AN ECONOMIC ASSESSMENT OF THE SUITABILITY OF TWO LOCATIONS IN CHINA FOR THE RE-INTRODUCTION OF THE CHINESE TIGER

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Executive Summary

During February and March 2004 a second visit was undertaken to China to assess two area identified by an earlier study undertaken by Anderson, Su, Lu and Stalmans (2004). The first of these sites was the in the Province of Jiangxi and the site was at Zixi, it measured approximately 180 km^2. The second site was in Hunan province at Zhushuqiao. This site was subsequently assessed as two sites, the first was smaller measuring about 100km^2 it was a subset of the larger site measuring about 150km^2. These sites were assessed for a number of attributes and these included the general support infrastructure such as roads, airports, communications, services and other tourism products in the immediate vicinity. A subjective assessment was made of the likely tourism demand for the product.

On all these issues it was felt that all the sites were well positioned and assuming the product is developed correctly it would seem that the reserves would attract tourists. Zixi is building a number of tourism products, focused on outdoor recreation, this may be an added advantage, but it may also impact on the profitability of these investments. This however was not seen as a major disadvantage, if necessary the province could increase its marketing and awareness of the products and position itself as a recreational holiday destination.

The more detailed phase of the investigation dealt with the development issues on the site which would need to be addressed in order to prepare the areas for the introduction of the tigers. The most important aspect initially would be the fencing of the area, resettlement of people living in the area and the introduction of game. The development costs are significantly influenced by the length of the fencing required and the terrain which this fence must pass through. The sites varied in the length and cost of the fence with Zixi being cheaper per km and the other two sites being significantly more. This could in some part be a function of how the provinces have undertaken their cost estimates. It is not likely that the costs between the areas should differ that significantly and these differences are not seen as significant, although the Zhushuqiao sites may be higher due to the topography. The smaller site will have a larger perimeter to area ratio as is common on smaller reserves.

The cost of resettlement is more difficult as it is unclear what the final costs will be, so the best assessment is to look at the likely number of families affected. Here the larger site at Zhushuqiao had the largest number of families at 964, next was Zixi with 608 and finally the smaller site only had 106 families. This is seen as a significant advantage as fewer families will be disrupted and the establishment will be less costly. However the smaller area will certainly support fewer tiger and perhaps only 3 breeding animals could live in the area sustainably. Other costs are very similar between the sites. Generally the smaller sites are more expensive per hectare to develop and maintain as the overheads are similar for all reserves from about 50km^2 to about 300km^2.

The tourism potential of an area for a product which has not been developed in China is more difficult to assess. Here the principles of game viewing in Africa have been used to assess the product. These include the density of the game and how it is distributed over the area, the visibility of this game and here the sighting distance is important and the ease of seeing the animals. It would appear that although the

carrying capacity of the sites for game are very similar the preferred habitat for game is more widely spread over the area in the Zhushuqiao sites and hence the game viewing is likely to be more patchy and perhaps not as good. The tigers are likely to be where the prey densities area highest and sighting of tigers may be more likely at Zixi. Here Zixi has a tremendous advantage of having a large contiguous agricultural area concentrated in a large valley with a highly irregular shape and this will surely create excellent habitat for all species of game. This is likely to make excellent game viewing and increase the chance of seeing tigers, while reducing the need and costs of roads.

Roads are a critical element in a product of this nature especially given the climate and topography. Tourists will need to drive to see game and tigers and this can only be achieved on roads. These however are costly to develop and maintain. Although the road costs in the areas are relatively similar, the Zhushuqiao sites may require more roads in more difficult areas to try and achieve the game viewing product they need. This is surely a possible disadvantage to these sites. The Zhushuqiao sites do have the added advantage of the reservoir, where boats may be used, which adds a different tourism experience and does substitute to some extent for the roads, but it is still a different experience.

The development costs and possible annual expenses including possible income projects show that the projects are not financially viable if the development costs of the conservation facilities are included in the project. Typically an internal rate of return (IRR) of –5% are yielded. The investment however is in biodiversity and it could be argued that this is a worthwhile investment to make. The development costs are also high and large proportion of these (up to 55%) is in resettlement costs. There is no guarantee that the projects will cover their operating budgets which are estimated to be about ¥6 million per year when operating at full capacity. The projects should check that investor would offer this in rental before the project is initiated, if possible.

The final analysis would suggest that the large site at Zhushuqiao is not an option as the development costs and number of people who will be dislocated would not be worth the marginal benefits which may be derived from the larger area. The smaller site at Zhushuqiao and the Zixi site are therefore the two better options although each has their weaknesses. Both require substantial investment to prepare them for the tiger introduction should they succeed. There is a substantial amount of planning and building of capacity both with staff and with institutions as well as dealing with resettlement and funding the developments. Finally the projects must find a partner or partners who will develop the tourism infrastructure and product and guarantee the rental required to carry the operational costs and perhaps offset some or all of the development costs of the area.

A summary of the important figures and costs are presented in the table below, these are self explanatory and where appropriate have been reduced to a cost per hectare to make comparisons possible.

	Zixi	**Hunan small**	**Hunan large**
Area (ha)	17,998	9,910	15,000
Carrying capacity (ha/AU)	**12.01**	**9.85**	**10.00**

Roads			
Cement	20	20	25
Other	59	59	69
4X4	100	95	95
Total	179	174	189
Hectares/km of road	**101**	**57**	**79**
Total cost of road	□20,820,000	□17,050,000	□20,750,000
Road cost per ha	□1,157	□1,720	□1,383
Cost of game	□1,635,000	□796,000	□1,270,000
Game cost/ha	□90.84	□80.32	□84.67
Potential no of breeding tigers	**5**	**3**	**4**
Fencing			
Length	77	116	208
Total cost	□6,930,000	□25,408,800	□45,520,000
Cost per ha	□385	□2,564	□3,035
Resettlement			
No of families	608	106	964
Cost of resettlement	□45,600,000	□7,950,000	□72,300,000
Resettlement cost/ha	**□2,534**	**□802**	**□4,820**
Total development cost	□82,595,000	□59,254,800	□151,720,000
Development cost/ha	**□4,589**	**□5,979**	**□10,115**
Annual management cost	□5,979,500	□6,100,440	□7,400,000
Management costs/ha	**□332**	**□616**	**□493**

Introduction

An initial assessment was made of seven sites within China in November 2003 by Anderson, Su, Lu and Stalmans (2004) to assess their suitability for the re-introduction of the South China tigers (*Panthera tigris* ssp. a*moyensis*). This report focused on two major areas, firstly the ecological suitability of the areas to sustain viable populations of tigers and secondly to broadly assess their social and economic potential. The report identified three potential areas which were more suitable than the other four sites. These sites were Zixi, (as a first choice, with the highest score) Zhushuqiao (as a second choice, with the second highest score) and Le-an as a third choice. On the basis of these the Chinese authorities decided to only focus on the first two areas, namely Zixi and Zhushuqiao, the major reason being that the third suitable area was not contiguous but was split and this would create management problems.

On the basis of this a second team was tasked to assess these two selected sites and make recommendations regarding their suitability for establishing a tiger reserve. The terms of reference of this work is, through working with Chinese counterparts to estimate the following:

1. At a macro level, the likely financial costs of establishing the reserves in the two locations (Zixi and Liuyang) which have been identified. These costs would be split into capital and annual operating.
2. To identify possible use options and cost implication to generate income from the project and then to quantify the costs and net financial benefit of these to the project.
3. To evaluate the overall financial feasibility of the project using internal rate of return (IRR) as an estimate of efficiency.
4. To broadly identify the social costs and benefits of the project. This would merely focus on the potential job creation and any displacement of people, but it would be at a very broad scale and would not involve any detailed social analysis.

Methods

The two sites where visited in China by an evaluation team from South Africa and China. The Zixi area was visited between the 25 and the 29 of February 2004 and the Zhushuqiao site was visited between 1 and 4 March. The two sites are located in adjacent provinces of Jiangxi and Hunan respectively. Each fall completely within the counties of Zixi and Liuyang. Comprehensive visits were undertaken to the project sites and immediate surrounding area, this was done with an assessment team comprising Mr P Viljoen (Save China's Tigers), Mr J Koen (from the Northern Cape Provincial Government, RSA), Mr Lu Jun (from the State Forestry Authority, Beijing), and Mr Qi Quan (from Save China's Tigers) and Richard Davies (private consultant from South Africa). Community representatives and wildlife experts from the Province and county provided all the information and arranged for visiting the various areas. All information was obtained from formal presentations, informal interviews and some information was specifically acquired via written requests.

The feasibility of the project will be based on a number of criteria. The environmental and ecological issues have been dealt with in the Anderson *et al* (2004) report. This assessment will focus on the following:

- tourism market demand;
- the service infrastructure to the area;
- other tourism and support infrastructure in the immediate region;
- the site development requirements to prepare the area for the introduction of tigers, this will include
    - fencing;
    - building of roads;
    - support infrastructure (offices, workshops, staff accommodation, etc)
    - relocation of people;
    - introduction of game;
    - habitat reclamation
- The ongoing maintenance of these issues will also need to be assessed;
- The suitability of the area to achieve the desired objectives, namely economic development through the development of tourism based on wildlife in their 'natural environment' of which tigers are a critical species.

The major objective of the exercise is to try and determine which area will be the most cost effective to establish the reserve and to estimate what the costs are in doing so. To make such a decision it is important that the analyses between the different options are similar, this relates not only to the structure of the report but also the financial figures used. It is realised that prices may vary from one region to the other but significant differences, which do not seem to be reasonable, will make comparisons impossible. For this reason not only has a standard approach been used in each area, but similar costs have been used to make comparisons possible. Although these may be at variance with estimates which the province has supplied, if they cannot be justified then approximately similar estimates will be used for similar products or services. For example the management costs and structures for any reserve is likely to be similar and therefore the same figures will be used for this.

Game stocking model

The number of animals which may be carried in an area will be influenced by the habitat and the types of animals. The number of animals will be directly linked to the size of the animal, with smaller animals eating less food than larger animals. However smaller animals have slightly higher energy requirements than large animals and their efficiency of food conversion is lower. For this reason the average body mass of an animal, which is the average mass for all the individuals in a typical population, for the species including juveniles, sub adults, adults and males and females has been used. These figures are based on the Anderson *et al* (2004) report.

This mass is then used in the following formula: $\boldsymbol{m^{0.75}/450^{0.75}}$, (where m is the mass of the animal in kilograms) to calculate the animal unit (AU) (Edwards 1981). This concept of an animal unit is a useful measure to determine how much land would be required to support an AU without a deterioration in the grazing (including browsers)

capacity[1] of an area. It allows comparisons between different areas irrespective of what animals are using the areas (Mentis 1977). There are many refinements on this model which are more appropriate for agricultural purposes, but this provides an approximate estimate for calculating stocking rates[2] in this type of environment. It will, however, be necessary to monitor the animals and vegetation condition on an annual basis to check the response and if necessary adapt this as more information is obtained.

There is very little data available on game stocking rates and densities for the selected species for these situations within the project areas in China. In the absence of this some basic assumptions were used to determine the likely carrying capacity of the different habitat types and appropriate stocking rates and ratios for the different species. These conditions may however change over time, especially if the old agricultural fields are allowed to revert back to scrub and forest, continual monitoring is therefore critical. The old agricultural lands especially the rice paddies will certainly provide higher quality feed than the forest areas. Similarly the scrub areas, where the available browse is likely to be more palatable and accessible than forest areas will also have a higher carrying capacity. Fire may help increase the amount of scrub or indeed hold the vegetation in this phase and prevent succession to a less productive phase (for grazers and browsers). The rice paddies would typically produce about 6 tons of rice per hectare, however this would be under good cultivation with fertilizers. The soil type and rainfall for these areas would suggest that approximately 2 hectares would support one animal unit. These relationships will however need to be monitored in the early years until the productivity of the system and the relationship between the animal species is better understood. It may be useful to determine what the successional phases are for rice paddies once they are withdrawn from cultivation, especially from a grazing capacity perspective.

It is also assumed that the animals will be stocked close to ecological carrying capacity[3], this will increase the number of animals per hectare and thereby increase the game viewing opportunity, but production per animal will be reduced at this level.

It is usually not cost effective to introduce game at the estimated carrying capacity, especially for species which reproduce rapidly, i.e. rate of increase over 20% per annum. It is preferable to introduce at lower densities and allow game numbers to increase. In this project, tiger prey densities must be sufficiently high to ensure there is sufficient food for them and have a good chance of them finding it. It must not be so low that the tiger's predation may prevent the game populations from growing at a reasonable rate. Ideally game should be introduced at between 30 to 50% of its long-term carrying capacity and allowed to settle and increase over time. If the game is introduced three to fours years before the tigers are introduced and the number of tiger

[1] The grazing capacity simply refers to the number of grazing and browsing animals, which may be carried on any area. It is determined by the rainfall, soils, vegetation and in some instances management. The animals are expressed in animal units.

[2] The stocking rate refers to the number of animals (usually animal units), which may be carried per unit area.

[3] Ecological carrying capacity is the stocking rate that optimises the number of animals per unit area rather than the production per animal. Typically agricultural systems would stock at rates 20 to 40 percent below this figure, this would increase production per animal. In this project game densities must be high to improve tourism game viewing and the biomass and number of prey animals for the tigers.

are limited to about 50% of their long-term carrying capacity then only about 30% of the target or final population may need to be introduced. The closer the game introduction is to the tiger introduction and the higher the number of tigers, then the larger the initial introduction must be.

The game introduction for the project area assumes that the prey will be introduced at 50% of the long-term carrying capacity. The species mix is somewhat arbitrary, but the larger the grazing area and the edge effect with scrub or forest, i.e. old agricultural lands, the higher the proportion of buffalo, sambar and sika deer, also wild boar numbers will be positively affected by higher grazing areas.

Game

There are many species which will be suitable to re-stock all the areas with and many of these are mentioned in the Anderson *et al* (2004) report. For the purposes of developing cost estimates for these projects, only those species which will provide a significant prey base for the tigers will be considered (species should have also have occurred in the area historically). It is likely that many other antelope could be introduced along with the Asian bear, however these have not been costed. Similarly the costs associated with the tiger re-location have not been included, it is assumed these will be carried to a large extent by the Save China's Tiger Trust.

For each project area estimates have been made for the carrying capacity. These must be viewed as being highly subjective and will need to be corroborated with production figures from the different areas. It is strongly suggested that this is done as a matter of urgency before game are sourced for the project. It is highly likely however that the production for the different habitats will differ significantly between the two project areas. It could be assumed that the rice paddies and old agricultural fields will be very productive (see Anderson *et al* 2004) as much of the forage will be palatable and useable, at least in the early years after withdrawal from agriculture and there is still some residual fertility. The long-term productivity is perhaps less certain. In addition to maintain the productivity some management action may be required such as burning (as proposed by Anderson *et al* 2004) or other mechanical measures.

From the estimates it is apparent that the carrying capacities of the old agricultural lands and the scrub areas are significantly higher than the forests. From this it follows that the largest biomass of game and therefore the tiger's prey will be found on the old agricultural fields (rice paddies). This is important, as it will indicate where the best game viewing is likely to be had. In addition most of the agricultural land is often on the relatively flat areas and the game visibility is very good.

The major food species for the tigers are likely to be made up of 4 species, namely buffalo, wild boar, sika and samba deer, with muntjac and other species complimenting the diet. The average weights of these animals have been drawn from the literature and the Anderson *et al* (2004) report, from this their animal unit equivalents calculated. The estimate of their existing population numbers together with the likely number to be introduced, the likely annual growth rate which could be expected from the different species and the estimated final target population number is presented for each site. The annual rate of increase is based on the individual species calving interval, number of offspring per litter, age at first calving, average

lifespan and normal mortality excluding predation from tigers. From this it can be estimated how long it will take the respective populations to reach their target number. It is realised that this model is extremely simple and must only be used for very broad based calculations, all the input assumptions need to be tested through monitoring on the ground after the release of the different species.

It must be stressed that the carrying capacity is a dynamic concept and will change over time as conditions change and the quality and quantity of the vegetation changes. It is recommended that the game is actually only stocked at about 80% of this maximum, especially until the functioning and production of the system is better understood and known. This will also hold a certain food reserve in the event of fires, droughts etc.

The initial introduction numbers should provide sufficient food to support the tigers and still allow for some population growth, however the longer the prey will have to establish their populations the better. Predation will certainly impact on the rate of growth and if the tigers take a high proportion of young animals then this growth estimate may be significantly reduced, to avoid any prey population from being over-harvested. The game numbers should be introduced by at least 2006 if the tigers are to be introduced in 2008, failing which the initial introduction numbers will have to be significantly increased. It is important that the estimates of the existing game numbers are approximately correct, if significantly fewer muntjac or wild boar are present, then the initial introduction may need to be increased accordingly to ensure these species occur at sufficiently high densities when the tigers are introduced. This will ensure adequate population growth and importantly the establishment of these animal populations before predators are introduced.

It has been assumed that tigers will occur in the area at densities of approximately 100 km^2 per breeding group of tigers (1 male and 2 females) (Anderson *et al* 2004). Each tiger will consume approximately 5 to 6 kg of meat per day with a wastage factor of about 30%. That means each tiger will require about 8 kg of meat per day. This has been used to calculate initial game introductions and long-term carrying capacities for the areas. All areas should meet these requirements, provided the game introduction targets are met and the game does settle and breed as predicted; this must be monitored and action taken if productivity is not as expected.

Fencing

The most important aspect of this project will be the erection of an effective barrier to keep the tigers constrained within the reserve, as well as being a barrier to prevent people and livestock staying into the area. The tigers are potentially dangerous to humans and livestock and every effort must be made to ensure they do not escape from the reserve. This fence must be a continuous line with no weak points in it and it must be effectively maintained. In areas of high mountains and river crossing this can be extremely difficult to achieve. The fence should at least be 2.0 m high (even as high as 2.4 m may be required) although in steep areas this may need to be higher to prevent tigers jumping from higher ground to lower ground or climbing trees or stumps and leaving the reserve. The bottom of the fence where it meets the ground must be secured so as to prevent tigers from crawling under it. Holes under the fence are often opened by wild boar and this creates points where tigers could escape. The

fence must either have a wire apron on the ground for about 1 m from the fence into the reserve and/or be electrified, ideally both is recommended.

Electricity though 5 well placed live wires off-set from the fence will help to improve the barrier created by the fence, 4 of these on the inside of the fence and one on the outside close to the ground. If an electric fence is used, and the authors strongly recommend this, it must be checked regularly to ensure the voltage (minimum 7 000V) is adequate, ideally it should be checked daily as short circuits may occur due to vegetation touching the wires, trees or branches falling or other breakages by animals or people as well as rainfall and flooding The fence should be patrolled daily and voltage reading taken at regular intervals, any voltages drops must be immediately identified and the problem rectified. The vegetation near the fence will need to be kept clear to ensure no vegetation touches the live stands. If herbicides are used to keep the vegetation clear, then these must be carefully selected to only kill the target species, not pollute the environment and not have long-term action.

A 4 m wide clearing needs to be cut before the fence is erected, this will allow for a 2 m clear strip either side of the fence where access can be gained to the fence either with vehicles or foot patrols. In some areas this clearing may be wider to allow for better vehicle access. Access to the fence is important as the fence may need to be accessed rapidly after a breach and good access roads are critical. River crossing will also have to be secured and here rock packing with steel mesh gabions may be required. These items increase the cost of the fence. Gates may also be required at strategic points to assist with management of the reserve, as well as allowing access at control points, although the tourist gates have been costed separately.

Legal and administration

It is assumed that some provision will need to be made for surveying the boundary to align the fence but also for purposes of proclaiming the reserves. The proclamation will need to be prepared and submitted to Government for approval. In addition a management plan and operational plan with a detailed budget is required. It is proposed that much of this work will be done internally by the state, provincial and county administrations, but this has been costed and provision made for extra input if required. A breakdown of these costs are presented below, these are seen as the same for all the sites.

Legal and administration	**Cost (Yuan)**
Survey boundary	150,000
Prepare and motivate proclamation	50,000
Prepare management plan and budget	350,000
Sub total	**550,000**

Roads

Roads are required for two reasons within the reserve, the first is for management purposes and the second for tourism use. In reality these roads are often shared by both users, although generally tourism roads do need to be of a higher standard than management tracks and often access different areas. There are existing roads within the area and most of these will be used. Their current asset value has not been captured, however their ongoing maintenance will now be the responsibility of the reserve. Some of the roads will be upgraded from gravel to cement and other gravel roads will be improved. In some areas new roads will be required to allow for management access (especially only the fence) or to access areas for tourism.

It is anticipated that the tourists will probably be permitted to drive their own vehicles to the reserve and to any hotel or lodge which may be situated in the area. But any game viewing will probably best be done on proper game drive vehicles with a driver and if necessary a guide. This will reduce the number of vehicles as more people can be carried on game drive vehicles, it will also decrease vehicle congestion and perhaps allow for lower quality roads to be built in some areas. It may be more cost effective to purchase vehicles which can access areas with gravel or areas not passable to normal sedan type vehicles, than to build and maintain more expensive roads. On the basis of this a budget has been proposed which would reduce the road network while still ensuring a reasonable game-viewing product.

Experience in African wildlife areas has shown that game-viewing product is influenced to a greater degree by the density of animals, which is influenced by the carrying capacity of the habitat and the visibility while moving through the habitat. Typically forest offers very poor viewing for two reasons, firstly the game densities are generally significantly lower than scrub or grassland and the visibility is much reduced due to the trees and scrub and sometimes the topography as well. To improve the chances of seeing animals and especially tigers, one would concentrate viewing in habitats with higher game densities and covering these areas as comprehensively as possible. Ideally this is best done in a vehicle, as large distances can be covered in relative comfort and bigger areas viewed. If game is seen, especially exciting game, then this holds tourists interest and improves the tourists' experience of the area.

Rehabilitation

The areas are currently being used for agriculture and residential purposes. It will be necessary to remove some of this infrastructure to improve the visual appearance of the landscape. Provision has been made for this in the cost estimates. This is difficult to estimate as the residents may remove much of the building materials when they leave, this could reduce the costs.

In addition to the rehabilitation of buildings and other infrastructure, it may be necessary to rehabilitate some of the agricultural lands. Retaining walls may need to be removed or modified in some areas to ensure erosion does not occur once agriculture and maintenance of agricultural facilities stops.

Holding pens will also be required for the game. This facility would simply be a fenced in area, similar to the perimeter fence. It would be an area of 1 to 6 ha, and may be divided into different camps if necessary. It would have a water point and

feeding area. Although most of the game will be brought to the area and released straight into the bush, some may need to be held in pens. This may be necessary for observation or to accustom them to the electric fence and to acclimatise to the area. Certainly it would be necessary to hold the tigers before release. It is also useful for holding animals once the reserve is operational, animals may need to be brought in for observation or for holding before relocating to other areas.

Staffing

The staff compliment and costs for the two regions are likely to be very similar, with smaller areas having perhaps fewer staff, although generally with reserves of between $50km^2$ and $300km^2$ the cost structure is very similar for these types of operations. The overhead costs are generally high for the level of management required. The variable cost as size changes are influenced but it is usually not that significant. Similarly the costs of staff and support infrastructure such as accommodation, offices, workshops etc do not vary significantly as the size of the area changes.

It is expected that a reserve manager and a deputy will need to be present to run the operation and to deal with management problems as and when they arise. These must be senior staff as the value and nature of the assets calls for competent and good management. Provision has been made for technical staff to deal with the day-to-day maintenance of assets and facilities. It is envisaged that a community worker would be required to liase with outside communities on issues of common concern. Field rangers are necessary to do the day-to-day field work of conservation management and monitoring as well as co-ordinating and managing security and other aspects. Finally field workers will be required to operate the access gates, undertake foot and other patrols and secure the fence and undertake security checks. Field workers will assist the technical person with management activities. A provision has also been made for the ongoing training of staff.

Income and tourism

There are likely to be two main sources of income for the reserve, although donations and sponsorships may also be available. The first major source will be from tourism and the second may be from selling excess game once the numbers are established after about five years depending on how many animals are introduced and when this occurs. No estimate has been provided for the game income, as it is unclear if this will indeed occur and how much could be generated from the sale of live animals. The possibility also exists to use the game meat from culling or even hunting operations. Limited hunting may be possible in isolated valleys away from tourism.

The major source of income will probably be generated from the lodges. This does expose the reserves to some risk, as any change in tourism could result in reduced income, depending on how the rental agreement is structured. Tourism is often linked to the state of an economy of a country and tough economic conditions in China, may impact on the tourism sector. The Chinese economy has seen spectacular growth in the last one to two decades and a downturn may have unknown consequences on the tourism sector. The financial assumptions for the lodge income model is likely to be similar at each location and the principles of this are explained below.

The required income per site is based on the amount required to offset the annual operational costs, or to not only cover these operational costs but also to cover the development costs (amortised over 20 years) of the reserve, or at least those costs which relate directly to the tourism requirements such as roads and entrance gates. Most of this income will be generated from investors who are willing to invest in developing the tourism products and to pay the annual operational and other costs via an annual rental. For them to achieve this they will need to not only cover their development and operational costs but also still be able to afford the rental. This must be done within a framework that can be supported by the reserve without negatively impacting on the tourism product on offer. The types of product may include a slightly more affordable experience, priced at about ¥200 per person per night up to about ¥800 per person per night. The more expensive product would probably imply less congestion and a more exclusive experience while the cheaper product would mean higher tourism densities and less exclusivity. These products are often mutually exclusive and do not mix well and may have to be accommodated in different areas if the two markets are to be accommodated.

From assessments it would appear that there are investors who are committed to building these types of tourism products. It would also appear that these are products, which are similar to those that may be required for this type of development.

The number of tourists, which may be accommodated in the area, is to a large degree dependant on the game viewing experience, which as explained previously is a function of the game densities, average visibility and each of these is to some degree influenced by the total amount of roads. Poorer game viewing, can to a limited extent, be improved by supplying more roads, but the game densities must still be good to maintain the tourist's attention and interest. In all instances there is a limit to the amount of vehicles that may use the area at any one time. Too many vehicles create congestion and will impact negatively on the tourist experience and possibly on the game, which will simply move to areas where they will be less disturbed.

The balance between too many vehicles and an enjoyable experience is a largely unknown 'value' for this product within China. It is difficult to draw on other experience from other areas, as game products of this nature are not usually offered in forest with steeply undulating topography. Hence the need to have areas where game will concentrate in significant numbers and be visible without the need for a large road and track network is important. A comparative study undertaken by Contour Project Managers (Pilanesberg National Park, 1999) indicated that the Kruger National Park had 0.26 vehicles per km for a lower priced product and this ranged up to 2.32 (over a busy long weekend) for Pilanesberg, also lower priced product. These are both Big Five Parks, offering a similar product to that proposed for the tiger reserve. Sabi-Sand and the state-owned reserve of Madikwe, where vehicles per km average less than 0.3; (off-road driving is permitted and the guides are in radio contact and therefore 'actively manage' the 'congestion' at sightings) operate at the higher end of the market.

These products have significantly better game densities, a higher number of species that will attract tourist's interest, the topography is more accessible and the game viewing is very good within reasonable sighting distances from the vehicle, i.e. not obstructed by forest. Although averages are difficult and extrapolations more

problematic, it is unlikely that the tiger reserve will accommodate more than about 0.3 vehicles per km and with an average of 15 people per vehicle. Thus for 100km of good game viewing road approximately 400 to 450 guests may be accommodated, these from the lower priced end of the market. This assumption is based on an area with about 100 km of roads available for use by tourist, excluding management tracks and fence-line roads.

If 400 to 450 beds are developed and these guests are driven in the reserve in purpose built vehicles that could accommodate from 10 to 20 passengers then that translates into between 20 and 40 vehicles or about 1 vehicle per 2,5 to 5 kilometres. This seems low, but in reality the vehicles tend to accumulate around interesting sightings and if too many vehicles are present the product is negatively affected. With trained drivers and guides this congestion can be minimised, especially if they are in radio contact with each other.

Assuming 400 beds are developed by a developer who is expected to pay a rental to the reserve of ¥6 million per annum. Under different scenarios they may be able to afford the rental but this will be influenced by the amount of turnover they generate from their operations. Three variables will affect their turnover and profitability; namely, their occupancy, the rate per bed they achieve and the rental they pay to the project.

A simple table indicating the possible turnover under different occupancies and achieved rates per bed per night has been calculated for different scenarios, these are presented in the table below for a 400-bed development. Lodges generally operate at a breakeven percentage occupancy of between 30 and 50%.

Expected turnover				
Number of beds	400			
	Rate per bed			
Occupancy	□**100.00**	□**200.00**	□**400.00**	□**800.00**
20%	□2,920,000	□5,840,000	□11,680,000	□23,360,000
30%	□4,380,000	□8,760,000	□17,520,000	□35,040,000
40%	□5,840,000	□11,680,000	□23,360,000	□46,720,000
50%	□7,300,000	□14,600,000	□29,200,000	□58,400,000
60%	□8,760,000	□17,520,000	□35,040,000	□70,080,000
70%	□10,220,000	□20,440,000	□40,880,000	□81,760,000

The lodges operating in the shaded areas of the table are unlikely to be able to afford a rental of ¥6 million per annum. Amy lodge with a turnover less than 30%, irrespective of the achieved rate, is unlikely to be profitable. Generally the more expensive rate per night includes a higher capital and operating cost. Over about ¥20 million per annum the lower priced facilities become profitable and here the ability to afford the rental will increase. Over about ¥30 million, higher rentals may be feasible than the ¥6 million. This does provide some indication as to the positioning of these tourism products. It is likely that the fee per night, excluding meals and game drives will be less than about ¥400 per person per night. This would therefore be a more expensive hotel. However if demand for the facility is high then fees in excess of ¥1 000 per person per night will be possible. The ability to afford the ¥6 million is marginal and is a high hurdle for the investors to afford, at least initially when the

product is still growing. It is also uncertain what the quality of the game viewing and tiger sightings will be, clearly this is a risky investment for an investor.

The most likely scenario is to have a large 300 to 350-bed facility that is priced from about ¥400 per person per night with a 50-bed facility in a more secluded area, perhaps offering a more exclusive experience. This could include elephant back safaris and other more personalised products, here fees in excess of ¥2 000 per person per night may be achievable.

There may be a case to reduce the rental by the lodges through passing more of the general development costs onto them. Specifically the roads, the lodges could be given development parameters and environmental conditions and then carry the costs of building the tourism roads themselves. This could save up to ¥15 million in development costs and save about ¥2 million in operational costs annually. This would reduce their rental to about ¥4 million but increase their development and annual operational costs. This may be a more acceptable route to follow if investors are prepared to take this option, as the risks of aligning the roads and their quantity will then be the lodge's responsibility. **The reserve however must set standards and limits for this to ensure that environmental damage is defined, limited and contained**. Other facilities such as hiking trails, board walks in the canopy etc could also be covered by the investor, these will reduce the costs and risks to the project, but as the facilities offered by the reserve are reduced so may the rental they can afford to offer in return for their investment.

The authors are uncertain what the demand for this product will be and it is suggested that each County engages with investors to see if they would be prepared to offer rentals of ¥6 million per year and carry the costs and risks of road building. In fact a figure of ¥8 million may be more appropriate as the costing of this exercise has been difficult in the absence of any other data to draw on in China and this figure may indeed prove to be more realistic.

The investment required for the 350-facility will probably range between ¥70 million and ¥100 million depending on the type of furnishings and fittings and its location within the reserve. The 50-bed, facility, which would be more luxurious, could cost between ¥20 and ¥30 million depending again on its location, furnishing and fittings.

Employment

The tourism will be the largest employer of all the operations, with only about 40 to 50 people employed in the conservation management of the reserve. The 350-bed facility could employ between 200 and 400 staff depending on the level of service they will offer and the facilities they provide. The 50-bed facility, if a top market facility is offered with elephant back safaris, then between 75 and as much as 150 jobs could be created. These combined operations should therefore generate between 300 and 600 permanent jobs, with many more short-term jobs during the construction phase. Many of these will be relatively low skilled jobs and will no doubt assist in alleviating the social disruptions caused to the local residents in the formation of the reserve, however training and active management will be required to ensure this does occur. Hence the position of a community officer and the training allocation in the annual operations budget.

Zixi

Introduction

The project site at Zixi measures about 180km^2. The site offers a wide range of habitats which include agricultural land, forest, scrub areas and wetland. The approximate area of these in the project site are presented below. These are drawn from a report presented to the authors by Zixi County Government (2004).

Habitat	Area ha
Forest	14,847
Agricultural land	3,009
Scrub	90
Other	54
Total area	**18,000**

The climate is relatively mild, although the extremes are very wide with winter temperatures as low as –13 ^{o}C having been recorded while and maximum in summer is almost 40 ^{o}C. The mean annual temperature however is a mild 17 ^{o}C.

Tourism Market Demand

Zixi is a fast developing county, the tourism numbers to the area are currently relatively small, about 120 000 in 2003. There are however a number of large tourism developments which are being planned or underway. The city of Zixi is expanding rapidly and a comprehensive development plan has been developed. The road network is also improving and is continually being upgraded. The county has spectacular scenery with a large percentage of the area being forest.

Zixi is also very well situated with access roads and an airport at Nanchang, which will provide connections with the rest of China. It is well situated in relation to the large cities in the east and will no doubt use these as source areas for the tourists.

Two large tourism developments are currently being developed, namely the Shizishan Mountain Resort and the Dajueshan Mountain scenic spot. In addition the Hot Springs are also being developed to cater for tourism. There are already over 3 100-tourist beds in the county spread over 30 hotels. It would appear that many of these operate at relatively low occupancies, but the developers are confident that the new facilities, which will add over 500 beds, will be viable even at occupancies of about 30%. From discussions it appears that the county is committed to building a tourism infrastructure based on the natural resources and natural beauty of the area. Good quality facilities such as the Lucid Breeze Villar are also an attraction in the region; these are priced at the top end of the tourism market.

Other tourism support infrastructure in the region

This focus on tourism will no doubt be an added benefit to the project as the region builds its tourism base. Currently the marketing is focussed on the China and south-east Asian market – the rest of the foreign market is still untapped. There is however a risk that too many beds may be available and if the marketing is not good these facilities may not achieve the occupancies to be economically viable. This could tarnish the perception of the area with tourists, especially if the quality of the product is compromised to make the operations viable. Good marketing could reduce this risk and perhaps the county could assist by developing and supporting a tourism marketing "Agency" to assist this growing sector in the economy. However the authors did get a sense that there is such a large demand for tourism generally in the region that the products will, if services are appropriate, prove successful. It is an issue which must still be borne in mind.

The county and province also has several interesting tourist features including the lake in Lu Mountain, Wuyi Mountain scenic area, the blue water, red cliff and Taoist culture at Longhu Mountain, Sanquing Mountain tourism area, the red culture of Jinggang Mountain, the fairy maiden lake and many others. The Dajueshan Mountain scenic spot, Matoushan Nature Reserve and Fanjiashan Mountain scenic spot are situated nearby the project area and are areas of scenic beauty. Cultural minorities and other facilities are also a strong feature of the area.

Service infrastructure to the area

The county has invested heavily in the recent past in improving access to the region. A large airport exists at Nanchang, which would be more than adequate for servicing the project; this is 200km away or about a 4-hour drive. Several roads have been completed or are planned to be completed by 2007. These will link the project area to Shanghai, Hong Kong, Beijing and the towns and cities of the east coast. Good rail links also connect with all the major cities.

Water, electricity and telecommunications are also good throughout the area. The cities and towns all provide banking and other services which tourists may require while travelling in the region. Hospitals are also available in the large towns and cities. Police are located in all the centres.

Game

Carrying capacity

A list of the different habitats with their respective carrying capacities in hectares per Animal Unit is presented in the table below.

Habitat	Area (ha)	Carrying capacity (ha/AU)	No of AU	No of AU at 80% of long term carrying capacity
Forest	14,846	50	297	238
Agricultural lands	3,008	2	1,504	1,203
Scrub	90	2	45	36
Other	54	2	27	22

Total area	**17,998**	**12.01**	**1,873**	**1,498**

It would appear that as a close approximation the area should be able to carry approximately 1 870 AU, although as an extra precaution it is suggested that this is only stocked at 80% initially until the dynamics and productivity of the system is better understood, i.e. that will give a carrying capacity of about 1 500 animal units. This figure should be adapted through regular monitoring. This should more than supply the food requirements for the tigers, if stocked with suitable prey species.

The agricultural lands will provide good viewing as sighting ranges of several hundred meters will be possible as opposed to 20 or 30 meters in forest or scrub. The fact that much of the Zixi agricultural land is concentrated in one area and has a large edge effect due to its irregular shape will significantly enhance the game viewing opportunities and this is seen as a major attribute of the area. It will also provide a good grazing that should offer a good prey base for tigers and excellent viewing opportunities for the prey and for tigers as well as other game.

These characteristics are likely to reduce the infrastructure costs as fewer roads will be required due to the good visibility and the higher game densities. The flattish nature of the area implies that the road infrastructure will be less costly than roads in steep mountain areas. It may however compound any tourist 'congestion' of the area, as tourist vehicles will also be visible to other tourists. The higher carrying capacity of the area may mean that the cost of fencing per tiger may be lower than for areas with lower game carrying capacities. However tiger home ranges of 36km^2 (Anderson *et al* 2004) may mean that although in theory the prey base is more than adequate, tiger numbers will be limited by their own social interaction and organisation. There is no guarantee that more than one pair will dominate and use the large flat agricultural area and thereby still limit sightings of tigers, although sighting of prey will be good.

Species

The average weights of the introduced game species, the estimate of their existing population numbers together with the possible number to be introduced, the estimated annual growth rate which could be expected from the different species, the estimated final target population number, the time to reach this population at the growth rate indicated and the total number of animal units is presented below

Species	Mass (kg)	AU equivalent	Existing numbers	Intro numbers	Initial population	Final No	Rate of growth	Total AU	Years to reach target (years)
Buffalo	800	1.54	0	100	100	210	15%	323	5.3
Samba deer	250	0.64	0	160	160	310	25%	199	3.0
Sika deer	86	0.29	0	200	200	400	25%	116	3.1
Muntjac	12.5	0.07	540	0	540	1,000	25%	68	2.8
Wild Boar	115	0.36	720	350	1070	2,200	30%	791	2.7
Total								**1,497**	

A likely population growth table for the different species under the above growth rates and assuming the initial population as set above is presented below for the first 5 years of the project. Once the population has reached its target number the target number is returned in the model and hence for samba deer their numbers have reached their target in year 4 when the actual population will be 366 but thereafter this number is set at 350. The extra animals may be available for capture and removal (possible live sale) to other areas or even hunted for food or for trophies.

Species	2006	2007	2008	2009	2010	2011
Buffalo	115	132	152	175	201	231
Samba deer	200	250	313	310	310	310
Sika deer	250	313	391	488	400	400
Muntjac	675	844	1,055	1,000	1,000	1,000
Wild Boar	1,391	1,808	2,351	2,200	2,200	2,200

From this an estimate of the likely growth of the population can be developed, this should provide some indication as to how many animals will be required initially to support the tigers and a tourism product by 2008 when the animals are to be introduced. What is apparent is that the longer it takes to establish the project the higher the initial introduction will have to be to achieve the two goals.

Costs

An estimate of the game introduction is provided in the table below.

Species	Intro numbers	Initial population	Purchase cost per animal (Yuan)	Capture cost per animal (Yuan)	Total cost of introduction (Yuan)
Buffalo	100	100	□3,000	□300	□330,000
Samba deer	160	160	□1,500	□750	□360,000
Sika deer	200	200	□3,500	□500	□800,000
Muntjac	0	540	□100	□500	□0
Wild Boar	350	1070		□500	□175,000
Total					**□1,665,000**

The costs have been split to include a purchase price and a capture and relocation fee. For some game either or both of these costs may or may not apply. Except for buffalo it is difficult to estimate these costs, so figures to capture similar animals in South Africa have been used, these may be totally inappropriate and these figures must therefore be used with caution. In addition the distance from the capture site will increase costs as transport and mortality may increase. The cost of the tiger introduction is not included.

Site development requirements

The area as it exists at the moment is not suitable for the establishment of a tiger reserve without modification. Significant infrastructural development will be required to prepare the area for the re-introduction of tigers as well as resettlement of people. Each of these items will now be described including the initial development component and the ongoing maintenance costs.

Fence

The perimeter is currently estimated to be 77km long and it is estimated that the cost of fencing per km is approximately ¥90 000. Thus the total cost for the fence is estimated to be about ¥7 million. This fence will need to be patrolled and maintained, these two items have been costed separately and the annual maintenance cost is estimated to be about 5% of the initial value (i.e. a design life of 20 years). The maintenance costs are likely to escalate towards the end of the life of the fence but provision has been made for an annual maintenance component of 5% of the initial capital cost. This will also cover breaks in the fence caused by falling trees, river wash-aways and other damage. These costs are presented in the table below:

Fence	Number of km	Cost/unit (¥/km)	Total development costs (Yuan)	% of total for maintenance	Annual maintenance
Total reserve	77	□90,000	□ 6,930,000	5%	□ 346,500
Sub total			**□ 6,930,000**		**□ 346,500**

The fence represents a significant cost to the reserve and its annual maintenance is critical to the success of the project.

Roads

A summary of the number of and associated development and maintenance costs of existing, upgraded and new roads are presented in the table below.

Roads	Unit	Number	Cost/unit	Total development costs (Yuan)	% of total for maintenance	Annual maintenance
Existing						
Cement roads	km	5	□320,000	□ 1,600,000	5%	□80,000
Gravel small vehicles	km	44.5	□120,000			
Gravel 4X4 vehicles	km	18				
Sub total		**67.5**				**□80,000**
Upgrade roads						
Upgrade gravel to cement	km	10	□320,000	□ 3,200,000	5%	□ 160,000

Improve quality of gravel	km	53	□120,000	□ 6,360,000	10%	□ 636,000
Sub total		**63**		□ **9,560,000**		□ **796,000**
New roads						
Cement roads	km	5	□700,000	□ 3,500,000	5%	□ 175,000
Good quality gravel	km	6	□460,000	□ 2,760,000	10%	□ 276,000
4X4 tracks	km	100	□50,000	□ 5,000,000	10%	□ 500,000
Sub total		**100**		□ **11,260,000**		□ **951,000**
TOTAL ROADS		**168**		□ **20,820,000**		□ **1,827,000**

There are currently about 68 km of roads with the project area. It is estimated that about 63 km of these will need to be upgraded at a cost of approximately ¥9,5 million. In addition a further 120 km of new roads will be required at a cost of about ¥11 million. A large proportion of these will be 4X4 tracks for use by management, especially near the fence or for game viewing in strategic areas. The total cost of upgrading the roads and developing new ones is estimated at just under ¥21 million. The number of hectares per km of road is approximately 100, this is a rough measure of the road coverage for the area. It does however not equate necessarily with game viewing quality, but does give an indication of the development per square kilometre or per unit.

It is further assumed that gravel and 4X4 tracks will incur about 10% of their capital cost annually to keep them in good repair and prevent soil erosion, for the cement roads this is estimated at about 5% of the capital cost. This provision should therefore maintain the assets in good order for the life of the project. To achieve this about ¥1,8 million will be required annually to maintain the roads, this is in addition to the vehicle and staff costs provided for in the annual budget.

Roads are a critical component of this project, both for effective management and for tourism use of the area; this component must be properly maintained.

Management support

For management to undertake their work within the reserve, support infrastructure will be required. This will include staff houses, office, information centre and workshops. It is realised that much of this already exists within the villages, however some refurbishment may be required. Entrance gates will be required to control access and to create a visual sense for the tourist entering the area. Staff will require training as this type of reserve management is new for China and the staff will need to be trained in dealing with issues of reserve management and tourism, especially working with prey and the tigers and other animals which may be released (Asian bear).

Signpost will need to be erected on major access roads so tourists can find the reserve and these may be required within the reserve as well, especially regulatory and informative signs.

A cost estimate of these items with their annual maintenance provision is presented in the table below.

Management support	Number	Cost/unit	Total development costs (Yuan)	Percentage of total for maintenance	Annual maintenance
Entrance gates	2	□150,000	□ 300,000	2%	□ 6,000
Staff accommodation	Refurb existing		□ 350,000	2%	□ 7,000
Training and staff development			□ 500,000		See annual budget
Sign posts		□180,000	□ 180,000	2%	□ 3,600
Office, workshops etc	Refurb existing		□ 450,000	2%	□ 9,000
Sub total			**□ 1,780,000**		**□ 25,600**

It is apparent from the table that approximately ¥1,8 million will be required in initial costs for development of management infrastructure and capacity with an annual requirement of about ¥26 000 for maintenance.

Equipment

The reserve will require basic equipment so that management can carry out their functions effectively. A list of the equipment required, amount and estimated cost is presented in the table below.

Equipment	Number	Cost/unit	Total development costs (Yuan)
4X4 Vehicles	4	□250,000	□ 1,000,000
Small truck	1	□200,000	□ 200,000
Motorbikes	3	□50,000	□ 150,000
Fire equipment		□150,000	□ 150,000
Tractor and trailer	1	□250,000	□ 250,000
Office & workshop equipment		□400,000	□ 400,000
Communication equip		□150,000	□ 150,000
Research and monitoring		□180,000	□ 180,000
Sub total			**□ 2,480,000**

The list of equipment is self-explanatory. This is seen as the minimum that would be required to carry out daily functions. Additional equipment may be required for example for road maintenance, if so this is catered for by the maintenance section for those items. Fire equipment will be required on site at all times and would include a water trailer with hoses and a pressure pump, other small items like fire beaters would also be included. The offices will require desks and furniture, computers, printers, fax machines etc and these are included in this item along with basic tools and machines for the workshop.

Radios and telephone equipment will be is essential to communicate with outlying stations and with foot patrols; provision has been made for these items. Finally a provision has been made for research equipment that may include tracking collars for

some of the game, receivers, computers and other monitoring equipment. The total equipment budget is estimated to cost approximately ¥2,5 million. The maintenance component is dealt with separately under the annual operating budget.

Rehabilitation

Some restoration work will be required and an estimated of this is listed in the table below.

Rehabilitation	Cost/unit	Total development costs (Yuan)
Infrastructure	□1,000,000	□ 1,000,000
Natural resources	□1,500,000	□ 1,500,000
Holding pens	□100,000	□ 100,000
Sub Total		□ **2,600,000**

The costs are self explanatory, their maintenance, if applicable, is provided for in the operational budget. Similar costs have been used for the all the study areas to make comparisons possible. Obviously as the size of the area increases and the nature of the area changes, so these will be adjusted accordingly.

Resettlement

There just over 1 900 people living in the area at present. The establishment of the reserve will therefore affect approximately 600 families as they will need to be relocated and compensated for dwellings and other infrastructure they may leave behind. In addition they will need to be compensated for agricultural and forest land to which they will no longer have access.

The county did not supply any estimates of the likely cost of this resettlement and as a result the figures used in Hunan have been used to estimate the costs. It is assumed that the costs to relocate and compensate families for moving will be ¥60 000 per family. In addition a further ¥15 000 will be paid to families for houses that will be left in the project area. Compensation for loss of agricultural and forestland is still unknown. Estimates of the costs for this are presented below.

Social	Number of units	Cost/unit	Total development costs (Yuan)
No of people	1,909		
No of households	608		
Relocation costs	608	□60,000	□ 36,480,000
Compensation for houses		□15,000	□ 9,120,000
Compensation for crops		□52.50	□ 31,920
Sub total			□ **45,600,000**

Summary of development

The items described and detailed above will need to be implemented in order to get the reserve operational. A summary of these expenses is presented in the table below.

Development	Cost (Yuan)
Fence	□ 6,930,000
Roads	□ 20,820,000
Legal and admin	□ 750,000
Conservation Infrastructure	□ 1,780,000
Equipment	□ 2,480,000
Rehabilitation	□ 2,702,500
Social costs	¥46,600,000
Game introduction	□1,102,500
TOTAL DEVELOPMENT	**□ 83,165,000**

Operational costs

The reserve, in addition to the development costs, will require an ongoing maintenance budget. Although a portion of this is directly linked to the assets that have been developed in the above section, there are additional costs as well.

Staff

The first and possibly the largest cost component will be the employment of staff to manage the reserve. A staff compliment is presented below with the total expected costs to employ them. The number and type, including their expected annual packages is presented below.

Staff	No	Total salary package annual (Yuan)	Total salary (Yuan)
Reserve manager	1	□200,000	□200,000
Deputy manager	1	□180,000	□180,000
Technical manager	1	□120,000	□120,000
Community worker	1	□120,000	□120,000
Field rangers	3	□120,000	□360,000
Research and monitoring	1	□150,000	□150,000
Fence patrols	8	□24,000	□192,000
Gate guards	8	□30,000	□240,000
Field workers	10	□24,000	□240,000
Game scouts	16	□30,000	□480,000
Training		□150,000	□150,000
Sub total	**50**		**□2,432,000**

The importance of training must be stressed for a reserve and an operational system that is likely to be very different from other reserves in China; where management

responsibility and the nature of the assets are very different. The staff structure may seem excessive and costly, but these reserves are more difficult to operate than forest reserves.

Maintenance

Maintenance of all the assets which were discussed in the development section will be required. This cost would include ongoing refurbishment of these assets so they remain in good working order. An estimate of this is detailed below; it is drawn mostly from the development section.

Maintenance	Distance	Amount (Yuan)
Roads	179	□1,827,000
Fence	77	□346,500
Buildings		□100,000
Equipment		□20,000
Sub total		**□2,293,500**

Vehicles and equipment

All the vehicles and equipment will need servicing and supplies; these are summarised in the table below.

Vehicles	Units	Cost per unit	Total (Yuan)
4X4	30,000	□1.50	□180,000
Motorbikes	24,000	□0.75	□54,000
Truck	20,000	□5.00	□100,000
Tractor	1,000	□100.00	□100,000
Other equipment		□20,000	□20,000
Sub total			**□454,000**

It is assumed that each vehicle will travel approximately 30 000km per year and the average cost per km is estimated at ¥1.50, this includes fuel, servicing, depreciation and spares, this is multiplied by the number of vehicles. The same principle is applied to motorbikes and the truck. The tractor is costed in hours of operation. Other equipment will require maintenance and an item has been allocated for this. The total operational budget once fully operational is estimated at approximately ¥454 000.

General overheads

Finally there are the general overhead costs of operating and administering a reserve of this nature, a list of these costs and an estimate of the annual amount required is presented below.

General overheads	Estimated annual cost (Yuan)
Office supplies	□50,000
Field supplies	□100,000

Fence clearing supplies	□150,000
Water and electricity	□100,000
Admin fees	□50,000
Communication	□100,000
Public relations and marketing	□250,000
Sub total	**□800,000**

The items include office supplies such as printing material and stationary; field supplies includes general tools, herbicides and uniforms other such as water and electricity are self explanatory; administrative fees may include bank charges, licences, permits etc; communication would include phones calls and other costs. Finally public relations and marketing is a small provision for entertainment and printing of literature on the reserve etc. The total annual provision is ¥800 000.

Timing of cash flows.

It is not expected that all the capital required will be spent in year one and equally the operational budget will develop over time as the developments are completed. A provisional cash flow schedule has been presented for the different items discussed in the report for the first five years of the project; these are presented below.

	Total	**2005**	**2006**	**2007**	**2008**	**2009**
Development						
Fence	□ 6,930,000	□ 4,851,000	□2,079,000			
Roads	□ 20,820,000	□ 4,164,000.00	□4,164,000	□ 4,164,000	□8,328,000	
Legal and admin	□ 750,000	□ 750,000				
Conservation Infrastructure	□ 1,780,000	□ 712,000	□712,000	□ 356,000		
Equipment	□ 2,480,000	□ 992,000	□992,000	□ 496,000		
Rehabilitation	□ 2,600,000	□ 520,000	□1,560,000	□ 520,000		
Social costs	□ 45,600,000	□ 5,600,000				
Game introduction	□1,635,000	¥ 981,000	□654,000			
TOTAL DEVELOPMENT	**□82,595,000**	**□ 58,570,000**	**□10,161,000**	**□ 5,536,000**	**□8,328,000**	
Annual operational						
Staff	□2,432,000	□1,216,000.00	□1,702,400	□ 2,432,000	□2,432,000	□2,432,000
Maintenance	□2,293,500	□0.00	□114,675	□ 229,350	□1,376,100	□2,293,500
Vehicles	□454,000	□227,000.00	□317,800	□ 454,000	□454,000	□454,000
General office costs	□800,000	□80,000.00	□240,000	□ 800,000	□800,000	□800,000
TOTAL OPERATIONAL	**□5,979,500**	**□1,523,000.00**	**□2,374,875**	**□3,915,350**	**□5,062,100**	**□5,979,500**

It is anticipated that the project will commence in 2005 and must be complete by 2008, when the tigers will be released in to the reserve. The development costs have been split accordingly and the operational budget increases as the developments and management needs increase. It is apparent that the reserve requires an operational budget of approximately ¥6,0 million to operate annually once operating at full capacity and a further ¥82,6 million in development costs.

The development costs and the initial operational costs will need to be covered by the province before the reserve is at a point where it may be in a position to generate some income.

Income

It would appear from the preliminary cost estimates that to cover the expenses of the reserve any tourism operation would need to pay rentals to the park in excess of ¥6 million per annum. Under this scenario, assuming the lodges start paying rental from 2009 and in this year it is 50% of their rental from then on, then the project yields an internal rate of return (IRR) of -5,53%. If this rental increases to ¥10,4 million then the project will return a slightly positive IRR, which implies the project is marginally efficient. This figure may not be possible and the possibility of retrieving the development costs may therefore be marginal; depending on what the investors are prepared to offer as rental and what risks they are prepared to accept.

To deliver a return worthy of attracting an investor, the IRR would need to be at least 10% (excluding inflation) or even significantly higher for a project with this level of risk. However as a state investment and with the biodiversity benefits, this may be a worthwhile investment. However as an investment to an investor, this project would not be an attractive option. If the state carries the risk on the conservation development aspects of the project it may then be attractive to investors in the tourism component. This scenario is not unique to China, most projects of this nature around the world; rarely return an IRR that is positive. Although analyses of this nature on protected areas have rarely been in the past it is becoming increasingly common.

Tourism development

The rental required of between ¥6 million and ¥8 million may indeed be possible for a product of this nature, where the game viewing areas in the agricultural lands are concentrated and sufficient habitat variability exists to ensure the tourism product is still of a good quality. The size of the area may also permit a few development sites scattered through the area. The road network does not need to be too extensive to still provide good coverage of the area.

Zhushuqiao[4]

Introduction

There are two alternatives for the Zhushuqiao site, the one is a smaller project area, measuring approximately 100km^2 while the second is a larger component of this measuring approximately 150km^2. The topography for both sites is very broken with many hills and steep valleys, this offers good habitat variation and according to Anderson *et al* (2004) the area is well suited to tigers and has high biodiversity conservation value. It is also bisected by a large reservoir which is about 35 km long

[4] Note that the general comments regarding stocking rates and general management of the area, which applied to Zixi, will apply to Zhushuqiao site as well.

and measures just over 1 000 hectares of open water. The banks of this reservoir are steep and offer relatively little transitional habitat between the water and adjacent forest or scrub forest. However the reservoir has many inlets where old agricultural lands or wetlands can be found, but although these are plentiful and offer excellent habitat variability they are often small and widely spaced.

The climate at this site is relatively mild with the average for January being 6.1 ^{o}C and for July it is a warm 27,8 ^{o}C, however the humidity is high during the summer.

The Province has supplied financial and other information for these two areas and this has been used in the summary and analysis below. Some of the costs are very different for those supplied for the Zixi site, these differences will be discussed in the site analyses later in this report. However the logic explained in the introductory section of this report regarding the game has been used for both areas and this will be used to determine the stocking rates, in spite of figures supplied by the provinces.

Tourism Market

Hunan province has a very good tourism market with over 57,6 million tourists visiting the province in 2002, this increased to 59,7 million in 2003 making it the 4th or 5th largest tourist destination in China. The largest proportion of the tourists are local. The area is an important business centre and Liuyang is a major producer of fireworks. It would appear that many of the visitors are coming to the area for business purposes but there are also several important cultural and natural areas in the province.

Other tourism support infrastructure in the region

There a many different areas within the province which offer sites of natural beauty and splendour, these include Wudaoshan, Daweishan nature reserve, Zhangjiejie, Huanglongdong, Boyuedong cave, Feitian Mountain and Langshan Mountain. There are also several cultural spots including Xiangxi scenic spot, the Yandi Emperor Temple of Zhuzhou, Yueyang Tower, Yuela school (an ancient school), the ancient town of FengHuang, Nanyue Grand Temple (Dao religion) and the Shundi Emperor Temple and many others. The city of Liuyang hosts the fireworks convention every year .

Service infrastructure to the area

The province has a well developed road infrastructure and access to the site from Liuyang city is excellent, with the western edge of the site only about 30km from the city of which 10km is on a tarred road with the remaining 20km a good gravel road. The airport at Changsha city is also very close to the site and access from this to the site is only about 1 and a half hours drive. The provinces road network link into the major highways of the region and connections with all the major towns and cities is not a problem. Similarly rail links also connect the area with major towns and cities.

Water, electricity and telecommunications are also good throughout the area. The cities and towns all provide banking and other services which tourist may require

while travelling in the region. Hospitals are also available in the large towns and cities. Police are located in all the centres.

Smaller site at Zhushuqiao

Game

The first project site at Zhushuqiao measures about 100km^2 and is situated just east of the city of Liuyang.

Carrying capacity

The approximate area for the different habitats in the project site together with the estimated carrying capacity of these habitats (in hectares per animal unit), the total projected number of animal units for each habitat and the conservative initial estimated stocking rate (i.e. 80% of the projected maximum number) are presented below.

Habitat	Area ha	Carrying capacity (ha/AU)	No of AU	80% of long term carrying capacity
Forest	7,113	50	142	114
Agricultural land	2,000	2	1,000	800
Scrub	230	2	115	92
Open water	567	0	-	-
Total area	**9,910**	**9.85**	**1,257**	**1,006**

The total number of animal units which could be carried on the project area is approximately 1 260, although if this is stocked at 80%, for a more conservative stocking approach, then the estimated carrying capacity is approximately 1 000 animal units. This gives an average stocking rate of about 10ha per animal unit.

Species

The average weights of the introduced game species, the estimate of their existing population numbers together with the likely number to be introduced, the expected annual growth rate for the different species, the estimated final target population number, the time to reach this population at the growth rate indicated and the total number of animal units is presented below.

Species	Mass (kg)	AU equivalent	Estimated existing numbers	Intro numbers	Initial population	Final No	Rate of growth	Total AU at target popn	Time to reach target (years)
Buffalo	800	1.54	0	60	60	120	15%	185	5.0
Samba deer	250	0.64	0	130	130	250	25%	161	2.9
Sika deer	86	0.29	0	120	120	250	25%	72	3.3
Muntjac	12.5	0.07	300	100	400	800	25%	54	3.1
Wild Boar	115	0.36	400	400	800	1,500	30%	539	2.4
Total								**1,011**	

It is assumed that 300 muntjac and 400 wild boar already occur naturally in the area and only a further 100 and 400 of each species respectively will need to be introduced initially. All populations except the buffalo should reach their desired target number within 3 to 4 years. The buffalo grow slower (reaching their target by year 5) but may not be killed as often by tiger, at least once they are familiar with tiger and their hunting habits.

A likely population growth table for the different species under the above growth rates and assuming the initial population as set above is presented below for the first 5 years of the project. Once the population has reached its target number the target number is returned in the model and hence for samba deer their numbers have reached their target in 2008 when the actual population will be 254 but thereafter this number is set at 250. The extra animals may be available for capture and removal (possible live sale) to other areas or even hunted for food or for trophies.

Species	2006	2007	2008	2009	2010	2011
Buffalo	69	79	91	105	121	120
Samba deer	163	203	254	250	250	250
Sika deer	150	188	234	293	250	250
Muntjac	500	625	781	977	800	800
Wild Boar	1,040	1,352	1,758	1,500	1,500	1,500

Costs

The province did supply an estimate of the initial game introduction numbers, however this has not been used but rather the model used in the introductory section of this report. This makes comparisons between the sites more appropriate as they are both based on similar points of departure. The game purchase costs supplied by the province have been used; this is apportioned between cost of the game and the capture and transport costs. These prices may be low for some of the species. An estimate of the game introduction is provided in the table below.

Species	Introduction numbers	Initial population	Purchase cost per animal (Yuan)	Capture and transport cost per animal (Yuan)	Total cost of introduction (Yuan)
Buffalo	60	60	□900	□300	□72,000
Samba deer	130	130	□50	□750	□104,000
Sika deer	120	120	□3,500	□500	□480,000
Muntjac	100	400	□0	□200	□20,000
Wild Boar	400	800	□0	□300	□120,000
Total					**□796,000**

The costs have been split to include a purchase price and a capture and relocation fee. For some game either or both of these costs may or may not apply. If the game are already in the area, then neither purchase or capture will be applicable. Some game may be sourced from other reserves for which no purchase cost will apply, only capture and transport. Except for buffalo, it is difficult to estimate these costs, so figures to capture similar animals in South Africa have been used, these may be totally inappropriate and these figures must therefore be used with caution.

Site development requirements

The area as it exists at the moment is not suitable for the establishment of a tiger reserve. Significant infrastructural development will be required to prepare the area for the re-introduction of tigers. Each of these items will now be described including the initial development component and the ongoing maintenance costs.

Fence

The province has provided estimates for both the length of fence required and the estimated cost of this fence for different areas. These are presented below:

Fence	Number of km	Cost/unit	Total development costs (Yuan)	% of total for maintenance	Annual maintenance
Forest	102.44	□220,000	□ 22,536,800	5%	□ 1,126,840
Lowlands	12.76	□200,000	□ 2,552,000	5%	□ 127,600
River crossing	0.8	□400,000	□ 320,000	5%	□ 16,000
Sub total			□ **25,408,800**		□ **1,270,440**

The fence will need to be patrolled and maintained, these two items have been costed separately and the annual maintenance cost is estimated to be about 5% of the initial value (i.e. a design life of 20 years). The maintenance costs are likely to escalate towards the end of the life of the fence but provision has been made for an annual maintenance component of 5% of the initial capital cost. This will also cover breaks in the fence caused by falling trees, river wash-aways and other damage. The fence represents a significant cost to the reserve and its annual maintenance is critical to the success of the project.

Roads

This particular site, although it has a relatively large proportion of old agricultural lands and scrub, **these are relatively small and widely dispersed**. Getting tourists between these areas will also be costly as a substantial road network will be required, which is further compounded because of the gradients within the area. There is little doubt that offering a reasonable game viewing experience will be more difficult at this site. The dam (reservoir) does offer a major alternative, but the suitable areas visible from the boat (flat and old agricultural lands) will be more limited than in a vehicle, provided there is a good road network. To offer a reasonable tiger and general game viewing experience a substantial road network will therefore be required. Through careful management and manipulation it may be possible to take tourists to areas

where game viewing is good, but roads will need to connect these areas and they will need to be relatively close to where the tourists are accommodated. Game drives in excess of 3 to 4 hours, especially if the time between sightings is large, will not hold the average tourists attention and the product may become hard to sell if these sentiments filter into the tourism market. There is only so much manipulation of habitat that can be done to improve the tourist product in these situations to not create a 'safari park' effect.

The area has an extremely limited road network with only one major road crossing the site from north to south. Substantial new roads will need to be built to overcome the shortcomings mentioned above. Road building in these mountainous areas is more costly both financially and environmentally and although tourists may be escorted in 4X4 vehicles, to reduce the maintenance costs and the environmental damage, sections of these roads may need substantial improvement through some hard surfacing which will add to the costs. As with Zixi it is assumed that tourist will be driven through the area in specially designed game drive vehicles for the same reasons as mentioned in the Zixi section.

The existing road network is limited to 19 km of road and 20 km of 4X4 vehicle tracks. Estimates have been supplied of additional roads that will be required and the estimated cost of these, these are presented below.

	Number km	Cost/unit (km)	Total development costs (Yuan)	% of total for maintenance	Annual maintenance
New roads					
Cement roads	20	420,000	8,400,000	5%	420,000
Good quality gravel	40	160,000	6,400,000	10%	640,000
4X4 tracks	75	30,000	2,250,000	10%	225,000
Sub total	**135**		**17,050,000**		**1,285,000**

The estimate when expressed on a number of hectares per kilometre of road is approximately 73. The ability to use boats and the river will no doubt add additional access and provide for alternative use of the area. However it may not be possible to get visitors from the boats and into vehicles to see game away from the water. The fragmented nature of the game viewing will make viewing still very difficult.

Roads are a critical component of this project, both for effective management and for tourism use of the area; this component must be properly maintained.

Management support

For management to undertake their work within the reserve support infrastructure will be required. This will include staff houses, office and workshops. It is realised that much of this already exists within the villages, however some refurbishment may be required. Entrance gates will be required to control access to create a visual sense for the tourist entering the area. Staff will require training as this type of reserve management is new for China and the staff will need to be trained in dealing with

issues of reserve management, especially working with prey and the tigers and other animals which may be released (Asian bear).

Signpost will need to be erected on major access roads so tourists can find the reserve and these may be required within the reserve as well.

A cost estimate of these items with their annual maintenance provision is presented in the table below.

Management support	Number	Cost/unit	Total development costs (Yuan)	% of total for maintenance	Annual maintenance
Entrance gates	3	666,667	2,000,000	5%	100,000
Staff accommodation	Refurb existing		300,000	2%	6,000
Training and staff development			450,000		
Sign posts		180,000	150,000	2%	3,000
Office, workshops etc	Refurb existing		400,000	2%	8,000
Sub total			**3,300,000**		**117,000**

It is apparent from the table that approximately ¥3,3 million will be required in initial costs for development of management infrastructure and capacity with an annual requirement of about ¥ 117 000.

Equipment

Similar figure to those use for Zixi have been used in this analysis. It was originally proposed that 20 vehicles and 14 boats would be required, (assuming most would be for tourism and these will be paid for by the tourism operator), but this figure has been reduced. The reserve will require basic equipment so that management can carry out their functions effectively. A list of the equipment is presented in the table below.

Equipment	Number	Cost/unit	Total development costs (Yuan)
4X4 Vehicles	4	250,000	1,000,000
Small truck	1	250,000	250,000
Motor boats patrol	4	130,000	520,000
Fire equipment		150,000	150,000
Tractor and trailer	1	250,000	250,000
Office & workshop equipment		400,000	400,000
Communication equip		150,000	150,000
Research and monitoring		180,000	180,000
Sub total			**2,900,000**

The list of equipment is self-explanatory. This is seen as the minimum, which would be required to carry out daily functions. Additional equipment may be required for example for road maintenance; if so this is catered for in the maintenance section for those items. Fire equipment will be required on site at all times and would include a

water trailer with hoses and a pressure pump, other small items like fire beaters would also be included. The office will require desks, furniture, computers, printers, fax machines etc and these are included in this item along with basic tools and machines for the workshop.

Radios and telephone equipment will be required to communicate with outlying stations and with foot patrols. Finally a provision has been made for research equipment that may include tracking collars for some of the game, receiver's, computers and other monitoring equipment. The total equipment budget is estimated to cost approximately ¥3.68 million. The maintenance component is dealt with separately under the annual operating budget.

Rehabilitation

The costs to undertake basic rehabilitation of existing infrastructure and the agricultural lands are set out below.

Rehabilitation	Number (ha)	Cost/unit	Total development costs (Yuan)
Infrastructure	40	7,500	300,000
Natural resources	2000	500	1,000,000
Holding pens		100,000	100,000
Sub Total			**1,400,000**

The costs are self explanatory, their maintenance, if applicable, is provided for in the operational budget.

Resettlement

The many families living in the area will need to be relocated and compensated for dwellings and other infrastructure they may have to leave behind. In addition they will need to be compensated for agricultural and forest land for which they will no longer have access to. Estimates of the costs for this are presented below.

Social	Number	Cost/unit	Total development costs (Yuan)
No of people	4,123		
No of households	106		
Relocation costs	106	60,000	6,360,000
Compensation for houses		15,000	1,590,000
Compensation for crops		52.50	5,565
Sub total			**7,950,000**

Summary of development

The items described and discussed above will need to be implemented in order to get the reserve operational a summary of these expenses are presented in the table below.

	Total
Development	
Fence	□ 25,408,800
Roads	□ 17,050,000
Legal and admin	□ 450,000
Conservation Infrastructure	□ 3,300,000
Equipment	□ 2,900,000
Rehabilitation	□ 1,400,000
Social costs	□ 7,950,000
Game introduction	□ 796,000
TOTAL DEVELOPMENT	**□59,254,800**

Operational costs

The reserve, in addition to the development costs, will require an ongoing maintenance budget. Although a portion of this is directly linked to the assets that have been developed in the above section, there are additional fixed and other costs.

Staff

The first and possibly the largest cost component will be the employment of staff to manage the reserve. A staff compliment including the number and type, their expected annual package and the total amount is presented below.

Staff	**No**	**Total salary package annual (Yuan)**	**Total salary (Yuan)**
Reserve manager	1	□200,000	□200,000
Deputy manager	1	□180,000	□180,000
Technical manager	1	□120,000	□120,000
Community worker	1	□120,000	□120,000
Field rangers	2	□120,000	□240,000
Research and monitoring	1	□150,000	□150,000
Fence patrols	6	□24,000	□144,000
Gate guards	7	□30,000	□210,000
Field workers	8	□24,000	□192,000
Game scouts	12	□30,000	□360,000
Training			□150,000
Sub total	**40**		**□2,066,000**

The annual costs will increase to this maximum as the reserve grows and develops over the first 4 to 5 years.

Maintenance

Maintenance of all assets, which were discussed in the development section, will be required. This would include ongoing refurbishment of these assets so they remain in good working order. An estimate of this is detailed below; it is drawn mostly from the development section.

Maintenance	Total distance km	Total annual cost (Yuan)
Roads	135	□1,478,000
Fence	102.44	□1,270,440
Buildings		□100,000
Equipment		□20,000
Sub total		**□2,868,440**

Vehicles and equipment

All the vehicles and equipment will need servicing and supplies, these are summarised in the table below.

Vehicles	Total units	Cost per unit	Total cost
4X4	30,000	□1.00	□120,000
Motor boats	24,000	□1.00	□96,000
Truck	20,000	□5.00	□100,000
Tractor	1,000	□100.00	□100,000
Other equipment			□20,000
Sub total			**□436,000**

It is assumed that each vehicle will travel approximately 30 000km per year and the average cost per km is estimated at ¥1.00, this includes fuel, servicing, depreciation and spares, this is multiplied by the number of vehicles. The same principle is applied to motorboats and the truck. The tractor is costed in hours of operation. Other equipment will require maintenance and an item has been allocated for this. The total operational budget once fully operational is estimated at approximately ¥580 000.

General overheads

Finally there are the general overheads costs of operating and administering a reserve of this nature, a list of these costs and an estimate of the annual amount required is presented below.

General overheads	Total per annum (Yuan)
Office supplies	□50,000
Field supplies	□80,000
Fence clearing supplies	□150,000
Water and electricity	□80,000
Admin fees	□40,000
Communication	□80,000

Public relations and marketing	□250,000
Sub total	**□730,000**

The items include office supplies such as printing material, stationary; field supplies includes general tools, herbicides; uniforms, water and electricity, administrative fees may include bank charges, licences, permits etc; communication would include phones calls and other costs. Finally public relations and marketing is a small provision for entertainment and printing of literature on the reserve etc. The total annual provision is ¥730 000.

Timing of cash flows.

It is not expected that all the capital required will be spent in year one and equally the operational budget will develop over time as the developments are completed. A provisional cash flow schedule has been presented for the different items discussed in the report for the first five years of the project; these are presented below.

	Total	**2005**	**2006**	**2007**	**2008**	**2009**
Development						
Fence	□ 25,408,800	□ 17,786,160	□7,622,640			
Roads	□ 17,050,000	□3,410,000.00	□3,410,000	□ 3,410,000	□6,820,000	
Legal and admin	□ 450,000	□ 450,000				
Conservation Infrastructure	□ 3,300,000	□1,320,000	□1,320,000	□ 660,000		
Equipment	□ 2,900,000	□1,160,000	□1,160,000	□ 580,000		
Rehabilitation	□ 1,400,000	□280,000	□840,000	□ 280,000		
Social costs	□ 7,950,000	□ 7,950,000				
Game introduction	□796,000	477600	□318,400			
TOTAL DEVELOPMENT	**□59,254,800**	**□ 32,833,760**	**□14,671,040**	**□ 4,930,000**	**□6,820,000**	
Annual operational						
Staff	□2,066,000	□1,033,000.00	□1,446,200	□ 2,066,000	□2,066,000	□2,066,000
Maintenance	□2,868,440		□143,422	□ 286,844	□1,721,064	□2,868,440
Vehicles	□436,000	□218,000.00	□305,200	□ 436,000	□436,000	□436,000
General office costs	□730,000	□73,000.00	□219,000	□ 730,000	□730,000	□730,000
TOTAL OPERATIONAL	**□6,100,440**	**□1,324,000.00**	**□2,113,822**	**□3,518,844**	**□4,953,064**	**□6,100,440**

It is anticipated that the project will commence in 2005 and must be completed by 2008, when the tigers will be released in to the reserve. The development costs have been split accordingly and the operational budget increases as the developments and management needs increase. It is apparent that the reserve requires an operational budget of approximately ¥6.2 million to operate annually once operating at full capacity and approximately Timing of cash flows.

It is not expected that all the capital required will be spent in year one and equally the operational budget will develop over time as the developments are completed. A provisional cash flow schedule has been presented for the different items discussed in the report for the first five years of the project; these are presented below.

¥60 million in development costs.

The development costs and the initial operational costs will need to be covered by the province before the reserve is at a point where it may be in a position to generate some income.

Tourism development

The tourism development opportunities may be slightly more limited than those at Zixi. Depending on where the development sites are located there may be additional infra-structural costs. There does not appear to be a good development 'node' which offers good access to good potential game viewing areas and that is well supplied with water, electricity, roads and telecommunications. These issues will need to be considered when approaching investors, as they will need to be offered different sites to develop and these are issues they would consider in their decisions. The costs of these services can add extra development limitations to a project and can, if the project is marginal, affect the viability of the operation.

Income

It would appear from the preliminary cost estimates that to cover the expenses of the reserve any tourism operation would need to pay rentals to the park of about ¥6,1 million per annum once the reserve and the tourism facilities are operational just to cover the annual operating costs. Under this cost structure, assuming the lodges start paying a rental from 2009 and in 2009 the rental is only 50% of maximum projected rental and thereafter they pay the full rental of ¥6,1 million then the project yields an internal rate of return (IRR) of just -2,25%. To get the IRR to be positive (for the project to be marginally efficient) the rental by 2010 must be at least ¥7,9 million.

These projections may only be possible if a suitable site/s can be found with good development potential. These will have to be in close proximity to potential good game viewing areas. If these issues cannot be addressed it may be difficult to attract investors to the site/s.

Larger site at Zhushuqiao

All the principles at the smaller site for Zhushuqiao will mostly apply at this site, the only issues which will be discussed in detail will be those issues which are different from the smaller site.

Game carrying capacity

The larger site includes a larger area and hence more game can to be stocked. A breakdown of the different habitat types, the respective areas of these and the carrying capacity expressed in animal units (AU) of these areas is presented in the table below.

Habitat	Area (ha)	Carrying capacity (ha/AU)	No of AU	80% of carrying capacity (AU)
Forest	11,128	50	223	178
Agricultural land	3,000	2	1,500	1,200
Scrub	305	2	153	122
Open water	567	0	-	-
Total area	**15,000**	**10.00**	**1,875**	**1,500**

This area is about 5 000ha larger than the smaller site; as would be expected this has resulted in a significantly higher carrying capacity of 1 500 animal when stocked at 80% of the estimated long term carrying capacity for the area. The general carrying capacity is much the same.

The species, which may be stocked, will remain the same but the number will now increase. The stocking proportions and game numbers for this area are presented below. The table includes the species, their metabolic mass (in kg), the animal unit equivalent, the estimated existing numbers, the proposed introduced number, the estimated target population, the rate of increase of the species, the total number of animal units when stocked at the target population and the estimated time to reach their target population (years), starting with the initial numbers and increasing at their projected rate of increase.

Species	Mass (kg)	AU equivalent	Estimated existing numbers	Intro numbers	Initial population after intro and existing	Final or target No of animals	Rate of growth	Total AU at target popn	Time to reach target (years)
Buffalo	800	1.54	0	75	75	150	15%	231	5.0
Samba deer	250	0.64	0	225	225	450	25%	290	3.1
Sika deer	86	0.29	0	200	200	400	25%	116	3.1
Muntjac	12.5	0.07	400	100	500	1,000	25%	68	3.1
Wild Boar	115	0.36	500	600	1100	2,200	30%	791	2.6
Total								**1,495**	

The corresponding increase in size has allowed for a corresponding increase in the number of animals. The larger area and increased number of animals may allow for more tigers to use the area.

The projected growth of the game populations over the time starting with their first year after the introduction (2006) is presented below.

Species	2006	2007	2008	2009	2010	2011
Buffalo	86	99	114	131	151	150
Samba deer	281	352	439	549	450	450
Sika deer	250	313	391	488	400	400
Muntjac	625	781	977	1,221	1,000	1,000
Wild Boar	1,430	1,859	2,417	2,200	2,200	2,200

The estimated cost of the game introduction is tabled below.

Species	Intro numbers	Initial population	Purchase cost per animal (Yuan)	Capture cost per animal (Yuan)	Total cost of introduction (Yuan)
Buffalo	75	75	□900	□300	□90,000
Samba deer	225	225	□50	□750	□180,000
Sika deer	200	200	□3,500	□500	□800,000
Muntjac	100	500	□0	□200	□20,000
Wild Boar	600	1100	□0	□300	□180,000
Total					**□1,270,000**

The numbers are self-explanatory; for species with no purchase cost implies they will be sourced from a reserve and captured in the wild.

Fence

The larger area will mean a longer fence and this add to the initial development costs as well as the annual maintenance cost. The length of the fence in different habitat types and the costs of fencing in the different habitats are presented below with the expected annual maintenance cost.

Fence	Number of km	Cost/unit (km)	Total development costs (Yuan)	% of total for maintenance	Annual maintenance
Forest	185	□220,000	□ 40,700,000	5%	□ 2,035,000
Lowlands	22.5	□200,000	□ 4,500,000		
River crossing	0.8	□400,000	□ 320,000		
Sub total	**208.3**		**□ 45,520,000**		**□ 2,035,000**

Other costs

There are some additional roads planned for the larger area, these are presented below.

New roads	Number (km)	Cost/unit (km)	Total development costs (Yuan)	% of total for maintenance	Annual maintenance
Existing roads	39		¥ 1,930,000	10%	¥ 193,000
Cement roads	25	□420,000	□ 10,500,000	5%	□ 525,000
Good quality gravel	50	□160,000	□ 8,000,000	10%	□ 800,000
4X4 tracks	75	□30,000	□ 2,250,000	10%	□ 225,000
TOTAL ROADS	**189**		**□ 20,750,000**		**□ 1,743,000**

There is an additional 15 km of road in the new area and this has added a cost of about ¥3,6 million and added an additional ¥265 000 to the annual maintenance cost.

The staff compliment will need to be increased slightly as the area will be larger and more patrols will be required, other costs may increase slightly as well.

Resettlement costs

The resettlement costs are significantly higher for the additional 50km^2 as there are significantly more families living in the area. The estimated cost of the resettlement is presented below.

Social	Number	Amount per unit (Yuan)	Total estimated cost (Yuan)
No of people	4,123		
No of households	964		
Relocation costs	964	□60,000	□ 57,840,000
Compensation for houses		□15,000	□ 14,460,000
Compensation for crops		□52.50	
Sub total			□ **72,300,000**

The ¥72,3 million represents a large cost and is almost ten times higher than the costs for the smaller site, while the area is only 50% more. This is a significant drawback for this site.

Summary of development and operational costs

A summary of the development and operational costs are presented below.

	Total	2005	2006	2007	2008	2009
Development						
Fence	□ 45,520,000	□ 31,864,000	□13,656,000			
Roads	□ 20,750,000	□4,150,000.00	□4,150,000	□ 4,150,000	□8,300,000	
Legal and admin	□ 550,000	□ 550,000				
Conservation Infrastructure	□ 6,000,000	□2,400,000	□2,400,000	□ 1,200,000		
Equipment	□ 3,280,000	□1,312,000	□1,312,000	□ 656,000		
Rehabilitation	□ 2,050,000	□410,000	□1,230,000	□ 410,000		
Social costs	□ 72,300,000	□ 72,300,000				
Game introduction	□1,270,000	762000	□508,000			
TOTAL DEVELOPMENT	□ **151,720,000**	□ **113,748,000**	□**23,256,000**	□ **6,416,000**	□**8,300,000**	
Annual operational						
Staff	□2,192,000	□1,096,000.00	□1,534,400	□ 2,192,000	□2,192,000	□2,192,000
Maintenance	□3,898,000		□194,900	□ 389,800	□2,338,800	□3,898,000
Vehicles	□580,000	□290,000.00	□406,000	□ 580,000	□580,000	□580,000
General office costs	□730,000	□73,000.00	□219,000	□ 730,000	□730,000	□730,000
TOTAL OPERATIONAL	□**7,400,000**	□**1,459,000.00**	□**2,354,300**	□**3,891,800**	□**5,840,800**	□**7,400,000**

The development costs for the additional area are almost ¥92 million more and this translates into a further ¥1,3 million more per year in operational costs. This is a significant increase (more than 2 and a half times more) and although more land is added (only 50%) and it will provide more habitat and a larger prey base, it is costing a significantly extra amount. The largest proportion of this cost is from resettlement,

while the fence also adds significantly. The additional 15 km of road are also not likely to add significantly to the tourism potential, as using the previous calculation of 0.3 kilometres per vehicle, this would add approximately 70 guests, assuming the habitat was suitable. It seems unlikely that 70 additional guests could justify the extra ¥92 million in development costs and the disruption which will be caused to the families and livelihoods with the commensurate ¥1,3 million in development costs.

Summary of the project areas

The two project area (with one having a further two choices) share many common attributes and there is very little to distinguish between them. The Anderson *et al* (2004) report has ranked the Zixi area slightly higher from an ecological perspective and hence their findings showed this reserve to be the better of all the options they surveyed.

From an economic perspective it is slightly more difficult to assess, as the costs of undertaking a venture of this nature in China, are simply not known as it has never been done before. The cost estimates are therefore based on the most likely items and quantities that could be expected. These have in most instances been obtained from the provinces or counties, but in some instances have merely been estimated from what may be involved in the process. From this perspective the costs and especially any income projections need to be revisited in more detail before the provinces embark on a development of this nature.

Resettlement issues

The issue of moving people away from their homes and livelihoods is extremely difficult to value. For many people this may not even be an option, no matter what compensation is offered. The costs of relocation are therefore stated in rather unsympathetic financial terms and the true costs to society, individuals and families will certainly in most instances be higher, but an exercise of this nature cannot even attempt to value this. The moving of people from the area will pose the largest single economic cost and this report has in no way attempted to capture this and this must surely be seen as a shortcoming of this evaluation.

Both areas contain many families whose lives are surely closely associated with the areas under consideration. There has been a drift by many away from these rural areas in search of a new life in urban areas, but many remain to pursue a rich and rewarding life. This project will disrupt their lives and impact on their livelihoods. To simply state this as a financial cost would be both insensitive and insulting; a solution to this perhaps needs to be found amongst community leaders and the cost portrayed in this report must be viewed in this context.

Summary of development costs per site

The major costs for the sites have been summarized and to make comparisons possible, most of these costs have also been presented as a cost per unit area (in this instance a hectare). These are presented below.

	Zixi	Hunan small	Hunan large
Area (ha)	17,998	9,910	15,000
Carrying capacity (ha/AU)	**12.01**	**9.85**	**10.00**
Roads			
Cement	20	20	25
Other	59	59	69
4X4	100	95	95
Total	179	174	189
Hectares/km of road	**101**	**57**	**79**
Cost of game	□1,635,000	□796,000	□1,270,000
Game cost/ha	□90.84	□80.32	□84.67
Potential no of breeding tigers	**5**	**3**	**4**
Resettlement			
No of families	608	106	964
Cost of resettlement	□45,600,000	□7,950,000	□72,300,000
Resettlement cost/ha	**□2,534**	**□802**	**□4,820**
Total development cost	□82,595,000	□59,254,800	□151,720,000
Development cost/ha	**□4,589**	**□5,979**	**□10,115**
Annual management cost	□5,979,500	□6,100,440	□7,400,000
Management costs/ha	**□332**	**□616**	**□493**

The Zixi site is the largest at 180km^2 with the smaller Zhushuqiao site only measuring just under 100km^2. The small site at Zhushuqiao has the highest herbivore carrying capacity at just under 10ha per animal unit, while the Zixi site has the lowest at 12ha/AU. The smaller site at Zhushuqiao has the highest density of roads at 57 hectares per kilometre of road, this increases to 79 ha/km for the large Zhushuqiao site and finally to 101 ha/km for the Zixi site. The Zixi site also has a more expensive game introduction per hectare, at least from the process used for the costing, however the price differences are not that large and the difference is not that significant.

The larger area means that Zixi could carry more breeding tigers. If a figure of 36km^2 per tiger is used to estimate their carting capacity, then the small site at Zhushuqiao can only accommodate possibly 2 females and one male, this is a good breeding group but a marginal population size. Perhaps the largest and most important item is the cost of the resettlement. The small Zhushuqiao site affects the fewest families and as a result has the lowest financial and probably social cost at just over ¥800 per hectare, this increases to ¥2,534 for Zixi and ¥4,820 for the larger Zhushuqiao site. The same costs of resettlement have been used for all sites; this may not represent the actual cost, but is does make the figures comparable.

The final figure is the total development cost. This must be seen in perspective as there are a few issues that significantly distort this figure. Firstly the cost of the fence, the figures supplied by the counties have indicated that the Zixi fence is only 77km long while for the large site at Zhushuqiao the perimeter is 208 km for a smaller area! The cost of the fence construction also varies between the sites, the cost per km at Zixi is estimated at ¥90 000 while at the Zhushuqiao site this is nearly ¥220 000! It

would seem logical that the cost of the fence at Zixi and the Zhushuqiao site should be similar, with the Zhushuqiao site being slightly higher due to the more mountainous nature of the area. The development costs may therefore be overstated at Zhushuqiao and/or perhaps understated for Zixi, this would have cost implications for the annual maintenance cost. If in fact the fence costs are made more comparable, then the development cost per hectare at the large Zhushuqiao site falls to ¥7,542 per hectare, while the maintenance cost falls to ¥381 per hectare per annum. For the small site the development cost falls to about ¥3870 per hectare and the maintenance drops to ¥510 per hectare.

The road building costs at Zixi and the large Zhushuqiao site are similar, however the Zixi site has a good existing road network and the number of kilometres of road required may need to be considerably less because of the potentially good game viewing. This fact may therefore distort the actual cost per potential benefit gained. This issue has been explained extensively in this report.

Site comparisons

The relative advantages of each site will now be discussed. The dis/advantages listed below are in addition to those raised in the Anderson *et al* (2004) report.

Advantages of Zixi

Notwithstanding the above, financially, the small site at Zhushuqiao would appear to be the more viable option as it will be less costly to establish and manage. However it is unclear if this will provide the income to fund the development and management costs of this. Although this may not also be the case at Zixi, it is seen as being significantly more likely. The single most important consideration for this is the fact that the likelihood of seeing tigers and seeing their prey, is probably more likely given the terrain and vegetation of some areas within the Zixi area. **This is ultimately one of the cornerstones of this project and must not be underestimated.**

The general tourism product is likely to be better and easier to access than the Zhushuqiao site. This may make the investment opportunity more attractive to an investor. The topography and level of services will also make development easier and probably less costly. These factors may increase the likelihood of attracting investment while simultaneously attracting a higher rental for a better product. The higher game densities on the more concentrated agricultural lands and better viewing may also increase the job creation potential and thereby contribute to mitigating the social disruption caused by the establishment of the reserve.

The Zixi area is building a wide range of nature based tourism products and this will contribute to this ‘brand’ and hopefully help the area build the product further.

This is a new product and it is important that a site is selected with the best chance of succeeding, Zixi clearly offers this.

The Zixi site may accommodate more tigers and importantly from the Anderson *et al* (2004) report, it has expansion potential.

Advantages of the Zhushuqiao sites

The Zhushuqiao sites are located closer to a large city and the airport at Changsha city. This will no doubt improve the marketability of the area.

The large reservoir offers an exciting and alternative recreation activity, to game drives on vehicles. It may in some way off-set the negative aspects of the high road costs and possibly poor game viewing.

The smaller Zhushuqiao site has very low resettlement costs as the number of people affected is relatively small.

The area has good habitat diversity and this has provided a good carrying capacity, however these patches are widely distributed.

Disadvantages of Zixi

The area is slightly more remote and the tourism products in the area are still new and developing. Although there is an emerging tourism destination, the large number of facilities which will be coming operational soon may compete with each other and result in all being marginal. It seems the tourism demand is high but this could be a reality. This may affect the viability of tourism operations in the reserve. It could be mitigated through monitoring and marketing if necessary.

There are many families which will be affected by the establishment of the reserve and this must surely not only be a financial cost but also a significant social cost.

Disadvantages of Zhushuqiao

Perhaps the greatest disadvantage is the type and distribution of the productive areas for game. The topography which separates these areas will make game viewing and tiger sighting more difficult and probably more expensive to achieve. This will undoubtedly impact on the overall financial viability of the project on a similar scale to Zixi. It may accommodate a different product, but this may not offer the same tourism use and scale of investment.

The large site at Zhushuqiao has the highest number of people resident in the area. This has added a significant cost burden as well as being a large social disruption for all the families affected.

The nature of the topography implies that many roads will be required and the costs of development and maintenance will be high. The cost of providing services to development sites may increase the development cost.

Potentially low tiger sighting possibility, especially for the smaller site where tiger numbers will be low.

Recommendation

The large site at Zhushuqiao does not seem to be a good option. The resettlement costs and the extra benefits gained for the extra costs incurred in extending the smaller Zhushuqiao site do not seem to be financially justified. Equally the income generation from the larger site may not significantly add to the product; it may in fact only increase the risk. From this perspective the smaller Zhushuqiao site is a better option, although it may hold fewer tigers. The terrain and the reservoir may allow for a higher tiger density as it may 'split territories, especially if the game densities are high, but this is merely speculation.

Although the Zixi site may be more costly to develop '(than the smaller Zhushuqiao site) it seems to have the best potential for providing the type of product that tourists may require. However in designing these products there are no 'definites'. It is mere speculation that this is where the tigers will be and tourist will see them - we simply do not know how the tigers will behave and if they will frequent the open areas. Either the Zixi or the smaller Zhushuqiao site may be equally good and will certainly provide different products, both for tourism and for tigers.

Perhaps the greatest challenge will be to find the funds to develop the sites to accommodate the tigers and to find investors willing to risk investing in building a tourism product and offering the rental required to operate these reserves.

Challenges for both sites

Each site has its financial advantages, and each may develop a different product, however before this can be achieved the project will need funds to establish the areas as set out in this and the Anderson *et al* (2004) reports. To this end the county and/or provinces will have to undertake the following:

- Finalise the planning of the reserves - this will include developing a management plan, detailed business plan and a development plan for the next 5 to 10 years. This must identify the actions required, the funding for these, including the amount and the source and demonstrate how the institutional capacity will be built and developed.
- Funds will have to be found to address the issues identified in this plan, or other issues which may be identified in future planning. Importantly they will need to find a partner or partners from the private sector who will be willing to invest to the level indicated, build and develop a tourism product and brand and be prepared to pay the rentals required to operate the area in a financially sustainable way.
- The role of the private investors will need to be defined and the processes and parameters in which they may operate will need to be developed and communicated to them. This will need to be balanced against the social, ecological and financial requirements of the project.
- The social issues relating to the people living in the area will have to be addressed and the area prepared for the establishment of a reserve before 2005.

This may include the re-training of the people in conservation and tourism enterprises.

- The planning for the reserve must be completed before 2005 and the fencing must commence in the same year. Animal introductions must commence at least by 2006 so that their populations are sufficient to provide food for the tigers and still be able to maintain viable populations of each species.
- Institutional capacity must be developed to operate and manage the reserve as a viable business entity, but based on sound ecological principles. This will require proper staff training and development. The skills required for this are very different from the operation of a conventional forest or nature reserve.

The ultimate test will be for the counties to demonstrate their ability to establish the areas and prepare them for the introduction of the Chinese tiger and show their ability to manage them. These will be the areas to receive the first tigers to be released into the wild in China. If both sites can deliver the reserves as set out in this report, then both may qualify for the program.

Summary of Requirements - The Two Candidate Sites

Zixi

1. Development of a detailed management and business plan.
2. Development of a strategy to ensure that all tourism destinations in the area are effectively marketed, and integrated, to avoid negative competition.
3. Sourcing of adequate funds for the project.
4. Ensure there is provision for an adequate operational budget to carry out the required ongoing management tasks in the operational phases of the project.
5. Development of relevant capacity to manage the reserve.
6. Relocation of families within allocated site.
7. Removal/demolition of certain buildings/constructions.
8. Fencing the reserve with tiger proof fencing.
9. Establishment of adequate prey populations.
10. Construction of management and game viewing roads.
11. Commitment from developers that they will be able to afford the rental fees which are required until at least the operational phase, and possibly also operating costs of the area.
12. Lodge/hotel development

Zhushuqiao

1. Development of a detailed management and business plan.
2. Development of a strategy to ensure that all tourism destinations in the area are effectively marketed, and integrated, to avoid negative competition.
3. Sourcing of adequate funds for the project.
4. Ensure there is provision for an adequate operational budget to carry out the required ongoing management tasks in the operational phases of the project.
5. Development of relevant capacity to manage the reserve.
6. Relocation of families within allocated site.
7. Removal/demolition of certain buildings/constructions.
8. Fencing the reserve with tiger proof fencing.
9. Effective tiger proofing of the waterway.
10. Establishment of adequate prey populations.
11. Construction of management and game viewing roads.
12. Lodge/hotel development.
13. Cost-effective and environmentally acceptable strategies for improving game viewing opportunities because of the topography and vegetation.
14. Commitment from developers that they will be able to afford the rental fees which are required until at least the operational phase, and possibly also operating costs of the area.

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