World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

FINAL REPORT
OF THE TULSEA PROJECT IN VIETNAM

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ABBREVIATIONS

BMNP	Bach Ma National Park
FSIV	Forest Science Institute of Vietnam
HUAF	Hue University of Agriculture and Forestry
ICRAF	World Agroforestry Centre
LEK	Local Ecological Knowledge
NDVI	Normalized Difference Vegetation Index
PaLA	Participatory **Landscape** Appraisal
PaPOLD	Participatory analysis of Poverty, Livelihoods and Environment Dynamics
PEK	Policy Ecological Knowledge
PES	Payment for Environmental Services
SEK	Scientists' Ecological Knowledge
RA	Reverse Auction for Environmental Services
RaCSA	Rapid Carbon Stock Assessment
RCFEE	**Research Centre for Forest Ecology and Environment**
RHA	**Rapid** Hydrological Appraisal
TUAF	Thai Nguyen University of Agriculture and Forestry
TULSEA	Trees in multi-Use Landscapes in Southeast Asia

7. Project Description - Introduction

7.1 TULSEA project in Vietnam

TULSEA (Trees in multi-Use Landscapes in Southeast Asia) is a regional project that has been carried out in five Southeast Asian countries and Yunnan province of China since 2008. The project aims at developing a toolbox that is replicable, rapid and cost effective for providing evidences to support the negotiation for enhancing natural resource management. The TUL-SEA project has four Work Packages (WP): Improving the integrated toolbox from existing generic tools and methods (WP1), Capacity building (National agricultural research systems and universities) through training and workshops (WP2), Local partners site-testing tools in a wide range of situations, and providing feedback (WP3), and Synthesis (WP4).

TULSEA in Vietnam has been implemented by local stakeholders, research institutes and universities in northern and central parts of the country, under the coordination by ICRAF Vietnam. The five tools Participatory **Landscape** Appraisal (PaLA), Participatory analysis of Poverty, Livelihoods and Environment Dynamics (PaPOLD), Rapid Carbon Stock Assessment (RaCSA), **Rapid** Hydrological Appraisal (RHA), and Reverse Auction for Environmental Services (RA) that are potentially applicable and important for Vietnam contexts were selected for training, testing, assessing their applicability, customizing them to be more suitable to Vietnam contexts, and disseminating them to local natural resource management organizations for broader application of these tools. Project outputs include results from training and testing of selected tools by local partners and publications such as books, lecture notes, posters, and reports. In addition, implications from testing these tools are useful for developing potential PES schemes. Most training activities and publications were carried out and produced in two languages, Vietnamese and English.

Within the frame of TULSEA project, ICRAF Vietnam contributed with the developing of two tools, namely PaLA and PaPOLD. Case studies from Vietnam on these tools have been shared with other SEA countries involved in TULSEA project through TULSEA regional training in the Philippines and Indonesia in 2009 and 2910, respectively.

7.2 Overview of main TULSEA activities in Vietnam - purposes and major outputs

i) Training: more details for the training activities are presented in Section 11 and Annex 2 of this report, and in the annual report 2009.

- *The first TULSEA training was organized during November 21-26, 2008 in Thai Nguyen province on* **RHA, RaCSA** and **PaLA** for lecturers, researchers, natural resource managers and natural resource workers. The objective was to introduce TULSEA tools and to transfer technology to Vietnamese partners for testing these tools in Vietnam context. The report of the training was presented as a part of the TULSEA Vietnam annual report in 2009.
- *The second TULSEA training was organized in Hanoi (31/3-1/4, 2011) and Bac Kan (4/4-8/4 and 25-28/4, 2011) on* **PaLA, PaPOLD, RACSA,** and **RA** for trainers of IFAD-PES project from Bac Kan province and three IFAD project districts in the province. The training was to apply and scale up relevant tools in a real life development project. The report is attached in Annex 2.

- *A mid-term review workshop and a write-shop were organized by ICRAF Vietnam during 2009 and 2010* for guiding data analysis and writing reports and publications.

ii) Testing of trained tools at different sites for different purposes

a) *For defining upstream-downstream relationship to find potential water Environmental Services:*

- PaLA and RHA were tested in Leng river basin of Ba Be district, Bac Kan province to obtain evidence to support negotiation for rewarding watershed functions. The activities were carried out by HUAF in close collaboration with ICRAF Vietnam.
- PaLA and RHA were tested in Nui Coc watershed of Thai Nguyen province, mainly for capacity building purpose and developing a one of the first TULSEA case studies in Vietnam. The activities were carried out by TUAF.
- RHA was tested in Hoa Binh province in a scoping survey to define impacts of Hoa Binh watershed into livelihood of communities in downstream areas. The activities were carried out by FSIV.

The short reports of three cases were presented in the TULSEA 2010 annual report.

b) For estimating carbon stock and changes over time to find potential Carbon ES:

- RaCSA was tested in Dai Tu district, Thai Nguyen province to define carbon stock changes of land use systems, focusing on tea-based Agroforestry. TUAF was the implementer (2009).
- RACSA was tested in Bach Ma National Park in Thua Thien- Hue province to define carbon stock changes of different forest land categories. The work was carried out by BMNP (2009-2010).
- RACSA was tested in Lam Son commune, Luong Son district, Hoa Binh province to assess carbon stock changes due to land use conversion in an industrial suburban area. The work was carried out by FSIV (2009-2010).
- RaCSA in Quang Khe commune, Ba Be district, Bac Kan province, conducted by FSIV to assess carbon stock in different agroforestry systems (2010).
- RaCSA was tested in Son La province, conducted by University of Hohenheim and in collaboration with ICRAF Vietnam and Institute of Soils and Fertilizers (ISF)

The short reports for Dai Tu and Bach Ma were presented in the 2010 annual report. Reports for RaCSA in Luong Son and Quang Khe were attached in Annex 3 and 4 of this report.

c) For pro-poor PES:

- Pro-poor PES is a two-week practical component for capacity building to IFAD-PES project during the second training. RaCSA and PaLA/PaPOLD at household level were applied by the local trainers in three IFAD project districts. The report is given in Annex 2.

iii) Developing training materials

- The TUL-Viet book compiles lecture notes of four TULSEA tools, including PaLA, PaPOLD, RACSA and RA, and case studies in Vietnam are finalized in English and Vietnamese. The final draft of the book is attached in Annex 1.

- In addition, a number of lecture notes, posters, leaflets, brochures in English and Vietnamese have been produced.
- One MSc thesis at Seoul University was produced using outputs of testing RACSA method in Quang Khe, Bac Kan province.
- Six case studies of Vietnam were developed to contribute to the TULSEA book in English, and produced by ICRAF SEA.

8. Major research findings

i) PaLA for water service

The **PaLA method in Leng River basin** looked at upstream, midstream and downstream relationship and impacts of land use on water in sub-watershed and watershed scales to identify potential payment for water or Carbon environmental services. In this research, the temporal PRA tools, such as village history, timeline and seasonal calendar, were useful for defining trends especially factors influencing water quality and quantity. *Seasonal calendar*, from which crop cultivation activities were visualized together with annual rainfall pattern, has been shown to be an effective tool for analyzing water availability. The spatial PRA tools, such as *village sketch* and *transect walk*, were proved important for defining hotspots of the landscape for more in-depth studies in each village as well as inter villages.

An improvement of PaLA in this research was the utilization of Global Position System (GPS) and participatory GIS mapping to support spatial PRA tools. GIS mapping was used to identify boundaries and hotspots of sub-catchments, water systems and land use systems. By linking findings from transect walks, including information from local key informants, with GIS maps, places with major issues and cause-effect relationships between upstream and downstream can be drawn. Similarly, the combination of GIS and PaLA were effective in defining research site as in the case of **PaLA in Coc Lake**. In this case, GIS helped identify boundary of the watershed, while data collected by PaLA helped select hotspots within that boundary.

The tool has also shown to have advantageous effects compared with other tools in TULSEA package in that it contribute remarkably to improve the ability of stakeholders to identify their own landscape and problems. It facilitates two-way interactions between researchers and local stakeholders.

ii) RaCSA

In the case of RaCSA in Thai Nguyen, the issue of land use conversion from poor forest to tea plantation was investigated. The RaCSA research in Thai Nguyen surprisingly showed that tea plantation (an agroforestry system) contained almost equal amount of carbon stock as poor secondary forests. Therefore, landscape carbon stock will not be reduced if poor forest land is converted to tea plantation. In addition, the research contributed an adjustment for the method. A simpler scaling up approach compared to the extensive GIS/RS method originally used in RaCSA was applied. This method was based on official plans or assumptive scenarios of the potential changes in land use areas without using real satellite image analysis. In this study, changes in the land use systems in coming 20 years were estimated by combining policy analyses for protected forests at national and local levels with local peoples' preferences as shown from PRA survey and forestry management knowledge.

In the case of Quang Khe commune, RaCSA was used in assessing/estimating carbon stocks in different agroforestry land use systems such as shifting cultivation, home garden, fruit garden and secondary forest. The total time averaged carbon stock from secondary forest was shown to be largest while that from shifting cultivation was the smallest. Similarly, the below-ground carbon stock will be reduced significantly if land use changes from secondary forest to home garden, fruit garden or shifting cultivation. During the implementation, it was found that participation by local people and staff plays a key role that determines the success of RaCSA method in assessing carbon stock of different land use systems. Information on land use history, land use planning (preferred future land use systems and demands for expanding any particular systems), and the rotation time for each system is essential for defining boundaries and for calculating time average carbon stock of different systems. Moreover, the participation of local people in these research activities help them understand roles of trees in carbon sequestration, effects of land use changes, as well as what they can benefit if they manage and protect these land use systems effectively.

In the case of Hoa Binh, RaCSA was used to assess Carbon emission in a suburban area where industrial factories, commercial, service and tourism activities are booming. The establishment of Luong Son Golf Yard (314 ha) and the cultural village of Hoa Binh groups (141 ha) in the large forest land area of Lam Son commune could potentially increase carbon emission. It was found during RaCSA implementation that there was a significant discrepancy between secondary data on area for each land use type provided by the commune and the satellite image analysis. Scenario analysis showed that the total carbon stock will remain stable if forest management strategies are applied in such a way that: the area of medium natural forests is well protected and the total area is unchanged; the entire area of vacant land will be used for *Acacia mangium* forest and open area kaingin; the area of poor natural forests is replaced by *Acacia mangium* plantations and kaingin; the area of kaingin doubled by using land from commune vacant land and from poor forest.

In the case of Bach Ma national park, the RaCSA was applied for a challenging project to estimate carbon stock of a rich natural forest area in order to assess effectiveness of the forest protection activities and find potential for REDD mechanism. The results showed that an increase in forested area may not reflect an increase in total carbon sequestration. Over the last 20 years, more than 1,000 ha of poor forest and 4,600 ha of medium forest naturally become rich forest. However, an equal amount *(>1,000ha)* of rich forest turned into poor forest and more than 3,000 ha of rich forest turned into medium forest. Furthermore, more than 2,000 ha of medium forest degraded to poor forest. The RACSA-findings showed that the range of carbon stock of five forest land categories was as follows: Rich forest>Medium forest>Poor forest>Restoration forest>Bare land = 401> 163>65>37>33 tC/ha. The carbon content in a rich forest is 2 times higher than in a medium forest, and about 5 times higher than in a poor forest. The net increase of total C-stock in BMNP was only 106,605 ton in 20 years, or 5,330 tC per year. Given the fact that BMNP is a protected area, and current forest monitoring based on forest coverage showed significant increase in forest coverage, this finding is surprising. The natural forest degradation substantially reduced the expected increase of total carbon stock in the BMNP. Consequently, the increases in plantation forest and secondary/regenerated forest could not significantly improve the total carbon stock. This research opened a promising opportunity to develop REDD mechanism in BMNP.

iii) RHA combined with PaLA

The first phase of RHA to identify water related issues, relationships between upstream and downstream, and potential for payment for water environmental services was carried out in three different sites. The modeling phase for RHA in Bac Kan was planned in detail.

The RHA testing in Nui Coc Lake was the first RHA implementation site in Vietnam as part of the field work during the first TULSEA training for Vietnamese partners. The research was further developed by staff from Thai Nguyen University of Agriculture and Forestry to assess the applicability of GIS model in RHA method. It was shown that applying digital elevation model (DEM) can rapidly and accurately determine watershed borders. In this research, Arc GIS 9.2 and Arc View 3.3 software were employed to map the rivers, streams, roads, bridges, drains, land use and DEM model. Furthermore, the combination of LEK, PEK and GIS data helped define PES potentials and issues for the negotiation when introducing environmental service fees in the watershed of Nui Coc lake. A local ecological knowledge (LEK) survey provided quantitative information on a time line of changes in water quantity and annual hydrological regulations in the research area. Transect walks in the upstream, middle and downstream villages provided a better picture of land use patterns and relationships between land use changes, water quantity and quality issues. PEK was conducted to study knowledge, awareness, and planning of the governmental institutions/organizations and various stakeholders, that have connections with Nui Coc Lake watershed, such as irrigation enterprise, protective forest management board.

RHA in Leng river basin was a comprehensive study applying RHA as one of the major tools for investigating potential for water environmental service in order to develop piloting plans for PES/RES I n collaboration with RUPES project and IFAD project in Bac Kan province. Within the TULSEA project, this study produced GIS data, qualitative information from LEK and PEK on land use change, and water related relationship/issues between upstream and downstream. It was shown that LEK and SEK obtained from PaLA by combining PRA and GIS was useful to define ‘hotspots’ for water related issues such as erosions, flood or drought, and to study perception on relationships between upstream and downstream in terms of water and land use interactions. In this research, a potential improvement for GIS related tasks in RHA and an alternative model for stimulating hydrology in Leng river basin were proposed.

NDVI (the Normalized Difference Vegetation Index) satellite images can be utilized as an indicator of possible vegetation stress in RHA. At the watershed level, NDVI satellite images may be good and detailed enough to classify vegetation cover types. The advantage of applying NDVI images (resolution about 1.0 km) for a cost effective RHA in Vietnam is that they are free of charge and can be downloaded from many public servers. Theoretically, the classification bases on the NDVI values ranging between -0.2 and +0.05 for snow, inland water bodies, deserts and exposed soils, and increasing from +0.05 to above +0.7 depending on the density and greenness of vegetation.

For modelling works in **Leng river basin**, due to the lack of available, long-term measured parameters for the Genriver model, it was impractical to build a reliable hydrology model for a limited time and financial resources. Instead, it was suggested to use a semi-distributed model and an implementation detailed plan was proposed. GenRiver is a **distributed** process-based model that extends a plot-level water balance to sub-catchment level. However, it needs various data that may make it inapplicable for Ta Leng conditions. Due to data/time limitations, a simpler model in terms of data requirement should be applied to the watershed, a **semi-distributed** process-based model. So far, there is limited research on

linking water- forest carbon because water and forest carbon are in two different processes: water follows a physical process while forest carbon is a bio-chemically based process. However, it might be possible to find a relationship between them via soil and land use integration since water and carbon depend on both. The proposed semi-distributed model requires fewer measurements. For example, soil properties (field capacity, permanent wilting point, saturated water content, evapotranspiration, and soil structure) are assessed as "lump" types rather than in each field plot types. Still, there is a challenging task in collecting necessary hydrological data, such as continuous time series of water levels, river discharges, and underground water at Ta Leng watershed. In-situ data measurements are also time- and manpower- consuming, and costly. That was the main reasons for that no modeling was applied as a part of RHA tool.

RHA in Binh Thanh commune, a sub-watershed of Hoa Binh hydropower dam, provided a useful lesson learnt about the importance of selecting an RHA research site of suitable scale and issues. Due to the importance of Hoa Binh hydropower plant, a largest power plant in Vietnam, the need to study water environmental service is acknowledged. However, the RHA study was for a small site in Binh Thanh commune sub-watershed only, because of limitations in budget and timeframe. Given that the total volume of the Hoa Binh dam is 9,000,000m^3, the assessment of water contribution from the selected sub-watershed in Binh Thanh commune is marginal.

Overall, the testing of RHA and PaLA in Vietnam suggests that the results from PaLA method in studying Local Ecological Knowledge can be used as one of the important parts of Rapid Hydrological Appraisal (RHA). The combination of PaLA with RHA is suitable for the development of decision support tool for water environmental services (RES), as shown in the case of Leng river basin in Bac Kan province.

9. Assessment of Research findings and implications for potential users

i) PaLA combined with RHA

PaLA and RHA findings are useful for PES/RES negotiation. In the case of **Leng river basin,** awareness on the importance of forest protection as a main solution for water conservation showed potential for negotiation between communities that provide water service and those benefit from the service. This is particularly important for downstream terrace rice cultivation. Forest coverage over time against areas of rice irrigation can be used as indicators for participatory development of PES/RES and for monitoring purposes. The RHA showed that links between deforestation rate in upstream villages, sedimentation accumulation and frequency of flooding in Pac Ngoi village at the downstream end of Leng river are good indicators of cause-effect relationships between upstream and downstream. This can potentially be used for the negotiation of rewarding the poor upstream communities by the better-off communities living in surrounding areas of Ba Be lake. If more scientific evidences are obtained, these cause-effect relationships can also be used for negotiations with the tourist branches in the province and district, for sharing tourist fees at Ba Be lake for forest conservation works in upstream areas of Leng river catchment.

ii) RaCSA

For BMNP, RaCSA proved to be a carbon monitoring method that is more participatory, efficient and transparent than the current monitoring approach which is based on forest cover only. Besides, the RaCSA results in BMNP can contribute to setting up REDD strategy for BMNP. The implementers are also interested in investigating how this degradation has been influencing other co-benefits, such as the rich biodiversity of BMNP, and water conservation, which is important for livelihoods in the buffer zone as well as at the downstream in Hue city. The need for further studies is under discussion as a part of the new REDD+ strategy for BMNP, which might lead to closer and longer-term collaboration between BMNP and ICRAF Vietnam. Importantly, implementers found that rewarding for carbon alone is insufficient for forest protection. The current government funding to BMNP is about 10 times higher than the total annual income that the park would get from the voluntary carbon market for their carbon increase. Still, the current government budget is insufficient for an efficient protection given the degradation due to illegal logging. This shows that rewarding for carbon alone is not enough. Therefore, the co-benefits that BMNP provides, such as biodiversity and water protection and other non-monetary benefits such as social and cultural protection need to be taken into account. Given that BMNP plays a vital role for water supply to Hue city, biodiversity conservation, as well as for its landscape beauty, a REDD+ strategy was proposed for BMNP. Several potential ES buyers were determined. They are water users in Hue, Hue city tourist branch, irrigation companies, drinking water companies, and international communities that want to conserve rare species of BMNP.

From implementing RACSA in Hoa Binh, a new carbon monitoring method has been transferred to Forest Science Institute of Vietnam (FSIV), a leading organization on sivilculture in Viet Nam. The study was carried out by the Forest Science Technology Application Research Centre (FSTARC) within FSIV, a centre for research and science and technology transfer. In recent year, FSIV and FSTARC have conducted research on ability to absorb carbon of some major types of forest, and on building the tree growing criteria for CDM by analyzing the carbon content of plants (above ground biomass) and below ground biomass in soil samples which can be extrapolated to below ground biomass for the whole forest land. However, this research has mainly focused on specific plants while landscape-level carbon stock has received less attention. There is a lack of methods for forecasting the amount of carbon that is absorbed and generated at the landscape level based on local regulations, policies, and schedule for development. Arising from that, the testing of RaCSA is valuable as a new approach which was carried out by a group from FSIV. The RaCSA in Lam Son village produced a good case study for applying RaCSA method in Vietnam and has implications for area where urbanization is exerting increasing pressure on the environment such as by increasing Carbon emission.

For **RACSA in Thai Nguyen,** the findings may help to change perspective of policy makers, who took into granted that tea plantation is always bad for the environment compared to poor forest. This perception affect the policy making process for conserving forest and promoting agroforestry tea cultivation systems. This research proved that carbon sequestration by tea plantation is higher than that by poor forest. However, it does not encourage massive replacement of poor forest land by tea plantation. Rather a balance between development and conservation should be considered. In addition, this research was applied by lecturers and

students from Thai Nguyen University. Therefore, the research provides a very useful case study and lecture notes for teaching in the fields of Agroforestry and carbon emissions.

For **RACSA in Quang Khe,** the scenario analysis shows that the total carbon stock for the landscape will continue to decrease by 39,743 Mg C in the scenario that the land use change patterns from 1995 to 2008 are to continue for the 2009 - 2020 period. In contrast, the total carbon stock will increase by nearly 4,000 Mg C in the scenario where population growth and forest management are well controlled and there is no shifting from secondary forest to other land use systems. This suggests the crucial role of good management for secondary forest ecosystem and reduction of shifting cultivation activies in Quang Khe. Changes in carbon stock for each scenario is crucial to assess potential for PES/RES projects in the area, and can be considered as a determining factor for choosing appropriate land use systems when the project is selected.

10. Knowledge Transfer

For University, the first training and practising of RHA, RACSA and PaLA were co-hosted by Thai Nguyen **University of Agriculture and** Forestry. This provided opportunities for lecturers from the University to learn these new tools. They then applied the tools in the field and obtained hands-on knowledge to develop lecture notes with their own case studies.

For institute, the training to FSIV provided them an option for landscape carbon stock measurement by a rapid, non-destructive and at landscape level method. This is an important addition to their current experience on destructive carbon measurement and quantification at the plot level. FSIV is now using RACSA as one of important tools for the MRV works on REDD+

For the national park, the training and tools equipped the BMNP staff with RaCSA, a simple and effective tool for monitoring the carbon stock. In addition, awareness was raised significantly regarding the forest degradation concept. The perception on the use of total forest area increase as an indicator for success in forest protection was denied from RaCSA result in BMNP, which showed that the rapid increase in total forest area did not reflect the real increase in Carbon stock because there is decrease in quality of rich natural forest. Bach Ma is using RACSA as one of the tools for REDD+ work.

For provincial staff, during this project, the training has been also provided to Bac Kan staff, who will be future trainers for IFAD-RUPES project in their own local area. These trainers will introduce the tools into a real life development project and scale up the tools to larger areas, particularly in the fields of Payment for Environmental Services (PES) and Integrated Natural Resources Management (INRM).

For local people, the use of PaLA as well as the involvement of local people in all implemented tools helped increasing their capacity and raising awareness on environmental services.

For wider dissemination of the tools, a TUL-Viet book is being developed to serve as a manual for on-field activities in Vietnamese context. Besides, a number of posters, leaflets, brochures in Vietnamese were produced to introduce relevant TULSEA tools to local partners.

11. Training

The first training on RACSA, RHA and PaLA was organized during five days in November, 21-26, 2008 in Nui Coc lake, Thai Nguyen province. With the participation of 26 national participants from research institutes, universities, representatives of Farmers Association in Ha Tinh province and IFAD project staff in Bac Kan province. The purposes were to introduce tools into Vietnam and transfer these technologies to local implementers. The training methods included two-way discussion of the principles, approaches, applications and operational steps of three tools with Vietnamese case studies from RUPES I project and hands-on practical activities. In general, the training course was successful. Within four days of in-house training, participants learned three new tools that are useful for natural resource management, quantification of carbon stock and watershed function. The one-day field trip played an important role in helping participants understand the tools more in-depth after useful lessons learnt had been drawn from the field trip. The evaluation of the training showed that most participants highly appreciated the training content and methods. After the trainings, 10 proposals were developed by the participants for testing the trained tools in their local specific contexts. Five proposals were selected by ICRAF Vietnam and ICRAF SEA. The detail training report was presented in the 2008 TULSEA annual report.

The second training was on PaLA, PaPOLD, RA and was organized in Hanoi (31/3-1/4, 2011) with field work in Bac Kan province (two weeks in April, 2011). The focus of this ToT was to introduce four key tools for developing PES/RES mechanisms. Participatory Analysis Of Poverty, Livelihoods And Environment Dynamics (PaPOLD) at community level helps identify target groups and payment mechanisms that are fair and sustainable. Participatory Landscape Analysis (PALA) at landscape, community and household levels helps identify the basis for decision making in land use and land-use changes. This knowledge is vital for designing PES. Reverse Auction (RA) is a new tool, which has been being tested in Africa and Southeast Asia, and is planned to be applied for PES negotiation in Bac Kan in 2011. Rapid Carbon Stock Appraisal (RaCSA) is a tool to identify carbon ES, and gives communities the opportunity to participate in reporting and monitoring contracts in payment for carbon ES. The training included over 20 enthusiastic participants who will continue to train IFAD-PES project in Bac Kan. The overall objective field work with the household survey was firstly to train the participants in using the PaLA tools. Furthermore, the survey aimed at collecting data on socio-economic data from three villages in three districts in order to assess potential PES mechanisms. The in-field PaLA training provided useful data for further analysis and further investigation in introducing PES mechanism at the village level. The participants were involved in all steps involved in the survey and touched upon fieldwork planning, interview techniques, tabulating data and analysis of data. However, the evaluation showed that more time for discussions were needed, which illustrates the participants' enthusiasm. Future trainings should then involve more discussion between each step and allow time for it. Detail report for this training is presented in Annex 2.

12. Lessons Learned

i) The PaLA

Pre-PaLA information obtained through review secondary data and use of GIS and remote sensing is suggested, particularly if PaLA is combined with RHA in defining hydrological issues. For example, in Vietnam communal annual social-economical development reports and plans, administrative maps, land use maps, existing project reports, GIS maps and RS maps if available ect. are useful for obtaining general information on boundaries, social-economical context, several main issues. Furthermore, the role of GIS is more or less depending on the scale of the study, the landscape, expertise, and research objectives. In some cases, village or commune sketches with the participation from local people and with the aid of existing communal administrative map or land use map were sufficient to define hotspots in the landscape. It is important to involve those who know the area well in the PaLA process. Making the findings transparent to all involved stakeholders and getting their feedbacks on the findings are the key for success. How to pack PaLA with other tools for different purposes and studies is a challenge. The 5,000 USD is enough for testing PaLA at a commune level in Vietnam if GIS maps are available.

ii) The combination of PaLA and RHA

PaLA alone is useful for scoping to define issues (water, carbon, soil erosion, etc.) in a landscape. However, when using PaLA for RHA, researchers need to be goal-oriented and focus on water issues. In order to use the tools in an efficient manner (both in terms of time and money), identifying 'domains' (areas with similar bio-physical, and socio-economic-cultural settings) and 'hotspots' (the place with critical water issues) is important. In this context, 'domains' can be defined by reviewing secondary data, while the GIS tool is useful for 'hotspot' identification. The combination of PaLA with RHA is suitable for the development of decision support tool for rewarding for environmental services (RES) as in the case of Bac Kan province.

The balance between three knowledge domain (LEK, PEK and SEK) is important for data interpretation, recommendations and communication to stakeholders. Within SEK domain, Genriver was useful in checking hydrological data availability. The case from Bac Kan showed the difficulty in obtaining inputs to Genriver. Therefore, due to limitations in data availability, short time frame and small budget, it is recommended to develop simpler methods to gather hydrological evidences. The parameters required and modelling method should be made simpler. A simplified model for Vietnam is recommended. Within the PEK domains, information on watershed management policy is important. This will be further obtained for the Bac Kan case.

When combining PaLA with RHA, the total financial support of 5,000 USD + 5,000 USD = 10,000 USD is efficient enough for a scoping study on upstream-downstream relationship and ES of a watershed of 16,000 ha as Leng river basin (Bac Kan case).

An important lesson learnt for site selection was drawn from **RHA in Luong Son District**, Hoa Binh Province. The planned objectives were to identify hydrology issues in Binh Thanh commune (Hoa Binh dam sub-watershed), and then determine types of environmental services and providers and beneficiaries as well as to propose PES mechanism for effective management of the watershed area. This project ended at a feasibility study for

water service in Hoa Binh dam sub-watershed, because the feasibility study showed that further RHA study was not suitable. Initial study found that hydrology data was not available, and that no critical issues could be identified. Also, Hoa Binh dam watershed is too large to be impacted by a small sub-watershed in Binh Thanh commune. Compared to the total volume of 9,000,000m^3 in Hoa Binh dam, the contribution of the hydrology network in Binh Thanh commune is insignificant, which results in difficulties for modeling and later development of potential payment scheme by the hydropower plant. An important lesson learnt was drawn. It is crucial to set suitable site selection criteria. Importantly, the research site should have defined watershed boundary. Basic data suitable for the application of Genriver model to rapidly assess water balance in the watershed area should be available. To determine effects of land use changes to water and people lives, the selected site should have issues on land use changes that lead to negative impact on water quality and quantity, which in turns affects local community. In this research Binh Thanh commune was selected. However, the scoping survey showed minor land use changes, which were mainly due to changes in forestland planning. Changes in water quantity in this area were largely caused by Hoa Binh dam, one of the biggest hydropower plant dams in Vietnam. Moreover, so far there has not been research that measures water flows and levels from this area

iii) RACSA:

In the case of Thai Nguyen, application of RACSA methods for estimation of C-stock at plot level was found to be simpler and more efficient, less time consuming and more cost effective compared to traditional carbon assessment method. In order to scale up C-stock from plot to landscape level, availability of spatial data and GIS experts is essential. In this case, another way to scale up was used based on the potential changes in land uses as predicted from policy and land management knowledge as well as local preferences on future land use .

In Bach Ma National Park, the RACSA method and remote sensing analysis of satellite maps were combined to assess the change in carbon sequestration in forest in order to make better plan for protection. However, because of time and budget shortage, the number of sample plots was limited. With only 3 to 5 plots for each type of land cover, the estimation may be less accurate. The quality of satellite maps and the techniques of image analysis were found to be two most important factors for deciding the accuracy of the assessment. If more sample plots and more high quality satellite maps (repeated in 5 years, for instant) could have been obtained, the study results would be more scientifically reliable. Besides, the estimation of wood density to be equal to 0.8 (heavy), 0.5 (average) and 0.3 (low) for humid tropical forest applied for the calculation of tree biomass may cause big differences. To reduce the variance, trees in sample plots should be identified in Latin names in order to look up for wood density values from the literature, e.g. ICRAF South East Asia database. Here, researchers could collect samples to calculate the wood density for trees which are not listed in the scientific publications.

In the case of RACSA in Quang Khe commune, it was found that local ecological and policy knowledge importantly influenced the three remaining components of RaCSA. For example, to set up scenarios for stimulating carbon changes in different land use options, it is critical to know land use planning by the commune as well as the preferences of local people

to grow what species in what land area. The more detailed and clearer the information on local ecological and policy knowledge was, the easier the tasks of researchers and modellers.

In most cases the 5,000 USD was sufficient enough to carry out the analysis but with some limitations as mentioned above. GIS maps and expertise availability, which are normally costly, are important for scaling up carbon from plot level to landscape level.

13. Future Research Needs

Besides results presented above, RHA in Leng river basin also generated a detail plan to develop a simple model for RHA in Bac Kan, a semi-distributed model that requires less measurement, and therefore becomes more practical for areas with little or no hydrological data. Although, this model could not be validated during the project phase, it looks promising for simplifying the current RHA approach, reducing costs and for making it applicable for a wide range of contexts. Future validation of the proposed model will be useful for introducing hydrology modelling into RHA for area where hydrology data availability is a constraint.

For RaCSA, future determination of wood density values for a number of species in natural forest for as many species as possible can increase the accuracy of Carbon stock estimation. In the case of **Bach Ma NP**, piloting fund raising for all ES provided by forest and defining 'best practices' from previous integrated conservation measures to be disseminated as ES rewarding measures are recommended as further steps. This requires an interface with other TULSEA tools. For example, RHA will be useful to define interrelations between five studied land categories (rich forest, medium forest, poor forest, restoration forest and bare land) with water availability in streams as sources of Huong river basin. Rapid AgroBiodiversity Appraisal (RABA) will be useful to link bio-diversity with those five land cover categories. Fund raising for forest protection in BMNP is recommended to go hand in hand with benefit sharing of REDD+ in Vietnam. A pilot study to develop RES/PES mechanism for carbon ES and co-benefits is recommended. 'Best practices' for livelihood improvement of people in buffer zone while reducing pressure on forest, from previous integrated conservation project should be defined and disseminated as options for rewarding. The sustainable livelihoods approach using five assets frame developed by DFID should be used in a participatory manner for this study.

TULSEA tools such as PaLA, PaPOLD, RA, and RaCSA are being applied to design a PES component for the IFAD-3PAD project and are being transferred to local project staff so that these tools can be used for a real life development project in Bac Kan. The hands-on field practices during the second TULSEA training, showed the potential of local staff at district and commune levels for scaling up the TULSEA tools in Bac Kan province. This is a step forward for scaling up the application of TULSEA tools in Vietnam and should be continued.

14. Summary

During 2008-2011, TULSEA project activities have been actively carried out in Vietnam. Relevant TULSEA tools, namely PaLA, PaPOLD, RaCSA, RHA, and RA have been introduced, trained, tested, and applied in a real life development project. Trainings on all five selected tools successfully transfer knowledge and skills to local partners, who have applied

and continue to disseminate the technologies at their institutions. Capacity building and partnership with local organizations have been improved.

Some key improvements or adjustments of the tools resulted from testing sites in Vietnam include: the combination of PaLA and RHA for watershed service; the utilization of GIS in PaLA; the use of publically available sattelite images to reduce implementation cost for RaCSA and RHA; the application of RaCSA for a wide range of different contexts and purposes; a simpler approach for the scaling up step in RaCSA; a proposal of a simpler semi-distributed hydrology model for applying RHA in areas with limited hydrology data. Important lessons were drawn from testing these tools in different contexts and for various purposes.

Overall, within the time and budget for the testing sites, RaCSA and PaLA were applied successfully. RHA was mainly applied in the first phase to find out issues, hotspots and qualitative data for upstream and downstream relationships. The combination of PaLA and RHA were effective in providing qualitative data for hydrological services. The RHA modelling phase, which was too costly and time consuming for sites with limited hydrology data, could not be carried out. A potentially more realistic and simpler model was proposed.

Results from applying TULSEA tools produced important implications to the natural resource management planning and strategies for local context. Opportunities for developing payment for environmental service mechanisms were investigated. TULSEA tools have been successfully transferred to local partners and continue to be applied, especially in the case of IFAD-RUPES project in Bac Kan province. A number of valuable publications have been produced to disseminate and scale up the technologies.

15. Publications, Papers and Reports

- Three **flyers** on RACSA, PaLA, RHA in Vietnamese
- One **brochure** on TULSEA project summary in Vietnamese
- One **project brief** on TULSEA in both English and Vietnamese
- Two TULSEA country **progress reports** (for 2009 and 2010) in English
- **Technical reports**: RACSA(Carbon stock at plot and landscape levels in Tan Thai commune, Dai Tu district, Thai Nguyen province; REDD+ strategy of Bach Ma National Park, Thua Thien Hue province - Findings from a rapid assessment of carbon stock; Rapid assessment of carbon stock in Lam Son commune, Luong Son district, Hoa Binh province); PaLA (Applying PALA and RHA in Leng river watershed, Ba Be district, Bac Kan province; RHA (RHA/PaLa in Coc Lake, Thai Nguyen province). All are in English.
- Two **training reports**: the first training in Thai Nguyen, the second training in Hanoi and Bac Kan in English
- TUL-Viet **book** in both English and Vietnamese (Series 1)
- Six Vietnam case studies to contribute to TULSEA book in English produced by TULSEA SEA project.
- One MSc degree at Seul University on the application of RACSA in Agroforestry research.

16. Attached documents

Attached 1: TUL-Viet Book in English and Vietnamese

Attached 2: 2nd training report in Hanoi-Bac Kan

Attached 3: RaCSA in Lam Son- Hoa Binh (this report was not presented in the 2nd progress report)

Attached 4: MSc thesis on RaCSA in Quang Khe commune, Bac Kan province