THE EX-ANTE CARBON BALANCE TOOL

EASYPol
Resources for policy making

APPLIED WORKS

EASYPol Module XXX

Lessons learned from appraising the impact of IFAD projects in Nepal on the GHG balance and stocks of natural resources

An analysis using the Ex-Ante Carbon balance Tool

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About EX-ACT: The *Ex Ante* Appraisal Carbon-balance Tool aims at providing *ex-ante* estimations of the impact of agriculture and forestry development projects on GHG emissions and carbon sequestration, indicating its effects on the carbon balance.

See EX-ACT website: www.fao.org/tc/exact

About EASYPol

EASYPol is a multilingual repository of freely downloadable resources for policy making in agriculture, rural development and food security. The EASYPol home page is available at: www.fao.org/easypol. These resources focus on policy findings, methodological tools and capacity development. The site is maintained by FAO's Policy Support team.

– Draft –

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ABBREVIATIONS

ADB	Asian Development Bank
GoN	Government of Nepal
GLOF	Glacial Lake Outburst Floods
Gg	Giga grams
AFOLU	Agriculture, Forest and Other Land Use
CC	Climate Change
CDM	Clean Development Mechanism
CH_4	Methane
CO_2	Carbon Dioxide
DM	Dry Matter
EX-ACT	EX-Ante Carbon Balance Tool
FAO	Food and Agriculture Organisation of the United Nations
GDP	Gross domestic product
GEF	Global Environmental Facility
GHG	Green House Gas
GIS	Geographic Information System
GWP	Global Warming Potential
HAC	High Activity Clay
HLFFDP	Hills Leasehold Forestry and Forage Development Project
IFAD	International Fund for Agriculture Development
IPCC	Intergovernmental Panel on Climate Change
LAC	Low Activity Clay
LAPA	Local Adaptation Plan of Action
LFLP	Leasehold Forestry and Livestock Project (IFAD)
LUC	Land Use Change
LU	Land Use
LULUCF	Land use, land use change and forestry
MRV	Monitoring, Reporting and Verifying
N_2O	Nitrous Oxide
NAMA	Nationally Appropriate Mitigation Actions
NAPA	National Adaptation Program of Action
NCSA	National Capacity Needs Self-Assessment
NTFP	Non Timber Forestry Products
ODA	Official Development Assistance
PPCR	Pilot Program for Climate Resilience
REDD	Reduced Emission of deforestation and forest degradation
RPP	Readiness Preparedness Proposal
SCCF	Special Climate Change Fund
SLM	Sustainable Land Management
t CO2-e	Ton of CO2 equivalent
t CO_2e .Ha^{-1}	Ton of Carbon Dioxide equivalent per hectare
t CO_2e .$year^{-1}$	Ton of Carbon Dioxide equivalent per year
UNFCCC	United Nations Framework Convention on Climate Change
WB	World Bank
WUPAP	Western Uplands Poverty Alleviation Project
HVAP	High-Value Agriculture Project in Hill and Mountain Areas

SUMMARY

In fragile mountain ecosystems specific to the Himalayan region, land-use change as well as forest and soil degradation have wide implications on greenhouse gas emissions, further ecosystem services and rural livelihoods. Numerous studies investigate the dynamics and complex interaction of land-use change, forest and soil degradation and C sequestration processes in Nepal due to its highly fragile ecosystem and the significant scale of forest and soil degradation (Upadhyay, 2005).

This paper is aimed at presenting the impact of four IFAD projects in Nepal on firstly the GHG balance and their potential for climate change mitigation, and secondly on their impact of natural capital stocks. The considered and quantified components of natural capital are linked with soil quality, increased landscape biomass and water availability, better crop protection/resilience from drought, prevented incremental erosion, additional flood protected areas, incremental forested area and increased biodiversity through protected areas. This value of the incremental natural capital, generated by farmers, is thereby interpreted as a public value which is adding to the public value generated through prevented GHG emissions due to the programme and project interventions.

The four projects analysed provide a wide range of project situations, from leasehold forestry support projects to value chain support and agriculture intensification projects. The four projects are:

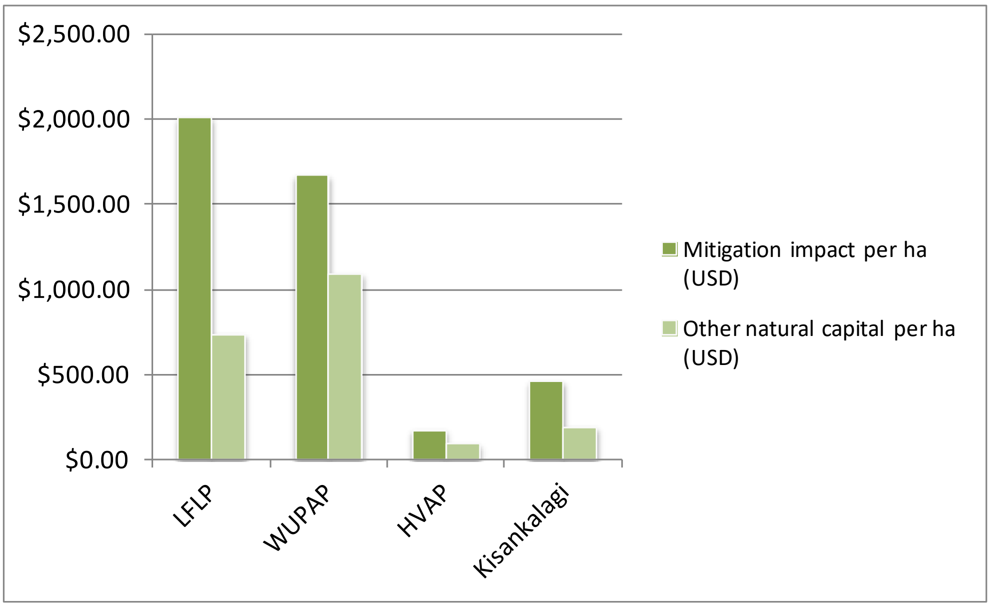
- (i) The Leasehold Forestry and Livestock Programme follow up of Hills Leasehold Forestry and Forage Development Project (LFLP-HLFFDP)
- (ii) The Western Uplands Poverty Alleviation Project (WUPAP)
- (iii) High Value Agriculture Project in Hill and Mountain Areas (HVAP)
- (iv) The Kisankalagi Unnat Biu-Bijan Karyakram project (improved seed for farmers)

EX-ACT, used in the present appraisal, is a tool developed by FAO which is aimed at providing ex-ante estimates of the impact of agriculture and forestry development projects/policies/programmes on GHG emissions and carbon sequestration.

The impact of a project on natural capital should be incorporated into planning decision-making processes of land use project appraisals. This is a precondition to explicitly meet sustainable development policy objectives and to ensure the continued provision of beneficial ecosystem services to rural and local populations.

The analysis allows to identify two different types of agricultural development projects: on the one hand, environmental and forest-sector targeted programmes, such as LFLP and WUPAP, for which both the value from prevented GHG emissions is over $ 1500 while increased natural capital is in a range of $ 700-1200 per hectare. On the other hand, we differentiate annual crop areas targeting projects, such as HVAP and the Kisankali project, for which both the value of avoided GHG emissions are below 500 and natural capital are estimated below $250 per hectare. This difference is illustrated in the figure below.

Fig1. : Mitigation and other natural capital impact per hectare



Adding together natural capital, financial capital and physical capital generated by farm beneficiaries, we measure an asset which strengthens landscape and household resilience to shocks like drought and heavy rains, while within improved financial and physical capital, we measure additional financial means to withstand critical situations. These ecologic and household resilience assets represent a value of 920 US$ / LFLP farmer and an aggregated value of 46.6 million US$ for the whole LFLP project area. WUPAP project will generate 2028 US$ of ecologic and household resilience assets per farmer and 34 million for the whole area. HVAP project is down to 323 US$/ farmer and a global value of 5 million for the project area.

1 INTRODUCTION

Objective: This paper analyses the impact of four IFAD projects[1] in Nepal on the balance of greenhouse gases (GHG) and their potential for climate change mitigation as well as on stocks of natural resources.

By making use of FAO's *Ex-Ante Carbon balance Tool* (EX-ACT, v.4; c.f. Bernoux et al., 2009; FAO, 2013) the analysis identifies which project activities were specifically beneficial for decreasing expected GHG emissions and increasing projected sequestration of carbon in soil and biomass. In a second step, the paper makes use of the natural resources accounts from EX-ACT and follows the guidance of the *System of Environmental-Economic Accounting* (SEEA; EC et al., 2012) in order to quantify the projects' impact on stocks of natural resources.

Agriculture and forestry development projects can have strong effects on the GHG balance as well as on the natural resource stocks, while both are not part of the core focus of conventional investment planning. This is firstly due to the technical difficulties to adequately estimate impacts on the two variables, which is the main problem addressed by this document. Secondly, they are not part of the narrower focus of project impact assessments as their benefits occur either for the public[2] or still forthe private actors, but at a considerable later point in time than when the project ends.

The former said, the actual realized or foregone benefits for rural people's livelihoods from selected natural resource stock increases, do not become less relevant. Increased soil organic matter in rehabilitated degraded land is the basis for continuous higher yields beyond shorter project horizons, erosion protection measures prevent ongoing resource-degradation, soil and water conservation measures and structures for water harvesting decrease the vulnerability to shifting rainfall patterns and, finally, additional forest area provides benefits from NTFP, fuelwood and timber. For the occurrence of these benefits, it is thereby central that land use changes and management practices introduced by projects, prove to have certain sustainability and are not reversed immediately after the project ends.

The paper at hand thus intents to give more visibility and importance to the impact of projects on the GHG balance as well as on natural resource stocks. It also shows at which point in time economic development objectives of classical investment planning can be strongly combined with GHG and environment objectives and also where trade-off exists.

Targeted audience: This module targets current or future practitioners in formulation and analysis of investment projects or on climate change issues, as well as people working in public administrations, NGO's, professional organizations or consulting firms. Academics can also find this material useful to support their courses in carbon balance analysis and development economics.

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[1] The four projects are the Leasehold Forestry and Livestock Project (LFLP), the Western Uplands Poverty Alleviation Project (WUPAP), the High Value Agriculture Project in Hill and Mountain Areas (HVAP) and the Kisankalagi Unnat Biu-Bijan Karyakram Project (Improved Seed for Farmers Project).

[2] This is the case for the benefits from reduced GHG emissions and increased carbon sequestration as well as for the benefits occurring in the form of environmental service provision originating from specific natural resources.

Required background: In order to fully understand the content of this module the user must be familiar with:

- Concepts of climate change mitigation and adaptation
- Concepts of land use planning and management
- Elements of project economic analysis

Readers can follow links included in the text to other EASYPol modules or references[3]. See also the list of EASYPol links included at the end of this module.

Context of the carbon balance appraisal

The following work combines a series of carbon balance appraisals of IFAD projects in Nepal, using the EX-ACT tool. The carbon balance appraisal is completed by an additional assessment of the impact of the projects on natural capital and on landscape and household resilience generated. In line with climate resilience objectives, such resilience appraisal is to consider as a first analysis, to provide to project managers and policy makers alternative performance indicators in term of climate adaptation and disaster management, to be used in multi-objective programmes which combine food security, poverty reduction, climate mitigation and adaptation.

2 COUNTRY CONTEXT: THE SITUATION OF CLIMATE CHANGE AND NATURAL RESOURCES

The current chapter provides the situational, project and methodological background as well as context of the paper.

It gives a concise introduction of the climate change situation in Nepal by describing the main risks and vulnerabilities associated to changes in climate and presenting the main sources of GHG emissions in the country.

2.1 Context of climate change in Nepal

Inhabitants of mountainous regions in least developed countries are recognized to be among the most vulnerable to climate change. They are usually characterized by, and confronted with, small land holdings, limited financial resources and little capacity to deal with the range of climate related impacts. Also differences within communities, such as socially marginalized groups and vulnerable parts of the population, are of special relevance for climate change adaptation interventions.[4]

Despite the understanding of general risk and vulnerability drivers in mountainous regions, the generation of a specific evidence base is needed in every location as well as

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[3] *EASYPol hyperlinks are shown in blue, as follows:*

a) training paths are shown in **underlined bold font**

b) other EASYPol modules or complementary EASYPol materials are in ***bold underlined italics***;

c) links to the glossary are in **bold**; and

d) external links are in *italics*.

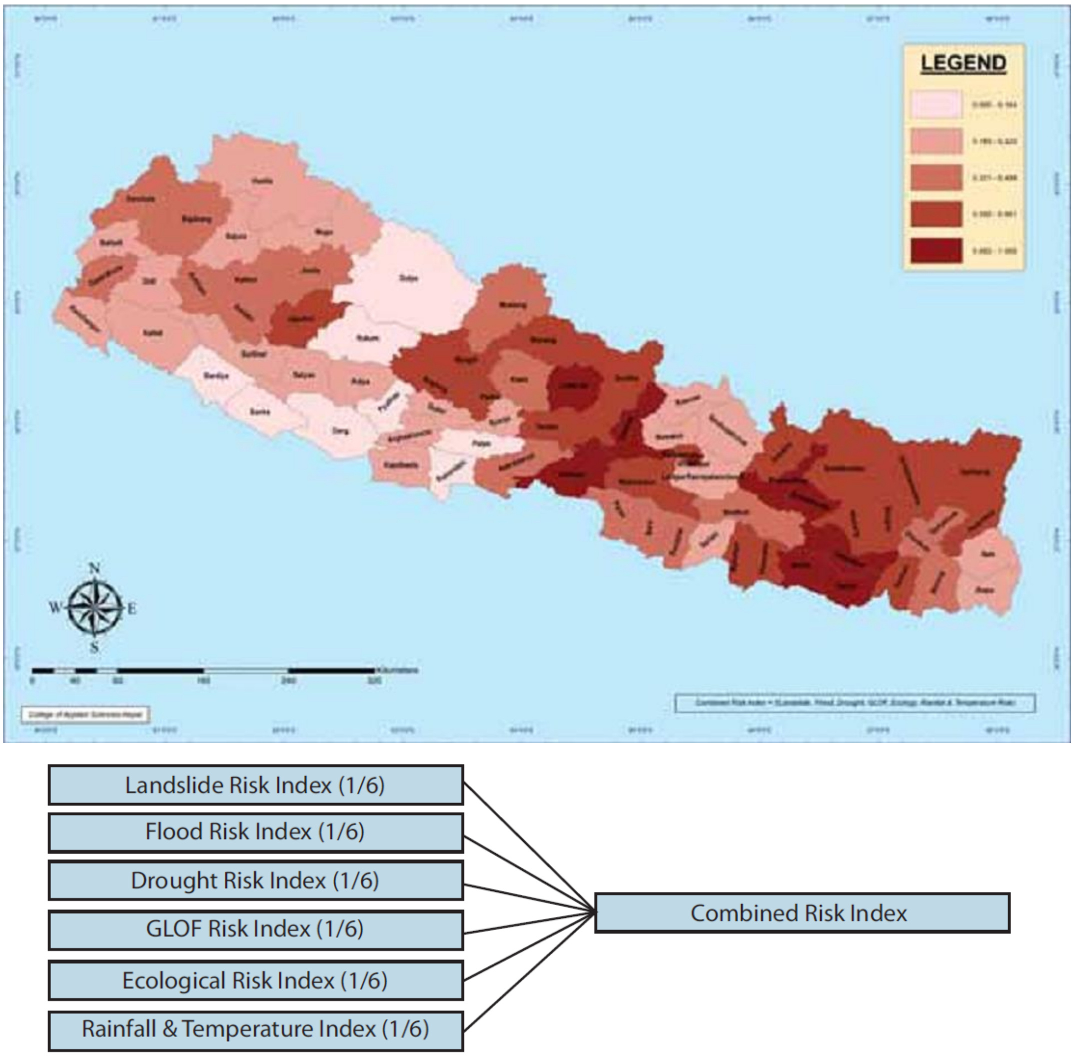
[4] *Sterrett, Charlotte (2011) Review of Climate Change Adaptation Practices in South Asia (Oxfam)*

a verified assessment of risks and potentials for adaptation and mitigation of climate change.

In the National Adaptation Programme of Action (NAPA; GoN, 2010b), the Government of Nepal identifies the country as an ecologically and socio-economically strongly vulnerable country to the adverse impacts of climate change. Rises in average temperatures are thus foreseen to be associated to changes in rainfall patterns (such as less frequent but more intense rainfall events), increasing frequency and intensity of floods, more erratic shifts in monsoon on- and offset that have consequences for seasonality, longer dry spells and drought events, and a growing likelihood of Glacial Lake Outburst Floods (GLOF). These impacts thereby promote furthermore soil erosion and landslides as other indirect impacts from climate change.

Figure 2 below from the National Climate Change Vulnerability Mapping (GoN, 2010a) depicts the combined risks from the most salient risk drivers (see the lower part of. figure 2 for the composition of the risk index).

Fig. 2: Combined climate risk exposure map (GoN, 2010a, p.23)



Note: Numbers in parenthesis are the weightage given to each of the indice

When leaving considerations on climate induced disaster risks aside and focussing instead purely on the impact on agriculture, main issues are the loss of topsoil from erosion, more erratic shifts of the monsoon, the decline in rainfall from November to April and longer dry spells during the same period that have a negative effect on winter and spring crops, promote crop failure and lower productivity (c.f. GoN, 2010b, 24f).

Though not all crop models (c.f. GoN, 2004) show a clear impact of climate change on yields of rice, wheat and maize, it is thus nevertheless taken as an urgent priority to promote drought resistant crops, improve cropping practices and to endorse conservation agriculture and crop diversification.

The impact on forests should be analyzed separately, as they are the source of firewood, food, fodder, timber and medicinal herbs and thus an important natural resource base of livelihoods in Nepal. GoN (2004, p.IX) presents evidence that Nepals bio-climatic diversity in forests will decrease under climate change. Thus it is expected that instead of the current 15 different forest types of the Holdridge Life Zone Classification, Nepal will only maintain 12 under doubled CO_2 concentrations (ibd.): tropical wet forest and warm temperate rain forest are expected to disappear and cool temperate vegetation would be transformed into warm temperate vegetation.

Turning to the issue of GHG emission, Nepal lastly reported in 2004 (GoN, 2004) its emission levels for the year 1994. Agriculture and land use change is pointed out as one of the major GHG emission sources. Agriculture accounts for 91% of the 948 Gg of methane emissions stemming mainly from enteric fermentation, rice cultivation and livestock manure management, and also accounts for a majority of the 27 Gg of nitric oxide emissions. In contrast, the 9747 Gg of net CO2 emissions are caused largely by the land use change and forestry sector. The latter is thereby the main source of carbon sequestration, which was estimated to lie at 4,738 Gg in the reporting year (only accounted for sequestration in biomass; ibd, p. iii).

2.2 Main issues

2.2.1 Degraded soil fertility and erosion

The complex farming systems of the hills have a decreasing level of soil fertility which in turn is reducing crop productivity. The manure to replenish soil nutrients comes largely from livestock, and requires more fodder/forage to obtain animal products and sustain the farming system. Agricultural production in the hills of Nepal is the result of the interaction of forest, animal and soil fertility. Animal-based farming systems in the hills have strong linkages with forest resources for fodder supply and nutrient recycling. The trees have nutritional, social, ecological and cultural value in Nepalese society (FAO[5], 2010)

2.2.2 Fodder tree expansion to feed goats and dairy cattle

In addition to these direct benefits to the farmer, fodder trees play an important role in environmental preservation by providing ground cover, thus minimising soil losses from run off. The self regeneration and high coppicing capacity of these trees enables them to be considered as a renewable natural resource with undigested leaf litter providing a good quality compost, and leftover branches providing fuelwood. Trees therefore help

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[5] *Paudel et al, Fodder and Forage Production, Sustainable livestock production in the mountain agro-ecosystem of Nepal, FAO, 2005 http://www.fao.org/docrep/004/T0706E/T0706E07.htm*

the farmers in many ways to sustain their hill farming systems in general, through animal production in particular (FAO, 2010).

Palatable tree species, including shrubs, and bamboo, that are fed to or browsed by animals are called fodder trees. Referred to as tree fodder, they are an important animal feed resource in Nepal particularly during the dry winter, when green grasses are not available. Livestock diets are usually composed of green grasses, crop by-products or fodder trees, with little or no concentrate feed. Over 50% of the total fodder supply comes from forest resources with forest trees supplying 20%. Fodder trees also provide significant amounts (15–29%) of crude protein. Fodder is usually fed as a supplement to crop by-products or grass, because although its production is limited, it is regarded as a high milk producing forage with high palatability. Thus, species such as Artocarpus lakoocha, Premna integrifolia, and Ficus semicordata are fed to lactating animals.

In terms of ownership, there are two sources of fodder trees in Nepal, namely private and community forest. The trees that are grown on and around farm land, terrace risers, kharbari, and khet land are regarded as private fodder, and the other type includes the trees from natural forest areas, community plantations and community forests. The management of these trees varies greatly from place to place, even at the household level, depending upon resources, techniques and time availability.

The concentration of the animal population in the mid-hills has already depleted fodder/forest resources to the extent that most of them are under threat. Pandey (1982) estimated that two tonnes of dry matter equivalent forage is required per livestock unit per year. From a study of on-farm managed buffaloes and cows at Lumle, Heuch (1986) showed that the total annual fodder used by cows and buffaloes was respectively nine and seventeen tonnes fresh weight, of which 27% (for cows) and 41% (for buffaloes) originated from tree fodder. However, this is not the present situation for all animals in the hills. MPFS (1988) stated that all the mid-hills, except the eastern hills, are in a fodder deficit situation, and this effect will continue until 2010 AD.

The surplus fodder that is available in the high hill areas is not being properly utilized due to uneven distribution of pasture land and animal population. Various studies have been carried out to estimate fodder needs on a household basis, and have found that the overall deficit of animal forage is around 20% (Pandey, 1982). Wyatt-Smith (1982) concluded that almost three hectares of unmanaged accessible forest are required to sustain one hectare of agricultural land for fodder. All these situations clearly show the need of further development of fodder to maintain existing animal populations.

2.3 Description of the IFAD project portfolio

IFAD's nine operations implemented during the 2006 COSOP (Country Strategic Opportunities Program) period (including grant projects but excluding the Poverty Alleviation Fund – II) were designed to be implemented in 43 of Nepal's 75 districts and reach around 233,000 households (5 percent of all rural households); of these, circa 151,000 households had been reached by the end of 2011.

The four main on-going and starting projects which have been appraised are:

The Leasehold Forestry and Livestock Programme (LFLP), which covers the middle hills area, where a large percentage of the population is poor. It targets poor families in the 22 districts not covered by the ongoing IFAD Western Uplands Poverty Alleviation Project, with particular attention to those living in areas adjacent to degraded forest and to those facing strong difficulties to secure enough food for their families all year round. With a budget of 16 million US$ (2005-2013), it targeted 43000 households. Combined with the precedent leasehold project, the Hills Leasehold Forestry and Forage Development Project (HLFFDP, 1991-2003), it represents an aggregate of 50,678 household beneficiaries (aggregated budget of 31 million).

The Western Uplands Poverty Alleviation Project seeks to promote more resilient livelihoods and basic human dignity of poor and socially disadvantaged groups through a rights based approach. An objective of the project is to create vibrant grass-roots institutions that will respond to the needs of the people, especially the target group and empower them to mobilise their own resources and to access external resources. The project intends to cover 115,000 households with a budget of 32.7 million US$ (2003 – 2016)

The High-Value Agriculture Project in Hill and Mountain Areas (HVAP) based in the mid-west of Nepal focuses on socially excluded and vulnerable people such as dalits, indigenous groups (janjatis) and women. It will help increase the incomes of these segments of the population by responding to the private sector's demand of 18 high-value crops, such as vegetables, fruits, non-timber forest products, medicinal and aromatic plants and livestock, all of which are currently not well processed or marketed. It targets 15300 households with a budget of US$18.9 million (2010-2017).

Kisankalagi Unnat Biu-Bijan Karyakram (Improved Seeds for Farmers Programme) targets an area of Nepal combining high poverty levels and relatively high population densities, with significant agricultural potential for seed and livestock production. The goal of the seven-year programme is to promote competitive, sustainable and inclusive agricultural growth in the target area in order to contribute to overall economic development. It seeks to improve productivity through market-led demand for improved seeds and livestock, investing and scaling up a growth model led by agriculture. The target group comprises nearly 350,000 households with a budget of 59.7 million US$ during 7 years of implementation (2012-2019).

In the future, it is anticipated that any further support for adaptation to climate change will be integrated into the framework of already existing (and proposed) IFAD projects. Within these projects they are foreseen to be selectively implemented in a fewer number of districts to ensure a sufficient level of capacity support to beneficiary households. In this regard, it is felt more relevant that investment in climate change adaptation is restricted to two to three regions of the country (preferably in the mid-Western, Western and Central Regions), where IFAD has already a significant presence. In particular, districts and villages for climate change adaptation interventions by IFAD would be largely selected on the basis of agreed criteria, such as: (i) prevailing poverty rates and total number of poor household in districts; (ii) extent to which local farmers and households see clear benefits in participating at implementing and mainstreaming innovations (particularly related to natural resource management and climate change); (iii) performance in relation to ongoing IFAD supported projects; and (iv) degree of district and local government support and endorsement of program support. (IFAD working document).

COSOP should focus on ways to better internalize climate change adaptation and resilience into its poverty reduction program support in the country, seeking to find new tools and approaches to mainstream climate change adaptation into its pro-poor agriculture, forestry, livestock and livelihood improvement programs.

3 STUDY METHODOLOGY

In the following the study methodology will be described. First we present the EX-Ante Carbon balance Tool and in its function to estimate the impact of agricultural and forestry development projects and programmes on the GHG balance. Then we outline the used accounting methodology of natural resource stocks.

3.1 The EX-Ante Carbon balance Tool

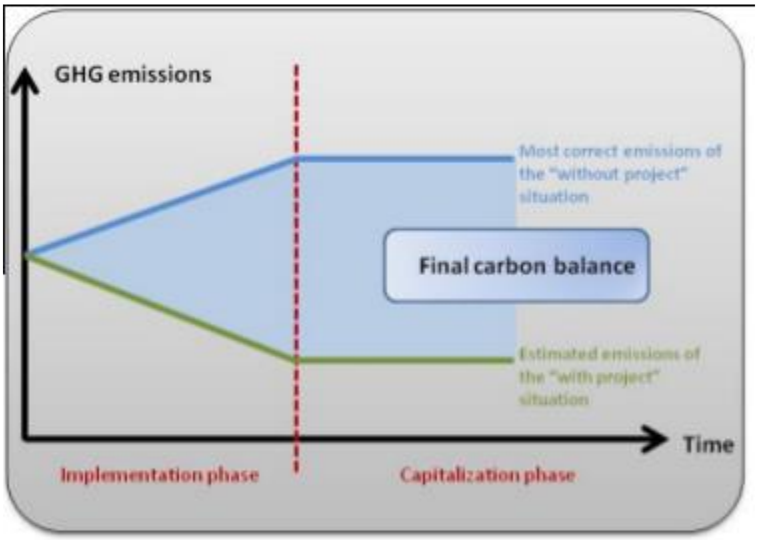
EX-ACT is a tool developed by FAO that aims at providing ex-ante estimates of the impact of agriculture and forestry development projects/policies/programmes on GHG emissions and carbon sequestration (Bernoux et al., 2010). The C-balance[6] is selected as indicator of the mitigation potential of the project/policy/programme.

EX-ACT consists of a set of Microsoft Excel sheets in which project designers insert information on dominant soil types and climatic conditions of project area, together with basic data on land use, land use change and land management practices foreseen under project activities as compared to a business as usual scenario (Bernoux et al., 2010).

EX-ACT can be used in the context of ex-ante project formulation and it is capable of covering a range of projects relevant for the land use, land use change and forestry sector. The main output of the tool consists of the C-balance resulting from the difference between the “with project” minus the “without project” scenario (Figure 3).

[6] C-balance = GHG emissions -carbon sequestered above and below ground.

Figure 3: Quantifying C-balance “with” and “without project” using EX-ACT



Source: EX-ACT flyer

EX-ACT has been developed mainly using the Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) complemented with other methodologies and review of default coefficients for mitigation options as a base. Most calculations in EX-ACT use a Tier 1 approach[7] (Bernoux et al., 2010), wheredefault values are proposed for each of the five pools defined by the Intergovernmental Panel on Climate Change (IPCC) guidelines and the United Nations Framework Convention on Climate Change (UNFCCC): above-ground biomass, below-ground biomass, soil, deadwood and litter. It should be highlighted that EX-ACT also allows users to incorporate specific coefficients (e.g. from project area) in case they are available, therefore working at Tier 2 level. EX-ACT measures carbon stocks and stock changes per unit of land, as well as Methane (CH_4) and Nitrous Oxide (N_2O) emissions expressing its results in tons of Carbon Dioxide equivalent per hectare ($tCO_2e.ha^{-1}$) and in tons of Carbon Dioxide equivalent per year ($tCO_2e.year^{-1}$). Detailed and technical information on the methodological conception of EX-ACT can be found in Bernoux et al. (2010).

3.2 Accounting and valuation framework of natural resources

Valuation frameworks of natural resources need to adequately fulfil three objectives: first they need to provide a clear categorization framework for natural resources, then resource stocks and stock changes have to be estimated by adequate methodologies, and finally these stocks have to be valued at adequate prices for the given context of Nepal.

[7] IPCC Guidelines provide three methodological tiers varying in complexity and uncertainty level: Tier1, simple first order approach which uses data from global datasets, simplified assumptions, IPCC default parameters (large uncertainty); Tier 2, a more accurate approach, using more disaggregated activity data, country specific parameter values (smaller uncertainty); Tier 3, which makes reference to higher order methods, detailed modeling and/or inventory measurement systems driven by data at higher resolution and direct measurements (much lower uncertainty).

These three steps of *categorization*, *resource stock estimation* and *environmental valuation* thus form the basis of the here below outlined approach and will each be discussed subsequently. The time reference of the analysis will thereby equally to other EX-ACT analysis, be 20 years, which is seen as the minimal time frame that needs to be covered in order to capture major impacts of an intervention on natural resources, as well as the approximation of a new state of equilibrium.

Such an environmental valuation of total natural resource stock changes is thereby associated to the problem that it is unclear whether the total amount of natural resources created will ever be valorised in their full amount and at current prices: though it is relevant to measure it e.g. how much additional timber has been created in total through the project, the valuation of the full amount of resources at current timber prices only allows for an indicative interpretation of its potential worth, while this amount will not translate into an equal income stream to project beneficiaries and resource users.

Increased natural resource stocks are understood as a natural form of capital that provide at a given point in time, a specific set of functional environmental services as well as opportunities for remuneration on markets. Directly occurring income benefits e.g. due to sustainable agricultural intensification measures, are adequately captured as part of the classical financial project analysis.

Environmental resources that are for a considerable timeframe neither processed nor transacted, but are intermediately conserved in their natural state; provide distinct, additional private and public values that need to be accounted for separately.

Natural resources thereby provide benefits either a) continuously and while being in their natural form (e.g. yield increases due to higher SOM content on rehabilitated land), b) by creating a single revenue stream in a considerable distant future (e.g. timber harvest from newly planted forest) or c) by providing public values that do not generate income streams (e.g. climate change mitigation or stream regulation function of watersheds).

The multiple benefits of natural resources for the rural population can thus be structured into:

- **Direct private values**

  This concerns the benefits from self-consumption or sale (in a considerable distant future) of additional timber, fuelwood and NTFP. It thus concerns a directly realized private benefit to the household, in form of either monetary revenue, increased household consumption or supply of inputs as the yield benefits of higher SOC contents through soil conservation practices, soil rehabilitation measures, composting, or the greater availability of fodder for livestock raising.

- **Indirect private values**

  This category subsumes functions of natural resources that over a longer period, provide benefits to mainly annual and perennial cultures or any other entities that provide direct private values. It thus concerns the indirect contribution to increases in monetary household revenue or increased household consumption.

This concerns the indirect benefits due the prevention of future erosion, the prevention of drought stresses, as the practices that limit the yield impacts of erratic rainfall and dry periods or measures that increase the availability of water and protect productive areas from flooding.

- **Public values**

  The mitigation of GHG emissions and increases in carbon sequestration provides an important public value, by minimizing the causes of further climate change and limiting resulting damage and abatement costs to society. Other public values that are provided by natural resources include biodiversity conservation and habitat provision, through protected and conserved natural areas as well as watershed functions (such as stream regulation and flood protection for settlements and infrastructure).

The in such a way evaluated occurring project benefits, through investing in natural resources, will be put into relation to the direct financial project benefits as calculated by standard project documents.

3.2.1 Categorization of natural resources stocks

The here below given classification provides a structured framework for accounting for the changes in natural resource stocks. It was oriented in central elements at the *System of Environmental-Economic Accounting* (SEEA; EC et al., 2012) and, was later further adapted in order to capture the main natural resources of the study conditions.

Table 1: Categorization of natural capital stock changes

	Natural Capital	Unit
	Direct private value	
A01	Incremental accumulated SOC on cultivated land (soil fertility)	t C
A02	Incremental stocks of non-timber biomass	t dm
	Fuelwood and -material	t dm
	Fodder	t dm
	Compost	t dm
A03	Incremental stocks of NTFP in forestry and agro-forestry	
	Indirect private value	
A04	Incremental area with erosion protection	ha
A05	Incremental area with increased drought resilience	ha
A06	Incremental water volume stored (dams, ponds, water harvesting)	m3
A07	Incremental water volume saved by improved irrigation practices	m3
A08	Incremental flood protected area	ha
	Public value	
A09	Incremental timber stocks in forestry and agro-forestry	t dm
A10	GHG balance (reduced emissions and C sequestration)	t CO2-e
A11	Incremental protected natural areas (forestry, peatland, wetland) (existence value)	ha
A12	Incremental new forest plantation (existence value)	ha

3.2.2 Estimation and valuation of natural resource stocks and stock changes

Estimations and accounting of natural resource stocks can be done by different means. It can be linked to survey based national statistical datasets as well as for some variables to GIS data.

In the case of the given study, we make use of the project documentation produced by IFAD project implementation staff as part of their regular project activities as well as on estimations and assumptions of project coordinators, implementing staff and other interviewed stakeholders. In some cases, the thus procured data was used directly in the section below, while for selected variables it served as input data into EX-ACT where changes in biomass or SOC were estimated using the established EX-ACT methodology. It should be clearly noticed that no statistically representative dataset could be procured as the basis of this study. Options to improve the data quality, as well as propositions to include data collection on relevant aspects of project monitoring in future projects are discussed in the last chapter of this document.

Besides accounting for the natural resource stock changes in physical units, it was also the objective to value the occurring benefits. While the categorization of natural resources provided above can also be used in similar country contexts, the monetary valuation is necessarily context specific. All specifications on resource valuation and selected precisions on estimations of resource stock quantities follow here below by resource category[8].

A01 Incremental accumulated SOC on cultivated land (soil fertility)

The effect on soil fertility from increased soil organic matter, is one of the most central and direct co-benefits between climate change mitigation and agricultural productivity. The capacity of increased levels of soil organic matter to bind carbon (mitigation), to increase the capacity to store water (adaptation) and to increase soil fertility (food security) makes it a central founding element of the concept of Climate Smart Agriculture. Wander and Nissen (2003) mention in addition "increased soil warming rates in temperate latitudes, reductions in energy required for tillage, enhanced soil tilth, ph buffering and, [possibly] disease suppression" as further benefits of increases in SOM content. Increased SOC levels are achieved by beneficial forms of land use change (e.g. involving land rehabilitation), the shift to adapted crop rotations as well as the use of reduced tillage and manure application.

In contrast to the A2 indicator we do not account here for increased SOC due to incorporation of biomass. Also we do not consider the benefits of avoiding future losses of SOC due to erosion, which is accounted for separately in A4.

The considered projects mainly achieve higher levels of SOC by reversing land degradation processes and bringing already strongly eroded land with low SOC content again under cultivation. The valuation of these benefits of SOM is nevertheless difficult. Wander and Nissen (2003) propose to link the value generated by marginal increases in SOC either to reduced production costs or improved yields. For this purpose they propose to estimate the increase in nitrogen availability through mineralization per additional SOC. Thereby the strength of this relation depends on many context variables, such as the initial SOM content or the soil type and structure. To nevertheless allow for a rough estimation, Wander and Nissen calculate for a given set of context parameters that per ton of SOC, annually 0.8 kg of nitrogen is made available through mineralization (ibd, p. 425). Thereby household data from Nepal States e.g. DAP fertilizer prices to be at 20.3 RS/kg (Agrifood, 2003, p. 141) translating into 113 RS (1.48 USD[9]) /kg N. Thus we arrive to a value of 1.18 USD/t of SOC. Discounting the 1.18 over 20 years generates a total value of USD 11.37.

A02 Incremental stocks of non-timber biomass

(Fuelwood and –material, Fodder & Compost)

An increased amount of biomass provides a set of various benefits for the territory in which it occurs. These benefits are composed of a) the additional amount of animal fodder from fodder trees, grasses and crop residues, b) the increased amount of organic biomass for compost production and incorporation into agricultural soil and c) the

[8] Thereby in the following only those resource categories are listed and valued for which stock changes actually occured in at least one of the cases of the four projects. Other resource categories are left out.

[9] Prices and exchange rate from 2002.

increased quantity of available fuelwood, crop residues and animal dung for heating purposes.

In the below calculation it was thereby assumed that of the additional biomass created trough the project, 10% could be valued for energy production, 10% used for compost generation and 20% as animal fodder.

The price of fodder was estimated at 12.96 USD/t and is based on Kanel and Davis (1999) that estimated tree fodder prices in Nepal by executing barter games with rural peasants, surveying how many hours they would be willing to work in exchange for a fixed amount of tree fodder in different locations of the country. The price per t of biomass used for compost was estimated at 10.06 USD, converting the biomass into resulting SOC in soil and valuing it with the method displayed under A01.

For fuelwood, Bajgain and Shakya (2005) report prices at 27 USD/t in the Hills and 20 USD/t in Terai. WECs (2006) shows that in Kathmandu the price lies even considerably higher at around 115 USD/t. With data from Baland et al. (2007), it is instead possible to roughly estimate the benefits of fuelwood based on an average collection time of 5 hours per headload of firewood, which we assume to account for 25kg. With the reported average opportunity costs of labour of 11.55 NR/h (ibd.) this would result in a worth of 27.18 USD/t of fuelwood. Seeing this relation of benefits and opportunity costs of fuelwood collection, we will assume a conservative average price of 10 USD/t of fuelwood in order to avoid overestimations.

For the other variables, we executed estimations of the associated costs for labour in order to arrive to a net worth of fuelwood, tree fodder and compost using the prices from Kanel and Davies (1999, p.48).

A03 Incremental stocks of NTFP in forestry and agro-forestry

Medicinal and aromatic plants; lokta paper; pine resin; katha, and sabai grass are important non-timber forest products in Nepal (c.f. MoF Nepal, FAO, 1997). Since the current study has been undertaken without intensive data from field surveys the marginal difference in availability and use of NTFP due to project activities cannot be evaluated and is thus not accounted for in this study. Nevertheless NTFP can account for a considerable share of additional benefits and constitutes an important part of rural livelihoods in Nepal.

A04 Incremental area with erosion protection

Complementing A01, it also has to be accounted for the benefits from prevented future erosion. Due to the dominantly mountainous project areas with predominance of slopes, soil erosion is a major issue.

Here it is accounted for benefits from active anti-erosive measures on productive land, since we have here a lower uncertainty that a further decrease in SOC content is indeed prevented and has not yet taken place to a huge extend. Thus it is accounted for the area that switches due to the project is to soil conservation practices.

For managed agricultural land, Upadhyay et al. (2005) use an average soil erosion rate of 7.5 t/ha/y though there can be strong variation observed due to slope, soil texture, rainfall intensity and timing of crop plantation. We will evaluate the benefits of preventing this average rate of soil erosion using a cost of 1.32 USD per ton of lossed soil established established by Acharya et al. (2010) for the context of community forests in Nepal. This leads to annual benefits of USD9.87 per hectare that are equal to discounted benefits of USD 94.8 per ha over the full 20 years.

A09 Incremental timber stocks in forestry and agro-forestry

Estimating average timber quantity per hectare is associated with certain imprecision, given the considerable variation of dominant tree types and densities in Nepal's 35 major forest types and 118 ecosystems (c.f. MoF, FAO, 2009, p.7).

EX-ACT estimates the total increased biomass on forestry and agroforestry area, whereby the IPCC guidelines (IPCC, 2003) provide an estimate of the average biomass expansion factor (BEF) for tropical broadleaf forest at 3.4, which allows to calculate the average amount of timber per amount of biomass.

Timber prices vary strongly by species and quality of the wood. While Kanel et al. (2012, p. 56ff) provides the detailed government fixed prices by species, length, girth and state of processing of the wood (round timber, sawn timber), Bhushal (2011) states that prices lie at RS 800 ($11.5) per cubic feet for Sal, Rs 1,000 ($14) for Shisham and ranged between Rs 300 ($4) to 500 ($7) for other type of wood. Since marketable quantities at the above mentioned relatively high prices are nevertheless strongly limited, we used a lower timber price derived from international markets lying at 87.72[10] USD per t of timber.

Again, also for timber extraction we subtracted estimated production costs in order to closer approximate the net worth of timber.

A10 GHG balance (reduced emissions and C sequestration)

The analysed four IFAD projects have at this project stage no possibilities anymore to receive funding from carbon markets. Also for similar projects that would be initiated nowadays, current market circumstances offer only very limited options of payments for carbon benefits. Mitigation of climate change can be considered a transfer of wealth from the present generation to future generations.

Thus not representing an actual realized value flowing to a private actor, we try to value in this section the public benefits from the GHG balance or more precisely the avoided public costs from additional emissions and reduced sequestration. Such social costs of carbon can be estimated by integrated assessment models such as e.g. DICE, FUND and are associated to high uncertainty on "(1) future emissions of greenhouse gases, (2) the effects of past and future emissions on the climate system, (3) the impact of changes in climate on the physical and biological environment, and (4) the translation of these environmental impacts into economic damages" (U.S. Government, 2010, p. 2).

[10] Comparing the European price (78 US$/m3) and US price (US$ 33/ m3) in the end of 2012, a conservative price of US$ 50/ m3 was chosen. Transformed in equivalents per ton using a timber density of 0.57, it is 87.72 US$/t."

Indeed results of integrated assessment models vary strongly. For the purpose of this study we will use the value established by the U.S. Interagency Working Group on Social Cost of Carbon lying at 21 USD per avoided ton of carbon (ibd.).

A11, A12 Incremental protected natural areas and new forest plantation

Additional conserved natural forest, the conservation of peatlands and wetlands as well as additional plantation forest are by many societal actors also perceived as having a pure existence value, beyond the instrumental benefits they provide. One example of such cultural values of natural resources, is the importance of forests for religious beliefs and practices in Nepal. While this study did not value such existence values in any way, their general importance is here shortly acknowledged.

4 GHG BALANCE APPRAISAL AND NATURAL RESOURCE STOCK ANALYSIS

After presenting the two methods of estimating the GHG balance with EX-ACT as well as valuing natural resource stock changes, this chapter presents the estimated impact of the four IFAD projects on both variables. Thereby we differentiate between the project duration as implementation period of specific intervention activities, but also monitor the impacts on the GHG balance over an additional time period. Like this our reference frame reaches at least a total of 20 years, since LUC interventions often have stronger impacts over several years.

4.1 Leasehold Forestry and Livestock Programme (HLFFDP+LFLP) 1992-2012

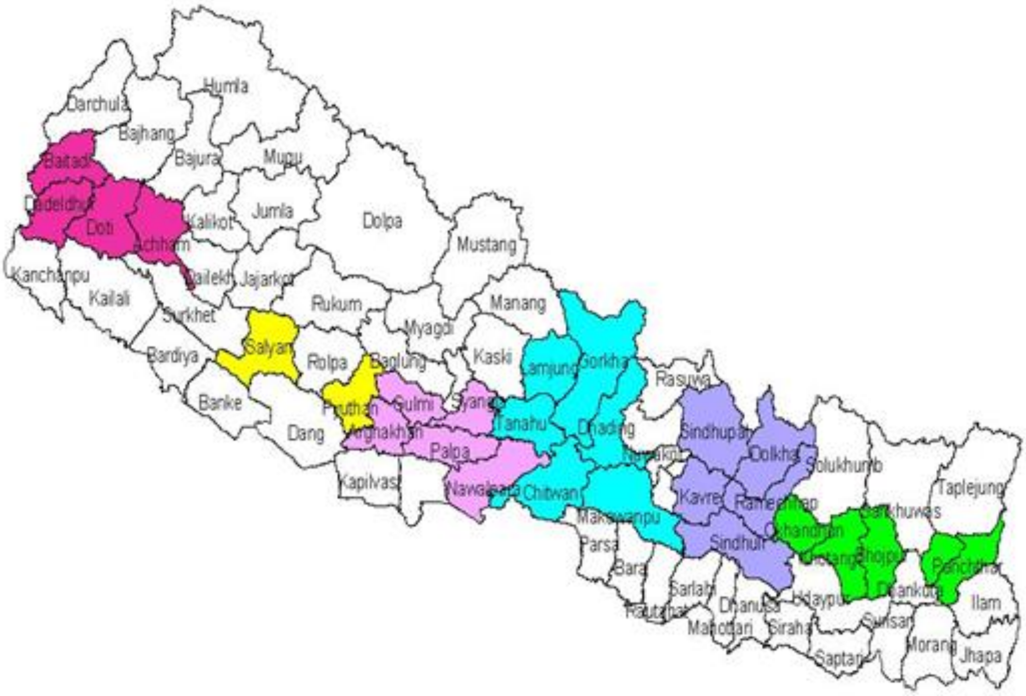
Taking into consideration the inequity in distribution of forest benefits between rich and poor, the concept of poverty reduction through Leasehold Forest was put into practice through the Hills Leasehold Forestry and Forage Development Project (HLFFDP) from 1991 to 2003 in 10 districts of Nepal funded by the International Fund for Agricultural Development (IFAD). The LFLP project builds upon this experience and the lessons learned, especially in the aspects of formation and functioning of local, self-organized groups of poor people (NPC, 2005).

The Leasehold Forestry and Livestock Programme (LFLP) aims at a sustained poverty reduction of 44 300 target households in 22 districts of Nepal through the allocation of degraded forestry plots as leaseholds and increased production of forest products and livestock (c.f. IFAD, 2012, p.2). Together HLFFDP and LFLP represent a continuum of 21 years (1992-2012) of project support which are covered by the present ex-post appraisal work. It is estimated that in total 50,678 households benefitted directly from participating in leasehold forestry.

“(i) leasehold plots are managed so as to meet household subsistence and income needs and protect the environment; (ii) livestock have contributed to meeting household food and income needs; (iii) the leasehold groups and village finance associations (VFAs) have become sustainable rural financial institutions providing financial services to leaseholders; (iv) Government has developed the capacity to implement leasehold forestry as a poverty reduction programme in a gender sensitive way”, (IFAD, 2004, p.23).

In terms of impacts on natural resources the programme thus contains the objective to bring degraded forest plots again under productive use with economic benefits for resource users, increase the value of the natural capital stock in a given territory by enhancing soil resources and preventing further erosion, promote benefits for water and stream flows in the watershed, increasing availability and reducing costs of timber, firewood and fodder and contribute to climate change mitigation by sequestering carbon in soil and biomass. Figure 4 below shows the programmes implementation districts.

Figure 4: LFLP implementation districts



In the following we will present the detailed impacts of the project on the GHG balance and natural resources. The input data for this analysis is thereby mainly based on IFAD (2012), FAO (2011), FAO (2009) and unpublished project monitoring documents made available under the project. The used information was verified during several consultation of IFAD implementing programme staff.

4.1.1 EX-ACT analysis of the HLFFDP+LFLP

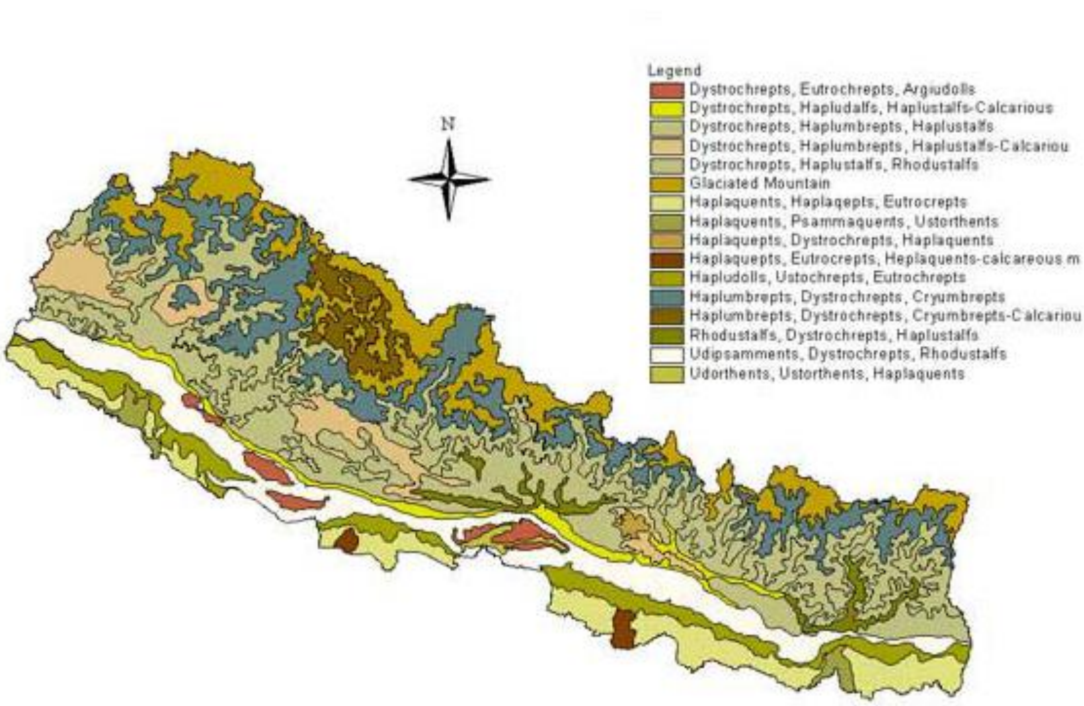
A) Global parameters

Nepal is characterized by diverse soils and agro-ecological zones. For simplicity EX-ACT makes global assumptions concerning soil types and climate of a project area, though the effect of variations in both variables can be analyzed by sensitivity analyses.

ISRIC (2009) provides a differentiated overview of the major soils in the different altitudes of Nepal, while figure 5 below gives a similar picture in a graphical way (FAO, 2008, p.15-19). Nepal soil is widely composite with no real dominant soil; the leasehold forestry areas targeted in degraded land use areas are dominated by Low Activity Clays (LAC).

Since major parts of the implementation area lie in the mid-hills at allevations between 800 and 2400 meters we assume a tropical climate and a moist moisture regime.

Figure 5: Soils of Nepal



B) Variety of agro-forestry mixes in with project situation

In line with the multiplicity of leasehold areas involving various altitudes, sun orientation and slope situations as well as divergences in market access, leasehold beneficiaries groups have developed locally smart choices of perennials which had to be appraised properly in the present study. Using the wide series of research papers and surveys done in the last five years, made it possible to develop a global profile of perennials which was submitted for critical review to a group of national senior officers of the LFLP and of the Ministry of Forestry and Environment[11] widely involved in the project monitoring, the advice to LFLP groups and technical supervision. The fodder trees commonly grown in Nepal are many, but the high yielding and preferred fodder tree species are Gogan (*Sauraria nepalensis*) and Nebaro (*Ficus roxburgii*) in relatively higher elevation (1500 to 2500 m), while in lower elevation (below 1500 m) are Baddar (*Artocarpus lakoocha*), Koiralo (*Bauhinia purpurea*), B.variegate, Bhimal (*Grewia optiva*) and Kabro (*Ficus lacor*) (PANDIT[12], 2009).

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[11] *Expert brainstorming meeting on 7 of March 2013 to review, discuss and update the first appraisal with MFE, IFAD, FAO, LFLP…*

[12] *Bishnu Hari Pandit K, 2009,Effectiveness of Leasehold Forestry to Poverty Reduction, TCP/NEP/3102: Institutional and Technical Capacity Building in Support of Leasehold Forestry*

Growing of fodder trees on farm lands, terraces and farm boundaries is a common practice. Fodder trees are also grown in pastures and leased lands. Kiff *et al*. (2000) showed that common fodder tree species have yields from 20-86 kg of fresh leaves and twigs per tree per year, with a dry matter content of between 100 and 600g/kg. Therefore the productivity of various forage and fodder species varies between years as well as regions, between type of species and management systems adopted. Kiff[13] *et al*. (2000) showed that Napier grass produced almost double the amount of green matter (30.5t/ha) compared to native grass (16.1t/ha) (PANDIT[14], 2009)

Table 2: Tier 2 coefficients of dry matter biomass and of carbon fixed per ha per year

% area		T DM/ha	T C/ha
Forestry			
10%	Shrubland (bush area)	6.38	3.00
Pasture			**3.00**
0%	lemon grass	10.00	4.70
30%	Local grass - open area	6.38	3.00
Perennials			**4.66**
7%	Napier perennial grass	13.00	6.11
7%	broom perennial cash	9.00	4.23
7%	Molasses perennial grass	15.00	7.05
18%	pineapple-fruit trees	8.51	4.00
18%	tree fodder	8.51	4.00
3%	Degraded land		
40%	annual crops		
60%	Agro forestry annuals mix	2.13	1.00

Source: Bisht[15], 2000, LASCO[16] 2001, FAOSTAT

In this table, technical coefficients of carbon fixing through above ground biomass are expressed in tons of dry matter per ha and converted in T of carbone par ha. In the case of LFLP, the distribution between different types of perennials, either perennial grass or perennial fruit trees was particularly critical to estimate due to the high variability between LFLUG and LFLP sites.

C) Overview: Main changes in land use and state of degradation

13 *Kiff, E. Thorne, P.J. Pandit, B.H. Thomas, D. Amatya, S.M. 2000. Livestock production systems and the development of fodder resources for the mid-hills of Nepal. DFRS,NRI and NAF*

14 *Bishnu Hari Pandit K, 2009,Effectiveness of Leasehold Forestry to Poverty Reduction, TCP/NEP/3102: Institutional and Technical Capacity Building in Support of Leasehold Forestry*

15 *Bisht N S, Broom Grass, SFRI information n°6, STATE FOREST RESEARCH INSTITUTE Pradesh, India, 2000*

16 *Lasco et al, Carbon budgets of tropical forest ecosystems in Southeast Asia: implications for climate change, FAO, 2001*

The presentation of changes in land use as well as in the state of degradation of soil resources will be here presented: once in a short overview to allow for an easy comprehension of the overall changes in the programme area, and in a second step, we will analyse the effects of this development in each EX-ACT module and identify the disaggregated effects on the GHG balance.

The LFLP newly allocated 20,150 ha of degraded area, formerly either degraded forest, degraded pasture or degrade land, in the form of leaseholds to beneficiaries for conversion into more sustainable and productive forms of land use. Besides the LFLP also took over the responsibility to maintain and further improve the management of existing leaseholds plots. In total, the project covers t 27408 ha of leasehold forest area and also affects the initially existing agriculture cropping areas of beneficiaries, accounting for additional 17737 ha.

Table 3: Evolution of land use of the LFLP programme area as foreseen with and without project implementation

		Year zero	ha		Without project	ha		With project	ha
Leasehold area	**Forestry**								
	moderately degr. shrubland	30%	8222	moderately degr.	20%	5,482			
				extremely degr.	10%	2,741	rehabilitated	10%	2,741
	Pasture								
	severely degr. pasture	30%	8222	severely degr.	30%	8,222	improved pasture	30%	8,222
	Perennials							57%	15,623
	Degraded land	40%	10963		40%	10,963		3%	822
existing farm area	annual crops	80%	14190		80%	14190		40%	7095
	agroforestry annual mix	20%	3547		20%	3547		60%	10642
Total area			45145			45145			45145

Source: Project monitoring data (LFLP consultation, March 2013)

The main rational is that the targeted forest area is initially degraded and dispatched in three types of land use: moderately degraded shrubland (30% of the leasehold), degraded pasture (30% of the leasehold area) and degraded land (40% of the area). In the without project scenario (baseline scenario), one third of the shrubland (10% of the area) is foreseen to become extremely degraded, while the rest of the land use does not experience further degradation, nor rehabilitation.

Under the project scenario, the majority of the land is brought again under constant crop cover. Indeed, the project monitoring reports that the ground cover has been increased from initially 32% to 90% of the leasehold forestry area (IFAD, 2012). Within the leasehold area, this means mainly the establishment of agro-forestry systems mixing grasses (stylosanthes, molasses grass, napier grass, amriso, mulato, sumba sateria, guatemala) and fodder trees (Ipil-Ipil, Kimbu), that will replace 20% of the degraded shrubland as well as most of the other degraded land (37% of the leasehold area).

Initially the 8,222 ha of pasture are severely degraded (soil carbon stock: 32.9 T C/ha) and it will stay severely degraded in the without-project situation in absence of any rehabilitation. In the with-project situation, this area of severely degraded pasture has been largely improved and became non-degraded (soil carbon stock: 47 T C/ha).

Table 4: SOC content of grasslands in different states of degradation

Avalaible options for Grassland	Soil C (tC/ha)
Non degraded	47.0
Severely Degraded	32.9
Moderately Degraded	45.1
Improved without inputs management	54.5
Improved with inputs improvement	60.5

D) First Results by EX-ACT module

Deforestation module: Under the LFLP 5,482 ha, degraded shrubland are converted into agroforestry. Though degraded at project start, this involves initially also the removal of a limited amount of above and below ground biomass, which will cause the release of 468, 311 tCO_2-e over the full duration of the analysis.

Forest degradation module: 2,740 ha of the leasehold forestry area would become more degraded in absence of the project, while it is rehabilitated with the project intervention. Due to this, benefits occur from increased levels of soil organic carbon (103,688 tCO_2-e) as well as augmented biomass (346 751 tCO_2-e).

Non-forest LUC module: Due to the LFLP, 10,140 ha of degraded land are converted into agroforestry. The change in land use and crop cover causes the sequestration of 699,800 tCO_2-e. Besides, 7,095 ha of existing annual crop area is converted into agroforestry, leading to the sequestration of 286,497 tCO_2-e.

Annual crop module: The maintained annual crop area on 7,095 ha is improved by manure application and better agronomic practices, leading to the sequestration of 212,272 tCO_2-e.

Perennial crop module: The areas converted to agroforestry instead are key areas of the project that account in total for 26,265 ha. Since project start, already existing agroforestry area leads over the project duration to the sequestration of 309,812 tCO_2-e. The other new agroforestry area of 17,236 ha that was created from conversion of annual cropping systems to a mixed system from annual crops and trees as well as from degraded land leads to the sequestration of 2.140,957 tCO_2-e. Additional 5,482 ha of agroforestry area was created as mentioned above from degraded shrubland. On this area 979,128 tCO_2-e are sequestered.

Grassland module: 8,222 ha of severely degraded grassland are rehabilitated mainly by the distribution of seeds and training on grassland and fodder crop management. By reversing the degradation state to non-degraded, 233,298 tCO2-e are sequestered

Livestock module: The LFLP provided various kinds of services to promote the sustainability and total production of livestock production.76,958 female and 4,011 male goats were distributed to LFUGs. Due to this component and the strengthened fodder availability the goat herd size is expected to increase from 152,000 to 253,400 heads. The new achieved herd size will create methane emissions from enteric fermentation of 111.745 tCO_2-e as well as from manure management of 3,799 tCO_2-e. Besides manure will also cause the emission of nitric oxides accounting for 77.733 tCO_2-e. Together the new herd size thus accounts for emissions of 193,317 tCO_2-e over the full period of the analysis.

Besides these elements, the analysis also accounted for the emissions from project vehicles and the building of offices and social welfare buildings. They account together for emissions of 1,948 tCO_2-e.

E) Gross Results: GHG emissions and sequestration under the LFLP

The EX-ACT modules allowed to estimate the likely GHG emissions as well as the extent of carbon sequestration due to the activities of the LFLP. Taking all the previous calculations together the LFLP is in total a sink, leading to carbon sequestration. It causes a sum of decreased emissions and increased carbon sequestration of 3,851,447 tCO_2-e. Its main contributing activities are thereby the practices of cultivating an extended area as agroforestry, accounting for benefits of 3,442,904 tCO_2-e and thus 89% of the whole projects benefits. The second most important positive contribution is the beneficial land use change from degraded land and annual crops to agroforestry as well as the perennial cropland.

As is it naturally the case, livestock production stays a source of GHG emissions in the project area. By emitting a total of 773,270 tCO_2-e it is nevertheless estimated to have only moderate negative impacts on GHG emissions.

F) GHG balance: The overall project impact as marginal difference between project scenario and baseline scenario

The previous estimations concerned the actually occurring emissions due to the activities implemented as part of LFLP and showed that they lead to net sequestration of GHGs. As a mean for project evaluation this is nevertheless not sufficient since it has to be compared to the hypothetical baseline situation in the project area. Only if the project has a positive marginal impact, it is evaluated as contributing to climate change mitigation.

For this purpose all the previous EX-ACT calculations also have been effectuated for the baseline scenario as described under the LUC outlook under B: due to the emissions from further forest degradation and the emissions of the livestock herd, the intervention area would be under the baseline scenario an overall source of GHG emissions, leading to the very low level of emissions of 482,353 tCO_2-e.

Comparing with and without project scenario the marginal difference or GHG balance accounts thus for 4,333,801 tCO_2-e. In the specific case of the LFLP, these benefits are caused solely by increased carbon sequestration that are high enough to account for more benefits than the increased emissions of GHG and the limited increased emissions of GHG under the project scenario cause as damage. The figure below illustrates the GHG balance of the LFLP.

Fig. 6: LFLP overall climate mitigation impact

Project Summary	
Name	LFLP
Continent	Asia (Indian subcontinent)
Climate	Tropical Moist
Dominante Soil T	LAC Soils

Area (Initial state in ha)		
Forest/Plantation		8222
Cropland	Annual	14190
	Perennial	3547
	Rice	0
Grassland		8222
Other Land	Degraded	10963
	Other	0
Organic soils/peatlands		0

Components of the Project	Balance (Project - Baseline) All GHG in tCO2eq		CO2 Biomass	CO2 Soil	N2O	CH4
Deforestation	**468311**	**this is a source**	468311	0	0	0
Forest Degradation	**-450439**	**this is a sink**	-346751	-103688	0	0
Afforestation and Reforestation	**0**		0	0	0	0
Non Forest Land Use Change	**-976283**	**this is a sink**	5957	-984540	1320	980
Agriculture						
Annual Crops	**-217272**	**this is a sink**	0	-217272	0	0
Agroforestry/Perennial Crops	**-3120085**	**this is a sink**	-2945539	-174546	0	0
Irrigated Rice	**0**		0	0	0	0
Grassland	**-233298**	**this is a sink**	0	-233298	0	0
Organic soils and peatlands	**0**		--	0	0	0
Other GHG Emissions			CO2 (other)			
Livestock	**193317**	**this is a source**	---		77773	115544
Inputs	**0**		0		0	---
Other Investment	**1948**	**this is a source**	1948		---	---
Final Balance	**-4333801**	**It is a sink**	**-2816075**	**-1713343**	**79094**	**116524**
Result per ha	**-96.0**		**-62.4**	**-38.0**	**1.8**	**2.6**

Such a result shows that the reversion of land degradation has very strong benefits for climate change mitigation. The overall GHG balance translates into benefits of 96 t of CO_2-e per hectare or 85 ton of CO_2-e per farmer[17] respectively. The global level of uncertainty in results is 38% which is relatively low and a result of the use of tier2 coefficients as part of the deforestation and agro-forestry module.

The performance per ha for the leasehold forestry area is up to 4.6 t CO_2-e per year. The project's mitigation effect is mostly based on the generation of biomass (2.8 million tCO_2-e) and the additional creation of SOC (1.7 Million tCO_2-e).

4.1.2 Accounts and values of natural resource stock changes generated by the LFLP

As introduced earlier the LFLP strongly targets to increase the benefits of households by improving the natural resource base on which their agricultural livelihoods are based

[17] Based on 50,678 beneficiaries of the LFLP (source M E unit).

upon. This section tries to estimate physical quantities of natural resource stock changes and provides as well a careful attempt of valuing them monetarily in order to provide a rough estimation of their importance.

Table 5 below applies the earlier presented natural resource estimation and valuation framework on the LFLP.

Table 5: Impact of the LFLP on natural resource stock changes

Project:	LFLP		1 United States Dollar = 85.85 (02/05/2013)			
Nb farmers	50678		Units	Quantity (units)	Economic price (US$)	Estimated total Value (US$)
Area	45145					
Duration:	21					
	Natural Capital					
Direct private value						
A01	Incremental accumulated SOC on cultivated land (soil fertility)		t C	106859	$11.37	$1,214,991
A02	Incremental stocks of non-timber biomass		t dm	653634	/	$8,636,386
		Fuelwood and -material	t dm	163409	$7.00	$1,143,860
		Fodder	t dm	326817	$18.74	$6,124,796
		Compost	t dm	163409	$8.37	$1,367,730
A03	Incremental stocks of NTFP in forestry and agro-forestry					$0
				Sum direct private value		**$9,851,377**
Indirect private value						
A04	Incremental area with erosion protection		ha	33360	$94.80	$3,162,515
A05	Incremental area with increased drought resilience		ha	7095	11.7	$83,011
A06	Incremental water volume stored (dams, ponds, water harvesting)		m3	/	/	
A07	Incremental water volume saved by improved irrigation practices		m3	/	/	
A08	Incremental flood protected area		ha	/	/	
				Sum indirect private value		**$3,245,525**
Public value						
A09	Incremental timber stocks in forestry and agro-forestry		t dm	230608	$87.72	$20,228,776
A10	GHG balance (reduced emissions and C sequestration)		t CO2-e	4333801	$21.00	$91,009,814
A11	Incremental protected natural areas (forestry, peatland, wetland) (existance value)		ha	/	/	
A12	Incremental new forest plantation (existance value)		ha	/	/	
				Sum public value		**$111,238,590**
	Total Natural capital					**$124,335,492.70**

Valuing natural resources is associated to various difficulties and uncertainties, such as type, quantity and time frame of their use, but also on the differing benefits from their existence, consumption or sale. Environmental valuation in contexts of limited markets and limited information is thus necessarily an approximate endeavour.

Since the above listed resources will neither be valorised at the indicated prices, nor in full quantities, one has to strictly specify that the indicated values may not be interpreted as income streams flowing to any agent. The value of the natural capital stock instead is an indication and illustration of the value of natural resources created by the project beyond purely physical accounting.

In such a way, the LFLP caused over the full period of the analysis an estimated increase in *SOC* by 106,859 t. Measured with the value of annually provided Nitrogen by mineralization on cultivated area this is equivalent to a fertilizer value of appr. $1,2 million. The incremental *fuelwood* stock is assumed at 163,409 t of dry matter, equivalent to a value of appr. $ 1.1 million. The additional *animal fodder* accounts for 326,817 t of dry matter with a value of $6.1 million. The project induced amount of *compost* and crop residues incorporated in topsoil (mulching) accounts for a total amount of 163,409 t of dry matter that increases SOC and thus N availability to an extend equal to a fertilizer value of $1,4 mio.

The area brought under active *anti-erosive measures* accounts for 33,360 ha, equal to an additional value provision of $3,2 million. Similarly only a small area of 7095 ha under the LFLP is concerned by a higher *drought resilience* (and concerns former annual cultures that were brought under agroforestry) which is equal to a value of $83,011.

Besides this the LFLP creates 230,608 t of dry matter of *timber* with a value of $20.2 million. As provided by the EX-ACT accounting further above the LFLP's benefits of 4.3 million tCO_2-e can be valued at 21 USD as the estimated global Social Cost of Carbon. In such a way the LFLP provided additional public benefits of $91 million. Besides the physical number in CO2-e, this monetary evaluation further underlines the strong co-benefits of the project for *GHG mitigation*.

Focusing on the *overall impact* of the LFLP on natural capital, it accounts for a created value of $124 million. This is equal to an increased value of $2,754 per hectare over all the analyzed period of 21 years, or an annual value of $131 per hectare.

Considering the high values of both the additional natural resources as well as the GHG benefits, and acknowledging the crucial need for further increases in private household incomes, a moderate payment for such environmental services is imaginable. It would comprehensively target the different objectives of increasing incentives to invest in the natural resource base, mitigating GHG emissions and establishing a cash transfer to rural households.

4.1.3 Increased physical capital stock changes

Distinct from the impact on natural capital, the LFLP also creates new physical capital. This accounts for additional capital invested at farm level which could be transformed in cash (livestock, material) if needed.

Table 6: Incremental Physical capital generated by the LFLP project (1992-2012)

INCREMENTAL CAPITAL GENERATED BY THE PROJECT INCREASING LANDSCAPE AND HOUSEHOLD RESILIENCE					
project:	LFLP - HLFFDP	**1 United States Dollar = 85.66334 Nepalese Rupee**			
Nb farmers	50678	**Units**	**Quantity**	**Economic**	**Estimated**
Area	45145		(units)	**value (US$)**	**Value**
	Physical Capital				
C1	Incremental working asset generated (plough, tractor, pump and other farm equipme	US$	1520340	1	1520340
C2	Incremental value of livestock asset owned	US$	101,356	80	8108480
	Sub total				9628820

Incremental working assets at farm level (farmers' equipment, water pumps, tractors, milling equipment, etc) can be valued based on residual market prices. The incremental value of livestock is accounted separately.

It represents an aggregated value of 9.6 million US$, 16% stemming from improved equipment of farmers and 84% being caused by incremental value of owned livestock, mostly goats. This incremental physical capital is translates into an additional capital of 190 US$ per farmer.

4.1.4 Financial capital accounts

The previous estimated values of direct and indirect benefits from natural resources, that occur either continuously or at a later point in time, as well as generated public value stemming from natural resources, can now be compared to the immediate financial benefits to project beneficiaries as accounted for by conventional project appraisal documents.

The incremental income per beneficiary as estimated by project documents, accounts for 122 USD/year, initiating from year 6 of the project (project document, 2004). This is equal to a NPV of US$ 921 if discounted at 6 percent over the full project duration of 21 years.

Revisiting the further above established value creation by enhanced natural resource stocks, the annual created value per farmer accounts for $231. Thereby it is important to stress that these includes also public values and does not translate into an equal income stream to a private actor. Nevertheless it helps to illustrate that the provided natural capital forms an important addition to the direct financial project benefits.

Though associated with considerable levels of uncertainties, the value of natural capital has been established by conservative estimations. They provide a first argument for evaluating the direct and indirect benefits of natural resources as a central contributing factor to rural incomes and livelihoods as well as the public interest. This first quantification is a strong argument for further more precise evaluations of such benefits and more systematic targeting of project and programme design towards supporting natural resources.

4.1.5 Conclusion

The previous analysis showed that the reversion of land degradation as part of the LFLP creates very high benefits of GHG mitigation, regardless of the smaller direct impact over the 20 year analysis time frame. Moreover, the promotion of agroforestry areas causes strong and enduring benefits for the GHG balance compared to the alternative of annual crops. Another main outcome of the analysis was that, the livestock components of the programme that lead to certain increases in emissions are comparatively less important to the further listed benefits.

In such a way, the LFLP caused over the 20 years,a marginal reduction of the GHG balance by 8.4 million tCO_2-e. This provides empiric evidence that agricultural development projects that focus on the reversion of resource degradation can have strong co-benefits, even if combined with moderate expansions in the livestock sector.

In a second step, a new methodology was applied, it intends to capture the additional value created by investments in natural resources. Though the results have to be understood as approximations, there is strong evidence that the additional value associated to increased natural resource stocks provides important amounts of public and private values. The overall value of the LFLP was thereby estimated to account for a total value provision of USD 58.7 mio through various forms of natural resources and an additional USD 214.3 mio through the avoided social costs of carbon.

Also compared to the direct private benefits to targeted households as accounted for by the project analysis, elements of natural capital thus prove to be important project components.

4.2 Western Uplands Poverty Alleviation Project (WUPAP)

The Project: Western Uplands Poverty Alleviation Project (WUPAP) is a joint endeavour of the Government of Nepal and the International Fund for Agriculture Development (IFAD) implemented from 2003 to 2014. The overall goal of the project is to strengthen the livelihood systems of the target group in the programme districts in a sustainable manner. The objective is to focus on poverty alleviation through a rights-based approach, by promoting the formation of grassroots level organizations to empower the participants, to mobilize their natural, physical, and financial resources and to obtain social justice.

The WUPAP project began in 2003 and has been implemented in 11 districts in the Mid Western and Far Western Development Regions of Nepal. The project has five main components: 1) development of rural infrastructure; 2) leasehold forestry and production of non-timber forest products (NTFPs) and medicinal and aromatic plants (MAPs); 3) development of smallholder agriculture; 4) microfinance and marketing; and 5) institutional development (policy change, organisational change). It currently covers 17,072 households who benefitted from the leasehold of 22,500 ha degraded land which was granted for a period of 40 years.

Figure 7: Vegetable farming - Koltee, Dogdebada Village, Bajura

The districts involved in the WUPAP project are in the mountainous and hill area of Western Nepal. The Climate is warm temperate climate in hill area (1,000-1,600m altitude; mean annual temperature = 15-20°C) and cool temperate in mountains area

(>1600m alt.; m.a. T. = 1-10°C). Rainfall average is 1000 mm per year. The climate type is considered as warm temperate dry.

4.2.1 EX-ACT analysis of WUPAP

The 22,500 ha of degraded leasehold forestry are in fact an aggregate of 30% of degraded, bare land (6,750 ha) and 70% of largely degraded forest (15,750 ha). With 17,072 households the area accounts for 1.32 ha per household.

Forest degradation: From initially 15,750 ha of largely degraded forest (60% degraded) 12,000 ha will experience a change in land use (see below), while 3,750 ha of leasehold forest are left in a degraded state. It was hypothesized that it will become *extremely degraded* (80%) without project implementation (with fire use), while with the project it will have a state of *very low degradation* (10%) by reducing the occurrence of fire.

Deforestation (from degraded forest to fodder trees): 8,000 ha of the initially degraded forest is brought under planned cultivation with fodder trees (800 ha/year), while 3000 ha will be changed into annual crops and vegetable farming and 1,000 ha will be turned into annual fodder crops and forage seed crops.

Afforestation-Reforestation: A total of 4,400 ha (400 ha/year for 11 years) of the degraded land is brought under NTFP/MAPs production with the project.

Non-forest Land use change: The remaining 2,350 ha of degraded land will be replanted: 650 ha of land are brought under commercial vegetable farming, 1,100 ha (100 ha/year) of land are brought under commercial fruit production, 600 ha of communal land is developed into grassland for pasture management.

Livestock: The initial livestock numbers are based on ad-hoc assumptions derived from the statistical average of livestock ownership in the region (ADB[18], 1993).

[18] *ADB, Livestock Master Plan, Volume 1: A strategy for livestock development, Nepal, Asian Development Bank, 1993*

Table 7: Average livestock ownership per household by ecological zone

Species	Mountains	Hills	Terai
Cattle	6.2	4.2-3.18	7.1-4.63
Buffalo	0.6	1.8-2.01	2.0-3.21
Equines	0.9	0.06	0.02
Sheep	3.2	0.4-0.13	0.3-0.29
Goats	3.4	2.1-3.53	1.3-3.08
Sub- Total	*14.3*	*8.56*	*10.72*
Pigs	0.4	0.1-0.25	0.2-0.15
Chickens	2.2	3.1	3.0
Ducks	0.02	0.07	0.1
Work oxen	2.2	2.4	3.2
Buffalo bullocks for work	0	0	0.5

(Livestock Master Plan, 1993; volume III; p. 222)

Out of the 17,072 households involved in the WUPAP project, on the basis of most of them being in the mountainous area and slightly poorer than the average (translating into fewer ownership of livestock), the following average livestock numbers were assumed. Increased head numbers concern mostly goats and sheep.

Table 8: Assumed livestock numbers under three scenarios

		Year zero	without P.	with project
Number of livestock per hh (Livestock Master Plan, 1993)	Goats / hh	3	3	6
	sheep/hh	3	3	6
	buffalo/hh	0.6	0.6	0.6
	cattle (incl. yak) /hh	3	3	3
	chicken /hh	2.2	2.2	5
Total number of livestock	Goats	51216	51216	102432
	Sheep	51216	51216	102432
	buffalo	10243	10243	10243
	cattle (incl. yak)	51216	51216	51216
	chicken	37558	37558.4	75117

Electricity consumed: Project implementation involves the use of various **office devices**, implying an additional electrical consumption of **184.5 MW-h/ year.** We hypothesize that the electricity is generated in Nepal.

Table 9: Assumed energy consumption by type of office and telecommunications equipment (Roth et al., 2002)

	units	kW-h/year *	MW-h/year
Generator	22	1000	22.0
computer * (PC desktop + monitors)	90	630	56.7
printers* (laser)	74	694	51.4
fax machine*	24	132	3.2
scanner*	24	38	0.9
photocopie/printer* (copiers)	24	1077	25.8
telephone* (public phone network, p	46	6	0.3
HF or VHF radio base station	22	100	2.2
HF or VHF radio field station	220	100	22.0
Total			***184.5***
*source: with **	*http://www.biblioite.ethz.ch/downloads/Roth_ADL_1.pdf*		

This is responsible for additional emission of 39.1 tCO2-e per year

<u>EX-ACT investment module extracts</u>

Table 10: Electricity consumption

Released GHG associated with Electricity Consumption

Origin of Electricity	Nepal		
Default values (T CO2 / MWh)	YES	0.013	

Losses of electricity during transportation: **10%**

OPTION 1 (Based on Total Electricity consumption over the whole duration of the project)

Total Electricity Consumption (MWh)		Associated tCO2eq
Without Project	0	0.0
With Project	0	0.0

OPTION 2 (Based on Annual Electricity consumption at the beginning and according to dynamic changes)

Annual Electricity Consumption (MWh/yr)					Emission (t CO2eq)	
Start	Without Project		With Project		All Period	
t0	End	Rate	End	Rate	Without	With
0	*0*	*Linear*	*184.5*	*Linear*	0	39

OPTION1 + OPTION2	Sub-Total Without	*0.0*	Sub-Total With	*39.1*	*Difference*	39.1

<u>Petrol consumption</u>: Additionally the project involves **6 vehicles** (double cab pickups), that we suppose to consume 100l of gasoline per week, hence a total consumption of **343.2 m^3 of gasoline** for the whole project. This is responsible for the additional emission of 979.2 tCO2 eq.

Figure 11: Fuel consumption

Released GHG associated with Fuel consumption (agricultural or forestry machinery, generators...)

GHG emissions associated with inputs transportation is not included here! But in "Inputs"

OPTION 1 (Based on Total consumption over the whole duration of the project)

Total Liquid Fuel Consumption (m3)	Gasoil/Diesel	Gasoline	Associated tCO2eq
Without Project	0	0	0
With Project	0	343.2	979

Finally the project includes the building of **750 buildings** (including agricultural buildings and buildings for public service provision) and **125km of green-road**. We hypothesis that 30% of the buildings are schools, health posts and health centres, with average surface of 90, 65 and 200 m^2 respectively (WUPAP, Working Paper 3, Appendix 1, p1) and are build in concrete. The other 70% are agricultural buildings in concrete, such as cellar storage for fruits and potatoes, and market sheds, with average surface of 40, 15 and 100 m^2 respectively (WUPAP, Working Paper 3, Appendix 1, p1).

Table 12: Infrastructure & construction

			Building type	materials				With	
green road constructed	125	km	Road for medium trafic	asphalts	road width	4.5	m	562500	**m2**
public buildings (school, health centers, health posts)	225	nb	Offices	concrete	av. Surface	118.3	m2	26625	**m2**
public agricultural infrastructures (cellar storage for potatoes and fruits, market sheds)	525	nb	Agricultural Buildings	concrete	av. Surface	51.7	m3	27125	**m3**
total number public infrastructure	*750*								

The construction of these building is responsible for the emission of 71,438 t CO2 eq.

Released GHG associated with building of infrastructure

Type of construction or infrastructure	Default value t CO2 /m2	Specific Value	Default Factor	surface (m2)		Emission (t CO2eq)	
				Without	With	Without	With
Road for medium trafic (asphalt)	0.073		YES	0	562500	0.0	41250.0
Agricultural Buildings (concrete)	0.656		YES	0	26625	0.0	17466.0
Offices (concrete)	0.469		YES	0	27125	0.0	12721.6
Please select	0.000		YES			0.0	0.0
Please select	0.000		YES			0.0	0.0
Please select	0.000		YES			0.0	0.0
Please select	0.000		YES			0.0	0.0
			Subtotal	0.0	71437.6	*Difference*	*71437.6*

WUPAP Carbon balance results

Table 13: WUPAP Carbon balance

Project Summary	
Name	Western uplands poverty alleviation WUPAP
Continent	Asia (Indian subcontinent)
Climate	Warm Temperate Dry
Dominante Soil	LAC Soils

Area (Initial state in ha)		
Forest/Plantation		15750
Cropland	Annual	0
	Perennial	0
	Rice	0
Grassland		0
Other Land	Degraded	6750
	Other	0
Organic soils/peatlands		0

Duration of the Project (years)	
Implementatio	11
Capitalisation	9
Total	20
Total Area	
Mineral soils	22500
Organic soils	0
Total Area	**22500**

Components of the Project	Balance (Project - Baseline) All GHG in tCO2eq		CO2 Biomass	CO2 Soil	N2O	CH4	Per phase of the project Implement.	Per phase of the project Capital.	Mean per year Total
Deforestation	**998929**	**this is a source**	947889	51040	0	0	998929	0	49946
Forest Degradation	**-710727**	**this is a sink**	-592169	-83738	-15653	-19168	-631201	-79526	-35536
Afforestation and Reforestation	**-1262163**	**this is a sink**	-1074081	-188082	0	0	-534794	-727370	-63108
Non Forest Land Use Change	**-110237**	**this is a sink**	-18077	-92159	0	0	-53034	-57202	-5512
Agriculture									
Annual Crops	**-14515**	**this is a sink**	0	-14515	0	0	-5506	-9009	-726
Agroforestry/Perennial Crops	**-1024524**	**this is a sink**	-980980	-43544	0	0	-366867	-657657	-51226
Irrigated Rice	**0**		0	0	0	0	0	0	0
Grassland	**-1914**	**this is a sink**	0	-1914	0	0	-726	-1188	-96
Organic soils and peatlands	**0**		--	0	0	0	0	0	0
Other GHG Emissions			CO2 (other)						
Livestock	**257666**	**this is a source**	---		98323	159344	97736	159931	12883
Inputs	**0**		0		0	---	0	0	0
Other Investment	**72455**	**this is a source**	72455		---	---	71991	465	3623
Final Balance	**-1795028**	**It is a sink**	**-1644962**	**-372911**	**82670**	**140176**	**-423472**	**-1371556**	**-89751**
In % of Emission without project:	**-113.8%**								
Result per ha	**-79.8**		**-73.1**	**-16.6**	**3.7**	**6.2**	**-18.8**	**-61.0**	**- 3.99**

Similar to the results of LFLP, WUPAP shows that the reversion of land degradation has very strong benefits for climate change mitigation. The overall GHG balance of 1.8 million t of CO_2-e translates into benefits of 79.8 t of CO_2-e per hectare or 105 Ton of CO_2-e per farmer.

The performance per ha is up to 3.99 t CO2 e/ year.The project mitigation effect is mostly focused on biomass generation (1.6 million TCO2) which generates 73% of the carbon balance impact. Soil carbon fixing (0.37 Million TCO2) generates soil enrichment of 16 TCO2 /ha.

4.2.2 Accounts and values of natural resource stock changes generated by the WUPAP

The table below, presents the incremental natural capital generated by the WUPAP. The total value generated accounts for $62.3 million. Thereby $37.7 mio stem from public value due to decreased GHG emissions and increased carbon sequestration. Other elements of natural capital instead create over the full project duration a value of $24,6 mio.

Table 14: Incremental natural capital generated by the WUPAP

INCREMENTAL CAPITAL GENERATED BY THE PROJECT					
Project:	Western uplands poverty alleviation WUPAP	1 United States Dollar = 85.85 (02/05/2013)			
Nb farmers	17072	Units	Quantity (units)	Economic price (US$)	Estimated total Value (US$)
Area	22500				
Duration:	20				
	Natural Capital				
Direct private value					
A01	Incremental accumulated SOC on cultivated land (soil fertility)	t C	15834	$11.37	$180,033
A02	Incremental stocks of non-timber biomass	t dm	381809	/	$5,044,798
	Fuelwood and -material	t dm	95452	$7.00	$668,166
	Fodder	t dm	190905	$18.74	$3,577,696
	Compost	t dm	95452	$8.37	$798,936
A03	Incremental stocks of NTFP in forestry and agro-forestry				$0
			Sum direct private value		**$5,224,831**
Indirect private value					
A04	Incremental area with erosion protection	ha	13750	$94.80	$1,303,500
A05	Incremental area with increased drought resilience	ha	0	$11.70	$0
A06	Incremental water volume stored (dams, ponds, water harvesting)	m3	/	/	
A07	Incremental water volume saved by improved irrigation practices	m3	/	/	
A08	Incremental flood protected area	ha	/	/	
			Sum indirect private value		**$1,303,500**
Public value					
A09	Incremental timber stocks in forestry and agro-forestry	t dm	206312	$87.72	$18,097,534
A10	GHG balance (reduced emissions and C sequestration)	t CO2-e	1795028	$21.00	$37,695,583
A11	Incremental protected natural areas (forestry, peatland, wetland) (existance value)	ha	/	/	
A12	Incremental new forest plantation (existance value)	ha	/	/	
			Sum public value		**$55,793,117**
	Total natural capital				**$62,321,448**

Looking at the single elements, WUPAP increases *SOC stocks* over the full duration of the analysis by 15,834 tons with a value of $180 thousand. WUPAP also induces *fuelwood stock* increases by 95,452 tons of dry wood, accounting for a value of $668 thousand. The increased *fodder* quantity accounts for 190.905 t of dry matter of a worth of $3.6 mio. Thus also the WUPAP provides strong added value over benefits for raising livestock and increasing the carrying capacity of a given territory, as already the LFLP. The additional *compost* created accounts for 95,452 t of dry matter which provide benefits equal to N fertilizer of a worth of $798,936.

The additional area under *erosion control* accounts for 13,750ha, which prevents financial losses through soil loss of $1.3 mio over the full project duration. The additional *timber stocks* account for 206,312 t of dry matter, being equal to a value of $18.1 if valorised on timber markets.

The here before estimated positive *GHG balance* of WUPAP translates into avoided social costs of carbon of $37.7mio.

4.2.3 Increased physical capital stock changes

Also the WUPAP creates additional physical capital goods that represent an additional value by providing productive functions or being a source of potential cash revenue or direct consumption.

The main revenue stems similarly to the LFLP from an increased livestock herd size that is equal to $8.4 mio, while the total generated physical assets account for $8.9mio.

Table 8: Incremental Physical capital generated by the WUPAP project

project:	Western uplands poverty alleviation WUPAP	1 United States Dollar = 85.66334 Nepalese Rupee			
Nb farmers	17072	Units	Quantity	Economic	Estimated
Area	22500		(units)	value (US$)	Value
	Physical Capital				
C1	Incremental working asset generated (plough, tractor, pump and other farm equipme	US$	512160	1	512160
C2	Incremental value of livestock asset owned	US$	8,419,908	1	8419908
	Sub total				8932068

4.2.4 Conclusion

The WUPAP has strong mitigation benefits due to avoiding otherwise effectuated deforestation, establishing considerable agroforestry area and rehabilitating degraded land. In total the WUPAP decreases emissions by 1.8 million t of CO_2-e in comparison to the baseline scenario, which are benefits of 79.8 t CO2-e per ha over the full duration and 3.99 t CO2-e per hectare annually. Valuing this benefit with the current estimate of the global social costs of carbon of $21 per t, indicates a public value of this service worth $62.3 million. Though a bit lower than the results for the pure leasehold area of the LFLP, also the WUPAP proves to have strong co-benefits for GHG mitigation.

Leaving aside the public value of GHG mitigated, WUPAP creates in addition further natural capital worth $24.6 mio. This is mainly caused by the additional stocks of timber accounting for 18.1 mio as well as fodder accounting for $3.6 mio.

4.3 High Value Agriculture Project in Hill and Mountain Areas

The project focuses on socially excluded and vulnerable people such as dalits, indigenous groups (janjatis) and women. It will help increase the incomes of these segments of the population by responding to the private sector’s demand for 18 high-value crops such as vegetables, fruits, non-timber forest products, medicinal and aromatic plants and livestock, all of which are currently not well processed or marketed. The project will also focus on allowing farmers to:

- Develop strong commercial links with traders and to sustainably raise their incomes,
- Receive training and support in production and post-harvest techniques,
- Get better access to technical services, finances, farm supplies and market information.

4.3.1 EX-ACT analysis of HVAP

The project is working with 15300 targeted beneficiaries. No specific area in hectares is delineated within project document as project area.

Table 15: Basic information HVAP

households	15300	HH
Total farming area	15300.0	Ha
Pasture area	16830.0	Ha

Forest area	9945.0	Ha
Total area	25245.0	Ha

However considering that the average farming area is reported at one ha, the directly affected agriculture area by the project will account for 15,300 ha. The project will also have an impact on pastures and grazing lands due to its impact on goat keeping. The regional area land use map provides the following rough sharing between agriculture lands (36%), pasture (40%) and forest (24%) that we use to define the project area:

Table 16: Evolution of land use of the HVAP project area as foreseen with and without project implementation

			year zero	without project	with project		change
			Ha			ha	ha
	Food crops		**7650**		**-20%**	**6120**	***-1530***
annual	Maize+ millet	80%	6120	No change	**-25%**	4590	*-1530*
irrig rice	Maize+ irrigated rice	20%	1530		**0%**	1530	*0*
	Cash annuals		**3,800**			**4,560**	
annual	Vegetable (irrig)		1,600		**20%**	1,920.0	*320*
annual	vegetable seeds (irrig)		800	No change	**20%**	960.0	*160*
annual	Ginger		1,400		**20%**	1,680.0	*280*
	Total annual		**11,450**			**10,680**	**-** ***770***
	Perennial Cash crops		3,850		**20%**	4620	*770*
perennial	Apple		1,900		**20%**	2,280.0	*380*
perennial shrub	Turmeric (curcuma)		1,300	No change	**20%**	1,560.0	*260*
perennial	Timur zanthoxylum		500		**20%**	600.0	*100*
perennial	Other		150		**20%**	180.0	*30*
	Pasture						
	low degraded pasture					7915	
	mod degraded pasture		16830			8415	
	pasture switched perennial grass					500	
	Forestry						
	mod degraded forestry shrubland		9945	no change		9945	*0*
	low degraded shrubland						

Based on project documents and discussion with HVAP experts, a tentative land use partition between crops and perennial crops has been established for year zero (2011) and for the final situation after implementation of the project. The without project scenario (baseline) is currently considered as a continuation of the initial land use situation.

- Vegetables, vegetable seeds and ginger are the dominant annual cash crops while apple, turmeric and timur as major perennials. A main target land use change is lying in the progressive switch from part of the food crop land towards food and perennial cash crops.
- No assumptions were made concerning the project's impact on forests and we do assume that there are neither positive nor negative effects of the project on land use change concerning forests or their state of degradation.

HVAP Land use matrix: This land use matrix produced by the software shows how the land use data of with and without project is distributed.

Table 17: HVAP land use matrix

Project name	High Value Agriculture Project

Mineral soils *Without Project*		FINAL							
		Forest/ Plantation	Cropland Annual	Cropland Perennial	Cropland Rice	Grassland	Other Land Degraded	Other Land Other	Total Initial
INITIAL	Forest/Plantation	0	0	0	0	0	0	0	0
Cropland	Annual	0	9920	0	0	0	0	0	9920
Cropland	Perennial	0	0	3850	0	0	0	0	3850
Cropland	Rice	0	0	0	1530	0	0	0	1530
Grassland		0	0	0	0	16830	0	0	16830
Other Lar	Degraded	0	0	0	0	0	0	0	0
	Other	0	0	0	0	0	0	0	0
	Total Final	0	9920	3850	1530	16830	0	0	32130
								Organic soils	0

Mineral soils *With Project*		FINAL							
		Forest/ Plantation	Cropland Annual	Cropland Perennial	Cropland Rice	Grassland	Other Land Degraded	Other Land Other	Total Initial
INITIAL	Forest/Plantation	0	0	0	0	0	0	0	0
Cropland	Annual	0	9150	770	0	0	0	0	9920
Cropland	Perennial	0	0	3850	0	0	0	0	3850
Cropland	Rice	0	0	0	1530	0	0	0	1530
Grassland		0	0	500	0	16330	0	0	16830
Other Lar	Degraded	0	0	0	0	0	0	0	0
	Other	0	0	0	0	0	0	0	0
	Total Final	0	9150	5120	1530	16330	0	0	32130

Input use: Under rainfed agriculture, the most common rotation is a pre-monsoon fallow period, a following maize culture during the monsoon and subsequent cereal crop in winter. The overall maize nutrient budget shows significant deficits in N and P, with the addition of compost to maize fields being insufficient. Estimated fertilizer usage in Nepal is 56 Kg nutrient/ hectare (HANZDECK[19], 2002), but there are high differences between hills and lowlands (OPM[20], 2003).

Table 18: Tentative estimates of inputs used in the target area

	Chem Fert	Organic - compost	pesticides
	Kg N/ ha	Kg/ ha	kg/ ha
Trad Maize -food crops	40	200	1
Improved maize food	60	200	3
Vegetables	40	600	5
Improv Veg	60	1000	5

19 ANZDEC, 2002 Nepal: Agriculture sector performance review (ADB TA No.3536-NEP), main report prepared for MOAC and Asian Development Bank. ANZDEC Limited: New Zealand

20 OPM, 2003. Nepal fertilizer use study. A study funded by the UK Department for International Development (DFID). Kathmandu: Oxford Policy Management and Ministry of Agriculture and Cooperatives.

Ginger		50	600	5
Without project	*T / year*	*380*	*2710*	*18.0*
with project	*T/year*	*493.8*	*4038*	*36.6*

Source Oxford Policy Management (OPM) 2002 hills figures in Ha

The Annual petrol consumption of the project has been estimated as follows

		liter/month	Tons petrol-gasoil / year	
4	four wheel cars of project	200	9.6	
12	motorbikes	40	5.76	
10	Private trucks	400	48	
50	Extension-and district staff	15	9	
	Total		72.36	tons

The evolution of goat livestock with support to goat value chain is based on following assumptions of goat evolution

80% of HH	Year zero	without P.	with project
Households	12240	12240	12240
Goats / hh	3	3	5
Total goats	36720	36720	61200
Increm			24480

Within building investment, 500 collection centres of a size of 4x5 m have been considered as support to the 550 farmers groups.

HVAP Carbon balance results

Table 19: HVAP Carbon balance

Project Summary	
Name	High Value Agriculture Project
Continent	Asia (Indian subcontinent)
Climate	Tropical Moist
Dominante Soil T	LAC Soils

Area (Initial state in ha)		
Forest/Plantation		0
Cropland	Annual	9920
	Perennial	3850
	Rice	1530
Grassland		16830
Other Land	Degraded	0
	Other	0
Organic soils/peatlands		0

Duration of the Project (years)	
Implementatior	8
Capitalisation	12
Total	20
Total Area	
Mineral soils	32130
Organic soils	0
Total Area	32130

Components of the Project	Balance (Project - Baseline) All GHG in tCO2eq		CO2 Biomass	CO2 Soil	N2O	CH4	Per phase of the project: Implement.	Capital.	lean per yea Total
Deforestation	0		0	0	0	0	0	0	0
Forest Degradation	0		0	0	0	0	0	0	0
Afforestation and Reforestation	0		0	0	0	0	0	0	0
Non Forest Land Use Change	-41386	this is a sink	13816	-55202	0	0	16	-41401	-2069
Agriculture									
Annual Crops	-84269	this is a sink	0	-84269	0	0	-21067	-63202	-4213
Agroforestry/Perennial Crops	-201888	this is a sink	-187664	-14224	0	0	-45932	-155956	-10094
Irrigated Rice	-38438	this is a sink	0	0	-2337	-36101	-430	-38009	-1922
Grassland	-112582	this is a sink	0	-112582	0	0	-28145	-84436	-5629
Organic soils and peatlands	0		--	0	0	0	0	0	0
Other GHG Emissions			CO2 (other)						
Livestock	71148	this is a source	---		28623	42525	17787	53361	3557
Inputs	127154	this is a source	14838		112316	---	31788	95365	6358
Other Investment	9738	this is a source	9738		---	---	7452	2286	487
Final Balance	-270522	It is a sink	-149271	-266277	138602	6424	-38531	-231991	-13526
In % of Emission without project:	-56.0%								
Result per ha	-8.4		-4.6	-8.3	4.3	0.2	-1.2	-7.2	-0.4

Based on the scenarios presented here before, the HVAP project presents a capacity to reduce GHG emissions by 270,552 TCO2e in 20 years. This is equivalent to a reduction of about 14,000 tons of GHG per year or 0.4 TCO2e per ha per year.

Based on a social cost of carbon (SCC) from the US interagency working group with a discount rate of 8% per year and with an average of annual GHG reductions of 13,526 TCO2e, the economic incremental NPV generated by the carbon balance over the complete 20 years is estimated at 2.8 million USD.

In such a way it is possible to quantify that it is associated to higher difficulties to create very favourable co-benefits for GHG mitigation by projects focussing on sustainable agricultural intensification, especially when evaluating performance by emissions per hectare. For projects of this type it is thus more adequate to evaluate the changes in emissions per ton of product as a second outcome variable that complements the area based results.

HVAP carbon footprint per ton of production

The EX-ACT value chain module provides estimates of the carbon footprint per ton of product. As usual the difference in emissions between the “with” and “without project” scenario is compared.

Table 20: HVAP product carbon footprint by crop type (cradle to farm gate)

	without project			with project		
Components of the Project	Flux in tCO_2eq	Production t of product	CO2 footprint per T produced	Flux in tCO_2eq	Production t of product	CO2 footprint per T produced
Deforestation	0			0		
Forest Degradation	0			0		
Afforestation and Reforestation	0			0		
Non Forest Land Use Change	0			-41386		
Agriculture						
Annual Crops	-122760	1128400	0.20	-207029	1279760	0.21
Agroforestry/Perennial Crops	-53900	524000	- 0.10	-255788	666240	- 0.38
Irrigated Rice	95765	107100	0.89	57326	143820	0.40
Grassland	86167	0		-26415	0	
Organic soils and peatlands	0			0		
Other GHG Emissions						
Livestock	133403	22,032	6.05	204551	43,574	4.69
Inputs	344805			471959		
Other Investment	0			9738		
Total	**483479**	**1781532**	**0.27**	**212957**	**2133394**	**0.10**

The results indicate that the aggregate footprint of annual crops stays largely unchanged and accounts for 0.2 t CO_2-e before the project and 0.21 t CO_2-e after its implementation. The increased introduction of higher yielding perennial crops leads to a decrease in the already negative aggregate footprint from -0.1 t CO_2-e to -0.38 t CO_2-e and thus causing further sequestration. The footprint of livestock, measured per t of meat is also reduced from 6.05 t CO_2-e to 4.69 t CO_2-e. This stems mainly from an increase in productivity of meat per goat by improved practices.

While the outcomes on the GHG balance of the HVAP per hectare are not especially high, it is instead in the projects main focus area – the productivity of plant and animal production – that strong co-benefits for GHG mitigation occur. While total emissions in the area thus are not strongly reduced, in an area with increased productivity, the average emissions per product unit decreased significantly.

4.3.2 Accounts and values of natural resource stock changes generated by the HVAP

The HVAP generates incremental natural capital worth USD 8.7 mio. Thereby $5.7 mio is the public value generated by prevented social costs from GHG emissions, while the other joint value accounts for $3.0 mio, with the value created from additional timber ($1.4 mio) and prevented costs from soil erosion ($800,000 as the main elements.

Table 21: Natural resource stock changes under HVAP

INCREMENTAL CAPITAL GENERATED BY THE PROJECT					
Project:	High Value Agriculture Project	**1 United States Dollar = 85.85 (02/05/2013)**			
Nb farmers	15300	**Units**	**Quantity** (units)	**Economic price (US$)**	**Estimated total Value (US$)**
Area	32130				
Duration:	20				
	Natural Capital				
Direct private value					
A01	Incremental accumulated SOC on cultivated land (soil fertility)	t C	26862	$11.37	$305,417
A02	Incremental stocks of non-timber biomass	t dm	34647	/	$457,788
	Fuelwood and -material	t dm	8662	$7.00	$60,632
	Fodder	t dm	17324	$18.74	$324,656
	Compost	t dm	8662	$8.37	$72,499
A03	Incremental stocks of NTFP in forestry and agro-forestry				$0
			Sum direct private value		**$763,205**
Indirect private value					
A04	Incremental area with erosion protection	ha	8500	$94.80	$805,800
A05	Incremental area with increased drought resilience	ha	770	$11.70	$9,009
A06	Incremental water volume stored (dams, ponds, water harvesting)	m3	/	/	
A07	Incremental water volume saved by improved irrigation practices	m3	/	/	
A08	Incremental flood protected area	ha	/	/	
			Sum indirect private value		**$814,809**
Public value					
A09	Incremental timber stocks in forestry and agro-forestry	t dm	16014	$87.72	$1,404,744
A10	GHG balance (reduced emissions and C sequestration)	t CO2-e	270522	$21.00	$5,680,965
A11	Incremental protected natural areas (forestry, peatland, wetland) (existance value)	ha	/	/	
A12	Incremental new forest plantation (existance value)	ha	/	/	
			Sum public value		**$7,085,709**
	Total natural capital				**$8,663,723**

4.3.3 Conclusion

Though beneficial for GHG emissions and leading to total benefits of GHG mitigation, the HVAP does not achieve as impressive area based reductions as LFLP or WUPAP. Evaluating the projects effects on GHG emissions as evaluated by the average emissions per agricultural output – and thus actually adopting the perspective of an agricultural project focussing on sustainable intensification – it can be shown that the HVAP even more significantly reduces emissions as estimated by a pure area based evaluation.

With its focus on introduction and promotion of stronger commercialized crops, the project focuses comparably little on the creation of additional natural capital. Benefits from increased timber stocks, increased fodder and fuelwood as well as increased SOC on rehabilitated land are thus not strongly promoted. Nevertheless, the promotion of commercial agriculture is accompanied by anti-erosion measures.

4.4 Kisankalagi Unnat Biu-Bijan Karyakram project (improved seed for farmers)

The programme has been designed within the framework of IFAD's results-based country strategic opportunities programme (RB-COSOP) and the national agricultural development strategy (ADS), which makes seeds a national priority. It advocates an approach that specifically targets private initiatives in order to achieve sustainable productivity increases. From the start, the project rational focused on climate change as well as on sustainable agricultural intensification which motivated an integrated focus on issues of technology, markets, natural resources management and adaptation to climate change. Productivity gains are based on the identification of areas of clear competitive advantage for farmers in different farming systems, in particular, the programme has identified the two subsectors, agricultural inputs (especially seeds) and small-scale livestock (especially goats), as key entry points for stimulating growth and productivity in hill areas. Both are thereby currently performing poorly concerning market linkages.

The programme aims to develop smallholder-based commercial agriculture and to ensure that a fair share of the value added in the value chain accrues to producers and creates opportunities for agribusiness companies to develop activities within the target area. With regard to sustainability, the programme will invest considerably in developing local leadership and planning capacities, and in regenerating and protecting the natural resource bases, building on the livestock experience of the IFAD funded Leasehold Forestry and Livestock Programme and other donor experience in improved seeds dissemination.

4.4.1 EX-ACT analysis of the Kisankalagi project

In the project design document, terrace risers and bunds are propagated as well as a combination of improved forage and fodder tree species. When available, community and leasehold forests will also be utilized for forage production. Forage species to be included will be Mott grass, Mulato, Paspalum, forage peanut and tree fodder crops such as Badahar, Morus alba, Ipil-ipil and Khanyu.

Livestock and fodder tree data used: The livestock numbers in the table below are based upon the assumption of 8,900 households raising goats (338 groups) in 54 VDCs and 8,550 households keeping dairy cows (240 groups in up to 30 VDCs).

Table 22: Livestock numbers and total meat production under the three scenarios

	without project		with project		Beneficiary hh	Ha		heads
goats	4	goats per farm	5	goats/ farm	8900			35600
cows	2	cows per farm	3	cows/farm	8550			17100
fodder trees		ha per farm	0.2	ha/farm	for goats	1780	Ha fodder trees	
			0.6		for cow	5130	Ha fodder trees	

	Heads without project	heads with project	kg meat/yr	kg prod /yr		T	T
goats	35600	44500	30	45	T meat	1068	2002.5
cows	17100	25650	650	1650	T milk	11115	42322.5

Table 23: EX-ACT livestock module

Choose Livestocks:	Start t0	Without Project End	Without Project Rate	With Project End	With Project Rate
Dairy cattle	17,100	17,100	*Linear*	25,650	*Linear*
Other cattle	0	0	*Linear*	0	*Linear*
Buffalo	0	0	*Linear*	0	*Linear*
Sheep	0	0	*Linear*	0	*Linear*
Swine (Market)	0	0	*Linear*	0	*Linear*
Swine (Breeding)	0	0	*Linear*	0	*Linear*
Goats	35,600	35,600	*Linear*	45,500	*Linear*
Please select	0	0	*Linear*	0	*Linear*
Poultry	0	0	*Linear*	0	*Linear*
User Defined- Specified val	0	0	*Linear*	0	*Linear*
User Defined- Specified val	0	0	*Linear*	0	*Linear*

PLEASE SPECIFY INFORMATION BELOW IF AVAILABLE

Country "Type"	*Developing*
Mean Annual Temperature (MAT*) in °C	20

PLEASE SPECIFY INFORMATION BELOW IF AVAILABLE

Percentage of animals corresponding to Pasture, Range and Paddock systems

Type of Livestocks	Default IPCC %age	Specific factor	Default Factor
Dairy cattle	20%	40%	NO

Areas of land use changes considered: In the module of Non Forestry Land Use Changes, the fodder trees planted on degraded land are entered as follows:

Table 24: Land use change

Your Name	Description of LUC: Initial Land Use	Description of LUC: Final Land Use
fodder tree crops planted	Degraded Land	Perennial/Tree Crop
	Select Initial Land Use	Select Final Land Use

	Area concerned by LUC: Without Project Area	Without Project Rate	With Project Area	With Project Rate
fodder tree crops planted	*0*	*Linear*	*6800*	*Linear*
	0	*Linear*	*0*	*Linear*

Areas of maize, paddy and wheat in Annual Crops Module: An area of 204,000 ha of annual crops is entered with a switch from traditional to improved agronomic practices using improved seeds and eventually manure application (vegetables).

Table 24: Annual crop module

Hectares	Start	Without project		With Project
annual crops	t0	End	Rate	End
Trad maize	101000	101000	*Linear*	0
Trad Paddy	41000	41000	*Linear*	0
Trad Wheat	55000	55000	*Linear*	0
Impr Maize	0	0	*Linear*	101000
ImprPaddy	0	0	*Linear*	50000
Impr Wheat	0	0	*Linear*	41000
Trad veg	7000	7000	*Linear*	0
Improv Veg	0	0	*Linear*	12000
	0	0	*Linear*	0

Your description	User-defined practices	Name	Rate in tC/ha/yr	Improved agro- -nomic practices	Nutrient management	NoTillage/residues management	Water management	Manure application	Residue/Biomass Burning	t dm/ha	Yield t/ha/yr
from Deforestation	NO			?	?	?	?	?	NO	10	10
Converted to A/R	NO			?	?	?	?	?	NO	10	10
Annual From OLUC	NO			?	?	?	?	?	NO	10	10
Converted to OLUC	NO			?	?	?	?	?	NO	10	1
Current system *	YES	Equilibrium	0	* A conservative approach is to consider this system at equilibrium or decreasing					NO	10	10
Trad maize	NO			?	?	?	?	?	NO	10	1.8
Trad Paddy	NO			?	?	?	?	?	NO	10	2.4
Trad Wheat	NO			?	?	?	?	?	NO	10	1.2
Impr Maize	NO			Yes	?	?	?	?	NO	10	1.44
ImprPaddy	NO			Yes	?	?	Yes	?	NO	10	2.88
Impr Wheat	NO			Yes	?	?	?	?	NO	10	1.44
Trad veg	NO			?	?	?	?	Yes	NO	10	10
Improv Veg	NO			Yes	?	?	Yes	Yes	NO	10	12
	NO			?	?	?	?	?	NO	10	0

Positive value= gain for soil

Description/example of the different options — See FAOSTAT or Click here

Improved agronomic practices:	using improved varieties, extending crop rotation…
Nutrient management:	precision farming, improve N use effciency
Tillage / residues Management	Adoption of reduced,minimum or zero tillage, with or without mulching, including Conserv
Water management:	Effective irrigation measure
Manure application	Manure or Biosolids application to the field as input

Vehicles and fuel consumption: A total of 70 motorbikes and 12 4x4 vehicles have been accounted for (c.f. project budget). The gasoline consumption details are given in the table below:

Table 25: Vehicle consumption

	Nb of vehicles	consumption/ week		Weeks /yr	Project duration (years)	petrol Total cons (T)
4 wheel cars	12	90	l/week	45	6	291.6
motorbikes	70	15	l/week	45	6	283.5
					TOTAL	575.1

Kisankalagi Carbon balance results

Table 26: Kisankalagi Carbon balance

Project Summary	
Name	Kisangani Unnat Biu-Bijan -Imp Seed Farmers Pr
Continent	Asia (Indian subcontinent)
Climate	Tropical Moist
Dominante Soil T	LAC Soils

Area (Initial state in ha)		
Forest/Plantation		0
Cropland	Annual	204000
	Perennial	0
	Rice	0
Grassland		0
Other Land	Degraded	6800
	Other	0
Organic soils/peatlands		0

Duration of the Project (years)	
Implementatior	8
Capitalisation	12
Total	20
Total Area	
Mineral soils	210800
Organic soils	0
Total Area	210800

Components of the Project	Balance (Project - Baseline) All GHG in tCO2eq		CO2 Biomass	CO2 Soil	N2O	CH4	Per phase of the project Implement.	Capital.	Mean per year Total	Implement.	Capital.
Non Forest Land Use Change	-668014	this is a sink	-39893	-628121	0	0	-196923	-471090	-33401	-24615	-39258
Agriculture											
Annual Crops	-3134560	this is a sink	0	-3134560	0	0	-783640	-2350920	-156728	-97955	-195910
Agroforestry/Perennial Crops	-1080973	this is a sink	-1004813	-76160	0	0	-245933	-835040	-54049	-30742	-69587
Other GHG Emissions			CO2 (other)								
Livestock	234250	this is a source	---		55590	178660	58563	175688	11713	7320	14641
Final Balance	-4649297	It is a sink	-1044707	-3838841	55590	178660	-1167934	-3481363	-232465	-145992	-290114
In % of Emission without project:	#######										
Result per ha	-22.1		-5.0	-18.2	0.3	0.8	-5.5	-16.5	-1.1	-0.7	-1.4

The Kisankalagi project has an overall GHG balance of 4.6 million t CO_2-e. The strongest impact on the GHG balance is thereby the change in practices of annual crops that creates sinks for GHG, even on annual cropping areas.

4.4.2 Accounts and values of natural resource stock changes generated by the Kisankalagi project

The Kisankalagi project induces additional natural capital worth of $137.7 mio. Thereby, the public benefits of avoided GHG emissions and increased carbon sequestration account for 97.6 mio, while the accumulated other value of natural capital lies at $40.1 mio. Of the latter the main benefits are generated by benefits from incremental SOC (9.96 mio), increased animal fodder availability ($2.3 mio), incremental timber stocks in agroforestry areas ($7.5mio) and very strong benefits from prevented costs of erosion on sustainably managed annual crop areas ($19.3mio).

Table 27: Natural resource stock changes under the Kisankalagi project

INCREMENTAL CAPITAL GENERATED BY THE PROJECT					
Project:	Kisangani Unnat Biu-Bijan -Imp Seed Farmers Pr	1 United States Dollar = 85.85 (02/05/2013)			
Nb farmers	350000	**Units**	**Quantity** (units)	**Economic price (US$)**	**Estimated total Value (US$)**
Area	210800				
Duration:	20				
	Natural Capital				
Direct private value					
A01	Incremental accumulated SOC on cultivated land (soil fertility)	t C	875651	$11.37	$9,956,151
A02	Incremental stocks of non-timber biomass	t dm	242485	/	$3,203,924
	Fuelwood and -material	t dm	60621	$7.00	$424,349
	Fodder	t dm	121243	$18.74	$2,272,175
	Compost	t dm	60621	$8.37	$507,400
A03	Incremental stocks of NTFP in forestry and agro-forestry				$0
			Sum direct private value		**$13,160,075**
Indirect private value					
A04	Incremental area with erosion protection	ha	204000	$94.80	$19,339,200
A05	Incremental area with increased drought resilience	ha	0	$11.70	$0
A06	Incremental water volume stored (dams, ponds, water harvesting)	m3	/	/	
A07	Incremental water volume saved by improved irrigation practices	m3	/	/	
A08	Incremental flood protected area	ha	/	/	
			Sum indirect private value		**$19,339,200**
Public value					
A09	Incremental timber stocks in forestry and agro-forestry	t dm	85745	$87.72	$7,521,463
A10	GHG balance (reduced emissions and C sequestration)	t CO2-e	4649297	$21.00	$97,635,234
A11	Incremental protected natural areas (forestry, peatland, wetland) (existance value)	ha	/	/	
A12	Incremental new forest plantation (existance value)	ha	/	/	
			Sum public value		**$105,156,698**
	Total natural capital				**$137,655,973**

4.4.3 Conclusion

The Kisankalagi project has strong benefits for climate change mitigation. It illustrates agricultural development projects that do not concern LUC issues, but impact mainly the production practices of annual crops, that can have strong co-benefits in avoiding further GHG emissions and increasing carbon sequestration. The effects of the Kisankalagi project are thereby also influenced by its huge scale.

The same practices of sustainable intensification measures also have other strong benefits: they prevent future costs from erosion and increase the content of SOC on productive areas.

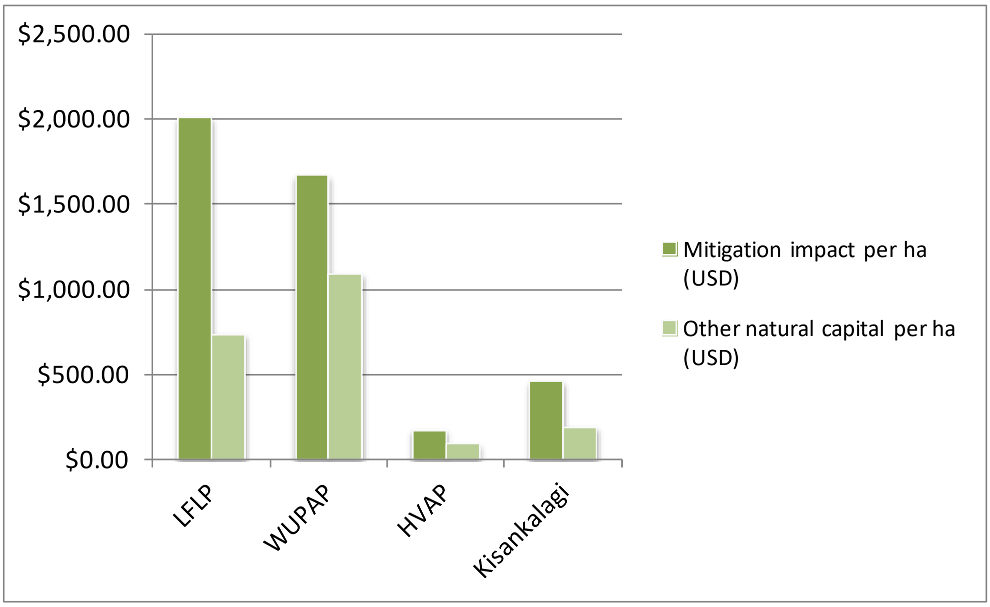
Since the Kisankalagi project,also in its conventional financial analysis, is expected to have very positive direct impacts on beneficiaries' incomes, it takes into account various objectives of interventions.

5 WHICH LESSONS LEARNED FROM THE DIFFERENT IMPACT APPRAISALS

The presented analysis allows to identify two different types of agricultural development projects. on the one hand, environmental and forest-sector targeted programmes, such as LFLP and WUPAP, for which both the value from prevented GHG emissions is over $ 1500 while increased natural capital is in a range of $ 700-1200 per hectare. On the other hand, we differentiate annual crop areas targeting projects, such as HVAP and the Kisankali project, for which both the value of avoided

GHG emissions are below 500 and natural capital are estimated below $250 per hectare. This difference is illustrated in the figure below.

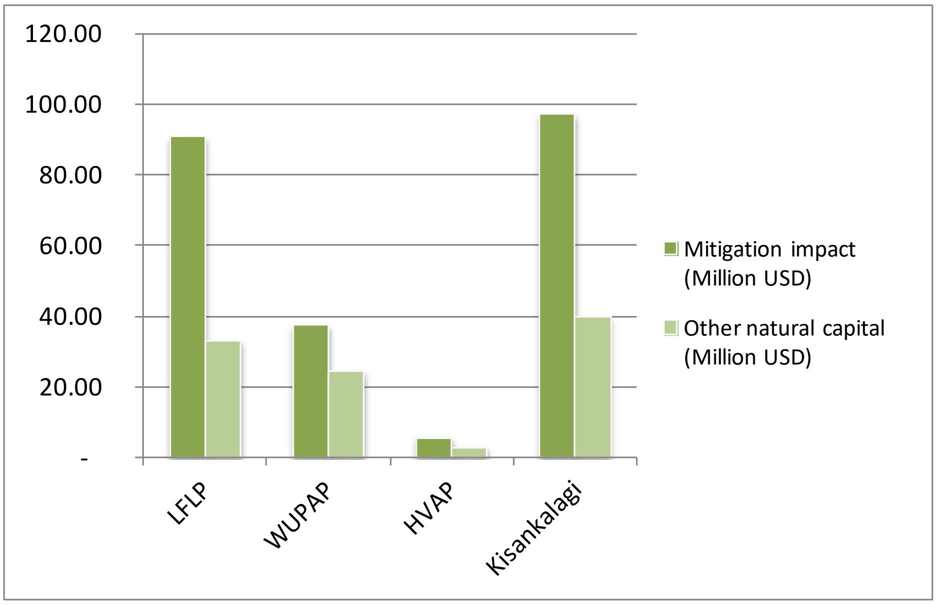
Fig 28. : Mitigation and other natural capital impact of projects per hectare



The LFLP thus achieves positive impacts on both dimensions, while especially sequestering a very high amount of carbon. Also in terms of the generating additional natural capital, LFLP and WUPAP are in a similarly extent very strong: thereby both projects achieve high increases in timber stocks and animal fodder. Beyond this, the LFLP achieves strong increases in levels of SOC on productive land as well as erosion prevention.

Moreover, HVAP and Kisankalagi have strong co-benefits on both dimensions. While they have given their general conception a more direct focus on increasing farmers' income, their improvement of agronomic practices leads to increases of SOC levels and erosion prevention as most important benefits for natural capital. Especially the Kisankalagi project, which has a stronger scope than the other projects. By this element, it achieves strong total benefits over the full project duration. The following figure compares the total impact of the four projects over the full 20 years.

Fig.29 : Total mitigation and other natural capital impact of projects over 20 years



The comprehensive comparison of the four projects identified several main issues and allows selected conclusions and :

- Projects focussing on land rehabilitation, support of agroforestry as well as fodder crops, constitute strong investments in natural capital that provides important functional services to beneficiaries and the public. Selected forms of natural capital are also a potential source of direct income flows.
- The value of natural capital can be approximately measured and major differences between projects can be clearly revealed. This allows to identify which project would better qualify for payments for environmental services.
- Taking into perspective the differences between the here analysed projects, LFLP and WUPAP, which especially increase natural capital, would also profit most strongly from the benefits of a PES scheme, since they focus less strongly then HVAP and the Kisankalagi project on providing direct private benefits to participating households.

6 STUDY LIMITATIONS AND ISSUES FOR FURTHER ANALYSIS

The present carbon balance appraisal has been done in a limited time, with simplification and basic assumptions. Results should therefore be taken with precautions, and will need to be further analyzed. The points listed below are some examples of the improvements and further details we could include in a more precise analysis of the mitigation potential of the projects:

- Verification of LUC scenarios by testing a limited area with the use of GIS.
- Verification of the state of soil degradation and rehabilitation by field survey and potentially soil sampling (if baseline available).

7 REFERENCES

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