In order to achieve the aims of the projcet, the first step was a stakeholder analysis on the whole (municipal/local) level. Stakeholders are all those who have a stake in the development of the region, either because they are living or working in that region or because they are involved in the development of that region as a policy maker or in another way. Generally stakholders include policy makers on urban planning, on land use planning, on agriculture development and on environment protection, and farmers, citizens, owners of enterprises and researchers. However for each different theme the specific stakeholders can be diverse, please see Guo et al., (2005, p. 13, 16 and 20; SEARUSYN project report).

Then we spent many hours to interview the key stakeholders and establish a regular visiting plan with them. We got a better understanding of the circumstances each stakeholder faces by the platform, and then conjecturing their reactions became possible. We kept regular contact with the stakeholders and invited them (or some of them) to take part in some following seminars, discuss the situation in the respective areas, and provide feedback to the researchers. Results of our progress was shared with them (or some of them with great interest in our project). The platform we built run well during the entire project due to our efforts. By analyzing each stakeholder, we could use the participatory analysis matrix as a tool to get a table about who can contribute towards solving the problem and actions needed. This helped us to find out which roles stakeholders may play in solving the problems, and also to find out which stakeholders can help or influence others (See Guo et al., 2005, p. 23 and 28).

In the second phase, the focus of the project shifted towards the local level, in particular the selected pilot areas. With the identification of the major selection criteria, Suoshi Village in Qilin town administrative area, a village under immediate urbanisation pressure, was choosen as a final pilot area to meet the requirements of the future step of the project.. At this phase a RDA was carried out in order to get up-to-date information on the current situation and the development in the recent past with respect to land use and socio-economic developments. For that purpose consultations and discussions with the farmers and village leaders were focussed on the economic, social and environmental impact of the urbanization process in their village. The results of the RDA's are summarized in the following paragraphs. But for detail please see (Chen et al., 2005).

Suoshi Village faces two sides of urbanization pressure:
- further developments of the university city at Xianlin district. By the year 2020 the university city at Xianlin district will include the north region of Suoshi Village.

- the east of the main city of Nanjing has developed, and the influence on Suoshi Village is large.

Urbanization has impact on farming in Suoshi Village as can be inferred from the agriculture structure. Before 1999, rice was the only crop, but now next to rice vegetables, ornamental plants are important crops. Farmer typology has been changed a lot since 1997. With the development of urbanization, local farmers steadily began shifting activities, for example working out, so agriculture production became less and less important. Since then immigrant farmers came to do agriculture production. After 1997, the number of immigrant farmers was rising each year. The number of immigrant families has reached 40 to 50 and is 10 percent of the total population. They converted to growing vegetables, flowers, fungus, and the area of the land leased out is increasing. As we know, the source of income has diversified, from income from agriculture production only to the main income to be quarrying (stone mining), transporting and the side occupation and so on.

Next to research on the municipality levels and the interviews with the local farmers, immigrant farmers and local leaders in RDA implementation, we also did a SWOT analysis for Suoshi Village. The purpose of the SWOT analysis was to develop a strategy for the different groups: e.g. immigrant farmers, local farmers, flower growers, mushroom growers.

Next we assessed the situation of the village as a horticultural production unit, including vegetables, flowers and mushroom growing. We looked at the strong and the weak points of these activities in the village. The results from the SWOT analysis can be found in (Li and Shi, 2006).

Finally, we tried to find out what opportunities the future may bring and what may constitute a threat. Confrontation of the identified strengths, weaknesses, opportunities and threats, provided indications on the possible measures for the development of horticulture in Suoshi.

The ultimate goal of the project was to illustrate the possibilities for integrating sustainable horticulture in new urban areas around Nanjing by scenarios for integrated solutions in the case study area Suoshi village. An important role in the designing process was played by the farmers in the case study areas, because their wishes for the future formed the starting point for the scenarios. Starting from the expectations of the farmers the research team designed three possible scenarios for Suoshi village that were also based on results of RDA and SWOT of Suoshi village (see Chen et al., 2005 and Li and Shi, 2005). A short summary for three scenarios is presented in figure 2.5.6.

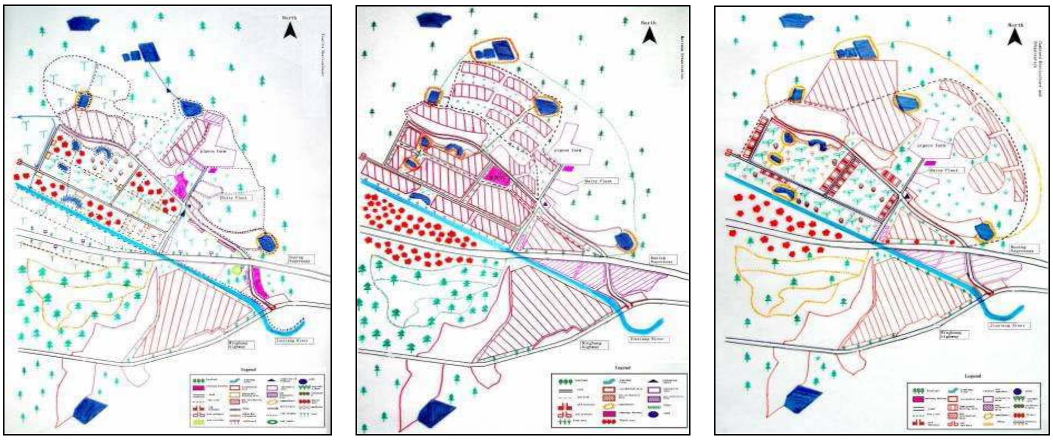
During the Feedback meeting on Sep 15th, 2005 (Li and Shi, 2005), farmers were invited and discussed the results of the Suoshi village development plans. Farmers became aware of the future development of their village. Finally, one of the major conclusions was that the project approach in exploring integrated solutions for "productive green zones" through scenarios developed in an interactive process with the major stakeholders was new but appeared to be useful. It was, therefore, recommended to organize follow up activities for a smaller group of directly involved officials.

At the same year, a policy seminar was organized in Nanjing by the project team to present the results of the scenario analysis. The participants of the seminar were from municipality levels, district levels, village levels to farm households, and also researchers from universities. The seminar provided opportunities to share the opinions on the development of Suoshi village. The results of the seminar can be found at the website of SEARUSYN in Policy Seminar Report (2006).

Three scenarios were designed for Suoshi village (see detail in Van den Berg, et al., 2006; Kamphuis, 2006). In the "tourist-horticulture" scenario: a large part of the agricultural production will be maintained but adjusted in such a way that it is attractive for tourists e.g. sightseeing, farm visits and possibility to buy special local products. The village infrastructure will be improved and connected with the nearby scenery spots. Polluting quarries and factories in the neighbourhood will be closed down. The residential area will be renovated and expanded for housing migrant farmers and citizens but a larger part of the fertile farming land will be protected against further urbanization. As a result the living standard of the migrant farmers will improve by higher value agricultural production while the job opportunities for local people will increase through the more diversified functions of the village.

In the "maximum urbanisation" scenario: most land of Suoshi village will be used for apartment blocks, but a small part will stay in use for floriculture, functioning as a park for the citizens, because of the housing shortage in Nanjing. Like in the former scenario, the local infrastructure will be improved, expanded with recreational routes along existing ponds and connected to the nearby scenic spots for recreation and leisure purposes. The current dairy and pigeon farm could also play a role in this. In this scenario the local farmers get compensation for loss of land and houses and most of the migrant farmers will leave, supported by the government in finding a living elsewhere.

In the "combined horticulture –urbanisation" scenario: in this scenario certain parts of the village with fertile farmland will be protected for horticultural use, while the rest will be turned into housing area including not only ordinary high and low apartment blocks, but also traditional rural houses and a number of modern bungalows for the high income families. This option is searching for a model to combine horticulture and urban functions in an organic way. Like in the other scenarios, the local infrastructure will be expanded with recreational routes along existing ponds and connected to the nearby scenic spots for recreation and leisure purposes. For compensating the parts of the woodland occupied for expensive housing, forestation and scenery construction on the slopes around the new bungalows and apartment blocks will be promoted. In addition, green zones will be designed along the main roads to alleviate and avoid air and noise pollution.



Tourist-horticulture | Maximum Urbanization | Combined Horticulture – urbanization

Figure 2.4.10. Three scenarios for the Suoshi village.

2.4.4. Considerations regarding the choice for participation in wetland management

The previous paragraphs demonstrated the values and benefits of participation. There is no doubt, participatory approaches, like any other approach, do also involve risks and costs and, have some limitations. It goes beyond the scope of this chapter to discuss these risks, costs and limitations at length. However, a few risks, costs and limitations are discussed as they should support decision making regarding the use of participation in wetland management.

Consider the costs of participation

Although the value of participation in wetland management is generally accepted, the use of participation and especially, the type of participation (see table 2.4.4) that is desired needs to be well considered at different stages as participation can be very costly. Costs of participation include costs related to *communication* and *providing access to information and* the costs of *developing knowledge, attitude and skills in* the facilitation of participatory processes. Moreover, the *costs to stakeholders of being actively involved* need to be considered. Some stakeholders (e.g., civil servants) will be able to engage through their existing jobs and roles. Others will need to take time from their livelihood activities. Last but not least, one should be aware that participation may generate considerable excitement, and expectations may be raised. If there is no follow-up to early discussions, disillusion may set in and jeopardize people's willingness to continue to participate in future wetland management activities.

Consider quality issues: Ensure the trustworthiness of findings

It is sometimes asserted that participatory methodologies constitute inquiries that are undisciplined and sloppy. It is said to involve only subjective observations, perceptions and opinions of particular stakeholders. Terms like informal and qualitative are used to imply poorer quality or second-rate work. Some people assume that participatory methodologies and methods are in contradiction with rigour and accuracy.

Conventional research uses four criteria in order to persuade their audiences that the findings of an inquiry can be trusted i.e., *internal validity, external validity*, *reliability* and *objectivity* (see Lincoln and Guba 1985 in Pretty 1995). These four criteria are the fundamentals of the conventional research paradigm and are not appropriate to assess the goodness of a participatory inquiry. The subjective nature of a participatory process does not imply that the quality of the inquiry is not important. Participatory approaches are usually validated experientially, by their efficacy, effectiveness and efficiency in reality. For judging the quality of a participatory inquiry an alternative set of *trustworthiness criteria* are developed (see box 2.4.5)) (Guba 1981 in Pretty 1995, Pretty, 1995). These criteria are scientifically accepted for judging the 'trustworthiness' of information that is obtained via a participatory process (*ibid).*

Box 2.4.5: Criteria for judging trustworthiness of information gained through a participatory process (Guba 1981 in Pretty 1995, Pretty, 1995)

Intense Engagement between the Various Actors for building trust and rapport, learning the particulars of the context, and keeping the investigator(s) open to multiple influences.
Persistent and Critical Observation: For understanding both a phenomenon and its context.
Parallel Investigations and Team Communications: If sub-groups of the same team proceed with investigations in parallel using the same methodology, and come up with the same or similar findings, then these findings are trustworthy.
Triangulation by Multiple Sources, Methods and Investigators. For cross-checking information and increasing the range of peoples' realities encountered, including multiple copies of one type of source or different copies of the same information; comparing the results from a range of methods; and having teams with a diversity of personal, professional and disciplinary backgrounds.
Analysis and Expression of Difference. For ensuring that a wide range of different actors are involved in the analysis, and that their perspectives are accurately represented.
Negative Case Analysis. For sequential revision of hypotheses as insight grows, so as to revise until one set of hypotheses accounts for all known cases.
Participant Checking. For testing the data, interpretations and conclusions with people with whom the original information was constructed and analyzed.
Peer or Colleague Checking. Periodical reviews with peers or colleagues not directly involved in the learning process, so as to expose investigators to searching questions.
Reports with Working Hypotheses, Contextual Descriptions and Visualizations. These are `thick' descriptions of complex reality, with working hypotheses, visualizations and quotations capturing peoples' personal perspectives and experiences.
Reflexive Journals. These are diaries individuals keep on a daily basis to record a variety of information about themselves and sequential changes in methodology.
Inquiry Audit. The team should be able to provide sufficient information for a disinterested person to examine the processes and product in such a way as to confirm that the findings are not figments of their imaginations.
Impact on Stakeholders' Capacity to Know and Act. For demonstrating that the investigation has had an impact, including participants having a heightened sense of their own realities, as well as an increased appreciation of those of other people.

Wetlands provide services of great value to society. They control floods, protect coastal zones, they host a great diversity of species, they provide water for agricultural production and enable timber. The cultural, social, ecological and economical importance of Wetlands to local communities and to provincial, national and international agencies are beyond words. Sustainable actions will be needed in order to secure wetlands and their values for the present generation as well as for those to come. Experience has shown that participation of stakeholders in wetland management tend to bring about more sustainable developments than those which are developed through traditional top down planning modes.

3 Selection of a potential wetland site in China to apply the methods to develop wise use scenarios

3.1 Workshop in Beijing 2008

In April 2008 a workshop was organized in Beijing with the aim to present the different methods and determine criteria to select a potential wetland site in China where the methods can be applied.
The program and presentations of the workshop are given in Appendix 2.

Next to obvious criteria such as the site has a nature value and protected species inhabit the site, also the argument that the site must be part of a flyway was chosen such to highlight the international importance. Sites must also be used or will be used for economic activities, such that there can be a conflict of interest between conservation and economic activities and data of ecological and socio economic aspects are either available or are perceived to be relatively easy to collect. Very important criteria were the priority the site has for policy, and the possibilities perceived to find funding for an analysis of the site. Table 3.1 gives an overview of eight scored wetland sites and the finally selected sites (highlighted in yellow). The final selection was not only based on the total score. Some of criteria were valued more important than others, priority criteria were possible funding opportunities and data availability sites that scored negative on these criteria were not considered further. Although site five (Yellow river delta), six (Yancheng) and seven (Chongming) had the highest scores, these sites were not considered further since the scored negative or low on funding possibilities. The three selected sites are Yalujiang, Shuangtaizi and Hengshui Lake.

Figure 3.1. Location of potential wetland sites in China

Table 3.1 Scores of eight wetlands in China.

.	1.Yalujiang	2.Shuangtaizi	3.Nandagang	4.Beidagang	5.Yellow river delta	6. Yancheng	7. Chongming	8 Hengshui Lake (not on coastline)
Nature reserve (National, Ramsar, or Provincial)	N	R,N	P	P	N	R,P	N	N
Protected species	+	+	+	+	+	+	+	+
Priority area of policy makers	+ National	+	-	-	++	+	+	+_
On the flyway	+	+	+	+	+	+	+	+
Competing claims	+	+	++ develop ment	+	+	++ Agricul ture	+++ urbaniz ation	++
Possible funding opportunities	SEPA American Medical group	WB	Small local	Small local	+_	SEPA -	-	ADB National
Data availability	+	+	-	-	+	+	+	+
Network connection	+	+	-	-	+	+	+	+
Total Scale	8	8	6	5	9	9	10	8

3.2 Site description of Wetlands selected to apply methods (Chen Kelin)

3.2.1 Yalu Jiang National Nature Reserve (YJNNR)

Location

Yalu Jiang is located on the northeast coast of the Yellow Sea in Liaoning Province, China, adjacent to North Korea.

Introduction

Yalu Jiang reserve is one of the most important wetlands with significant ecological value in Asia. More than 40 species of shorebirds have been observed in this reserve, with up to 500,000 individual shorebirds and other water birds using the Yalu Jiang reserve annually as habitat for breeding, feeding and staging.

Birds do not recognize national boundaries. This is the principal basis of cooperative international activities. Since some shorebirds migrate from north to south, and from south to north, often passing through numerous countries on the way, it is essential to collaborate at the international level to conserve the birds and their habitats throughout the world. In order to achieve this objective, Yalu Jiang National Nature Reserve was designated as a Site in the East Asian-Australasian Shorebird Site Network in 1999.

The Yalu Jiang National Nature Reserve is on the northern Yellow Sea coast of China close to the border with North Korea. It is known to be an important staging site for over 500,000 migratory water and shorebirds in the East Asian-Australasian Flyway (EAAF), including Bar-tailed Godwit from New Zealand and Australia. At least eleven species occur in numbers of international importance as defined by the Ramsar convention at more than one percent of the flyway population. The Bar-tailed Godwit (*Limosa lapponica*) is the most numerous species with both flyway subspecies, *baueri* and *menzbieri* occurring in large numbers, a maximum count of 66,000 was recorded in mid-April 2004. The most common leg-flag colours seen are white and orange, indicating birds from the North Island of New Zealand and Victoria, Australia respectively.

Yalu Jiang has been considered the second most important site for shorebirds in the Yellow Sea, exceeded only by Saemangeum in South Korea. However, with the completion of the sea wall in the 40,000 ha Saemangeum reclamation area in April 2006, Yalu Jiang is set to become the most important site in the region. The 101,000 ha Yalu Jiang reserve includes intertidal mudflats, fish and shrimp ponds, rice paddies and reed beds along 60km of coastline southwest of the North Korean border. The mudflats of Yalu Jiang National Nature Reserve extend across the border and along the coast of North Korea. Yalu Jiang is by far the most important single site yet discovered for Bar-tailed Godwit on northward migration in the East Asian-Australasian Flyway.

Sister-site Partnership

Since the mid 1990s shorebird surveys have been conducted along most of the Yellow Sea coastline of China and South Korea. With the initial large scale survey work almost complete, the need to survey significant individual sites at a much finer scale was seen as the next priority. The surveys undertaken in 1999 and 2000 at Yalu Jiang indicated that large numbers of New Zealand and northwest Australian Bar-tailed Godwit staged there. A further survey in April 2004 confirmed that approximately 50% of the *baueri* population was present in the reserve at that time.

Given the importance of the site, Miranda Naturalists' Trust (MNT) recognized the need for research-based conservation programs in the region.

Discussions between the Miranda Naturalists' Trust and a visiting delegation of Chinese reserve managers at Miranda, New Zealand, agreed that establishing a partnership with a nature reserve in China would be a good step forward and would provide a great opportunity to help educate the Chinese people about shorebirds. It was agreed that the first step should be to form a sister-site partnership with a Chinese shorebird site. Yalu Jiang was an obvious choice for three reasons.

Surveys and banding had shown that godwits banded in New Zealand were being seen at Yalu Jiang and vice versa.
Yalu Jiang National Nature Reserve staff was very keen to participate in flyway activities.
Access to the site was good, an important consideration if regular work were to be undertaken and the profile of shorebirds with local people was to be raised.
A Memorandum of Understanding (MOU) between the two sites was drawn up and in April 2004 a delegation from MNT lead by Chairman, David Lawrie, traveled to Yalu Jiang and at a ceremony in Dandong City on 26 April 2004 the partnership was officially launched with the signing of the MOU by David Lawrie and Yu Liangsheng, Director General of the Dandong Environment Protection Bureau. The ceremony made the national television news in China and was taken very seriously by the Chinese who saw this partnership as a valuable joint venture and major step towards their understanding of migratory shorebirds.

Important species
The first shorebird surveys were carried out by Wetlands International – China with the help of Mark Barter in May 1999, before that, reserve staff knew very little about shorebirds. In addition, surveys have since been conducted in 2000, 2004, 2005, 2006 and 2007 again with the help of Mark Barter and the Miranda Naturalists' Trust. Since 2004 the help from members of the Miranda Naturalists' Trust has been extremely valuable in developing our knowledge and understanding of the shorebirds use of the reserve during their migrations.
We were very keen to learn more about the shorebirds use of the reserve through banding and flagging so in April 2002 Pete Collins (AWSG) and David Melville (NZ) travelled to Yalu Jiang to run a banding training workshop. Birds were caught in mist nets at night on the mudflats and in shrimp ponds. They were marked with green-orange flags. Further attempts to mist net shorebirds at night were conducted in April 2007 with very limited success, due partly to the very windy weather at the time and the fact that there were only five nights in April and May when tides were suitable. Further attempts will be made in 2008 possibly using cannon nets at artificial roosts.

Major threats
Habitat Loss and Alteration
Although the reserve management does its best to protect the area from habitat modification, developments have occurred as recently as 2006 when a further 100 ha of mudflat at 'Site 7' were converted into fishponds through the construction of a seawall to enclose an area of the mudflats. The reserve staff is negotiating with the local community to mitigate the consequences of this action.

Pollution
Oil, inorganic phosphorous, inorganic nitrogen and heavy metals are major pollutants to the wetlands. It has severely reduced the function of wetlands as important habitat for migratory shorebirds, although the local affects of pollution at Yalu Jiang have yet to be studied in any detail.

Human Disturbance and Competition
The traditional dependence of coastal communities on wetland food resources has meant that people have always been using the intertidal areas, either directly for food or as a means of access to fishing boats moored at the water's edge. Unsustainable harvesting of shellfish by humans will, inevitably, adversely affect shorebirds.

Financial aspects
Government Funding
Yalu Jiang management income is provided by a mensal subvention from the Dandong city's Environment Protection Administration. The Reserve Manager drafts the subvention application, and after receiving approval from the Dandong Government, a formal application is then submitted by the reserve before the start of each survey and meeting.

Private Sector Donations
The private sector has also provided financial support to Yalu Jiang. In 2007 Bristol-Myers Squibs Company donated US$25,000 to the Yalu Jiang reserve to help with permanent preservation of the wetland.

3.2.2 Shuangtai Hekou National Nature Reserve

Location
Shuangtai Hekou Nature Reserve is located in the estuary of Shuangtaizi River, Panjin City, Liaoning Province. The total area is 128000 ha and the geographic coordinates are 121°30'-122°00'E and 40°45'-41°10'N.

Introduction
The reserve was established in 1985 after it was approved by the Panjin City Government, it was updated to a national level in 1988. The main conservation objectives are, the maintenance of the complex ecosystems consisting of inland and coastal wetlands which are utilized by numerous rare waterbirds. In 1997, the reserve joined the East Asian-Australasian Shorebird Site Network.
Shuangtai Hekou Nature Reserve is consists of reed marsh, shoals, shallow sea, river, reservoir and rice paddy. Reed marsh is the most dominant ecosystem of the reserve, covering over 44.7% or 57000 ha of the total area; shoals which include beach and floodplain is 40000 ha accounting for 31.6%, river is 20000 ha accounting for 15.8%, other wetlands is 10000 ha accounting for 7.9%.
Shuangtai Hekou Nature Reserve is integrative nature reserve that involves biodiversity conservation, science research, public education, ecotourism and sustainable utilization. It is an important base for protection of rare and endangered birds such as cranes, anatidaes, Saunders's Gull and shorebirds, and for wetland ecosystem research. It plays an important part in China's wetland biodiversity and species diversity conservation. The reserve has been the site of many scientific research investigation conducted by research institutes, universities and international conservation organizations such as Shenyang Application Ecology Institution of CAS, China Birds Banding Centre, Forest Planning and Designing Academy of SFA,

Liaoning Birds Research Centre, Liaoning University, Liaoning Normal University, WWF, Department of Environment of Australian Government, Wild Birds Society Japan.

Important biodiversity

The reserve has abundant plant resources, among which reed and seep weed are dominant groups. Unique vegetation and ecosystems support rich animal resources and unique animal communities including excellent habit for water birds. 411 species of vertebrates are recorded in the reserve including 21 species of mammals, 15 species of amphibian and reptiles, 124 species of fish, 253 species of birds. Five species of birds are nationally protected species of Grade I, such as Red-Crowned Crane, Siberian White Crane, Oriental White Stork, Black Stork, Golden Eagle; and 28 nationally protected species of Grade II, including Whooper Swan, Common Crane, Demoiselle Crane, Greater White-fronted Goose, Chinese Egret and White-tailed Eagle. The site includes 145 bird species that are listed under the Sino-Japan Agreement on the Protection of Migratory Birds and their habitats and 46 bird species under the Sino-Australian Agreement on the Protection of Migratory Birds and their habitats. The reserve is the south most breeding area for Red-Crowned Crane and the largest breeding site for Saunders's Gull. More than 540 Red-crowned Crane rest here while nearly 2700 Saunders's Gull nest here each year. 200 000 anatidaes and 100 000 shorebirds stop and refuel in this area during their migration.

Major threats

Panjin City, where the reserve located has a rising petrol chemical industry resulting in a sharp conflict between conservation and development. There are a number of issues facing the Reserve. Firstly, land tenure. The land use rights of only 4.6% of the total area belong to the reserve administration office, the rest belong to reed farm, ocean administration sector and aquatic product sector. Over fishing and exploitation of the reserve due to conflicting land use management objectives impacts upon the ecological environment, bird survival and wetland biodiversity. Secondly, environmental pollution is having a major impact on the reserve. The highly polluted Liao River passes through the reserve carrying high concentrations of contaminants, resulting in a decline in fish production, food quality and a reduction in the water bird population and species diversity. Thirdly, the impact from development activities such as oil field exploitation, wetland reclamation, aquiculture, reed harvesting. Fourthly is lack of management staff and infrastructural investment.

Financial aspects

Liaoning Shuangtai Hekou National Nature Reserve Management Plan was approved by the Panjin City Government in 1994. The central government, provincial government and Panjin city government allocated a large amount of funding to the reserve for infrastructure construction, facilities, conservation, management, public awareness and scientific research. The reserve also received grants from international conservation and research organizations.

3.2.3 Hengshui Lake National Nature Reserve

Location

Hengshui Lake National Nature Reserve is located in Hengshui City which lies 260 km to the south of Beijing and about 110 km to the east of Shijiazhuang City, capital of Hebei Province. The Nature Reserve Lake has a total area of 1878700 ha and the geographic coordinates are 115°27'45"-115°42'6"E and 37°31'39"-37°42'18"N.

Introduction

Hengshui Lake Wetland is an inland freshwater wetland in Northern Chinese Plain. It is a natural wetland ecological system which consists of waters, shoals, swamps, grass marshlands and forests. The lake, situated in the inland region of northern china is a rare oasis in an otherwise dry landcape, as such it harbours significant biodiversity. Hengshui Lake Provincial Nature Reserve was established in July 2000 and updated to national level through approval by State Council in June 2003.

The wetland has a large water surface, and abundant reed and cattail resources. Many kinds of fish, invertebrates and large numbers of aquatic plants provide food for waterbirds. There are 296 species of birds in the reserve, including 31 species of resident birds, 88 species of summering birds, 37 species of wintering and 140 species of passage birds. The reserve is an important stopover site for migratory birds on the East Asian - Australian Flyway and joined the East Asian-Australasian Shorebird Site Network in October 2006.

Important biodiversity

Of the 296 species of birds found in Hengshui Lake there are seven national protected species of Grade I protection level and 44 national protected species of Grade II. The site includes 151 bird species that are listed under the Sino-Japan Agreement on the Protection of Migratory Birds and their habitats, and 40 bird species under the Sino-Australian Agreement on the Protection of Migratory Birds and their habitats.

Hengshui Lake, as a cross-over site for many migratory birds from different species makes it an important staging site for rare and endangered species in the middle-southern part of Northern China. The reserve mainly supports Palaearctic birds, but could be considered partly oriental or eurychoric realms. Migratory birds make up 89.1% of the species. Among the 296 bird species the waterbirds are dominant, in particular, cranes, anatidae, gulls and shorebirds, amounting to over a hundred thousand individuals every year either staging or breeding here.

There are seven species with Grade I Level of national protection: Red-Crowned Crane (*Grus japonensis*), Siberian White Crane (*Grus leucogeranus*), Oriental White Stork (*Ciconia boyciana*), Black Stork (*Ciconia nigra*) Great Bustard (*Otis tarda*), Golden Eagle (*Aquila chrysaetos*), Imperial Eagle (*Aquila helicaca*); and 44 national protected species of Grade II, including Whooper Swan (*Cygnus cygnus*) Whistling Swan (*Cygnus columbianus*), Mandarin Duck (*Aix galericulata*), Crane (*Grus grus*) and White-naped Crane (*Grus vipio*). Some 50 000 individuals nest in the wetlands, including Whiskered

Tern (*Chlisonias hybrida*), Common Tern (*Sterna hirundo hirundo*), Black-winged Stilt (*Himantopus himantopus*), Water Rail (*Rallus aquaticus*), Moorhen (*Gallinula chloropus*), Dusky Willow Warbler (*Phylloscopus fuscatus*), Oriental Great Reed Warbler (*Acrocephalus orientalis*) and Little Grebe (*Tachybaptus ruficollis*). Some 2 000 individuals of the Common Crane (*Grus grus*) spend winter in the reserve (December 2000), which accounts for 10% of the total in China and more than 1% of the world total. Thirty-five (35) species of shorebirds use the site, and 12 of these species have met the 1% criterion of international importance: Northern Lapwing, Grey-headed Lapwing, Eurasian Curlew, Marsh Sandpiper, Green Sandpiper, Common Sandpiper, Spotted Redshank, Pintail Snipe, Common Snipe, Temminck's Stint, Black-winged Stilt and Pied Avocet.

Major threats

The Hengshui Lake Reserve is close to the northern urban area of Hengshui City, but is also near to Taocheng City and Jizhou City. The population of Hengshui City and Jizhou City is about 400,000 and 200,000 respectively. There are 106 villages and a population of 60 000 people in the reserve (an average of 293 people per square kilometre). Most of the villagers live below the poverty line and survive on fishing and farming, therefore, up to now Hengshui was one of the most impoverished areas in Hebei province. The farming and fishing lifestyle has resulted in wetland reclamation, wetland area reduction and diffuse-source pollution. The large population, limited fish resources and overfishing have resulted in a drastic reduction in fish popultation, not only threatening human wellbeing but the survival of the wetland birds and biodiversity. In addition the over abundance of reeds and cattail, when not harvested, die in the winter, causing a large build up in organic matter, when the weather warms the dead plant matter begins to decay reducing oxygen in the water and releasing nutrients. The reeds and cattail are a significant resource that can be utilised by the local people. On one hand, Hengshui Lake possesses abundant natural resources; on the other hand, the community suffers from poverty. It is urgent to improve the living standard of local people. Therefore, sustainable wetland and biodiversity conservation, management and poverty reduction is a challenge faced by the Nature Reserve.

Financial aspects

The funding mainly includes special capital from the central government, donation from international and national organizations, investments attraction and income from resources utilization. Several international projects have been conducted in the reserve, such as Wetland Sustainable Management Demonstration Project supported by IUCN-NL, the Development of Project Proposal on Wetlands and Poverty Reduction supported WI, Study on Sustainable Development Strategy Plan and Natural Resources Sustainable Utilization Demonstration Project supported by WB. The People's Government of Hengshui City pay great attention to the Hengshui Lake Wetland conservation promulgated a legally binding instrument entitled "Management Rules of Hengshui Lake National Nature Reserve in Hebei Province", which authorized the Administration Office of the reserve to manage the reserve entirely.

4 Concluding remarks

China is one of the most biodiversity-rich countries in the world. Given its vast size, it spans five climatic zones and crosses two bio-geographical realms, China harbours a high diversity of species and habitats. Over the last decades China's economic development has strongly increased, resulting in an increased risk on biodiversity loss. In 2005, China became the world's second largest economy when measured in terms of purchasing power parity. Although the "ecological footprint" (the ecological footprint measures the area of biologically productive land and sea required to sustain the resource consumption of a given population) of the average Chinese is less than one-sixth that of the average individual living in the United States, China's growth rates have been averaging close to 9% a year for much of the last decade. This economic development has resulted in a large pressure on the natural environment, leading to deterioration of the environment and natural resources. The rapid deterioration of the nation's environmental quality and depletion of its natural resources are threatening the lives and health of the largest population in the world and the potential for sustained growth of the economy. Moreover, biodiversity is currently under threat as indicated by the large number of species on the Red Species Lists.

Economic development specifically poses a strong pressure on biodiversity in wetlands in China. Wetlands are often located in parts of the country were economic development is booming, and are susceptible to threats from a range of activities carried out not only inside the reserve but also elsewhere in the water catchment which affect the quality and quantity of water flows and by it the quality of the wetland ecosystem. Today China still has 65.94 million ha of wetlands. However, some 50% of coastal wetlands have already been lost and nearly 1000 lakes have disappeared, whereas in the parts of China where economy development was strong over the last decades, like the Northeast of China, over 90% of the vast wetland plains have been drained and converted to farmlands. Unwise use of wetlands has caused biodiversity to decrease significantly. Conservation and management of wetland resources have received inadequate attention for a long period. The approach in China has been fragmented with many departments responsible for conserving wetlands. Marshes have continued to decrease and are used for cultivation, fish or shrimp ponds. Wildlife species have been killed, and wetland ecosystems have deteriorated due to poor planning and management, as well as other reasons.

The most promising solutions to develop plans for wise use of biodiversity in wetlands is by including People, Planet and Profit in the considerations in the management plan. Management plans are not viable on the long term if they are not socially acceptable, they must make ecological sense and should make not be only applicable at extreme high costs.

In this report we described general approaches to deal with ecological, economic and social aspects of wise use of wetlands in China. In this respect we aimed to cover the three main dimensions of sustainability, i.e. People, Planet and Profit, with the different methodological approaches as presented in this study. We also illustrated the approaches by examples of projects executed in China by Alterra and its partners, like NAU. Depending on the specific problem at stake more tailor made methods are available and can be used. However, the examples given show the application of the methods described separately, not combined together and integrated. Potential wetland sites have been selected during the workshop held in China in 2008 and the next step will be to apply the approaches described in this report in a case study at one of these wetland sites in an integrated way. The financial resources needed for the execution of the case study will be the main concern to be explored on short term.

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Appendix 1 Definition of terms

Carrying capacity:	the maximum population of a species that a specific ecosystem can support indefinitely without deterioration of the character and quality of the resource, i.e., vegetation or soil
Dispersal capacity:	capacity of most individuals of a species (80%) to bridge distances to new, potential habitat
Ecological network:	network constituted of physically separated habitat patches, for a population of a particular species or a set of species with similar requirements, that exchanges individuals by dispersal.
Ecotope:	a physically limited ecological unit, whose composition and development are determined by abiotic, biotic and anthropogenic aspects together
Habitat:	an area which can support living organisms for at least part of its life cycle
Habitat patch:	spatially defined area of habitat for a species
Physiotope:	The spatial element defined as homogeneous concerning the abiotic circumstances, relevant for vegetation development
RU, Reproductive Unit:	breeding pair, couple; often half of the potential population size, provided the sex ratio is equal.
Scenario:	image of a desirable and possible future situation.
Vegetation structures:	areas, at a specific scale, with a homogene vertical and horizontal vegetation structure and intensity of management. Floristically and abiotically, they can be heterogeneous.
Vegetation types:	are the sociological translation of one or more ecotopes.

Appendix 2 Workshop Program and Presentations

Program "Wise use of wetlands in China"
Venue KAIKANG International Hotel

10th of April 2008

9.00 -9.30 introduction participants and introduction to the project (Chris Klok, Alterra)
9.30-10.00- presentation on DPSIR approach to wetland management (Chris Klok, Alterra)
10.00-10.30- presentation on Ecological methods to wetland management (Bert Harms, Alterra)

Tea break

10.45-11.15- presentation on Economic methods to wetland management (Ou Weixin, Shi Xiaoping, NAU)
11.15- 11.45- presentation on Participatory approaches to wetland management (Annemarie Groot, Alterra)

Lunch break

13.00-13.30 setting criteria for site selection (all)
13.30-14.00 presentation on potential wetland sites (Chen Kelin, WI)
14.00-14.10 selection of most appropriate site (all)
Tea break
14.20-16.30 drafting the LOGFRAME for the selected site (Annemarie Groot, Alterra)
16.30-17.00 division of work for the final report and development of action list for next steps.