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Modified Sustainable Livelihoods Framework (MSLF):

A tool for monitoring and assessing GIAHS sites

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Glossary

FAO	Food & Agriculture Organization
FAOB	Food & Agriculture Organization, Bangladesh
FAOE	Food & Agriculture Organization, Ethiopia
FAOI	Food & Agriculture Organization, Indonesia
GIAHS	Globally Important Agricultural Heritage Systems
SLF	Sustainable Livelihoods Framework
MSLF	Modified Sustainable Livelihoods Framework
TFG	Traditional Floating Gardens
NTFG	Non-Traditional Floating Gardens

Contents

Executive Summary

The conceptual development of the Globally Important Agricultural Heritage Systems (GIAHS) has been substantial over the past 10 years, with the development of criteria for designation and the establishment of a series of international GIAHS site designations. These sites represent traditional systems of agriculture, livelihood and associated biodiversity, landscapes and knowledge. The diversity of GIAHS that have been designated and the present governance structure has highlighted the need to develop a semi-quantitative approach to standardise evaluation and certification procedures. IFAD has supported the development and verification of a tool to assist with: i) designation and characterisation ii) monitoring and evaluation of GIAHS sites' dynamic conservation and iii) knowledge transfer. To this end a systematic classification of potential GIAHS, using a **Modified Sustainable Livelihood (MSLF) Framework,** has been proposed and tested in the 3 case study areas of Ethiopia, Bangladesh and Indonesia in order to provide:

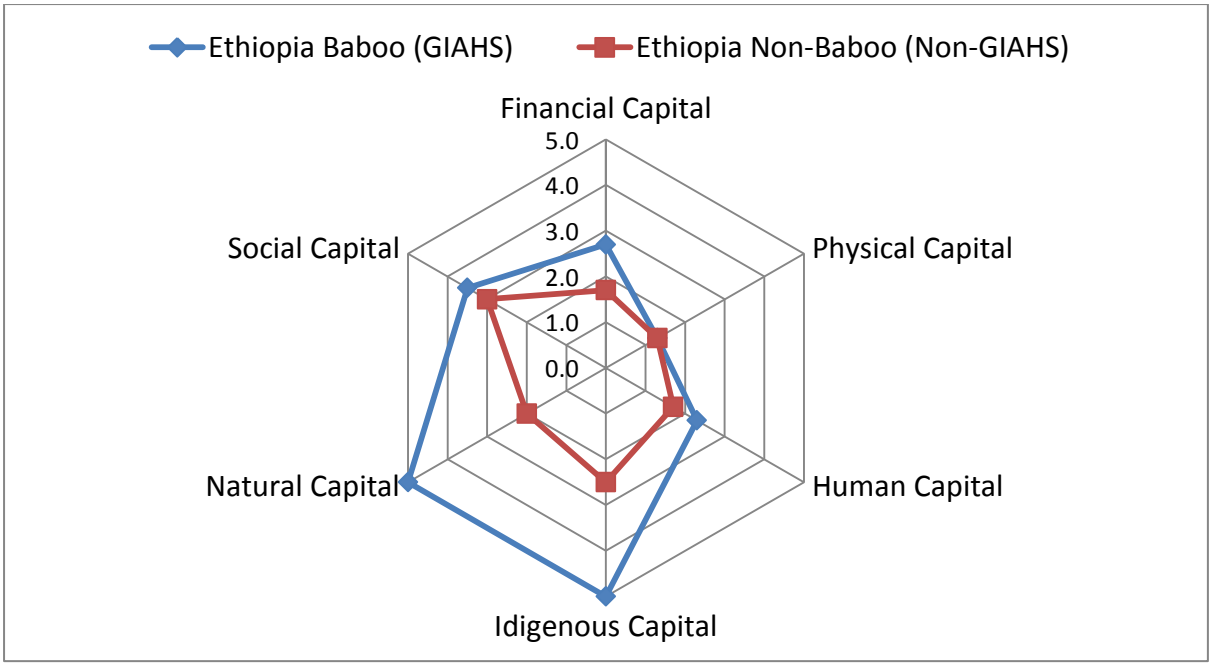


Figure 1. Example from Ethiopia of a Modified Sustainable Livelihood Framework (MSLF) Radar plot showing a high potential GIAHS verses a low potential GIAHS

i) Designation criteria of GIAHS: There is an imperative to provide a rapid, systematic, semi-quantitative and comparable method of characterising designation criteria for candidate GIAHS. This approach needs to capture the key components that are important for both the biophysical and socio-economic description of the system.

ii) Monitoring and evaluation of GIAHS systems. Once an effective classification process has been established, the same process can be utilised to i) monitor change within a given the system ii) provide guidance as to where changes in the system are occurring.

iii) Structured learning: The process of identification of components of a GIAHS and their comparison internationally affords the opportunity to develop understanding of GIAHS both spatially and temporally, as well as their role in the broader landscape.

The outcome of this work has been that a modified Sustainable Livelihood Framework (SLF) is recommended for use in the designation and monitoring of GIAHS, which introduces a new criterion that specifically differentiates the Indigenous Capital. The designation is directly derived from the **ratio** of the capitals identified in the communities in question (Table 1).

Ratio of (NC+IC)/(FC+PC)	**GIAHS Status**
>1.5	GIAHS
1.0 – 1.4	Weak GIAHS/GIAHS under threat
< 1.0	Non GIAHS

Table 1. Suggested GIAHS classification associated with capital ratios. NC = Natural Capital, IC = Indigenous Capital, FC = Financial Capital, PC = Physical Capital.

1. Introduction

The Globally Important Agricultural Heritage Systems (GIAHS) is an international partnership initiative that aims to identify, support and safeguard Globally Important Agricultural Heritage Systems and their livelihoods, agricultural and associated biodiversity, landscapes, knowledge systems and cultures around the world. The GIAHS type Partnership recognizes the crucial importance of the well-being of family farming communities in an integrated approach while directing activities towards sustainable agriculture and rural development. The conceptual development of the Globally Important Agricultural Heritage Systems (GIAHS) has been substantial over the past 10 years (Howard et al 2012) creating criteria for designation and the establishment of a series of international GIAHS site designations.

Over the past decade, the GIAHS type Initiative has been piloting an innovative model of engaging communities, local and national governments in the adaptive management of agricultural heritage and conservation of system's goods and services. It has served as a learning laboratory for identifying new ways to sustain nature's bounty, the health of ecosystems, conservation and sustainable use of biodiversity and genetic resources for food and agriculture, protection of traditional knowledge systems, culture, and more importantly, building a bridge for the sustainable future.

In May 2013, an international forum on GIAHS type was held in Noto, Ishikawa, Japan where participants from around the World shared their knowledge on the fundamental values of agricultural heritage, as well as shared their experiences on managing and revitalizing local economies through GIAHS type dynamic conservation. The Forum was distinguished by the presence of the FAO Director General and several High -level officials from existing GIAHS type sites and key international organizations and resulted, *inter alia,* in the adoption of the Noto Communique.

The Noto Communique recommends (i) the progressive designation of further GIAHS type sites to promote the conservation of agricultural heritage and its contributions towards global food security and economic development; (ii) promotion of on-the-ground projects and activities, particularly in developing countries; (iii) the existing GIAHS type support the recognition of candidatures of GIAHS type areas in less developed countries; and (iv) promote the twinning of GIAHS type sites between developed and developing countries.

Within this context, an introductory workshop on GIAHS type was organized in Addis Ababa on 27th February 2014 and was supported by the findings of a brief fact finding/scoping field mission designed to initiate the process of developing a systematic approach to the identification and monitoring of GIAHS type systems at a community level. The introductory workshop on GIAHS type aimed to launch the GIAHS type Initiative in Ethiopia, to enhance understanding and promote awareness of the fundamental values, essential goods and services harboured in globally important agricultural heritage systems.

In advancing this progressive designation the approach to identifying the qualifying criteria and distinguishing GIAHS type systems from other traditional agriculture has been considered. This document reports on the IFAD-commissioned research to explore approaches to the development and verification of a systematic framework for the classification of potential GIAHS qualifying sites.

1.1 Modifying the Sustainable Livelihoods Framework (MSLF) to reflect GIAHS

The sustainable livelihood framework is a people-focused approach to the understanding of key drivers of enabling sustainable approaches to livelihood and therefore to the alleviation of poverty. (DFID 2003). As a framework it has been extensively utilized and studied (IFAD, FAO, ODI, CARE, OXFAM) and it provides a valuable tool for the comparison of community systems through the dimensions of livelihood impacts. The underpinnings of the approach are a series of "Capitals", which characterize all good and services of a community (Figure 2) . So, just as it is possible to have financial capital, so it possible to have natural capital in the form of forests, rivers and ecological services or social capital in the forms of social networks, associations and communities that support the community livelihood.

Five capitals are usually described:

Natural Capital – the natural resource stocks (soil, water, air, forestry, genetic resources, etc.) and environmental/ecological services (hydrological cycle, pollution sinks, etc.) from which resource flows and services useful for livelihoods are derived.

Financial Capital – the economic base (cash, credit/debt, remittances, savings, and other economic assets, including food stocks, production equipment and technologies) which are essential for the pursuit of any livelihood strategy.

Physical Capital – the infrastructure capital base (roads, power lines, bridges, services) that contribute to the development and sustainability.

Human Capital – the skills, knowledge, labour availability, good health and physical capability important for the successful pursuit of different livelihood strategies.

Social Capital – the social resources (networks, social claims, social relations, affiliations, associations) upon which people draw when pursuing different livelihood strategies requiring co-ordinated actions (modified from Krantz, 2001).

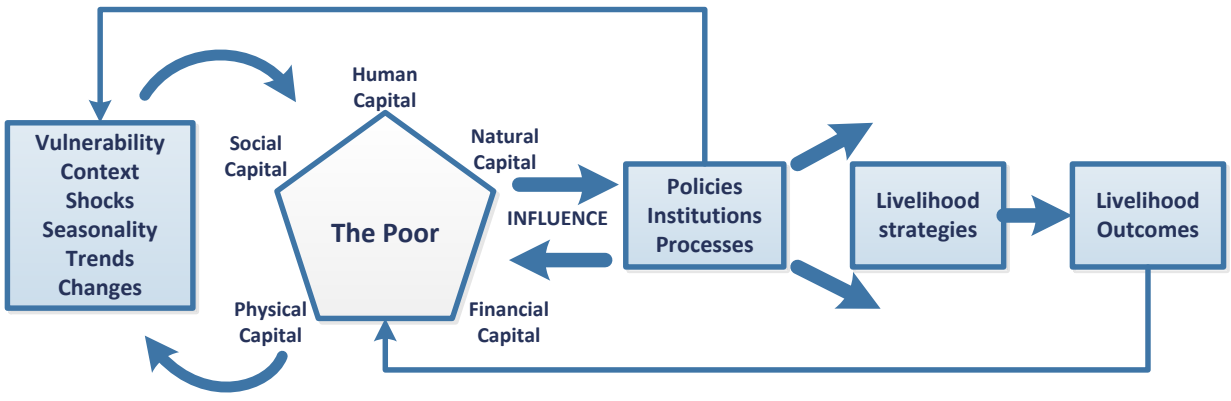


Figure 2. IFAD Sustainable Livelihood Approach or Framework.(SLF)

The presented tool utilises the relationship between capitals of the SLF to designate a GIAHS. Furthermore In the modified SLF (MSLF) – the additional **Indigenous Knowledge Capital** specifically recognises the extensive traditional knowledge base, skill sets and their transfer within a community

that underpins the operation and maintenance of a GIAHS. Within the SLF this might be represented across Social and Human Capitals, but here we explicitly discriminate the Indigenous Capital as a critical component in GIAHS operation. Once a potential GIAHS candidate community is identified it is then possible to apply this method within the community, to provide specific categorisation values of the various capitals and use this information to determine both the relationship between the various capitals and the values within other GIAHS and non-GIAHS cases. It is also possible to apply the same method outside candidate GIAHS, to provide comparative assessment with similar agricultural production systems.

1.2 The GIAHS is in the Ratio of the Capitals

The tool outlined recognises that GIAHS can occur in a wide range of settings from the developing world (e.g. Ethiopia & Bangladesh) to the developed world (e.g. Japan & Italy) and as such they cannot be defined by absolute measures of community capitals, but should be defined, and consequently monitored, through categorising characteristic **ratios or associations between capitals**. That is to say that it is the relative prominence of certain capitals within a system is indicative of a potential GIAHS. The current work, based upon strongly qualifying GIAHS candidates in the developing world, suggests that the relevant ratio is that of:

(Natural Capital + Indigenous Knowledge Capital) / (Financial Capital + Physical Capital)

This approach asserts that:

i) A stable GIAHS site must have a relatively stronger focus on bio-diverse agricultural and ecosystem services as well as a high requirement for specific agricultural skill sets and specialist knowledge relative to reliance upon infrastructure and external sources of income. So it is anticipated that GIAHS will have high Natural and Indigenous Capital. Examples of these might be:

> **High Natural Capital**: e.g. High biodiversity use in agriculture, extensive and diverse ecosystem services provisioning, regulating etc.
>
> **High Indigenous Capital**: e.g. agricultural processes are deeply embedded in culture evidenced through songs, story-telling, religious associations, dedicated educational process for younger generations etc.

ii) GIAHS is likely to be non-existent or at least highly unstable in an environment where assets, financial capital and infra-structure are **more dominant** than the Natural and Indigenous Capital. Examples of High Financial and Physical Capital might be:

> **High Financial and Infrastructure Capital:** e.g. highly urbanised environments with substantial access to a service sector and industrial employment coupled with extensive and intense infrastructure, such as electricity, water supply, road networks etc

This approach does not presuppose that a GIAHS must be poor, but that high levels of Financial and Physical Capital can be corrosive to a GIAHS system unless carefully managed. An example of this is seen in the case study presented below for the Indonesia proposal for GIAHS located in Bali where tourism and local commercialisation has the potential to undermine the GIAHS unless strategic management plans are used to protect it and the associated community. This highlights one of the

strengths of such an approach; the modified SLF provides inputs targeting action to maintain the GIAHS locations.

The specific value of the ratio between the capitals identified can provide a differentiation not only between GIAHS and non-GIAHS but potentially also identifying GIAHS that are coming under threat. The table below (Table2) is indicative of the ratios suggestive of GIAHS status:

Ratio of (NC+IC)/(FC+PC)	GIAHS Status
>1.5	GIAHS
1.0 – 1.4	Weak GIAHS/GIAHS under threat
< 1.0	Non GIAHS

Table 2. showing the suggested GIAHS classification associated with capital ratios

These are not seen as absolute threshold ratio values, being based on a small sample of evaluation of GIAHS and non-GIAHS sites.

1.3 Application of the GIAHS MSLF tool

This method aims to identify where the ratio of capitals is such that a community can be identified as a GIAHS type, weak GIAHS type or non-GIAHS type. It is inherently developed from the integration of communities with their agricultural systems rather than just an inventory of features of the agricultural system. The approach to the application of the Modified SLF is intentionally relatively straight forward and involves qualitatively **estimating categories** of a given capital based upon a process of:

i) Interview and stakeholder meetings with community representation

ii) Interviews and stakeholder meeting with local government

iii) Community and surrounding area observations

iv) Data sets of relevance to the site such as remote sensing, census land cover data etc.

To develop the categorizations it is necessary to i) divide the Capitals into sub domains which are relevant to the local area and ii) develop a catagorisation (1-5) describing a state of a sub-domain where 1 is the lowest anticipated state in the region and 5 is the highest anticipated state in the region of interest. An example is provided here for the assessment of a component of Financial Capital (Table 3).

Financial Capital	1	2	3	4	5
Infrastructure	Very poor roads or power supply				Substantial road and power access to all in community
Income	High levels of destitution with barter economy				No visible destitution, remittance incomes common
Employment	Very high levels of unemployment				Limited unemployment in both men and women

Table 3. Simplified for clarity – an example of Sub-Domains which sit below the Capitals. The mean value of the 3 sub domains makes up the final value of the chosen Capital. The sub domains and the categories can be bespoke to the region of study, however in the test case presented on this report values were kept the same to allow for comparison. ***See Appendix 1 for field form.***

The GIAHS type method is international and as such any method of identification needs to be generic, transferable and to facilitate inter-comparability between regions and development context. As such specific measurements of indicators would be very much a product of the local system, however, a categorized approach effectively normalizes the capitals (giving a value of say 1-5 relative to the best and worst in the region) and as such would better facilitate the development of a **ratio** of the capitals. So what constitutes the lowest and highest states will vary depending on the ambient development state of the region. As such where a similar exercise to be conducted in a GIAHS in a developed country (e.g. Japan) the description of 1-5 would need to be modified accordingly.

1.3.1 Study of the Counterfactual

The methodological approach proposed suggests that there is a distinctive ratio of capitals which allows for the identification and monitoring of GIAHS. One aspect of a validation approach is to study an agricultural system which is clearly not a GIAHS but is i) close to the geographical setting or location of the GIAHS and ii) has an agricultural production overlap with the GIAHS system.

The intention of this approach is to demonstrate that a close geographical counterpart agricultural system, which is believed to have little in common with a GIAHS, does not demonstrate the ratio of Capitals associated with a qualifying GIAHS. As such, this approach shows *what a GIAHS is not,* to enhance understanding of *what GIAHS is*.

2. Case Studies: Demonstrating the Principles of the Tool

In order to develop and test the Modified SLF approach for GIAHS, a number of test sites in the developing and emerging economy world were identified as of particular relevance. These sites were new to GIAHS, so were not already designated but had been identified nationally as high potential candidates. In association with the selected sites were the suitable counterfactuals which received an equal study time. **Further details of selected sites can be found in Appendices i)-iii).**

A series of case study sites were selected based upon the interest of the local and national governments, the objectives of IFAD and the suitability of the sites to demonstrate the MSLF approach. All 3 sites fall in within a development of emerging economy context.

The case studies were:

1. Case Study 1: Gedeo Highlands, Ethiopia
2. Case Study 2: Province of Bali, Indonesia
3. Case Study 3: Floating Gardens in the Barisal Region, Bangladesh

2.1 n Case Study 1: Gedeo Highlands, Ethiopia

The Baboo culture of the Gedeo highlands, southern Ethiopia is a highly bio-diverse and socio-environmentally complex agro-forestry system which cultivates upwards of 80 plant species in an agro-forestry context. Coffee is grown among the forest floor mixed agriculture for commercial purposes and provided 40% of Ethiopia's premium grade coffee. The Gedeo country is located around the capital Dilla, in the humid south eastern Ethiopian highlands (Figure 3). Dating back from neolithic times, the Gedeo land use systems are among the oldest agricultural systems in the world. With more than 420 persons per square kilometre, the Gedeo highlands are one of the most densely populated regions in the country (Ethiopian Central Statistical Authority 2007). The fact that this population density exists and has been maintained for millennia without external inputs, agrochemicals, the Gedeo of southern Ethiopia, living 360 km to the south of Addis, in a mountainous terrain receiving over 1400 mm of rainfall, with slopes at places exceeding 70%, have developed the cheapest way of harnessing rainwater for coffee production, using their food crop Ensete, which has bulbous water carriers as part of it morphology.

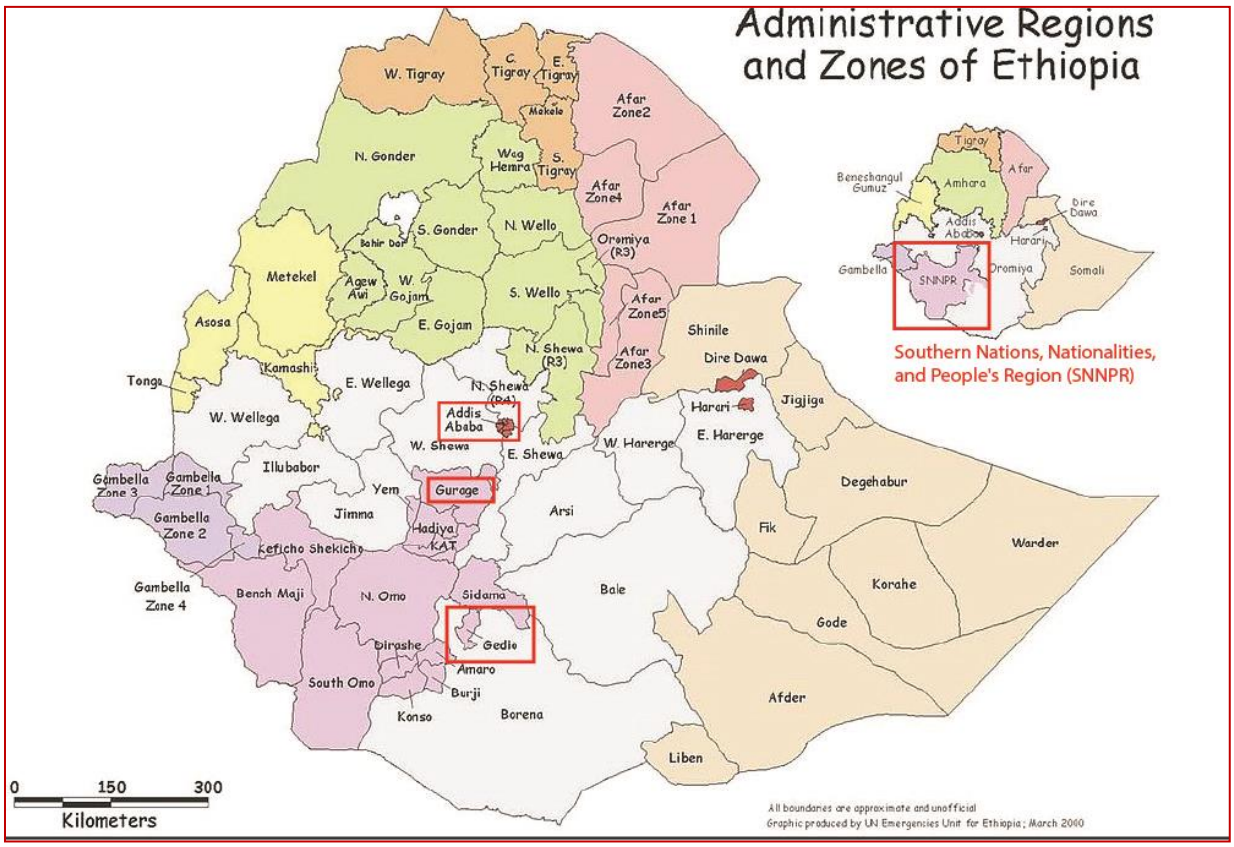


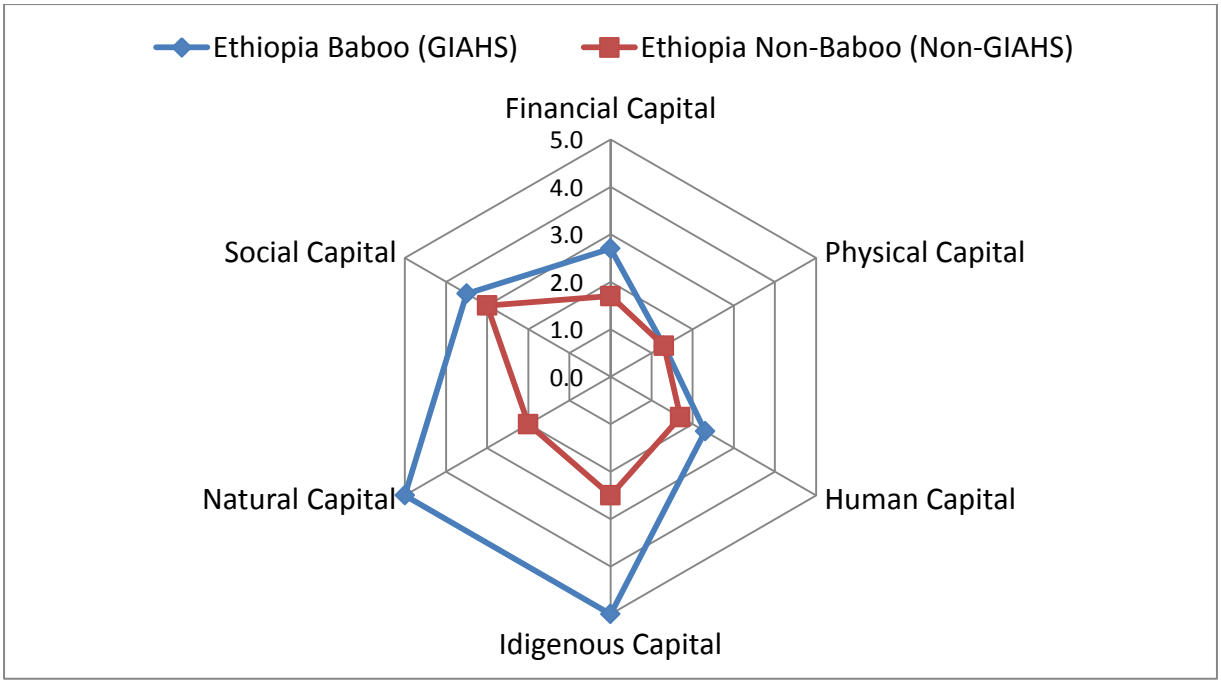
Figure 3. Location of the Geodea highland where Baboo agroforestry is conducted (sometimes called Ensete system)

Sometimes called the Ensete (false banana) agricultural system, the Ensete plant has a special place in the Baboo culture tradition, proving food, building materials as well as storing large quantities of water in the body of the plant which buffers the agro-forestry system against drought.

Figure 4 Landscapes associated with Baboo culture (left) and non-Baboo culture (right) which is mono-crop agriculture nearby. The non-Baboo culture was Baboo some 40 years ago, but once converted to monoculture has suffered from extreme soil loss.

The resulting comparative MSLF capitals for the Baboo and non-Baboo systems (Figure 4) are shown on the radar graph (Figure 5) and the capital ratios indicate high (2.9) GIAHS ratio when compared to the non-GIAHS system of the non-Baboo culture which has a ratio of 0.5. This s mainly due to the agroforests (a form that was strong in Gedeo tradition) have been found to be both very biodiverse and requires a lot of indigenous knowledge transfer from one generation to another in order to maintain the Baboo culture: Biodiversity can thus be regarded as an inherent property of the complexity of the Gedeo ensete/coffee agrosystem.

It is clear that there are also substantial ecosystem services contributions by the coffee/ensete system in all categories – Provisioning (food, fibre, water); Regulating (soil erosion control, pest control, shading); Supporting (soil enrichment, nutrient cycling, water cycling); and Cultural (cultural heritage). Indeed, the breadth of services provided by ensete can only be regarded as exceptional



Socio-Agricultural system	**GIAHS ratio of (NC+IC)/(PC+FC)**
Baboo (Enset)	2.9 (GIAHS)
Non-Baboo	0.5 (Non-GIAHS)

Figure 5 MSLF Radar diagram showing the relative and total capitals of the Baboo (GIAHS nominated) and non-Baboo (non-GIAHS) agricultural practices along with the related ratio. A high ratio figure shows dominance of the Natural and Indigenous Capitals. It is suggested that a GIAHS must exceed a ratio of 1.5.

The Gedeo country is located around the capital Dilla, in the humid south-eastern Ethiopian highlands. Dating back from Neolithic times, the Gedeo land use systems are among the oldest agricultural systems in the world. With more than 420 persons per square kilometre, the Gedeo highlands are one of the most densely populated regions in the country. The fact that this population density exists and has been maintained for millennia without external inputs, agrochemicals or improved crop varieties, and without terracing in such an undulating environment, is most likely to be unique. Arguably, this is the most durably sustained land use system of the planet. The major crop components that characterize the Gedeo Zone highlands are enset (*Ensete ventricosum* (Welw.)) and coffee (*Coffea arabica* L. RUBIACEAE). These crops grow in combination with a wide range of other plant and animal species.

2.2 Case Study 2: Province of Bali, Indonesia

The wet, Subak water management system for paddy rice cultivation (as opposed to the dry system and associated fishing) studied is located on the southern coast of the island of Bali in Indonesia. It is within the large village community of Bugbug. This potential GIAHS system is clearly marked by the deep integration between religious and spiritual rituals and an ancient method of water and crop pattern allocation that has bound the community together for a millennium. The community refers to a series of sacred texts that extend back to the 12th century which provide both a technical and philosophical platform for the agricultural calendar of the community (Figure 6). Issues, such as land rights, land use change, diversity of crops and the effective and agreed utilisation are all covered in a general framework which allows room for dynamic incorporation of selected modern interventions as required (some minimal fertilizer and pesticides). This agricultural approach is deeply rooted in the Hindu beliefs and values of the community and those of their ancestors and this provides a common reference point by which the community is able to cooperate. ***Further details are available from Appendix 3: The Subak Agricultural system***

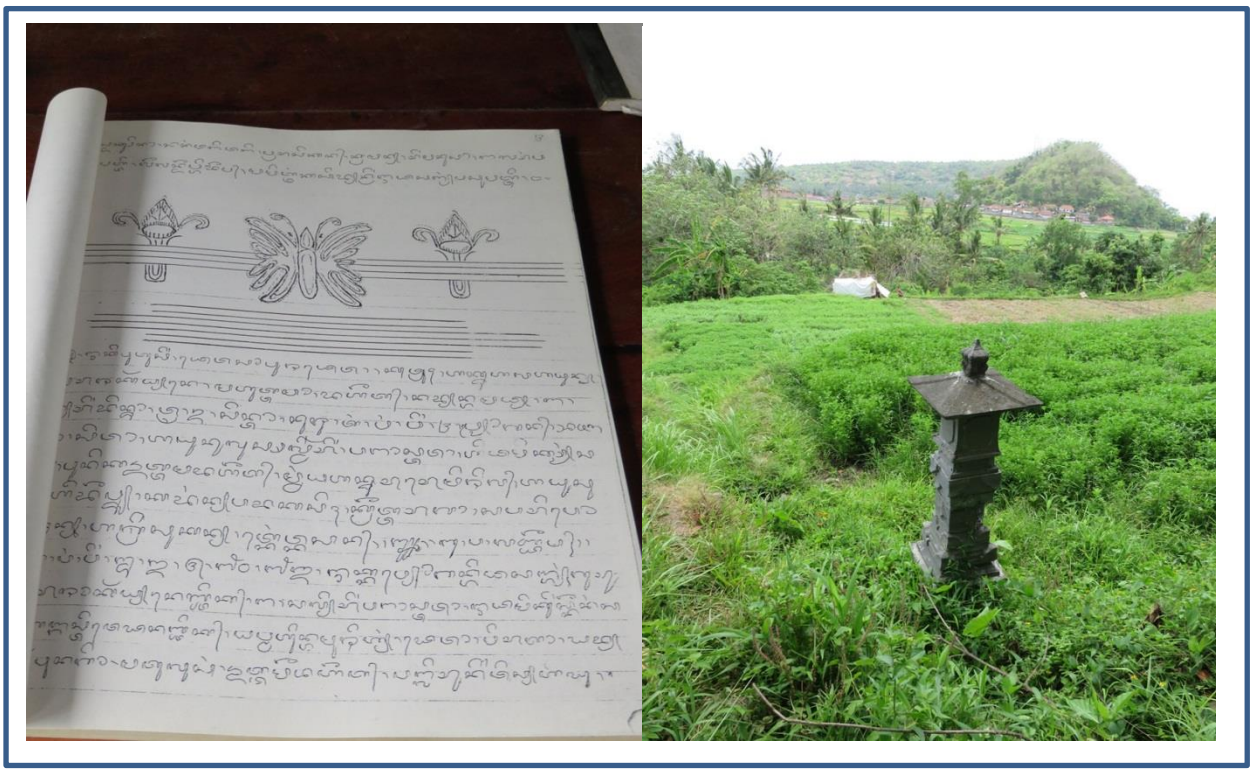
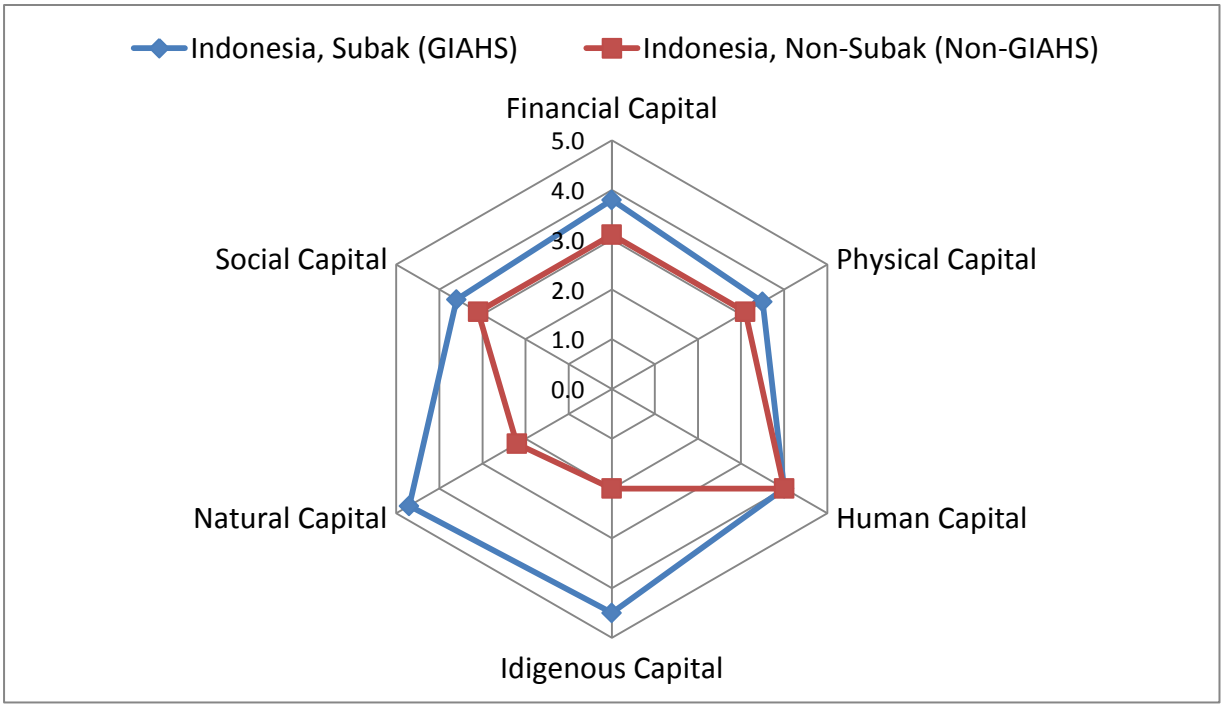


Figure 6. A page form a copy of one of the sacred texts (Perarem AD 1617) written in Sanskrit local translations are used on a yearly basis to agree the distribution of resources and optimise crop patterns. This approach is accompanied by extensive rituals in the field that clearly bind the community and encourage such resilience as diversity.

However, the system, which is functioning well today, is under threat from recent developments along the coastal zone including tourism and associated economic growth. Whilst not impacting directly on the land the potential for the community to provide the deep spiritual and agricultural commitment to the system could be eroded with time due to the potential for the next generation of farmers leaving the village and pursuing economic and educational interest elsewhere. Local

farmers have identified this issue themselves and cite the low financial returns as the main reason for this potential threat to the dry Subak. It needs to be understood that this is not a simple farming system, but a sophisticated socio-religious framework which requires commitment in time and resources from the community.

It should be noted that it is not necessary for a GIAHS system to be poor as such, but that the financial input and indeed that of Physical Capital need to be understood clearly and not pose a threat to the GIAHS. Ecotourism, branded premium quality goods and indeed government financial mechanisms, which recognise the value of the GIAHS to local biodiversity, might all be used to sustain the effective economic development of the site without directly threatening the GIAHS itself. The modified SLF approach clearly identifies this as an issue, with very high levels of Natural and Indigenous Capital but accompanied with high levels of Financial and Physical Capital, which demonstrates the validity of the approach, at least in terms of identifying that further investigation is required (Figure 7).



Socio-Agricultural system	**GIAHS ratio of (NC+IC)/(PC+FC)**
Subak	1.3 (GIAHS under threat)
Non-Subak (Sempu)	0.7 (Non GIAHS)

Figure 7 MSLF Radar diagram showing the relative and total capitals of the Subak (GIAHS nominated) and Non-Subak (Non-GIAHS) agricultural practices along with the related ratio. Here the Subak system, whilst clearly a high potential GIAHS candidate, needs to address some issues associated with the high financial and infrastructure inputs that have recently occurred if the GIAHS is to be sustainable.

2.3 Case Study 3: Floating Gardens in the Barisal Region, Bangladesh

In order to tackle the devastating effects of floodwater and associated subsequent water logging on agriculture, a number of communities in southern Bangladesh have developed and established a sustainable means of cultivating seasonal vegetables and seedlings during the monsoon season. This practice is commonly known as 'floating gardens', or locally known as Baira (Av Rajib Shaw, Mallick, Islam, 2013). Baira's, a form of hydroponics or soil-less agriculture, is a traditional cultivation system that has been practiced in southern Bangladesh for at least two hundred years (IUCN Bangladesh, 2005 p.6). The practice provides an effective technique to overcome the lack of dry land and continue horticulture practices for food consumption as well as commercial supply in the floodplains of Bangladesh. Baira's are also known as gathua, geto, daap and gatoni in Bangladesh. This indigenous practice is highly productive, cost effective and ecologically sound, but is only practised in its full diversity to a limited extent, in about 8 communities covering around 2500 hectares. However, in the south-west region of Bangladesh as a whole a derivative practice of simplified floating garden practice is practiced extensively.

Worldwide it is thought that over 51 million poor and lower-middle class farmers are engaged in hydroponic agriculture; 48 million of whom are located in developing countries. Both natural and artificial floating beds are used for agriculture in many tropical wetlands of the world. As a traditional practice, floating gardening is often associated with specific indigenous communities who gave these floating bodies different names. The Hanjis community of Dal Lake of Kashmir (India) calls it radh, the Intha tribe of Inle Lake of Shan (Myanmar) calls it kaing, the people of Kuttanad area of Kerala (India) call it pontha, and the people around Loktak Lake of Manipur (India) call it phumdi.

Floating bed cultivation in Bangladesh has proved to be a successful means of agricultural crop production in wetland areas. The primary objective of the technology is aimed at adapting to more regular or prolonged periods of flooding which impacts key cropping zones and inhibits rural farmers from accessing their land or attain a means of sustaining a livelihood. The approach employs beds of rotting vegetation, which act as compost for crop growth. These beds are able to float on the surface of the water, thus creating areas of 'land' suitable for agriculture within waterlogged regions. Scientifically, floating agriculture may be referred to as hydroponics. The use of such platforms made up of plant materials to grow crops dates back a few thousand years and have been studied all over the world for their ecological, indigenous and economic significance. In recent years, floating gardening has become a widely talked about climate change adaptation option. Economic opportunity and demand encouraged smart farmers to transform this traditional practice into a commercially viable agro-business as well as an opportunity to manage invasive weeds, thus maintaining natural water flow. For further information on traditional

Traditional versus Non-Traditional Floating Gardens (TFG/NTFG)

The practice of floating garden cultivation is relatively widespread in the South West region of Bangladesh such as Barisal, Gaibandha, Gopalgani and Faridpur, however, the deeply traditional and highly diverse approach to floating gardens is practiced in a limited area within the Pirojpur District only. Here some 8 communities practice a highly bio-diverse and intensive form of agriculture that is distinct from the standard floating gardens practice. This traditional (as opposed to the later non-traditional form adopted mostly after the green revolution) approach can be identified by the following field characteristics:

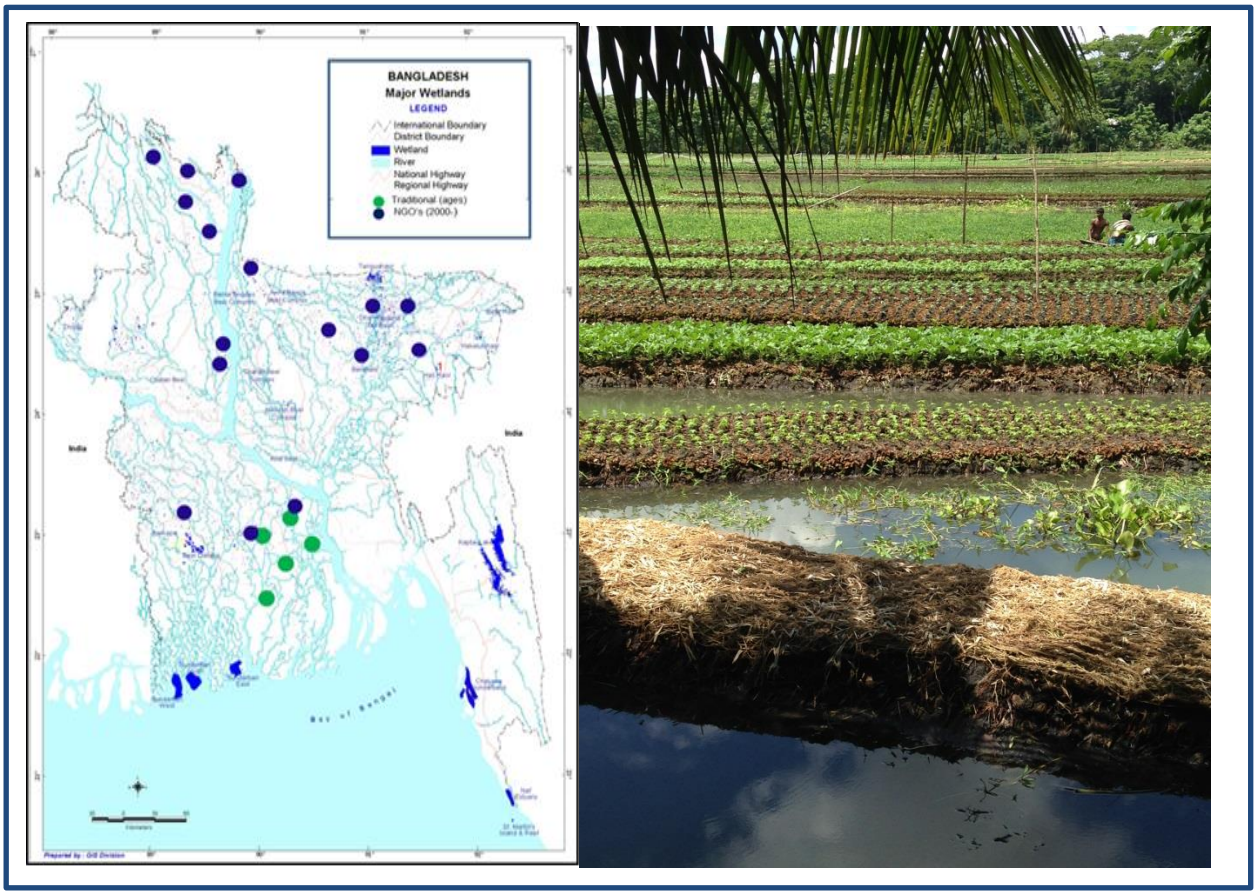
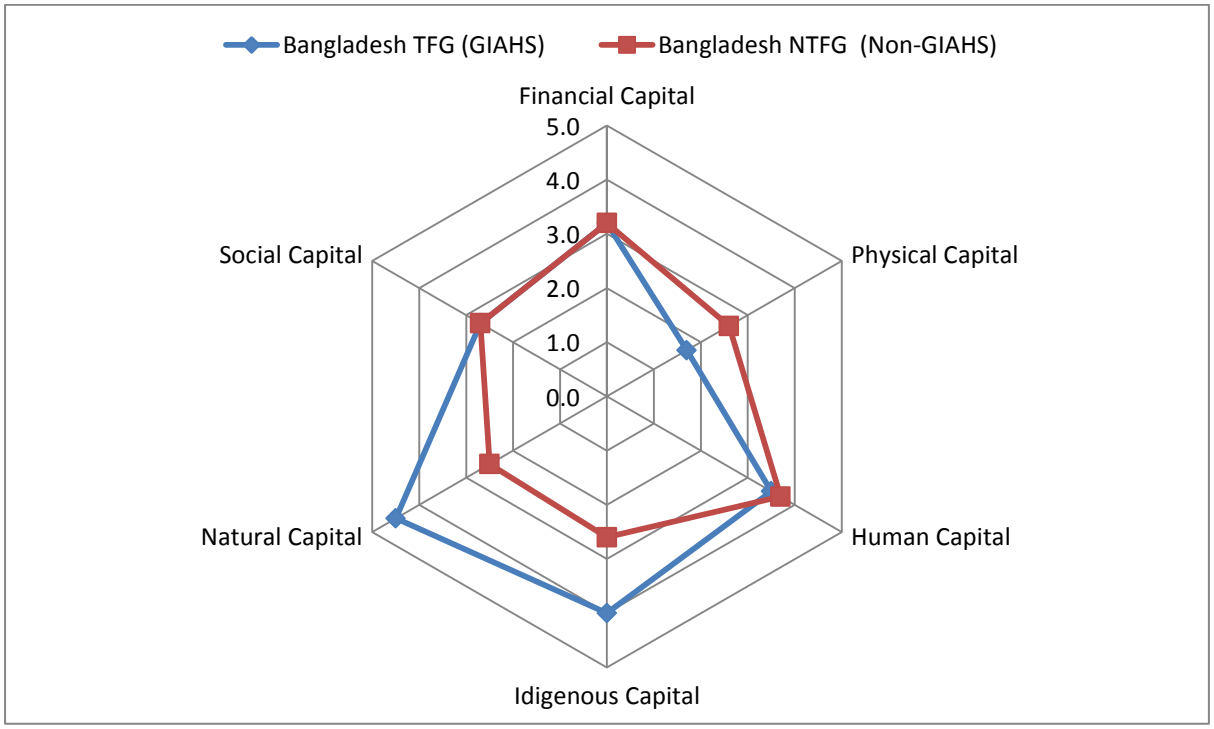


Figure 8: Global locations of floating gardens Source: Modified by author from Practice Action (2014 p.4) and floating gardens in Barisal region of Southern Bangladesh

- The construction of the raft beds is considerably more extensive and organized than that of the non-traditional areas with ranks of 50m rafts developed and systematically tended.
- Construction of rafts utilizes up to three forms of aquatic plant which are locally cultivated and layers of these plants are carefully managed to ensure maximum growth conditions - sometimes able to produce four crops in one year.
- Seedling ball production is a more sophisticated process than in the NTFG as coconut husks are used for raising the seeds, followed by a ball based upon water hyacinth but also bound with additional fresh water weed.
- The use of Water Hyacinth has been traditional at this site inter generationally.
- Boatmen collect the appropriate long stemmed Hyacinth within a 5km radius and construct the rafts which are then floated to the village location and anchored with bamboo poles.
- Farmers here consider themselves as floating garden farmers first and foremost.
- There are no cultural associations identified with the use of the rafts such as songs, religious festivals (although produce from the raft are also used in temple offerings along with other products). However, this potentially an aspect of the culture of the community rather than any reflection on importance of the floating gardens.

- Up to 80% of income can come through this farming approach.
- The gender roles in the production of the rafts are carefully defined with men involved in the manual labour of the construction but almost all other tasks (seed balls, weeding, grading, harvesting, and pest control) are the domain of women. However sales of goods and finance remain with men.
- One of the prevailing conditions that have allowed the sustained presence of the traditional floating gardens is the presence of wetlands. Indeed it is important to note that many of the techniques, such as the multiple aquatic plant use, are linked to the fact that the TFG are wetland communities – unlike the NTFG communities which are mainly associated with flooded river plain. This limits the potential transfer of knowledge to some degree from TFG to NTFG to water hyacinth alone as cultivation of other aquatic species outside of the wetlands in limited.

Capitals ratios (Figure 9) show with high levels Indigenous Capital and Natura Capital. Human, Social and Financial capitals are the same but the Physical Capital is lower in the GIAHS system Capital reflecting the specific situation as a response to flood risk.



Socio-Agricultural system	GIAHS ratio of (NC+IC)/(PC+FC)
Traditional Floating Gardens	1.7 (GIAHS)
Non-Subak (Sempu)	0.9 (Non GIAHS)

***Figure 9**. MSLF Radar diagram showing the relative and total capitals of the Traditional (GIAHS) and Non-traditional (Non-GIAHS) floating garden agricultural practices, along with their related GIAHS ratio.*

3. Conclusion and recommendations for utilisation of tool

A tool is presented that utilises a modified SLF framework **(MSLF)** to present a systematic, relative and semi-quantifiable approach to the classification, designation and monitoring of GIAHS. The tool offers a first order summative approach to defining qualifying areas and the relative grading of systems based upon the ratio of capitals with a modified Sustainable Livelihoods Framework. The methods is intended to be rapid and readily deployed, cost effective, consultative (from a community perspective) and repeatable, as well as usable both in the early stages of GIAHS designation as well as for ongoing monitoring. A series of recommendations are made for the effective deployment of the tool:

i) The Capitals utilised should remain statistic through time and between sites to ensure comparability. However, the components that make up each capital and the indicator sets used can be bespoke to the region of study without losing the value of comparison. Indeed the use of the *ratio* of capitals allow meaningful comparative between site that are in developing and developed regions

ii) The utilisation of the GIAHS MSLF is intended to facilitate a first order classification of a socio-agricultural system in order to provide guidance as to likelihood of designation. The approach does not substitute for the further characterisation, application and designation processes delineated by GIAHS as practices globally. It does however provide a tool whereby: a) large numbers of communities and agricultural systems might be rapidly tested in a region to distinguish between qualify and non-qualifying candidates b) an ongoing and repeatable methodology for monitoring and evaluation c) the possibility of developing a systematic GIAHS typology based upon the more precise ratios of the MSLF. This might involve such classifications as pre-GIAHS for systems that are near to designation status and weak to strong GIAHS types.

iii) As the tool is used and applied in more settings there will be the possibility to refine the approach and cover such areas as a) urban environments b) the more precise ratios that define a GIAHS c) development of strategies for monitoring and evaluating GIAHS in the light of:

- Impact of new policy applications
- Development of targeted policy development in support of GIAHS
- Characterising specific threats to GIAHS
- Methods for determining the spatial extent of the GIAHS sites qualifying agricultural systems based on the use of the tool.
- Evaluating dynamic conservation efforts within GIAHS communities.

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APPENDICIES

The following appendices were developed through the offices of the FAO in country working closely with the University of Southampton. The national case study appendices often rely upon material already in existence and the layout and structure are reflective of this. Each appendix represent the material that was utilised for act ground reading prior to investigation in the field. The final appendix is a documentation of the field data gathered during the in country activities presented for comparison.

Appendix i: Background literature on Ethiopian GIAHS study site

Study Site and Context

Gedeo is a Zone in the South Nation Nationality and People Regional State (SNNPR) of Ethiopia. This Zone is named after the Gedeo people, whose homelands lie in this zone. The zone is well known by producing high quality coffee (Yirgacheffe-Coffee) to international market. Gedeo Zone is located 369 km from Addis Ababa to south on Addis Ababa-Moyale international road and 90 km from Hawassa (capital city of the region) in South Nation Nationality and People Regional State (SNNPRS). On the basis of the current border delineation, the land area of the region is estimated at 1347.04 square kilometres. Geographically, the Zone is located North of Equator from 50 53'N to 60 27'N Latitude and from 380 8' to 380 30' East, Longitude. The altitude ranges from 1500 to 3000m. The zone has sub-humid tropical climate and receives a mean annual rainfall of 1500mm with range of 1200 and 1800 mm. The rainfall pattern is bimodal, with short rain season between March and May accounting for 30% of total rain fall and long rain season between July and October accounting for more than 60 % of total rainfall. The mean monthly temperature is 21.5^{o}C with mean monthly maximum and minimum temperature of 25^{o}C and 18^{o}C, respectively. The Zone experiences three distinct agro ecologic Zone Namely 'Dega' (30%),'Woyina Dega' (67%) and 'Kefil-Kola' (3%).

The Gedeo country is located around the capital Dilla, in the humid southeastern Ethiopian highlands. Dating back from neolithic times, the Gedeo land use systems are among the oldest agricultural systems in the world. With more than 420 persons per square kilometre, the Gedeo highlands are one of the most densely populated regions in the country (Ethiopian Central Statistical Authority 1997). Currently available topographical maps are of poor precision and reliability, thus rendering them of little use to land use planning in the Gedeo zone. The fact that this population density exists and has been maintained for millennia without external inputs, agrochemicals or improved crop varieties, and without terracing in such an undulating environment, is most likely to be unique. Arguably, this is the most durably sustained land use system of the planet. The major crop components that characterize the Gedeo Zone highlands are enset (*Ensete ventricosum* (Welw.)) and coffee (*Coffea arabica* L. RUBIACEAE). These crops grow in combination with a gamut of plant and animal species. The land use systems of the Gedeo Zone represent a common ancestor of modern-day forestry and agriculture (Kippie 1994).

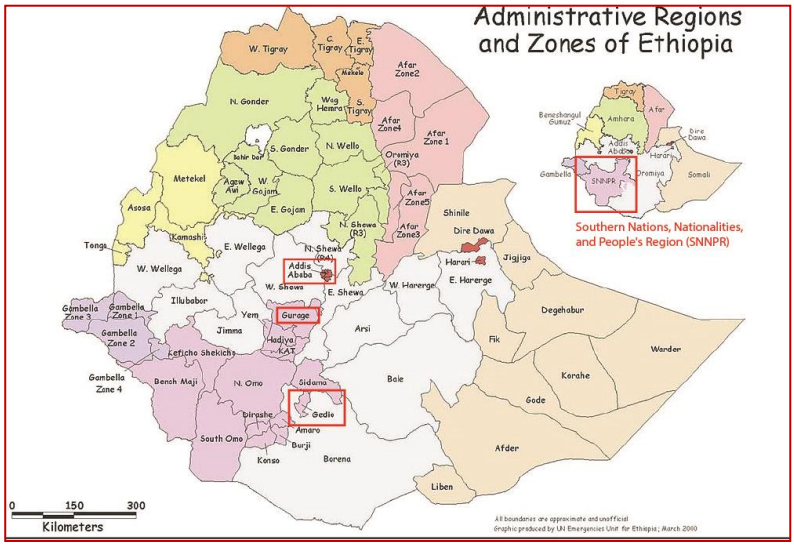

Figure 0-1. Location of main study sites

Based on figures from the CSA, in 2005 this zone has an estimated total population of 820,944; of which 411,163 were males and 409,781 were females with annual growth rate of 2.9%. 118,440 or 14.4% of its population are urban dwellers. The Gedeo zone is one of the most densely populated regions in the country with an estimated population density of 617.53 people per square kilometre. They are part of the Sidama people cluster. This people group is found only in Ethiopia. The history of Gedeo people is related with the Oromo. The Gedeo people, like other south Ethiopia peoples, were brought under Menelik II's control but in a peaceful manner. Later the people experienced the heavy burden of northern settlers in their land and were denied of all rights. The peak of reaction to northern domination came in 1960 when Gedeo peasants rebelled against the government, killing hundreds of settlers. The revolt however was suppressed by the heavy hand of the Haile Selassie government. Gedeo land exists in the Southern Nations, Nationalities, and People's Region (SNNPRG) in eastern escarpment of Rift Valley, east of Lake Abay. It is surrounded by Sidama in the north, Oromo in the east, south, and west. Gedeo are leading coffee producers, but the peasants of the areas benefit little; they use what they sell in a single day or weeks. There is high population pressure; they have been marginalized from self-governance because the people are not educated. The abundance of natural beauty that blesses the zone offers a surprising variety of landscapes with well-kept agroforestry agricultural system. The zone is endowed with magnificent tourist attraction components which are classified as Natural, Historical and Cultural attractions. The Gedeo agro forester agricultural system is contrasts by its nature which is home for many different floras and faunas which are valuable for tourism and scientific study. Yirgachefe organic coffee which is internationally known by its high quality is product from this agricultural system.

Figure 0-2. Details location of the Gedeo Highland

The Ensete / Coffee Baboo Agrosystem – a GIAHS candidate*

The Gedeo of southern Ethiopia, living 360 km to the south of Addis, in a mountainous terrain receiving over 1400 mm of rainfall, with slopes at places exceeding 70%, have developed the cheapest way of harnessing rainwater for coffee production, using their food crop ensete. A maturing ensete plant called beyaa could collect over 62.4 litres, i.e., or 249,600 litres of rainwater from a hectare planted to such ensete plants, using the spacing 1.5m by 1.5m. per annum. Kept in ensete pockets, well protected from evaporation and wild animals by its dry ensete leaves and leaf-sheaths, it is released to the landscape either when the ensete tissue holding it senesces, or when the previously held water is recharged by an incoming rainwater or by the hand of the farmers. The coffee that goes with the trade name Yirgachaffee is coffee produced in this way. Ensete is generally seen as a tree against hunger, but the present finding highlights its far-reaching significance in the Gedeo hands.*

The Gedeo system is based on the food crop ensete (*Ensete ventricosum*) and yields one of the finest highland Arabica coffees, on landscapes where slopes exceed 70%. However, little is known of this

scheme, largely because it is part of farmers' knowledge, which is often regarded as backward. Thus, farmers' insistence to add ensete to their coffee farms was rejected, taking it as farmers' hidden agendum, not to lose their food crop ensete. Indeed, ensete is everything for farmers, as it not only provides food, livestock feed and one of the finest vegetable fibres. But, most of all, ensete the very coffee which meant to replace it needs rainwater collected and stocked by ensete plants. Another point relates to the role of the ensete, as it through harnessing rainwater to productive uses, also protects and stabilizes the landscape. This is evident in the evergreen landscape which issues out streams and rivers throughout the year. Although physical conservation structures such as terraces are non-existent, thanks to the ensete, severe soil erosion and landslides are unknown over the Gedeo landscape. Unlike the situation over most parts of the Ethiopian highlands, Gedeo farmers are free from fear of crop failure following failure of rains. No doubt that the Gedeo scheme owing to its simplicity and practicality helps poor farmers in marginal areas. The Gedeo zone is divided into three agro-ecological zones, namely, the plateau (over 2800 m.a.s.l. the escarpment(1500 <X<2500 m.a.s.l.) and the valley (below 1500 m.a.s.l.): the escarpment has the coffee belt within it.

Bananas are widely intercropped with coffee, for their shade and mulch. But, use of ensete as coffee shade or for its mulch is not reported outside Ethiopia. So is use of ensete for harnessing rainwater for coffee production. The connection between the rainwater and the coffee quality was discovered when ensete removal from the coffee farms was followed by disappearance of the quality sought in coffee. An important link is therefore implicated between the rainwater collected and held by the ensete plants and the reproductive physiology of coffee trees.

Indeed farmers thrive because of the forests. For hundreds of years before coffee was even discovered, these farmers have taken to preserving forests as tradition, today the forests feed them, not by providing fruits but through the organic coffee that grows in the shade. Buried in the thick mountain forest of the Gedeo Highland in Ethiopia, is a poor community of Gedeo people. They have lived from one generation to another in these forests for over five thousand years. Amazingly, the forest in which the poor community of Gedeo lives is still as thick as the forests were years ago.

"*We practice an indigenous agro-forestry system that calls for respect for forests. No one in this community cuts down trees. It's a taboo*," says Tifera Edibo, a farmer and father of ten who was born and grown up here. His farm down the slope of the mountain is the one passed to him from his ancestors. He expects to cut it into nine sections to give a piece to each of his nine sons. His daughter is to be married away. "*We pass on the tradition from one generation to the other. We keep the tradition and the forests. These forests are our life*," Edibo says through an interpreter.

According to Ethiopia's planning report of rural development of 2004 out of the 267,371 people of the Wonago 74 percent of the population in the district is the Gedeo tribe. Estimates indicate each live on an 895 km2 piece of land, and the district is one of the densely populated areas in Ethiopia. But looking at the preserved forest one question that comes to mind is how can such a poor community preserve forests when they have little to survive on? "*It's an age old tradition that the community cannot cut trees, forests are their very own existence. Their livelihood is the forest. They believe that without this forest they cannot live happily*. "Therefore each family takes care of the forest. Most of their income comes from Yirgachefe Organic Coffee, a forest coffee which grows in these protected forests," Samuel Kekebo, Zonal Administrator.

The main food in Gedeo is Enset or false banana. Livelihood strategies for these people include agriculture which accounts for 80 percent, livestock fattening about 2 percent, trade of food crops and coffee accounts for 10 percent while selling handcraft contributes 8 percent to their livelihood. According to Kekebo, sufficient food supply is available for the Gedeo people unlike those down the mountains. "*The community has its own ways of surviving. For example, poor farmers can together buy a thin ox, fatten it here and sell it to share the profit. For women, they borrow Kocho (mature Enset) if they do not have enough food and repay it when their Enset is mature. Most of the Enset is sold at the market for money. Livelihood is better here*" he says.

This indigenous agro forestry system is unique in its kind and can be a model not only for Africa but also for the rest of the world, he suggests. "*It is in realization of this base fact that CSO's become motivated to come to this place and witness the situation on the ground and advocate for this place to be registered by UNESCO as one of the World's heritage sites*" says Dr. Habtemariam Abate, Executive Director of Sustainable Land Use Forum (SLUF) a leading CSO in Ethiopia advocating for the registration of Gedeo as heritage site. The Agro-forestry system has been one of the oldest best practice models in striking balance between environmental conservation and subsistence farming and is the most resilient system even under the highest rural population pressure. The resilience of the people is very adapted to the unique agro-ecology, special biodiversity, climate, soil, physical location and strong local cultural heritage. "*We know how important forests are to agriculture and we depend on agriculture. Without forests there is no agriculture*" Edibo says proudly.

Government of Ethiopia has connected most of the Gedeo homes with electricity for lighting. Money has also followed the Gedeo community, a mile down the mountain a coffee factory is opening to buy and process the wet coffee which is naturally grown by the Gedeo community. "*We make a lot of money from coffee so why cut down trees?*" quizzes Edibo. But with the population growing and pressure for land increases the Gedeo Agro-Forestry system is under intense threat. Now the question is how do these people continue to preserve Gedeo Forests for posterity?

*[Harnessing rainwater in Yirgachaffee coffee (Coffee arabica L. RUBIACEAE) production : the case of ensete (Ensete ventricosum)-based Gedeo landscape (Southern Ethiopia) : Dr. Tadesse-KippieKanshie]

Local Government Perspective

The field work focuses on the Gedeo Coffee/Ensete Agroforestry System in the South Nation Nationality and People Regional State (SNNPRS) of Ethiopia. This Zone typifies the Gedeo Highlands landscape and people, and is well known for its production of high quality Yirgacheffe Coffee (*Coffea arabica*) for the international market. In this very stable, sustainable and long-established heritage approach, the coffee is grown alongside the water-conserving food crop Ensete, which provides excellent water efficiency, drought resistance and land protection. The Gedeo zone of southern Ethiopia lies about 360 km south of Addis Ababa, in a mountainous Rift Valley terrain with over 1400 mm of rainfall and slopes sometimes exceeding 70%. The Gedeo communities have developed a highly-effective inter-cropping approach to harnessing rainwater for coffee production using ensete as a staple food and source of many other products. This provides a powerful sustainable heritage system to view alongside commercial coffee production in the same general area.

Meeting with Bureau of Agriculture

This Bureau had been briefed on GIAHS by Dr Abel (FAO Hawassa) and were already informed, insightful and supportive. The Gedeo Highlands Agroforestry System is highly regarded as a productive and stable basis for very high population densities (800 persons per km2): the agroforestry system is seen as almost inevitable given the landscape and "nature" of the region. Despite these apparent limitations, however, the region contributes around 40% of the Ethiopian coffee export crop, which means that it has National recognition and support. There is no pressure on farmers to move away from enset (for example, land plots are too small to grow a maize crop). Indeed, there is scope to extend this effective sustainable system to other areas.

The Bureau of Agriculture provides local support through the well-developed system of Coffee Farmers' Cooperatives and the Farmers' Unions – which provide significant advantage to their members.

- An important support is the supply (free!) of improved coffee seedlings (better disease resistance?). In practice this is facilitated by a US NGO.
- Collective negotiation maintains price (and farm income) at a high level.
- The Farmers' Union builds roads and scholls through income from these premium prices

Climate change pressure is recognised regionally and nationally – and farmers are beginning to perceive change. Enset provides resilience, for example through effective shading and water storage.

Potential gains from GIAHS Designation include:

- Recognition and valuation of heritage and respect for "ancestors" in their own right (Konso is an example of this)
- Knowledge sharing from other areas
- Potential to promote value of enset/coffee agroforestry in new areas
- Farmers gain direct benefits!
- Tourism has a recognised potential but it requires great attention and is not currently significantly developed
- GIAHS designation may help to strengthen outreach efforts to those many farmers (80-90%) who are not currently Cooperative or Union members.
- Supports passing down local knowledge to children
- Recruiting young people to sustainable small-holder development who need but do not currently have vital local knowledge.

The Agriculture Bureau recognises international partnership and coordination as a key to development, and GIAHS may play a role in this. It is highly supportive of these efforts.

Meeting with Natural Resources Environment Protection Authority

This agency had no previous knowledge of GIAHS, but it apparently recognises the cultural heritage of the Gedeo Agroforestry System. Traditionally, this highland/steep slope landscape has effectively been protected by farming practices such as those involving enset or fruit trees. It is a very high population density zone, but the traditional farming practice is not in decline.

Climate change is having an impact. This is a bimodal rainfall area, but the short rains that would traditionally have been expected by 15th February at the latest may now not arrive until start of May. This reduces the growing season and increases ground exposure. Over the last 10-20 years there may have been a loss of 20% annual rainfall. This means that enset is pressured by the twin drivers of climate change and population increase.

Potential gains from GIAHS Designation include:

- There is scope for some development of ecotourism, but should avoid over reliance.
- There is some local support to diversify beyond coffee, and this could be underpinned by a more general promotion of agroforestry.
- Within the promotion of enset agroforestry there is scope for evolution – for example to add inter-stripping of high biomass grasses (for cattle feed) which provide further land protection but can be cut every 20 days.
- Outreach is a complex process through a series of levels Regional State Zone District Local Development Area Cooperatives (one for each speciality such as coffee). It is suggested that increased international recognition can strengthen the quest to reach the whole community. Possibly some economies of scale.
- Is there potential to provide job opportunities for the unemployed (a major problem regionally)? There are many associations fro the unemployed thart could facilitate this. (Not easy to see how GIAHS could contribute directly).
- Microfinance is a key catalyst, and this might be encouraged by GIAHS status.
- Similarly there is huge pressure to provide job opportunities for women.

Meeting with Bureau of Culture and Tourism

The Deputy Head had no prior knowledge of GIAHS, and was insistent (Monday) that the consultation should be held on Tuesday with the Head of Bureau (Dr Zewdie Zerihun Alako), who he believed to have been briefed. In fact the Bureau Head was still in Addis Ababa on Tuesday, so the meeting went ahead with Shigute Tiyite Menesah.

The Bureau regards culture as “how people live and cooperate”, and this is in its own right worthy of being preserved for future generations, who can then benefit from an understanding and appreciation of past heritage. It is probably the case that National Government as a whole emphasises economic development over heritage, but this is not true of the Bureau of Culture and Tourism. In fact the Regional States themselves (such as SNNPSR) are “nationalities” with very distinct cultures that deserve preservation.

The Gedeo Highlands are a perfect example of a distinctive culture with a lifestyle based on sustainable Forest use and protection. This balanced agroforestry is its distinctive feature. Overall there is little threat from population increase. Traditional knowledge passes down generation to generation, but additional and more formal training and skills sharing are important both to allow for new approaches and technologies, but also to provide skills and attitudes to incomers. Women and children play a major role in forest protection: lose a tree, plant a tree.

However, the long term future is difficult to predict for local government, and this is where GIAHS status may play a more direct role. GIAHS will be important for whole country not just the Region. The Bureau of Culture and Tourism is already making an effort, and data on culture and lifestyle are being collected and are available to researchers. Again, GIAHS status may be a catalyst here.

As a comparator, the Konso World Heritage Site designation brought substantial benefits. Cultural forms such as housing and terracing were major attractions, but approaches to land management were also recognised.

In principle, the Gedeo Region could gain even more than Konso, with natural resources as the main attractant. Tourist infrastructure is planned but not implemented (though there is some limited coffee tourism) – so there are quick-win benefits here if funding streams could be identified. Resources so far have been provided by USA, UK, Germany and Italy for Eco-Tourism and Coffee-Tourism.

- Labour availability is no problem as there are many unemployed people.
- There is an immediate need for training as tour guides.
- Much scope for producing tourist products from forest resources (including enset and bamboo trees).
- Knowledge sharing from similar agroforestry areas could be invaluable.
- Enset is viewed as a key resource within the eco-tourism offering (products including carpets and rope). Its magical "tree of life" image could be a high-profile to international tourists.
- Overall skills and capacity building are a high priority.
- The Gedeo Highlands are already recognised as extremely important by the Bureau, and could be even more so in the future if it gained international profile.

Meeting with Bureau of Cooperatives and Marketing

No prior knowledge of GIAHS but immediately saw the potential as far as economic development was concerned. The farmers' cooperatives are the key to cooperation and joint investment in the coffee lands, yet only 11-14% of farmers are members. There is much scope to extend the work of the cooperatives and extend their membership.

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Strengths of Enset/Coffee Agricultural Systems (Baboo Culture)

Specific Enset/Coffee strengths		
1	Due to intense soil tillage enset has a positive impact on soil fertility and micro climate, and shows soil preserving capabilities.	Karin Zippel, Enset in subsistence farming systems in Ethiopia. 2002
2	In order to protect the soil from erosion, ensete was planted in zig-zag rows. In this way, coupled with the practice of spot planting which necessitated tilling only a small part of the land for ensete plants, farmers were able to effectively protect the ensete landscape from the impact of torrential rains. As a result, the Gedeo highlands were immune to severe erosion and landslides.	Harnessing rainwater in Yirgachaffee coffee production: the case of ensete-based Gedeo landscape Tadesse-KippieKanshie
3	Systems with enset are integrated production systems, whose different production lines integrate with each other. These systems respond much better to ecological or structural changes than systems which have only one or very few production lines.	Karin Zippel, Enset in subsistence farming systems in Ethiopia. 2002
4	Enset protects and stabilizes the landscape. Although physical conservation structures such as terraces are non-existent, thanks to the ensete, severe soil erosion and landslides are unknown over the Gedeo landscape.	Harnessing rainwater in Yirgachaffee coffee production: the case of ensete-based Gedeo landscape Tadesse-KippieKanshie
5	The connection between the rainwater harvesting by enset and coffee quality was discovered when ensete removal from the coffee farms was followed by disappearance of the quality sought in coffee. An important link is therefore shown between the rainwater collected and held by the ensete plants and the reproductive physiology of coffee trees.	Harnessing rainwater in Yirgachaffee coffee production: the case of ensete-based Gedeo landscape Tadesse-KippieKanshie
6	Ensete also plays an important role in soil improvement. The fibrous ensete roots, infiltrating the top soil, were as a rule left on the site. When these are decomposed, the epidermis remains intact in the soil, where it acts as airways or assists in soil aeration. Evidence for this exists in the practice of putting degraded soils under ensete plants for rehabilitation.	Harnessing rainwater in Yirgachaffee coffee production: the case of ensete-based Gedeo landscape Tadesse-KippieKanshie

7	Once protected from loss, the ensete rainwater was released, automatically, albeit slowly, and also initiates flowering in the productive coffee trees. In the absence of ensete moisture, these flowers were aborted, leaving farmers without yield. The rainwater from the ensete leaf-sheaths not only helped the coffee and other plants survive the dry spell between January and March, but is also essential for the coffee seedlings to help them survive the dry season but for their subsequent growth and performance. In the dry season, coffee trees needed moisture in order to initiate their flowers, but without ensete water these were aborted, leaving farmers without yield.	Harnessing rainwater in Yirgachaffee coffee production: the case of ensete-based Gedeo landscape Tadesse-KippieKanshie
8	The ensete rainwater tempers the tendency in coffee trees to overbear, which weakens them and makes them susceptible to pest and/or disease attacks. Coffee trees so weakened needed resting from 2 to 3 years, or even 5 years in worst cases. Thus, ensete through its rainwater also keeps the health of coffee trees.	Harnessing rainwater in Yirgachaffee coffee production: the case of ensete-based Gedeo landscape Tadesse-KippieKanshie
9	Farmers also reported that ensete plants are also protected from the notorious bacterial wilt locally known as we'lo. Indeed, wee'lo, a menace to other ensete regions, was unknown in the coffee belt of the Gedeo zone.	Harnessing rainwater in Yirgachaffee coffee production: the case of ensete-based Gedeo landscape Tadesse-KippieKanshie
10	Besides irrigating coffee, ensete water was used domestically for washing farm implements and ones feet and hands, after farm work, which is far away from rivers, streams or home. Farmers could also draw from the ensete water for their livestock. Milk cows, sheep and domestic fowl were fond of the ensete water.	Harnessing rainwater in Yirgachaffee coffee production: the case of ensete-based Gedeo landscape Tadesse-KippieKanshie
11	Ensete plants provide ample shade to coffee trees. Farmers preferred ensete shade to the shade of trees, as ensete leaves (unlike tree branches) could be easily be removed as needed. Ensete leaves could be lowered without severely impairing its photosynthetic capability.	Harnessing rainwater in Yirgachaffee coffee production: the case of ensete-based Gedeo landscape Tadesse-KippieKanshie
12	With the ensete, rainwater is held mechanically and available to use without much damage to the plant - in this regard, farmers have rightly called enesete a biological tanker. Using this capacity in the ensete, farmers were able to produce coffee without foregoing the production of their food by the ensete. Ensete is thus responsible for the superior flavour and aroma of the coffee bearing the name Yirgachaffee.	Harnessing rainwater in Yirgachaffee coffee production: the case of ensete-based Gedeo landscape Tadesse-KippieKanshie
13	Because of its capacity to integrate production with conservation, ensete is seen as a pillar of the Gedeo land use system. All other land use elements are considered as secondary. The evergreen Gedeo landscape covered by crop plants, forest species and livestock along with semi-domesticated and wild elements owes its quality to the integrative role of the ensete.	Harnessing rainwater in Yirgachaffee coffee production: the case of ensete-based Gedeo landscape Tadesse-KippieKanshie
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GIAHS Profile potential match for Gedeo Coffee/Ensete System

This initial profiling is based on the FAO GIAHS standard criteria/template and uses desk-based research. It is open to redefinition of criteria during the project, and to refinement of content through field research

Objectives of GIAHS Global Partnership Initiative	Leverage global and national recognition of the importance of agricultural heritage systems and institutional support for their safeguard There is much detail (pro- and anti-GIAHS) that will need to await clarification from the field visit, but the basic position is that the Gedeo coffee/*ensete* system in well-known and well-regarded in heritage agriculture circles (*published literature and the FAO International Forum meeting in Noto, Ishikawa, Japan 29 May to 1 June 2013*). It is also in active FAO and GIAHS consideration as a candidate for GIAHS designation, which would make it a flagship Ethiopian exemplar of traditional sustainable agrosystems. However, it is also clear that this enthusiasm is not currently shared at government level in Ethiopia (Ministry?), apparently because the intercropping of *ensete* is regarded as a cultural throwback that reduces the coffee yield that could be expected from mono-cropping. The substance of this debate needs to be specified in detail so that the technical facts can be established in a way that is acceptable to both sides of the argument. It is hoped that a convergence of thinking could then be achieved; with the outcome that coffee/*ensete* could be encouraged in appropriate circumstances as a viable 21st Century food producer and livelihood supplement rather than just a heritage/cultural feature.
	Promote enabling policies, regulatory and incentive environments to support the conservation, evolutionary adaptation and viability of GIAHS. *To be confirmed in field visit*
	Capacity building of local farming communities and local and national institutions to conserve and manage GIAHS, generate income and add economic value to goods and services of such systems in a sustainable fashion *To be confirmed in field visit* The local farming community has the skills necessary to support maintenance and expansion of the coffee/*ensete* system in Gedeo zone, but there are suggestions that the skill base is falling into neglect and is being degraded by outmigration. *Ensete* unambiguously generates income at a community level as well as providing broad-based livelihood support as a foodstuff, building material, mulch and erosion control.

Remarkable characteristics of GIAHS	High levels of biodiversity provide ecosystem services *This requirement appears to assume that both biodiversity and ecosystem services targets are being met. This will need checking in the field, particularly with respect to ecosystem services.* The agroforests (a form that was strong in Gedeo tradition) have been found to be very biodiverse: this applies specifically to the forest version rather than the herbaceous weedy vegetation of the more recent *ensete*/coffee agrosystem. The capacity of the Gedeo agroforests to provide biotopes for wildlife has been establised. The same is true for the weedy vegetation, which the Gedeo regard differently: in fact the use of the term "weed" is due to a lack of another more appropriate term in agriculture or forestry. Biodiversity can thus be regarded as an inherent property of the complexity of the Gedeo *ensete*/coffee agrosystem. It is clear that there are also substantial ecosystem services contributions by the coffee/*ensete* system in all categories – Provisioning (food, fibre, water); Regulating (soil erosion control, pest control, shading); Supporting (soil enrichment, nutrient cycling, water cycling); and Cultural (cultural heritage). Indeed, the breadth of services provided by *ensete* can only be regarded as exceptional. These roles are explained in more detail in sections 2.2-2.6 below.
	Driven by traditional knowledge systems, innovations and technologies Gedeo agroforests represent the most ancient (more than five thousand years old) *ensete*-based systems in Ethiopia. *Ensete* is the basis of one of the four traditional agricultural systems in Ethiopia as viewed in the 1990s. It has its origins in the Neolithic period and has been important in Ethiopia continually since that time, but its cropping practices and associated culture have evolved over the centuries and the recent decades. The traditional Gedeo system blended elements of pastoralism, silviculture and cropping – with *ensete* being an important element of the latter. To the farmers, *ensete*-based land use was a survival strategy. Traditionally, the feudal landlords (who took 30%-50% of the local Gedeo production) were uninterested in *ensete* as food and focused on coffee. Intercropping of coffee and *ensete* was important to the farmers and the landlords did not interfere with this, to the benefit of all as sustained yield was possible. The feudalists were ignorant of the way coffee was produced by the Gedeo farmers and accepted it: had they known that coffee could be grown in monoculture, they would have forced farmers to maximize yield from coffee by eliminating everything else. The Gedeo *ensete* intercropping represents the only remaining example of traditional *ensete*-based land use, from which simpler forms of *ensete* mono-cropping practised by other southern and south-western peoples

	of Ethiopia emerged. Gedeo land use is also considered an indirect progenitor of conventional agriculture, forestry and agroforestry.
	Ingenious practices that can improve modern agrosystems The connection between the rainwater harvesting by *ensete* and resulting coffee quality was demonstrated when *ensete* removal from the coffee farms was followed by reduction of the desired coffee quality. Once protected from loss, the *ensete* rainwater is released automatically and slowly, and also initiates flowering in the productive coffee trees. In the absence of *ensete* moisture, these flowers were aborted, destroying the coffee crop. The *ensete* rainwater reduces the tendency of coffee trees to overbear, which weakens them and makes them susceptible to pests and/or disease attacks. An important link was therefore shown between the rainwater collected and held by the *ensete* plants and the reproductive physiology of coffee trees – and this advantage could be applied to modern non-intensive agrosystems. With *ensete*, rainwater is held mechanically and is available to use with minimal damage to the plant. Using this feature, farmers were able to produce coffee without foregoing the production of their food by the *ensete*. Ensete was also regarded as being responsible for the superior flavour and aroma of the Yirgachaffee coffee. In addition to irrigating coffee, *ensete* water was used domestically for washing farm implements, feet and hands. Farmers could also draw *ensete* water for livestock. Elements of this direct water provision may retain value in modern agrosystems. *Ensete* also plays an important role in soil improvement. The fibrous *ensete* roots in the top soil were left on the site and when these decompose the epidermis remains intact in the soil, where it acts as airways or assists in soil aeration. Evidence for this exists in the traditional practice of putting degraded soils under *ensete* plants for rehabilitation. This is another practice that could be transferred to modern agrosystems. It has also been reported that *ensete* plants are protected from the notorious bacterial wilt locally known as we'lo. This is an active threat in other *ensete* regions but was unknown in the coffee belt of the Gedeo zone. There may be generic value in this link.
	Diversified systems that add to food security The core components of the Gedeo coffee/*ensete* system regulate both food production and environmental protection in the agro-ecosystems, and in combination they are both ecologically and socially comprehensive. Together, they provide invaluable stability and resilience.

	These roles are achieved by *ensete* and diverse multipurpose tree species which render the overall system robust and resilient. The economic contribution includes crops grown for sale including coffee, together with farm. The weedy herbaceous vegetation plays an important role in maintaining the ecological base of production, the soil. Because of its capacity to integrate production with conservation, *ensete* is seen as the key to the traditional Gedeo land use system. However, *ensete* agriculture as practised by the Gedeo is unique in its diversity as well as in its functioning. It has been noted that while other *ensete* peoples concentrate on *ensete* as a crop which they grow in the homestead, the Gedeo maintain a complex mixture of crops (grain and vegetable annual and perennials such as coffee and multipurpose tree species and shrubs) with *ensete*. This approach to *ensete* cultivation gives the Gedeo agroecosystem a strong resemblance to forests – with all the value that the consequent diversity brings to lifestyle and food security.
	Exhibit resilience and robustness to cope with disturbance and change The Gedeo coffee/*ensete* system supports soil maintenance, since with intercropping and rotation only a small proportion of the farm area is harvested and replanted at any one time so adverse impact of rainwater and scorching heat of the sun are minimised. The integrative system uses "weeds" for soil maintenance by their physical presence (they are not touched during the rainy seasons) and by sharing soil nutrients and other site resources with "crop" plants and conserving these in their biomass. The nutrients contained in the weedy biomass are returned to the soil by mulching. Weeds therefore have the same function as the fallow vegetation in shifting cultivation. The soil is also replenished by the leaf litter from the multi-purpose trees, crop by-products and farmyard manure and household refuse. Systems with *ensete* are integrated production systems, whose different components support each other. These systems respond much better to ecological or structural changes than systems which have only one or very few production components.
	Provide local, regional and global ecosystem services See Section 2.1 above for a general statement on ecosystem services. In the case of *ensete*, the impacts are mainly local – but the wide distribution of the crop gives it regional beneficial outputs. In addition, in order to protect the soil from erosion, ensete was planted in zig-zag rows. In this way, coupled with the practice of spot planting which necessitated tilling only a small part of the land for ensete plants, farmers were able to effectively protect the ensete landscape from the

	impact of torrential rains. *Ensete* protects and stabilises the landscape. Although physical conservation structures such as terraces are non-existent, thanks to the *ensete* severe soil erosion and landslides are unknown over the Gedeo landscape.
	Regulated by strong cultural values and collective forms of social organisation Gender division of responsibility is important in the traditional Gedeo ensete system: women had a monopoly on decisions regarding most farm products but men were viewed as controlling coffee activities.
Generic examples of Heritage Systems	The Gedeo coffee/*ensete* agrosystem has affinities to several of the familiar GIASHS exemplar systems, including: Mountain rice terrace agrosystems The Gedeo coffee/*ensete* system has some common features with terrace agrosystems in general: it is in no way reliant on terracing (because of its excellent soil erosion resistance) but could well extend its water conservation advantages to other terraces systems in Ethiopia Multiple cropping/polyculture farming systems The Gedeo coffee/*ensete* system is strongly based on polyculture with the two crops cropped together and the coffee reliant for quality and drought resistance on the ensete Understory farming systems The coffee is grown as an understorey to the *ensete*, which serves as a shade plant which aids water conservation Nomadic and semi-nomadic pastoral systems Ancient irrigation, soil and water management systems Complex multi-layered home gardens Below sea level systems Tribal agricultural heritage systems High-value crop and spice systems Hunting-gathering systems
Unique features principles and processes that may be	Biodiverse production system *To be confirmed in the field – the literature does not stress biodiversity, either because this is not a feature of the system or because most of the*

derived from GIAHS	*detailed work on coffee/ensete predates the current focus on biodiversity.*
	Agro-biodiversity and Genetic resources for food and agriculture *As above – biodiversity aspects are not clear in the literature and will need clarification in the field.* *Ensete* is only vegetatively propagated, so a narrow genetic base means higher risk if extensive *ensete* cultivation were to be envisaged for other parts of Ethiopia or the world.
	Customary management and social organisation The use of *ensete* (whether intercropped with coffee or not) is deep embedded in the Gedeo culture, and has been for many centuries – it is a major lifestyle element as well as a livelihood support. In reality, of course, it is the very broad range of livelihood services provided by the plant that give it the basis for its cultural importance. Indeed, there is apparently a strong view in parts of government that the Gedeo dedication to maintaining the use of *ensete* is based more on its cultural role than on any agro-economic status, though the two are so symbiotic that this probably under-values agro-economic aspects. However, there are indications that the traditional cultural systems and values have been declining and transforming over the past two decades with demographic and social change and outmigration: *this will need clarification in the field*. There has also been some traditional denigration of *ensete*-based agrosystems by pastoralist and cereal-growing peoples in the region. However, there have been close economic traditions of cooperation between the Gedeo and the Guji, Sidamo and Wolaita people (exchange of products; share cropping; inter-use of grazing land). *Ensete*/coffee intercropping has traditionally emerged essentially as a subsistence farming component, though over the last two decades there has been increasing government-level pressure to transform the Gedeo agrosystem into a more modern commercial structure (which implies intensive monocropping). However, despite the significance of *ensete* in the Gedeo and adjacent regions (Highlands to east of the Rift Valley (Gedeo and Sidamo), and to west of the rift valley e.g., Guraghe, Hadiya, Kambata), the plant's cultural importance does appear to be livelihood-based and is not affiliated with religious belief or practice (traditional or Christian).
	Traditional knowledge Many of the modern development interventions into Gedeo land use have failed, which is not surprising as they were introduced without a basic understanding of the land use system. Understanding why farmers

	have resisted new technologies and practices is important, as is knowledge of the constraints under which farmers operate as these may support the planning of future interventions.
	Agro-ecological knowledge and low-input technologies *Ensete*-based systems are environment-friendly and have higher carrying capacity despite requiring few external inputs and only very limited agro-technology. This higher carrying capacity is often attributed to farmyard manure applied to *ensete:* integrated agrosystem design and crop architecture, which play fundamental roles, have been substantially underestimated as key elements in the combined production and maintenance roles.
	Locally-adaptable food processing and storage techniques An important element of "food storage" in the traditional Gedeo coffee/ensete system in the fact that intercropping and rotation mean that growing plants maintain a healthy food reserve that can be drawn on easily.
Replicable features principles and processes that may be derived from GIAHS	Sustainable utilisation of agro-biodiversity and natural resources The design of livelihood systems and related agrosystems to a large extent determine their capacity to resist pressures such as pests, diseases, unpredictable natural hazards and environmental change. Gedeo land-use design provides insights into the processes underpinning this sustainability and resilience. Examination of the design would identify the nature and characteristics of the components providing the sustainability.
	Resiliency of production system The Gedeo coffee/*ensete* system is self-regulating and self-regenerating, and the role of farmers is simply to recognise and support these integrated protection and production functions. It was this resilience rather than cultural inflexibility that led farmers to defend this agro-ecosystem design from less appropriate modern development interventions (intensive monoculture), which dismantled the system and replaced it with simpler systems that had inferior resilience and sustainability. This has prompted a re-evaluation of previous agricultural interventions in Ethiopia which were often based on introducing "modern" agricultural technologies and practices. Areas practising *ensete* agriculture, with or without coffee, have often been able to resist famine: ensete has been called the tree against

	hunger, showing that interest in the crop is being revitalised after long time negligence. There is consensus that *ensete* offers a unique opportunity to easily avert the precarious food situation in Ethiopia.
	Adaptation to harsh environments Ensete has significant inherent drought resistance, and the intercropping practice provides excellent resistance to soil erosion and soil fertility loss. Shading and rainfall impact protection are also provided.
	In-situ conservation of genetic resources
	Multiple use of landscapes The ensete/coffee agrosystem sits comfortably alongside many other crops and also fits within an agro-forestry mosaic.
GIAHS Project goal and outcomes	An internationally-accepted system for recognition of GIAHS is in place
	The conservation and adaptive management of globally-significant agricultural biodiversity harboured in GIAHS is mainstreamed in sectoral and inter-sectoral plans and policies in pilot countries
	Globally-significant agricultural biodiversity in pilot GIAHS is being managed and sustainably used by empowering local communities and harnessing evolving economic, social and policy processes and by adaptation of appropriate new technologies that allow interaction between ecological and cultural processes
	Lessons learned and best practices from promoting effective management of pilot GIAHS are widely disseminated to support expansion and up-scaling of the GIAHS in other areas/countries and creation of the GIAHS network.

Appendix ii: Background Literature on Bangladesh GIAHS study site

Floating bed cultivation has proved to be a successful means of agricultural crop production in different wetland areas of the world (Isalm & Atkins, 2007 p.1). The primary objective of the technology is aimed at adapting to more regular or prolonged periods of flooding which covers key cropping zones and inhibits rural farmers from accessing their land or attain a means of sustaining a livelihood. The approach employs beds of rotting vegetation, which act as compost for crop growth. These beds are able to float on the surface of the water, thus creating areas of land suitable for agriculture within waterlogged regions. Scientifically, floating agriculture may be referred to as hydroponics. The use of such platforms made up of plant materials to grow crops dates back a few thousand years (IUCN Bangladesh, 2005 p.7); and have been studied all over the world for their ecological, indigenous and economic significance (Box 2. *See below*). In recent years, floating gardening has become a widely talked about climate change adaptation option – and has been referred to as becoming almost a "climate celebrity" (Irfanullah, 2013 p.1).

Floating gardening attracted different people for different reasons. Historians love its link with civilization. Anthropologists love its indigenous aspects. Nature enthusiasts enjoy the wild beauty of floating islands and associated wetland biodiversity. Development practitioners find the beds as a low-cost tool to grow food for starving community in monsoon season (IUCN Bangladesh, 2005; Irfanullah *et al.*, 2008; Irfanullah, 2013). Economic opportunity and demand encouraged smart farmers to transform this traditional practice into a commercially viable agro-business (IUCN Bangladesh, 2005). Environmentalists see this as an opportunity to manage invasive weeds, thus maintaining natural water flow (Sinolinding *et al*., 2013). This form of gardening is also considered to reduce the sufferings of the people from flooding. Source: (cited by Irfanullah *et al*., 2013 p.4).

Worldwide it is thought that over 51 million poor and lower-middle class farmers are engaged in hydroponic agriculture; 48 million of whom are located in developing countries (New Age news site, Online). Both natural and artificial floating beds are used for agriculture in many tropical wetlands of the world (IUCN Bangladesh, 2005; Sidle *et al*., 2007; John *et al*., 2009; Irfanullah 2013; Mushatq *et al*., 2013). As a traditional practice, floating gardening is often associated with specific indigenous communities who gave these floating bodies different names.

Floating Agriculture in Bangladesh (Baira): A GIAHS Candidate

In order to tackle the devastating effects of floodwater and associated subsequent water logging on agriculture, a number of communities in southern Bangladesh have developed and established a sustainable means of cultivating seasonal vegetables and seedlings during the monsoon season (Irfanullah et al, 2013). This practice is commonly known as floating gardens, or locally known as baira (Av Rajib Shaw, Mallick, Islam, 2013). Baira's, a form of hydroponics* or soil-less agriculture, is a traditional cultivation system that has been practiced in southern Bangladesh for at least two hundred years (IUCN Bangladesh, 2005 p.6). The practice provides an effective technique to overcome the lack of dry land and continue horticulture practices for food consumption as well as commercial supply in the floodplains of Bangladesh (IUCN Bangladesh, 2005 p.6). Baira's are also known as gathua, geto, daap and gatoni in Bangladesh (IUCN Bangladesh, 2005 p.8). This indigenous practice is highly productive, cost effective and ecologically sound, but is only practised to a limited extent, in around 2500 hectares. In the south-west region of Bangladesh there exists about 200 000 hectares of natural and artificial wetlands. Of this, about 20 000 hectares could potentially be used

for of soil-less agriculture (LEISA, 2004, p.20). Floating garden agricultural systems are not restricted to Bangladesh, Figure 1 (Practical Action, 2014) shows other similar systems .

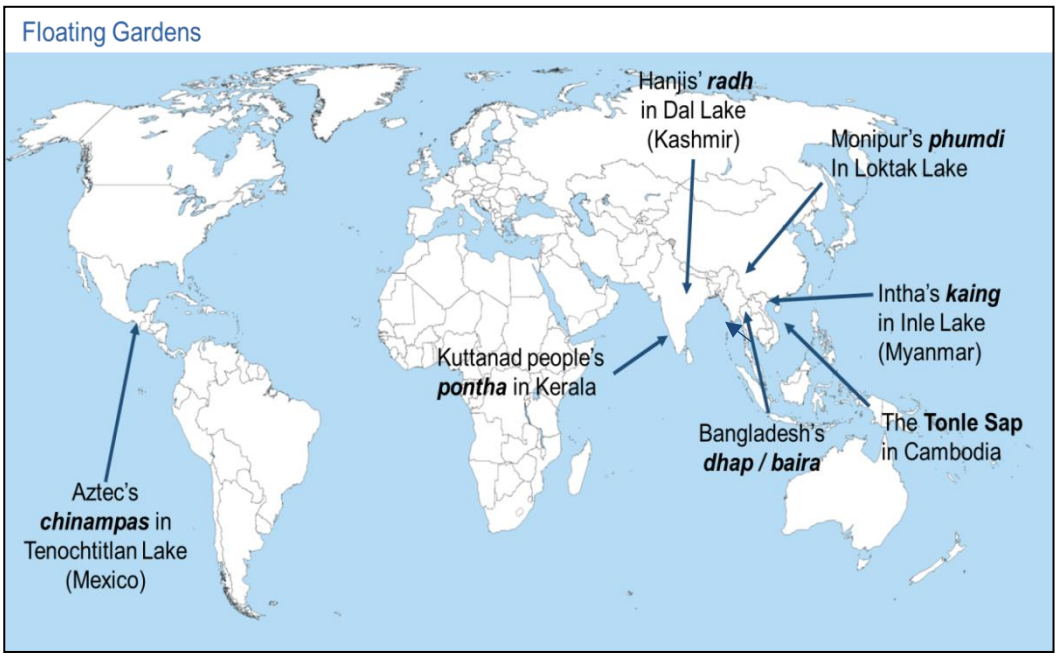

Figure 1: Global locations of floating gardens Source: Modified by author from Practice Action (2014 p.4)

Figure.2 Baira Farming in Pirojpur districts in Bangladesh. Source: IUCN (2005 p.8)

Traditional *Baira* cultivation is predominantly found in a number of remote districts, also known locally as sub-districts in southern parts of Bangladesh, namely in the districts of Barisal, Gaibandha Gopalgani, Faridpur, and Pirojpur (IUCN Bangladesh, 2005), Figure 2. Table.4 (*See below*) lists the *upazilas* where this practice has been practiced. The indigenous practice is not common in other parts of the country, however according to a paper published by the IUCN (2005 p.10), other

districts, namely Jessore, Narail, Bagerhat, Khulna and Satkhira have numerous wetlands suitable for *baira* farming. Other areas have also come under organized *baira* extension recently under a couple of environment development projects. Figure 3 (*See below*) shows the areas in Bangladesh which have utilized traditional baria cultivation as well as NGO and government run projects. Little literature remains on these initiatives.

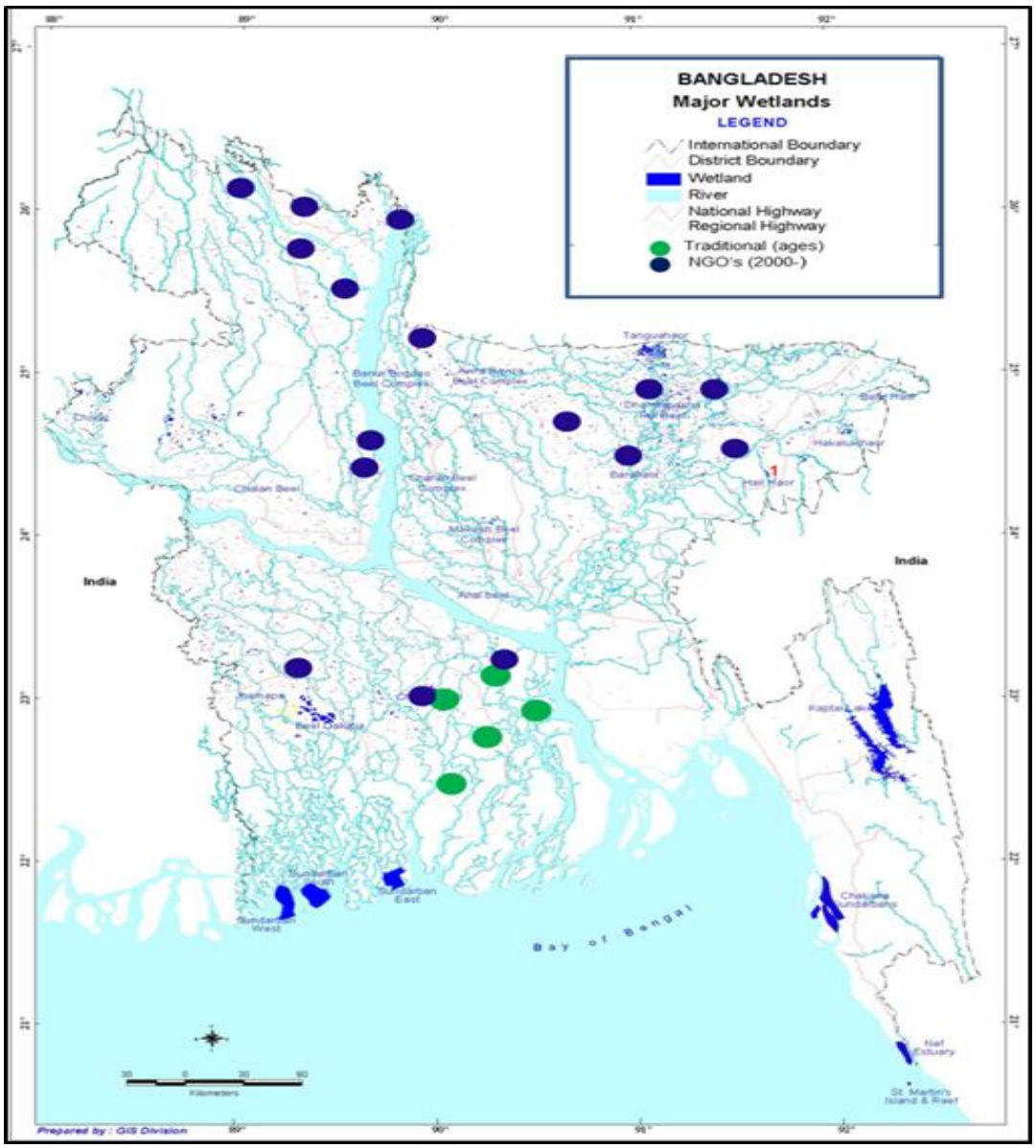

Figure.3 Areas of Traditional and NGO implemented Baira agriculture in Bangladesh Source: Modified by author from Practical Action (2014, p.8)

Community Field Study Sites

The field research involved visiting 8 communities in four locations across the Gopalganj and Pirojpur Upzila. These were located in Gopalganj, Kotalpara, Tongipara in the upzila of Gopalganj and Nazipur in the upzila of Pirojpur (Figure 4).

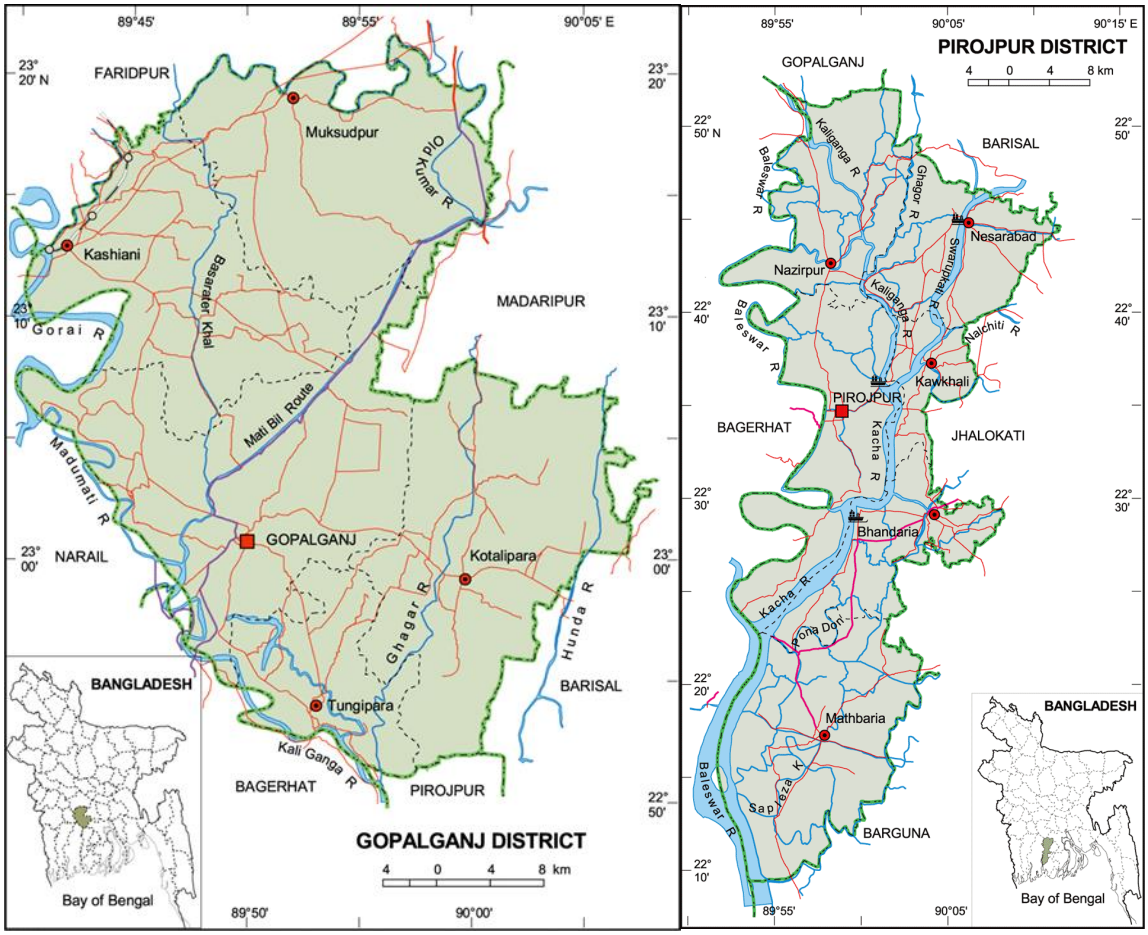

Figure 4. Showing locations of community visits to discuss floating gardens: Gopalganj, Kotalipara, Tungipara and Nazipur (Pirojpur)

Gopalganj District Communities
Bagan Uttarpar village, Kotalipara
Bannabari village of Tungipara
Mitradanga village of Tungipara
Zoaria village of Tungipara
Raghunathpur village of Gopalganj

Pirojpur Districts Communities
Mugarjhar village of Nazirpur
Gaokhali village of Nazirpu

Materials for Floating Agriculture (Baira)

The method of making method Baira agriculture has been adopted and modified within different *upazilas* locations in the country. The modified activities include the size, shape and elements used for preparing the floating bed (APEIS and RIPSO, 2004 p.2). Floating bed agriculture usually measure 8 meters in length, 2 meters in width and 0.6-1 meter in depth. If there is a lack of space or if raw materials are in short supply then the rafts can be made smaller (Practical Action, 2005.p.3). Floating gardens usually consist of two or three key layers. The first usually consists of a highly invasive aquatic plant called water hyacinth, locally known as *Kochuripina.* Water hyacinth are the most common material used as the floating base of floating agriculture. Irfanullah (et al, 2011 p.2) described traditional cultivation as an environmentally-friendly way to utilize the natural resources of wetlands to

grow vegetables and other crops almost all-the-year-round. There are many benefits of using this highly invasive aquatic plant, these are presented in Box. .. (*APPENDIX*). If water hyacinth is not available other materials can be used such as paddy straw, nalkhagra – a freshwater wetland tree, and any available organic materials such as azola, coconut straw, bamboo, and old rope(Practical Action, 2005.p.3). Once water hyacinths are collected they are piled into a rectangular, compact, thick structure where an upper later, consisting of decomposed water hyacinth, other vegetation and sometimes mud (Irfanullah, 2013 p.1). The layering of the floating garden is presented in Figure 13 (*See below*). Figure 5. (*See below*) shows a flow diagram regarding the preparation and planting process of floating gardens.

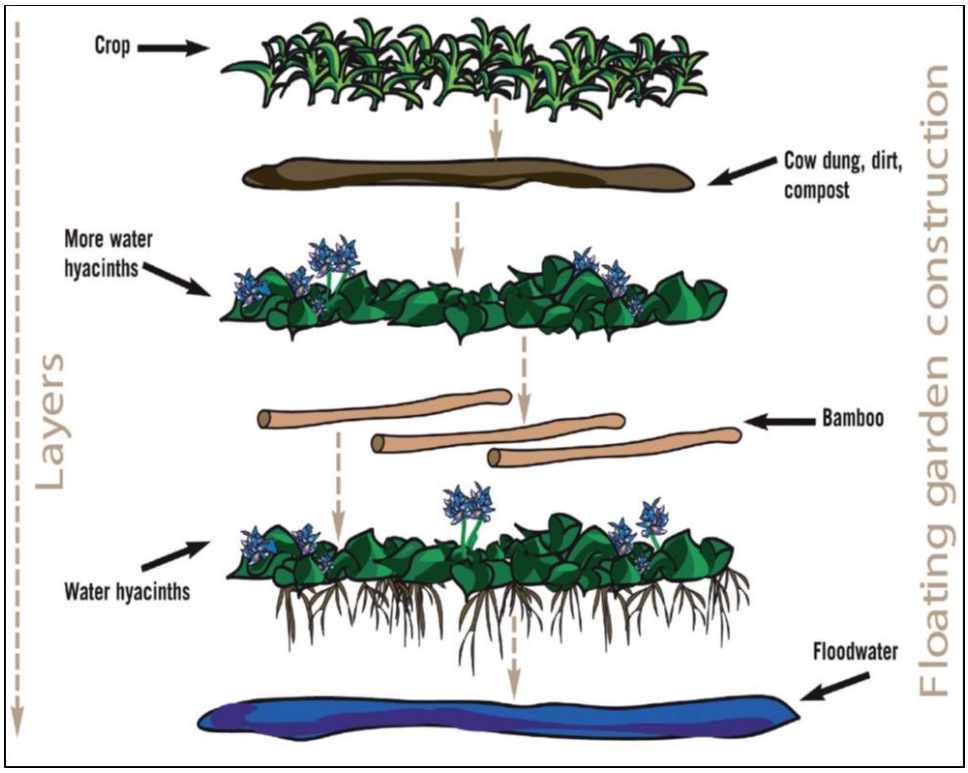

Figure 5: Material used for floating agriculture. **Source:** (Irfanullah, 2013 p.5)

Growing Crops and Vegetables on Floating Beds

Whilst crop cultivation varies between seasons, more than 20 varieties of vegetables and other crops have been successfully grown on baira agriculture. Such crops include: red amaranth, Indian spinach, coriander leaves, cauliflower, cabbage, tomato, lady's finger, cucumber, bitter, gourd, bottle gourd, snake gourd, ash gourd, sweet pumpkin, bean, radish, brinjal (eggplant), potato and spices including chilli, onion, garlic, turmeric and mustard are grown on *baira* in different locations in Bangladesh (IUCN, 2005 p.5).

Financial Requirements and Costs

Floating agriculture practices have minimal infrastructure and very little capital requirement (Saha, 2010). Costs can also be kept low because raw materials for the construction of floating beds are readily available from local waterways. Haq et al. (2004) conducted an analysis of the costs of implementing floating agriculture in Bangladesh. Their findings are shown in Table 5 (*See below*).

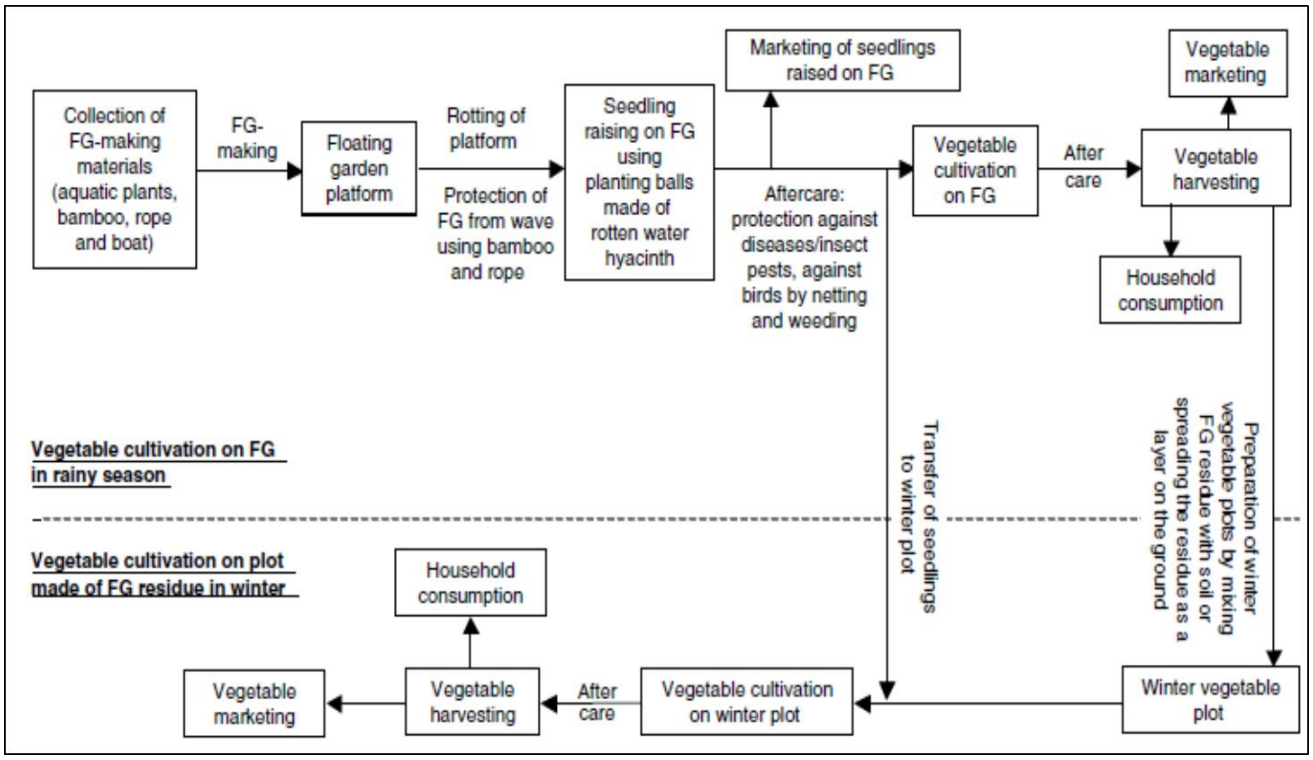

Figure 6: Floating and associated winter vegetables gardening traditionally practiced in Bangladesh (Irfahlluah, 2011 p.2)

Table 1: Costs of implementing a floating agricultural system in Bangladesh Irfanullah et.al (2011, p.6)

Activity	Duration	Total Cost (Tk)	Total cost converted to US$ (in 2009 US$)
Construction of floating beds	60 man days	3000	63
Collection of raw materials (weeds)	20 man days	1000	21
Seed and/or seedling purchase	-	600	13
Bamboo, rope, crop harvesting and maintenance	-	1000	21
Total		**Tk 5600**	**US$ 118**

Benefits & Disadvantages of Floating Agriculture (Baira)

Populations located in the floodplains of Bangladesh are mostly poor and are often constricted by not having sufficient space to crop and or access to or ownership of land. Access to land is additionally restricted during monsoon season and flooding for prolonged periods of time. During these times, local rural people are often constricted to growing only one cop per annum. *Baira* agriculture provides an opportunity with additional cropping space the time most suitable for cultivation. In addition to this, the technique allows farmers to generate an income during monsoon season. A study by the IUCN (2005, p.5) elaborated on this by noting that if the local poor community prepare *baira* and get involved into marketing of seedlings and vegetables, they would prepares five average size (30 ft x 9 ft) *baira* platform, at the end of the season his net income would be around Tk. 8,000-10,000, which is a good sum for a poor farmer or a vulnerable person in the *beel* areas. Irfanullah (2013 p.3). have noted that the productivity of such farming systems can generate 10 times higher than traditional land-based agricultural production in the southeast of Bangladesh. . However, since floating gardening is completely dependent upon rainfall (for water to come in and water hyacinth to grow in it) and since the cultivation mechanism is poorly understood, floating

gardening might be a limited adaptation choice under uncertain climate regime (Irfanullah, 2013 p.4). Table. 6 (*See below*), highlights some of the social, economic, agricultural, ecological and environmental benefits associated with *baira* practice. The table also highlights key disadvantages of using such technology.

Table2: Benefits & disadvantages of floating agriculture

Socio-economic benefits
6. 1. Cultivation on baira platforms facilities employments in the floodplains areas in rainy season.
2. It increases quality food production, which positively influences the health of the local communities.
3. Baira cultivation promotes the expansion of local techniques of hydroponics, thus helping in conserving indigenous knowledge.
Agricultural benefits
7. 1. *Baira* platforms provide additional cropping and seedling raising areas in the floodplains especially during rainy season when the cultivation land is scanty.
2. Prime nutrient elements of plants, namely, nitrogen, potassium and phosphorus, are available in water hyacinth. A comparative study on water hyacinth and cow-dung has shown more or less similar concentrations of these elements (Aktar et al. 1997). *Baira* thus cuts down fertilizer expenses considerably.
3. Crops require shorter time to mature when cultivated of *baira* platforms
4. Increase vegetables supply in the area an the surroundings
5. The floating platforms could be used as additional space for community nursery in the wetlands.
6. When water recedes from the *beels*, *baira* platforms are used as organic fertilizer. In this way *baira* enhances eco-friendly agriculture practice in the following winter to cultivate robi/winter crops.
Ecological benefits
8. 1. As chemical fertilizers are not used in baira cultivation in large amounts, this cultivation practice does not harm the environment by supplying chemical pollutants to the water.
2. Since *baira* residue could be used as organic fertilizer for winter crops, this practice cuts down pollution from chemical fertilizer.
3. *Baira* provides a good use of an invasive species like water hyacinth. This is a very effective way to control this notorious weed.
Disadvantages of technology
1. **Few studies have been carried out to assess how salinity may affect floating agriculture**
2. **The methods used in floating agriculture have the drawback of encouraging insect and rodent infestation. This may cause health problems and damage to crops (Saha, 2010).**
3. **The technology can also cause conflict within the community if common property areas are dedicated to the practice. Such an approach may lead to politically more powerful individuals attempting to acquire these areas for their own gains (Islam & Atkins, 2007).**
4. **Although this technology provides the advantage of maintaining food production, it may be difficult to transport produce to market because the area remains waterlogged most of the time (APEIS & RIPSO, 2004).**

Source: Irfanullah et.al (2011, p.6)

National/Local Government Perspective:

The field work focuses on the Gopalganj floating garden. This Zone typifies the landscape and people that utilse this agricultural approach, and is well known for its production of high quality, pesticide and fertilizer free high value horticultural products . In this very stable, sustainable and long-established traditional approach, the rafts are used alongside traditional Paddy (rice) farming approaches and offer substantial additional income to families in the area.

National Meeting: Dept. Agricultural Extension (DAE), Ministry of Agriculture

A meeting was conducted to understand the perspective of the key national government agencies with responsibility for the development of agricultural at the community level in Bangladesh. The floating gardens approach needs to be developed under scientific conditions and essentially optimized to offer greater productivity. To this end test sites have been established to demonstrate the approach to interested farmers. Additionally, Not aware of any cultural or social associations with Floating gardens. Highly supportive of further research into floating gardens

Local Government in Gopalganj: Benefits of promotion of floating gardens

- Uptake of rafts has been a singular success with 1000's of farmer in the region adopting the approach. Floating gardens are widely seen as a simple and wide spread technology to be used as an effective tool. All efforts are into optimizing production with the addition of fish and perhaps more effective pest management. Indeed Training needed to utilize this approach is minimal and full benefits are available. Widely agreed that there were no ecological or productivity improvements to be had with further examination of the more traditional approach. Floating gardens are simply constructed and used and will take a season for a new farmer to utile effectively
- Floating gardens are substantial providers of income to poor communities particular yin the production of high quality spices and vegetables. It is also Suggested there may be positive or indeed negative impacts on fish – baseline survey is required
- Identification of **substantial sustainable livelihood benefits** to farmers up taking the development of floating gardens within their communities. Specifically the production of cash crops as well as an effective compost for field fertilization
- Women have a substantial role to play in the development of floating gardens and as the managers of micro-credit in communities have an effective role in the utilization of financial proceeds from production – at least in comparison to normal terrestrial production.
- However it is also noted that there was a general consensus that whilst women are the main access point of micro-credit provided by NGO's the **money made from the development of floating gardens rarely if ever makes it back to the women themselves**. This raises the question of why women are asked to apply for the micro-credit in the first place. The response was that women are supposed to benefit financially in principle but do not as a rule.

Challenges to the development and adoption of Floating gardens

Meeting could not identify any social or cultural associations with floating gardens (songs, festivals, cultural events) in Gopalganj

- It is noted that the use of water hyacinth as a base for raft building in this area has only come to dominated in the last 30-35 years with the advent of the green revolution. Prior to this the straw component of the deep water Amman rice (which grew in deep water and is no longer grown) was used for the building of rafts and composting. As such in many areas,

though not all, the use of water hyacinth is a modern innovation. Challenge to GIAHS status in this area

- Composting of the rafts is also a relatively new technique – only around since the use of water hyacinth some 30 years ago. This shift 30 years ago is associated with the decline in use of deep water Amman rice which once provided the base straw for the rafts. Challenge to GIAHS status
- Potential disadvantages were associated with i) Rat infestation and problems with navigation of rafts though these are outweighed by benefits
- Climate change directly threatens the development of the rafts as i) Salinity is a major problem that substantially depletes the water hyacinth ii) the rafts are reliant on the arrival of the rains. Main hopes at avoiding these issues is placed upon the effective development of the coastal embankment system. It would appear that this agricultural method will not provide an adaptive pathway for expected climate change in the delta unless further work done to research benefits of thickening the rafts in reducing impact of salinity
- All present were dominantly interested in the recent modifications (described as scientific) that have been applied to the design and scale of production of floating gardens. Where once small and circular they are now mostly standardized with 10m x 2m x 1.5m dimensions.
- There are substantial outlay cost for the development fo rafts which limits their utility for pooper communities.

Government Training activities

There has been substantial and ongoing training in the development of floating gardens in the Gopalganj area. This is tempered by a stated need to extend this training to many more sites other than the test sites so far covered. Few of those attending the meetings had visited Naipipur traditional floating gardens where the practices is at its most sophisticated**.** There was agreement that there is a need for **greater coordination between NGO and government** agencies in regards to training.

Government Research priorities

- Shape and form of the floating rafts to optimize access and durability
- Depth of beds for optimal growth and potential resilience to salinity (CC)
- Value of layering rafts with varying plant species to control moisture content
- Impacts of salinity on growth and decay rates of water hyacinth
- Cost benefit analysis
- Potential for expanded market access for organic goods in Bangladesh
- Other areas of Bangladesh and of the world with water logging and excessive growth of water hyacinth

Summary Information for Floating Garden agriculture under GIAHS (Provided by FAOB)

Name/Title of the Agricultural Heritage System (local Name and Translation, if necessary): Floating Vegetable Cultivation, Floating Cultivation in Dhap or bed, Vasoman Chash, Baira, Geto, Floating agriculture, Soil less agriculture etc.
Requesting Agency/Organization: FAO Bangladesh / Ministry of Agriculture (not finalized)
Country/location/Site (please annex maps and geographical coordinates of the site):

Bangladesh (Kotalipara, Tungipara, Gopalganj Sadar, and Muksedpur upazila of Gopalganj district and Nazirpur upazila of Pirojpur district). Maps and geographical coordinates are attached in the annex (pdf).
Accessibility of the site to capital city or major cities: It takes 5 to 6 hours coming from Dhaka by Bus (Aricha point) and 5 hours (Mawa point) to the site. Air travel from Dhaka to Barisal takes 45 minutes and from Barisal to the site takes 2-3 hours by road.
Approximate Surface Area: Surface area of the site is 42718 hectare.
Agro-Ecological Zone/s: 12, 13,14 & 19
Topographic features: The site is located at the Gorai-Modhumoti - Kumar river system which is typically meander floodplain, almost levelled, low- lying basins with low ridges along rivers and creeks. Thick deposits of peat occupy perennially on wet basins, but they are covered by clay around the edges and by calcareous silky sediments of Ganges distributaries crossing the area. This is the largest peat basins of Bangladesh. This area is inundated by flood during monsoon for 6-7 months. During this lean period farmers cultivate vegetable and raise seedling on floating beds.
Climate Type: The area is prone to violent storm and tropical cyclones during pre-monsoon and post monsoon season. The site lies under tropical monsoon climatic region having three distinct seasons e.g. rainy season (May to October), winter (November to February) and Summer (March to April). The mean annual temperature varies from 12.1°C to 36.1°C. Heavy rainfall starts from June which continues up to September. The average rainfall is about 2178.6 mm.
Approximate Population: Population of the area is 294948.
Main Source of Livelihoods: Main occupation of this area is agriculture. Peoples mainly live on Boro rice and T. Aman. Wheat, Broadcast Aus and other Rabi crops are grown in scattered areas. Some peoples live on fishing. Other occupations are rearing of livestock, poultry and duck, boat building, fishing net making, mat making. Local peoples are also earning extra money from homestead gardening, tree plantation and vegetables and seedling raising on floating garden which has increased their livelihood
Ethnicity/Indigenous population:

Out of total population of some 300,000, 6000 farmers are involved in vegetable cultivation on floating gardens and 12oo farmers are involved in seedling rising on floating bed.
Summary Information of the Agricultural Heritage System: The area is enriched with natural eco- system consisting of khals, beels, canals, gher (prawn/Galda) and other natural resources. Peoples of low–lying areas of the area adapted alternative source of income to support their livelihood through floating agriculture for their survival. During the lean period about 6-7 months of the year the peoples of this area cultivate floating agriculture. Floating agriculture means the cultivation of vegetable, spices, seedling raising and other crops on floating bed prepared by water hyacinth and other aquatic plants. During this period almost all of low lying areas of this site are covered with water hyacinth and have no land for cultivation. It is their tradition to cultivate vegetables, spices, seedling and other crops on floating ‘‘dhap’’ prepared by decomposed water hyacinth. Farmers grow different types of vegetables and spices. Vegetables and seedlings raised on floating beds during the monsoon season include ladies finger (okra), cucumber, ridged gourd, bitter gourd, snake gourd, amaranth, red amaranth, eggplant (brinjal), pumpkin, Indian spinach, taro, wax gourd, turmeric and ginger. The productivity of this floating bed system is higher than the traditional soil-based agricultural production.

FAOB Characteristics of the proposed GIAHS (Floating Agriculture)

The combined effect of higher sea water levels, subsidence, and siltation of estuary branches, higher riverbed levels and reduced sedimentation in flood protected areas will impede drainage and gradually increase water logging problems. This will decrease arable areas and may lead to migration of people to other parts of the country. To cope with the changed situation local knowledge based best practices may prove to be vital for sustainable livelihood security.

The southern and south-western areas of Bangladesh (especially Gopalganj and Pirojpur districts) remain submerged for long periods every year, especially during the monsoon season. People in these areas have been coping with submerged/flooded conditions for generations. The people of these areas depend on agriculture. They have adopted a method of cultivation, locally referred to as *“Vasoman Chash/ Dhap,”* meaning floating agriculture, since the time of their forefathers. Floating agriculture is a farmers’ innovation that is being practiced for centuries in Bangladesh.

This system is similar to hydroponics, where the plants are grown in the water and they derive their nutrients from the water instead of from the soil. A bio-land or floating bed is prepared with the biomass using water-hyacinth, aquatic algae and the other water born creepers, straws and herbs or plants residues.

Floating vegetable garden is easy to set up, operate and maintain wherever there is water; this makes it eminently suitable to tropical countries especially those affected by regular flooding and the effects of climate change (increased rainfall etc.).

Criteria for the selection of the Globally Important Agricultural Heritage System (GIAHS): Food and livelihood security

The productivity of floating vegetable cultivation is ten times higher than on a similar sized land plot. It increases the size of arable cropping space available to small hold farmers; even landless beneficiaries can apply this technique. There are no issues of land ownership, lease, rent etc.

It strengthens the resources base of the community because it is accessible not only to farming but also fishing households and also to those engaged in other forms of livelihoods – in fact anyone with access to a pond or river. It allows the cultivation of a wide range of fast growing, year-round crops and hence contributes to food security and diverse, healthy nutrition. Seedlings grown on the floating vegetable platform can be transferred from land plots (for example, at the inception of a flood), and transferred back (for example, after the flood has receded). It is ecologically friendly as it does not require the input of fertilizers and pesticides. Prime nutrients (nitrogen, potassium and phosphorus), are abundant in the organic floating platform. The decomposed hyacinth (main input to prepare floating bed) can be applied as organic fertilizer to land plots or other platforms, enhancing soil quality and cutting down fertilizer expenses considerably. During the annual floods, floating platforms can be covered with a mat (*dhap*) and shelter humans, animals, and household articles, up to a certain weight depending on the size of the platform.

2. Biodiversity and ecosystem function

The present waterlogged areas of Bangladesh could be turned into productive wetlands because of their biodiversity and the abundance of various kinds of highly productive aquatic vegetation, fish, aquatic organisms and birds. For example, floating vegetable cultivation can have a positive impact on open water fisheries by reducing weed congestion and using nutrients in the water. This biodiversity, if properly managed, could contribute to revitalizing the rural economy, particularly for the poorer sections of the community.

The water logged areas and nearby rivers are fully congested with water hyacinths (*Eichhornia crassipes*) and other aquatic weeds during monsoon and has become a breeding ground for mosquitoes. As the carrying capacity of the river has been reduced and the drainage system has broken down, the water level now rises during the monsoon. To improve the livelihoods and food security the soil-less agriculture as a possible solution, considering the regular flooding every year, the waterlogging, availability of aquatic weeds and the situation of the landless farmers for high agricultural production.

3. Knowledge systems and adapted technologies

There is no organizational arrangement yet to disseminate this technology. The people use their traditional techniques, knowledge and the conventional wisdom to cope with the flood and submerged condition. Sometimes people of the community help each other in the practice, which strengthens the social and communal harmony.

There is limited awareness and capacity building program to promote the technology. The Department of Agricultural Extension (DAE) can disseminate and promote the practice to other parts of the country.

4. Cultures, value systems and social organisations (Agri-Culture)

The floating agriculture technique has some positive social impacts. It involves both men and women, thereby improving the gender balance, as well as people's perception of particular areas as suitable places to live. People who are practicing floating agriculture cultivation are enjoying a better life economically, than those in other flood-affected areas who have not yet adopted this practice.

5. Remarkable landscapes, land and water resources management features

A properly designed hydroponic system needs less water and nutrients than conventional soil-based agriculture, as the nutrients are recycled. This advantage is important as it can help in reducing the pollution of water bodies with the high level of runoff nutrients from agricultural land. In addition, an enormous amount of compost material is produced, which can be used to increase the organic content of the soil for land-based agriculture systems. Compost selling could potentially be a good opportunity for income generation, as soil degradation due to loss of organic matter is significant in Bangladesh.

II. Techniques of preparing a floating bed:

The basic construction of the floating bed requires bamboo poles, a boat and a simple tool to cut the weeds. The bed is then built up of layers of aquatic weeds, mainly water hyacinths (*Eichhornia crassipes*) but also other kinds of water weeds like water lettuce (*Pistia stratiotes*), duckweed (*Najas gramin*ea), *Salvinia* spp. and *Potamogeton alpinus*.

Organic materials like paddy stubs, straw and coconut husk are also added. In perennial wetlands and permanently waterlogged areas it is possible to cultivate on these floating beds the whole year round. In seasonally waterlogged areas, the beds are used during the wet season and left to decompose on the agricultural land once the water withdraws. The floating beds are primarily constructed where water hyacinths are available. The beds can be prepared in any depth of water and they can be moved by dragging them behind a boat.
The farmers construct floating beds using the masses of water hyacinths and other aquatic weeds that grow naturally and profusely in the river, surrounding wetlands, canals and ditches. Construction starts at the beginning of the monsoon (June-July) with the collection of water hyacinths and other aquatic weeds and it continues up to late autumn. To start the construction, farmers put a long bamboo pole (as long as they want the final bed to be), on a collected mass of fully matured water hyacinths. To build one bed, water hyacinths growing in an area roughly five times larger than the bed itself are required.

Mature water hyacinths are preferred because they decompose slower than immature water hyacinths. The first layer of water hyacinths acts as the base of the floating bed and maintains the stability, buoyancy and thickness of the bed. A single man then stands on the bamboo pole lying over the mass of water hyacinths and starts to pull the water hyacinths together from both sides of the bamboo. In this process, he proceeds towards the end of the bamboo and compacts the accumulated hyacinths under his feet. This process is continued until the desired height and length of the bed is obtained. When the construction of the bed is complete, the bamboo is removed. After 7 - 10 days a second round of water hyacinths are dumped on the bed and then the bed is left to decompose before being planted.

The top of the floating bed needs 15 - 20 days to decompose before sowing seed or planting seedlings. Sometimes farmers use semi-decomposed aquatic plants such as water lettuce, duckweed and immature water hyacinths on the top of the bed to speed up the decomposition, thereby making nutrients available for seedlings and reducing evaporation from the bed. To improve conditions for the young seedlings further, the seeds are sometimes placed inside a ball made of compost, manure and aquatic creepers (locally called tema), before being planted on the floating bed. In this way, a smooth germination and sufficient nutrients are ensured for the initial establishment. However, the newly constructed floating bed can also be cultivated from the first day – if compost is available and is spread thickly on the bed before planting.

There are no fixed rules about the size and shape of the floating beds, but generally the villagers construct beds that are 15 - 50 meters in length, 1.5 - 2.5 meters in width and about one meter in height above the water level.

III. Historic relevance

The people of the southern parts of Bangladesh adopted floating agriculture technology based on their traditions and the community's culture and wisdom. This technology has been practised on a limited scale in the coastal wetlands of southern Bangladesh for more than 200 years.

IV. Contemporary relevance

Though the practice has good impacts in many areas of the coastal belt and other water logged areas of Bangladesh, it has not yet been disseminated broadly. The DAE needs to disseminate this practice and provide technical support to the farmers for its adoption and dissemination. There are however a few drawbacks with the system specially for rodent infestation. Since the area is water logged most of the times, it is difficult to get the agricultural produce to the markets for sale. The possibility of damaging the seed is higher since the bed is always watery. Sometimes there is a scarcity of the materials (water hyacinth, stubble, etc.) for the preparation of the water beds.

V. Threats and challenges

Quality planting material is not available and it is a challenge
Due to lack of developed market system the farmer does not benefit more as they expect
Communication system is poor
Lack of technical support
Lack of Community Based Organizations (CBO) etc.

VI. Practical considerations

a) On-going efforts to promote Floating Agriculture

- The government of Bangladesh has recently established Bangladesh Climate Change Trust Fund (BCCTF) from its own resources with an initial capitalization of $45 million. Under the Ministry of Agriculture, Department of Agricultural Extension (DAE) is implementing a project on Floating Agriculture in relevant areas funding from BCCTF.
- Several national and international NGOs are implementing different project related to floating agriculture.

- Disaster and Climate Risk Management in Agriculture (DCRMA) project of Comprehensive Disaster Management Programme (CDMP II/ DAE part) has disseminated this technology to other potential areas of Bangladesh.

b) Potentials and opportunities for sustainability and management of Floating Agriculture

- Baseline assessment and Detailed Data base is required
- Involvement of GoB and other relevant stakeholders to promote this technology
- Coordination among the GoB and other relevant stakeholders to implement this technology at field level
- National and International recognition of the technology

c) Expected impacts of Floating Agriculture on society and ecology

- Floating agriculture is a possible local knowledge based technology which would help in attaining sustainable livelihood security in vulnerable waterlogged areas. It is a useful method considering the economical, environmental and as well as social aspects.

d) Motivation of the local community, the local/national authorities and other relevant stakeholders

- Capacity building and mass awareness programmes will enhance the adoption of this technology.

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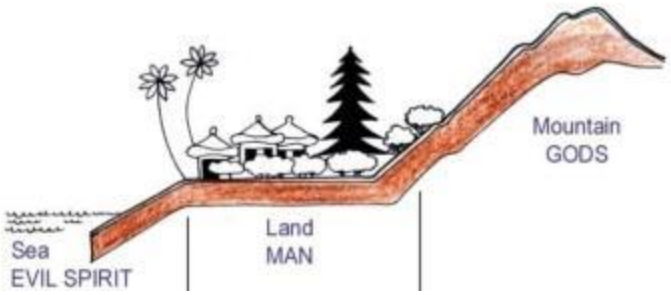
Appendix iii: Background Literature on Indonesian GIAHS study site

The following material was utilised in the study as background material and is abstracted from:

TRI HITA KARANA AGRICULTURAL SYSTEM IN BUGBUG TRADITIONAL VILLAGE, BALI, INDONESIA: A CANDIDATE FOR GLOBALLY IMPORTANT AGRICULTURAL HERITAGE SYSTEMS (GIAHS) PROGRAMME, FAO, ROME (2014)

Summary Information on proposed GIAHS Site

Candidate's name	Tri Hita Karana Agricultural System in Bugbug Traditional Village, Bali, Indonesia
Applicant	Faculty of Agriculture, Bogor Agricultural University
Supporting Organization	Coordinating Ministry of Public Welfare, Republic of Indonesia Faculty of Agriculture, Udayana University Local Government of Karangasem District Karangasem District Planning and Development Agency (BAPPEDA) Bugbug Traditional Village (*Desa Adat*) Bugbug Village (*Pekon*)
Location	Wet (*subak*) and dry (*abian/sayang*) agricultural system Administrative: Bugbug Village – Karangasem Sub-District – Karangasem District – Bali Province 76 km from Denpasar City, Bali Province Coordinate: 08° 29' 00" Latitude dan 115 ° 35' 21" Longitude 
Accessibility of the site to capital city or major cities :	Bugbug Village is the eastern most administrative village in Karangasem District, Bali Province, access by boat or aircraft 2.0 hr flight: Jakarta → Denpasar 2.0 hr drive: Denpasar → Bugbug 5.0 hr boat: Karangasem →Lembar Harbour (West Lombok) – Padang Bai (Karangasem) 15 min drive: Padang Bai - Bugbug
Area :	± 8.87 km^2
Land Use	Main landuse types in Bugbug Village are classified into *sawah*/paddy field (129.73 ha), *tegalan*/dry land (30.36 ha), *pekarangan*/home gardens (64.87 ha), *kebun campuran*/mixed gardens (340.00 ha), cemetery (3 ha), and others (319.00 ha) (Statistic Data of Karangasem District 2012).
Agro-Ecological	Type E (Schmidt-Fergusson)

Zone/s	
Topographic features :	Flat and hilly (hill name as follow: Bukit Asah, Bukit Dukuh, Bukit Bako, Bukit Curu, Bukit Tenganan, Bukit Penyu, and Bukit Maninggal)
Climate Type :	Bali has tropical climate appropriate to its proximity to the equator. Year round temperatures averaging 31º C. High humidity can be expected during the Wet Season between the months of October - April. The Dry Season between the months of May - September have also the lowest humidity.
Village Population :	2,732 households or 10,134 inhabitants (Statistic Data of Karangasem District 2012)
Livelihoods :	Farmer and Fisherman
Ethnicity/Indigenous community	Balinese
Summary Information of the Agricultural Heritage System	*Tri Hita Karana* (THK) as a hinduism philosophy in Bali also implemented on Subak agricultural systems. It consists of three concepts. The first, "Parahyangan" is relation between human and God(s), which is implemented as Pura Sawah (temple in the paddy field). The second is "Pawongan", this concept implemented as farmer (pekaseh/leader and pawongan/member). The last one is "Palemahan" paddy field/dried field and its boundaries. The position and arrangement describe the orientation of human position both vertically and horizontally toward the position of mountains, land and sea. The existence of space allocation based on religious tradition has made it possible for the distribution of building mass and plants to happen in each part purposively. Artificially and naturally, the realization of space management pattern result in variations in habitat that looks like a cultural extent (landscape). THK also implemented on variety of dry land system (abian syatem) both on their "kebun campuran" or mixed gardens and "pekarangan" (home gardens). The variety of plants are found on "Parahyangan" area of the house "merajan" or "sanggah" ("utama-mandala"), i.e. spirituals plants; on "Pawongan" area of the house where the main building placed ("madya-mandala") are herbal plants; and the "Palemahan" area of the house ("nista-mandala") are bulbs crops and livestock feed crops.  Tri Hita Karana Concept

Tri Hita Karana Concept from the Local to the Global

This Sub-Chapter consists of the back-ground of Tri Hita Karana (THK), a concept of space management. This concept has been implemented by Hindu community in all Bali Island in order to arrange the spatial management from bio-regional scale, rural and banjar area scale, until the smallest open space of "pekarangan" or home garden.

Expression of indigenous knowledge about landscape has the purpose of giving appreciation toward different experiences in human's relation with his environment. One of these is a rural landscape system in Bali. Human being as a creature of culture always attempt creation, not just accepting the universe in its natural condition as a dwelling place. Based on place (*desa*), time (*kala*) and condition (*patra*), human being makes a creating place, which are among others village layout, the home garden and the house exposed in culture extent (landscape). Landscape between village (residential areas) having agricultural production system in the form of rice fields and dry fields, and system of worshipping place. The result of this creation as a cultural extent is expected to give them feeling of establishment, peacefulness and welfare, just like calmness of each creature in each habitat/nature. Based on experiences, point of view and belief, human beings duplicate macro-cosmos as a concept in building houses, arranging the home garden pattern as well as the position of their village as an adaptation of miniature universe. Figure 1 indicates integration of human's perception toward the university and himself as a micro-cosmos in *Tri Mandala* system (Suryadarma, 1991). In a hierarchy it can be seen that in building system, houses, home garden as far as the island human beings perceive themselves as proportional parts the head is expressed as the main part, the body as the middle one and the lower part as an expression of services (Arifin, Arifin, Suryadarma, 2003). In Tri Hita Karana concept, as a human body consists of head (Parahyangan), body (Pawongan) and legs (Palemahan). Furthermore, in spatial management of village we have recognized Parahyangan is sacred or holy zone for praying such as "pura" or temple site, Pawongan is a settlement, place for human activities, and Palemahan is agricultural supporting zone.

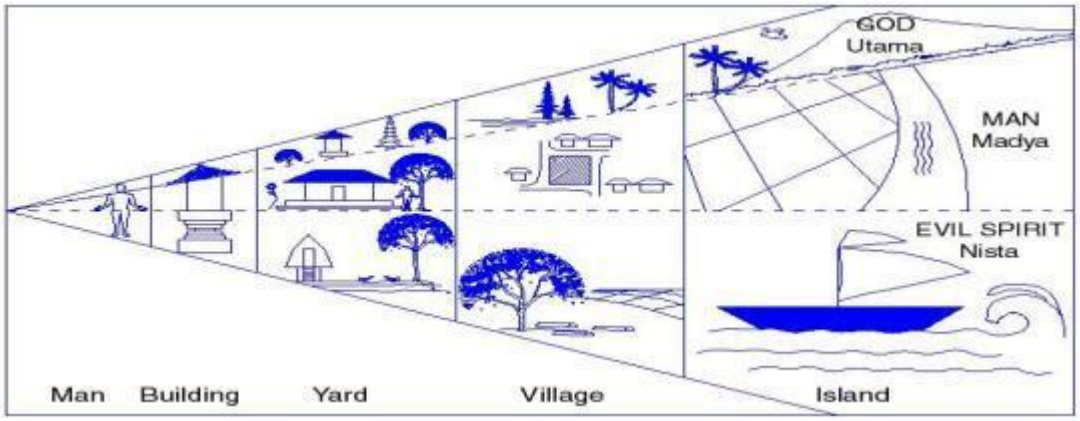


Fig. 1. Balinese basic "man on space" concept: the relationship between micro-cosmos and macro-cosmos in *Tri Mandala* system (Arifin, Arifin, Suryadarma 2003).

Subak and *Abian* System, the Cultural Landscape of Bali Province

The Subak System as a Mmanifestation of the Tri Hita Karana Philosophy comprises five sets of rice terraces and associated water temples. The Subak System refers to the thousand year old self-governing associations of farmers who share the use of irrigation water for their rice fields. Water from volcanic lakes is diverted through rivers and channels to end up in the rice terraces (World Heritage Site, http://www.worldheritagesite.org/sites/bali.html). Subak and Tri Hita Karana (STHK) was already known by the world community, especially landscape subak in Jatiluwih which has been established as a world cultural heritage system by UNESCO.

Subak, agriculture water management system in Bali is not a mere irrigation system. The water that irrigates the paddy fields comes from the water temple surrounded by the paddy fields. The cultural landscape of Bali consists of five rice terraces and their water temples that cover 19,500 ha. The temples are the focus of a cooperative water management system of canals and weirs, known as *subak,* that dates back to the 9th century. Included in the landscape is the 18th-century Royal Water Temple of Pura Taman Ayun, the largest and most impressive architectural edifice of its type on the island (http://whc.unesco.org/en/list/1194). The *subak* reflects the philosophical concept of *Tri Hita*

Karana, which brings together the realms of the spirit, the human world and nature. This philosophy was born of the cultural exchange between Bali and India over the past 2,000 years and has shaped the landscape of Bali. The *subak* system of democratic and egalitarian farming practices has enabled the Balinese to become the most prolific rice growers in the archipelago despite the challenge of supporting a dense population.

Distinctive Traditional Village of Bugbug

The history of Bugbug village can not be separated from the natural phenomenon of the eruption of Mt. Agung. Based on the book of "Eka Ilikita" the eruption area caused the land become so fertile and that inviting people to settle surroundings. But, the former lava and such a big rock were blocking the river flow toward the east (coastal/downstream area) and it formed a swamp called "Telaga Ngembeng". Later, people who settled around "Telaga Ngembeng" is known as a forerunner of Bugbug villager.

Bugbug is a representative of traditional village in Bali. It's managed by two leaders of the village. As a traditional Village or "Desa Adat", Bugbug is managed by "Kelian Desa Adat". On the other side, as an administrative structure, Bugbug is known as "Desa Perbekel or Desa Dinas", administratively it's managed by a government representative leader, namely "Kepala Desa" or "Lurah". Both of leaders are working together in harmonized system.

Bugbug Village has diverse landscapes from hilly, undulating, until flat areas, which is closed to the beach. Therefore, Bugbug has varies of land uses and land covers for agriculture system. Beside *Subak*, farmer organization that manages the water resources system for wet land/paddy field, also it's found "Subak Abian". *Subak Abian* is general term in Bali for farmer organization of dry land management system. However, in Traditional Village of Bugbug, it's well known a special term of "Sayan", it's same meaning with "Subak Abian" in general of Bali.

Furthermore, there are 1127 groups of *Subak Abian* as dry land farmer organization in Bali (Statistic data 2013). Subak Abian is a partnership of Plantation & Estate Agency ("Dinas Perkebunan"), Bali Provincei in order to operate plantation development in Bali.

The relation of the diagram to agricultural practices today (Subak & Abian) has long been applied by the "Padukuhan" who lived there for the first time by giving the area name "Persubakan Bunglunan". They began working in the rice fields and dry land in *Subak Bunglunan*. The people worship "Bhatara Hyang Siwaning Bhumi" as a centre of worship and belong to Hindu "Vaishnava" stream or *Vaishnavism*.

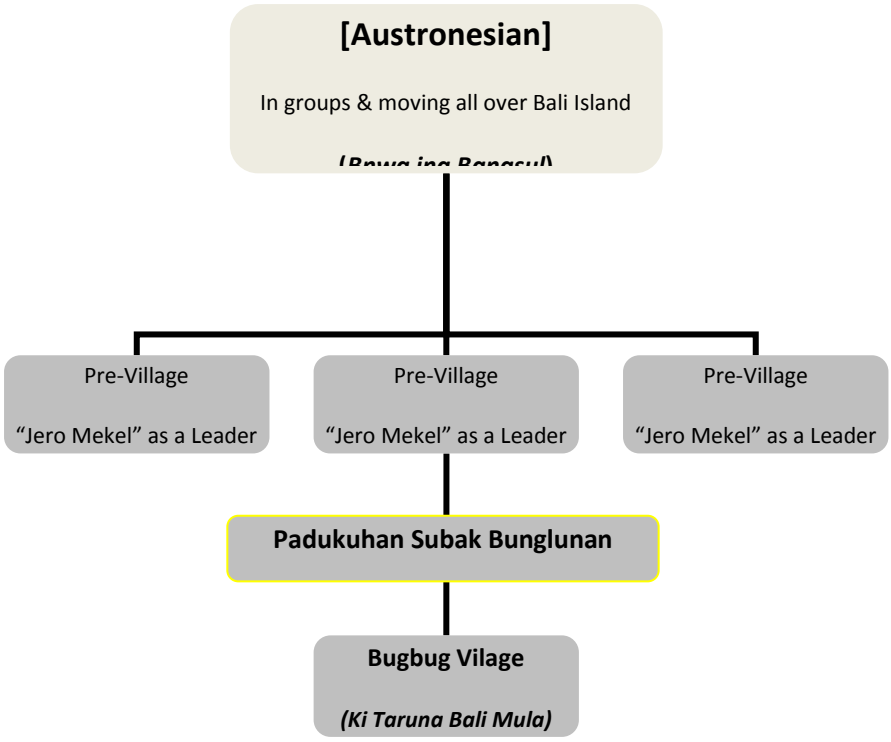


Fig. 2. Historical Diagrams of Bugbug People

Today's Agriculture practices of Bugbug is currently still based on the teachings of Hindu religion in which one of concept applied in Balinese Hinduism life is "Tri Hita Karana". The concept means "three causes of happiness" and the concept was applied also to the farming activities of Bugbug villager. The first is "Parahyangan" can be seen from "Pura Subak" and "Pura Bedugul" in the Subak to performed the ceremony before planting, harvesting both in land or at the sea (a*ci segara*). The second is "Pawongan" can be seen from the *subak* or *sayan* organization. The last is "Palemahan" can be seen as the area of agriculture and its diversity such as Bali rice variety, wani mango, grapefruit, Bali cattle variety, Bali goats, Bali chickens, and local pork.

Farmers in Bugbug also working in other than agricultural sectors such as carpenter, merchants/traders, or even government officers. For that kind of farmer they work the farm in early morning - working in other sector - go back to the farm in the evening. They maintain their farm land actually to fulfil their needs and religious needs (crops and livestock as a means of ceremony). Therefore, they can sustain various agricultural crops such as rice, glutinous rice, collards, water spinach, green beans, corn, chili, cucumber, water melon, and *pacar air* flower. Some plants also planted on the edge of rice fields such as bananas, sugar cane, African marigold, hummingbird trees, *pandan* leaves, elephant grass. Intercropping system was also carried out (long beans with *pacar air*, corn with peppers). Most farmers used organic fertilizers and pesticides. Therefore, Subak Tri Hita Karana in Bugbug Traditional Village is potential candidate for both national and international GIAHS.

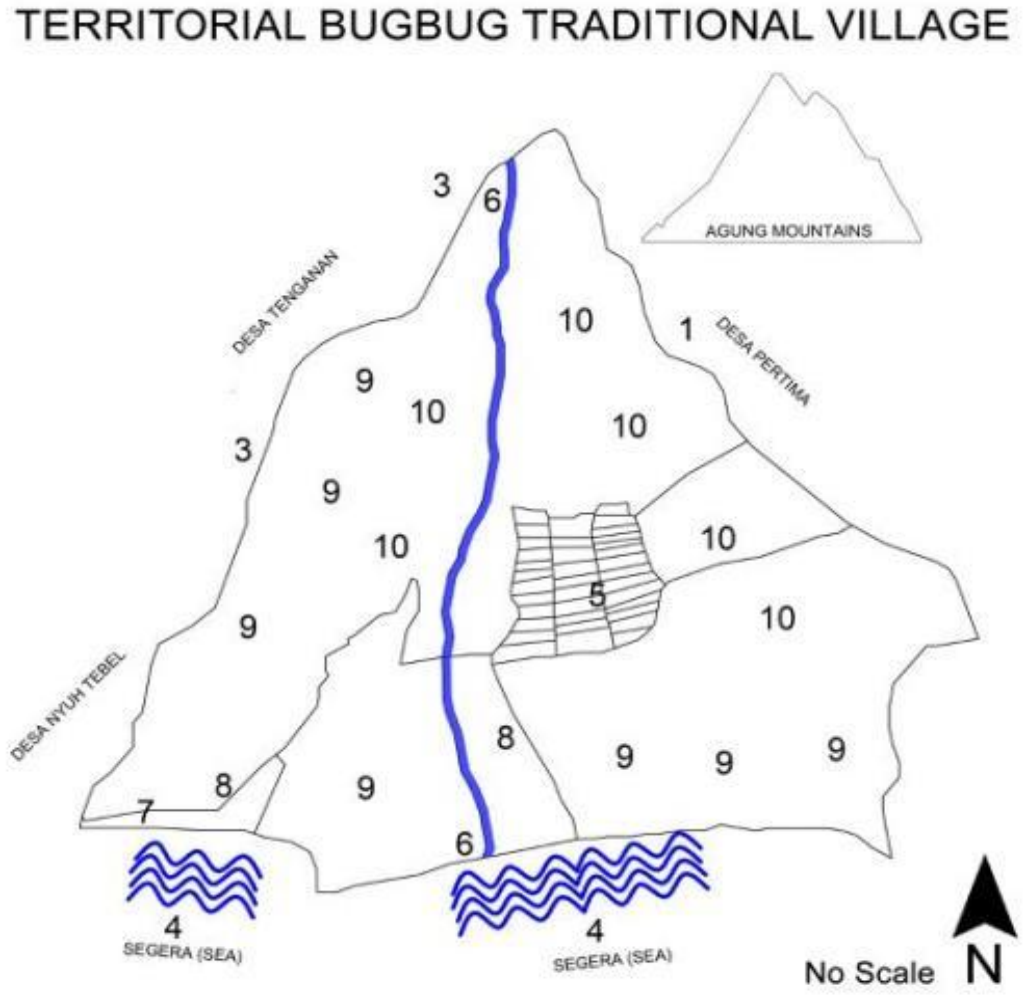


Fig. 3.Territorial and orientation of Bugbug Village

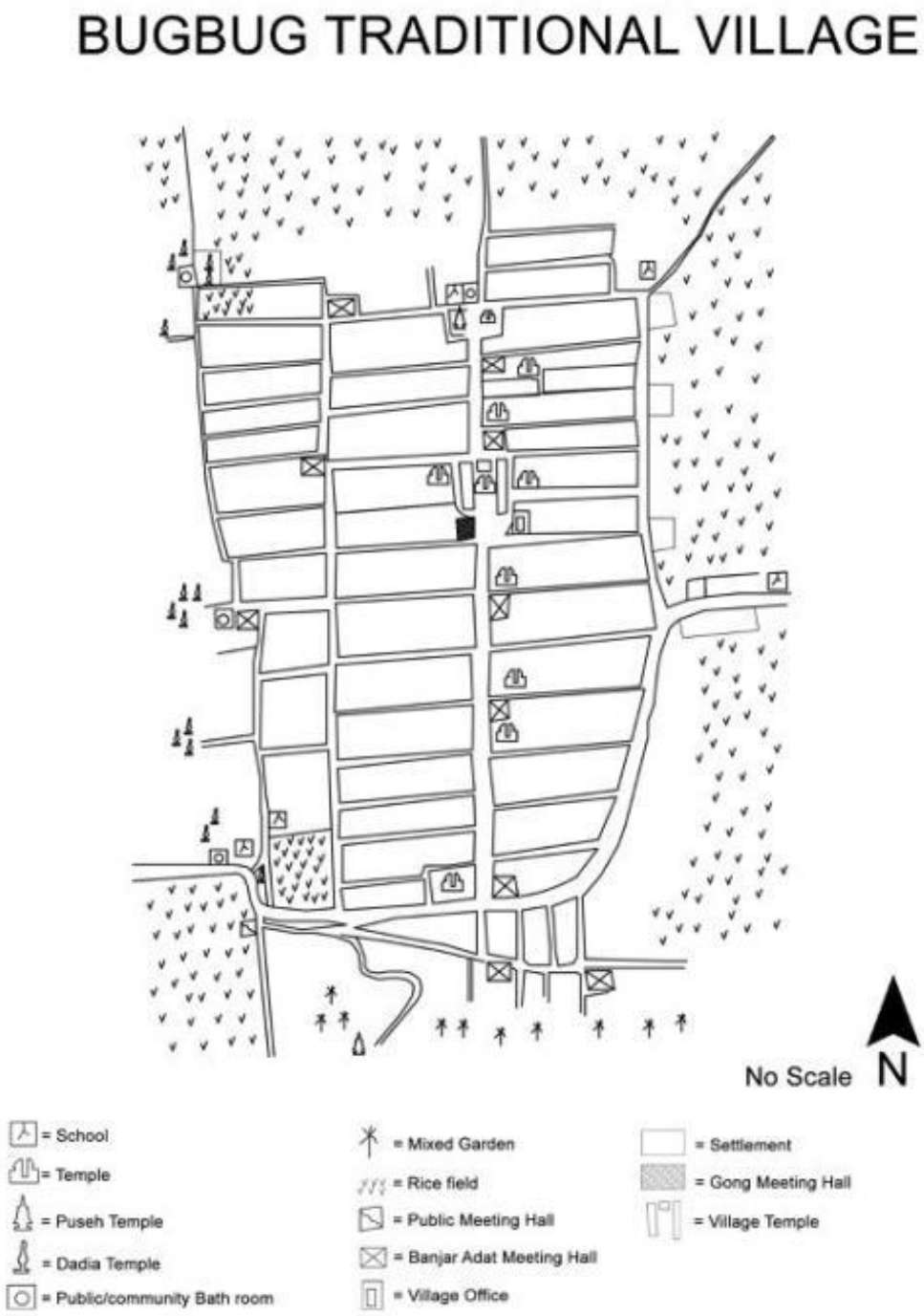


Fig. 4. Bugbug Traditional Village

Characteristics of the Proposed GIAHS Community

Livelihoods of the people in Bugbug village mostly are farmers and fishermen. Agricultural activities practiced mostly rice cultivation managed with Subak irrigation system. Besides paddy, there are some other agricultural commodities also cultivated i.e. dry crops (*palawija*) and other crops such as bananas , corn , long beans and cashew. To meet the needs of protein, they get it from the local fishermen. Type of fish the fishermen usually get is tuna (field survey, September 2013) .

Land use types in Bugbug village are divided into paddy area, approximately about 126.96 Ha (14.32 % of surface area) and non-paddy area or dry land, approximately about 756.89 Ha (85.68 % of surface area). The area also divided in to Subak management system, there are five Subak in Bugbug village (Subak Glogor, Subak Pesa, Subak Mepaang, Subak Tegakin, and Subak Lumpadang) with 545 members (District of Karangasem In Figures 2012).

Table 1. Type and Number of Agricultural Commodity in Bugbug Village

Type of Comodity	**Total area (ha) Or Number of Owners (persons)**	**Productivity (ton/ha) Or Population**
Agricultural:		
Chilli	2.25	-
Corn	17.00	68.00
Cucumber	7.25	
Long beans	7.57	-
Peanuts	62.95	314.75
Rice	27.50	1,925.00
Sweet potato	11.45	-
Water melon	1	-
Bali Cattle	283	467.00
Bali Chicken	-	9,632.00
Broiler	-	94,200.00
Ducks	-	615.00
Dogs	-	283.00
Goats	-	30.00
Pork	-	1,876.00

Source: Potency of Bugbug Village, 2012

Community Characteristics

The village administration system in Bugbug managed by "*Desa Perbekel"* or *"Desa Dinas"* (governmental administrative village) and "Desa Adat" (tradition village). Desa adat is an extension of the "desa dinas". In "desa adat" systems, land occupied by indigenous communities. Only Bugbug people entitled to use the land, not to control it or even to sold it to outsider. This system has already protected the agricultural system in Bugbug. It is because the customary land were not divided and that the land - at least - were designated as agricultural land will survive and be maintained by the heir of the land managers.

Furthermore, the harmonization of leadership occurred between both the village leader in deciding policy. It is conditioned because until now both the village leader are brothers, they are a direct

descendant of Bendesa Mas (the first government leader in Bugbug which is sent directly by the King of Klungkung).

HISTORY OF THK AND TRADITIONAL VILLAGE

Based on the experience, a view on culture and cosmology referred to religious values has been expressed by Balinese in a space management pattern for hundred years. Cosmological actualization is in the home garden pattern along with the expression of colour symbols. The positioning of building mass and the types of plants is the realization of totally concrete thought, possessing visual characteristic of that magical and religious (Arifin, Arifin, Suryadarma 2003). Pattern of behaviour existing in the society and uniformly adopted is expected to be supportive to the strategy of sustainable living picturing fairness between one region and another and among generations in agro-ecosystem land, home garden in rural areas especially (Fig. 18).

Conception of traditional architecture in Bali (Budihardjo, 1986) is based on nine-roomed conception (*sanga mandala*) as a cosmological orientation and three-hierarchical value (*tri angga*) on the position of all objects in space dimension. A realization of it has been zoning of home garden pattern into three parts (mandala): (1) *Parahyang*, (2*) Pawongan*, and (3) *Palemahan*. *Parahyangan* as part of primary *mandala*, a sacred part, directs the head toward the direction of mountain and the sunrise. *Pawongan*as middle *mandala* (madya), place of building mass is located in on the land considered as the body. *Palemahan* as the last *mandala*, as a service centre is at the sea direction of the sea and the sunset. Hence integration of space functional structure of home garden based the conception of religious tradition and cosmology is realized. This is accordance with the essence of relationship between human being-nature-and the creator in *tri hitakarana* conception, which are three causes of happiness (Pendit, 1984): (1) God as the main cause and source of happiness, (2) Human being as the doer based on obligation (*sivam*), and (3) The universe as place of implementation. The integration of three is the source of our happiness (*hita*). Space management of rural areas, the home garden and placing arrangement of buildings are related to arrangement of

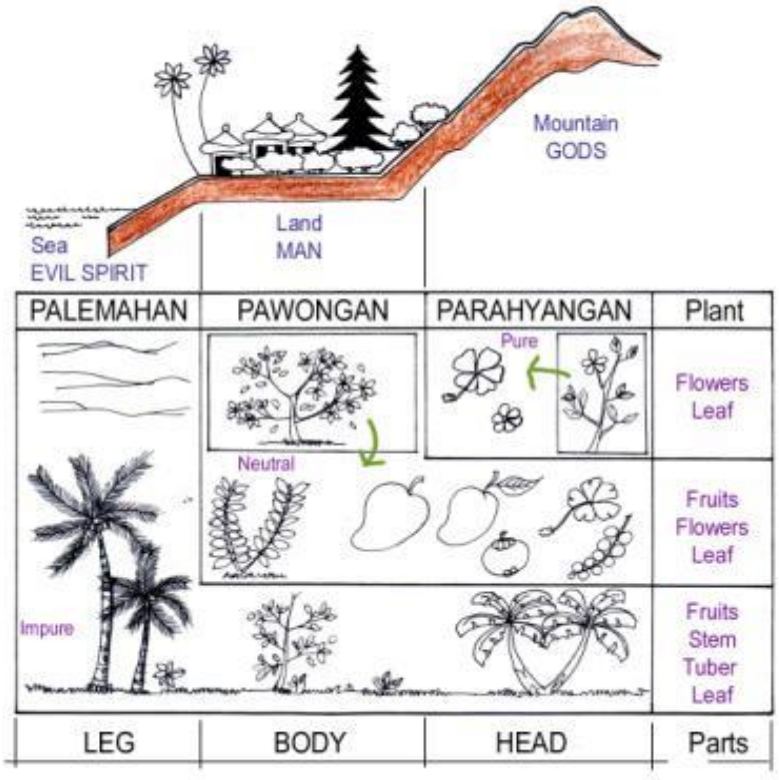


Fig. 5. *Tri Angga* Concept: Part of Plant on a Home Garden (Arifin, Suryadarma and Arifin, 2003)

plants cultivation. Plants producing flowers used in rituals are grown in *parahyangan* areas, which are sacred zones. *Palemahan* is a place for caging animals and growing plants for daily needs (Dherana, 1981). The plants grown in *pawongan* are those of functional ones used in religious ceremonies, medicine, and spices (Gelebet, 1982). Fig. 19 indicates the realization of home garden patterns conception as a part of rural landscape (Budihardjo, 1986).

The position and arrangement describe the orientation of human position both vertically and horizontally toward the position of mountains, land and sea. The existence of space allocation based on religious tradition has made it possible for the distribution of building mass and plants to happen in each part purposively. Artificially and naturally, the realization of space management pattern result in variations in habitat that looks like a cultural extent (landscape).

History of Traditional Bugbug Village

The history of Bugbug people according to the book "Eka Ilikita" is that the word “Bugbug” derived from the Balinese language of "Buwug-buwug" which means “the swamp” and then become "Bugbug". According to Bugbug history, during the eruption of Mt. Agung was caused the area become so fertile that inviting people to settle surroundings the mountain. Otherwise, the former lava and such a big rock were blocking the river flow toward the east (coastal/downstream area) and it formed a swamp. Later, people who settled around the swamp of “Telaga Ngembeng” (which is now already covered) is known as a forerunner of today's Bugbug villager (Eka Ilikita). Another story also explained the word “Bugbug” in ancient Balinese language means “center”, “centered”, “one”, or “united”. This is where groups of people (Krama Desa) which was originally located in the “pre-villages” inhabiting village huts in the rice fields around Gumang hill which were focused, united or collected into one.

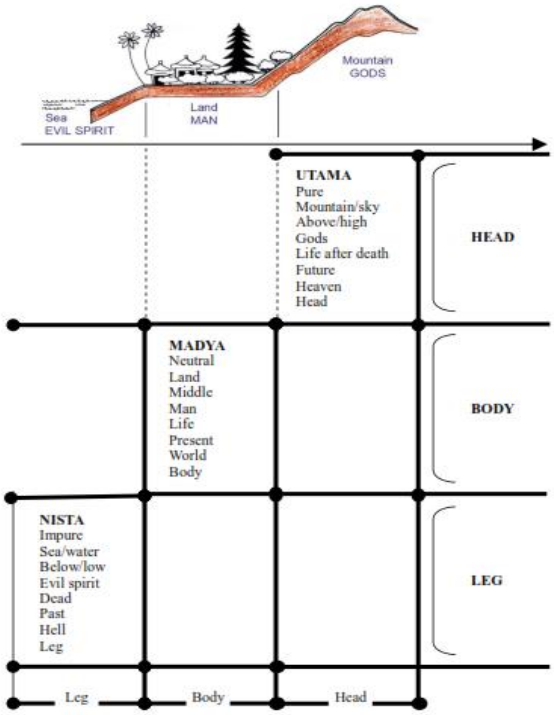


Fig. 6, *Tri Angga* Concept based on the basic philosophy of *Tri Hita Karana*: Realization of the conception of space management and the conception in Balinese society (Arifin, Arifin, Suryadarma 2003)

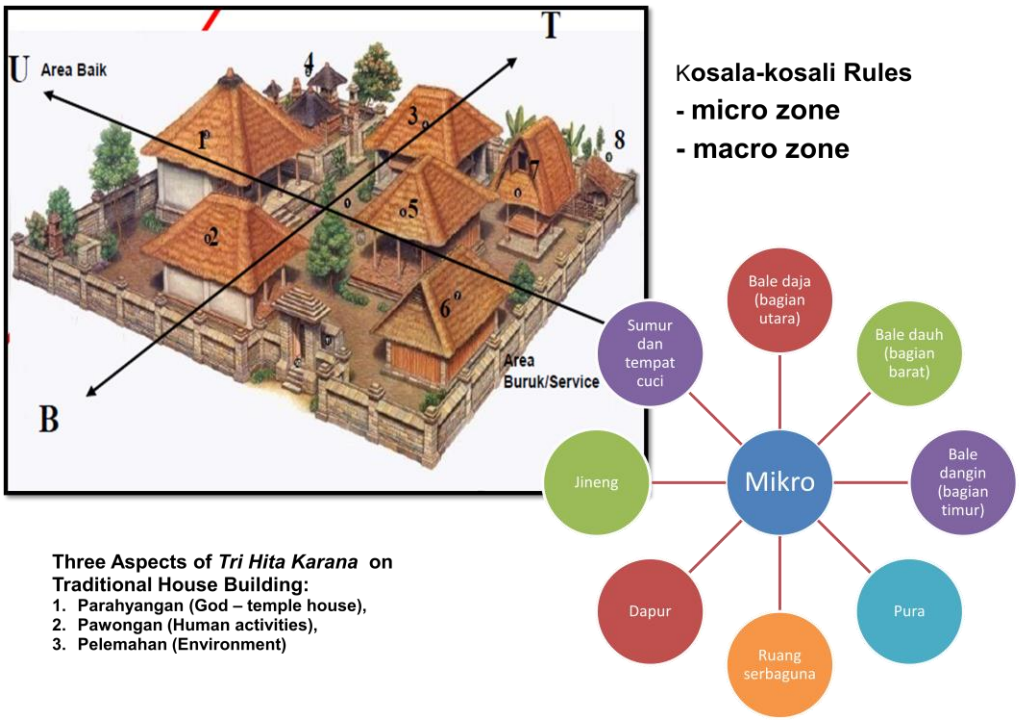


Fig. 7. Implementation of Tri Hita Karana concept on the spatial management of house building in one “pekarangan”

Table 2.Historical Literature of Bugbug Village

Title	**Author**	**Time Note**
Prasasti Desa Bugbug	-	1103 Saka
Eka Ilikita	Kelihan Desa Adat Bugbug	1996
Awig-Awig lan Pararem Desa Bugbug	Kelihan Desa Adat Bugbug	Puput ring rahina Coma Wage Dukut, Purnama Sasih Kapitu, tanggal 28 Januari 2001
Bugbug Traditional Calendar	Desa Adat Bugbug	Created in every year daily activities guidance

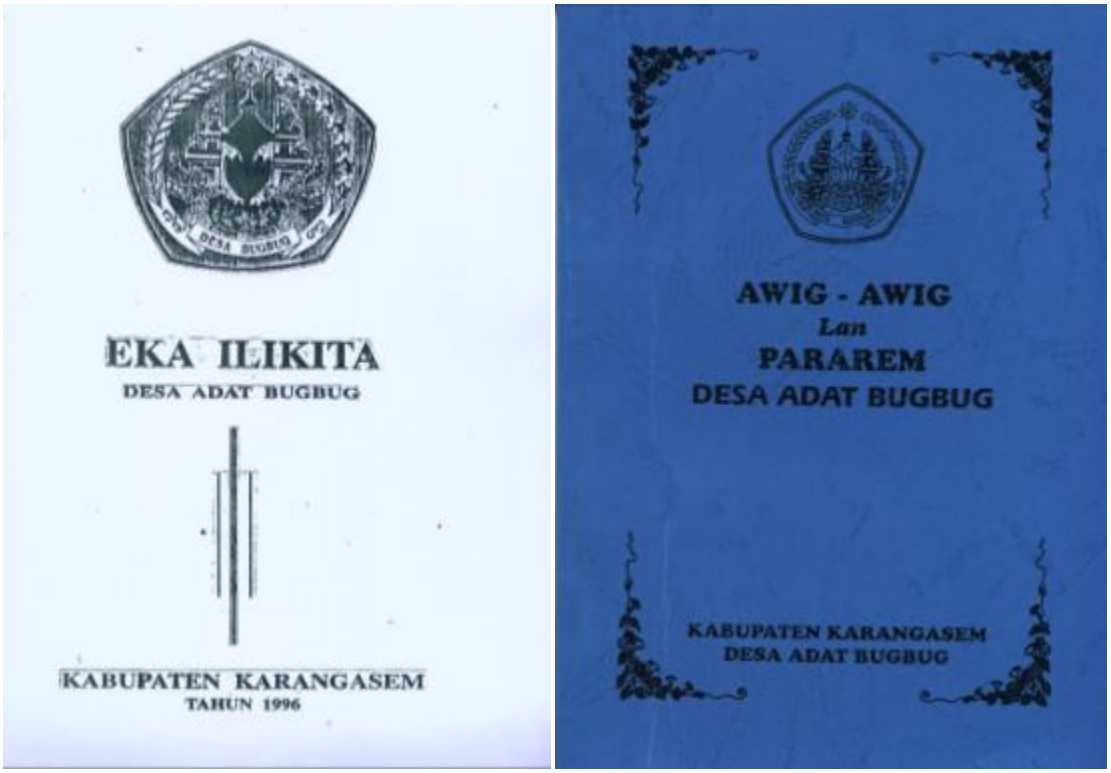


Fig. 8. *Eka Ilikita,* Village Monography (left) and *Awig-Awig Lan Pararem*, local rules and ethics (right) of Bugbug Traditional Village

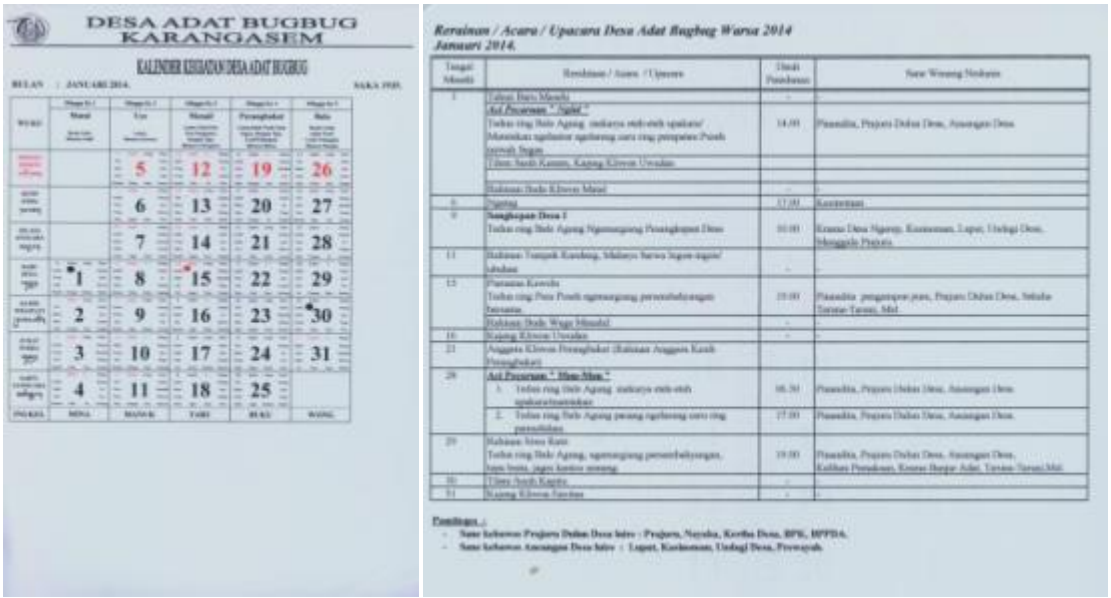
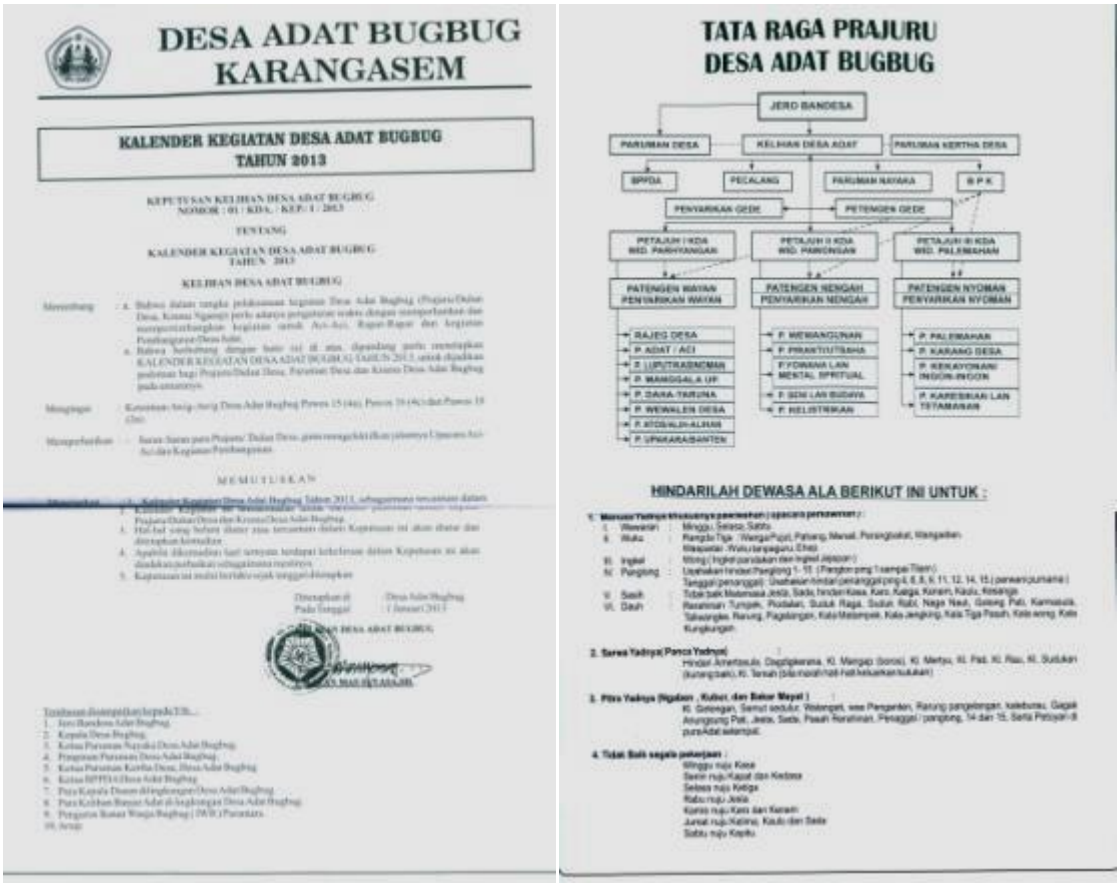


Fig. 9. One month sheets, an example of Bugbug Traditional Village Calendar, each date consists of detail activities guidance of Bugbug community



DESA ADAT BUGBUG
KARANGASEM

KALENDER KEGIATAN DESA ADAT BUGBUG
TAHUN 2013

KEPUTUSAN KELIHAN DESA ADAT BUGBUG
NOMOR : 01 / KDA. / KEP / I / 2013

TENTANG

KALENDER KEGIATAN DESA ADAT BUGBUG
TAHUN 2013

KELIHAN DESA ADAT BUGBUG

TATA RAGA PRAJURU
DESA ADAT BUGBUG

JERO BANDESA

PARUMAN DESA | KELIHAN DESA ADAT | PARUMAN KERTHA DESA

BPPDA | PECALANG | PARUMAN NAYAKA | B P K

PENYARIKAN GEDE | PETENGEN GEDE

PETAJUH I KDA WED. PARHYANGAN | PETAJUH II KDA WED. PAWONGAN | PETAJUH III KDA WED. PALEMAHAN

PATENGEN WAYAN PENYARIKAN WAYAN | PATENGEN NENGAH PENYARIKAN NENGAH | PATENGEN NYOMAN PENYARIKAN NYOMAN

- RAJEG DESA
- P. ADAT / ACI
- P. UPUTRADNEMAN
- P. MANGGALA UP.
- P. DANA-TARUNA
- P. WEWALEN DESA
- P. ATOGWALIH-ALIHAN
- P. UPAKARA/SANTEN

- P. MEMANGUNAN
- P. PRAKTI/UTSAHA
- P. OWANA LAN MENTAL SPRITUAL
- P. SENI LAN BUDAYA
- P. KELISTRIKAN

- P. PALEMAHAN
- P. KARANG DESA
- P. KEKAYONAN/ INGON-INGON
- P. KAREBEKAN LAN TITAMANAN

HINDARILAH DEWASA ALA BERIKUT INI UNTUK :

1. Manusa Yadnya tinukunnya pawinihan / upacara perseorangan :
   I. Wewaran : Minggu, Selasa, Sabtu
   II. Wuku : Rangda Tiga : Wangsa Pujut, Pahang, Merakih, Perangbakat, Wangaiden, Wasputar. Wuku tanggaguru, Ehed
   III. Ingkel : Wong / Ingkel panulakan dan Ingkel Jejepan /
   IV. Pangiwa : Upalekan hindari Pangiwa 1- 15 (Pangiwa ang 1 sampai Tilem)
   Tanggal penanggal : Dudahakan hindari penanggal pring 4, 8, 9, 11, 12, 14, 15 (panean jurnama)
   V. Sasih : Tidak baik Mabesaka Jeksa, Sada, hindari Kasa, Karo, Kaliga, Kenem, Kaulu, Kesanga
   VI. Dauh : Penalinan Tungeh, Pondalan, Sulluk Raga, Sulun, Rabi, Naga Nasi, Goleng, Pati, Kamasalia, Tahasangke, Narung, Pagabangan, Kala Metemyek, Kala Jengking, Kala Tiga Pasah, Kala wong, Kala Kungkungan.

2. Sarwa Yadnya (Panca Yadnya)
   Hindari Amertasula, Dagdigkarana, Kl. Mangap Soroa), Kl. Merkya, Kl. Pati, Kl. Rau, Kl. Sudukan (kurang baik), Kl. Tarsah (bila mandi hati-hati kekuatan kukatan)

3. Pitra Yadnya (Ngaben , Kubur, dan Bakar Mayat)
   Kl. Galengan, Semut sedulur, Watangan, sae Pangantan, Rarung pangelengan, kalebutau, Gagak Anyinggung Pati, Jeeta, Sada, Pasah Perahiman, Penaggal / pangtong, 14 dan 15, Serta Petoyan di pura Adat setempat.

4. Tidak Baik segala pekerjaan :
   Minggu nuju Kasa
   Senin nuju Kajut dan Kedasa
   Selasa nuju Kaliga
   Rabu nuju Jeksa
   Kamis nuju Karo dan Kenam
   Jumat nuju Kalima, Kaulu dan Sada
   Sabtu nuju Kapitu

Fig. 10. Rules and organization in Bugbug Traditional Village

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Appendix iv: Data for Modified SLF (MSLF) for GIAHS in Case Study Areas

Summary Table

	Ethiopia Baboo (GIAHS)	Ethiopia Non-Baboo (Non-GIAHS)	Bangladesh TFG (GIAHS)	Bangladesh NTFG (Non-GIAHS)	Indonesia, Subak (GIAHS)	Indonesia, Non-Subak (Non-GIAHS)
Financial Capital	2.7	1.7	3.2	3.2	3.8	3.5
Physical Capital	1.3	1.3	1.7	2.6	3.2	3.6
Human Capital	2.3	1.7	3.5	3.7	4	4.0
Indigenous Capital	5.0	2.5	4.0	2.6	4.5	2.0
Natural Capital	5.0	2.0	4.5	2.5	4.7	2.2
Social Capital	3.5	3.0	2.7	2.7	3.6	3.1

Full Data Comparative Table

				GEODEO HIGHLANDS				BANGLADESH				INDONE		
GIAHS - Sustainable Livelihoods Framework Domains for effective characterisation of GIAHS (Development context; Ethiopia)				**GIAHS TYPE: Baboo Culture**		**Non-GIAHS: Non-Baboo**		**GIAHS TYPE: Traditional Floating Gardens**		**Non-GIAHS: Non-Traditional Floating Gardens**		**GIAHS TYPE: Subak Culture, Bali**		N M fa
Domain	**Sub-Domain/*key issues***		**Descriptor Notes**	**Sub-Domain Value**	**Domain Mean Value**	**Sub-Domain Value**	**Domain Mean Value**	**Sub-Domain Value**	**Domain Mean Value**	**Sub-Domain Value**	**Domain Mean Value**	**Sub-Domain Value**	**Domain Mean Value**	D
Financial Capital	**Household Asset**	1	Very low access to basic household commodities such as tin roofing, radio, fridges, bicycles, clothing etc.		**2.7**		**1.7**		**3.2**		**3.3**		**3.8**	
	household	2	Low access but a few households	2		1				3.7				

			which have some basic access											
	transport	3	Most households have access to basics but a lot of variance					3				4		
	personal	4	Most households have access to a reasonably high level of assets											
		5	Almost all households have access to a high level of asset											
	Income ($)	1	Very little access to cash economy at a family level - dominantly barter and exchange high levels of destitution											
	cash	2	Low access to sources of cash - some barter some destitution	3		2		3.5		3.3		4		
	barter	3	Some cash economy present and some remittance and external incomes high general poverty but low destitution											

	destitution	4	low hard poverty and low destitution, reasonable number of remittance											
		5	low poverty, relatively high incomes for rural communities in region, high remittance, no evident extremity											
	Employment	1	Unemployment and landless labour dominate											
	local	2	Subsistence farming activities dominate, some unemployment and landless labour	3		2		3		3		3.5		
	landless labour	3	Mix of subsistence, cash crop farmers, landless labour and external employment											
	external	4	Mix of subsistence farmers, cooperative and cash crop farming, diverse livelihoods (tourism, other) and external											

			employment											
	remittance	5	Dominantly cash crop farming, diverse livelihoods and external employment											
Physical Capital	**Local Infra-structure**	1	Tracks only, no clear road network, no power supply and no local water infrastructure poor access to main settlements		**1.3**		**1.3**		**1.7**		**2.6**		**3.2**	
	roads	2	Minimal infrastructure basic roads mainly dirt	2		1		2		3.7				
	engineering for water	3	Some metalled roads and localised power for commercial application- possibly small resources and dam structures locally											
	commercial power provision	4	Reasonable number of metalled road access, prevalent power distribution and water infra-structure. Reasonable access									3		

			to main settlements. Good access to main settlements											
	main settlement access	5	Well developed infra-structure development with power supply to local industry and commercial activity and dominance of metalled roads. Clear access to main settlement											
	Community amenities	1	Poorly supplied with domestic water and community power	1		1		2		3				
	domestic water	2	Basically supplied with domestic water supplied and community power - shops have power											
	domestic power	3	Reasonably supplied with domestic water supply and community power - shops and some homes have power									3.5		

	schools, shops and healthcare	4	Reasonably high levels of domestic power supply, household taps and powered shops and some amenities such as medical facilities and schools											
		5	Majority of houses have own power and water supply and accessed to shops, schools and health amenities											
	Technology in agriculture	1	No use of modern technologies such as fertiliser or mechanisation											
	fertiliser	2	Minimal use of some technologies	1		2		1		1				
	mechanisation	3	A number fo technologies such a f fertiliser and mechaisation are used sparingly									3		
		4	Substanitvive tecnology utilisation in many areas of agriculture											
		5	Highly mechanised and modern											

			approach to agricultural activity										
Human Capital	**Education**	1	No or very few children in the community attend schooling of any kind		**2.3**		**1.7**		**3.5**		**3.7**		**4.0**
	distance	2	Some children at school who walk substantive distances, mainly primary school										
	primary/secondary/HE	3	Limited primary and secondary attendance - some education conducted locally to community	2.5		2		4		4			
		4	Extensive primary and reasonable secondary education - some higher education									4	
		5	Good levels of primary and secondary as well as many student in HE										
	Health	1	Households are evidently in poor health with poor			1.5							

			access to health care or intervention/training											
	access	2	Households are in poor health although there is some evidence of external health interventions	2				3		3.3				
	evident in community	3	Households are in reasonable health but have some clear issues accessing health care									4		
		4	Households have reasonably good access to health care and health issue in community are limited											
		5	Households have excellent health care which is evident in the community											
Indigenous Knowledge Capital	**Skills/knowledge sets/livelihood diversity**	1	Working population have very limited training or specific livelihood skill sets		**5.0**		**2.5**		**4.0**		**2.6**		**4.5**	

			- predominance of supervised labour e.g. factory, farm labour etc.										
	supervised labour	2	Some additional skills sets and knowledge but mainly supervised labour with some subsistence farming			2.5							
	diversity	3	Mix of supervised labour with some agricultural skills requiring specialist knowledge										
	specialist skillsin socio-environment	4	Diverse agricultural with some requiring sophisticated skill sets - community resilience through crop diversity is evident								4		
		5	Highly diverse aricultural practices with substantive skill sets utilised to produce a resilient living	5				5		2.7			
	Indigenous knowledge transfer	1	Agricultural practices are simplified and										

			dominated by external inputs (NGO/Ministries etc)											
		2	Standard agricultural practices with minimum need for skills tranfer between generations (monoculture)			2.5				2.5				
		3	Some skills transfer through cultural learing - songs retuals etc					3						
		4	Clear cultural context to knowledge tranfer. Knowledge requirment of system is high											
		5	Cultural knowelge transfer is substantive and forms dominat cultural compoent of community. Evidence of religious context, childhod education and extensive ceremonies	5										

												5		
Social Capital	***CBO/ Cooperative /gov(commercial)***	1	No evidence of cooperative organisation - either commercial or community based		**3.5**		**3.0**		**2.7**		**2.7**		**3.6**	
	informal groups	2	CBO/Cooperatives exist but are very weak											
	social/religious groups/gov	3	Some coop/cbo/gov activity is evident but highly variable											
	womens groups	4	Clear evidence of CBO and cooperative activity, high awareness anf gov activity	3.5		3		2		2				
	financial	5	CBO/Cooperatives/ gov are main community instruments for decision making and commercial work									4		
	health													
	Family size/cohesion	1	small families with many women headed households, elderly and other											

			vulnerable groups living alone with high migration rates											
	family size	2												
	generational levels	3												
	diversity of family based labour	4		4		3		4		4		4		
	migration	5	Large and extended family groups sharing labour tasks and working together cross generationally. Minimal migration and mainly short periods											
	Gender & Equity	1	No evidence of gender considerations or vulnerable groups in community structures and decision making											
		2	limited or token efforts within gender and equity issues as well as decision making											
		3	Some evidence of	3		3		2		2		3		

			gender and equity consideration - not deeply rooted											
		4	Clear evidence of gender and vulnerable groups considerations											
		5	Strong equity partnerships and representation at all levels of community and decision making											
Natural Capital	**Diversity Provisioning E S**	1	very low association with direct ecosystem service provision - most services are mediated through cash, industrial activity, virtual access (shops/factory work) low utilisation of biodiversity		**5.0**		**2.0**		**4.5**		**2.5**		**4.7**	
	food	2	some access to farming and other limited provisioning services			2.5								

	shelter	3	provision services as well as evidence of some regularly or maintenance service provision some utilisation of biodiversity in livelihoods											
	medicine	4	clear use of diverse provisioning services as well as other service types possibly including cultural with supporting use of biodiversity											
	cultural	5	high utilisation of diverse ecosystem services are main contributor to livelihoods including substantive cultural service provision and very high biodiversity utilisation	5				4		2		5		
	other ES													
	Socio-ecological adaption	1	Community is completely reliant on external service provision for managing			1.5								

			environmental shocks - tankered water, supplies, income from external sources etc.											
	adaptation	2	Community has a few limited socio-environment responses to stress e.g. adjustments to agricultural calendar patters or use of fishing when other livelihood are reduced											
	planning	3	community shows clear evidence of adaptation strategies associated with seasonal changes and shocks											
	diversity of ES	4	Community has plans that anticipate variance in conditions and adaptation strategies are clear e.g. houses on mounds, multiple cropping to reduce impact of flood,									4.5		

			livelihood diversity designed to compensate for stressors.											
		5	Extensive planning for the perennial and diverse utilisation of natural resources/Ecosyste m services in a sustainable approach which has high resilience to environmental shocks e.g. diverse cropping patterns, sustainable utilisation of high biodiversity sites (forest/reef)	5				5		3				