Conceptual framework for economic evaluation of Globally Important Agricultural Heritage Systems (GIAHS):

The case of Rice Fish Culture in China

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GIAHS
Globally Important Agricultural Heritage Systems

Abstract

The Globally Important Agricultural Heritage System (GIAHS) initiative was launched by the Food and Agriculture Organization (FAO) of the United Nations in 2002 with the aim of establishing the basis for the global recognition, dynamic conservation and adaptive management of outstanding traditional agricultural systems and their associated landscapes, biodiversity, knowledge systems and cultures.

There is anecdotal evidence that designated GIAHS are economically better than non-GIAHS sites. However, there have not been done an economic analyses to prove this. Nor are any sophisticated economic performance criteria for GIAHS in place for a continuously monitoring of the functioning. Therefore, the main objective of this study is to conduct an economic valuation for a GIAHS system versus a similar non designated GIAHS system. For this, a Cost-Benefit Analysis (CBA) is chosen. The major constraint is the data availability. Therefore, a framework for economic analysis shall be developed with the intention to provide directions, assumptions, and data requirement to carry out an economic analysis and so give guidance on future inclusion of economic valuations of GIAHS. The conceptual framework for economic assessment will use the Rice Fish pilot site in China as a case study. The example calculations on the rice fish culture (RFC) have to be taken cautiously due to data availability on different activities (tourism, marketed products on local and international markets) as well as comparison to similar systems.

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Table of Contents

List of Tables

List of Figures

Abbreviations

CNACH	Center for Natural and Cultural Heritage
CBA	Cost-Benefit Analysis
FAO	United Nation Food and Agriculture Organization
GIAHS	Globally Important Agricultural Heritage System
IGSNRR	Institute of Geographic Sciences and Natural Resources Research
IRR	Internal Rate of Return
NPV	Net Present Value
RFC	Rice Fish Culture
TEV	Total Economic Value

1. Introduction

The Globally Important Agricultural Heritage System (GIAHS) initiative was launched by the Food and Agriculture Organization (FAO) of the United Nations in 2002 with the aim of establishing the basis for the global recognition, dynamic conservation and adaptive management of outstanding traditional agricultural systems and their associated landscapes, biodiversity, knowledge systems and cultures. These systems, defined as *"unique, remarkable traditional agricultural practices and evolving systems that demonstrate multiple goods and services to humanity and the environment"*, and providing livelihood security for million of poor and small farmers (FAO, n.d.).

GIAHS are resilient systems, traditionally-based family-scale agro-systems and their associated high-value ecosystems are sustainable. Nevertheless, these traditional agricultural systems have to compete with commercial and extensive systems as well as vanishing knowledge of the systems by the youth. The initiative is recognizing this and aiming through de-constructing the traditional knowledge and skills base so as to identify elements suitable to strengthening, thereby yielding transferable best practices which is specifically destined for promotion in related systems outside the GIAHS network. In this way, the GIAHS project approach is based on a principle of spreading economic and social gain.

The GIAHS concept can be seen as supporting stronger ecosystems services, including biodiversity in a way that is both more sustainable and potentially richer and more resilient than parallel agricultural systems that do not meet the concepts and characteristics of GIAHS. The overall project goal is to identify and safeguard GIAHS, through mobilizing global recognition and support for such systems and enhancing global, national and local benefits derived through their dynamic conservation, sustainable management and enhanced viability. Therefore, it is a great challenge to establish an enabling environment conducive to establishing a dialogue between local communities, national actors and global stakeholders finding a balance between conservation, adaptation and socio-economic development. Because one important aspect to recognize is that without a common understanding of the systems, but also clear benefits for the local communities, there will be no motivation for a successful sustainable dynamic conservation of GIAHS.

1.1 Problem Statement

There is anecdotal evidence that the designated GIAHS are economically more attractive than non-GIAHS systems. But there has not been done a lot of economic analysis to prove this. Nor are any sophisticated economic performance criteria for GIAHS in place for a continuously monitoring of the functioning.

In order to make the initiative sustainable and demonstrate the impact of GIAHS, it is a valuable tool to compare economic success with and without GIAHS designation. Moreover, there is a need for a refined methods for economic valuation of GIAHS. The economic valuation should serve as a tool for communication with decision makers and incentive for local communities.

1.2 Objectives

Given the amount of time and data availability, it is not possible to do a complete economic assessment for a specific GIAHS sites, including all costs and benefits and then comparing it with a similar non designated traditional system. For this, data collection in the field would be necessary, as not enough quantitative data is available.

Thus, the idea of an economic analysis for GIAHS shall not be completely abandoned. Therefore, a framework for economic analysis shall be developed with the intention to provide directions, assumptions, and data requirement to carry out an economic analysis and so give guidance on future inclusion of economic valuations of GIAHS. The conceptual framework will use one of the GIAHS pilot sites as underlying example. Where applicable and depending on the data availability, the theory will be underlined with calculations and numbers. The framework will give an overview but raises no claim of being complete and exhaustive.

The main task will be to do an economic evaluation for a GIAHS system versus a similar non designated GIAHS system and so to have a horizontal comparison between project and no-project. For this, the application of a Cost-Benefit Analysis (CBA) has been chosen. The following general questions are sub questions to this main research question and will be milestones along the framework development:

- Which costs and benefits have to be taken into consideration? (on-site and off-site, direct and indirect effects, ecological benefits)
- What are the data requirements? How to collect this data?
- How to analyze the data? Which economic tools can be used?
- What are useful valuation approaches to place a monetary value on non marketed ecosystem services?
- What are appropriate discount rates and time horizons to be used in the Cost-Benefit Analysis
- How to incorporate economic considerations in all GIAHS to assess the benefits of local communities?

2. Research Design

As explained, the framework will be underlined with one GIAHS pilot system. Out of three pre-selected ingenious GIAHS pilot sites (Shimbue Juu Kihamba Agroforestry Heritage Site,

Tanzania, Rice fish agriculture, China and Chiloe Agriculture, Andean Agriculture, Peru), the rice-fish culture (RFC) in China was chosen. The decision was made due to the availability of promising studies and research work done by the Institute of Geographic Sciences and Natural Resources Research (IGSNRR) in China. Moreover, the availability and willingness of the national focal point institution in China, to provide information on the available data, share the data and studies, had supported the study.

2.1 Data Collection

General literature was used to support the development of the framework. Data for reference or base for further calculations was received from IGSNRR and the local government of Qingtian County. The local government provided data on the agricultural production system of RFC and mono rice, from 2005-2012 in Qingtian County. No data on ecosystem services from local government. The IGSNNR undertook a field research in the Qingtian County in 2006, assessing the RFC and rice mono system including ecosystem services. The field research was conducted in Longxian and Shaoshan villages. For this report no primary data was collected and only secondary data used.

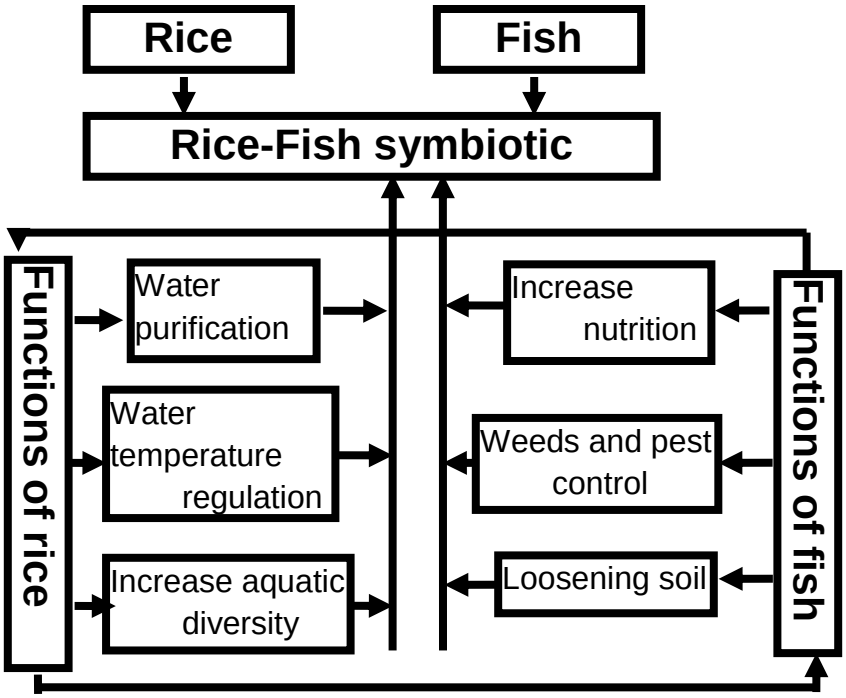
2.2 Case Study: Rice Fish Culture China

Within one of the original five pilot systems selected for the GIAHS initiative, is the RFC in China. RFC has a long tradition in China and historical records, in the selected site of Longxian village, in Qingtian County, Zhejiang Province, cover more than 1000 years. Longxian village covers around 461 ha, including 60 ha of traditional RFC. Moreover, a rich biodiversity component can be found, including 20 native rice varieties, six native breeds of carp, forest species, plant species for home gardens and medicine to name a few (Min & Sun, 2007:3-5).

The RFC is a complex symbiotic ecosystem. Within the system rice and fish are grown simultaneously, with multiple benefits. The rice plants provide shade for the fish, whereas the fish are responsible for reduced application of chemicals, improved soil fertility and water conditions which reduce fish diseases and control rice pests as well as provision of nutrients for the rice plants as illustrated in figure 1.

Thus, with rapid economic growth, modern agricultural techniques and better labor opportunities in the cities, the traditional RFC are slowly disappearing. Moreover, the food safety, the many ecological functions and the environment conservation services are seriously undervalued. Besides that, the major source of income of the remaining inhabitants of Longxian village is remittance from relatives living abroad.

Figure 1: Functions of RFC System



Source: CNACH & IGSNRR, 2011: 17

3. Economic Analysis

The first question, that comes to one's mind, when discussing economic analyses of GIAHS is whether it is really necessary that designated GIAHS systems, unique, remarkable traditional agricultural systems, are economical viable or attractive, or if these should be preserved regardless of their economic profitability? But the decision how to use an agricultural system is an economical question as the farmer can only preserve a system, if he will still make a living from it. So the RFC system will only continue to exist, if farmers continue maintaining it. For this, they either have to make a living with it, or they need to get a compensation for the provision of multi non-market ecosystem services and reduced income compared to another system.

To understand the dynamic of the systems, it is important to assess the difference between participating in the GIAHS project and the relevant benefits for the farmers and the society on the one hand and a similar non designated GIAHS system or alternative system on the other. Therefore, it is quite necessary to have economic information to make the best choice on the different options. In support of the acceptance of GIAHS and their comparison to non-GIAHS

designated systems an economic cost benefit analysis shall be developed. The method is applicable to all GIAHS systems.

3.1 Cost-Benefit Analysis

Cost Benefit Analysis (CBA) is commonly used for project and policy appraisal. It is a decision tool judging projects by comparing their related costs and benefits. Moreover, it gives the opportunity to accept or reject a specific activity, choose between different project options, or prioritize between projects or systems. The economic information provided, is one option of choice for decision makers. Moreover, one should take into account that classic CBA often fails to take environmental services into considerations. A lot because these services don't have a market or cannot be valued in monetary terms and project selection is often biased. Therefore, it is important to have knowledge on the economic value of environmental goods and services, for better decision making. The limitations of CBA e.g. not quantifiable or measurable benefits and costs cannot be included in the calculations, and are therefore ignored. An additional qualitative assessment of the non-quantifiable aspects should be included (Bann, 1997:14, 26; Lal & Keen, 2002:21).

A sound CBA will compare the project to the most likely outcome in the absence of the project (Bann, 1997:14). Therefore, the net benefits of a *project A* must exceed the net benefits of the alternative *project B*. (NBa-NBb>0)

For a CBA all costs and benefits need to be assessed in monetary terms, and then have to be aggregated on an annual basis. As benefits and costs are spread over time and project changes usually involve costs and benefits occurring over a longer period, the time aspect needs to be taken into consideration, as benefits and costs occurring in the future have a different value today. The distribution of costs and benefits over time is accounted for by using appropriate discount rates to determine streams of discounted costs and benefits. Out of both streams the present value will be received.

3.1.1 Discounting

The choice of the value for the discount rate and time horizon has a crucial impact on profitability and needs therefore careful selection. The question regarding the used discount rate is as old as the CBA itself. For the interest rate in a financial CBA, the market interest rate is used as opportunity cost of the capital. For economic CBA common suggestions are 2-3% for effects occurring within a single generation and conducting a sensitivity analysis with 7%. For multiple generations, a discount factor between 0-3% in the sensitivity analysis is recommended (Pearce et al. 2006:56-57; EPA, 2002).

A major critique is that for projects with big influence on the environment the discount rates are set too high. As then the benefits and costs from the future are weighed less. So damages to the environment in the long future will be made much smaller by discounting.

3.1.2 Decision rules

Common indicators of economic returns are the net present value (NPV) and internal rate of return (IRR).

The NPV is the net value of the cash flows in today's Dollar or in our case Yuan. Thus, it shows the difference between the present value of cash flows and the cash value of cash outflows. The NPV is mostly used to analyze the profitability of a project.

The NPV is calculated as follows:

$$NPV = \sum_{t=1}^{n} \frac{(B_t - C_t)}{(1+r)^t}$$

With B=benefits, C=costs, r=social discount rate and t=time.

Projects with a NPV of zero or greater are accepted as the benefit stream is equal or higher than the cost stream. When choosing between two projects ($NB_1 > NB_2$), the project with the higher NPV selected, here NB_1. Another decision rule, when benefits are unknown is to select the project with the minimum costs for cost effectiveness, so in the case of $C_1 > C_2$, project two is selected (Lal & Keen, 2002:21).

A further indicator used is the IRR, which is the return of the capital invested. The IRR is related to the NPV, as it is the discount rate corresponding to a zero NPV. As result, this would be the highest interest rate that a project can pay to recover the costs and still break even. Therefore, projects with an IRR higher then opportunity costs of capital should be accepted.

3.1.3 Sensitivity Analysis

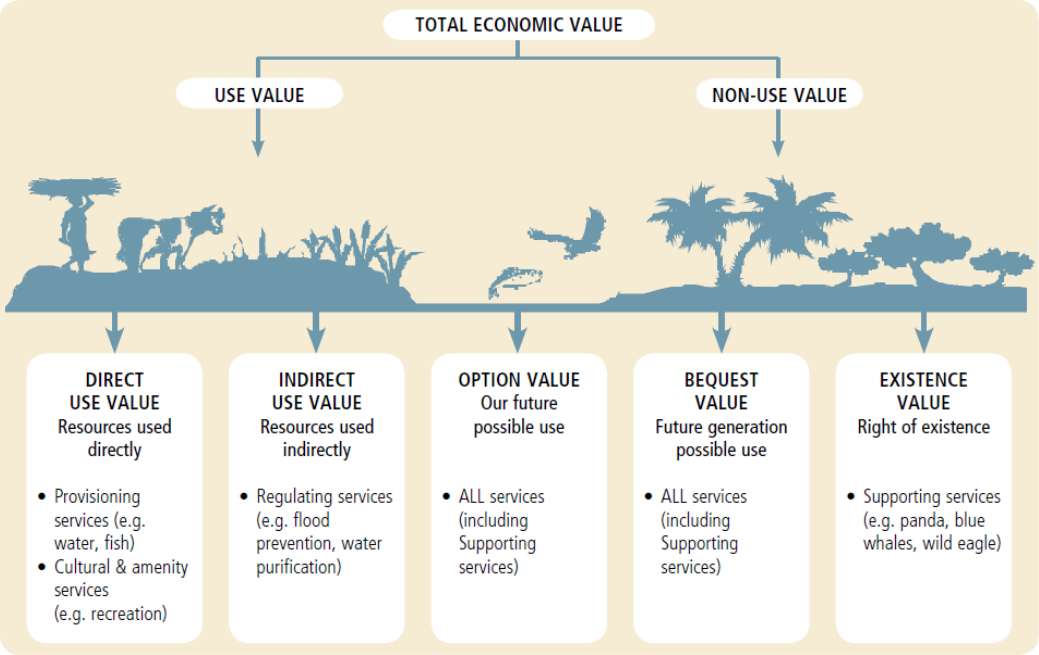
When all the elements of the CBA come together, and an initial conclusion is reached about whether the NPV is positive or negative, a sensitivity analysis should be done to test the robustness of the results. The sensitivity analysis observes how the result changes, when major costs or benefits change. This can also give an indication about key elements, having big influence on the result.

3.2 Total Economic Value

The foundation for an economic evaluation of GIAHS is the identification and quantification of all potential and actual impacts and services that GIAHS deliver. All services have an economic value, depending on the benefits humans receive from them. The total economic value (TEV) comprises all values from the different services in an overall framework for economic valuation of environmental resources (Bann, 1997: 21, 24). The TEV depends on the different types of

economic values arising. The main distinctions are made between direct use values, indirect use values and non-use values as illustrated in figure 2.

Figure 2: The total economic value of ecosystems



Source: Smith, M., de Groot, D. & Bergkamp, G. 2006: 30

Direct use values are received from direct provisioning of services as marketed goods and services. This involves not only commercial but also subsistence and leisure activities. The main economic products from the RFC are fish and rice. Ecotourism also falls under this category. The main direct economical benefits for the villagers from tourism are from running restaurants and selling rice and fish products. In the near future entrance fees from a museum will be added.

Indirect use values might not be paid for directly, but they are the underlying aspects of the direct use and are influenced by that. As these values cannot be directly estimated through market behavior, they are often difficult to measure. The RFC has quite a number of indirect values as shown in figure 3. The RFC is responsible for the biological control of pest, disease and weeds due to the incorporation of natural enemies into the rice fields. Furthermore, RFC produces quite an amount of oxygen, as well as has an influence on the climate due to release and sequestration of carbon. Another indirect value of RFC is the water regulation as the water storage capacity is increased. Additional values for consideration are water pollution and nutrient up keeping.

Non-Use Values are neither from direct nor indirect use of the GIAHS and don't leave trace in market behavior. These values arise mainly from the pure pleasure of knowing that something exists. Often the people concerned about the system will never directly or indirectly benefit from the system but still want to preserve it, just for satisfaction of existing (Bann, 1997:26). For the

RFC the preservation of traditional rice varieties and traditional carp breeds as well as other species of the rich biodiversity is an important non-use value. Moreover, the up keeping of the traditional knowledge and system as cultural heritage, is an important value in the GIAHS.

Figure 3: Total Economic Value of the RF

Use Values		**Non Use Values**
Direct Value	***Indirect Value***	
Rice production	Recreation value (aesthetic landscape)	Social importance (Cultural Heritage)
Fish production	Biological control	Biodiversity conservation
Rice Stalk	Oxygen production	
Tourism	Climate regulation	
	Water regulation	
	Water pollution	
	Health issues (reduction of Malaria)	
	Pollination	
	Nutrient Cycle	

Source: own illustration

After identification of the main values for the services, a ranking according to their importance to the outcome is recommended. Best would be to estimate all costs and services related to the GIAHS. In reality, often it is not possible to quantify all services, due data limitations, finance and skills. In order to provide the best information possible it is important to rank the different components and their cost of collecting the needed data. Priority is then given to the ones with highest ranking. For values, which are not possible to quantify, a qualitative assessment should be undertaken and presented (Bann, 1997:26).

3.3 Estimation of Environmental Costs and Benefits in Monetary Terms

The next challenge is to put a monetary value on these just highlighted different services provided by the RFC. Different methods are used to provide the different environmental services with a monetary value. Only a brief overview shall be given here about the different methods.

The most commonly used are the following:

- **Market Price Method**

The market price of commercially traded products and services from an ecosystem (rice, fish, entrance fees) are used to calculate the economic value.

- **Travel Cost Method**

This method is used to calculate the value of recreational benefits generated by an ecosystem. The underlying assumption is that the value of a site is reflected by how much people are willing to pay to get there (King, Mazzotta, & Markowitz, 2000) or their expenses to the sight.

- **Replacement Cost**

The Replacement Cost method estimates the value of non-market services based on costs of substitution, avoided damage or replacement of ecosystem services (Sakuyama & Stringer, 2006:5; Bann, 1997:27)

- **Hedonic Pricing Method**

This method assumes that "*the price paid for a commodity is directly related to the supply of the commodity's attributes.*" Often uses property variation values "*to reveal implicit values and demand for environmental amenities*" (Sakuyama & Stringer, 2006:5).

- **Contingent Valuation Method**

This method is the only method, which is used for the non-use value. For the valuation of non-use values it is required to create a hypothetical market and therefore people are directly questioned through surveys about their willingness to pay for keeping or maintaining this service (King et al. 2000).

Table 1 indicates an overview of possible valuation methods that can be used for putting a monetary value on the different services of our RFC.

Table 1: Valuation Techniques used to value different components of RFC

Total Economic Value	**Valuation Technique**
Direct Use Value	
Rice	Market Price Method
Fish	Market Price Method
Tourism	Travel Cost Method, Hedonic pricing Method
Indirect Use Value	
Recreation Value (aesthetic landscape)	Travel Cost Method
Biological Control	Market Price Method
Oxygen Production	Replacement Cost
Climate Regulation (Carbon sequestration/Carbon store)	Replacement Cost
Water regulation	Replacement Cost
Health issues (reduction of Malaria)	
Nutrient Cycle	
Existence Value	Contingent Valuation Method

Source: own illustration based on Bann, 1997:28

4. Results from Case Study

In the following discussion, the state of the art of the research of the GIAHS RFC shall be introduced, what evaluation methods have been used to assess the ecosystem services in the GIAHS RFC in Longxian village. In practice, not all services identified, under 3.3, have been valued, yet. Some model calculations for CBA was illustrated in the following discussions.

4.1 Model calculations CBA-RFC

After assessing all benefits and costs of the different services, an overall cash flow table needs to be created (Table 2) and will then be observed over time and discounted. This is done for the GIAHS system and a similar non designated system. Moreover, a differentiation is made between farmers' perspective (financial CBA) and society's point of view (economic CBA). The data from the field research in Longxian village in 2006 collected from IGSNRR is used for the GIAHS system and observed over time with a few assumptions regarding the price changes, as there is only information about 2006. The data from the local government with data representing the whole county is used to show the variations in results. No data from a similar village but not GIAHS designated system were available, therefore direct comparison was here not possible.

A few aspects regarding labor shall be mentioned. When doing a financial CBA labor is not included as the assumption is that farmers are paid from their net income (Gittinger, 1982). When observing from a society's point of view, labor will be included as opportunity costs for not working somewhere else (for example a factory in the city).

The provided data from the local government suggests that the price for fish from RFC has increased from 22 Yuan/kg (2005) to 50 Yuan/kg in 2012 compared to fish from mono system with only 30 Yuan/kg in 2012. The rice price of 2.4 Yuan/kg in RFC and mono systems in 2006 increased in RFC to 4.4 Yuan/kg, compared to 3.4 Yuan/kg in mono systems for 2012. This was also indicated in the progress report, with a rice price increase from RFC of 60% in the county since the beginning of the project compared to rice prices in the mono systems (CNACH & IGSNRR, 2011:59). Unfortunately, it was not possible to link this information with clear conclusion whether the price increase is related to the project in Longxian village or other reasons. Additionally, the price increase is reported for the whole county, whereas the price changes of the products in Longxian Village have not been observed, so no significant statement can be drawn.

Financial CBA farmer

Individual farmers are mainly interested in their net income, as that is what they have in their pockets at the end of the day. Therefore, the financial analysis, takes into consideration only costs and benefits that occur to an individual farmer. As base numbers the data collected in 2006 in Longxian village was used for one hectare (Annex 1) and the data from the local government representing the whole County (Table 2). Based on the indication of price increase from the data of the local government, the assumption is that the prices of Longxian village also experience a

price increase, which was included (5% increase every year until 2012 for establishment and maintenance costs and revenues). The time horizon chosen is 10 years which is slightly longer than the project runs (2013).

The results illustrated in table 3 indicate a positive NPV for both data sets and relatively stable results as the sensitivity analysis shows. The sensitivity analysis further indicates that the decrease in benefits has a bigger impact as the increase in production costs. The results between the data from the local government and the data from the field research are quite different. One explanation is that the reported outcomes for rice and fish are much higher in the data from the local government, in addition revenues from sale of dried fish is not included in the data from the field research. On explanation could be that in 2006 the farmers didn't sell dried fish, yet.

Table 2: Financial Analysis RFC

(Interest Rate 6%)		**20% Decrease in benefits**	**20% Increase in costs**	**20% Decrease in benefits and 20% Increase in costs**
	NPV	NPV	NPV	NPV
Designated GIAHS RFC	124,755	93,574	122,608	91,427
RFC local county data	305,447	227,623	291,175	213,351

Source: own calculations based on data from Liu et al. 2010 and government

Another possibility, which moves a bit away from the original question, would be the comparison to an alternative system of RFC, if the project would not exist, which in our case could be a swop to mono rice systems. When using the mono rice data provided from the local government as well as the data from the field research, also a positive NPV is indicated (table 4), but with a lower NPV compared to RFC, which suggests that the investment in RFC is more recommendable for the farmers.

Table 3: Cash Flow individual Farmer RFC (Yuan/ha)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Establishment Cost:	***618***	***732***	***936***	***1,389***	***1,494***	***2,286***	***2,178***	***2,178***	***2,178***	***2,178***	***2,178***
Rice seedling	168	192	216	264	294	336	378	378	378	378	378
Fingerlings (fish)	450	540	720	1125	1200	1950	1800	1800	1800	1800	1800
Maintenance Cost:	***5,220***	***5,715***	***6,045***	***6,618***	***8,186***	***9,054***	***12,975***	***12,975***	***12,975***	***12,975***	***12,975***
Fertilizer	1,980	2,160	2,145	2,310	2,250	2,400	2,550	2,550	2,550	2,550	2,550
Pesticide	255	270	300	258	236	144	225	225	225	225	225
Feed Fish	2,535	2,835	3,150	3,600	4,950	5,610	6,300	6,300	6,300	6,300	6,300
Costs for labeling and packing	450	450	450	450	750	900	900	900	900	900	900
Transportation							3,000	3,000	3,000	3,000	3,000
Revenue:	***28,080***	***28,980***	***35,310***	***36,750***	***44,580***	***54,030***	***69,600***	***69,600***	***69,600***	***69,600***	***69,600***
Sale of rice on local market	16,560	16,740	18,900	19,350	21,360	24,510	29,700	29,700	29,700	29,700	29,700
Sale of rice on international market											
Sale of fish on local market	7,920	8,640	9,660	12,600	15,120	16,920	25,500	25,500	25,500	25,500	25,500
Sale of dried fish on local market	3,600	3,600	6,750	4,800	8,100	12,600	14,400	14,400	14,400	14,400	14,400
Sale of dried fish on international market											
Gross Cash Flow	***16,626***	***16,737***	***21,267***	***21,393***	***25,984***	***31,884***	***40,527***	***40,527***	***40,527***	***40,527***	***40,527***

Source: based on data from Government Qingtian County

Table 4: Financial Analysis mono rice system

(Interest Rate 6%)		20% Decrease in benefits	20% Increase in costs	20% Decrease in benefits and 20% Increase in costs
	NPV	NPV	NPV	NPV
Mono Rice system (Data field research)	103,989	79,725	100,922	76,658
Mono Rice system (County data)	127,439	93,659	119,665	85,885

Source: own calculations based on data from Liu et al. 2010 and government

Within the data available, there was no data on tourism revenues received by the individual farmer, as additional income. Although, research indicates that the majority of the tourists spent between 200-400 Yuan during their stay in Longxian village in 2008. This data was not disaggregated to costs and revenues for farmers. Therefore, the activity could not be included. One assumption is that without the project no real additional income from tourism for farmers can be found, and so the results of the designated RFC would further increase. To come to a proper conclusion the results need to be compared to a similar system without project, but due data shortage this was not possible here but only comparison to the alternative mono rice system.

Additionally, no data was available for Longxian village on labeling costs and transportation of the products. The local government indicated values for labeling and transportation, but again it was not clear how this is related to the project or if the values are higher or lower in Longxian village. Moreover, no disaggregated data of amount of RFC products sold on local or international markets. There is information that some of the GIAHS RFC products are labeled and exported to Europe, with a price of 80-100 Euro/kg. But no detailed data on quantity and costs related to exporting was available.

Economic CBA

For the economic CBA, which observes all costs and benefits from a society's point of view, not just the main marketed products have to be observed but all ecosystem services of the system and possible other costs from the project. The outcomes of field research discussed under 4.1 are now included into the cash flow table (Annex 3). Although the assumption is weak, for the observation over time, one assumed that the calculated values for the ecosystem services will remain the same over time and are then tested for robustness in the sensitivity analysis.

The labor opportunity costs calculated in the field research estimated that the net income of a farmer working in the city, including costs on traffic, room and board, was 6300 Yuan per year in 2006. Moreover, the amount of labor needed to cultivate one hectare of RFC is four. For the

economic analysis, as opportunity cost of labor is used the amount that a farmer could get when working in the city.

The data on tourism was not precise enough to include, as the boundaries between Longxian Village and the whole county became blurred. According to the progress report the number of tourists in the county increased from 2000 in 2004, to 1,980,000 in 2010. Moreover, it was indicated that the income from tourism in the county increased by 194% from 2006 to 2011, reaching 2, 84 million Yuan in 2011. No clear data on village level was available.

Again the time horizon observed is ten years. The discount rate for an economic CBA should be lower than the private discount rate. To show the differences, discount factors of 2, 5 and 10% are used. When including all major ecosystem services, the social NPV remains positive, so the RFC system has a gain for the society. The sensitivity analysis indicates not very robust results. The key factor here, are not the ecosystem services per se but the labor opportunity costs, which are quite high. Consequently, farmers are more likely to abandon the RFC and find work in the city, which we are also observing as reality and threat to the RFC.

To mention here is that the results are not very realistic as a number of additional services are not included in the calculation, including the value of biodiversity preservation, value for the cultural importance, tourism, but also the costs of the stakeholders in the GIAHS for awareness raising, trainings and other inputs. As these aspects, which indicate major comparison values to a non designated similar RFC system are not available no meaningful result would be received with the given data.

Table 5: Economic CBA designated GIAHS RFC

Assumptions	**Interest rate 10%**	**Interest rate 5%**	**Interest rate 2%**
	NPV	NPV	NPV
Designated GIAHS RFC	**42,075**	**55,739**	**67,080**
Sensitivity Analysis			
20% Decrease in benefits	16,697	22,801	27,921
20% Increase in costs	7,589	11,607	15,058
20% Decrease in benefits and 20% Increase in costs	-17,785	-21,331	-24,101

Source: own calculations based on data from Liu et al. 2010

When again observing the alternative without project the swop to a mono rice system, the results in table 7 suggest that the mono rice system would reduce the overall societies gain and rather add costs to the society, as the results of the NPV are negative. Key factor is here again the labor opportunity costs. Another indication is if the value of the overall ecosystem services increases the negative value of the NPV also raises.

Table 6: Economic Analysis mono rice system

Assumptions	Interest rate 10%	Interest rate 5%	Interest rate 2%
	NPV	NPV	NPV
Designated GIAHS RFC	**-64,113**	**-106,017**	**-124,012**

Source: own calculations based on data from Liu et al. 2010

Limitations of the model calculations

The results of these CBA have to be taken cautiously due to massive lack of data. The data from the field data, which would actually be from Longxian village, didn't include all data on inputs and outputs. The variation between the observations from the field and the data from the local government is quite different, and follow up would be needed. Moreover, the comparison to a similar but non GIAHS designated system was not possible due to data. Additionally, the boundaries of the GIAHS designated system in China faded within the different researches and no clear separation was done, which again has an impact on the data quality and results. Relevant factors for comparison between designated GIAHS and non-designated system, like tourism, additional income generating activities and project costs, were not available, which weakens the whole analysis.

5. Data Requirement

For every economic analysis sound data is a crucial aspect and for a full assessment quite a lot of data is required. This leads to the most common reason for not carrying out economic assessments as extensive data collection is not only timely but also very costly. For projects it is often not feasible to collect all the necessary data. Therefore in practice, it is usually a trade-off between time, money and effort. When a lot of environmental values are to be analyzed, it is recommendable to decide based on the most prominent type of values, available and feasible information for collection and resource availability for analysis (Bann, 1997:29).

A general important tool for data collection is the baseline survey. Baseline surveys are essential when a new project site is designated, as it is the foundation for later impact assessment and a measure of benefits and costs. The baseline should not only include socio-economic aspects but also economic data on the agricultural system (productivity, costs and return, income earnings).

In order to compare a designated GIAHS system with a similar traditional system but non-designated GIAHS, it is necessary to have data on the direct used values, including yield and inputs (in cash and in kind). On the output side, it is relevant to have data on the revenue of GIAHS products with a clear distinction between market and non-market. Moreover, if GIAHS labeled products are exported overseas, information on quantity and prices should be available. Information on the labor time for the activities is needed as the opportunity costs of working somewhere else might be relevant.

Import feature in the GIAHS is the recreation and tourism value, as direct used environmental function and additional benefit of the designated GIAHS compared to non-GIAHS. Here, not only data on recreation, what purpose used for, and potential willingness to pay for these, but actual data on costs paid to whom and revenues for farmers from tourism. Otherwise it is relative hard to prove the anecdotal evidence that GIAHS increases the income of farmers due to tourism.

Although the valuation of the non-use or existence value is extremely important for the GIAHS it is difficult to assess and therefore further research and collection of data needed. The same is true for the comparison to a non GIAHS designated system. A clear distinction between designated GIAH and non- designated system was not possible in this research.

Within the progress assessments of the GIAHS it would be necessary to focus more specific on quantitative data collection of progress. For this, it might be also required to change the indicators, as the projects might not see the need to collect the data, without request through the indicators. Moreover, a close link to a research institute is of great value for the GIAHS in support of the data collection and analysis, as research institutes might have interest to focus on different aspects in more detail, which might not be feasible for the projects otherwise.

6. Discussion

The original task was to do an economic assessment comparing a GIAHS with a similar non GIAHS designated system to see if the project is worth doing and so preventing the disappearance of these valuable traditional agricultural systems, turned out to be difficult due to the available data. When extending this question, an alternative observation could be a comparison of the designated GIAHS system with the alternative most likely outcome in the absence of the project, which would mean a swop to mono rice system in our case. The traditional agricultural practices are very complex ecological systems including many different services and only taking into consideration direct use values would not do justice to these systems. But the often resource poor farmers, who are responsible for maintaining these valuable systems, do have to make a living and earn their livelihood.

For the observation of the economic viability, all services provided by the system need to be listed, assessing with a monetary value and ranked according to their importance and possibility to collect the data. Important in our case would be to highlight the different services that result due to the existence of the project. For example, extra tourism activities, marketing of "special GIAHS products" in niche markets, labeling and higher prices for the labeled products due to the awareness and appreciation of the consumers. So far these aspects are mainly mentioned in a rather qualitative manner, as in the progress report of RFC, "*Being the first GIAHS pilot site for RFC in China now made Longxian village a destination for visitors from home and abroad. The number of tourists increased greatly since 2005 and so did the incomes of local farmers* (CNACH & IGSNRR, 2011:8).

As in reality, the major problem occurring during the carrying out of the example CBA for the RFC in China was the availability of reliable data. The first challenge was to understand the clear boundaries of the designated GIAHS system, as within the project Longxian village is protected but the data and results indicated in the progress report were mixed between village level and the overall county. In addition, data on major additional economic activities were not available. The results from the CBA, which have to be taken cautiously, indicate that private and social NPV for the RFC are positive, although the results of the social NPV are not very robust. The sensitivity analysis indicated that the labor opportunity costs play a key role in the outcome. Unfortunately, the data availability didn't allow a significant conclusion of the impact of the project, as it was also not possible to compare it to a similar traditional system. When comparing it to the alternative of mono rice system, the social NPV of mono rice suggested negative values, which means a cost on the society.

The area of new livelihood opportunities, with labeling system, niche markets, eco tourism, and others should be explored much further and monitored closely, as the marketing and potential "commercialization" is part of the success of GIAHS. Of great value would have been a Baseline on village level and monitoring over time on village level as well as monitoring possible spillover effects on the county.

A more economic approach can help to convince, especially decision makers about the benefits of the protection of the traditional system. Moreover, for the farmers itself is it absolute crucial to make a living. Therefore, economic assessments can help to actually show if farmers make a living or not. If not, this means that the project or the local government needs to discuss about possible compensation for the preservation of the multiple ecosystem services, otherwise farmer will not maintain it sustainably.

7. Summary and Conclusion

A CBA is not just a standalone activity but rather part of a bigger attempt of appraisal and evaluation of a project, or system. Moreover, it is not just the outcome of the CBA that is valuable but the constructing itself. During the process of carrying out a CBA, clarification can be achieved on indicators and required data to determine whether benefits are achieved at different levels. This again can help to improve monitoring and evaluation efforts as well as indicator development (WB, 2010:22, 48). As such economic considerations should be included in GIAHS throughout the different stages of the project cycle (identification/pre-feasibility assessment, feasibility assessment, project design, implementation, and monitoring/evaluation) (Lal & Keen, 2002:31-38).

The additional creation of economic opportunities is a relevant important consideration within GIAHS. Additional income opportunities for the GIAHS custodians and communities, e.g. labeling system and agri-eco tourism, have not been monitored closely, which makes it difficult

to assess the economic contribution or success. To assess the economic contribution, it is important to monitor, but not limited to, the following data (i) value of rural businesses linked to environmental services (value of services from eco tourism, value from niche market access); (ii) per cent increase of farmers involved in additional economic activities; and (iii) per cent increase in marketed goods (agricultural products). There might be the need for further research or need assessment of trainings for farmers related to business and finance, farmers' organization, farmer information. Although highly debated, an overall change in income indicator could be included (e.g. per cent iIncrease of income of farmers in pilot site (should represent the different additional income activities due to the project).

With all the work and success, the GIAHS initiative has done and achieved within the last ten years, it is a great challenge to underline these successes with economic evaluations, but definitely a worthwhile effort not just for the continuation of the project but for the sustainable management of the unique, remarkable agricultural heritage systems.

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Annexes

Annex1: Net income of rice-fish agriculture and rice mono cropping

Production model	Income (Yuan hm^{-2})			Cost (Yuan hm^{-2})					Net income (Yuan hm^{-2})
	Rice	Fish	Total	Seed	Fry	Fertilizer and pesticides	Feed	Total	
Rice monocropping	12 760		12 760	210		1 613		1 823	10 937
Rice-fish agriculture	10 198	6 199	16 397	197	1 950	570	559	3 276	13 121

Source: Liu et al. 2010:167

Annex 2: Ecological service value of RFC and rice mono cropping (Yuan/ha)

Production model	Air regulation		Nutrients conservation	Pest control	Water regulation	Tourism development	Water pollution	Total		
	CO_2 fixation and O_2 production	CH_4 CH_4 emission						Benefit	Cost	Net benefit
Rice monocropping	10 417	−1 569	1 660	0	4 530	0	−6 440	16 607	−8 009	8 598
Rice-fish agriculture	8 789	−1 076	1 624	1 007	6 795	1 146	−2 240	19 361	−3 316	16 045

Source: Liu et al. 2010:167

Annex 3: Cash Flow ind. Farmer Mono Rice System (Yuan/ha)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
***Establishment Cost*:**											
Rice seedling	210	240	135	330	336	384	432	432	432	432	432
Maintenance Cost:											
Fertilizer	2,805	3,060	3,120	3,360	3,600	3,600	3,825	3,825	3,825	3,825	3,825
Pesticide	408	432	420	419	405	288	375	375	375	375	375
Costs for labeling and packing					300	450	450	450	450	450	450
Transportation							2,250	2,250	2,250	2,250	2,250
Revenue:											
Sale of rice on local market	17,640	18,360	18,720	19,110	20,160	20,250	25,500	25,500	25,500	25,500	25,500
Sale of rice on international market											
Gross Cash Flow	***14,217***	***14,628***	***15,045***	***15,001***	***15,519***	***15,528***	***18,168***	***18,168***	***18,168***	***18,168***	***18,168***

Source: based on data from Government Qingtian County