ADB REGIONAL TECHNICAL ASSISTANCE PROJECT RETA8564
PROMOTING ECOSYSTEM SERVICES AND SUSTAINABLE FOREST CARBON FINANCING IN THE ASIA PACIFIC

BORDER AREA DEVELOPMENT PROJECT - RAPID ECOSYSTEM ASSESSMENT

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Background

A Rapid Ecosystem Assessment of the Border Area Development Project (BADP) was undertaken to inform project preparation, contribute to the Project's Fact Finding Mission and identify opportunities for integrating natural capital and ecosystem considerations into Project implementation. This Rapid Ecosystem Assessment has been undertaken as part of ADB's Regional Technical Assistance Project - RETA 8564 – Promoting Ecosystem Services and Forest Carbon Financing in the Asia Pacific.

The main objective of the Border Area Development Project (BADP) is to help the five provinces of the Central Highlands - Kon Tum, Gia Lai, Dak Lak, Dak Nong, and Binh Phuoc to better realize their growth potential and become more closely integrated into sub-regional frameworks including the Greater Mekong Sub-region (GMS), the Cambodia – Lao PDR – Viet Nam Development Triangle Area (CLV-DTA), and the ASEAN Economic Community (AEC).

The proposed BADP includes three outputs:

- Output 1: Improved connectivity and inclusiveness in the five VDTA provinces.
- Output 2: Improved Trade and Transport Facilitation (TTF), including the development of inclusive tourism opportunities across the provinces.
- Output 3: Strengthened Institutional Capacity for DTA Investment Planning, Project Design and Implementation, and Resource Management.

The Border Area Development Project as a multi-sector project presents an opportunity for **integrated planning approaches**. It takes a holistic view to development consistent with an **Ecosystem Services approach**. The Project approach requires transport to be planned in a way that provides a service to other economic activities, such as agriculture and tourism, rather than as an end in itself. Such an integrated approach is central to the delivery of the United Nations **Sustainable Development Goals (SDGs)**.

The Rapid Ecosystem Assessment adopts an ecosystem services approach as its conceptual framework. The ecosystem service approach (ESA), based on the Millennium Ecosystem Assessment (2005), classifies ecosystem services into four categories: provisioning, regulating, cultural and supporting. The ESA explicitly recognizes that ecosystems and the biological diversity contained within them contribute to individual and social wellbeing. Importantly it recognizes that this contribution extends beyond the provision of goods such as timber or fish to the natural regulating functions of ecosystems such as carbon sequestration and protection against natural hazards.

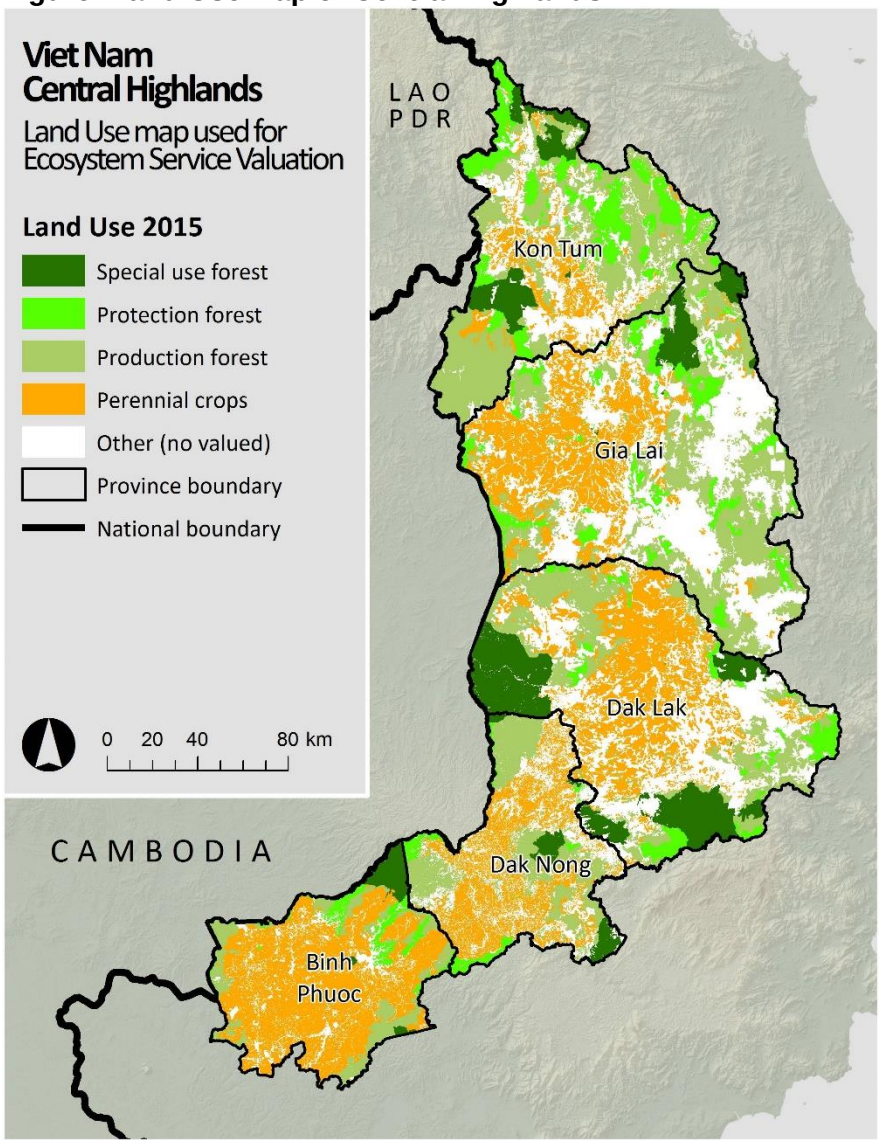
The Rapid Ecosystem Assessment was undertaken at both a landscape and a project level scale.
It highlights current land use in the Central Highlands, key ecosystem services and their value to the economy and local livelihoods, the pressures that ecosystems face and opportunities for inclusive green growth across the region. **This assessment is the first study on ecosystems services and their value in the Central Highlands**.

Landscape Assessment

The landscape scale assessment covered the five provinces of the Central Highland region. A high level analysis of the region's ecosystems and their value was undertaken using a

Geographical Information System (GIS) and value transfer approaches. This basic Spatial Multi-criteria Assessment (SMCE) is supported by a qualitative description of the VDTA's ecosystems and their services based on a literature review and stakeholder consultations. The Figure below presents the land use map used in the SMCA.

Figure: Land Use Map of Central Highlands



Source: Ministry of Environment and Natural Resource (MONRE)– General Department of Land Administration (GDLA), 2015

Based on the preliminary assessment, the ecosystem services of the Central Highlands are valued at US$3.1 billion per year. This can be taken as an underestimate because: (i) a conservation approach has been taken to estimate the sub set of ecosystem services for which data was readily available; (ii) a number of significant forest ecosystem services have *not* been included such as water provisioning services, natural hazard protection and tourism: (iii) the analysis only includes perennial crops (62% of the land area); and, (iv) other important ecosystems such as lakes and rivers and groundwater have not been included which provide important services such as energy provision (hydropower), water provision and natural hazard mitigation.

Based on this partial analysis, agriculture represents 72% of the total value. **This results should however only be reported in context.** Firstly, a number of key forest ecosystems have not been included in the analysis, and secondly, the productivity of the agriculture sector *depends on* a range of services provided by other ecosystems such as forests and water bodies. The Central Highland's **natural forest** is key to the economy and to livelihoods. While industrial/agriculture crops (e.g. rubber, cashew, coffee) are very important to the economy and directly support livelihoods through employment, they are *dependent on the regulatory services provided by the forest*.

It is evident that the economy of the Central Highlands is underpinned by its natural resources. Agriculture, tourism, industry and energy (hydropower) all depend on a range of ecosystem services such as the provision of clean water, flood mitigation, and erosion control. Development of the area therefore presents an opportunity to align with the **Government of Viet Nam's Green Growth strategy**.

In particular **agriculture**, the key driver of the economy, depends on the sustainable management of the area's land, forest and water (surface and groundwater) assets. Agriculture is the main means of employment in the area and therefore crucial to local livelihoods and tackling poverty levels.

The Central Highland's **Forests** provide a range of services including: (i) provision of timber and of non-timber forest product (NTFPs) that help support (poor) households located near forest areas; (ii) water regulation; (iii) protection against soil erosion; and, (vi) maintenance of the indigenous culture of the Central Highland which is closely linked to the forest. For example: (i) in Kon Tum the province's watershed forests **regulate the supply of drinking and irrigation water** for most of the Central Highlands and central coastal provinces (Quang Nam and Da Nang) through the Se San river and Vu Gia - Thu Bon river system; (ii) Across the Central Highlands forests provide **good protection for many national roads** (e.g. Road 14, 14c, 19, 24, 25, 26, 28, 29) that cut through forest areas and where adjacent forest slopes mitigate landslide and erosion that can cause road closures and higher maintenance costs; (iii) they are also vital for **electricity production** across the Central Highlands and nearby provinces supporting an intensive hydropower plant system. Hydropower makes a significant contribution to provincial budgets.

Nature based / cultural tourism in the area has high potential to both build the economy and offer alternative livelihood opportunities to poor / ethnic communities, especially associated with National Parks and Nature Reserves but is under developed.

Ecosystem services are also at the heart of development and poverty alleviation. The forest ecosystem supports local communities especially the indigenous ethnic people who live in and next to the forest. Ethnic minorities have almost no livestock or home gardens so are dependent on market products and the forest for their nutrition. Local people still use timber from the forest for their housing and household furniture, and use fuel wood for cooking.

Key pressures facing ecosystems in the Central Highland are land use change (e.g. forest to agricultural land) and forest encroachment by local communities driven by the lack of alternative livelihood opportunities. The on going loss and degradation of ecosystems is of concern given its importance to the local economy and local livelihoods and hence poverty alleviation. Key challenges are water availability for agriculture and developing sustainable livelihoods

There are around 403,000 ha of protected areas in the Central Highlands. All the sites face a similar range of pressures including: land encroachment for agriculture, illegal hunting and timber extraction, over exploitation of Non-Timber Forest Products, grazing of livestock,

infrastructure development (dams and roads) and forest fires. As the forest area *outside* of protected areas has declined the pressure on Protected Areas as a resource for supporting local livelihoods has intensified, with a detrimental affect on the area's biodiversity. The Protected Areas of the Central Highlands are central to the provision of fundamental regulatory services, such as water provision and soil erosion control, as recognized through their inclusion in the Government's PFES schemes. Management of these Protected Areas is therefore important to sustain the economy of the Central Highlands. Part of a sustainable management strategy includes the need to create new and / or improved livelihoods for local communities, to halt land encroachment into protected areas and over exploitation of forest products.

Project level assessment

The Rapid Ecosystem Assessment at the project level looked at Road 675A in Kon Tum province, which suffers from erosion and landslides. The assessment focused on understanding the role ecosystems play, specifically the forested slopes adjacent to the road, in *supporting* the road and the proposed road investments and other economic activities in the area such as agriculture and hydropower. Such an assessment can inform land use planning for the area surrounding the road, and highlight the benefits of investing in natural capital and Ecosystem Based Adaptation.

In this way the Rapid Ecosystem Assessment complimented the Initial Environmental Examination (IEE) undertaken as part of Project Preparation of the site by the BADP Project Preparatory Technical Assistance (PPTA) team. The IEE is focused on the impacts of the road investment at the design, construction and implementation stages on the environment.

Section 1 of Road 657A comprises 58.7km running along the Sesan River. This section has some steep slopes and road areas impacted by landslides. Based on ecological surveys undertaken as part of the Rapid Ecosystem Assessment it is clear that the forested slopes adjacent to Road 675A in these areas play a vital role in: (i) **mitigating the affects of landslides** and hence protecting the proposed road investment by minimizing operating and maintenance costs and increasing the longevity of the road; (ii) **protecting against soil erosion** and associated increased siltation of nearby hydropower dams (Sesan 3A and 4) and hence increased operating costs and reduced longevity of the dams. Soil erosion could also impact the cultivation areas of local people in Hamlet No.7 of Ia Toi commune; and, (iii) **protecting water supplies** that support nearby agricultural activities and communities. The status of the forest area has recently changed from protection to production forest. A change in land use will adversely impact the ecosystem services provided by the natural forest. The issue is of concern to the provincial authorities and was discussed during Fact Finding. DONRE-Kon Tum supports designating a 100 meter band of natural protection forest along the road.

Forest protection is effectively used as a management mechanism along Road 14 especially the section from Dak Glei district (Kon Tum) to Nam Giang district (Quang Nam). Application of this approach in other areas including Road 675A would reduce the cost of road maintenance while supplying vital forest resources to local people and ecosystem service to that underpin the local economy.

Next Steps

Phase 2 of the work under RETA 8564 (July – December 2016) will be focused on the strategic level / landscape assessment and the development of the Spatial Multi-Criteria Tool used in this rapid assessment. The objective of this work is to inform Output 3 of the Border Area Development Project - **Strengthened Institutional Capacity for DTA Investment Planning, Project Design and Implementation, and Resource Management.** Output 3 will consolidate the long term development program of the VDTA towards becoming a cohesive and strong

economic area. The indicators for achieving this output are: (i) VDTA master plan revisited and an implementation action plan supporting the VDTA master plan prepared with ***ecosystem services***, climate change, gender and ethnic minorities considerations; and (ii) Officials nominated by the Provincial People's Committees (PPC) trained to implement the action plan.

An understanding of the VDTA's ecosystem (e.g. forest, rivers, lakes, groundwater and land) and the services they provide is vital to ensuring the sustainable development of the Central Highlands. This requires an assessment on their spatial location and extent, quality, economic value, uses and the pressures that they face. A Spatial Multi Criteria Tool is one tool that can be utilized to inform strategic planning. It provides a spatial overview of ecosystem services and their economic value which can be overlaid with road and tourism investments, and socio-demographic data. Such an analysis can inform the risks to ecosystems and hence the economy from proposed investments, management approaches and actions, and the opportunities for promoting inclusive green growth. A key output of the Spatial Multi Criteria Tool is a set of maps, which serve as an accessible communication tool for decision makers. The accompanying valuation of ecosystem services can help identify the potential costs to the economy of the Central Highlands from ecosystem degradation or loss. In addition, it can help identify potential land use opportunities, such as areas that may have high suitability for tourism development.

The tool developed to date is in principle a very simple Spatial Multi-criteria Assessment (SMCA) – working only with a single layer (land use), a limited set of criteria, and no weighting. Priority areas of development, in line with proposed BADP are:

- **Increase detail of land cover and land use data.** An attempt will be made to use disaggregated land use by crop type focused on the five key crops for the area (rubber, coffee, cashew, pepper and cassava).

- **Include additional layers to provide greater spatial precision to the ecosystem service values**. For example: (i) integrating slope data into GIS to inform watershed protection benefits; (ii) overlying population data with an emphasis on poverty and ethnic minorities to inform targeting of tourism investments, distribution / social issues generally and ecosystem valuation; and, (iii) identifying areas prone to drought, floods and other key climatic risks in supported for the proposed climate risk assessment work.

Guidance on the methodology will also be prepared to support future applications and capacity development.

As a special feature of the BADP implementation it is proposed that ADB will provide additional technical assistance (TA) under a new TA to the VDTA provinces to support the integration of natural capital and ecosystem considerations into strategic planning and the development of the VDTA Master Plan. The Spatial Multi Criteria Analysis tool may be futher enhanced to address the priorities of the VDTA and training will be provided in the use of the tool and its application for the Master Plan.

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1 Introduction

1.1 Background and context

This Rapid Ecosystem Assessment for the Border Area Development Project has been undertaken as part of ADB's regional technical assistance project - RETA 8564 – Promoting Ecosystem Services and Forest Carbon Financing in the Asia Pacific. This regional technical assistance project seeks to support the protection and management of large scale ecosystems by building knowledge, partnerships and capacity for the assessments and valuation of ecosystem services, and by strengthening planning and project level decision making (ADB, 2013). The pilot project in Viet Nam is focused on understanding the social and economic impacts of a transport investment project on ecosystem services, the opportunities for investing in natural capital and simultaneously enhancing and sustaining the performance of transport sector investments, and the development of tools that can integrate ecosystem considerations into strategic planning. The Viet Nam pilot project is being managed by the Institute of Strategy and Policy on Natural Resources and the Environment (ISPONRE), in collaboration with the Ministry of Planning and Investment (MPI) and the Ministry of Transport (MOT).

The objective of the Rapid Ecosystem Assessment of the Border Area Development Project was to inform project preparation, contribute to the Project's Fact Finding Mission 30 May -18 June 2016 and identify opportunities for integrating natural capital and ecosystem services consideration into project implementation.

Background on the Border Area Development Project

The main objective of the **Border Area Development project (BADP)** is to help the five provinces of the Central Highlands - Kon Tum, Gia Lai, Dak Lak, Dak Nong, and Binh Phuoc to better realize their growth potential and become more closely integrated into sub-regional frameworks including the Greater Mekong Sub-region (GMS), the Cambodia – Lao PDR – Viet Nam Development Triangle Area (CLV-DTA), and the ASEAN Economic Community (AEC).

The BADP aims to improve the area's connectivity by developing critical transport infrastructure, leading to increased movement of people, agricultural produce and other goods. It is also intended that the BADP will facilitate trade (with a focus on tourism), and help develop the Provinces' capacity for investment planning from a regional integration perspective. The Provinces share borders with Cambodia and Lao PDR and the BADP will enable them to serve as a gateway to wider markets and as an **engine for growth** for the CLV-DTA sub-regional initiative (Contrans, 2016).

The proposed BADP will include three outputs:

- **Output 1: Improved road infrastructure in five VDTA provinces**. Rural and provincial roads critical to the integration of productive agricultural areas with National Road 14, which runs through the Central Highlands, and the markets along the way will be improved. This will increase commodity flows and hence the incomes of farmers and small traders by enabling better access to buyers and markets.
- **Output 2: Enhanced benefits of TTF on inclusive growth** including the development of inclusive tourism opportunities across the provinces.
- **Output 3: Strengthened institutional capacity for VDTA investment planning, project design and implementation, and resource management.** This output will consolidate the long term development program of the VDTA towards becoming a

cohesive and strong economic area. The indicators for achieving this output are: (i) VDTA master plan revisited and an implementation action plan supporting the VDTA master plan prepared with ***ecosystem services***, climate change, gender and EM considerations; and (ii) Officials nominated by the PPC trained to implement the action plan.

The Border Area Development Project as a multi-sector project presents an opportunity for **integrated planning approaches (Box 1)**. It seeks to take a holistic view to development consistent with an **Ecosystem Services approach**. Although the bulk of the proposed investment is targeted at developing critical transport infrastructure, the high level project objective - economic growth, is being pursued through a multi-sector framework. The main economic activity and source of livelihoods for the DTA Provinces is agriculture. Planning for agricultural and rural development and for transport have traditionally been made in isolation without due regard for potential synergies. This leads to investment plans that are narrowly focused on immediate sector issues, but are "blind" to the bigger development potential. The Border Area Development Project is focussed on the transport, agriculture and tourism, but could have broader sector benefits e.g. health, water, and forestry along with associated livelihood benefits. The Project approach requires transport planning to be carried out such that transport is a service to other economic activities rather than as an end in itself. Such an integrated approach is central to the delivery of the United Nations **Sustainable Development Goals (SDGs)**[1].

The Sustainable Development Goals (SDGs) came into force at the start of 2016. They build on the Millennium Development Goals (MDG) and articulate a new global development agenda to eradicate poverty and shift the world onto a sustainable development path by 2030. The SDGs are comprehensive and include goals on poverty reduction, education, health, the environment, inequalities, and peaceful and inclusive societies. The 17 SDGs and their 169 targets are designed as a web of inter-relationships and dependencies, where progress toward one goal can enhance progress in others (UNDESA, 2015). They reflect a shift in global policy from a predominantly economic focus to one that holistically addresses the economic, social and environmental dimensions of sustainable development. Environment cuts across *all the* SDGs and is directly reflected in seven. For example, SDG15 is to restore and promote sustainable use of terrestrial ecosystems, sustainably manage forest, combat desertification, and halt and reverse land degradation and halt biodiversity loss. Implementation of the SDGs requires an understanding of the interdependencies between the economy and environment, including the impact the economy has on the long term health of natural systems (Bann, 2016).

Box 1: What are Integrated Development Approaches

Integrated development approaches simultaneously advance multiple benefits across the three dimensions of sustainable development (social, environmental, and economic). They ensure that poverty eradication and environmental sustainability go hand-in-hand (UNDP & UNEP, 2013). They require effective governance, policy coordination and coherence across government departments and stakeholders to fully understand and manage the many interactions between economic growth, poverty eradication, and the environment, and ensure policies and plans are designed and implemented in ways that do not progress on one dimension at the expensive of another (UNDP, 2016).

[1] For example SDG 9.1 – Develop quality and reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well being, with a focus on affordable and equitable access for all.

Furthermore strategic development of the Central Highlands presents the opportunity to action Viet Nam's **Green Growth Strategy (Box 2)**. Key engines of growth in the area are considered to be agriculture and tourism, both of which depend on the integrity of the area's natural assets (forests, land and water bodies).

Box 2: Inclusive Green Growth and Viet Nam's Green Growth Strategy

***Inclusive Green Economy (*IGE)** approaches can help achieve sustainable development and align with the application of integrated development approaches. There are many definitions of IGE, all of which seek to promote human well-being, social equity, resilience and environmental sustainability. Core common elements of an inclusive green economy include: (i) e*fficient resource use; (ii) r*educing environmental impacts; (iii) reducing vulnerabilities; and, (iv) p*romoting an inclusive and transparent approach. UNDP* (2015) highlights opportunities for achieving triple wins (revenue generation, environmental improvement and poverty reduction) through the adoption of IGE approaches across key economic sectors such as forestry, fisheries, tourism, energy and waste management. The report concludes, however, that for green economy approaches to deliver on inclusion and poverty reduction, deliberate and complementary poverty reduction policies need to be integrated into their design and implementation.

Viet Nam's Green Growth Strategy was adopted in September 2012[2]. The strategy has three main objectives: (1) ensure low-carbon growth; (2) encourage green production systems; and, (3) promote green lifestyles. The specific targets of the Green Growth Strategy are to:

- reduce Green House Gas (GHG) emission intensity by 8-10 percent compared to the 2010 level by 2020.
- reduce energy consumption by 1-1.5 percent per year per unit of Gross Domestic Product (GDP)
- increase the value of high-technology and green technology to a share of 42-45 percent of GDP by 2020.
- ***invest 3-4 percent of GDP in developing investments in sectors that support and enrich natural capital.***
- ***mainstream green economic development by 2050*.**

1.2 Scope of assessment

Following an initial scoping mission in Mid March 2016, a consultancy team was contracted to undertake this Rapid Ecosystem Assessment from May to June 2016 to support the preparation of the Border Area Development Project and its Fact Finding Mission. The assessment is based on readily available information, and stakeholder consultations. Under the ongoing ADB Regional Technical Assistance (RETA 8564) – Promoting Ecosystem Services and Forest Carbon Financing in the Asia Pacific – the Rapid Ecosystem Assessment undertaken as part of the Border Area Development Project preparation will be further developed during 2016 (Phase 2). The Rapid Ecosystem Assessment highlights current land use in the Central Highlands, key ecosystem services and their value to the economy and local livelihoods, the pressures that ecosystems face and opportunities for inclusive green growth across the region. **This assessment is the first study on ecosystems services and their value in the Central Highlands**.

[2] Prime minister decision No.1393/QD-TTg.

1.3 Conceptual framework

The Rapid Ecosystem Assessment adopts an ecosystem services approach as its conceptual framework. The ecosystem service approach (ESA), based on the Millennium Ecosystem Assessment (2005), classifies ecosystem services into four categories: provisioning, regulating, cultural and supporting. The ESA explicitly recognizes that ecosystems and the biological diversity contained within them contribute to individual and social wellbeing. Importantly it recognizes that this contribution extends beyond the provision of goods such as mineral products, timber or fish to the natural regulating functions of ecosystems such as carbon sequestration and protection against natural hazards. The ESA therefore provides a framework for considering whole ecosystems in decision making and for valuing the services they provide.

A Rapid Ecosystem Assessment was undertaken at both a landscape and a project level scale. The landscape assessment is presented in Section 2 and the project level assessment in Section 3 of this report.

2 Landscape assessment

This section provides an explanation of the GIS process used for the landscape assessment, an overview of ecosystems and their services across the five provinces, the value transfers adopted for the study and a presentation of the key findings.

2.1 Approach

The landscape scale assessment covered the five provinces of the Central Highland region in Viet Nam: Kon Tum, Gia Lai, Dak Lak, Dak Nong and Binh Phuoc. A high level analysis of the ecosystems provided across the region and their value was undertaken using a Geographical Information System (GIS) and value transfer approaches. This is supported by a qualitative description of the VDTA's ecosystems and their services based on a literature review and stakeholder consultations.

This rapid assessment calculated estimates for selected ecosystem services using the following three sources of information:

- *Land use map:* a GIS layer that identifies the geographic distribution of key land cover, land use and land management categories within the target area. Each of these categories can serve as a basic proxy for one or several ecosystem services (ES), e.g. protected forest for watershed protection (regulating service) or perennial crops for food production (provisioning service);
- *Administrative unit map:* a GIS layer of province, district and commune boundaries. This information is used to statistically summarize the land use information, which provides not only a clear reference to planning processes but also is the basic requirement for comparing areas;
- *Ecosystem service unit values (coefficients)*: a set of values expressing per hectare values of selected ecosystem services in USD, for a specific land use type.

The calculations consisted of three consecutive steps:

1. Calculate zonal statistics for the land use map (value layer) using the administrative unit map as the zone layer (in a GIS). The result is a cross-table summarizing, for each commune (a) which land use is available, and (b) how much (in hectares).

2. Apply the ecosystem service value coefficients (in Excel). The result is a table with selected ecosystem service values (USD) for each commune and each land use type.
3. Perform additional calculations (subtotals, averages, ranks) to identify communes with highest the ecosystem values.

2.2 Overview of ecosystems in the Central Highlands

All stakeholders consulted on ecosystem services in the Central Highlands hold the view that the areas' **natural forest** is key to the economy and to livelihoods. While industrial/agriculture crops (e.g. rubber, cashew, coffee) are very important to the economy and directly support livelihoods through employment, they are *dependent on the regulatory services provided by the forest*.

Ecosystem services provided by natural forest ecosystems in the area include: (i) provision of timber and of non-timber forest product (NTFPs) that help support (poor) households located near forest areas; (ii) water regulation; (iii) protection against soil erosion; and, (vi) maintenance of the unique indigenous culture of the Central Highland which is closely linked to the forest. The forests in Central Highlands are however quite diverse and the services they provide is influenced by location, soil and climatic conditions.

The forest ecosystem supports local communities especially the indigenous ethnic people who live in and next to the forest. Most ethnic groups in the Central Highland do not have home gardens, and a large part of their nutritional requirements are sourced from nature such as wild animals and vegetables.

Table 1 presents the loss in natural forest cover in the Central Highlands between 2010 and 2014.

Table 1: Change in natural forest cover, Central Highlands 2010-2014

Province	Natural forest (ha)	
	2010	2014
Kon Tum	612,225	547,265
Gia Lai	673,541	555,807
Dak Lak	567,854	475,909
Dak Nong	261,713	220,701
Binh Phuoc	70,884	58,295

Source: Forest protection Department, MARD, 2010:2014[3]

Land used for agriculture (rubber, pepper, coffee, cassava) is important to the economy and local livelihoods. In addition, agricultural lands regulate water flow and protect land from erosion, but to a lesser extent than natural forest due to a number of factors including: (i) the seasonal and short-term nature of some crops; (ii) a lower vegetation density and simpler ecological structure than forest land; and, (iii) their location in flat areas. Co-benefits are therefore

[3] MARD decision no. 3135/QĐ-BNN-TCLN date 6 August 2015

considered to be relatively limited. Further, these agriculture ecosystems depend on water regulated by forest ecosystems.

There are a number of major rivers in the Central Highlands. Local people fish in rivers, streams, dams and reservoirs. It is estimated that fish production in Gia Lai, Kon Tum and Dak Lak provinces amounts to 500 tonnes annually from the Se San River. This figure is considered to be a gross underestimate as fish catch is often not well recorded and does not include fish consumed domestically. At least 41 migratory fish species are commonly caught by fishermen in the Se San River, and these migratory species represent 60% of the fishermen's total catch (Baran *et al*, 2011).

2.2.1 Kon Tum

Kon Tum province is the Northern most province of the Central Highlands. It is a mountainous province, with high forest cover. Forest cover (including all types of forest and rubber plantations) is 62.3% of the province (603,814 hectares). Forest cover *excluding* rubber plantations is 58.5%. The province has 546,913 hectares of natural forest [4].

Swidden cultivation, infrastructure development and illegal logging places huge pressure on forest management in Kon Tum province. There are 3 special use forests (1 national park, 2 nature reserves) and 7 Protection Forest Management Boards and 7 state Forestry Companies in Kon Tum province[5]. Important forest ecosystems of Kon Tum province include Chu Mon Ray National Park, Ngoc Linh Natural Reserve, Dak Uy Special Use Forest and other forest area in Com Plong, Dak Glei, Sa Thay, Ngoc Hoi and Ia H'Drai districts. The protection forest areas are home to many endangered and endemic species. However, all of these areas have been degraded and face pressures from: rapidly increasing population (thus increasing demand for land for cultivation and housing), infrastructure development (e.g. roads, hydropower plants) and overexploitation of NTFP (bamboo, honey, medicinal plants). The natural forest area has been reduced from 612,225ha in 2010 to 547,265 in 2014 (Forest Protection Department, MARD, 2010:2014)

The tropical monsoon climate of the Central Highlands presents favorable condition for *tropical evergreen forest* which dominate forest land cover in the province. Evergreen forests are found in mountainous areas with rugged terrain such as the forest around Ngoc Linh mountain and Sa Thay Mountain, which serve as critical watershed forest not only for Kon Tum but also for other coastal provinces such as Quang Nam and Quang Ngai.

Provisioning services include timber and non-timber forest products. In 2014, 20,418 m^3 of timber, 238,900 ster[6]of firewood and other products including bamboo, cork, rattan, resin, cinnamon were produced. The value of these forest products were VND 139,906 million (USD 5.62 million)[7] for timber and firewood and VND 30,430 million (USD 1.44 million) for other non-timber products (Kon Tum Statistical Yearbook, 2014).

In terms of regulating services, the province's important watershed forests **regulate the supply of drinking and irrigation water** for most of the Central Highlands and central coastal

[4] Kon Tum People' Committee' Decision no. 637/QĐ-UBND on declaration on the information of forest area in Kon Tum province dated 14 June 2016
[5] Report of Kon Tum FPDF to the ES mission from May 25-30, 2016
[6] 1 ster = 0.7 m^3
[7] Exchange rate: US$1 = VND 21,500

provinces (Quang Nam and Da Nang) through the Se San river and Vu Gia - Thu Bon river system. They are also vital for **electricity production** in Kon Tum and its nearby provinces (such as Gia Lai and Quang Nam) supporting the most intensive hydropower plant system in the region. Hydropower makes a significant contribution to the provincial budget. Currently, 360,103 hectares of forest in Kon Tum are designated as strategic upstream forest area and received PFES of 164.1 billion (USD 7.4milion)[8] in 2015. The natural forest also **protects against soil erosion and landsides** that would impact key national roads such as the NR14, 14c, 24 and other provincial roads. For instance, Dak Glei district where the road cuts through high mountain the natural evergreen forested slopes prevents landslide and enable this road to be open all year round.

The forest plays an important role in supporting local livelihoods, especially indigenous ethnic group who mostly live in remote, mountainous and forest area. Indigenous people in Kon Tum are well-known for their traditional culture which is in harmony with the forest. Uses of the forest by local communities include timber harvesting to build local houses and family furniture, and the collection of non-timber forest products such as honey, bamboo and vegetables which provide additional income and/or are a source of nutrition. They also benefit from Payments for Forest Ecosystem Service (PFES).

Rubber plantations cover 7.7% (74,381 ha) of the province's total area[9]. Other key agriculture crops include rice and cassava which are seasonal and grown in fragmented areas mostly situated in flat and low-land areas, co-benefits are therefore considered to be relatively limited. Further, these agriculture ecosystems depend on the water supply regulated by forest ecosystem. Rubber has created new employment opportunities, for example in Ia H'Drai district, however many of these have been filled by in-migrants not local people. According to the Provincial Socio-Economic Development Master plan up to 2020, vision toward 2030, there are about 151,00 people (accounting for 58% of provincial labor force) working in agriculture sector. Table 2 summarizes production area, value and other information of key agricultural crops of Kon Tum.

Table 2: Area, production volume and value of key crops in Kon Tum

Key Crop		Planted area (ha)	Production (ton)	Exporting stock (ton)	Gross output at current price	
					VND. million	USD. million
Cereal crop	Rice	23,569	85,650		967,297	44
	Maize	6,660	24,960			
Perennial industrial crop	Rubber	74,917	37,099	21,514	4,226,694	196.6
	Coffee	14,107	32,063	775		
	Cashew-nut	49	51			
	Pepper	82	100			

Source: Kon Tum Statistical Year Book, 2014

Water bodies in the province include 71 reservoirs (for freshwater and irrigation) and the Se San river system which includes 3 main rivers - the Dak Bla, Po Ko, Sa Thay rivers which flow into the Mekong River, and hundreds of small streams.

[8] Exchange rate: US$1 = VND 22,300

[9] The report on the implementation of 2014 year's plan, Department of Agriculture and Rural Development of Kon Tum province

There are 5 large and 23 medium and small hydropower dams in the province creating a new and fragmented man-made network of waterbodies. These manmade ecosystem, while not significant from a biodiversity perspective, present an opportunity to develop fishery resources that could provide additional livelihood and subsistence support to local communities.

2.2.2 Gia Lai

Natural Forests cover 38% of Gia Lai province and are the most important ecosystem in the province (Forest Protection Department, 2015)[10]. Evergreen forest and semi-evergreen forest dominate. The semi-evergreen forest is mostly located in relatively flat areas where they are under high pressure from land-conversion; only small and fragmented areas remain. The evergreen forest, located mostly in the high mountain areas, face less pressure from land conversion and logging and represent the province's key forest ecosystem. Kon Chu Rang Nature Reserve and Kon Ka Kinh National Park in K'Bang district are strategic upstream / watershed forest for the key rivers of the Central Highland (Se San) and south-central coast province (Ba rivers). These rivers are not only important for drinking water and irrigation but also for the electricity production in both the Central Highland and south-central coast provinces. Forests are also important to indigenous and local people especially the poor who use the forest to collect timber, wild animals and NTFP.

In 2014, 555,807 ha of natural forests and 67,474 ha of plantations contributed VND 318,461 million (USD 14.83 million) to the provincial economy from timber production (VND 295,556.5 million) and non-timber products (VND 22,906.9 million). A total of 100,000 m^3 of wood and 453,500 ste of firewood were harvested from forests in the same year (Gia Lai Provincial Statistic Yearbook, 2014).

Cultivated agricultural ecosystems cover 612,497 hectares. Key crops are rubber, pepper, cashew, coffee, maize and rice. Agriculture makes an important contribution to the provincial economy and to local livelihoods through the provision of employment and food security. Nearly 80% of the workforce, 612,295 people, work in the agriculture sector (Hung, 2013)[11]. Agriculture areas also provide some regulating services such as regulation of water flow and protecting land from erosion, but to a far less extent than natural forest as discussed above. Table 3 summarizes production area and value of key agricultural crops of Gia Lai.

Table 3: Area, production volume and value of key crops in Gia Lai

Key Crop		Planted area (ha)	Production (ton)	Exporting stock (ton)	Gross output at current price	
					VND. million	USD. million
Cereal crop	Rice	75,196	566,738		4081	189.8
	Maize	52,563	305,101			
Perennial industrial crop	Rubber	17,055	13,060	1,520	18,813.3	875
	Coffee	13,104	32,497	239,796		
	Cashew	17,055	13,060			
	Pepper	13,104	32,497	227		

Source: Gia Lai Statistical Year Book, 2014

[10] MARD decision no. 3135/QĐ-BNN-TCLN date 6 August 2015

[11] Tran Anh Hung , 2013. Doctoral thesis, Da Nang University.

The Se San and Ba Rivers are the key river systems in the province and major tributaries of the Mekong River. The Ba River runs eastward through the coastal provinces of Quang Ngai, Phú Yen and Binh Dinh into the East Sea. Other key waterbodies in the province are Bien Ho, Ayun Hạ lakes and the Se San 3 Se San 3 A and Se San 4 hydropower reservoirs. Bien Ho Lake is the most important natural lake in Gia Lai and the Central Highland. Rivers, lakes and streams are critical to agriculture productivity and for drinking water and and for biodiversity and aquatic species conservation. For example, the Se San is an important river for the Mekong and its associate biodiversity and fishery resources (Hong Truong *et al*, 2013). Manmade ecosystem, while not significant from a biodiversity perspective, present an opportunity to develop fishery resources that could provide additional livelihood and subsistence support to local communities. Local people already fish in all the waterbodies, include rivers, streams, dams and reservoirs.

2.2.3 Dak Lak

Dak Lak province located in the centre of the Central Highland is the home to many important rivers that connect with the Mekong River including the Serepok river system. Dak Lak is well-known to have the richest forest ecosystems in the Central Highland representing a range of forest types - deciduous, semi-deciduous, dry-dipterocarp, grassland and evergreen forest. As a result, Dak Lak forests have been heavily disturbed by logging and land conversion. Dak Lak province is mostly flat with high quality basaltic soil idea for industrial crops and is also known for its extensive coffee and rubber plantations.

Key ecosystems underpinning the province's development are its forest and the Serepok River, which are inter-related. The frequent occurrence of **drought** in last five years has drawn attention to the important role of the forest in regulating water on which households and agriculture depend. Most of Dak Lak province falls within the catchment of the Serepok River. The flow and water capacity of the river depends entirely on the upstream forest.

Most of the natural forest in Dak Lak has been cleared for industrial and agriculture crops. Recently the endemic Indochinese dry-dipterocarp forest was classified as poor forest and converted to rubber (in Ea Sup and Buon Don districts) but failed to be productive as the rubber trees could not grow in the hard dry-land. Remaining forests in the province are found in the high mountain areas and in protected areas such as Yok Don, Chu Yan Sin and Nam Ka. According to provincial statistical data, 475,909 hectares of natural forests and 3,158 hectares of plantation forests contributed VND 462,682 million (USD 21.52 million) to the economy of Dak Lak in terms of timber and non-timber forest products only (Dak Lak Statistical Yearbook, 2014).

The Serepok river system connects most of the province's key streams that provide drinking and irrigation water. It is also well-known as a fishery resource as the river connects directly to the Tonle Sap lake in Cambodia and the Mekong river. Every year fish from the Mekong river swim up-stream to find spawning grounds within the forest providing a significant source of protein for local communities and supporting the biodiversity of the Serepok and Mekong river systems.

Cultivated agricultural ecosystems cover 539,081 hectares. Key crops are rubber, pepper, cashew, coffee, maize and rice. Agriculture makes an important contribution to the provincial economy and to local livelihoods through the provision of employment and food security. There

are 722,000 people (accounting for 67.6% of labor force) employed in agriculture[12]; alternative livelihood opportunities are limited in rural areas. Agricultural areas also provide some regulating services such as water regulation and protecting land from erosion, but to a far less extent than natural forests as discussed above. The use of agro-chemicals is also affecting water quality. Table 4 summaries agriculture production practice in Dak Lak province.

Table 4: Area, production volume and value of key crops in Dak Lak

Key Crop		Planted area (ha)	Production (ton)	Exporting stock (ton)	Gross output at current price	
					VND. million	USD. million
Cereal crop	Rice	94,334	577,791		9,305.7	432.8
	Maize	122,285	671,400			
Perennial industrial crop	Rubber	40,629	30,207	7,330	22,187.9	1,032
	Coffee	203,746	444,121	221,721		
	Cashew	20,505	25,740	842		
	Pepper	16,075	24,695	4,812		

Source: Dak Lak Statistical Year Book, 2014

2.2.4 Dak Nong

Dak Nong is the southernmost province of the Central Highlands. The province has quite rugged terrain and is dominated by hilly areas, with the exception of the northern part (close to Dak Lak) which has relatively flat terrain. The forest consists of mainly evergreen and semi-evergreen forests located in low and medium mountain areas. A lot of the natural forest area in the Province has been converted to other land uses such as rubber, cashew, pepper plantation and other agriculture area. The remaining forest now are located in Ta Dung, Nam Nhung and Dray Sap nature reserves. Other small fragmented forest areas are found in Quang Truc district, the south-west area with Cambodia and Binh Phuoc province, and other dry-dipterocarp forest area locate in the north—west corner of the province which connect with Yok Don National park in Dak Lak. Dak Nong's forest fauna and flora is plentiful and diversified. It has many kinds of precious woods and specialty crops that both have economic and scientific value. It is home to rare animals such as elephants, bears and tigers, which are recorded in the Viet Nam and World Red Book, and to rare trees used as traditional medicine.

In 2014, 11.929 m^3 of timber, 20,181 ster of firewood, 820 tons of paper material and 500 ton of bamboo shoot were harvested from 58,258 hectares of natural forest and 102,131 hectares of plantations of Binh Phuoc. The total value of timber and NTFPs of Binh Phuoc was VND 49,806 million (equivalent to USD 2.32 million) in 2014 (Dak Nong Statistical Yearbook, 2014).

All the forest areas are upstream to the Province's key rivers - Dong Nai river on which industries in the provinces of southern Viet Nam (Đồng Nai and Ho Chi Minh city) depend, and the upper Serepok river system that are important to Dak Lak and the Mekong river. All forest in Dak Nong is covered by PFES schemes on account of the services they provide in regulating water flow and purifying water quality in the Dong Nai river and Serepok river systems. In 2015,

[12] Dak Lak Provincial People Committee, 2015. Program "Restructuring Agriculture Sector toward increasing additional value and sustainable development to 2020 and vision to 2030, Dak Lak.

total PFES payments were VND 65 billion (USD 2,921,348)[13] for the protection of 180,000 hectares of forest.

Indigenous ethnic groups in the province do not have home gardens or vegetable fields and collect various forest products to supplement their needs including honey, mushroom, bamboo shoots, and medicinal plants.

Key crops are rubber, pepper, cashew, rice and cassava. Agriculture makes an important contribution to the provincial economy and to local livelihoods through the provision of employment and food security. Currently, 223,760 people (accounting for 64.5 per cent of people at working age) are employed in agriculture[14]. Agricultural areas also provide some regulating services such as regulation of water flow and protecting land from erosion, but to a far less extent than natural forest as discussed above. Table 5 summaries agriculture production practice of key crops in Dak Nong province.

Table 5: Area, production volume and value of key crops in Dak Nong

Key Crop		Planted area (ha)	Production (ton)	Exporting stock (ton)	Gross output at current price	
					VND. million	USD. million
Cereal crop	Rice	12,620	73,560		3,226.5	150.1
	Maize	52,630	145,640			
Perennial industrial crop	Rubber	31,311	20,215		126,668.2	5,891.5
	Coffee	118,832	238,897	156,777		
	Cashew	15,656	14,333	31,913		
	Pepper	13,896	17,628	18,294		

Source: Dak Nong Statistical Year Book, 2014

Dak Nong has little rainfall in the dry season and prolonged periods of dry weather can cause drought. Water shortages affect agriculture, industry hydropower production and living conditions, therefore, the province has taken the initiative to build a number of lakes and dams to store surface water. Serepok river is the main river in the province, fed by Krong No and Krong Ana rivers. Due to the complicated geologic tectonics, the river-bed becomes narrow and sloppy creating big waterfalls such as Trinh Nu, Gia Long and Dray Sap, of hydro power potential. Streams and rivers in the province have abundant **hydroelectric potential**. The Dong Nai, Krong No and Serepok river are suitable for large hydroelectric power plants with a total capacity of up 1.500MW such as Buon Kuop 280MW, Duc Xuyen 92 MW, Buon Tua Srah 85 MW, Dak Tih 140MW, Dong Nai 3-180MW, Dong Nai 4-340MW, Dong Nai 6&6A. Groundwater serves as a supplementary water source for agriculture and domestic use in the dry season.

2.2.5 Binh Phuoc

Officially Binh Phouc province is not a part of the Central Highlands but belongs to the South-Eastern provinces which runs from the sea to the Cambodian border. Binh Phước is a mixed

[13] Exchange rate: Exchange rate: US$1 = VND 22,300

[14] Dak Nong Provincial People Committee, 2015. Annual report on socio-economic development in 2014

mountainous and low land province with rugged terrain in the north (connecting with Dak Nong province) and flat area in the south. Forest areas in the province have been heavily converted to rubber and cashew plantation and Binh Phuoc is one of the most intensive rubber and cashew producers in Viet Nam. The trend to convert non-protection forest to rubber and cashew plantations is on-going. Pepper and cassava are also common. Currently forest cover is >40%, with forests mainly located in protected areas. The most important forests in Binh Phuoc is located in Bu Gia Map National Park and Cat Tien National Park, and other protection forests in the north-west and north-east corner of the province. These are important watershed forests located upstream of the **Dong Nai river system** that support important industrial cities in South Viet Nam such as Dong Nai and Ho Chi Minh City and underpin agriculture productivity in the province. Currently all forest areas are under PFES payments. The forest also sequester carbon, which contributes to reducing the impacts of climate change. Further forest are part of local people's life and culture, especially ethnic minorities. Ethnic minorities have almost no livestock or home gardens so are dependent on market products and the forest for their nutrition. Local people still use timber from the forest for their housing and household furniture, and use fuel wood for cooking.

Key crops are rubber, pepper, cashew, coffee, cassava and rice. Agriculture makes an important contribution to the provincial economy and to local livelihoods through the provision of employment and food security. Currently, more than 376,863 people (accounting for 68 per cent of the provincial labor force) work in agriculture sector; alternative livelihood opportunities are limited in rural areas. Agriculture areas also provide some regulating services such as regulation of water flow and protecting land from erosion, but to a far less extent than natural forest as discussed above. Table 6 summaries agriculture production in Binh Phuoc province.

Table 6: Area, production volume and value of key crops in Binh Phuoc

Key Crop		Planted area (ha)	Production (ton)	Exporting stock (ton)	Gross output at current price	
					VND. million	USD. million
Cereal crop	Rice	12,918	42,660		325,039	15.2
	Maize	4,937	18,413			
Perennial industrial crop	Rubber	232,650	277,005	131,230	18,722.7	870.8
	Coffee	15,823	27,498			
	Cashew	134,107	191,734	26,697		
	Pepper	12,110	25,919	27		

Source: Binh Phuoc Statistical Year Book, 2014

2.2.6 Protected Areas in the Central Highland

There are around 403,000 ha of protected areas in the Central Highlands (Table 7). All the sites face a similar range of pressures including: land encroachment for agriculture, illegal hunting and timber extraction, over exploitation of Non-Timber Forest Products, grazing of livestock, infrastructure development (dams and roads) and forest fires. As the forest area *outside* of protected areas has declined the pressure on Protected Areas as a resource for supporting local livelihoods has intensified, with a detrimental affect on the area's biodiversity. The Protected Areas of the Central Highlands are central to the provision of fundamental regulatory

services, such as water provision and soil erosion control, as recognized through their inclusion in the Government's Payment for Forest Ecosystem Services (PFES) schemes. Management of the Protected Area's is therefore important to sustain the economy of the Central Highlands. Part of a sustainable management strategy includes the need to create new and / or improved livelihoods for local communities, to halt land encroachment into protected areas and over exploitation of forest products. More detail on the management challenges facing protected areas in the Central Highlands is provided in Annex 2.

Table 7: Overview of Protected Areas in the Central Highlands

Name / date established	Area (ha)	PFES
KON TUM		
Chu Mom Ray National Park (1997)	56,003	Yes
Ngọc Linh Nature reserve (1999)	38,007	Yes
Đắk Uy Species and habitats Conservation Site (2014)	660	Yes
GIA LAI		
Kon Chư Răng Nature reserve (2004)	15,900	Yes
Kon Ka Kinh National Park (1995 Nature Reserve / 2004 National park)	42,057	Yes
DAK LAK		
Chu Yang Sin National Park (2002)	66,980	Yes
Yok Don National Park (1991)	111,126	No
Ea So Nature reserve (1999)	21,195	Yes
Nam Ka Nature reserve (1991)	19,912	Yes
Lắc Lake Cultural, historical and natural conservation site (1986)	284	Yes
The swamp- cypress Species and habitats Conservation Site *(2011)*	128	No
DAK NONG		
Yok Don National Park (1991)	2,728	
Tà Đùng Nature Reserve (2003)	21,207	Yes
Nam Nung (1995)	12,308	Yes
Đray Sáp – Gia Long Cultural, historical and natural conservation site (2003)	1,515	Yes
BINH PHUOC		
Bu Gia Map National Park (1995 Nature Reserve /-2002 National Park)	403	Yes
Cat Tien National Park (1992 Nature Reserve / 1988 National Park)	4,193	Yes
Núi Bà Rá Cultural, historical and environment conservation areas (1996)	854.3	Yes

Note: 1/ Includes 51,722 ha in Dong Nai province and 27,229 ha in Lam Dong.

A study of key National parks in the Central Highlands indicates that >70% of local communities depend on the forest resources. Cao Thi Ly (2008) surveyed 106 local people living in the buffer

zones of three national parks Chu Mom Ray National Park (Kon Tum), Yok Don National Park (Dak Lak), and Chu Yang Sin National Park (Dak Lak) on their collection of forest products. Popular forest products collected were timber, bamboo, rattan, medicinal plants and wild animal. Quantitative data are provided in Table 8.

Table 8: Forest Products collected from National parks in the Central Highlands

Forest product collected	Unit	Quantity
Timber	m^3/person/year	0.4
	m^3/village/year	223
Bamboo shoot	kg/person/year	47
	kg/village/year	29,717
Bamboo tree	trees/person/year	17
	trees/village/year	9,434
Resin	kg/person/year	20
	kg/village/year	8,448
Wild animal	individual/village/year	50

Source: Cao Thi Ly, 2009

An estimated 90% of ethnic minorities depend on the forest around Chin Mon Ray National Park in Kon Tum province. Incidents of encroachment into the National Park are on the rise, party explained by the fall in the price of rubber, which is affecting local incomes. People caught undertaking prohibited activities in the NP have their tools confiscated and are fined, but typically local people do not have the means to pay[15].

2.3 Initial spatial analysis

The rapid assessment uses government datasets and ecosystem values derived from local rather than national, regional or global studies to the extent possible. This was considered essential to ensure that the results are accepted by the government stakeholders.

The available land use dataset (MONRE - GDLA, 2015) required significant processing and corrections. For instance, the information is developed for each province separately and stored in Microstation DGN format and VN2000 projection. Each individual province had to be converted from DGN to Shape file and undergo extensive topological and attribute cleanup, then projected from VN2000 to UTM WGS84 Zone 48. At this point the individual province files still showed spatial shifts of up to 500m compared to national reference layers (roads, rivers) and had to be georeferenced to the latter. In a last step, the five provinces were stitched together into one layer which required additional manual editing to resolve smaller overlap and gap areas along the province border.

The processing of the Ministry of Agriculture and Rural Development – Forest Inventory and Planning Institute (MARD-FIPI) forest data was less challenging, but - as expected - the forest dataset doesn't align well with the forest – non-forest boundaries of the MONRE land use dataset. Combining both to increase thematic resolution was attempted but discarded in light of this introducing additional spatial inaccuracies which would not have been able to resolve within the timeframe of this rapid assessment.

All of the above errors can be fixed with sufficient time. However, this also highlights that the selected government datasets can be challenging to work with especially for rapid assessments,

[15] Personal communication with Chin Mon Ray National Park Management Board, March 2016

and that there is a very real risk that these data are not used to support and inform sustainable planning and development as originally intended.

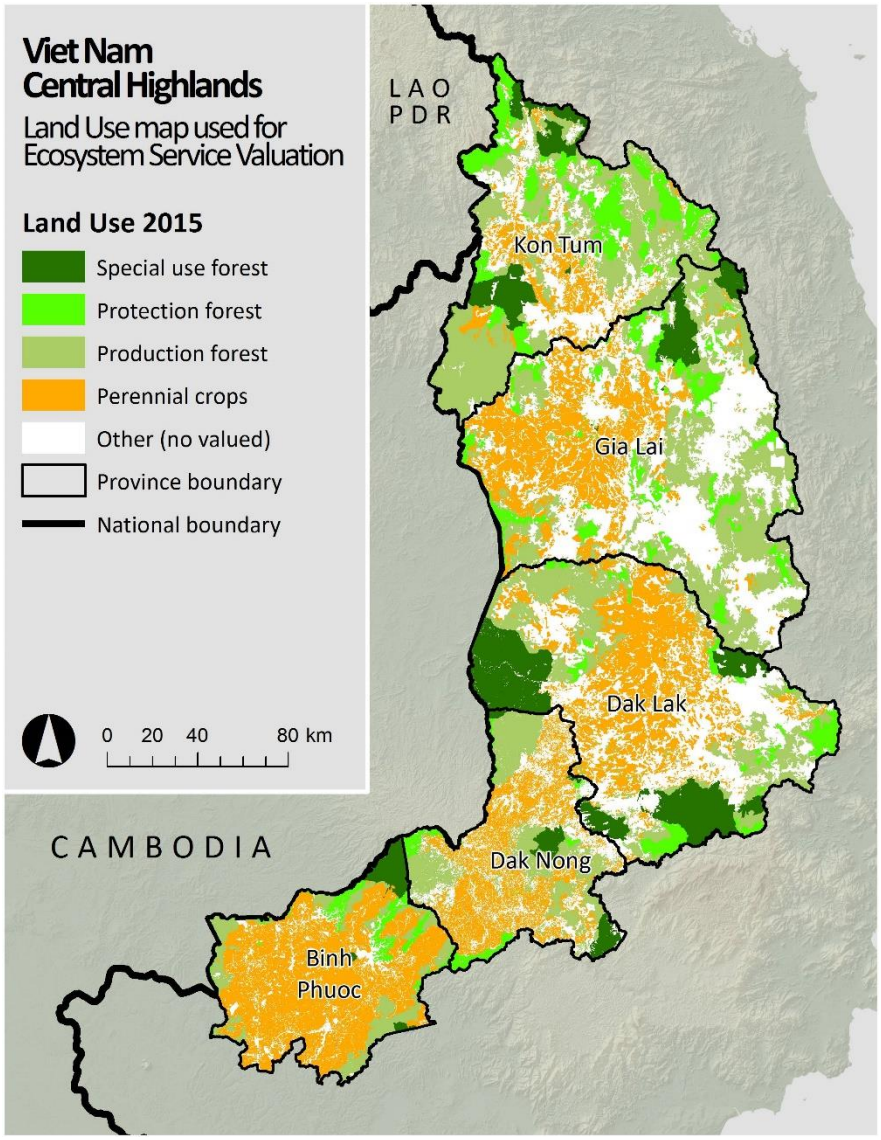
For processing zonal statistics, the LU dataset was rasterized to 100m pixel size (hectare size). Table 9 presents the GIS data sets collected as part of the Rapid Ecosystem Assessment.

Table 9: GIS datasets collected

Dataset	Year	Scale	Source	Remarks
Land Use (used for calculating ESV)	2015	1:50000 and 1:25000	Ministry of Environment and Natural Resources (MONRE) – General Department of Land Administration (GDLA)	• Forest classified by management classes (not by forest type or other quality proxies) • Produced by each province individually (DONRE or contractors) • Bentley Microstation DGN file format • VN2000 projection
Administrative units (used for calculating ESV)	Commune boundary in 2008 District boundary updated in 2013		Topographical map Ministry of Environment and Natural Resources (MONRE)	• Contains two different numerical coding systems (2002 and 2004), • Codes and names of two communes missing, • File also contains an OBJECT-ID which is unique and complete
Roads (used for overlay)	2010	1:100000	Topographical map Ministry of Environment and Natural Resources (MONRE)	• Coding of road and types of roads • Road names • ESRI Shape file
Forest Cover (not used)	2010	1:100000	Ministry of Forestry and Rural Development (MARD) – Forest Inventory and Planning Institute (FIPI)	• Forest classified by some form of timber value (rich, medium, poor) and forest types • Produced by each province individually (DARD or contractors) • ESRI Shapefile or MapInfo file • VN2000 projection

Figure 1 presents a land use map of the VDTA based on Ministry of Environment and Natural Resource (MONRE)– General Department of Land Administration (GDLA) data in 2015, these data are presented in Table 10.

Figure 1: Land Use map



Source: Ministry of Environment and Natural Resource (MONRE)– General Department of Land Administration (GDLA) , 2015

Table 10: Central Highland provinces – Land use (hectares)

Province	Special use forest	Protection forest	Production forest	Annual crops - irrigated	Annual crops - non-irrigated	Perennial crops	Total
Binh Phuoc	31,463	44,789	96,210	8,872	27	434,075	615,436
Dak Lak	223,301	68,290	246,620	72,890	145,387	366,431	1,122,919
Dak Nong	30,844	31,098	174,182	31,279	73,153	241,796	582,352
Gia Lai	55,738	128,830	433,762	43,206	393,243	338,279	1,393,058
Kon Tum	81,316	172,789	371,989	38,332	116,550	111,681	892,657
Central Highlands	**422,662**	**445,796**	**1,322,763**	**194,579**	**728,360**	**1,492,262**	**4,606,422**

Source: Ministry of Environment and Natural Resource – General Department of Land Administration, 2015

2.4 Valuing key ecosystem services

Table 11 provides a summary of the unit values used to derive initial valuation estimates for a sub-set ecosystem services for which data was available for the land use categories identified in Figure 1 / Table 10. A summary explanation of the unit values adopted is provided below, along with a description of key ecosystems services associated with forest and agricultural landscapes.

Table 11: Ecosystem Services Unit values (US$/hectare)

	Timber	*NTFP*	*Agriculture*	*Watershed protection*	*Carbon sequestration*
Special use forest		26		90	728
Protection forest		26		90	728
Production forest	105	5			
Annual crops - irrigated (paddy in RRB)			n.a.		
Annual crops - non-irrigated			n.a		
Perennial crops (e.g. rubber, cassava, pepper, cashew, coffee)			1,500		

2.4.1.1 Provisioning Services

Provisioning services relate to the tangible products, such as timber and NTFPs provided by forests.

Timber

Table 12 below presents information on forest area, volume of timber harvested and economic value of timber by provinces in Central Highland.

Table 12: Value of timber harvested from forest ecosystems by province in Central Highland, 2014

Province	Production area (ha)	Volume of timber harvested (m^3)		Timber value			
		Natural forest	Plantation	VND million	VND million/ha	USD million	USD/ha
Kon Tum	378,692	13,340	7,078	139,906	0.37	6.51	17.19
Gia Lai	519,061	0	100,000	295,556	0.57	13.75	26.49
Dak Lak	310,129	19,435	16,452	453,731	1.46	21.10	68.04
Dak Nong	197,215	7,377	5,175	29,070	0.15	1.35	6.85
Binh Phuoc	99,845	1,034	10895	46,752	0.47	2.17	21.73

Source: Kon Tum, Gia Lai, Dak Lak, Dak Nong and Binh Phuoc Statistical Yearbooks, 2014

A transfer value has been used for timber based on a meta analysis undertaken for the Great Mekong Region (WWF, 2013), that values timber at US$104 hectare per year. This value was applied to all production forests. This estimate will be refined based on site specific timber production data and market prices in Phase 2 of the assessment. Table 12 suggests a lower site specific timber value of around US$28 / hectare may be appropriate, although this is low compared to other studies in the region and Viet Nam. Possible explanations for this will be examined in Phase 2 of the study.

Non-Timber Forest Products

NTFPs play an important role in supporting communities near forest areas, both in terms of subsistence use and as a form of income when products are sold. The number of households collecting NTFPs is not know but is considered to be high based on anecdotal evidence. Dependence on NTFP is particularly intense for poor and tribal people, the most disadvantaged section of society, who live in forest fringe areas.

Up to 90 % of households located near protected areas depend on forest resources as discussed above. In **Kon Tum** province approximately, 9,000 households out of total 116,000 households (7.8%) collect NTPF such as rattan, bamboo, Pinus resin, wild fruit, small wild animals and medicinal plants[16]. In **Dak Lak** local people reportedly collect many products from the forest including rattan and bamboo for products and art[17]. In Eaket Commune, Kmag District, Dak Lak an estimated 10-15% of the population use the forest to collect fuelwood, bamboo and medicinal plants, which are either use domestically or sold in markets. Many NTFPs of medicinal value were observed being sold in the stalls around Buon Don Tourist center, e.g. medicinal mushrooms 500,000 VND / kg that help sleep and improve health. These forest products are collected by ethnic minorities.

Transfer values have been used to estimate NTFPs. For special use forest and protection forest a transfer value is draw from a meta analysis of studies in the Greater Mekong region (WWF, 2013), that estimated NTFPs to be worth US$26 / ha. A study in Nghe An Province estimated

[16] Personal communication Mr Ho Thanh Hoang – Director of Provincial Forestry Department, May 2016
[17] PPTA Provincial stakeholder meeting on Ecosystem Services, March 2016

NTFPs to be worth US$20-70 a hectare (Nguyen and Nong, 2007), while an ADB study (ADB GMS-EOC, 2011) estimated NTFPs in the Central Highlands at US$4.7. A lower value of US$5 / hectares (compatible with the ADB GMS-EOC, 2011 study) has been assigned to production forest.

More site specific evidence would require surveys of households who collect NTFPs and/or forest inventory work, which are not currently envisaged under Phase 2 of this study.

Agriculture

Viet Nam is the largest agricultural producer within the CLV-DTA. The main industrial crops grown in the VDTA are coffee, cashew, rubber, pepper and cassava. Viet Nam is the world's largest producer of Robusta coffee, cashew and pepper and the VDTA produces the majority of Viet Nam's output for these five main industrial crop.

The agriculture sector attracts 72.2%[18] of the labor force employs and is a major contributor to provincial Gross Domestic Product (GDP) (Table 13). In rural areas dependence on agriculture is high. For example, In Eaket Commune, Kmag District, Dak Lak around 85% of population are engaged in agriculture, most own their land. The rest of the population work in the small service sector. Main crops include rubber, pepper, coffee, cashew, avocado and durian but production levels and price are not stable. Agricultural products are mostly sold to middlemen, some of whom are local people. Irrigation water is a problem as there is no irrigation system in the commune and people depend on groundwater.

Table 13: Agricultural GDP by province (2013/14)

	GDP	*Agriculture*	Area	*Agriculture Value*			
Province/ Sector	**Billion Dong**	**(%)**	**(ha)**	**VND Billion**	**VND million/ha**	**US$ billion**	**US/ha**
Dak Lak	54,871	47	539,081	25,789	47.84	1.16	2,145.2
Dak Nong	18,480	53	318,444	9,794	30.76	0.44	1,379.2
Binh Phuoc	39,368	37	440,698	14,566	33.05	0.65	1,482.2
Gia Lai	44,437	39	612,497	17,330	28.29	0.78	1,268.8
Kon Tum	14,437	37	215,356	5,341	24.80	0.02	1,112.1
V-DTA	172,181	42	n/a	72,316	n/a	3.24	n/a
Viet Nam,	3,937,900	18	26,791,580	70,882	2.65	31.77	118.6

Source: GSO, Statistical Yearbook of Viet Nam, 2014

Understanding how ecosystems in the Central Highlands support agriculture productivity is key to ensure that agriculture, a key driver of economic growth is not threatened but instead supported and enhanced.

A generic per hectare value of US$1,500 ha has been used for perennial crops based on available site data (Table 13). Production costs have not been deducted. At the time of writing insufficient information was available to specify the relevant crops and their output under the

[18] Ministry of Planning and Investment, 2013. Report on Survey of Labor and Employment, Hanoi, Viet Nam.

annual crops - irrigated and annual crop-non-irrigated categories. Perennial crops account for around 62% of agricultural land cover across the Central Highlands. This value, while covering a high percentage of agricultural land, may well underestimate the total value of agriculture in the area.

Further refinement of the land use, for example defining the land area under the five main commercial crops types of the region is planned for Phase 2, to understand the value of land per hectare under key crop types, and their relationship to key ecosystems on which they depend for water and other services.

The following provisioning services are also important, but it has not been possible to value them as part of the Rapid Ecosystem Assessment.

- **Water provision / supply.** Forests play an important role in the provision of drinking water. About 1/3 of the world's largest cities obtained a significant proportion of their drinking water directly from forested protected areas (http://www.fao.org/docrep/010/a1598e/a158e10.htm). They also play a role in the provision of water for irrigation, power generation and industrial purpose.

- **Energy security and hydropower generation**. Hydropower generation depends on clean, abundant, and reliable water. Forested watersheds supply water to reservoirs behind hydroelectric dams and protect against erosion and sedimentation that shortens the useful life of such infrastructure. According to Central Highlands Steering Committee, the Central Highlands and immediate surrounding areas have 118 hydropower sites with a total capacity of 5,789 MW. Others are under construction with planned capacity of around 5,000 MW (accounting for 25% of the total power capacity of the whole nation). Since 2002, the Central Highlands has witnessed the highest growth in hydropower with a series of hydropower plants constructed along Ba River, Serepok River, and Dong Nai River. Hydropower capacity (in operation and planned) by province is:
    - Kon Tum (5 completed hydropower projects and 27 under construction. For example, PleiKrong (total capacity of 100 MW, output of 417 million kWh/year), Thuong Kon Tum (total capacity of 220 MW, output of 1,1 billion kWh/year).
    - Dak Lak (6 completed hydropower projects and 23 under construction projects). For example, Buon Kuop (total capacity of 280 MW, and output of 1.4 billion kWh/year, becoming operational in 2010), Serepok 3 (total capacity of 220 MW, and output of 870 billion kWh/year, becoming operational in 2010).
    - Gia Lai (29 completed hydropower projects and 15 under construction). For example, An Khe Kanak (total capacity of 173 MW, average output of 685 million kWh/year, completed in 2009), Se San 3 (total capacity of 260MW, providing 1.3 billion kWh/year, operational in 2006), Ba Ha River (capacity of 220MW, average output of 825 million kWh/year, which started producing electricity in 2007).
    - Dak Nong (6 completed hydropower projects and 27 under construction). For example, Dong Nai 3 and Dong Nai 4 (180 MW and 340MW, total power of 1.7 billion kWh, generating electricity in 2009); Buon Tua Srah (capacity of 86 MW, average output of 360 million kWh/year, which became operational in 2008).

2.4.1.2 Regulating Services

Regulating services refer to the natural processes of forests such and carbon sequestration and watershed protection that contribute to social wellbeing.

Watershed services. Forested watersheds provide a range of services – they capture and store rainwater, reduce soil erosion, protect against natural hazards, and improve soil nutrient and carbon content.

One of the most important ecological functions provided by forest is the regulation of soil erosion. Forest ecosystems with their high species diversity, multilayered canopy structure, and thick layer of litter with dense root architecture protect the soil against the erosive force of raindrops. Forest in Viet Nam receive payments for this function through the PFES schemes (Decree 99/2010/ND-CP). Protection forests, where trees are not harvested, provide a permanent service. For production forest, the forest is typically not cut completely, thus keeping the erosion rate constant or very low in comparison with other types of land use such as agriculture crops (seasonally cut) and rubber, coffee plantation (periodically cut).

A transfer value of US$90 / hectare has been used to estimate forest watershed services. This is the value used in a recent study of the Red River Basin for high quality forest (Soussan, 2013), which is based on the following key studies in Viet Nam:

- MARD (2008) *Values of Forests on Water Conservation and Erosion Control, Da Nhim Watershed, Lam Dong Province* MARD, Hanoi, a detailed study which estimates the value of watershed conservation for *hydropower* through PFES to be worth $69/ha/year (based on water regulation worth $15 ha / year and soil conservation worth $54 ha / year).
- Vuong Van Quynh, Xuan Mai (2007) *Environmental value of forests in Northwest Mountains, Viet Nam*, which estimated the values of watershed functions for Son La *hydropower* plant to be between $6-10 ha / year for water regulation and $69-120 ha / year for soil conservation.

This value has been applied to Special use Forest and Protection Forest.

Payments for Forest Ecosystem Services

The importance of forest watershed services in Viet Nam is reflected in recent legislation on Payment for Forest Environmental Services (PFES). Government Decree No.99/2010/ND-CP recognizes five types of forest ecosystem services which should be paid for: (i) Soil protection, erosion control and the mitigation of the sedimentation of reservoirs, rivers and streams; (ii) Regulation and maintenance of water sources for commercial and domestic use; (iii) Forest carbon sequestration and storage, reduction of greenhouse gas emissions through preventing forest degradation and loss and sustainable forest management; (iv) Protection of natural landscapes and conservation of biodiversity for tourism; and, (v) Provision of spawning grounds, sources of feed and natural seeds, use of water within forests for aquaculture.

In **Kon Tum Province, as an example,** only (i) is currently paid for under PFES. The other forest ecosystem services are considered to be negligible or difficult to implement. Service (ii): if implemented, will generates PFES revenue of only VND 230 (US$ 0.01) per ha because not many households in the province use clean water provided by clean water factory; the expected PFES revenue from service (ii) is about VND 140 million (or USD 6,278) and this amount will be distributed to 640,000 hectares of forests on the watershed area. Service (iii) depends on international market on carbon credit to be realized. There is currently no legal or practical basis

for the establishment of a domestic market for this service. Service (iv): Currently there is only one eco-tourism site (Mang Den Eco-tourism site), which operates at a small scale and generates a small amount of revenue for the province. Service (v): forest water-based aquaculture is of small scale and is not considered a priority in Kon Tum in terms of PFES implementation in the coming years

An overview of PFES implementation in 2015 is provided in Table 15.

Table 15: Kon Tum, Dak Lak, Dak Nong, Gia Lai and Binh Phuoc Provinces - PFES Payments collected and disbursement 2011-2015

	Kon Tum	Dak Lak	Dak Nong	Gia Lai	Bình Phuoc
Paid area (ha)	363,117.48	240,547.7	172,315.6	489,897.4	53,692.6
Total PFES revenue collection (VND billion)	155.9	47.1	65.9	79.1	21.3
Total PFES revenue collection USD million)	7.0	2.1	3.0	3.5	1.0
Total PFES disbursement (VND billion)	46.45	58.68	38.30	52.85	162.28
Total PFES disbursement (USD million)	2.08	2.63	1.72	2.37	7.28
Number of forest owners being forest management boards	11	6	7	19	3
Number of forest owners being state forest enterprises	7	8	13	11	3
Number of forest owners being other types of organization	3	10	36	8	3
Number of forest owners being households/communities	3600	33	102	7	0
Number of forest owners being Commune People Committee	76	17	35	90	0

Source: Report on implementation of assigned tasks in 2015 and plan in 2016, Vietnam Forest Fund.

Payments for forest ecosystem services contribute greatly to household income, especially for ethnic minority households. It is one of four main income sources of household living in or near by forests[19] (Box 3). The other sources of income include: upland crop cultivation, non-timber forest production collection, and financial aids from government.

[19] Personal communication Mr Ho Thanh Hoang – Director of Provincial Forestry Department

Box 3: PFES and local livelihoods

Chu Mon Ray National Park (NP), Kon Tum Province: Under Decision no. 21/2012/QD-TTg of the Prime-Minister[20] every village in the buffer zone of a protected area receives 40 million VND / year to support their forest protection effort. Currently, 16,000 ha within the NP have been assigned to local people to protect. They are paid 200,000 VND/year/ha from PFES payment for protecting the forest benefiting 960 households. The park supports the Yaly, Se San (3,3A, 4) and Krong hydro power plans. This money is paid through the Provincial Forest Protection Fund, and then on to the NP management which is then responsible for distributing it to the contracted community and households. Raising the income of local people is a priority to reduce pressure on the park. New roads risk increasing the pressure on the National Park, and deforestation will be hard to manage unless alternative livelihoods are guaranteed.

Ngoc Linh Nature Reserve (NR), Kon Tum Province. In 2015, 27,430 ha of the NR were assigned to local people for protection at 200,000 VND / ha and 2-3 hamlets are paid 3.5 million VND / month for community based forest protection. The NR protects 2 reservoirs downstream for which it receives PFES - Ya Ly reservoir– 148,000 VND/ha/ year for 7,314 hectares and Dak Min reservoir – 92,000 VND/ha/year for 28,926 hectares. Suggested avenues to improve livelihoods include: (i) increasing the forest protection fee from 200,000 VND to 400,000 VND; and (ii) providing support for agriculture such as seed provision and infrastructure to enable the transport of products to markets.

Carbon sequestration

Carbon emissions are avoided by maintaining forest cover and quality. Data on wood standing volumes and total biomass carbon content above and below ground for different categories of land cover have been obtained from the Forest Inventory and Planning Institute, Viet Nam Forest Administration. It should be noted that these data do not include soil carbon, for which no reliable data is available, and so the estimates are conservative. The value of these carbon stocks is derived using a figure of US$4/ton (Ecosystem Market Place, 2015)[21]. The values reflect a total stock (not annual flow) for the carbon sequestration functions of different types of forest (rich, medium and poor). The high value of US$728 / ha has been applied to the area of Special Use Forest and Protection Forest only.

Table 16: Carbon Sequestration Values

Forest Type	Total biomass carbon	Market Price	Value
	tC/ha	US$	ha / US$
Rich Forest	182.22	4	728.88
Medium forest	143.29	4	573.16
Poor forest	96.9	4	387.6
Plantations	?	4	

The following regulating services are also important, but it has not been possible to value them as part of the Rapid Ecosystem Assessment.

[20] Decision no. 24/2012/QD-TTg of Prime-Minister on investment policy of special - use forest development stage 2011 – 2020.

[21] The average price for 2014 - US$ 3.8 t/Co2e. Reducing Emission from Deforestation and Forest Degradation (REDD) early movers (REM) proxy price was US$5.00 t/ Co2 e. The average price including REM is US$4.00 t/Co2 e

Disaster mitigation. Tropical forests play an important role in mitigating the impacts of tsunamis, cyclones, landslides, and floods. Deforestation and land degradation on the steep slopes and mountainous areas of upper catchments contributes to the incidence and impacts of floods.

In the Central Highlands, the forest ecosystem helps to regulate water flow through their ground vegetation and root system which help to prevent floods and landslides in mountainous area. For instance forests have been providing good protection for many national roads such road no. 14, 14c, 19, 24, 25, 26, 28, 29 that all cut through the forest area where the slope area is often protected by forest to prevent landslide and erosion from blocking the roads. The forest ecosystem also protect land and other open areas from the impact of storms by reducing the wind speed with their thick and multiple layers of canopy.

In north-west provinces of Viet Nam, flash floods are more common and are associated with forest loss; hence the forests in the Central Highland are very important to prevent the types of disasters happening elsewhere in Viet Nam which could have been mitigated through forest protection. The remaining natural forest in the Central Highlands is all located in strategic areas such as highly important watershed and high sloping and mountainous area and are therefore important in term of preventing and mitigating natural extreme events such a flood, storm and landslide.

Other services include: (i) Water purification as forests remove pollution from water flowing overland and filtering into groundwater. Dirty water causes millions of children to die every year from waterborne diseases such as diarrhea; (ii) micro-climate stabilization; (iii) Forested watersheds play a role in groundwater recharge and conservation.

2.4.1.3 Cultural Services

Cultural services have *not been valued* as part of the Rapid Ecosystem Assessment, but are considered to be very important to the Central Highlands. A qualitative analysis of cultural services is provided below.

Tourism and recreation

Tourism and ecotourism are considered to have high potential in the CLVDTA[22]. The Central Highland's natural landscape combined with its rich cultural diversity make the area an attractive tourism destination. Tourism could serve as a driver of growth, livelihood diversification and poverty alleviation in the area. Of particular interest is the development of ecotourism linked to the area's National parks, lakes (reservoirs) and rivers. It should be noted however that not all PAs will be suitable for tourism. Tourism revenue is relatively low at the moment due to low visitor numbers as a result of under-developed infrastructure and facilities, marketing and management capacity. The development of ecotourism is consistent with the concept of inclusive green growth and the Government's Green Growth Strategy. If well managed eco-tourism / nature based tourism can achieve growth and promote decent jobs for local communities that align with environmental sustainability.

[22] Nguyen Binh giang, 2012. Cambodia-Laos-Vietnam development triangle: a view point from Vietnam. In Five triangle areas in the Greater Mekong Sub-region, edited by Masaimi Ishida, BRC Research Report No. 11, Bangkok Research Center, IDE-JETRO, Bangkok, Thailand

An overview of eco-tourism activities and potential in the five provinces is provided below:

- **Dak Lak province**. Ecotourism in Dak Lak is focused on Yok Don and Chu Yang Sin National Parks. Yok Don National park is the largest of Viet Nam's nature reserves encompassing 115,000 hectares of mainly dry deciduous forest. It offers many tourism activities such as: trekking, bird watching, elephants riding and elephant bathing. Mainly local (including minority) people are employed in the tourism center with an average income of VND 200,000 per person per day. Chu Yang Sin National Park covers an area of 59,000 ha of diverse vegetation. It has high ecotourism potential including: trekking, wild animal and bird watching, cultural exploration, etc. On average, the park welcomes 6,800 visitors a year, of which 30 per cent are foreigners (Chu Yang Sin National Park Centre for Eco-tourism and Environmental Training, 2015).
- **Gia Lai province**. Gia Lai has high ecotourism potential since it is home to primeval forests with diversified fauna and flora, beautiful natural landscape and has a distinct culture characterized by its ethnic minorities. Kon chư răng and Kon Ka Kinh Nature Reserve have significant ecotourism potential, but have not yet been studied or developed for this purpose and there is no budget to promote ecotourism.
- **Dak Nong province**. Ecotourism sites in the province include: Dray Sap, Gia Long waterfalls, Ea Sno Lake (Krong No District); Dak Mil Prison, Ho Tay Tourist Site (Dak Mil District); Nam Nung Cultural Historical – Ecotourism Site, Luu Ly Waterfall, Truc Lam Dao Nguyen Monastery (Dak Song District); Ta Dung Cultural Ecotourism Site (Dak G'long District); and, Dak G'lun Waterfall Ecotourism Site, Dak BukSo Waterfall, Doan Van Lake and traditional ethnic minority festivals (Tuy Duc District). In 2014, Dak Nong welcomed more than 75,000 visitors (of which, 2,470 were foreigners) (Dak Nong Department of Tourism and Sport, 2015). Two outstanding ecotourism sites in Dak Nong province are Nam Nung Natural Reserve (25,000ha) and Ta Dung Natural Reserve (28,000 ha), which consist of primeval forest zones with beautiful scenery creating an attractive eco-tourism destination.
- **Kon Tum**: Mang Den Eco-tourism site is located in Kon Plong District, 50 kilometers far from Kon Tum city to the northeast. It covers an area of 720 hectares and consists of Dak Ke Lake Trade and Tourism Center, Dak Ke and Ba Lo Waterfall Eco-tourism, Toong Dam-Toong Zo ri and Toong Po Lakes Eco-tourism site. The site was established in 2013 and provides the following services: landscape tourism (i.e., visiting streams, waterfall and lake), adventure tourism (trekking, hunting and boating), cultural and sport tourism (golf, mountain biking, home-stay with local ethnic minorities), and spiritual tourism (temples), culinary tourism. On average, there were 50,000 visitors to come to Mang Den Eco-tourism in 2015, up 150 per cent over 2011 (Mang Den Tourism Center website, 2016)
- **Binh Phuoc** is relatively abundant in eco-tourism resources including forests, waterfalls and lakes. Bu Gia Map National Park, which covers an area of 26,032 ha attracts travelers interested in extreme sports and wild nature. Other sits with eco tourism include: Western Cat Tien National Park (7,801 ha) and Ba Ra – Thac Mo eco-tourism site. However, due to poor infrastructure, there is a limited number of tourists visiting these sites. For example, in 2015 around 1,000 tourists visited Bu Gia Map National Park (Ministry of Tourism and Sport, 2016). The entrance fee at Bu Gia Map National Park is VND 70,000 (USD 3.20) per visitor. Núi Bà Rá Cultural, historical and environment conservation areas (1996) is a recognized tourism site in the area as it close to town with high mountains and a cable car. As a result, the reserve has been exposed to high levels of human disturbance for a prolonged period, including the continuous development of tourism activities and construction of a television antenna on the top of Nui Ba Ra mountain. This disturbance has had serious negative

impacts on wildlife and natural habitats at the reserve. This illustrates the need for eco-tourism activities, especialy in protected areas o be carefully managed.

The challenge is for tourism to develop in a sensitive way, so as not to destroy the asset on which is is based (natural environment/aesthetic beauty of the area / cultural diversity). Lessons based on international experiences are provided in Box 4.

Box 4: Ecotourism and pro poor growth – lessons from international experiences

Ecotourism is an important tool for achieving inclusive sustainable development. Many ecotourism initiatives contribute to sustainability and poverty reduction objectives. For example, in the Nam Ha ecotourism project in Lao People's Democratic Republic communities directly benefit from the jobs created in trekking, guiding, accommodation and local services. In Nepal, the Simikot Train sustainable tourism project benefited 56 poor households who lived along the trail from activities related to tourism.

However, making sure that the benefits of ecotourism initiatives reach all sections of the community, and in particular the poor and vulnerable, is often challenging. There are number of factors that should be considered in the design of eco-tourism projects including: (i) multi-stakeholder participation is important; (ii) assessment of synergies and trade-offs between policies, ecosystems and people. It is necessary to ensure that the poor and those dependent on natural resources benefit and not just the elite wealthier and more powerful groups who are better placed to access jobs and finance small, micro enterprises (SME); (iii) projects need to be specific to the local area and take into consideration existing livelihoods that may in conflict with the proposed ecotourism venture; (iv) leakages need to be minimised to ensure benefits accrue to local communities and national governments. For example, in Lao PDR, the Nam Ha Ecotourism Project provided linkages for SME merchants to sell services to tourists (e.g., transport, food, water, guides, handicrafts); and, (v) in some cases groups will need to be identified and targeted to benefit from ecotourism initiatives (e.g., poorest of the poor). The Nam Ha Ecotourism Project **in Lao PDR** successfully initiated an Ethnic Minority Participation Programme to encourage ethnic minority participation in conservation and development activities.

Key factors needed to successfully implement ecotourism initiatives are: (i) Community engagement and ownership; (ii) Partnerships at multiple levels (Government, NGOs, donors, private sector; (iii) Financial planning (ecotourism Business Plans). Successful projects typically have some level of community financial investment from the outset; (iv) Long term involvement given that projects can take time to become established; (v) capacity building of communities in planning, designing, implementing and monitoring initiatives. Education and training is typically needed in understanding tourists and how the industry works, business skills, standards for community-run SMEs, and community organization (e.g., managing common resources, distributing benefits); and, (vi) Piloting and understanding the replicability of initiatives. Many initiatives start with small site specific projects which serve as pilot sites which can be replicated elsewhere building on the lesson learned at the pilot site.

The most common drivers of success are: (i) commitment and collaboration across multiple partners; (ii) transparent revenue sharing processes; and, (iii) proper planning including establishing commercial viability, product development, marketing and investment.

Ecotourism can benefit poor populations from its growth as an industry and provision of employment. However, the link between ecotourism and poverty reduction isn't automatic. **Deliberate and complementary poverty reduction policies, regulations and incentives** integrated in ecotourism design and implementation are required for ecotourism to directly result in poverty reduction.

Source: UNDP 2015

Culture and spiritual

Anthropological and forest management studies in the Central Highlands indicate a strong link between the forest, livelihood and culture of indigenous ethnic people (UNHCR, 2002)[23], Nguyen & Sunderlin, 2008[24]). Indigenous groups in the Central Highland traditionally depend on the forest for the collection of non-timber forest products, timber for constructing traditional houses and household furniture, traditional medicine (medicinal plants), fishing, hunting. Furthermore culture ceremonies all relate to the forest and natural resources.

2.5 Key Findings

Based on a preliminary assessment, the ecosystem services of the Central Highlands are valued at US$3.1 billion a year (Table 17). This can be taken as an underestimate because: (i) a conservation approach has been taken to estimate the sub set of ecosystem services for which data was readily available; (ii) a number of significant forest ecosystem services have *not* been included such as water provisioning services, natural hazard protection and tourism; (iii) the analysis only includes perennial crops (62% of the land area); and, (iv) important ecosystems such as lakes and rivers and groundwater, which provide important services such as energy provision (hydropower), water provision and natural hazard mitigation, are not been included.

[23] UNHCR, 2002. Viet Nam: indigenous minority groups in the Central Highlands.
[24] Nguyen Quang Tan, William D. Sunderlin, 2008. Forest Tenure Reform in Vietnam: Case Studies from the Northern Upland and Central Highlands Regions. RECOFTC.

Table 17: Central Highland provinces – Ecosystem service value, by land use type (US$)

Province	Special Use Forest			Protection Forest			Production Forest		Perennial Crops	Total
	NTFP	Watershed protection	Carbon sequestration	NTFP	Watershed protection	Carbon sequestration	Timber	NTFP	Agriculture	
Binh Phuoc	818,038	2,831,670	22,905,064	1,164,514	4,031,010	32,606,392	10,102,050	481,050	651,112,500	43,089,788
Dak Lak	5,805,826	20,097,090	162,563,128	1,775,540	6,146,100	49,715,120	25,895,100	1,233,100	549,646,500	1,006,093,004
Dak Nong	801,944	2,775,960	22,454,432	808,548	2,798,820	22,639,344	18,289,110	870,910	362,694,000	555,031,068
Gia Lai	1,449,188	5,016,420	40,577,264	3,349,580	11,594,700	93,788,240	45,545,010	2,168,810	507,418,500	880,047,212
Kon Tum	2,114,216	7,318,440	59,198,048	4,492,514	15,551,010	125,790,392	39,058,845	1,859,945	167,521,500	478,745,410
Total	10,989,212	38,039,580	307,697,936	11,590,696	40,121,640	324,539,488	138,890,115	6,613,815	2,238,393,000	3,114,845,482

Table 18: Overview of Ecosystem Service Values in the Central Highlands

1/ Code: ++ means that the service is important; + means that the service is provided; - means that the service is not relevant; and, ? means that there is uncertainty surrounding the provision of a service.

	Ecosystem Service (Benefit / outcome)	Forest	Agricultural Land	Valuation approach where applicable
Provisioning Services	Timber	++	-	Value Transfer
	Crops		-	Partially value through perennial agriculture (excludes annual crops irrigated and non-irrigated) and domestic production
	Food from forest	++	-	Value transfer (under NTFPs)
	Fodder	+	-	
	Fuel and fibre	++	-	Value transfer (under NTFPs)
	Biochemical and medicinal resources	++	-	
	Genetic resources	+	-	
	Ornamental resources	++	+	
	Fresh water supply	++	+	
	Energy provision – Hydro power	++		
	Climate regulation	++	+	Excludes soil carbon so an underestimate
	Micro-climate regulation regulation	++	+	
	Water quality regulation	++	-	
	Natural Hazard regulation (floods, storms, landslides)	++	-	
	Erosion regulation (protects against sedimentation of downstream waterbodies, maintains soil quality)	++	-	Valued under watershed services based on PFES
	Disease and pest regulation	+	+	
	Pollination	++	++	
Cultural Services	Cultural, spiritual, religious,	++	+	
	Scientific and educational information	+	+	
	Tourism and recreation	++	-	

Based on this partial analysis, agriculture represents 72% of the value. **This result should however only be reported in context.** Firstly, a number of key forest ecosystems have not been included in the analysis, and secondly, the productivity of the agriculture sector depends on a range of services provided by other ecosystems such as forest and water bodies (Box 5).

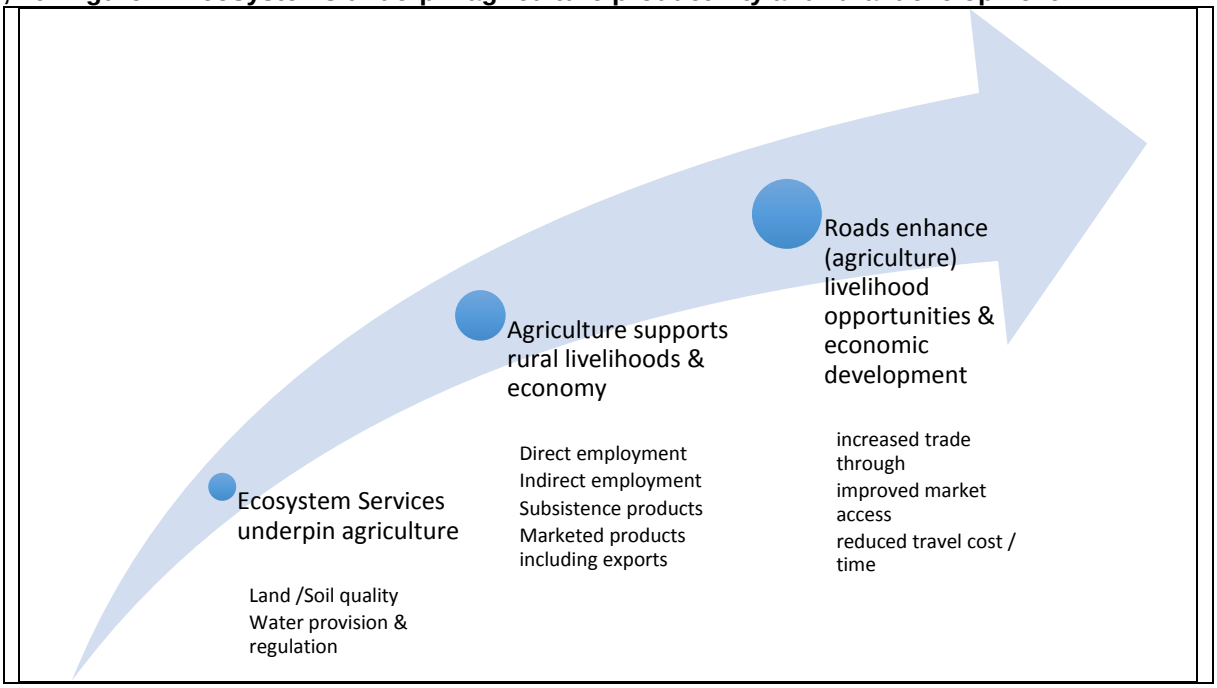
Box 5: The relationship between Agriculture and supporting Ecosystem Services

Agricultural production depends on the provision of ecosystem services (ES) such as water, soil fertility and pollination. The quality and quantity of these ecosystem services in turn depends on management of natural ecosystems. For example, the pollination of many crops depends on there being sufficient natural habitat in landscape surrounding the agricultural field to maintain viable populations of pollinators. Many agricultural crops depend on streams or rivers for water provision, and whether or not these streams retain adequate water flow depends, in part, on whether or not the upper catchments of the watershed are forested. The implication of this dependency of agriculture on ecosystem services is that what happens to natural ecosystems, and their ability to provide ecosystem services will have important impacts on agricultural system productivity. Degradation of ecosystem services will negatively affect farming systems (Bovarnick, 2010).

Ecosystem services to agriculture affect not only the location and type of farming, but also farmland's economic value. While determined in part by crop price, the economic viability of agricultural land also depend on production costs linked to ecosystem services such as soil fertility and depth, suitable climate and freedom from heavy pest pressure (Roka and Palmquist, 1997).

Figure 2 illustrates the links between ecosystem services, agriculture productivity and livelihoods and road connectivity.

, 201Figure 2: Ecosystems underpin agriculture productivity and rural development



It is evident that the economy of the Central Highlands is underpinned by its natural resources. Agriculture, tourism, industry and energy (hydropower) all depend on provision of a range of ecosystem services such as the provision of clean water, flood mitigation, and erosion control. Development of the area therefore presents an opportunity to align with the **Government of Viet Nam's Green Growth strategy**.

In particular **agriculture**, the key driver of the economy, depends on the sustainable management of the area's land, forest and water (surface and groundwater) assets.

Agriculture is the main means of employment in the area and therefore crucial to local livelihoods and tackling poverty levels.

The Central Highland's **Forests** provide important watershed services which support agriculture productivity through the provision of water and soil stabilization functions. They are also rich in non timber forest products (e.g. fuelwood and medicinal plants) which support (poor) households when used domestically or sold at market. Forests, especially through the Central Highland's protected areas, house important biodiversity, and are of high cultural significance.

Nature based / cultural tourism in the area has high potential to both build the economy and offer alternative livelihood opportunities to poor / ethnic communities, especially associated with National Parks and Nature Reserves but is under developed.

Ecosystem services are also at the heart of development and poverty alleviation. Ecosystem services are estimated to contribute between 47-89% of rural incomes, the so called 'GDP of the poor' (TEEB, 2010). Loss or degradation of these natural assets therefore has significant implications for poverty eradication and inclusive growth.

Key pressures facing ecosystems in the Central Highland are land use change (e.g. forest to agricultural land) and forest encroachment by local communities driven by the lack of alternative livelihood opportunities. The on going loss and degradation of ecosystems is of concern given its importance to the local economy and local livelihoods and hence poverty alleviation. Key challenges are water availability for agriculture and developing sustainable livelihoods.

3 Project Level Assessment - Road 675A Kon Tum Province

3.1 Approach

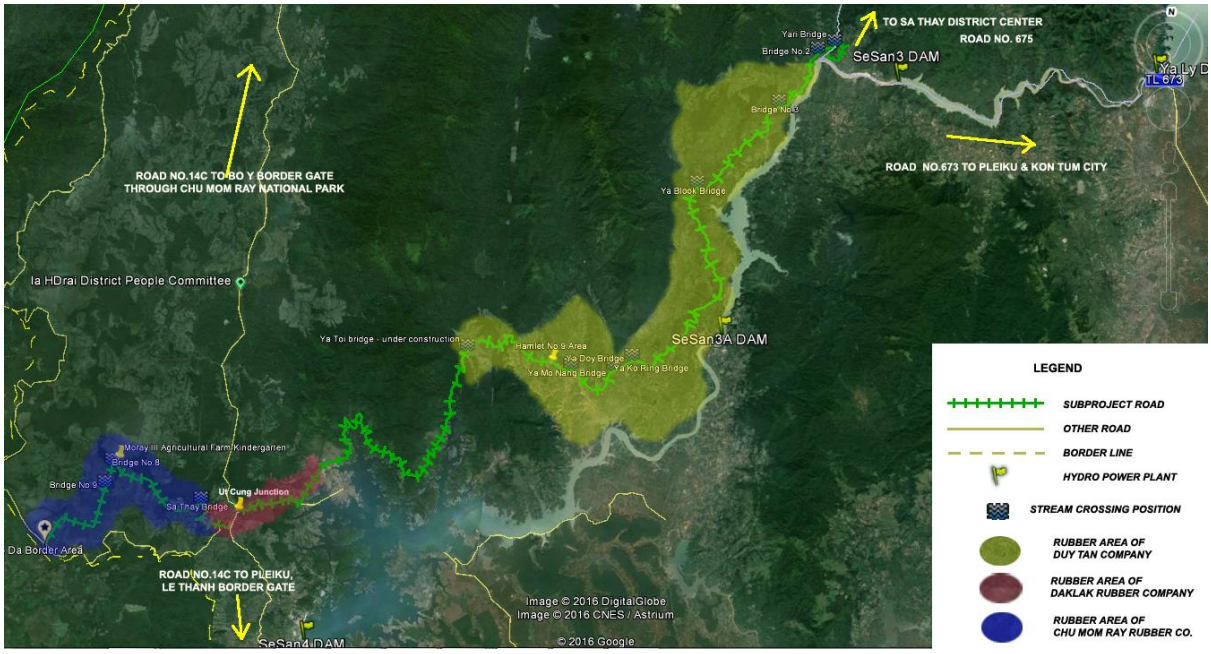
The Rapid Ecosystem Assessment at the project level looked at Road 675A in Kon Tum province, which suffers from erosion and landslides. The assessment focused on understanding the role ecosystems play, specifically the forested slopes adjacent to the road, in *supporting* the road and the proposed road investments and other economic activities in the area such as agriculture and hydropower. Such an assessment can inform land use planning for the area surrounding the road, and highlight the benefits of investing in natural capital and Ecosystem Based Adaptation.

In this way the Rapid Ecosystem Assessment complimented the Initial Environmental Examination (IEE) undertaken as part of Project Preparation of the site by the BADP Project Preparatory Technical Assistance (PPTA) team. The IEE is focused on the impacts of the road investment at the design, construction and implementation stages on the environment.

3.2 Background on Road 675A

There are two sections of Road 675A proposed for upgrade: **Section 1** from Se San 3 to NR 14C. The length: of this section is 58.7Km, beginning at Km 22+198 PR675A at Km80+910 PR675A (crossing NR14C); and **Section 2** from NR14C to Ho Da auxiliary border gate of about 12.1Km in length. This is a 5m-wide earth road passing Sa Thay River, Border Post 713 (old name) and ending at Ho Da auxiliary border. Figure 3 presents a map of the area.

Figure 3: Map of Road 675a and the current forest and land use



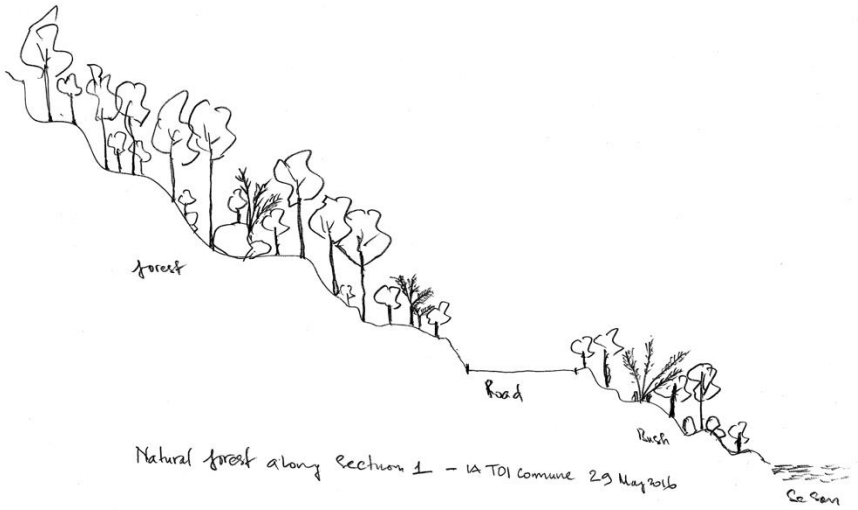
Source: PPTA IEE report for Kon Tum.

Road 675A cuts through a mountainous terrain from the north-east to south-west corner of the province linking Sa Thay district and Ia H'drai district.

The beginning (northern) end and southern end of the road falls within a wide valley with a relatively low elevation area range of 200 to 350 m asl. The middle from Ut Cung junction to Hamlet no. 9 falls within a mountainous area with the northern side of the road facing a high mountain slope (up to 1,528m asl). The southern side of road is limited by the Se San River and the Se San 3a, and 4 hydropower reservoirs. The road runs on the hill ridge (beginning of section 1 and all section 2) and narrow valley along the Se San river (most of section 1) crossing a variety of land use and forest types.

Road 675A runs through three communes in Ia H'drai district - Ia Dom, Ia Toi, Ia Dal. However most of the land either side of the Road are rubber plantations with some seasonal cassava field. Along Section 1 of road is the rubber plantation area of Duy Tan Investment & Trade Company. The company was allocated 10,000ha of forest in 2013; currently 230 ha have been planted. Other areas will be soon converted to rubber resulting in the loss of a large area of natural forest, especially in the southern end of section 1. The entire section 2 of road 675A goes through the area of Chu Mom Ray Rubber Co. Ltd. The forest was a part of Sa Thay Protection forest but was transferred to production forest in 2011. This forest is in the buffer zone of Chu Mom Ray National Park are serves as a protection belt to the park's core zone.

Figure 4: Sketch of natural forest along Section 1 of Road 675A



3.3 Overview of Ecosystem Services at Project Site

Currently 61.08% of Ia H'Drai district is covered by natural forest. The forest are of good quality as the standing wood volume is high and the forest canopy good. The forest are mostly situated on high mountain areas and slopes and receive ecosystem service payments for their role in water provision and protection against soil erosion. This income benefits the communities and will be lost if the forest is converted to rubber.

Most of the natural forest in the district have been allocated to state management boards and Rubber Companies such as the Dak Ha State Forest company, Sa Thay Rubber Company, Duy Tan Rubber Company or Dak Lak Rubber Company. For instance, the Sa Thay State Forestry Co. Ltd manages 34,346 ha of land of which 30,491 ha is natural forest, and a large area of the forest along the Road 675A (section 1) have been allocated to Duy Tan Investment & Trade Company and Chu Mom Ray Rubber Co. Ltd to be converted to rubber plantation.

The natural forest is the most important ecosystem along Road 675A. Section 1 of Road 657A comprises 58.7km running along the Sesan River. This section has some steep slopes and road areas impacted by landslides. The forested slopes adjacent to Road 675A in these areas play a vital role in: (i) **mitigating the affects of landslides** and hence protecting the proposed road investment by minimizing operating and maintenance costs and increasing the longevity of the road; (ii) **protecting against soil erosion** and associated increased siltation of nearby hydropower dams (Sesan 3A and 4) and hence increased operating costs and reduced longevity of the dams. Soil erosion could also impact the cultivation areas of local people in Hamlet No.7 of Ia Toi commune; and, (iii) **protecting water supplies** that support nearby agricultural activities and communities. The status of the forest area has recently changed from protection to production forest. A change in land use will adversely impact the ecosystem services provided by the natural forest. The biggest threat to

ecosystem services is the potential conversion of the natural evergreen forest rubber plantations and cassava areas. The extension of rubber is obvious now, and cassava now also plant more commonly within the young rubber plantation (1-3 years) and in most of the tiny land within rubber block and along the road. A large natural forest area situated in section 1 of the road has been allocate to Dak Lak and Duy Tan Rubber company, are is likely to be converted to rubber production. The issue is of concern to the provincial authorities and was discussed during Fact Finding. DONRE-Kon Tum supports designating a 100 meter band of natural protection forest along the road.

Rubber plantations do provide some ecosystem services, but the ecological structure and density of the plantations are far lower than the natural forest, and hence the provision of these services is not on the scale of the natural forest.

While the road will increase travel, transportation, facilitate the economic development especially the rubber industry, it will also lead to some negative impact that will have immediate and long-term impact to the area. For instance creating man-made separator to the landscape, increasing assess (good and bad), create erosion and landslide, facilitate land conversion of the natural ecosystem which all contribute to reduce the ecosystem service along the road.

According to the current forest management planning in Kon Tum, The evergreen forest along the road was classified as poor forest 5 years ago, however based on the forest survey undertaken for this project (from 29-30 May 2016) this classification is not accurate. The forest can be classified as 'good'; the main forest canopy is intact and the forest clearly presents multi-layed forest canopies of a good forest and the wood stand volume is higher than 200 cubic meter per hectare[25]. In fact the forest's condition is better than many other protected areas in the Northern provinces and the dry-dipterocarp forest found in York Don National park.

Furthermore, the evergreen forest along the section 1 of Road 675A is a contiguous with forest in Sa Thay District and connects with Chu Mom Ray National Park forming an important forest landscape, which is home to endangered wildlife such as the Indochinese tiger (*Panthera tigris cobertti*), crested gibbon (*Nomascus* spp.), douc langur (*Pygathrix* spp.), gaur (*Bos gaurus*), great horn-billed (*Buceros bicornis*) and threaten flora such as rosewood (*Dalbergia* spp.), and padauk wood (*Pterocarpus* spp.).

Assessment of Ecosystem Services

The forest system along the road 675A provides a range of ecosystem services, as described below. Of note is that the natural forest in this area is a part of the Sa Thay-Chu Mom Ray National park biodiversity complex, home and key habitat for a large range of flora and fauna supporting biodiversity conservation in Kon Tum province, the Central Highland and the Indochinese region.

Provisioning services

NTFP - food. Local communities depend on NTFPs for their daily food / nutrition requirements and as a source of cash income. NTFPs include fruits, nuts, wild vegetables (bamboo shoots, leaves and fish), wild animals and honey. These are all important to local communities as they are living in a remote area with limited regular access to markets. The closest markets is 30km away in Ia Grai town, Gia Lai province and Sa Thay town 50km away from the furthest commune (Ia Dal). In addition, the newly established residential areas, mainly occupied by in-migrants, are virtually without home gardens or fish ponds, increasing the dependence on the forest for food.

[25] Poor forest has wood standing volume of 10 to 100 m^3/ha.

In terms of cash income, the following NTFPs are commonly sold at market: bamboo shoots, wild vegetable and honey. For instance, one litre of honey can be sold for US$40 equivalent to three days of income from working for a rubber company. In addition, local demand for NTFPs is greater now as most of the forest have been converted or are inaccessible. This is putting pressure on the remaining forest areas and the tiny forest patches along the road or within the rubber plantation.

A limited selection of foods are collected from the rubber plantations, for example some fish can be caught in the streams within plantation during the wet season.

Box 6: Perspective on Ecosystem Services – Village 3, Ia Dal Commune, Ia H'Drai District.

Ia Dai is one of three communes of the newly established District – Ia H'drai. It has 858 households, of which, 672 are classified as poor and 72 marginally poor. The village is located at the easternmost point of Ia Dai commune. Most people living in the village are employed by Dak Ha Rubber company, and have been living in the village for 2 to 5 years

The key ecosystem in the commune is poor evergreen broadleaved forest, which has been dramatically degraded recently due to the decision to convert forestland into rubber plantations. Almost all households in the village heavily depend on natural forests located 200 -300 m from their homes. Uses of the forest include:

- Timber: Each household uses 3-5 m^3 timber of class V-VI for building a house, which lasts up to 10 years. Market price for timber of class V-VI ranges from VND 2,000,00 – 3,000,000 m^3 (USD 89-134).
- Fuelwood: Each household collects 10-15 kg fuelwood per day. Fuelwood is used mainly for domestic cooking. Fuelwood is not sold in local market, however the market price for fuelwood mentioned in Decision No.40/2015/UBND of Kon Tum province, dated 16 September 2015 is about VND 210.000/ste[26] ((or VND 300,000/m^3 and or VND 3000/kg)
- Bamboo shoot: This is popular food for almost every household during the rainy months (June – August). Each household often collects 10-15 kg of bamboo shoot, twice a week during this three month period for household use. Bamboo shoots can be bought at the price of VND 10,000/kg (USD 0.45/kg) from local markets.
- Vegetable: Each household collects 3 kg per day during the rainy season (June – August).
- Honey: A few households (10% of the village) collect bee honey (10 litres per week 6 months of a year). Market price for honey is from VND 500,000/litres (USD 22,4/litres)
- Medicinial plants: Very few households still collect medicinal plants (10-15 kg per year for minor illness)

Note: Based on 6 household interviews.

Timber & Fuelwood The local forest is an important source of timber and fuel wood for local people. Along Road 675A, all households interviewed as part of the Rapid Ecosystem Assessment use fuelwood, 50% use timber for building houses and 100% use timber to make wooden furniture for their house. Most local people cannot afford to buy building materials. In addition to the domestic use of timber, local residents also extract timber for commercial purpose. Most households are involved in collecting good construction timber to sell to a local timber broker. The collection of timber for sale contributes to household income in Ia Dal, Ia Toi and Ia Dom communes, where household crop production is limited and since rubber has not yet matured, a reduced workforce is required to maintain the plantations. Income alternatives are limited, putting pressure on the forest resource for timber harvesting.

[26] 1 ste = 0.7m^3

Natural Medicine. According to local people natural forests are an important source of medicinal plants, however relatively little data are available on the extent of medicinal products extracted, used and sold from the forest. Some species are exclusively used for medicinal purposes, while others also used as food or spice. Based on discussions with local residents around 20% of their medicine is sourced from the forest and are especially important for the immediate treatment of common illneses.

Grazing area for livestock. Animal husbandry is a key source of food and cash income for local people. The types of animals reared is determined by various factors such as food availability, terrain/vegetation condition and cultural practices. In Ia Dal, Ia Toi and Ia Dom and other communes around road 675a where the human population is not high, large livestock such as cow, buffalo, goat and pig are common. These animal are semi-captive and graze freely in the grassland fragments between forest/rubber plantation and along streams. Further conversion of land to rubber plantations will make it increasingly difficult for local people to raise livestock in this way.

Regulating services

As discussed above, the Government of Viet Nam officially recognizes the importance of forest regulatory services through its PFES initiative (Decree 99/2010/ND-CP). Many forest regulatory services support the sustainable supply of many provisioning services provided by the forest and other ecosystems. Currently the forest along the Road 675a receives approximately VND200,000 per hectare per year under PFES schemes. Agricultural land / plantations also provide regulatory services but at a far lower level than the forest. Plantations have simple species composition and ecological structure and low density. Agriculture areas are not currently eligible for payment for ecosystem services in Viet Nam. Forest regulating services are discussed below.

Carbon sequestration. Forests mitigate CO_2 emission by sequestering carbon from the atmosphere. The evergreen forest in Kon Tum have high carbon storage value on account of their species richness and diversity, ecological structure, density and high productivity and could qualify for REDD+ payment[27].

Micro Climate regulation. Along Road 675a, the remaining forest ecosystem with its dense vertical structure of trees and species helps to control microclimatic conditions by influencing the air temperature, radiation flux, soil moisture, and wind speed and maintaining an ambient temperature which helps to prevent the local climate from extreme event such as drought, flooding, erosion and landslide.

Erosion regulation. A study of the soil erosion in Central Highlands indicates that poor and heavily impacted forest is still better in providing soil protection than rubber and agriculture plantations. Seasonal agriculture crops lose an average of 107.5 tons of earth/year/ha; long-term industrial crops (rubber > 6 years) lose 23 ton of earth/ha/year (Ngo *et al*, 2015). Hence, keeping the forest ecosystem along the road will definitely help to prevent the possible damage or blockage of the road from landslide and erosion. This maintains the transportation capacity of the road and reduces maintenance and other operational costs due to landslides. In addition, the forest along the road also reduces sedimentation of nearby dams, thereby reducing the dam's maintenance cost (dredging) and contributing to energy security.

Road maintenance costs associated with landslides in Kon Tum. While there is no site specific information for the cost of repairs on Road 675A, based on the costs of road clearing and maintenance after landslides at National Road 24 from Km 69 to Km 116+650 (47,760

[27] FFI, 2015. REDD+ policy brief

m) in 2013 the average cost is approximately VND 31,670,00 (US$ 1,423) per km of road (Table 19).

Table 19: Road maintenance costs following landslides

Work Items	Cost (VND)	USD[28]
Management cost	28,621,000	1,283.5
Site survey cost	24,680,130	1,106.7
Cost for cost estimation	4,117,846	184.7
Design cost	8,323,765	373.3
Supervision cost	35,706,338	1,601.2
Implemetation cost (including material cost and labor cost for road clearing and maitenance)	1,393,690,000	62,497.3
Vertification and approval of settlement cost (According to Circular No.19/2011/ BTC, dated 14 Jan 2011, of Ministry of Finance)	2,945,405	132.1
Accouting (According to Circular No.19/2011/ BTC, dated 14 Jan 2011, of Ministry of Finance)	10,913,500	489.4
Project appraisal fee (According to Circular No. 76/2011/TT-BTC)	294,540	13.2
TOTAL	1,509,292,524	67,681

Source: Kon Tum Public Transportation Department

Waste treatment and water purification. The forest ecosystem provides a natural water treatment and purification service, reducing the cost of producing drinking water and helping to sustain the water quality in hydropower reservoir and preventing hydropower turbine from corrosion (Decree 99/2010/ND-CP). Upstream forests of areas where water is taken for drinking and electricity production qualify for PFES in Viet Nam. The forest patches along Road 675a, all receive PFES (Kon Tum FPDF, 2015), which are paid to local people to protect the forest. They help to maintain the quality of water flowing directly into the reservoirs of Se San 3a and Se San 4.

Pest regulation and pollination. Natural forest provide shelter for many animals (birds, bees, bats and other species of insect and reptile) that help to control pests and facilitate pollination of surrounding areas. As in other areas of the Central Highlands, fruit trees and coffee will soon be extended in Ia H'Drai[29]. Forest ecosystem will help the pollination process and control pesticides in these cropping area.

Cultural services

Culture and spiritual. In Ia H'drai district, the population are mainly from ethnic groups such as indigenous Se Dang and G'rai group. In-migrants from the northern province are from ethnic groups such as Muong, Tay, Thai, Dao in Ia H'drai. There is a strong link between the forest and culture. Preservation of indigenous culture depends on conserving natural forest, and local culture and indigenous knowledge can help to protect the forest and its ecosystem services (Alcorn, 1993).

[28] Exchange rate: US$1 = VND 22,300

[29] Kon Tum MPI, 2010. Build and develop the key economic sector and products for Kon Tum toward 2020. Department of Plaining and Investment of Kon Tum province.

Scientific and educational information. Kon Tum is a strategic area not only for the Central Highlands and Viet Nam but also for the Indochinese region and the Mekong river. The forest and ecosystems in Kon Tum province help to regulate the climate, the soil, the water and nutrient cycle of the whole region (Torfoff *et al*, 2003). The forest in Kon Tum has been recognized as an important part of the Central Annamite landscape which is one of the most important biodiversity landscapes in Indochina and home to many endemic and globally conservation important species (Baltzer *et al*, 2001). In addition, the forest along road 675A is a contiguous area of the Chu Mom Ray National Park a biodiversity hot-spot and one of the key trans-boundary conservation area in Indochina (Mac Quarrie et al, 2013). Chu Mom Ray National Park is home to a significant number of endangered species such as the Asia elephant, the gaur, Indochinese tiger, gibbon and black/red shanked douc langurs. However, there are no detailed biological surveys to confirm the biodiversity richness of the forest in Ia H'drai district yet. This forest therefore offers potential scientific and educational information, for instance the possibility of finding new species (small mammal and bird) and populations of endangered species. Hence conversion of the natural forest in this area foregoes this opportunity, contributes to the reduction of natural forest and wildness area in Kon Tum and the Central Highlands and further fragments the natural habitat reducing the connectivity of this important transboundary biodiversity landscape.

Tourism and recreation. Tourism often can offer economic development, jobs and income for local people. Ecotourism has been identified as the most suitable type of tourism in the province for which natural assets such as forests and wilderness landscape will be key. Currently the natural landscape along road 675A offers this condition as tourist can enjoy seeing the forest, animals, plants and nearby waterway (Se San hydropower reservoirs) while traveling along the Road. Therefore, protecting this natural forest supports future tourism development in Kon Tum and the Ia H'drai district.

Annex 4 provides a summary table on the ecosystem services provided by forest ecosystems in the area and a qualitative discussion of the likely impact of the proposed road upgrade on these services.

3.4 Key findings

Section 1 of Road 657A comprises 58.7km running along the Sesan River. This section has some steep slopes and road areas impacted by landslides. The area of concern is about about 15km from Km 60 – Km 75 of the PR675A. The area is under the management of Duy Tan Investment and Trade Company (locally referred to as the Duy Tan Rubber Company).The forested slopes adjacent to Road 675A in these areas play a vital role in: (i) **mitigating the affects of landslides** and hence protecting the proposed road investment by minimizing operating and maintenance costs and increasing the longevity of the road; (ii) mitigating the affects of flooding which result in road closures and affect the economic activity and access to social services[30]; (iii) **protecting against soil erosion** and associated increased siltation of nearby hydropower dams (Sesan 3A and 4) and hence increased operating costs and reduced longevity of the dams. Soil erosion could also impact the cultivation areas of local people in Hamlet No.7 of Ia Toi commune; and, (iv) **protecting water supplies** that support nearby agricultural activities and communities. The status of the forest area has recently changed from protection to production forest. A change in land use will adversely impact the ecosystem services provided by the natural forest. The issue is

[30] Based on discussion with households in Yed Del Commune, la H'Drai District, floods occur 1-2 times a year causing the road to be closed for up to 7 days per flood event.

of concern to the provincial authorities and was discussed during Fact Finding. DONRE-Kon Tum supports designating a 100 meter band of natural protection forest along the road

Forest protection is effectively used as a management mechanism along Road 14 especially the section from Dak Glei district (Kon Tum) to Nam Giang district (Quang Nam). Application of this approach in other areas including Road 675A would reduce the cost of road maintenance while supplying vital forest resources to local people and ecosystem service to that underpin the local economy.

4 Next Steps

4.1 Development of Landscape Analysis to inform output 3 of Border Area development Project

The rapid ecosystem landscape assessment will be further developed under RETA 8564 to the end of 2016 with the objective of informing Output 3 of the Border Area Development Project. Output 3 of the Border Area development project - Strengthened Institutional Capacity for DTA Investment Planning, Project Design and Implementation, and Resource Management, will consolidate the long term development program of the VDTA towards becoming a cohesive and strong economic area. The indicators for achieving this output are: (i) VDTA master plan revisited and an implementation action plan supporting the VDTA master plan prepared with ***ecosystem services***, climate change, gender and ethnic minorities considerations; and (ii) Officials nominated by the PPC trained to implement the action plan.

The work will focus on developing the Spatial Multi-criteria Analysis tool used in the Rapid Ecosystem Assessment at the landscape scale. Spatial Multicriteria Analysis (SMCA) provides a foundation for exploring the synergies and constraints across the concerned sectors and hence can inform strategic development planning within. It can be used to flag constraints and opportunities with respect to agriculture and tourism development, and suggest areas of institutional / capacity development that will encourage sustainable and inclusive development linked to the proposed road upgrades. The tool can be used to indicate ecosystem values at the commune level as demonstrated in Annex 5 based on the analysis undertaken for this rapid assessment. This analysis should be taken as illustrative only – the values will be refined under the on-going RETA to provide a more accurate spatial picture of the location of high value ecosystem services in relation, to example, ethnic minority groups and tourism opportunities or proposed developments.

The tool developed to date is, in principle a very simple Spatial Multicriteria Assessment (SMCE) – working only with a single layer (land use), a limited set of criteria, and no weighting. This emphasizes how the comprehensiveness and accuracy of this assessment could be improved in the near future.

Priority areas of development, in line with proposed BADP are:

- **Increase detail of land cover and land use data.** An attempt will be made to disaggregated land use by crop type focused on the five key crops for the area (rubber, coffee, cashew, pepper and cassava).

  Considerations: The LCLU dataset is the main driver for the ecosystem service values. However, there is no government dataset that is equally detailed on forest, agriculture and other land use classes. Comparable regional datasets don't exist and global datasets lack spatial resolution and local specificity. One solution is to develop a combined dataset merging a) forest classes from the MARD-FIPI FC (2015)

dataset, b) agriculture classes from the NIAPP (2012) dataset, and c) other land use classes from the MONRE- GDLA LU (2015) dataset. Respective datasets are currently collected (FC 2015, NIAPP 2012) and processed. Alternatively, it is also possible to build the SMCE not directly in a GIS but based on commune-level statistical data (forest cover, agricultural land etc.). Such statistics might be available from GSO, the assessment could be entirely performed in MS Excel, and only the results would be imported into a GIS for display, using the commune code. This approach comes at a loss of spatial resolution though (hectare size pixels versus commune).

- **Include additional layers to provide greater spatial precision to the ecosystem service values**. For example: (i) integrating slope data into GIS to inform watershed protection benefits; (ii) overlying population data with an emphasis on poverty and ethnic minorities to inform targeting of tourism investments, distribution / social issues generally and ecosystem valuation; and, (iii) identifying areas prone to drought, floods and other key climatic risks in supported for the proposed climate risk assessment work.

  Considerations: While the land use dataset is the key dataset used for ecosystem services valuation, stakeholders might argue that the land use classes and coefficients are too generic for a highly diverse landscape such as the Central Highlands. A solution for this problem could be to introduce additional GIS layers serving as proxies for level of dependence on selected ESV (risk, vulnerability, exposure) and which could be used to refine the land use dataset and its ES values. For instance, the ESV coefficient for watershed protection function of a protected forest (90 USD/ha) could be increased by a set factor if the slope is steep and reduced by a set factor if the land is flat. Likewise, the value for NTFP of a Sustainable Use Forest could be increased or decreased by a set factor depending on socio-demographic statistics of a commune (poverty, ethnicity, type of livelihood). There is no limit to how many layers could be included in the assessment but the factors used would have to be researched and justified well.

- **Amend and refine ecosystem service coefficients**. Currently, the available ecosystem service valuation coefficients cover only four broad land use classes and do not include a significant amount of regulating, cultural and supporting services. Increasing the level of detail of the land use layer and including additional exposure and vulnerability layers also requires more criteria (coefficients) which would have to come from research, case studies, or expert opinions.

- **Involve stakeholders.** The method will always have to deal with data limitations, assumptions and simplifications that create room for criticism. By actively engaging government stakeholders in contributing data and knowledge, in the analytical process (e.g. training of trainers), and in co-designing solutions for data and analytical challenges, essential understanding and ownership is created and the risk of substantial criticism from their side minimized.

4.2 Development of guidance on integration of ecosystem services into sector planning

Under ADB RETA8564 – Promoting Ecosystem Services and sustainable financing in the Asia Pacific Development the Rapid Ecosystem Assessment will be futher development as a pilot study for testing a methodology for mainstreaming natural capital and ecosystem services into the investment approval process and transport sector guidelines in Viet Nam.

This analysis and guidance could be further developed and utilised by the provincial Governments of the Central Highlands to integrate natural capital and ecosystem services considerations into strategic planning.

4.3 Proposed inputs to BADP Implementation

As a special feature of the BADP implementation it is proposed that ADB will provide additional technical assistance (TA) under a new TA to the VDTA provinces to support the integration of natural capital and ecosystem services considerations into strategic planning and the development of the VDTA Master Plan as well as on climate change considerations. The Spatial Multi Criteria Analysis tool may also be further enhanced to address the priorities of the VDTA. Training will be provided in the use of the tool and its application for the Master Plan.

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6 Annexes

6.1 List of interviewees

	Full name	Organization	Position
1	Ms. Nguyen Thanh Huong	Faculty of Agriculture and Forestry, Tay Nguyen University	Vice Head of Faculty
2	Mr. Pham Thanh Duong	PPTA Project	Environment and Climate Change expert
3	Mr. Ho Thanh Hoang	Kon Tum Provincial Forest Protection Fund	Director
4	Mr. Tran Van Duc	Kon Tum Provincial Forest Protection Fund	Vice Director
5	Mr. Pham Van Thanh	Kon Tum Provincial Forest Protection Fund	Vice Head of Technical Department
6	Mr.Truong Thanh Hoang	Kon Tum Provincial Forest Protection Fund	Vice Head of Technical Department
7	Mr. Le Thanh Tai	Kon Tum Provincial Forest Protection Fund	Technical staff
8	Mr. Nguyen Ngoc Chien	Kon Tum Department of Forest Protection	Vice Head
9	Mr. Ho Van Phong	Kon Tum Department of Public Transportation	Infrastructure management Division staff
10	Mr. Nguyen Quan	Kon Tum Department of Agriculture and Rural Development	Vice Head of Finance Division
11	Mr. Pham Van Tinh	Kon Tum Department of Agriculture and Rural Development	Forest Ranger staff
12	Mr. Truong Dat	Kon Tum Department of Natural Resources and Environment	Vice Director
13	Mr, Huynh Thuc Vien	Kon Tum Department of Natural Resources and Environment	Head of Environment Division
14	Mr. Le Quoc Trung	Kon Tum Department of Natural Resources and Environment	Environment Division staff

6.2 Annex 2: Overview of Protected Areas in the Central Highlands

Note on Table:

- Protected Area title, location, area and conservation objectives based on Prime-Minister Decision 1976/2014/QD-TTg[31].
- Protected Area management issues based on recent publications on the conservation and management of protected areas in Central highland include: Tordoff et al, 2004 Rawson et al, 2011, Nguyen, 2009, Nguyen et al, 2014, and Nguyen et al. 2015[32].

[31] GVN, 2005. Prime-Minister Decision no. 1976/QĐ-TTg approval of the Special Use forest planning toward 2020 and vision to 2030 (dated 31 October 2014). Government of Viet Nam.

[32] Nguyen Manh Ha, 2009. The status of Vulnerable gaur *Bos gaurus* and Endangered banteng *Bos javanicus* in Ea So Nature Reserve and Yok Don and Cat Tien National Parks, Vietnam. *Oryx*, 43(1), 129–135.

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TORDOFF, A. W., TRAN QUOC BAO, NGUYEN DUC TU AND LE MANH HUNG, EDS. 2004. *Sourcebook of existing and proposed protected areas in Viet Nam*. Second edition. Hanoi: BirdLife International in Indochina and the Ministry of Agriculture and Rural Development.

No.	Name / date established	Area (hectares)	Conservation objective	Management issues	PES scheme
Kon Tum					
1.	Chu Mom Ray National Park (1997)	56,003 ha (GVN, 2014)	Protect ecological diversity, forest ecosystems, rare and precious species of animals and plants (GVN, 2014)	The park has a large bufferzone and population of ethnic groups who largely depend on natural resources for their livelihoods – this puts pressure on the Park's biodiversity. - **Land encroachment** for industrial (rubber) and cassava planting remain one of the key issue as the boundary of the national park is not clearly demarcated. - **Hunting** is taking place within the national park quite frequently posing a serious threat to terrestrial animals, especially large mammals. - **Over exploitation of non-timber forest** products (particularly rattans, dipterocarp resins, *Scaphium macropodium* fruit) is quite common in the park especially the area close to road and local community. - **Habitat fragmentation** is perhaps the biggest issue in the long-term as the north-east side of the park is completely cut off from other forest areas due to road improvements, agriculture and industrial crop extension (rubber, cassava). It is anticipated that other forest in buffer zone area of the park will be soon converted to rubber production. - **Conversion of forest nearby the park**. Conversion of forest in Sa Thay and Ia H'rai to rubber and other crops, increases pressure for timber, hunting and NTFP collection in the Park, as the only forest area where such resources are available.	Yes – the Se San river
2.	Ngọc Linh Nature reserve	38,007 ha	Protect natural forest, rare and precious species and Vietnamese ginseng.	- **High population in the bufferzone** in both Quang Nam and Kon Tum provide pose some direct threats to the NR as many of the groups are indigenous ethnic tribes who heavily depend on the forest resources for their livelihoods. - **Hunting** of forest animals is quite common in the area driven by as the illegal wildlife trade. - **Illegal logging and harvesting of NTFP** is very common in the park for both domestic use and trade. Illegal logging is the most serious threat facing the NR; loggers extract high value rosewood timber. - **Land encroachment for agriculture** is an issue fueled by population growth increasing the demand for new areas for industrial crops and acacia plantations. Forest thinning for ginseng planting is also common in some parts of the NR, especially in high elevation. - **Weak conservation management**, under staffing, and budgeting, lack of conservation management training and long-term conservation planning	Yes – Vu Gia-Thu Bon Rivers System
3.	Đắk Uy Species and habitats	660 ha	Preserve habitats for genetic	- **Forest fire** is a serious threat in the dry season. The Site area is small and very vulnerable to fire.	Yes – Se San River

	Conservation Site (2014)		resources of rosewood (*Dalbergia cochinchinensis)*	- **Illegal logging** is degrading the forest - **Forest fragmentation.** The site is surrounded by coffee and agriculture crops and isolated from other forest area.	
Gia Lai					
4.	Kon Chư Răng Nature reserve (2004)	15,900 ha	Preserve natural forests, yellow-cheeked crested gibbons, gray shanked douc langurs, giant muntjac.	- **Forest clearance for coffee and and other industrial agriculture crops**. The NR is surrounded by residential areas and agriculture land and encroachment into the park is on-going. - **Illegal hunting** is also a serious threat. Large mammals suffer badly from snaring and hunting for the bush-meat trade. - **Illegal logging and NTFP collection**. Rose and red wood and other high-quality timber are targeted by illegal loggers for commercial purposes. - **Forest fire** is a threat in the dry season, especially in the area close to local communities where the forest is heavily disturbed by logging and other activities and is subsequently dominated by bamboo and bushes. - **Fragmentation**. The NR is becoming increasingly cut-off from other forest areas as a result of the conversion of surrounding areas to agriculture areas	Yes – the Se San river
5.	Kon Ka Kinh National Park (1995-2004)	42,057 ha	Protect ecosystem of natural forest, rare and precious species.	- **Illegal logging** is the most serious issue in the park as the area represents the richest forest area in the region supporting high quality and valuable timber such as rosewood and other redwood species. - **Illegal hunting**. Snaring and hunting by local hunters and hunters from other provinces is common. Hunters target terrestrial animals, especially large mammals in the park to supply the bushmeat trade. As a result important species such as bear are becoming rarer in the park. - **The high population around the park** continues to pose a threat as many local ethnic groups still depend on forest resources and/ or forest land for agriculture. - **Fragmentation**. Action is required to control land conversion to prevent the park becoming permanently isolated from other forest landscapes. At present the Park is only connected to Kon Chu Rang Nature Reserve; the best option would be to combine these areas as a single park to maintain connectivity and strengthen conservation measures for the long-term survival and development of wildlife.	Yes – the Se San and Kon River
Dak Lak					
6.	Chu Yang Sin National Park (2002)	66,980 ha	Protect natural forests, black shanked douc langurs, yellow-cheeked crested gibbons, Fujian	- **Land encroachment** driven by the growing demand for new land to accommodate new industrial and domestic crops. In-migration and land encroachment need to be strictly control to reduce pressure. For migrants the forest resource typically provides their immediate livelihood and forest land their only land resources for future crops. - **Illegal logging** focused on high value redwood and rosewood trees and timber for	Yes – Serepok River

			cypress[33] and Krempf's Pine (*pinus krempfii)*[34].	household furniture and construction timbers. - **Hunting** for local usage but predominantly for trade. Hunting is targeted at large terrestrial mammals such as ungulates and reptiles (e.g. turtles and monitor lizards). - **NTFP collection** - e.g. rattan and honey collection. Collection is increasing as cash markets develop.	
7.	Yok Don National Park (1991)	Dak lak - 111,126ha Dak Nong- 2,728 ha	Preserve ecosystem of Indochinese dry-dipterocarp forest, endangered, rare species including elephants, gaurs and tigers, elk, hog deer, vulture, white winged duck and other threated plants such as rosewoods and orchids	- **Illegal logging**. Currently the park is the only large forest left in the North-west corner of Dak Lak. In addition, the relatively flat and open area of the park and its high wood and timber volume (rosewood and padauk wood) attracts illegal loggers. Around 90% of logging is for commercial purpose. - **Hunting**. Yok Don is well-known for its large ungulate population, reptiles (turtle and monitor lizard) and fish which attracts local hunters to the park. Hunting is largely for the bushmeat trade and threatens the survival of some large species such as elk deer, hog deer and tiger, and the Kouprey. - **Agricultural encroachment**. Seasonally local ethnic people cultivate wet-rice in the park. Cultivation reduces habitat quality and disturbs fauna during land preparation, maintenance and harvesting. - **Livestock grazing by local indigenous people**. Cows and water buffalo graze in the park, this creates competition for food with other wildlife and poses a threat of disease being transmitted from livestock to wildlife. - **Infrastructure development**. Hydropower dams cause significant changes to the Serepok river. Lower water levels could potentially make the park drier in the dry season. Changing water resources also impact local livelihoods and there is a risk that people may shift to forest animals as fish become rarer, to meet their nutritional needs. - **[Unnecessary] infrastructure development** in the park will damage the park's integrity. There is a newly constructed border patrol road which separates the park with other contiguous forest in Ratanakiri province in Cambodia, and a new concrete road is being built in the park to facilitate better forest patrol which will make the park more fragmented and increase access to the forest. - **NTFP** collection. Bamboo, honey, medicinal plants, orchid have been traditionally been collected from the park by local people. Collection is however increasing driven by market demand and tourism.	No

[33] A threatened species in Viet Nam. It is considered to be a precious timber in Viet Nam on account of its aroma and weight. It is sued to make art works, pieces of furniture and charcoal of high heat value,

[34] Endemic species to Viet Nam, with a restricted habitat at higher altitudes in the border areas of Dak Lak, Lam Dong, Khanh Hoa and Ninh Province. There has ben a decline in the extent of its occurrence of more than 30% over the last three generations as a result of deforestation and conversion of forest to other uses. It faces continuing decline in quality and is assessed as Vulnerable in the IUCN Red List of Threatened Species.

				- **Forest fire**. Open forest with tall grass is susceptible to fire in the dry season. The park suffers seasonal fires in some areas especially close to residential area and agriculture land.	
8.	Ea So Nature reserve (1999)	21,195ha	Protect forest natural grassland and open deciduous forest, evergreen forest, and endangered ungulates such as gaur, banteng and other threated wildlife	- **Hunting**. Ea So accommodates the largest remaining natural grassland in the Central Highland which provides a perfect habitat for large ungulates and big cats. However, relatively flat and opened grassland conditions are also favorable to poachers. - **Illegal logging**. High value timber trees have all been taken and now other high quality construction wood is targeted by loggers. - **Forest fire**. 70% of the reserve is grassland and open forest which becomes extremely dry in the dry season and easily catches fire. Significant resources and time have been spent to prevent forest fire. - **Infrastructure development**. The construction of Song Hinh Hydropower dam (2005) flooded 800ha of the Park's natural grassland, and construction of the provincial highway (2002) from Dak Lak to Phu Yen province cuts through the reserve and cleared 200ha of the natural habitat for wildlife and increased access for poaching and illegal logging. Road traffic is increasing and impacts the reserve. - **Migration** into the nature reserve is likely to increase as the reserve is the only remaining forest in the area and therefore a target for timber and livelihood support for new in-migrants. - **Cattle grazing**. Natural grassland habitat provides perfect conditions for cattle grazing. Cows, water buffalo owned by local people increasingly use the park for grazing posing a threat to wildlife by creating the risk of disease transfer and competition for feeding areas. - **NTFP collection**. The Reserve is the only remaining forest in the North-East of Dak Lak and serves as a public assess area for local communities especially for ethnic groups to collect medicinal plants, bamboo, fuel wood and vegetables and fish. As the local population increase their demand for NTFP increases accordingly.	Yes – Ba River
9.	Nam Ka Nature reserve (1991)	19,912ha	Protect natural forest, rare and precious species.	- **Fragmentation**. 7 years ago the reserve was well connected with Nam Nung Nature Reserve in Dak Nong province and formed a large and contiguous landscape. Now Nam Ka is surrounded by industrial and agriculture crops and the two reserves are separated. - **Land grabbing and encroachment**. In migration is putting pressure on the reserve. The new agriculture areas are appearing within the borders of the Reserve due to weak management and law enforcement. - **Logging** is destroying endangered plants such as rosewood and red wood in the area and other types of timber.	Yes – Serepok river

				- **Hunting**. Pressure from hunting is high as it is the only forest area in southern Dak Lak province. As a result, large mammals are becoming very rare and small mammals are also threatened. - **NTFP collection**. The Reserve serves as a public access area for local communities especially for ethnic groups to collect medicinal plants, bamboo, fuelwood, vegetables and fish. The demand is increasing. New migrants in particular depend on NTFPs as they lack agricultural land or need to wait for their first harvest - **Infrastructure development**. New roads have been constructed within the reserve dividing the landscape and facilitating access for loggers and poachers. The construction of hydropower dams nearby resulted in the flooding of low lying areas important for large mammals and birds.	
10.	Lắc Lake Cultural, historical and natural conservation site (1986)	10,284ha	Protect wetland landscape and threatened habitat and aquatic, terrestrial species of the Reserve	One of the few natural water bodies in the Central Highlands, and second largest freshwater lake in Viet Nam. - **Logging, hunting and intensive NTFP collection** have negatively impacted the Reserve over last 10 years.. The Reserve is the only remaining forest in the area where people can collect medicinal plants, bamboo, fuel wood and fish. It serves as a public access area for local communities especially for ethnic groups. The population surrounding the Reserve is high and growing resulting in mounting pressure on the Reserve. - **Land encroachment / conversion**. The area surrounding the lake is suitable for domestic and industrial crops and a lot of natural habitat has been converted to agriculture. Intensive land manipulation and the degradation of forest and vegetation cover on the steep slopes around the lake has resulted in severe soil erosion and siltation of the lake. - **Uncontrolled fishing** creates a huge pressure on the lake's aquatic resources and wetland areas. The lake plays an important role in providing livelihood and income for local people, however fishing is not well regulated and destructive fishing using small size nets and electric-shocks is common. - **Agricultural pollution.** The use of agro-chemicals (fertilizers and pesticides) is damaging the water and wetland environment of the lake. As the result the quality and size of fish has been significantly reduced. - **Forest fire**. The natural forest and habitat has been reduced to grassland, bush and bamboo forest and thereby vulnerable to fire during the dry season, especially in the areas close to agriculture.	Yes – Krong Ana and Serepok rivers
11.	The swamp-cypress Species and habitats	128.5ha	Preserve habitats of Chinese swamp cypress	The reserve is the smallest protected area in Viet Nam. - **Forest fires**. The reserve is surrounded by domestic and industrial crops where grass and the crop remains are often burned as a part of land clearance process	No

	Conservation Site *(2011)*		(*Glyptostrobus pensilis)* and other rare and precious species.	which can trigger fires in the Reserve's vulnerable mixed bush and grassland areas. - **Illegal logging**. The remaining 161 cypress trees left in the reserve remain a target for illegal logging. - **Land encroachment**. Local people try illegally extend their agricultural land into the reserve.	
DAK NONG					
12.	Tà Đùng Nature Reserve (2003)	21,207ha	Preserve natural ecosystem, evergreen forest in medium mountain, large ungulate, primate and endangered species.	Ta Dung is the largest Nature Reserve in Dak Nong province. The Government plans to upgrade the Reserve to a National Park. - **Land grabbing and encroachment**. The area is surrounded by local residential and agriculture areas without proper demarcation. - **Illegal logging** is common in the reserve. Timber is mostly found in the good forest area above 800m; there is no longer good timber at low elevation. As a result of Illegal logging the woodland in low elevation (below 800m) is now converted to bush and bamboo forest, while higher elevations are degraded. Logging is for both local consumption and trade, but the illegal trade is the key driven. - **Illegal hunting** is common in Ta Dung Nature reserve, mostly to supply the illegal wildlife trade and bush meat market. Shot-guns and snares are commonly used which devastates the reserve's fauna, for instance the gaur (*Bos gaurus*) once a flagship for the reserve is believed to have been wiped out as a result of poaching. Other large ungulates and mammals are likely to suffer the same fate if management and law enforcement are not improved. - **Infrastructure development**. The construction and operation of the Dong Nai 3 hydropower plant flooded lower areas of the reserve and increased access leading to more poaching and illegal logging. - **NTFP collection**. The Reserve is the only remaining forest in the south-east of the province and serves as a public access area for local communities, especially ethnic groups. Medicinal plants, bamboo, fuel wood and fish are commonly collected and demand is increasing threatening the natural habitat. - **Forest fire** is a risk, especially at low elevations dominated by bush and bamboo, and in areas located close to agriculture land.	Yes – the Dong Nai river
13.	Nam Nung (1995)	12,308 ha	Preserve natural ecosystem, evergreen forest in medium mountain, large ungulate, primate and	Nam Nung is second largest Nature Reserve in Dak Nong province and is located in the north of the province. - I**llegal logging.** Good timber is now located at higher elevations. Illegal logging has devastated woodlands in low elevation which are now reduced to bush and bamboo forest. Logging is for both local consumption and for sale, but the illegal wood trade is the key driven.	Yes – Krong No, and Dong Nai rivers

			endangered species.	- **Land encroachment**. The Reserve is surrounded by local residential and agriculture areas which are not properly demarcated. Rubber and pepper production areas are moving towards and into the reserve. - **Illegal hunting**. Hunting is common in Nam Nung Nature reserve, largely to supply the illegal wildlife trade and bushmeat market. Short-guns and snares are the most common methods. Poaching has devastated the reserve's fauna, for instance the gaur (*Bos gaurus*) was a flagship of the reserve however there are now believed to be less than 10 individuals in the reserve. - **NTFP collection**. The Reserve is the only remaining forest in the North-East of the province and serves as a public access area for local communities especially for ethnic groups. Medicinal plants, bamboo, fuel wood and fish are collected from the reserve. - **Forest fire** especially in low elevations and areas close to local residential areas and agriculture land is a risk.	
14.	Đray Sáp – Gia Long Cultural, historical and natural conservation site (2003)	1,515ha	Protect historical remains, and dry-dipterocarp forest and grassland, watershed area for Serepok river	Dray Sap is among the smallest protected areas in Viet Nam. It is the only historical and natural conservation site in Dak Lak province. - **Land encroachment**. The reserve is situated upstream of Serepok river with relatively flat and moist land suitable for agriculture crops. The reserve is under great pressure from local residents trying to convert the Reserve's land to agriculture areas and encroach on the Reserve to grow crops. - **Illegal logging.** The remaining timber is of a high price and a target for loggers. - **Hunting**. Due to its small area and small population of wildlife, poaching has extirpated most of the animals in the reserve, especially large mammals such as deer, Muntjac, and endangered primates and gibbon. - **Forest fire**. The Reserve's small and fragmented habitat is vulnerable to forest fire, which is also common in the agriculture land nearby. In the dry season, the dipterocarp forest and grassland become extremely dry and vulnerable to fire and the reserve could easily be destroyed without an appropriate management effort.	Yes – Serepok river
BINH PHUOC					
15.	Bu Gia Map National Park (1995-2002)	25,788ha	Protect natural habitat and evergreen, semi-evergreen forest of the southern Annamite and endangered and threaten animal and plant.	Bu Gia Map is situated in the southernmost of the Annamite range protecting the last evergreen semi-evergreen forest of the southern Central Highlands. The park is part of transboundary landscape between Viet Nam and Cambodia. - **Illegal timber extraction**. Bu Gia Map has a large area of intact natural forest with many endangered and valuable species such as rosewood, redwood that attract illegal loggers. - **Hunting**. Connectivity with other forests in Dak Nong and Cambodia creates a favorable living condition for animals, including large and endangered animals. However, this richness also attract poacher. Hunting is common in the park	Yes – Song Be river

				threating terrestrial animal species, and resulting in the absence of tigers, elephants and other large carnivores. Many other animals will be soon extirpated if law enforcement is not increased. - **Land encroachment**. The park is now surrounded by agriculture areas (rubber and pepper). Some land within the park has also been converted to agriculture. in-migrant into the park bufferzone is also putting pressure on the park. - **NTFP collection**. Honey, medicinal plants, bamboo, *Scaphium macropodium* fruit and other forest resources are regularly collected from the park. The recent increase in collection is putting pressure on the park.	
16.	Cat Tien National Park	Dong Nai - 51,722ha Lam Dong - 27,229ha Binh Phuoc - 4,193ha	Protect natural ecosystems, rare and precious species such as elephants, gaurs, bears, primates, and riverhead.	Cat Tien National Park is the second largest National Park in Viet Nam. The park has two separate sections situated in three provinces - Lam Dong, Binh Phuoc and Dong Nai. Only 5% of the park area is situated in the North-East corner of Binh Phuoc province. The threats mention in this section refer only to the Binh Phuoc section of the park. - **Conversion of forest land** into agricultural and industrial crops such as rubber, pepper, cashew and cassava threaten the park and its natural habitat for globally threatened species such as the Asian Elephant, Gaur and Orange-necked Partridge. This conversion is being undertaken by people residing within the national park boundaries. Currently, all the forest around the park has been converted to rubber and cashew plantations. - **Illegal logging, largely for commercial use**. As the only forest left in the area the park is the focus of illegal loggers. - **Illegal hunting**. The park is well-known for it ungulates and large mammals population and attracts hunters supplying bushmeat to local markets in big cities. As a result of hunting the park has already lost the last Javan rhinoceros in Viet Nam, tigers and the Siam crocodile. Other animals under threat are gaur, deer and primate species. - **Infrastructure development**. There are plans to construct hydro-electric dams close to the park (the Dong Nai 3, 4 and 5) on the Dong Nai river, upstream of the national park. Such developments may cause flooding of the park's key wetlands and lowland area important for water birds, as well as large mammal (browsing areas). Construction of the dams may lead to a reduction in the size of these important wetlands, with implications for migratory and resident bird species, fish species and grazing mammals. - **NTFP collection**. The area is dominated by mixed bamboo-woodland where quite a lot of NTFP are found such as medicinal plants, rattan, honey, *Scaphium macropodium* fruit and bamboo shoot. Collection exceeds the sustainable volume, especially for rattan. This over exploitation reduces the forest resource and degrades habitat for wildlife.	Yes - Dong Nai river

				- **Forest fire**. A large area in the park is mixed bamboo forest, or grassland that becomes quite dry in the dry season and vulnerable to fire, especially areas located close to agriculture land where fire is regularly used for land clearance.	
17.	Núi Bà Rá Cultural, historical and environment conservation areas (1996)	854.3ha	Protect historical site and natural landscape and habitat of the south-east area	The reserve is one of the smallest protected areas in Viet Nam and is situated in the middle of an urban area. - **Land conversion**. The key threat to biodiversity at Nui Ba Ra is the conversion of forest to other land uses such as industrial and domestic crops. The reserve is surrounded by agriculture land and illegal extension into the reserve's land is of concern. - **Development of infrastructure**. The reserve is a recognized tourism site in the area as it close to town with high mountains and a cable car. As a result, the reserve has been exposed to high levels of human disturbance for a prolonged period, including the continuous development of tourism activities and construction of a television antenna on the top of Nui Ba Ra mountain. This disturbance has had serious negative impacts on wildlife and natural habitats at the reserve. - **NTFP collection**. As all the forest in the surrounding area have gone, the reserve is the only locality where local people can collect forest products to support their livelihoods Over exploitation is an issue, for example bamboo has been overharvested resulting in decline of natural habitat and a changing landscape.	Yes – Song Be River

6.3 Annex 3: Current land use in Ia H'drai district, Kon Tum province.

Commune/ Forest owners	TOTAL	Under Forestry Planning				Out of Forestry Planning		
		Natural Forest	Plantation Forest	Rubber	Unplanted Forest	Natural Forest	Plantation Forest	Other land use type
Total	**98,013.22**	**59,711.16**	**29.35**	**24,352.74**	**10,685.23**	**121.69**	**6.02**	**3,107.03**
Ia Dal commune	***21,794.69***	***9,207.16***		***10,673.73***	***1,857.81***	***8.83***		***47.16***
Border Protection Unit No. 713	115.24	44.67		8.88	61.69			
Provincial Border Protection Command	245.06	87.43		9.56	148.07			
Chu Mom Ray Rubber Co.Ltd	2,458.03	243.77		2,125.7	50.62	0.13		37.81
Sam Ngoc Linh Co.Ltd	1,185.45	282.07		722.29	181.09			
78 One Member Co.Ltd	4.48			4.48				
Sa Thay Rubber Co.Ltd	3,621.55	610.43		2,677.99	333.13			
716 Company branch	3,857.24	464.92		3,166.51	225.81			
Household	333.91	303.99		23.86	6.06			
Commune People Committee	9,973.73	7,169.88		1,934.46	851.34	8.7		9.35
Ia Dom commune	***32,254.7***	***25,200.58***		***4,743.45***	***2,171.74***	***0***	***0***	***138.93***
Duy Tan Investment & Trade Co.Ltd	1,886.54	964.53		628.6	291.12			2.29
Sa Thay Forestry 1 Member Co.Ltd	13,255.03	12,715.43			493.21			46.39
Sam Ngoc Linh Co.Ltd	2,140.2	828.93		1,203.05	89.89			18.33
Sa Thay Rubber Co.Ltd	1,332.5	128.81		904.78	294.75			4.16
Household	3,496.81	3,262.25		131.83	102.73			
Youth Career Village	1,396.58	374.32		773.76	246.54			1.96
Commune People Committee	8,747.04	6,926.31		1,101.43	653.5			65.8
Ia Toi commune	***43,963.83***	***25,303.42***	***29.35***	***8,935.56***	***6,655.68***	***112.86***	***6.02***	***2,920.94***
Border Protection Unit No. 713	0.16				0.16			
Duy Tan Investment &Trade Co.Ltd	9,201.65	2,639.46		4,371	1988.21	18.76		184.22
Sa Thay Forestry 1 Member Co.Ltd	21,090.96	17,756.77			3,180.91	18.74		134.54

Chu Mom Ray Rubber Co.Ltd	1,677.53	22.66		1,318.24	336.63			
Daklak Rubber 1 Member Company	3,380.84	1,159.02	29.35	1,521.68	391.07	59.69	5.9	214.13
Sa Thay Rubber Co.Ltd	1,002.37	347.06		567.76	87.55			
716 Company branch	0.1			0.1				
Sesan4 Hydro Power Plant	1,398.67				86.59			1,312.08
Commune People Committee	6,211.55	3,378.45		1,156.78	584.56	15.67	0.12	1,075.97

Source: Kon Tum Department of Agricultural and Rural Development, 2016.

6.4 Annex 4: Qualitative analysis of Ecosystem Services provided by *Forest* Ecosystems & potential impact of Road 675A upgrade

	Ecosystem Service (Benefit / outcome)	Significance [1]	Justification for rating	Potential Impact of road investment on ES [2]	Justification for rating
Provisioning Services	Timber	++	Timber for local consumption and trade	+/-	The road provides better access to the forest areas and facilitates transportation of timber including illegal timer.
	Food	++	High dependence of local community on food collected from forest (e.g. vegetables, fruits, nuts, honey, wild animals, fish)	+/-	Positive effect as better transport links will facilitate the supply of food supply. Forest food resources will decline if forest is lost and /or collection intensity increases
	Fodder	+	Fodder and browsing area for livestock (cows buffalo, goats, pigs)	+	The road provides better access to markets for livestock trading
	Fuel and fibre	++	High dependence of local community on fuel and fibre collected from forest	+/-	Initial positive effect as better transportation will facilitate the supply of goods Improved road may encourage over exploitation
	Biochemical and medicinal resources	++	All biochemical and medicinal resources use for local consumption and for trade are from the forest ecosystem	+/-	Initial positive effect as better transportation will facilitate the supply of goods Improved road may encourage over exploitation
	Genetic resources	+	The forest provide genetic pool for immediate need and long-term usage for local people and human well-being	-	The road provides better access to the forest areas and risks increasing the illegal trade and over exploitation of genetic resources
	Ornamental resources	++	The forest provides ornamental resources for local people such as ornament trees, singsong bird, and other wooden furniture and decorative items	-	The road provides better access to the forest areas and risks increasing the illegal trade and over exploitation of ornamental resources
	Fresh water supply	++	Forest play the key role in providing fresh water supply	-	The road investment will improve access that could lead to faster deforestation that create negative impact on fresh water supply

	Ecosystem Service (Benefit / outcome)	Significance [1]	Justification for rating	Potential Impact of road investment on ES [2]	Justification for rating
	Climate regulation	++	The forest plays an important role in mitigating climate impacts through carbon storage and sequestration.	-	The road investment will improve access that could lead to faster deforestation that would have a negative impact on Climate regulation of the forest
	Micro-climate regulation regulation	++	Forests regulate micro-climate	-	The road investment will improve access that could lead to faster deforestation that could have a negative impact on micro-climate regulation function of the forest
	Water quality regulation	++	The forest ecosystem helps to regulate the water flow and water quality	-	The road will provide better access that could lead to faster deforestation and loss of this service.
	Natural Hazard regulation (floods, storms, landslides)	++	The forest ecosystem help to regulate the water flow that help to prevent flood and landslide. The forest ecosystem also protect land and other area from the impact of storm by reducing the wind and water flow	-	The road investment will improve access that could lead to faster deforestation that could have a negative impact on the natural hazard function of the forest
	Erosion regulation (protects against sedimentation of downstream waterbodies, maintains soil quality)	++	The forest ecosystem with its complexity of ecological structure, multi-layers of canopies and root system helps to regulate the surface water flow and protects the land from erosion reducing the sedimentation in rivers, stream, reservoir and downstream.		The road investment will improve access that could lead to faster deforestation that could have a negative impact on the erosion regulation function of the forest
	Disease and pest regulation	+	The forest ecosystem is home to natural predator that help to control disease and pests in agriculture area	--	The road upgrade may bring new diseases and pest as good and agriculture products are transported from other area. In addition the road investment will improve access that could lead to faster deforestation and a loss of habitat for

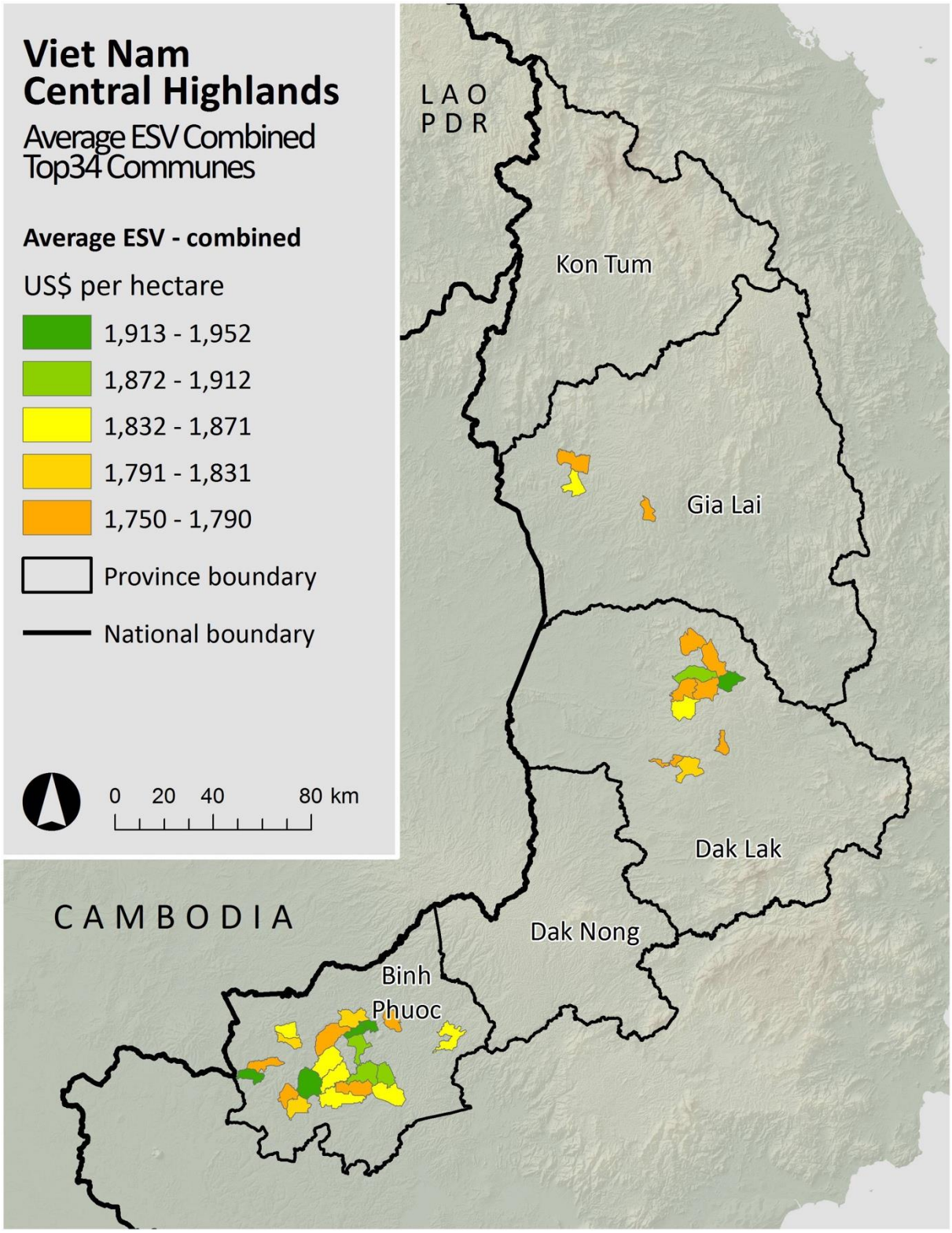
	Ecosystem Service (Benefit / outcome)	Significance [1]	Justification for rating	Potential Impact of road investment on ES [2]	Justification for rating
					natural predators
	Pollination	++	The forest ecosystem is home to natural pollinators such as insects, bats and birds that contribute to the productivity of the forest, home-gardens and agriculture areas	--	Then road upgrade will provide better access that could lead to faster deforestation and loss of for natural pollinators
Cultural Services	Cultural, spiritual, religious,	++	The forest has high cultural, spiritual, and religious value especially to the ethnic people	+/-	The road investment will provide better access to local communities and facilitate better culture and religious exchange. The road upgrade will provide better access that could lead to faster deforestation thus creating a negative impact on natural resources that are important for cultural, spiritual and religious life of the ethnic groups.
	Scientific and educational information	+	Forest ecosystems provide important research and education opportunities	+/-	The road investment will provide better access to the scientific community. The road upgrade will provide better access that could lead to faster deforestation that could lead to faster deforestation and the loss of forest related research and educational opportunities
	Tourism and recreation	++	Forest and its associated plants, animal species, and landscapes are potential tourism resources	+/-	The road investment provides better access to local communities and tourists, who can appreciate the natural forest landscape along the road. The road upgrade will provide better access that could lead to deforestation and the loss / decline in tourism.

1/ Code: ++ means that the service is important; + means that the service is provided; - means that the service is not relevant; and, ? means that there is uncertainty surrounding the provision of a service.
2/ Code: +: constant positive effect; +/-: initial positive effect but returns start to decline due to resource degradation; 0 no /neglible effect; - : negative effect; - - significant negative effect

6.5 Annex 5: SMCA – Illustration of commune level results

Table and map: Average ESV **in USD** - Top 34 communes (5% of all communes in Central Highlands). Sorted by ESV, descending

OBJECTID	COMMUNE	DISTRICT	PROVINCE	Avg ESV ALL
3517	Ea Tan	Krong Nang	Dak Lak	1,951.96
11088	An Phu	Hon Quan	Binh Phuoc	1,929.12
11097	Binh Son	Bu Gia Map	Binh Phuoc	1,923.00
3078	Tan Hung	Hon Quan	Binh Phuoc	1,915.64
11099	Long Giang	Phuoc Long	Binh Phuoc	1,913.12
3525	Ea Nam	Ea H'leo	Dak Lak	1,908.31
3087	Phu Trung	Bu Gia Map	Binh Phuoc	1,895.93
3091	Phu Rieng	Bu Gia Map	Binh Phuoc	1,877.93
11096	Binh Tan	Bu Gia Map	Binh Phuoc	1,871.93
3044	Dong Tam	Dong Phu	Binh Phuoc	1,869.10
3088	Long Tan	Bu Gia Map	Binh Phuoc	1,862.05
3673	Ia Krel	Duc Co	Gia Lai	1,859.38
3477	Cu Pong	Krong Buk	Dak Lak	1,852.11
1631	Doan Ket	Bu Dang	Binh Phuoc	1,845.70
3138	Loc Thuan	Loc Ninh	Binh Phuoc	1,839.72
633	Long Ha	Bu Gia Map	Binh Phuoc	1,834.34
3039	Thuan Phu	Dong Phu	Binh Phuoc	1,831.70
3010	Tan Quan	Hon Quan	Binh Phuoc	1,817.64
1645	Da Kia	Bu Gia Map	Binh Phuoc	1,815.55
3119	Loc Dien	Loc Ninh	Binh Phuoc	1,808.25
3395	Ea D'Rong	Cu M'gar	Dak Lak	1,795.15
3038	Phuoc An	Hon Quan	Binh Phuoc	1,786.18
3511	Ea Sin	Krong Buk	Dak Lak	1,785.60
3431	Ea Blang	Buon Ho	Dak Lak	1,785.08
3096	Thanh Luong	Binh Long	Binh Phuoc	1,777.43
3398	Quang Tien	Cu M'gar	Dak Lak	1,776.22
1099	Dle Yang	Ea H'leo	Dak Lak	1,774.18
3134	Long Binh	Bu Gia Map	Binh Phuoc	1,770.14
3512	Cu Ne	Krong Buk	Dak Lak	1,768.19
3649	Ia Glai	Chu Se	Gia Lai	1,762.84
11093	Duc Hanh	Bu Gia Map	Binh Phuoc	1,758.15
512	Ia Grang	Ia Grai	Gia Lai	1,756.86
1110	Ea Ral	Ea H'leo	Dak Lak	1,756.54
3048	Thuan Loi	Dong Phu	Binh Phuoc	1,749.83


Viet Nam
Central Highlands
Average ESV Combined
Top34 Communes
Average ESV - combined
US$ per hectare
1,913 - 1,952
1,872 - 1,912
1,832 - 1,871
1,791 - 1,831
1,750 - 1,790
Province boundary
National boundary
0 20 40 80 km
LAO
PDR
Kon Tum
Gia Lai
Dak Lak
Dak Nong
Binh
Phuoc
CAMBODIA