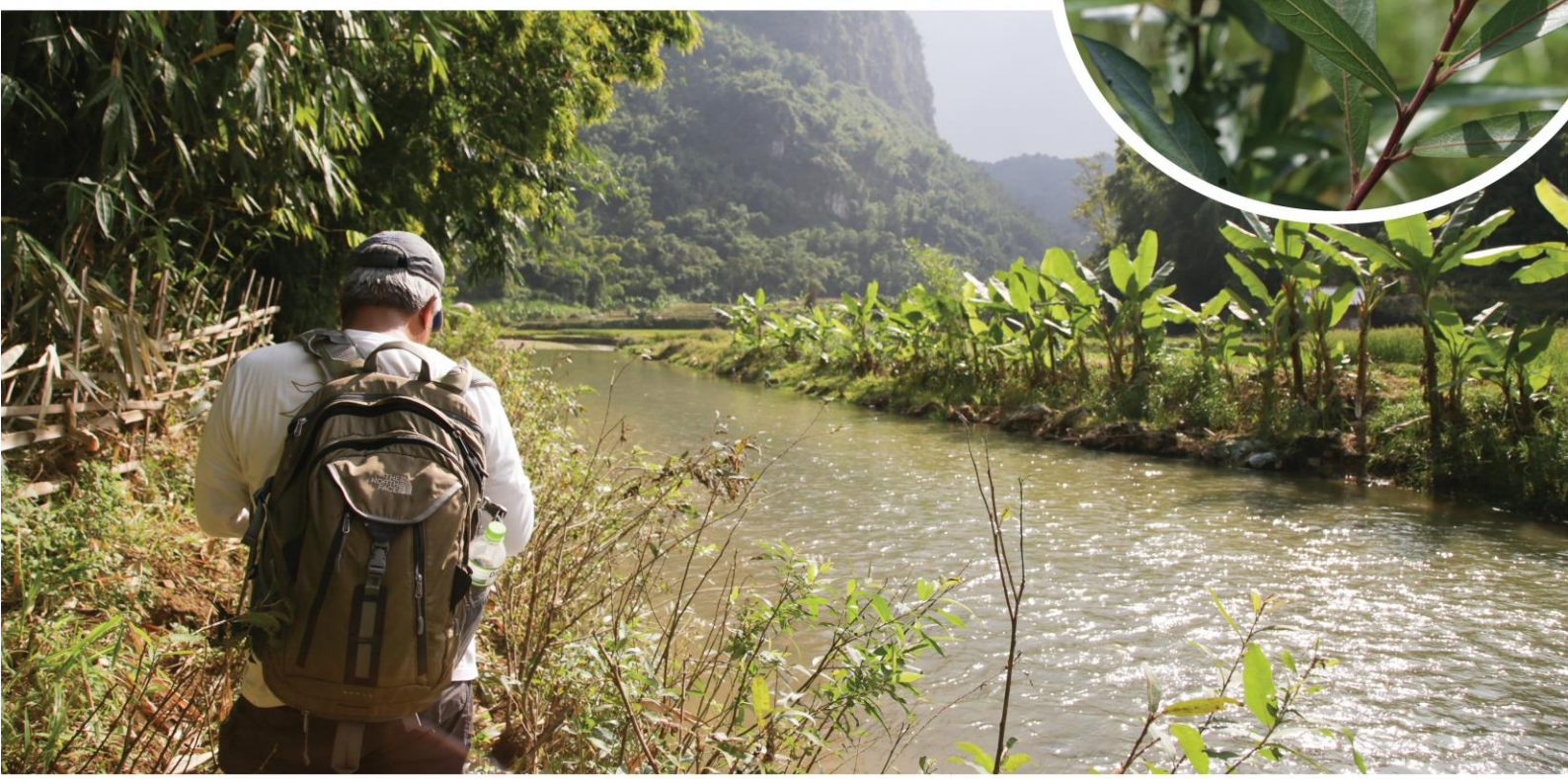
Final Report

TA 8102-VIE: Promoting Climate Resilient Rural Infrastructure in Northern Viet Nam

Progress Report No. 15 May 2017



Prepared for: Ministry of Agriculture and Rural Development
Asian Development Bank

Prepared by: ICEM in association with PHILKOEI

This report is one of a series of progress reports prepared by ICEM as part of Asian Development Bank (ADB) capacity development technical assistance (CDTA) project Promoting Climate Resilient Rural Infrastructure in Northern Vietnam. ICEM, in association with Philkoei, has been engaged by the ADB to undertake the project, working with the Ministry of Agriculture and Rural Development (MARD). This Final Report is the last of 15 **Progress Reports** submitted for the project (see Annex 16 for full list).

DISCLAIMER

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More information:	www.icem.com.au | info@icem.com.au ICEM International Centre for Environmental Management 6A Lane 49, To Ngoc Van Tay Ho, HA NOI, Socialist Republic of Viet Nam
Cover image:	Clockwise from top left: local community members planting Vetiver grass at SP32 Son La; completed fill slope at SP35 Thai Nguyen; SP32 Son La

ACKNOWLEDGEMENTS

This Final Report is prepared under TA 8102-VIE Promoting Climate Resilient Rural Infrastructure in Northern Vietnam funded by the Global Environment Facility through the Asian Development Bank.

The ICEM team wishes to acknowledge the very important support they have received from all participants in the project, specifically from the residents of the five communes where the demonstrations are located, from the respective district and provincial authorities in the three provinces of Bac Kan, Thai Nguyen and Son La, from the Agricultural Projects Management Board (APMB), the Department of Construction Management of the Ministry of Agriculture and Rural Development (MARD) and other MARD departments and institutions, the contractors who installed the demonstrations, the United Nations Development Programme and their consultants, and the Asian Development Bank.

Special thanks go to the 16 members of the Technical Core Group (the list of TCG members is provided in Annex 2) who visited the demonstration sites and attended the training workshops, and who will help to promote the concept of bioengineering in the years ahead. Also, sincere thanks and appreciation go to TA team members and ICEM support staff for their hard work and patience in delivering the project.

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Mr Đới Văn Thiều, Director, PPMU (Bac Kan)

Mr Hà Quyết Nghị, Director, DARD (Son La)

Mr Cao Viết Thịnh, Director, PPMU (Son La)

Mr Bùi Tiến Chính, Deputy Director, DARD (Thai Nguyen)

Mr Nguyễn Tiến Thịnh, Director, PPMU (Thai Nguyen)

And leaders of the communes Thanh Mai (Bac Kan), Thom Mon and Phong Lap (Son La) and Lien Minh (Thai Nguyen).

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Of course the project would not have been possible without the vision, initiative and support from the Global Environment Facility – to whom we would like to express our sincere thanks and appreciation.

We would also like to thank our partners at the UNDP in helping to coordinate and maximise the benefits of project activities.

EXECUTIVE SUMMARY

Background

1. The increasingly severe weather events associated with predicted climate change in Northern Vietnam will affect rural infrastructure – roads and bridges, riverbanks and irrigation schemes – which is already affected by current extreme events – rainfall and floods. Increasing the resilience of both existing and new rural infrastructure is important but a major challenge given the high investment requirements. Available capital must be targeted at the most vulnerable assets and should use the most cost-effective techniques. Accordingly, the Global Environment Facility (GEF) grant-funded the project **Promoting Climate Resilient Infrastructure in Northern Mountain Provinces of Viet Nam** to assist the Ministry of Agriculture and Rural Development (MARD). Four of the project's five components focused on mainstreaming and capacity development and were administered by the United Nations Development Programme (UNDP). The remaining component demonstrated low cost, easily implementable measures to reduce the vulnerability of rural infrastructure to extreme climate events, and was administered by the Asian Development Bank (ADB).

The Technical Assistance

2. The ADB component was set up as a three-year capacity development technical assistance (CDTA) project called **ADB TA 8102-VIE: Promoting Climate Resilient Rural Infrastructure in Northern Vietnam**. ADB recruited the International Centre for Environmental Management (ICEM) in association with Philkoei International, Inc. (PKII) as consultant to provide the technical assistance to MARD.

3. ICEM's services commenced on 02 January 2013. The project was extended twice, first by 11 months to 02 December 2016, then by 6 months to 31 May 2017.

TA Activities and Achievements

4. TA activities were organised under three Outputs:

- **Output 1: Climate change threats and impacts are assessed and adaptation options identified**

  Activities included initial scoping and data collection, climate change impact and vulnerability assessment in target locations, and development of climate resilient technical options.

- **Concept and detailed designs developed, communities engaged, and demonstration adaptation activities implemented**

  Activities under this output centred on establishment of four physical demonstrations of bioengineering as a technique for increasing the resilience of slopes to climate change: concept and detailed designs, tender documents, contraction and construction, maintenance and monitoring.

- **Strengthened capacity of project stakeholders to assess climate change impacts and select, design and implement bioengineered solutions**

  Activities under this output included development of a knowledge development and communications strategy, capacity building and training centred on a "Technical Core Group", and preparation of extensive technical recommendations.

The TA's main achievements were:

- Design and installation of four demonstrations featuring a range of low-cost slope protection measures with a focus on bioengineering techniques. The demonstrations were co-located with sub-projects of the ADB loan-financed Sustainable Rural Infrastructure Development Project (SRIDP). Two demonstrations are on riverbanks (at Thanh Mai Commune in Bac Kan Province and at Thom Mon Commune in Son La Province), and two are on fresh roadside cut and fill slopes (at Lien Minh Commune in Thai Nguyen Province and at Phong Lap Commune in Son La Province).
- Four major training workshops:
  (i) Vulnerability & Adaptation Response Workshop
  (ii) Bioengineering: design and construction – riverbanks
  (iii) Bioengineering: design and construction – roads
  (iv) Lessons Learned
- Preparation of 20 technical reports covering all aspects of (i) climate change vulnerability assessment, (ii) design, construction and monitoring of the demonstrations and their effectiveness, (iii) all the workshops and training, and (iv) technical recommendations on design and use of bioengineering for rural infrastructure in Northern Vietnam.

Lessons Learned

5. Key "lessons learned" during the TA are noted below. It is important to point out that these are not new lessons – they are common to all low-cost slope protection projects everywhere in the world. Design and construction of the four demonstrations by this TA has reconfirmed their importance.

- Include bioengineering at the earliest stage of project planning.
- Identify high-risk locations as early as possible in a project using proven vulnerability assessment and slope condition criteria.
- Apply geotechnical knowledge to identification and analysis of specific slope problems, using low-cost geotechnical investigation procedures such as the Dynamic Cone Penetrometer.
- Integrate hard and soft slope protection measures as appropriate to solve the problem.
- Recognise the limitations of bioengineering – it cannot fix deep slope failures.
- Use local knowledge of plants to identify appropriate species, sources, replication methods and planting seasons.
- Apply quality control during construction to ensure that the correct materials and methods are used.
- Give clear and simple design guidance for practitioners.
- Bioengineering measures are significantly cheaper to apply than conventional hard or grey infrastructure measures for slope stabilisation.

Recommendations for Mainstreaming

6. Based on discussions at the project's final workshops, requirements for moving towards acceptance of bioengineering as a mainstream slope protection measure for rural infrastructure in northern Vietnam include:

(i) An **applied research programme** to generate locally-specific **knowledge of plants appropriate for each bioengineering technique**, including detailed propagation methods such as size of cuttings, and seasonality.

(ii) Development of **technical standards and cost norms** to allow engineers to apply the techniques within the administrative system that governs design procedures in Vietnam.

(iii) **Awareness and training amongst engineers at all career levels:** undergraduates for exposure to the concept of green engineering; in-service technical training for practising engineers so they can confidently apply this approach to slope protection; and awareness for senior personnel who can influence policy, planning and funding decisions.

(iv) **Application of bioengineering techniques to major infrastructure projects** (e.g. a major new road construction project in hilly terrain, a major road maintenance programme in the mountains involving slope and drainage issues, or a large river-training project), so that engineers, policy-makers and trainers gain direct, hands-on experience of bioengineering best practice.

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ABBREVIATIONS

ADB	Asian Development Bank
APMB	Agricultural Projects Management Board
CC	Climate Change
CPMU	Central Project Management Unit
DARD	Department of Agriculture and Rural Development
DCM	Department of Construction Management
DOI	Department of Irrigation
DONRE	Department of Natural Resources and Environment
DPC	Dynamic Cone Penetrometer
DSTE	Department of Science, Technology and Environment
DWR	Department of Water Resources
EA	Executing Agency
GAP	Gender Action Plan
GEF	Global Environment Facility
ICEM	International Centre for Environmental Management
IEE	Initial Environmental Examination
IMHEN	Vietnam Institute for Meteorology, Hydrology and Environment
IWE	Institute of Water and Environment (of VAWR)
JSC	Joint Stock Company
LIC	Loan Implementation Consultant
MARD	Ministry of Agriculture and Rural Development
M&E	Monitoring and Evaluation
MONRE	Ministry of Natural Resources and Environment
MTR	Mid-Term Review
O&M	Operation and Maintenance
PCRRI	TA project: Promoting Climate Resilient Rural Infrastructure in Northern Vietnam
PPMU	Provincial Project Management Unit
PR	Progress Report
RAP	Resettlement Action Plan
SRIDP	Sustainable Rural Infrastructure Development Project
SIR	Sub-project Investment Report
TA	Technical Assistance
TR	Technical Report
UNDP	United Nations Development Programme
VAWR	Vietnam Academy for Water Resources
VO	Variation Order

1 INTRODUCTION

1.1 REPORT INFORMATION

Report type	Final Report
Report number	PR-15
Reporting period	02 January 2013 – 31 May 2017
Project	TA 8102-VIE Promoting Climate Resilient Rural Infrastructure in Northern Vietnam
Executing Agency	Ministry of Agriculture and Rural Development
Funding agency	Asian Development Bank
Contract	ADB Contract No. 100423-S41987 dated 06 December 2012
Originator	ICEM

1.2 BACKGROUND

1. The Asian Development Bank (ADB) recruited ICEM – International Centre for Environmental Management (ICEM) in association with Philkoei International, Inc. (PKII) to provide technical assistance to the Ministry of Agriculture and Rural Development (MARD) in implementing the project **Promoting Climate Resilient Infrastructure in Northern Mountain Provinces of Viet Nam**. This project is funded by a grant from the Global Environment Facility (GEF) and has five components. The ADB capacity development technical assistance (TA) **TA 8102-VIE: Promoting Climate Resilient Rural Infrastructure in Northern Vietnam** supports one component of the project to demonstrate low cost, easily implementable measures to reduce the vulnerability of rural infrastructure to extreme climate events. . The remaining four components of the overall project focus on mainstreaming and capacity development and are administered by UNDP.

2. ICEM was contracted on 06 December 2012, the services commenced on 02 January 2013 and the project ended on 31 May 2017.

1.3 THE PROJECT

3. The **Objective** of the overall project was "to increase the resilience and reduce vulnerability of local, critical economic infrastructure in the northern mountain areas of Vietnam to the adverse impacts of climate change and to create a policy framework conducive to promoting resilient northern mountains zone development". The **Outcome** of the ADB-administered component was that effective climate-resilient measures are mainstreamed into the MARD rural infrastructure programme. To achieve this outcome the TA was organised around three **Outputs**, each comprising various **Activities**.

- **Output 1: Climate change threats and impacts are assessed and adaptation options identified.**
- **Output 2: Concept and detailed designs developed, communities engaged, and demonstration adaptation activities implemented.**
- **Output 3: Strengthened capacity of project stakeholders to assess climate change impacts and select, design and implement bioengineered solutions.**

4. The TA physically demonstrated bioengineering in four locations in three provinces and, through training and capacity building, promoted bioengineering as an alternative, low cost approach to increasing the resilience of rural infrastructure to extreme weather events (rainfall and floods). The four locations are sub-projects of the ADB-funded **Sustainable Rural Infrastructure Development Project** (SRIDP), which is rehabilitating and upgrading rural infrastructure in 15 provinces in northern Vietnam.

5. The TA project was scheduled to last for 36 months from January 2013 to December 2015. The Mid-Term Review recommended an 11 month extension to November 2016, and this was approved by ADB in September 2015. The new TA termination date of 02 December 2016 was later amended to 31 May 2017 giving a 53-month project duration.

1.4 PURPOSE AND LAYOUT OF THIS REPORT

1.4.1 Purpose of Report

6. This Final Report is one of a series of 15 progress reports (PR) tracking project implementation progress towards the TA outputs. The report has three purposes:

- It records the project's activities in the period July 2016 – May 2017.
- It records the project's principal activities and achievements since inception, for the record.
- It provides an opportunity to reflect on the achievements of the TA and lessons learned through the implementation of TA activities.

1.4.2 Layout of Report

7. The report is divided into the following sections:

1. Introduction
2. TA Organisation and Approach
3. Achievements
4. Lessons Learned and Recommendations

Annexes

1. List of TA Team Members
2. List of Technical Core Group Members
3. Issues during TA Implementation
4. Overview of TA Specialist Inputs and Time Use
5. Surveys and Services
6. Key Events and Milestones
7. Meetings
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11. Staffing
12. Facilities and Equipment
13. Administrative Issues
14. Budget
15. Project Activities
16. List of Progress Reports
17. List of Technical Reports

2 TA ORGANISATION AND APPROACH

2.1 METHODOLOGY

2.1.1 Project Purpose

8. The challenge facing government and communities in protecting rural infrastructure from climate change entails (i) developing, demonstrating and promoting viable climate resilient construction techniques; (ii) ensuring that, at the national level there is an awareness of climate change and the dangers it poses leading to climate resilient techniques being included in standard planning and design procedures; (iii) capacity development especially at the provincial level to ensure that provincial agencies involved in infrastructure management are aware of the risks of climate change and the measures which can be taken to reduce them; and, (iv) the need to share the results of initiatives taken to identify and develop climate resilient techniques and their adoption on a nationwide and international basis as well as to provide experience to other regions of the country and to the governments of neighbouring countries.[1]

9. The **Objective** of the overall GEF project was "*to increase the resilience and reduce vulnerability of local, critical economic infrastructure in the northern mountain areas of Vietnam to the adverse impacts of climate change and to create a policy framework conducive to promoting resilient northern mountains zone development*"[2].

10. Given this overall objective, the ADB Technical Assistance Report for the CDTA (TAR, May 2012) described the TA's impact and outcome as follows: "… the **Impact** of the TA will be improved climate resilience of rural infrastructure" and "… the **Outcome** will be effective climate-resilience measures mainstreamed into the MARD rural infrastructure programme".

2.1.2 TA Scope of Services, Outputs and Activities

11. **Scope of Services:** the TA consultant was to be responsible for:

(i) identification of low-cost climate-proofing measures suitable for rural infrastructure in northern Viet Nam;

(ii) demonstration of climate change resilient techniques in the provinces of Bac Kan and Son La on two rural roads, one irrigation scheme, and one river embankment;

(iii) establishment of a trained cadre of technical personnel familiar with the protection measures;

(iv) preparation of recommendations for the integration of the demonstrated approaches into training curricula, standard design procedures, and contract specifications; and

(v) identification of climate change risks and vulnerabilities, and the potential for applying the measures used in the demonstrations for strengthening the resilience of nearby communities.

12. The TA defined three **Outputs**, each comprising three to four **Activities**. These are listed in table 1.

[1] Source: Memorandum of Understanding between the Asian Development Bank and the Socialist Republic of Viet Nam for the Technical Assistance Project Promoting Climate Change Resilient Rural Infrastructure in the Northern Mountain Provinces, 21 Jan. 2011

[2] Source: UNDP Project Document for Promoting Climate Resilient Infrastructure in Northern Mountain Provinces of Vietnam, Sep. 2012

Table 1: TA Outputs and Activities

Output 1	**Climate change threats and impacts are assessed and adaptation options identified**
Activity 1.1	Initial scoping and data collection
Activity 1.2	Climate change impact and vulnerability assessment
Activity 1.3	Develop and select climate resilient responses
Output 2	**Concept and detailed designs developed, communities engaged, and demonstration adaptation activities implemented**
Activity 2.1	Concept designs
Activity 2.2	Detailed designs and tender documents
Activity 2.3	Contracting
Activity 2.4	Implementation, maintenance and monitoring
Output 3	**Strengthened capacity of project stakeholders to assess climate change impacts and select, design and implement bioengineered solutions**
Activity 3.1	Knowledge development and communications strategy
Activity 3.2	Capacity building and training
Activity 3.3	Recommendations on revisions to curricula and standards, and way forward

2.2 PROJECT STRUCTURE

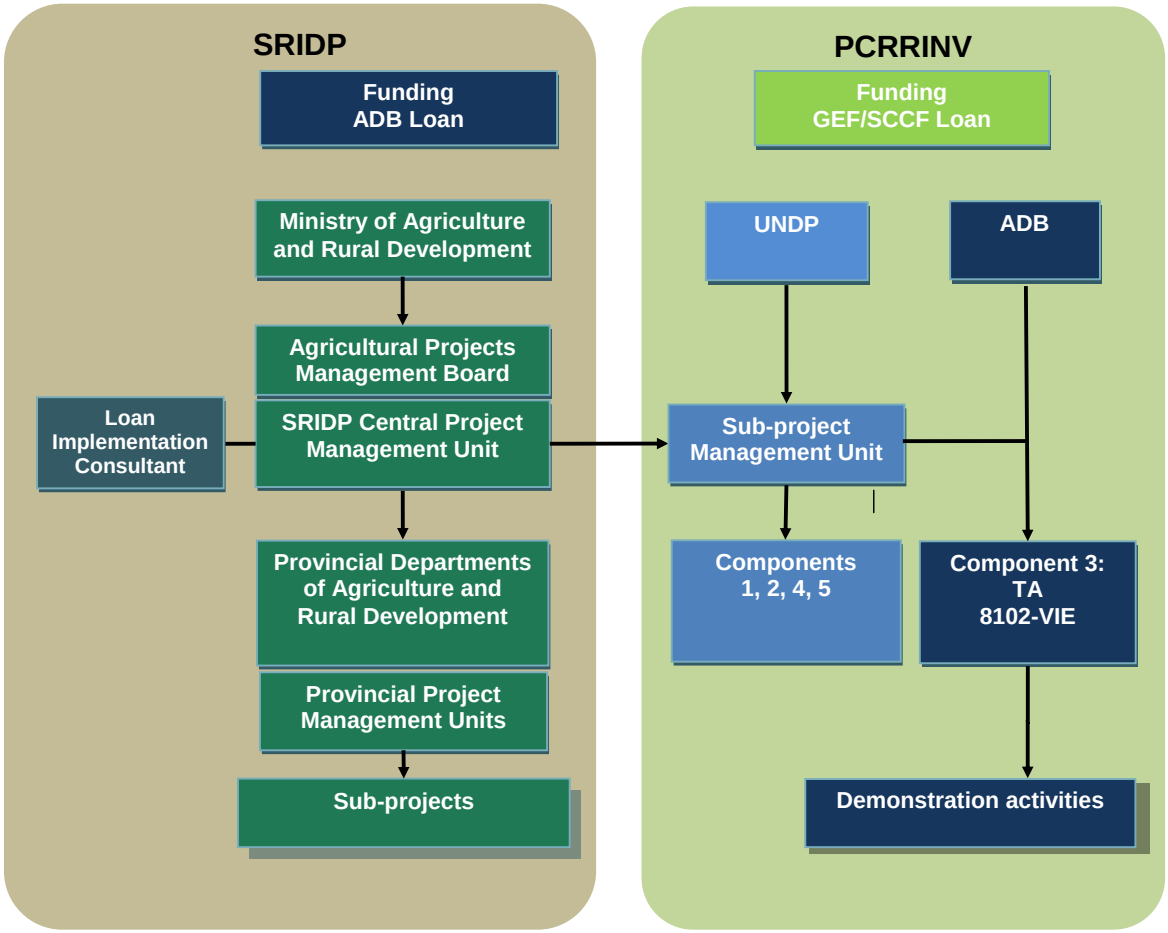
13. TA 8102-VIE's executing agency (EA) was the Ministry of Agriculture and Rural Development. Its implementing agency (IA) was the central project management unit (CPMU) for a large ADB loan-financed rural infrastructure project - Sustainable Rural Infrastructure Development Project (SRIDP), which was established within MARD's Agricultural Projects Management Board (APMB).

14. The overall GEF project organisational structure included a GEF sub-project management unit within the CPMU. Within this framework the ADB component was undertaken by the TA Consultant (ICEM in association with Philkoei) working closely with MARD and the UNDP components. This structure is illustrated in Figure 1.

2.3 PROJECT LOCATION

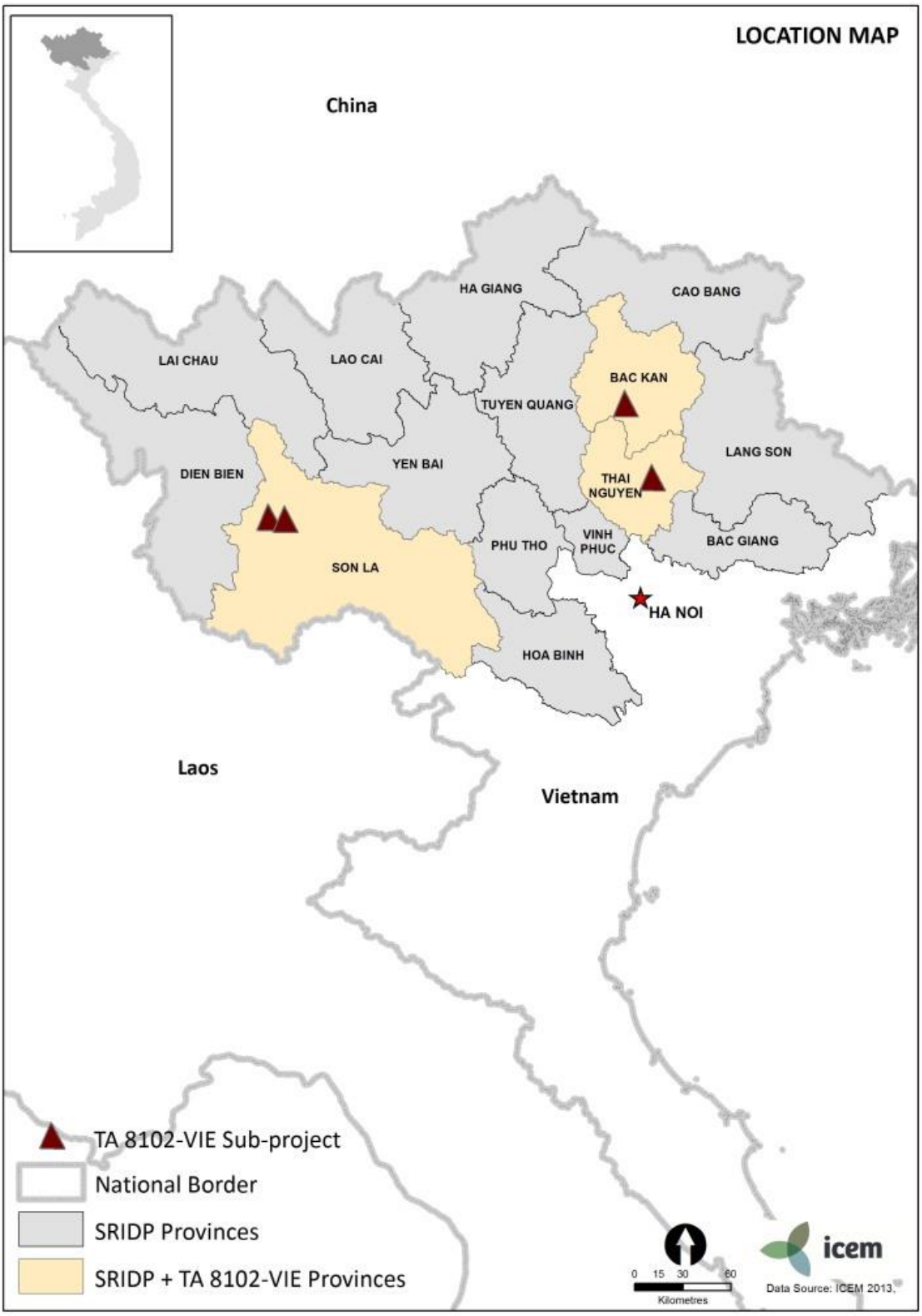
15. The location of the demonstration sites is shown in Figure 2.

Figure 1: Overall Project Structure



SRIDP - Sustainable Rural Infrastructure Development Project in the Northern Mountain Provinces
PCRRINV - Promoting Climate Resilient Rural Infrastructure in Northern Viet Nam

Figure 2: Location Map



16. Details on staffing are provided in Annex 11 and information on facilities and equipment used is provided in Annex 12. A summary of administrative issues encountered during implementation is provided in Annex 13.

2.4 BUDGET

17. The TA Consultant requested a number of Variation Orders to adjust the budget in keeping with the evolving TA work plan. The VOs and their status are listed in Annex 13.

3 ACHIEVEMENTS

3.1 STATUS OF WORK

3.1.1 Overall Progress

18. Overall progress against the End-of-Project Targets established in the overall GEF project's Project Results Framework for this TA (Outcome 3 of the GEF project) is illustrated in Table 2.

Table 2: Progress against GEF Project's End of-Project Targets

GEF Outcome 3		Effective climate-resilience measures mainstreamed into the rural infrastructure programmes				
End of Project Target (revised as per MTR report)		**Completion Indicator**				**Comment**
1	A vulnerability assessment (VA) and adaptation prioritizing framework completed at community level; Preferred bioengineering solutions for rural infrastructure projects developed	TR-5: Approach to CC assessment		Design recommendations and materials		Vulnerability assessment completed (TR-5); Bioengineering solutions: see Target 4
2	Four bioengineering demonstration projects developed, implemented and evaluated with community engagement by June 2016, based on 4 selected SRIDP sub-projects in three provinces	Rivers: Consultat'n	Design	Approvals & procurem't	Constr'n	Both completed
		Roads: Consultat'n	Design	Approvals & procurem't	Constr'n	Both completed in 2016
3	Up to 5 training courses and workshops provided to a technical group of 16 members on climate change impact assessment and selection, design, implementation of bioengineering solutions	Training event 1: VA workshop	Training event 2: Bioeng. Workshop – rivers	Training event 3: Bioeng. Workshop – roads	Training event 4: Lessons learned workshop	Training focused on Technical Core Group (membership 16); all 4 major training events completed; Wrap-up workshop held May 2017
4	Lessons learned and recommendations submitted latest by September 2016					Originally scheduled for 2015; completed in May 2017

19. A list of project activities in each year is presented in Annex 15.

3.1.2 Training Events and Workshops

20. The list of major training events and workshops for the whole project is provided in Annex 15.

3.1.3 International Cooperation

21. International cooperation included (i) participation in the 2015 riverbank and 2016 roadside bioengineering workshops by delegates from the Lao People's Republic, (ii) a visit to the two riverbank demonstration by delegates from Timor Leste in September 2015, arranged by UNDP, and (iii) in November 2015, a visit to the riverbank protection demonstration site in Bac Kan by UNDP delegates from Bangkok (see **RSV-46**).

22. In September 2016 a group of students and faculty from the Transport University in Hanoi visited the roadside demonstration site in Thai Nguyen.

3.2 KEY EVENTS AND MILESTONES

23. Key events and milestones since the start of the services to the date of submission of this Final Report are provided in Annex 6.

3.3 MEETINGS

24. In addition to internal team meetings and fieldwork, the TA held a large number of meetings with project partners, stakeholders and other organisations. These are listed at Annex 7.

3.4 FIELDWORK

25. The TA involved a large amount of fieldwork to inspect and confirm the demonstration sites, undertake consultation with local stakeholders, carry out technical investigations, and install, monitor and evaluate the demonstrations. A list of site visits is given in Annex 8. Almost all site visits were recorded in a written and photographic Record of Site Visit (RSV), as noted in the annex.

3.5 REPORTS AND DOCUMENTS

26. The services involve preparation of a variety of reports and other documents. Annex 16 lists all Progress Reports (**PR**) and Annex 17 lists all Technical Reports (**TR**) (the dates given refer to the English version of the reports; Vietnamese translations are later (see Annex 9 for exact dates of submission of all versions)). A summary table of all documents prepared to date is given in Annex 9, excluding Minutes of Meetings.

27. Table 3 lists the Contract Documents (**CD**) completed for the four demonstration sites.

Table 3: List of all Contract Documents (CD)

No.	Topic or Title	Date
CD-1	Contract Documents for Demonstration Measures at SP4 Bac Kan	February 2015
CD-2	Contract Documents for Demonstration Measures at SP32 Son La	March 2015
CD-3	Contract Documents for Demonstration Measures at SP35 Thai Nguyen	May 2016
CD-4	Contract Documents for Demonstration Measures at SP31 Son La	June 2016

3.6 SURVEYS AND SERVICES

28. As part of the detailed design process the TA required technical inputs and services as follows: (i) detailed topographic surveys of the demonstration sites (cross-sections etc. plus the establishment of benchmarks); (ii) geotechnical surveys to determine the bearing strength of the soils, using a Dynamic Cone Penetrometer (DCP); and (iii) the services of an AutoCAD technician for preparation of the final design drawings for incorporation in the contract documents.

29. Further services were required in relation to biophysical monitoring systems, plant irrigation and minor additional works.

30. Proposals for these surveys and services were approved by ADB as shown in Annex 5, and their status is also shown in the annex. The surveys and services were funded under TA Budget Line 1300 which covered training, seminars, and the demonstration measures themselves.

3.7 ROAD SLOPE DEMONSTRATION SITES

3.7.1 Overview

31. The four project demonstration sites are located in rural communities where inhabitants rely on agriculture for their livelihoods. Those who live in these communities are very vulnerable to changes in the local environment. The cost to a rural family from loss of agricultural land from erosion, for example, can be debilitating.

32. Though the main aim of SRIDP is to create and maintain functioning rural roads, these investment efforts bring benefits that reach much further than the actual construction sites. Through stabilising road embankments, road repairs lead to the protection of other assets such as houses, agricultural fields, and transmission lines.

33. Integrating bioengineering solutions into traditional grey infrastructure can bring even greater benefits, as the plant species employed in these techniques can provide raw materials for food, fodder and medicines. On roadsides, plants also reduce the amount of debris that flows down from degrading slopes. Such debris is one of the largest contributors to road maintenance costs as it blocks drains and damages pavements.

34. Each demonstration site selection started with a thorough geotechnical assessment of site suitability, followed by a detailed topographical survey. A detailed technical design was then developed, which included the type, locations and selection of plants, materials and methods to be used in the demonstration. Then, the detailed design went through an approval process.

35. Following construction, a monitoring programme was carried out to assess the progress and success of each demonstration in maintaining slope stability and preventing erosion.

3.7.2 Phong Lap Commune, Son La Province (SP31)

36. Most famous for the imposing Moc Chau Plateau, Son La is a mountainous province located in the north-west of Viet Nam. Annual rainfall varies from 1,200 - 1,700 mm and tends to increase gradually from south to north. The year is divided into two distinct seasons: wet and dry season. Wet season runs from May to September and receives roughly 80% of total annual rainfall. The highest rainfall occurs in July and August, which averages 260 - 270 mm per month.

37. Son La averages 125 rainy days per year, but due to the uneven distribution of rainfall across the year, there are frequent wet season floods that cause property damage and loss of life, and dry season water shortages that affect manufacturing and domestic sectors.

38. SRIDP Sub-project 31 (SP31) entailed road improvements over a distance of 24 km of Road 108. The project site is located some 50 km north-west of Son La City, the capital of Son La province. In this area, flash floods are the most frequent extreme natural events. A result of short-term intense rainfall, these flash floods tend to occur two to three times a year between June and October. Rainfall bursts lasting for as short as one to two hours can cause serious surface erosion and landslides along the slopes of Road 108.

39. In Muong E and Phong Lap communes, Thuan Chau District, upwards of 97% of the population depends on agriculture for their livelihoods. Poverty rates in these communes and in neighbouring Phong Lap commune are high - as much as 42% - but upgrades to Road 108 could help alleviate that poverty.

40. The road serves a predominantly agricultural, livestock-rearing and timber-exploiting community and hence, apart from serving the general needs of the community, it is the key conduit

through which agricultural inputs are brought in and products like rice and timber are moved to market. The road also serves through traffic from three communes: Chieng Bom, Phong Lap, and Muong E of Thuan Chau District. Traffic and goods volumes are relatively high due to the inter-district connection.

3.7.2.1 Demonstration measures at SP31

41. The bioengineering demonstration measures helped to stabilise part of the cut slope on one side of Road 108 in Phong Lap Commune, which requires protection from erosion caused by flash floods.

42. Demonstration project measures extend along approximately 102 m of one side of the roadside cut slope, and have a total slope area of approximately 1,700 m2. Five techniques were initially selected for demonstration, all involving vegetation. Techniques entailed the use of local short grass, palisades, jute netting with grass seed and mulch, Vetiver grass lines, and truncheon cuttings.

43. Locally available plants such as blanket grass and indigo berry were used, plus the commercially available Vetiver grass. In addition, the base of the slope is protected by a narrow strip of wire-mesh reinforced concrete revetment (a MARD requirement for this site). Interceptor and roadside drains were built on one side of the road. Two drainage cascades were constructed from gabions to divert surface water away from the plants and slopes.

44. After initial test results proved unsatisfactory, the use of jute net with grass seeding and mulch was replaced with local short grass planting; jute net was largely unavailable, and even when installed, seeds that were intended to grow and strengthen washed away in heavy rain events before taking root.

3.7.2.1.1 Cost comparison

45. Construction costs of pure bioengineering measures were very low when compared to the cost of conventional slope protection techniques, such as using revetments of 10 cm pre-cast concrete tiles enclosed by a reinforced concrete frame at 3 m spacing.

46. The least expensive bioengineering measure at this site was only 8.9% of the cost of conventional techniques, while the most expensive was still only 21.3% of the cost of conventional techniques. The total cost to construct the roadside slope demonstration site in Phong Lap Commune was 652 million VND ($31,000 USD). The unit cost was 383,710 VND per m2 (or, $18 USD per m2). Unit construction costs in Phong Lap were higher than at the cut slope in Thai Nguyen (SP35) because the slope gradient had to be reduced to 1:1, which added excavation and surplus material transportation costs. A large proportion of the overall demonstration construction costs were for the hard measures, i.e. the gabion cascades and concrete revetment. Furthermore, the construction was delayed for nearly two months due to constant rainfall, increasing the overall cost.

3.7.2.1.2 Community involvement and benefits

47. The local community played an important role in implementing the demonstrations in Phong Lap Commune, during both the construction phase and with overall maintenance. 52 local workers were hired to install the demonstration measures and to perform maintenance duties such as watering and trimming. All members of the local team were from ethnic minorities and six were female. Their work time amounted to 1682 labour days at an average daily wage of 160,000 VND per day. Compared to the average daily income from selling crops such as cassava, an estimated 100,000 VND per day, this source of income constituted a significant improvement.

48. Beyond salaries earned while working on the site, local people also benefitted economically from the bioengineering measures through harvesting the Vetiver grass to use as fodder for livestock. The installed bioengineering measures will protect the cut slope from erosion and shallow failure, safeguarding the inter-district road. The road will facilitate economic development by

providing better access to markets and services, healthcare, education and other social services, and by reducing the time and cost of travelling and transporting commodities.

49. The community continues to be involved in the maintenance of the site. Local workers were hired to perform daily watering and care activities, and residents have agreed to keep cattle from grazing the new plants. Upon completion of the contractor's one-year maintenance period, the management responsibility was passed on entirely to the commune.

3.7.3 Lien Minh Commune, Thai Nguyen Province (SP35)

50. The Lien Minh Commune in Vo Nhai District, Thai Nguyen Province, is a farming community. As many as 98% of households include workers engaged in agriculture.

51. Typical of the northern mountains of Vietnam, the Dong Hy and Vo Nhai Districts have a tropical monsoon climate. In Vo Nhai District, the annual average temperature is 25.6ºC; temperatures vary between an average monthly maximum of 39.6ºC in June and average monthly minimum of 10.4ºC in January. The rainy season lasts from May to October and accounts for about 80% of the total average annual rainfall of 1,390 mm. The wettest month is usually August, which receives about 278 mm of rainfall.

52. In the rainy season, this heavy rainfall coupled with steep catchments causse flash floods and landslides which affect infrastructure and local people in both Lien Minh and Van Han communes.

53. In order to improve transport conditions to allow for better distribution of agricultural products to the market, SRIDP upgraded a section of Nhau Pass. These road improvements covered a 28.5 km section of the Linh Nham — Trang Xa road, spanning from National Highway 379 in Dong Hy District to Provincial Road No. 242 in Vo Nhai District.

54. The road serves a predominantly agricultural, livestock rearing and timber-exploiting community. Hence, apart from the general needs of the people, it provides the key lifeline through which agricultural inputs are brought in and products exported. Exports include green tea, rice, and timber.

55. The road over the Nhau Pass also serves the through traffic from Van Han Commune of Dong Hy District. Traffic and goods volumes are relatively high due to the inter-district connection over the Nhau Pass (Deo Nhau).

56. The bioengineering demonstration site is located on the Linh Nham — Trang Xa road in Lien Minh Commune, on the east side of Nhau Pass, within 450 m of the summit. Stabilisation measures were installed on both a cut slope and a nearby fill slope (embankment). The measures will prevent slope failures caused by surface erosion of the weathered rock, residual soil, and compacted soil materials which comprise the slopes at the demonstration locations.

3.7.3.1 Demonstration measures at SP35

57. The demonstration measures extend along 94 m of roadside cut slope to protect a slope area of approximately 2632 m^2, and then along 87 m of fill slope to protect an area of approximately 1131 m^2.

58. The eight bioengineering techniques installed include concrete blocks with grass, palisades, brush layers, live fences, fascines and Vetiver grass lines. Seven of the bioengineering techniques involve vegetation using local plants such as blanket grass, tiger grass, and indigo berry, together with commercially available vetiver grass.

59. In addition, a drainage cascade was constructed from gabions to divert surface water away from the fill slope. Non-vegetated dry stone pitching and a live mini-check dam were used to protect the drain at the base of the fill slope.

60. Due to the unavailability of jute net and the tendency for rain to wash away grass seeds, jute net with seeding and mulch techniques were replaced with short grass and bamboo mesh.

61. Community members reported that they thought that bioengineering measures had positive effects on roadside slope protection. Regarding the performance of the plants, the residents pointed out that cuttings on fill and cut slopes were showing good signs of growth, but they also gave some recommendations for the selection and maintenance of plants in future.

3.7.3.1.1 Cost comparison

62. The total cost of roadside slope demonstration site in Lien Minh commune was 778 million VND ($37,000 USD). The unit cost was 206,681 VND per m^2 ($9.9 USD per m^2). Construction costs of pure bioengineering measures were very low compared to the cost of conventional techniques for slope protection using concrete tiles. As at SP31 in Son La, the lowest installed bioengineering technique was only 8.9% of the cost of conventional techniques, while the most expensive bioengineering technique was still only 25.5% of the cost of its conventional counterpart. A large proportion of the overall demonstration construction costs were for the hard measures such as the mortared masonry framework and the gabion cascade.

3.7.3.1.2 Community involvement and benefits

63. Local community members—including men, women, and ethnic minorities—were directly involved in the implementation of the demonstrations in Lien Minh Commune, Thai Nguyen. For example, they assisted the technical team in the selection of local plants for erosion control, specifically indigo berry, blanket grass and tiger grass.

64. 25 local workers were hired to construct the demonstration measures and to perform maintenance duties such as watering and trimming. Twenty of them were female and six were ethnic minorities. Their work time amounted to 1300 labour days at an average daily wage of 180,000 – 200,000 VND. This amount is higher than their average daily income generated from agriculture, and as such improved the income of many households in the commune significantly. Furthermore, the plants used to construct the techniques have subsistence value to the local community. For example, Tiger grass is used to make brooms and Vetiver grass is used as fodder. Once established, the plants will be of economic value to the community.

65. After the contractor finished the one-year maintenance period, the management responsibility was passed on to the commune. The local community is maintaining and repairing the measures themselves.

66. The upgrades to Nhau Pass will be to the direct benefit of 12,802 people living in Lien Minh and Trang Xa Communes.

3.8 RIVERBANK DEMONSTRATION SITES

67. Riverbank stability is necessary to avoid damage to crops in the adjacent floodplains, and more specifically, to individual farmer's fields and rural infrastructure next to river channels. Some erosion is inevitable unless rivers are fully "channelized", a highly expensive process with many negative consequences to habitats, ecosystems and downstream flood management. Instead, efforts should be made to keep or restore a healthy riparian zone using vegetation and natural materials. Healthy river systems will produce many benefits to local communities.

68. Bioengineering using local materials, such as rock and bamboo lattices helps stabilise banks and promotes growth with multiple advantages. The habitat for aquatic and other animals and birds are enlarged and the vegetation reduces flow velocity and damage potential during floods. Some species of vegetation on riverbanks also provide useful food, fibre or wood for communities. Another benefit of bioengineering approaches is greater self-reliance through local community monitoring, management and repair.

3.8.1 Thanh Mai Commune, Bac Kan Province (SP4)

69. Bac Kan Province is a scenic, mountainous region located north of Hanoi in the northeast midlands of Viet Nam. Dominated by forests, the area has numerous lakes, rivers and streams. The province experiences the typical tropical monsoon, with a rainy season from May to October. During this time the province receives the bulk of its annual rainfall with as much as 75 – 80% of the total average annual rainfall of 1,791 mm falling. Dry conditions are experienced from November to April.

70. The SRIDP Sub-project 4 (SP4) involves the construction of riverbank revetments using conventional techniques on different tributaries of Bac Kan Province's Cau River to protect adjacent agricultural land; one located in Thanh Mai Commune, and the other in Cao Ky Commune. Tributaries of the Cau River, which run through the communes, support local agriculture and livelihoods through the provision of fish, fresh water and sediment.

71. The SP4 bioengineering demonstration site is located in Ban Phat Village on the left bank of one of these tributaries, namely the Thanh Mai River, in Thanh Mai Commune. The catchment of the Thanh Mai River at Ban Phat village is 59.7 km^2. Average annual flows are low at roughly 1.6 m^3 per second. However, heavy rains at any time of the year can cause sudden floods with peak discharge of 300 m^3 per second or more and result in riverbank erosion and loss of productive agricultural land.

72. The demonstration is on a section of the riverbank that has been damaged during floods, and where resulting erosion threatens agricultural fields and an access track along the top of the bank. By stabilizing the riverbank and limiting erosion caused by annual flooding, the bioengineering measures will directly benefit the Ban Phat's 168 residents whose farmland lies adjacent to the site, though other commune residents who rely on the access track along the riverbank will also benefit.

73. The structural stability of the riverbank will increase as the plants' root systems establish. The measures will help to increase the resilience of the site - and the local communities which benefit from it - to increases in rainfall and flooding that are expected with climate change.

3.8.1.1 Demonstration measures at SP4

74. Seven riverbank protection techniques were selected for the 106 m stretch of Thanh Mai riverbank. Six involve vegetation; one to protect the toe of the bank (vegetated riprap) and five more to protect the slope. The techniques include brush layers, live poles, live fences, fascines and Vetiver grass lines. In addition, there is a short stretch of non-vegetated riprap in the riverbed where the fascines are located on the riverbank. In total, the demonstration site covers an area of 800 m^2.

75. Plants used in these bioengineering techniques include two local species—willow-leaved water croton and weeping fig - and Vetiver grass. The weeping fig did not grow well and was later replaced with willow-leaved water croton.

3.8.1.1.1 Cost comparison

76. The total construction cost of the SP4 Thanh Mai riverbank bioengineering demonstration measures was 624.5 million VND ($30,000 USD). The unit cost was 45 million VND/m ($219 USD/m). This equals only about 40% of the unit cost of the conventional riverbank protection measures applied at SRIDP SP4, involving revetments of 10 cm thick pre-cast concrete tiles enclosed in a reinforced concrete frame at 3 m spacing. The construction cost of pure bioengineering measures ranged from as low as 9.5% to 22.8% of the cost of conventional counterparts.

3.8.1.1.2 Community involvement and benefits

77. The local community made a large contribution to the implementation of the demonstration techniques throughout the process, from the selection of willow-leaved water croton and weeping fig as the most suitable plants to be used, to building the demonstration under the guidance of international and local experts, and also in monitoring.

78. In Thanh Mai commune, 50 local workers were hired to construct the demonstration measures. Of these, 35 were female, and 14 were ethnic minorities. Workers earned an average wage of 150,000 – 200,000 VND per day, amounting to 2000 labour days. This income contributed significantly to the improvement of many households. Since the contractor completed their one-year maintenance period, the commune's Women's Union was assigned to maintain and repair the measures. The local community participated actively in reviewing the performance of the demonstration measures.

3.8.2 Thom Mon and Chieng Ly Communes, Son La Province (SP32)

79. Located in Thuan Chau District of Son La Province, Thom Mon Commune is susceptible to heavy rains that can cause sudden flash floods. As with the rest of the project sites, Thuan Chau District's rainfall is distributed unevenly throughout the year, and the bulk (49%) of the annual 1317 mm is received in the relatively short period from July to September.

80. The heavy downpours result in riverbank erosion, which can have a severe impact on the agricultural community that make a living here. In Thuan Chau District there are three crops per year; two crops of rice and one of vegetables or corn. Some aquaculture is also practiced.

81. SRIDP carried out upgrading and rehabilitation of the headworks and intake structures for three small irrigation systems (total 174 ha) in the area, as well as the repair and upgrade of lined and earthen canals. The project also undertook the construction of a new weir, the upgrade of an existing one, and riverbank protection works using concrete and revetments on two tributaries of the Da River in Thuan Chau District (the Muoi and the Nhop streams). The revetments were to strengthen eroding riverbanks and thereby protect rice fields and agricultural land in the commune.

82. The demonstration area is on the bank of the Muoi stream, situated about 120 m upstream of the Phai Mon weir that was rebuilt by SRIDP. It was intended to extend the SRIDP left bank protection works above the weir which are subject to erosion during floods. The catchment of the Muoi stream is some 124 km^2 and average annual flows are low (approx. 1.92 m^3/s). However, heavy rains at any time of year can cause sudden floods with peak discharge of 150 m^3/s or more and inducing riverbank erosion and overtopping.

83. The total length of the bank protection with bioengineering techniques is 111 m. Of this, some 83 m is within Chieng Ly Commune and 28 m within Thom Mon Commune. Protecting the bank will protect adjacent farmland and houses, and will provide additional protection to the Phai Mon weir.

3.8.2.1 Demonstration measures at SP32

84. The demonstration measures at Thom Mon aim to protect the riverbank from bed scouring, bank erosion, and bank overtopping, which occur during flood events in the rainy season. Seven measures have been implemented along the 111 m of the Muoi stream to protect a total area of 750 m2. Six of these involve vegetation; one to protect the toe of the bank (vegetated riprap) and five to protect the slope. The height of the bank protection is designed for a flood return period of 10 years, taking climate change into account.

85. The non-vegetated technique entails gabion boxes and mattresses used for scour protection on the riverbed. Two gabion boxes, one on top of the other with a 0.5 m offset, were placed at the toe of the riverbank slope. The gabion mattresses were laid on the riverbed after the gabion boxes. A granular filter layer at the back of the gabion boxes and mattresses serve to retain the bank soil material.

86. Bioengineering techniques have also been applied for bank erosion/slope protection above the gabion mattress. These techniques include brush layers, live poles, live fences, Vetiver grass lines, and vegetated gabions.

87. The plants used in these bioengineering techniques also include two local species, namely Indian willow and willow-leaved water croton.

3.8.2.1.1 Cost comparison

88. Construction costs of pure bioengineering measures were very low in comparison to the cost of conventional techniques for slope protection using concrete tiles. The total cost of the Thom Mon demonstration was 958.7 million VND (about $46,000 USD). The unit cost was 6,369,921 VND/m (or $307 USD/m). Per individual technique, the cost of bioengineering techniques amounted to as low as 9.5% of their conventional counterpart, up to 22.8%.

89. Construction costs at Thom Mon were higher than at Thanh Mai (SP4) due to limited access to the site and manual transportation of construction materials. It should be noted that a very large part of the cost of the demonstration measures was for construction of gabion mattress and gabion box bed and bank protection; this was necessary to ensure that the works resist most predicted floods.

90. The major cost saving in using bioengineering techniques comes in the protection of the sloping part of the riverbank above the hard toe protection works. For example, conventional riverbank revetment comprises 10 cm thick pre-cast concrete tiles enclosed by a reinforced concrete (RC) frame at 3 m spacing, placed on a prepared slope at 1V:1.5H; bioengineering techniques used on similar slopes are Vetiver grass lines, live fences, brush layers and live poles, and are significantly less expensive per square meter.

3.8.2.1.2 Community involvement and benefits

91. Local community involvement was emphasized in the implementation process of the demonstrations at the Son La riverbank site. Community members assisted the technical team to select Indian willow and willow-leaved water croton as the most suitable local plants to be used. They formed the main workforce that constructed the measures.

92. In Thom Mon commune, 39 local workers were hired as construction workers. Fifteen of them were female and 36 ethnic minorities. Their work time amounted to 1720 labour days, and the average daily wage of 161,000 – 167,000 VND significantly improved the income of many households in the commune. As the Vetiver grass can be used as fodder, it adds further economic benefit to farmers with livestock.

93. In addition to construction work, local community members participated in site maintenance. After the contractor finished their one-year maintenance period, the site management was handed over to the commune. The households adjacent to the riverbank where the demonstrations are located are now maintaining the measures.

94. Finally, the local community actively engaged in reviewing the performance of the demonstration, such as the bioengineering techniques' effectiveness in protecting the riverbank and the growth of plants, and provided advice for future replication of the techniques.

95. Community members reported that the riverbank protection revetments remained intact and stable after two flood seasons while the plants continued to show strong growth. They also found that the bioengineering techniques positively contributed to riverbank protection and irrigation systems.

4 LESSONS LEARNED AND RECOMMENDATIONS

4.1 SUMMARY OF LESSONS LEARNED

96. Key "lessons learned" during the TA are noted below. It is important to point out that these are not new lessons – they are common to all low-cost slope protection projects everywhere in the world. Design and construction of the four demonstrations by this TA has reconfirmed their importance.

(i) Include bioengineering at the earliest stage of project planning.

(ii) Identify high-risk locations as early as possible in a project using proven vulnerability assessment and slope condition criteria.

(iii) Apply geotechnical knowledge to identification and analysis of specific slope problems, using low-cost geotechnical investigation procedures such as the Dynamic Cone Penetrometer.

(iv) Integrate hard and soft measures as appropriate to solve the problem.

(v) Recognise the limitations of bioengineering – it cannot fix deep slope failures.

(vi) Use local knowledge of plants to identify appropriate species, sources, replication methods and planting seasons.

(vii) Provide on-site supervision and quality control during construction to ensure that the correct materials and methods are used.

(viii) Give clear and simple design guidance.

(ix) Appraisal and approval of bioengineering designs is a challenge when no official standards exist for this purpose.

4.2 EFFECTIVE ACTIONS AND PROGRESS GAPS

97. The Promoting Climate Resilient Rural Infrastructure in Northern Vietnam project ran for four and a half years, and was the first of its kind in the country. Lessons emerging from the project will be helpful going forward. Whilst some are unique to Vietnam, most of the lessons learned from constructing the bioengineering demonstration sites in the mountainous region of northern Vietnam apply to all low-cost slope protection projects anywhere in the world.

4.2.1 Effective Actions

98. Applying the following actions will help to improve the implementation of any bioengineered slope stabilisation effort.

1. **Include bioengineering at the earliest stages of project planning**

   Generally the process of infrastructure planning begins with recognition of the need for a project and strategic prioritisation. This is followed by an investigation into preferred options, the development and design of a specific technical solution, and implementation.

   Bioengineering techniques should be considered during the first step in the infrastructure planning process to avoid unnecessarily selecting more expensive conventional engineering measures and to maximize the overall benefits of the bioengineered design solution.

2. **Identify high-risk locations as early as possible in project planning using proven vulnerability assessment and slope condition criteria**

   The initial assessment of potential project locations should include consideration of climate change effects and other natural hazards. Climate change is best considered at the pre-

feasibility through to the concept design stage of planning. As the focus of an infrastructure project narrows toward detailed design, the ability to consider climate threats and impacts and responses to them in a flexible and creative way is reduced. Defining the climate change threat (e.g. increased intensity and frequency of rainfall and associated runoff) can help identify which sectors and locations will be most vulnerable and therefore shape priorities and siting decisions. It can also help guide the design of infrastructure for optimum resilience to climate change. Once a project reaches the detailed design stage there is limited scope to incorporate climate change factors not considered at earlier stages of planning.

Assessing the suitability of slopes at sites for the application of bioengineering methods should also be conducted using criteria such as:

- Slope angle
- Nature of near-surface slope materials—soil or rock
- Potential for surface erosion
- Occurrence of and depth of slope instability

3. Apply geotechnical knowledge to identify and analyse specific slope problems using low-cost geotechnical investigation procedures such as the Dynamic Cone Penetrometer

Designing slope protection measures requires knowledge of parameters such as soil strength. This information is needed to ensure that the design solutions meet accepted engineering standards. Obtaining geotechnical data can be costly, but there are some useful low-cost techniques.

Project personnel conducted a low-cost geotechnical survey of the each demonstration site using a dynamic cone penetrometer (DCP). This hand-held equipment measures the strength of soils by checking their resistance to penetration by a standardised cone.

Each survey was carried out by:

a) Collecting documents related to the specific demonstration site, conducting visual field observations at each site, and preparing a survey implementation plan.
b) Testing the soil strength properties on road cuttings and riverbanks at each site using a DCP.
c) Analysing and reporting on the findings.

The data were then used as an input into designing the foundations and filter layers of the slope protection measures at all four sites.

4. Integrate grey and green measures to solve the problem

Both bioengineering and conventional civil engineering systems are often required on the same site to provide the most cost-effective and durable solution to a slope erosion problem. If conventional (“grey”) measures are installed first, this may rule out bioengineering (“green”) options, reduce slope resilience and increase costs. To provide the most effective, economic and sustainable solution, bioengineering measures must be integrated with conventional approaches at the planning stage and treated as an essential component or alternative to conventional, grey infrastructure.

In northern Vietnam most hill roads are engineered near to the margin of safety. The steep slopes, variable soils, and heavy rainfall result in frequent slope failures and blockages or loss of access. Along rivers, flooding often results in erosion of riverbanks and loss of farmland and riverside infrastructure. Under these conditions, bioengineering is an affordable and effective way to enhance civil engineering structures to protect them from erosion and increase their resilience. In this respect, bioengineering is a part of wise and

sustainable asset management as it helps to extend the life of physical structures and reduces overall maintenance costs.

5. **Recognise the limitations of bioengineering – bioengineering alone cannot fix deep slope failures**

   Plants and landscaping cannot replace all of the functions of civil engineering systems, particularly those that have effects deeper than about 0.5 metres. A plant's ability to meet engineering requirements also varies with the species and conditions of the site's climate, soil, aspect, and slope. For example, grasses are more suited to armouring the surface, while shrubs and trees fulfil functions such as reinforcing and supporting. Under many circumstances, bioengineering can be effectively combined with appropriate and low cost geotechnical applications (e.g. gabion support walls, gravel drainage systems) to provide the most cost-effective, integrated solution to slope stability problems.

   Under ideal conditions some plants can develop impressive root systems capable of reinforcing soil at depth. However root development is closely linked to the presence of penetrable soil conditions, and caution should be used when designing bioengineering measures since favourable conditions may not exist on at-risk slopes. Slopes with evidence of deep failure will require more costly measures that combine both conventional and green approaches. For example, at the roadside slope demonstration site in Son La, a section of the cut slope on one side of the road has a deep slope failure that threatens an electrical pylon; the project team decided that this slope could not be stabilised by bioengineering measures alone and would require conventional slope protection measures (e.g. drainage, toe support) as well.

6. **Use local knowledge of plants to identify appropriate species, sources, replication methods and planting seasons**

   The type of vegetation used in bioengineering solutions should suit the site's local conditions. For example, *Ficus benjamina* proved difficult to propagate at the riverbank sites and is not recommended for riverbank erosion control without further research.

   Adhering to the planting seasons of each plant species used in a bioengineering technique is very important. According to results from the project, the best season for planting woody species in northern Vietnam is in spring (January to March).

   Planting techniques applied are also important. For example, *Salix tetrasperma* cuttings (Indian willow) did not do very well when used in brush layers and instead should be should be planted vertically, and Vetiver grass does better when not frequently inundated. Proper plant spacing is always recommended for the best mechanical slope protection and subsequent plant growth.

   The use of local and environmentally friendly species (i.e. plants that are not invasive and do not spread) and plants that have economic benefits is recommended. For example, *Thysanolaena latifolia* (Tiger grass) s used to make brooms and Vetiver grass can be used as fodder.

   Bioengineered slope protection systems take time to develop to their full strength and effectiveness: the young plants are most vulnerable in their first year when their roots are just starting to grow and the soil is still loose following construction. At this early stage, intensive community watch and involvement is required.

   A final point is site access: this is necessary for easy care and maintenance, and should be taken into consideration during the design process.

4.2.2 Process Gaps

99. The following knowledge and policy gaps slowed progress in this project and should be taken into consideration in implementing bioengineering projects in Viet Nam and other regions.

7. **The importance of quality control during construction to ensure that the correct materials and methods are used**

   The methods and materials required for bioengineering were new and unfamiliar to construction workers. Despite clear drawings and specifications, the local contractors required significant support and supervision to ensure correct installation. In addition, locally manufactured materials such as galvanised wire for gabions were of low quality. These challenges highlight the need for close supervision and quality control during the construction process, including hands-on training of local engineers, technicians, foremen and workers.

8. **The need for clear and simple design guidance**

   The lack of official MARD and MoT technical standards is a major barrier to more widespread use of bioengineering in Viet Nam. One of the project's most significant achievements has been the creation of support within these two ministries for the development of official bioengineering standards. Project stakeholders concluded that the demonstrations could and should be replicated elsewhere in the country. The bioengineering demonstrations proved their effectiveness in erosion control, using locally available plants and materials and at lower costs than conventional measures. The demonstrations also proved that, with the support and instruction of experts, these simple techniques could be mastered and maintained by local residents.

9. **Appraisal and approval of bioengineering designs is a challenge when no official standards exist for this purpose.**

   Bioengineering is a new and untested technology in Vietnam, without any officially approved standards and regulations governing its implementation. Hence one of the key motivations behind this project was to promote the process of uptake through demonstration, training and development of sample specifications and other knowledge products. For this project, however, this meant that there were no official standards against which the government (MARD) could approve the design of the demonstrations — a classic catch-22 situation. This was overcome by commissioning an intermediary appraisal company to review the project team's designs and make a recommendation to the government.

   The unfamiliar nature of the technology, lack of official technical standards, and requirement for central government approval (a prerequisite for construction in this case) resulted in longer than expected approval times for the bioengineering designs. When combined with delays in obtaining access to sites and missed planting seasons, the original three-year project took four and a half years to complete.

4.3 GOING FORWARD

100. The widespread application of bioengineering measures in road and riverbank slope protection requires a number of integral steps to be successful. When designing and implementing an innovative infrastructure project like Promoting Climate Resilient Rural Infrastructure in Northern Vietnam, all steps in the framework—from research through to design standard reform—should be considered. This project focused on the first four of five key steps to successfully embedding bioengineering in Vietnam:

1. **Drafting** relevant specifications, procedures, and guidelines derived from procedures and lessons learned from other bioengineering installations;

2. **Dissemination** of bioengineering in specifications and guidelines to all levels from the central authority down to district levels;
3. **Training and capacity building** on bioengineering procedures among relevant authorities and groups;
4. **Up-take** of the demonstrated procedures in current, planned, and future infrastructure projects;
5. **Embedding** of technical specifications, designs, and procedures within official Ministerial and Government standards so that they become a mandatory consideration in all future projects.

101. Under this broad framework, there are **five main recommendations for moving toward acceptance of bioengineering as a mainstream slope protection measure**:

1. First, it is necessary to **initiate an applied research and demonstration program to generate locally specific knowledge of plants** appropriate for different bioengineering techniques, including detailed propagation methods such as size of cuttings and seasonality.
2. Second, it is necessary to **develop technical standards and cost norms** to allow engineers to apply the techniques within the administrative system that governs design procedures in Viet Nam.
3. Using knowledge generated by these first two recommendations, a third is to **create awareness and training programmes for engineers at all career levels**, from undergraduate students through practicing engineers and up to senior personnel.
4. A fourth recommendation would provide the opportunity for engineers, policy makers, and trainers to gain hands-on experience in bioengineering best practice: **bioengineering techniques should be applied to a major infrastructure project** (e.g. a major new road construction in hilly terrain, a road maintenance program in the mountains involving slope and drainage issues, or a large river-training project).
5. A fifth recommendation is to **facilitate knowledge sharing workshops and study tours** throughout South and South-east Asia so that policy makers and engineers can be exposed to international bioengineering practice, and can build a community of expertise around incorporating bioengineering into infrastructure development.

102. Ultimately there must be a framework like the one described here if the knowledge and experience gained from these four demonstrations is to be effectively disseminated. The local value of constructing these bioengineering demonstrations has been documented. With additional monitoring and evaluation and a framework within which their lessons can be communicated and applied, the influence of the lessons learned from these efforts will reach far beyond northern Vietnam.

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ANNEX 1. LIST OF TA TEAM MEMBERS

Table 4: List of TA Team Members

ID	Position	Team Member	Related Output
International			
1	Team Leader / Bioengineer	James Ramsay	All
2	Climate Change Adaptation Specialist	Jeremy Carew-Reid	Output 1
3	Civil Engineer	David Rojas, Jr.	Output 2
4	Geotechnical Specialist	Jasper Cook	Output 2
5	Trainer	Jasper Cook	Output 3
6	Social Specialist	Alain Lefebvre (R - Jens Sjorslev)	All
7	Communications Specialist	Petro Kotze	Output 3
National			
8	Deputy Team Leader/Agricultural Engineer	Nguyen Dinh Ninh	All
9	Civil Engineer	Nguyen The Hai (R - Nguyen Tran Thuat)	Output 2
10	Forester/Agronomist	Can Van Tho	Output 2
11	Geotechnical Engineer	Nguyen Thanh Long	Output 2
12	Meteorologist/Hydrologist	Vu Phuong Nam (R - H. Lan Huong)	Output 2
13	Trainer	Tran Tan Van	Output 3
14	Assistant Technical Trainer	Do Huan (R - Bach Tze Dung)	Output 3
15	Gender Specialist	Hoang Hong Hanh	All
16	Poverty Specialist	Le Thi Mong Phuong	All
17	Indigenous Peoples Specialist	Le Thi Mong Phuong	All
18	GIS Specialist	Mai Ky Vinh	All
19	Interpreter/Translator	Dam Thanh Hang	All

ANNEX 2. LIST OF TECHNICAL CORE GROUP MEMBERS

Table 5: List of Technical Core Group Members

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16	Hoang Thu Ha	APMB	0989 995 436	hoangthuha@apmb.gov.vn

ANNEX 3. ISSUES DURING TA IMPLEMENTATION

103. Key issues that arose during project are listed below, together with comments.

Table 6: Issues in chronological order

No.	Issue	Solutions	Comment
1.	ADB requires clarity in GoV ability to fund counterpart staff for participating in project activities outside Hanoi; this issue affected the July 2013 Son La workshop, resulting in postponement	• Interpret 'counterpart staff' as only CPMU staff; allow TA funding for other government staff including all members of the technical core group since these are TA beneficiaries and their involvement is essential to achieve the project Outcome	*Agreed*
2.	Technical Core Group not established yet	• Clarify the issue of support for counterpart and other government staff • When this is clear, CPMU to accelerate the process of issuing invitations to establish the Core Group	*Done: Group formally approved by MARD 02 Oct. 2013* *First meeting at VA Workshop. Nov. 2013, second at Riverbank Workshop Apr. 2015*
3.	Workshop invitations: the CPMU has made issuing invitations dependent on prior submission to the CPMU of all presentations, completed. This is impractical and results in delays in issuing the workshop invitations	• De-link issuing workshop invitations from completion of workshop presentations	*Done*
4.	TA social specialists' time and TA resources for fieldwork used up on first three sub-projects, since approval of the fourth site in a different province was not expected	• Review work plan and use unallocated time and contingency funds in future months, if necessary	*Resource use under continuous review by TA team management*
5.	Road-related demonstration measures can only be designed in detail and implemented when the road slopes have been rehabilitated by the road contractor; this is anticipated for some time in mid-2014	• Split the design and implementation process: focus on the river-related demonstration sites first, since these are not dependent on SRIDP construction schedules	*Done by TA team*
		• Give high priority to SRIDP sub-projects 31 and 34 (roads)	*Done by MARD - CPMU - SRIDP*
6.	Alteration of the river channel at Sub-project 32 (Son La) by flood flows in the 2013 rainy season may necessitate re-design of some SRIDP structures and relocation of the TA demonstration site	• Liaise closely with PPMU and LIC	*Done by TA team: adjacent site identified and agreed*

No.	Issue	Solutions	Comment
7.	TA international support staff not permitted to participate in fieldwork since they are not listed on the official ADB-GOV contract (a new issue arising in July 2013)	• Re-confirm that ICEM's project support staff are essential members of the TA team for delivery of the services and should be assisted by MARD, as was done in the first two quarters of 2013	*Done by a communication from ADB to CPMU in Oct. 2013*
8.	Although the SP32 demonstration site in Son La is entirely on the Left Bank of the river, local officials now say that the adjoining commune, Chieng Ly, extends across the river at this location and part of the TA site is actually in Chieng Ly Commune.	• Additional consultation to obtain the agreement of Chieng Ly Commune as well as Thom Mon Commune. TA team to visit Son La for further consultation (April 24)	*The site was chosen specifically because it was said by local officials to be entirely within Thom Mon Commune. Resolved by a site visit and consultation in April 2014*
9.	Delayed completion of concept design report and detailed design reports for the two riverbank sites.	• TA to focus all available resources on these reports	*Reports will now comprise (i) Feasibility Studies, and (ii) Contract Documents*
10.	Delays in design mean construction cannot start until after the 2014 rainy season.	• Build timing flexibility into the construction contracts and/or delay formal contractor mobilisation until after the rains	*In practice, these demonstrations were installed in the first half of 2015*
11.	Changes in the construction schedule affect the proposed 2014 training events which are centred on the demonstration measures.	• Re-schedule the training events and associated TA team inputs to coincide with construction in Q4 2014	*Done; in practice, 2015 and 2016*
12.	CPMU wishes to avoid "paying twice" for treatment of road slopes – once by SRIDP road contractor and once by TA contractor, and has asked that precise locations for road slope demonstration measures be determined now so these areas can be excluded from the road contractors' contracts	• The TA demonstration measures on road slopes involve treatment of small areas of untreated slopes created by the road contractors, to enhance slope stability and reduce erosion and consequent repair and maintenance costs. Their general location is known, but their precise location cannot be determined until after the slopes have been constructed. The TA needs to ensure that the CPMU has a clear understanding of this concept	*TA team to prepare clear description of decision process for determining precise location of demonstration measures on road slopes – see TR-6 Concept Design*
13.	Earthworks for the road sub-project in Thai Nguyen (SP34) by SRIDP have been delayed; design and approval of the TA's demonstration measures cannot commence until these have been completed.	• Revise the TA implementation schedule for this sub-project *or* switch to SP35, the adjacent sub-project where suitable slopes are available now. Note: as of mid-May 2015 the switch had been formally approved by Thai Nguyen PPMU and informally by the CPMU.	*The project has been extended to 02 December 2016, allowing time for construction and evaluation of the two roadside demonstrations in 2016*

No.	Issue	Solutions	Comment
14.	Construction of the road sub-project in Son La (SP31) by SRIDP did not start until May 2015, which delayed design and implementation of the TA demonstration measures at this site.	• Revise the TA implementation schedule for this sub-project and accelerate the design and approval process. Note: as of mid-July 2015 a cut-slope demonstration site became available.	
15.	The MARD approval process for the demonstration measure feasibility studies is very lengthy (around 4 months)	• Accelerate the MARD approval process.	*Both roadside demonstrations approved. The lengthy approval process had a significant impact on tasks and activities*
16.	SRIDP sub-contractor for SP35 has gone out of construction business	• Identify alternative SRIDP sub-contractor for TA demonstration construction.	*Done.*
17.	MARD approval of the SP35 demonstration was conditional, excluding a key hard slope protection measure	• Request MARD to reconsider this issue	*Request made to MARD by CPMU on 19 July 2016. Not approved*

ANNEX 4. OVERVIEW OF TA SPECIALIST INPUTS AND TIME USE

Table 7: Overview of TA Specialist Inputs and Time Use

Positions				Used						Allocated	Balance
				2013	2014	2015	2016	2017	Total		
International											
1	Team Leader / Bioengineer	Ramsay	Home	7	31	40	37	21	137	137	1
			Field	189	86	72	82	0	429	428	-2
2	Climate Change Specialist	Carew-Reid	Home	21	0	0	7	21	50	50	0
			Field	3	0	0	0	0	3	3	0
3	Civil Engineer	Rojas	Home	11	9	14	10	5	49	52	4
			Field	52	0	22	17	0	91	93	2
4	Geotechnical Specialist	Cook	Home	19	3	16	9	20	66	52	-14
			Field	5	0	7	4	0	16	16	0
5	Training Specialist	Cook	Home	32	9	6	12	29	87	87	0
			Field	1	0	4	29	6	39	53	14
6	Social Specialist	Lefebvre	Home	0	0	0	3	0	3	3	0
			Field	56	0	0	0	0	56	56	0
7	Communication Specialists	Beams	Home	0	0	0	0	56	56	51	-4
			Field	0	0	0	0	0	0	0	0
8	KP Peer Reviewer	Howell	Home	0	0	0	0	6	6	5	-1
			Field	0	0	0	0	0	0	0	0
Total			**Home**	**90**	**52**	**76**	**77**	**157**	**452**	**437**	**-15**
			Field	**306**	**86**	**105**	**132**	**6**	**633**	**649**	**15**
National											
7	Deputy Team Leader / Agricultural Eng.	Ninh	Home	204	229	152	184	35	803	813	10
			Field	31	18	47	47	9	151	141	-10
8	Agronomist / Forester	Tho	Home	17	0	3	2	5	26	27	1
			Field	11	0	9	22	9	51	40	-11
9	Civil Engineer	Hai	Home	0	0	0	0	0	0	10	10
			Field	0	0	0	20	0	20	26	6
10	Geotechnical Engineer	Long	Home	13	0	9	2	3	27	31	4
			Field	18	0	16	4	0	37	39	2
11	Technical Trainer	Van	Home	18	0	0	0	1	19	25	6
			Field	8	0	0	0	0	8	8	0
12	Indigenous Peoples Specialist	Phuong	Home	9	0	4	8	1	22	22	0
			Field	8	0	5	7	0	20	19	-1
13	Poverty Specialist	Phuong	Home	14	0	0	6	8	27	26	-1
			Field	10	0	1	7	3	21	22	1
14	Gender Specialist	Hanh	Home	11	0	0	0	10	21	21	0
			Field	8	0	0	0	0	8	7	0
15	Interpreter	Hang	Home	184	235	229	238	73	958	954	-4
			Field	8	6	9	7	0	29	29	0
16	Meteorologist / Hydrologist	Nam	Home	27	2	0	2	6	36	37	1
			Field	10	0	0	1	0	11	10	-1
17	GIS Specialist	Vinh	Home	15	9	14	6	6	49	49	0
			Field	7	0	0	1	0	8	7	-1
18	Assistant Technical Trainer	Do Huan	Home	0	0	4	4	3	11	25	14
			Field	0	0	5	3	0	8	23	16
Total			**Home**	**511**	**475**	**414**		**149**	**1998**	**2040**	**42**
			Field	**116**	**24**	**91**		**21**	**369**	**369**	**1**

ANNEX 5. SURVEYS AND SERVICES

Table 8: Surveys and services – proposals

Date	Item	Status
8 Oct 2013	Topographic Survey and DCP – Proposal	Approved by ADB 21 October 2013
29 Nov 2013	Detailed Design Drawings by Draftsman - Proposal	Approved by ADB 16 December 2013
20 July 2015	Topographic Survey and DCP – Proposal (SP35)	Approved by ADB 22 July 2015
26 Aug 2015	Geotechnical Measurements and Topographic Services for SP31	Approved by ADB 27 August 2015
25 July 2016	Installation of Biophysical Monitoring, Concrete Frame and Well at Sub-Project 35	Approved by ADB 26 July 2016
21 October 2016	Additional works at SP4	Approved by ADB 21 October 2016
21 October 2016	Additional works at SP32	Approved by ADB 21 October 2016
21 October 2016	Additional works at SP35	Approved by ADB 21 October 2016
31 October 2016	Installation of Biophysical Monitoring at Sub-Project 31	Approved by ADB 31 October 2016

Table 9: Surveys and services – status

No.	Item	Ordered	Completed	Status / Condition
1	Topographic surveys in Thanh Mai Commune, Cho Moi District, Bac Kan Province	28/10/2013	12/11/2013	Hardcopy report
2	Topographic surveys in Thom Mom Commune, Thuan Chau District, Son La Province	29/10/2013	11/11/2013	Hardcopy report
3	Geotechnical survey using DCP	28/10/2013	13/11/2013	Hardcopy report
4	Detailed design drawings by Draftsman	16/12/2013		Ongoing, as needed
5	Topographic surveys for SP35	24/7/2015	20/8/2015	Approved, with report
6	Geotechnical survey using DCP for SP35	24/7/2015	28/10/2015	Approved, with report
7	Topographic surveys for SP31	27/8/2015	21/10/2015	Approved, with report
8	Geotechnical survey using DCP for SP31	27/8/2015	10/12/2015	Approved, with report
9	Additional soil tests for SP31 and SP35	14/11/2015	10/12/2015	Approved, with report
10	Installation of Biophysical Monitoring, Concrete Frame and Well at Sub-Project 35	27/11/2016	06/08/2016	Approved following inspection
11	Additional works at SP4	22/10/2016		Approved
12	Additional works at SP32	22/10/2016	01/11/2016	Approved following inspection, with report (RSV 61)
13	Additional works at SP35	22/10/2016		Approved
14	Installation of Biophysical Monitoring at Sub-Project 31	31/10/2016	31/10/2016	Approved

ANNEX 6. KEY EVENTS AND MILESTONES

Table 10: Key events and milestones

Year / Date	Topic	Event / Milestone / Other
2012		
06.12	Consulting contract	Signing of contract
2013		
January – March 2013		
02.01	Consulting contract	Commencement of services, mobilisation of Deputy Team Leader
10.01	Consulting contract	Mobilisation of Team Leader
21-23.01	Fieldwork	Site visit – Bac Kan
31.03	Communication	Submission of Capacity Assessment Report of 3 MARD Agencies
30.01	Workshop	Launch workshop
26.02	Reporting	Submission of TR-1, Launch Workshop
27.02-01.03	Fieldwork	Site visit – Son La
19-20.03	Fieldwork	Site visit – Thai Nguyen
April – June 2013		
17.04	Reporting	Submission of PR-1, draft Inception Report
16-17.04	Fieldwork	Site visit – Bac Kan
23-24.04	Progress review	ADB Inception Mission
24.04	Workshop	Component 3 Inception Workshop
08.05	Fieldwork	Site visit – Hoa Binh
10.05	Reporting	Submission of PR-1, draft Inception Report, v2
14.05	Reporting	Submission of TR-2, Inception Workshop
20-24.05	Fieldwork	Site visit – Son La
27-29.05	Fieldwork	Site visit – Bac Kan
12-15.06	Fieldwork	Site visit – Son La
13.06	Reporting	Submission of PR-1, Inception Report (final)
24-25.06	Fieldwork	Site visit – Bac Kan
15.06	Facilities	Access to joint TA-UNDP office space
July – September 2013		
01-04.07	Fieldwork	Site visit – Son La
15.07	Project province	Approval of Thai Nguyen sub-project
25-26.07	Fieldwork	Site visit – Thai Nguyen
28-30.07	Fieldwork	Site visit – Son La
29.07	Reporting	Submission of PR-2, Quarterly Progress Report
31.07	Facilities	Start of operations from joint TA-UNDP office space
04-05.08	Fieldwork	Site visit – Bac Kan
07.08	Fieldwork	Site visit – Thai Nguyen
10.08	Training	Submission of proposal for Technical Core Group

Year / Date	Topic	Event / Milestone / Other
October – December 2013		
02.10	Training	Ministerial approval of proposal for Technical Core Group
16.10	Reporting	Submission of PR-3, Quarterly Progress Report
04-08.11	Workshop/Training	Vulnerability Assessment and Adaptation Response Workshop
13.11	Design	Receipt of topographic surveys and geotechnical data for river sites
19.11	Reporting	Submission of TR-4, Vulnerability Assessment and Adaptation Response Workshop (English)
30.11	Reporting	Submission of TR-3, Knowledge Development and Communications Plan (English)
12-14.12	Fieldwork	Site visit – Son La
16-17.12	Fieldwork	Site visit – Bac Kan
20.12	Reporting	Submission of TR-4, Vulnerability Assessment and Adaptation Response Workshop (Vietnamese)
27.12	Reporting	Submission of TR-5, Approaches to Building Climate Change Resilience in Rural Infrastructure (English)
2014		
January – March 2014		
07.01	Reporting	Submission of TR-3, Knowledge Development and Communications Plan (Vietnamese)
10.02	Reporting	Submission of PR-4, Quarterly Progress Report
20-22.03	Fieldwork	Site visit – Son La
24-25.03	Fieldwork	Site visit – Bac Kan
April – June 2014		
14.04	Reporting	Submission of TR-5 Approaches to Building Climate Change Resilience in Rural Infrastructure (Vietnamese)
14.04	Progress review	Submission of Position Paper for ADB review mission (English)
15-18.04	Progress review + Fieldwork	ADB Review Mission inc. field trip to Bac Kan and Thai Nguyen on 15-16.04
17.04	Progress review	Submission of Position Paper for ADB review mission (Vietnamese)
22.04	Training	Request for Technical Core Group Member replacement
22.04	Reporting	Submission of PR-5, Quarterly Progress Report
23-25.04	Fieldwork	Site visit – Son La
08-09.05	Fieldwork	Site visit – Thai Nguyen
15.05	Reporting	Submission of draft Mainstreaming Strategy (English)
28.05	Design	Submission of TR-6 Feasibility Study: Demonstration Measures at Sub-Project 4, Bac Kan (English)
23.06	Design	Submission of TR-6 Feasibility Study: Demonstration Measures at Sub-Project 4, Bac Kan (Vietnamese)
27.06	Reporting	Submission of PR-6, Quarterly Progress Report/Mid-Term Report (draft)
July – September 2014		
16.07	Reporting	Submission of PR-6, Quarterly Progress Report/Mid-Term Report
01.08	Design approval	Appraisal meeting of TR-6 Feasibility Study: Demonstration Measures at Sub-Project 4, Bac Kan

Year / Date	Topic	Event / Milestone / Other
06.09	Design	Submission of revised TR-6 Feasibility Study: Demonstration Measures at Sub-Project 4, Bac Kan (Vietnamese)
09.09	Workshop	UNDP component workshop: *Review Conference on Climate Change Policy and Adaptation Responses for Rural Infrastructure in the Northern Mountain Provinces of Viet Nam*
10.09	Design approval	Bac Kan: inspection of SP4 demonstration site by design appraisal company
October – December 2014		
15.10	Reporting	Submission of PR-7, Quarterly Progress Report
12.11	Design	Submission of TR-7 Feasibility Study: Demonstration Measures at Sub-Project 32, Son La (Vietnamese)
16-18.11	Design approval	Son La: inspection of SP32 demonstration site and also SP31 by design appraisal company
08-09.12	Fieldwork	Site visit – Thai Nguyen
12.12	Design	Thai Nguyen: submission of proposal to switch from SP34 to SP35
31.12	Design approval	Bac Kan: MARD approval of TR-6 Feasibility Study: Demonstration Measures at Sub-Project 4, Bac Kan
2015		
January – March 2015		
23.01	Procurement	Bac Kan: contract negotiations with construction company
04.02	Procurement	Bac Kan: submission of draft contract package for demonstration at SP4 (CD-1) to ADB for approval
17.02	Procurement	Bac Kan: ADB no-objection to CD-1 for demonstration at SP4
25-26.02	Procurement	Bac Kan: site visit for signing contract for demonstration at SP4
26.02	Construction	Bac Kan: start of SP4 construction contract
09.03	Design approval	Son La: MARD approval of TR-7 Feasibility Study: Demonstration Measures at Sub-Project 32, Son La
15-16.03	Construction	Supervision – SP4 Bac Kan
17.03	Procurement	Son La: contract negotiations with construction company
26-27.03	Construction	Supervision – SP4 Bac Kan
30.03	Procurement	Son La: submission of draft contract package for demonstration at SP32 (CD-2) to ADB for approval
30.03	Design	Thai Nguyen: re-submission of proposal to switch from SP34 to SP35
April – June 2015		
02-03.04	Construction	Supervision – SP4 Bac Kan
07.04	Mid-term review	Mid-term review kick-off meeting
08.04	Procurement	Son La: ADB no-objection to CD-2 for demonstration at SP32
11-12.04	Construction	Supervision and materials (vetiver grass) – SP4 Bac Kan
13.04	Mid-term review + Fieldwork	MTR mission field trip to Bac Kan
14-16.04	Procurement	Son La: site visit for signing contract for demonstration at SP32
17.04	Mid-term review	MTR wrap-up meeting
21-23.04	Workshop/Training	Bioengineering Workshop: Design and Construction (Riverbanks), Bac Kan

Year / Date	Topic	Event / Milestone / Other
05-10.05	Workshop	Da Nang – International Vetiver Workshop
14.05	Construction	Bac Kan SP4 – acceptance of riverbank construction
18.-20.05	Construction	Son La SP32: site visit – supervision
22.05	Reporting	Progress report to CPMU
25.05	Fieldwork	Thai Nguyen: site visit
27.05	Procurement	Bac Kan SP4: Biophysical monitoring installation contract
28.05	Fieldwork	Bac Kan SP4: site visit – supervision
30-31.05	Fieldwork	Thai Nguyen SP35: supervision of topo and DCP surveys
06-09.06	Construction	Son La: site visit – supervision
09-19.06	Construction	Son La: site visit – supervision
17-19.06	Construction	Son La: site visit – supervision
30.06	Procurement	Son La SP32: Biophysical monitoring installation contract
July-September 2015		
06-09.07	Construction	Son La SP32: site visit – supervision and monitoring; SP31 – inspection
12-14.07	Fieldwork	Son La SP31: site visit to identify specific demonstration sites
28.07	Fieldwork	Bac Kan SP4: site visit – monitoring
11-13.08	Construction	Son La SP32: acceptance of riverbank construction
29.08	Fieldwork	Thai Nguyen SP35: supervision of DCP survey
03.09	Project implementation	ADB decision to extend project by 11 months to 02 December 2016
04-07.09	Fieldwork	Son La SP31: supervision of topo and DCP surveys
10-11.09	Progress review + Fieldwork	ADB Review Mission: field trip to Son La SP32 and SP31
14.09	Progress review + Fieldwork	ADB Review Mission: field trip to Bac Kan SP4 and Thai Nguyen SP34/35
16.09	Progress review	ADB Review Mission: wrap-up meeting
17.09	Consulting contract	ADB approval of VO#9 covering 11 month project extension
21.09	International cooperation	Presentation of TA to UNDP delegates from Timor Leste
22-24.09	International cooperation – fieldwork	Introducing demonstrations at SP4 Bac Kan and SP32 Son La to delegates from Timor Leste
29.09	Fieldwork	Thai Nguyen SP34 – visit for detailed design
October-December 2015		
02.10	Fieldwork	Bac Kan SP4 – monitoring
08.10	Fieldwork	Thai Nguyen SP34/35 – design
04.11	Fieldwork	Thai Nguyen SP34/35 – review by APMB + CPMU
19.11	International cooperation – fieldwork	Introducing demonstration at SP4 Bac Kan to delegates from UNDP Bangkok
25-26.11	Fieldwork	Thai Nguyen SP34/35 – consultation
30.11-02.12	Fieldwork	Son La SP32 – monitoring
08-10.12	Fieldwork	Son La SP31 – visit for detailed design
18.12	Design	Submission of TR-9 Feasibility Study: Demonstration Measures at Sub-Project 34, Thai Nguyen (English & Vietnamese)

Year / Date	Topic	Event / Milestone / Other
2016		
January – March 2016		
16.01	Design	Submission of TR-10 Feasibility Study: Demonstration Measures at Sub-Project 31, Son La (English & Vietnamese)
10.03	Design	Submission of revised TR-10 to CPMU (hard copy)
30.03	Design	Submission of final clarifications of TR-9
April – June 2016		
06.04	Reporting	Submission of TR-11 Initial Monitoring Report for Riverbank Bioengineering Demonstrations at SP4 Bac Kan and SP32 Son La
27.04	Design approval	Thai Nguyen: MARD conditional approval of TR-9 Feasibility Study: Demonstration Measures at Sub-Project 35, Thai Nguyen
19.05	Procurement	Thai Nguyen: SP35 procurement approval by ADB
20.05	Construction	Thai Nguyen: start of work on SP35 demonstration by contractor
23.05	Construction	Thai Nguyen: site visit for official start of construction of demonstration at SP35
23.05	Design approval	Son La: MARD conditional approval of TR-10 Feasibility Study: Demonstration Measures at Sub-Project 31, Son La
25.05	Progress review + Fieldwork	ADB Review Mission: field trip to Thai Nguyen SP35
30.05-01.06	Construction	Thai Nguyen SP35: site visit – vetiver planting
07.06	Hand-over	Bac Kan: official hand-over of demonstration at SP4 to province
08-09.06	Construction	Thai Nguyen SP35: site visit – construction and planting
09.06	Review mission	ADB Review Mission wrap-up meeting
12-14.06	Workshop/Training	Bioengineering Workshop: Design and Construction (Roads), Thai Nguyen
21.06	Procurement	Son La: SP31 procurement approval by ADB
24-25.06	Construction	Thai Nguyen: SP35 site visit – cut slope construction and planting
28.06	Construction	Son La: site visit for official start of construction of demonstration at SP31
July – September 2016		
01.07	Construction	Son La: start of work on SP31 demonstration by contractor
07-08.07	Monitoring	Bac Kan: SP4 site visit for monitoring; Thai Nguyen: SP35 site visit to install monitoring system markers
18.07	Meeting	CPMU: Project Progress meeting
22.07	Construction	Thai Nguyen: SP35 construction inspection and supervision
04-05.08	Construction	Thai Nguyen: SP35 site visit – preparation for acceptance
17-18.08	Workshop/Training	UNDP component workshop
19.08	Construction	Thai Nguyen: SP35 – acceptance of roadside demonstration construction
01.09	Training	Thai Nguyen: SP35 – visit by Transport University
11-13.09	Social evaluation	Bac Kan: SP4 social evaluation
14-15.09	Social evaluation	Thai Nguyen: SP35 social evaluation
18-20.09	Social evaluation	Son La: SP32 social evaluation
21.09	Hand-over	Son La: SP32 – official hand over of demonstration to Thuan Chau District
October-November 2016		

Year / Date	Topic	Event / Milestone / Other
01-03.10	Construction	Son La: SP31 construction supervision
04-06.10	Workshop/Training	Lessons Learned Workshop, Hanoi
14-15.10	Construction	Son La: SP31 site visit
20-24.10	Construction	Son La: SP31 site visit
26-27.10	Construction/Maintenance	Final works at SP35 and maintenance at SP4
31.10-02.11	Construction	Son La: SP31 – acceptance of roadside demonstration construction
04.11	Review mission	Thai Nguyen: SP35 – visit by UNDP project review mission
07-09.11	Review mission	Son La: SP31 and SP32 – visit by UNDP project review mission
10.11	Training evaluation	Wrap-up meetings with core group members of DWR, DSTE and DCM
24.11	Review mission	ADB Review Mission: kick-off meeting
25-26.11	Review mission fieldwork	ADB Review Mission field trip to SP31 Son La
29.11	Review mission	ADB Review Mission: wrap-up meeting
02.12	Consulting contract	End of TA
09.12	Consulting contract	Extension of TA to 31 May 2017
2017		
January – March		
26-29.03	Construction	Son La: SP31 site visit
April – May		
13-16.04	Monitoring/evaluation	Son La: SP31 social assessment; SP32 inspection
04.05	Workshop/Training	Wrap-up Workshop, Hanoi
15-17.05	Monitoring	Son La: SP31 and SP32 site visits for monitoring
18.05	Monitoring	Bac Kan: SP4 site visit for monitoring
19.05	Monitoring	Thai Nguyen: SP35 site visit for monitoring
31.05	Consulting contract	End of TA

ANNEX 7. MEETINGS

104. The following table gives an overview of meetings held since the commencement of the TA, excluding conference calls, fieldwork and internal team meetings. Minutes have been prepared by the TA for the meetings indicated in the column "MoM".

Table 11: List of Meetings

No.	Date	Time	Topic	MoM
2013				
January – March 2013				
1	02.01.2013	0900	CPMU: initial planning and coordination meeting	
2	02.01.2013	1100	LIC: initial coordination meeting	
3	11.01.2013	1400	CPMU: introduction of TA staff	
4	14.01.2013	1500	UNDP: introduction of TA staff, coordination	
5	14.01.2013	1600	CPMU: coordination with ADB, LIC	
6	14.01.2013	1700	LIC: introduction of TA staff	
7	15.01.2013	0900	Vietnam Academy for Water Resources: capacity assessment	
8	15.01.2013	1400	Water Resources University: capacity assessment	
9	16.01.2013	0900	Institute of Water Resources Planning: capacity assessment	
10	17.01.2013	1330	CPMU: coordination	
11	24.01.2013	1630	CPMU: fieldwork debrief, launch workshop planning	
12	31.01.2013	1200	CPMU: liaison ADB	
13	06.02.2013	0800	ADB: liaison	
14	19.02.2013	1500	CPMU: coordination with LIC	Y
15	22.02.2013	1200	ICEM: coordination with NMPRP2	
16	11.03.2013	1600	CPMU: inception workshop planning, GEF reporting and UNDP coordination	
17	13.03.2013	0930	LIC: coordination with LIC on sub-project options	
18	13.03.2013	1400	ICEM: coordination with Second Northern Mountains Poverty Reduction Project (NMPRP2)	Y
19	18.03.2013	1600	CPMU: workshop administration	
20	25.03.2013	1700	CPMU: workshop planning, sub-projects, reporting	Y
21	27.03.2013	1400	CPMU+PPMU Bac Kan & LIC: re-design of sub-project #4	Y
April – June 2013				
22	03.04.2013	1000	MARD: liaison Dept. of Dyke Management & Flood, Storm Control	
23	08.04.2013	1600	CPMU: workshop planning	
24	22.04.2013	0930	CPMU: workshop planning	
25	23.04.2013	1400	ADB: safeguard policies and procedures	Y
26	24.04.2013	1400	CPMU+ADB+UNDP: coordination	Y
27	24.04.2013	1545	ADB+UNDP: coordination – technical issues	Y
28	25.04.2013	1215	ADB: coordination	Y
29	25.04.2013	1645	ADB: climate resilience and transport	Y
30	02.05.2013	1000	LIC: social safeguards	
31	04.05.2013	0900	CPMU: inception report comments	Y
32	16.05.2013	1400	LIC: soft copies of sub-project design documents	

No.	Date	Time	Topic	MoM
33	31.05.2013	1600	CPMU: Thai Nguyen sub-project	
34	20.06.2013	1600	CPMU: Thai Nguyen sub-project	
35	24.06.2013	1500	CPMU: inception report submission	
36	24.06.2013	1600	CPMU: project office	
July – September 2013				
37	01.07.2013	1400	CPMU: vulnerability assessment workshop planning	
38	03.07.2013	1400	CPMU+UNDP+VAWR: demonstration site monitoring by VAWR	Y
39	08.07.2013	1400	CPMU+Dept. of Construction Management: approval of Thai Nguyen site	
40	08.07.2013	1500	CPMU: workshop planning, core group, project office	
41	15.07.2013	1000	CPMU: workshop administration	
42	16.07.2013	0815	CPMU+VAWR: monitoring	
43	16.07.2013	1430	CPMU: workshop budget and counterpart staffing	
44	22.07.2013	1500	LIC: briefing TA engineers	
45	23.07.2013	1000	CPMU: work planning and administration	
46	02.08.2013	0830	MARD Directorate of Water Resources: KDCS needs assessment	
47	02.08.2013	1000	MARD DOSTE: KDCS needs assessment	
48	02.08.2013	1330	MARD Dept. of Construction Management: KDCS needs assessment	
49	05.08.2013	1330	CPMU+UNDP+TA: first monthly coordination meeting	Y
50	27.08.2013	1430	UNDP: Terms of Reference for UNDP components	Y
51	05.09.2013	1330	CPMU+UNDP+TA: monthly coordination meeting	Y
52	10.09.2013	1530	CPMU: Technical Core Group planning	
53	20.09.2013	1500	UNDP: hydrological data sharing	
54	24.09.2013	1500	UNDP: vulnerability assessment documents	
October – December 2013				
55	10.10.2013	1030	CPMU: workshop, planning & administration	
56	14.10.2013	1040	LIC: coordination	
57	14.10.2013	1600	CPMU: workshop planning	
58	18.10.2013	1030	ADB: case study for TA 6422-REG	
59	31.10.2013	1500	CPMU: workshop planning	
60	01.11.2013	1530	UNDP: climate change vulnerability assessment approaches	
61	12.11.2013	1000	VAWR-IWE: monitoring and evaluation	Y
62	18.11.2013	1300	UNDP: climate change vulnerability assessment approaches	
63	20.11.2013	0830	UNDP: internal workshop on UNDP components	
64	21.11.2013	0830	UNDP: external workshop on UNDP components	
65	25.11.2013	1630	CPMU: progress review	
66	03.12.2013	1500	CPMU: provision of extra project documents	
67	10.12.2013	0830	Ministry of Transport: ADB workshop on vulnerability assessment for transport projects	
68	11.12.2013	0830	Ministry of Transport: ADB workshop second day	
2014				
January – March 2014				

No.	Date	Time	Topic	MoM
69	25.01.2014	1500	LIC: status of SRIDP sub-projects	
70	14.02.2014	0830	CPMU: progress review	
71	26.02.2014	1500	CPMU: meeting with ADB re project progress	
72	07.3.2014	1600	CPMU: capacity of VAWR-IWE for procurement of demonstration measures	Y
73	14.3.2014	1600	CPMU: submission of draft detail design drawings of two river sites	
April – June 2014				
74	08.04.2014	0845	CPMU: project progress and planning for ADB review mission	
75	10.04.2014	1600	CPMU: planning for ADB review mission	
76	14.04.2014	0900	CPMU: project progress and planning for ADB review mission	
77	15.04.2014	0900	MARD: ADB review mission kick-off meeting	
78	15.04.2014	1000	CPMU: ADB review mission	
79	17.04.2014	1030	ADB: project status and forward planning	
80	17.04.2014	1330	CPMU: ADB review mission tripartite meeting (director-level)	
81	17.04.2014	1500	CPMU: ADB review mission tripartite meeting with TA on Aide Memoire	
82	18.04.2014	0900	MARD: ADB review mission wrap-up meeting	
83	12.05.2014	1500	UNDP: project status and coordination	
84	22.05.2014	1500	CPMU: project status up to May	Y
85	10.06.2014	0800	UNDP workshop: methodology for component implementation	
86	11.06.2014	0900	UNDP: documents to share between components	
July – September 2014				
87	22.07.2014	1000	CPMU: FS appraisal and approval process	
88	01.08.2014	0800	Dept. of Construction Management: TR-6 appraisal	Y
89	05.08.2014	0900	CPMU: FS appraisal company selection	
90	11.09.2014	0900	CPMU: Thien Nam company – TR-6 appraisal	
91	16.09 2014	0900	Thien Nam company – TR-6 appraisal	
92	24.09.2014	0900	Thien Nam company – TR-6 appraisal	
93	30.09.2014	0900	CPMU: Thien Nam company – TR-6 appraisal	
October – December 2014				
94	7.10.2014	1400	UNDP: technical coordination	
95	16.10.2014	900	Thien Nam company – TR-6 appraisal	
96	05.11.2014	1100	CPMU: situation review	
97	19.11.2014	0900	Thien Nam company – TR-7 appraisal	
98	25.11.2014	0900	Thien Nam company – TR-7 appraisal	
99	26.11.2014	1400	Thien Nam company – TR-7 appraisal	
100	28.11.2014	1515	CPMU: TR-6, TR-7 appraisals and road site delays	
101	02.12.2014	0900	Thien Nam company – TR-7 appraisal	
102	03.12.2014	1500	UNDP: status update and coordination	
103	03.12.2014	1630	CPMU: alternative road sites	
104	04.12.2014	1230	ADB: project status update	
105	04.12.2014	1600	UNDP: technical coordination	

No.	Date	Time	Topic	MoM
106	05.12.2014	1030	CPMU: ADB review of project status and way forward	
107	10.12.2014	0830	DCM: TR-6 appraisal	
108	10.12.2014	1400	Thien Nam company – TR-6 appraisal	
109	29.12.2014	1600	Department of Embankment Management – TR-6 appraisal	
110	30.12.2014	1000	MARD administration – TR-6 appraisal	
111	31.12.2014	1400	DCM: TR-6 design approval decision	
2015				
January – March 2015				
112	28.01.2015	0900	DCM: TR-7 design approval	
113	13.02.2015	0900	Thien Nam company: TR-7 appraisal	
114	24.02.2015	1000	DCM: TR-7 design approval decision	
115	25.02.2015	1000	Project office: signing of SP4 construction contract	
116	26.02.2015	0830	Thanh Mai commune: start of SP4 construction	
117	17.03.2015	1400	Project office: Negotiation meeting with Thanh Tung company	
118	26.03.2015	1000	CPMU: CD-2 progress and MTR preparation	
April – June 2015				
119	07.04.2015	1330	UNDP HQ: Mid-Term Review kick-off meeting	
120	08.04.2015	1400	CPMU: SP34 Thai Nguyen – status and timing	
121	09.04.2015	0900	Mid-term review planning meeting	
122	10.04.2015	1000	Project office: signing of SP32 construction contract	
123	15.04.2015	1030	Thom Mon commune: start of SP32 construction	
124	17.04.2015	1015	CPMU: SP34 demonstration location, workshop logistics	
125	17.04.2015	1330	APMB: Mid-Term Review wrap-up	
126	24.04.2015	1500	UNDP: coordination of reports	
127	14.05.2015	0900	Thom Mon commune: Acceptance of SP4 riverbank construction	
128	19.05.2015	0900	Thanh Tung company: construction supervision	
129	25.5.2015	1600	CPMU Thai Nguyen: switch to SP35	
130	10.6.2015	0900	Thanh Tung company: construction supervision	
131	18.6.2015	0900	Thanh Tung company: construction supervision	
132	26.6.2015	0900	CPMU: project progress	
133	30.6.2015	0900	Thanh Tung company: monitoring system installation contract	
July-September 2015				
134	8.7.2015	0800	Thanh Tung company: construction supervision	
135	14.7.2015	0800	PPMU Son La: SP31	
136	12.8.2015	0830	Acceptance of SP32 construction in Thom Mon	
137	13.8.2015	0900	Thanh Tung company: documents for payment	
138	20.8.2015	0900	Construction company 306: SP31 topo survey contract	
139	26.8.2015	0900	Acceptance of SP35 topo survey contract	
140	09.09.2015	0830	APMB: ADB review mission kick-off meeting	
141	09.09.2015	1040	APMB: CPMU/ADB/UNDP/TA coordination meeting	
142	16.09.2015	1000	APMB: ADB review mission wrap-up meeting	
143	25.09.2015	1000	UNDP: coordination planning	

No.	Date	Time	Topic	MoM
October-December 2015				
144	01.10.2015	1400	UNDP: coordination planning	
145	02.10.2015	0900	UNDP: communications coordination	
146	23.11.2015	14.00	Thien Nam company: contract adjustment	
147	26.11.2015.	16.00	Son Phat company: construction of SP34 Thai Nguyen	
148	09.12.2015	16.00	Thanh Tung company: O&M of SP32 Son La	
149	21.12.2015	08.00	CPMU: submission of TR-9 (hard copy)	
150	29.12.2015	14.00	Thien Nam company: appraisal of TR-9	
2016				
January-March 2016				
151	07.01.2016	08.30	Hung Kieu company: O&M of SP4 Bac Kan	
152	15.01.2016	08.30	Thien Nam company: contract adjustment	
153	18.01.2016	08.00	CPMU: submission of TR-10 (hard copy)	
154	26.01.2016	08.30	APMB: workshop – overall GEF project recommendations and progress review	
155	03.02.2016	08.30	Dept. of Construction Management: appraisal meeting for SP35 Thai Nguyen	
156	22.02.2016	08.30	DCM: appraisal meeting for SP31 Son La	
157	08.03.2016	14.00	CPMU-ICEM-UNDP: progress review meeting	
158	10.03.2016	08.30	CPMU: submission of revised TR-10 (hard copy)	
159	14.04.2016	10.00	CPMU: meeting Thai Nguyen PPMU re SP35 sub-contractor	Y
April-June 2016				
160	14.04.2016	13.30	UNDP: Training course	
161	21.04.2016	13.30	UNDP: Training course	
162	05.05.2016	14.00	Negotiation of CD-3	
163	10.05.2016	08.30	CPMU: Progress review meeting	
164	24.05.2016	0830	APMB: ADB review mission kick-off meeting	
165	01.06.2016	-	Thien Son Technology Corp.: submission of proposal for SP31 Son La	
166	09.06.2016	1100	APMB: ADB review mission wrap-up meeting	
167	17.06.2016	10.00	Payment for Thien Nam company	
168	22.06.2016	10.00	Signing of CD-4	
169	28.06.2016	09.00	Start-up of construction at SP31 Son La	
Jul-Sep 2016				
170	18.07.2016	14.00	CPMU: project progress meeting	
171	18.08.2016	08.00	UNDP component: workshop in Bac Kan	
172	01.09.2016	10.00	Thai Nguyen: Transport University training in visit SP35	
173	30.09.2016	09.00	UNDP: review of UNDP videos and film scripts	
Oct-Dec 2016				
174	18.10.2016	08.00	APMB: GEF project progress review and closure	Y
175	10.11.2016	08.00	Wrap-up meetings with core group members of DWR, DSTE and DCM	
176	10.11.2016	14.00	UNDP: draft report of UNDP project review mission	
177	24.11.2016	10.30	APMB: ADB review mission kick-off	
178	29.11.2016	15.00	CPMU: ADB review mission wrap-up	
179	05.12.2016	08.00	Close the project office in Thuy Khue street	

No.	Date	Time	Topic	MoM
2017				
Jan-May 2017				
	13.04.2017	11.00	ADB: review of technical reports	
	15.04.2017	08.00	Meeting for Social evaluation for SP31	
	17.04.2017	15.00	CPMU: review of technical reports	
	05.05.2017	08.00	The final workshop	
	19.05.2017	08.00	Transfer SP35 to Thai Nguyen PPMU	

ANNEX 8. FIELDWORK

105. The following table gives an overview of site visits since the commencement of services. Records have been prepared for the site visits indicated in the column "RSV".

Table 12: Site visits

No.	Date	Topic	RSV	Status
	2013			
1	21-23.01.2013	Bac Kan: familiarisation	01	Submitted
2	27.02-01.03.2013	Son La: familiarisation	02	Submitted
3	19-20.03.2013	Thai Nguyen: sub-project re-selection	03	Submitted
4	16-17.04.2013	Bac Kan: team fieldwork	04	Submitted
5	08.05.2013	Hoa Binh: field-testing geotechnical methodology	05	Submitted
6	20-24.05.2013	Son La: social and technical fieldwork	06	Submitted
7	27-29.05.2013	Bac Kan: social and technical fieldwork	07	Submitted
8	12-15.06.2013	Son La: climate change fieldwork	08	Submitted
9	24-25.06.2013	Bac Kan: social and climate change fieldwork	09	Submitted
10	01-04.07.2013	Son La: social fieldwork	10	Submitted
11	25-26.07.2013	Thai Nguyen: baseline assessment and consultation	11	Submitted
12	28-30.07.2013	Son La: concept design	12	Submitted
13	04-05.08.2013	Bac Kan: concept design	13	Submitted
14	07.08.2013	Thai Nguyen: concept design	14	Submitted
15	01-02.11.2013	Bac Kan: survey supervision	-	-
16	04-06.11.2013	Son La: survey supervision	-	-
17	12-14.12.2013	Son La: survey supervision and fieldwork	15	Submitted
18	16-17.12.2013	Bac Kan: survey supervision and fieldwork	15	Submitted
	2014			
19	20-22.03.2014	Son La: detailed design and preparation for construction of SP32	16	Submitted
20	24-25.03.2014	Bac Kan: detailed design and preparation for construction of SP4	17	Submitted
21	15-16.04.2014	Bac Kan and Thai Nguyen: SP4 and SP34 site visits by ADB Review Mission	18	Submitted
22	23-25.04.2014	Son La: SP32 detailed design	19	Submitted
23	08-09.05.2014	Thai Nguyen: SP34 earthworks status	20	Submitted
24	10.09.2014	Bac Kan: SP4 site inspection by design appraisal staff	-	-
25	16-18.11.2014	Son La: SP32 and SP31 site inspection by design appraisal staff	-	-
26	08-09.12.2014	Thai Nguyen: SP34 and SP35 earthworks status and alternative sites	21	Submitted
	2015			
27	25-26.02.2015	Bac Kan: SP4 signing construction contract and start of construction	22	Submitted

No.	Date	Topic	RSV	Status
28	15-16.03.2015	Bac Kan: SP4 construction supervision	23	Submitted
29	26-27.03.3015	Bac Kan: SP4 construction supervision	24	Submitted
30	02-03.04.2015	Bac Kan: SP4 construction supervision	25	Submitted
31	11-12.04.2015	Bac Kan: SP4 construction supervision and materials	26	Submitted
32	13.04.2015	Bac Kan: SP4 Mid-Term Review mission	27	Submitted
33	14-16.04.2015	Son La: SP32 signing construction contract and start of construction; SP31inspection	28	Submitted
34	13-14.05.2015	Bac Kan: SP4 check and take over completed work	29	Submitted
35	18-20.05.2015	Son La: SP32 construction supervision	30	Submitted
36	25.05.2015	Thai Nguyen: SP35 inspection of proposed site	31	Submitted
37	28-29.05.2015	Bac Kan: SP4 construction supervision and monitoring	32	Submitted
38	30-31.05.2015	Thai Nguyen: SP35 survey supervision	-	-
39	17-19.06.2015	Son La: SP32 construction supervision	33	Submitted
40	09-19.06.2015	Son La: SP32 construction supervision	34	Submitted
41	06-09.07.2015	Son La: SP32 construction supervision, installation of monitoring equipment, photographic / video monitoring, collecting video footage of SP31 and 32	35	Submitted
42	12-14.07.2015	Son La: SP31 inspection of proposed demonstration site	36	Submitted
43	28.07.2015	Bac Kan: SP4 monitoring	37	Submitted
44	11-13.08.2015	Son La: SP32 check and takeover of completed work	38	Submitted
45	29.08.2015	Thai Nguyen: SP35 survey supervision	-	-
46	04-07.09.2015	Son La: SP31 survey supervision	-	-
47	10-11.09.2015	Son La: SP32 and SP31 site visits by ADB Review Mission	39	Submitted
48	14.09.2015	Bac Kan (SP4) and Thai Nguyen (SP34/35): site visits by ADB Review Mission	40	Submitted
49	22-24.09.2015	Bac Kan (SP4) and Son La (SP32): site visit by delegates from Timor Leste (UNDP South-South Cooperation)	41	Submitted
50	29.09.2015	Thai Nguyen: SP34/35 detailed design	42	Submitted
51	02.10.2015	Bac Kan: SP4 biophysical monitoring	43	Submitted
52	08.10.2015	Thai Nguyen: SP34/35 detailed design	44	Submitted
53	04.11.2015	Thai Nguyen: SP34/35 status review	45	Submitted
54	19.11.2015	Bac Kan: SP4 site visit by delegates from UNDP Bangkok	46	Submitted
55	25-26.11.2015	Thai Nguyen: SP34/35 consultations	47	Submitted
56	30.11-02.12.2015	Son La: SP31 detailed design	48	Submitted
57	08-10.12.2015	Son La: SP32 biophysical monitoring	49	Submitted
	2016			
58	22-23.05.2016	Thai Nguyen: SP35 official start	50	Submitted

No.	Date	Topic	RSV	Status
59	25.05.2016	Thai Nguyen: SP35 visit by ADB Review Mission	51	Submitted
60	30.05-01.06.2016	Thai Nguyen: SP35 site visit – vetiver planting	-	
61	07-08.06.2016	Bac Kan: official hand-over of demonstration at SP4 to province	52	Submitted
62	08-09.06.2016	Thai Nguyen: SP35 site visit – construction and planting	-	-
63	13.06.2016	Thai Nguyen: SP35 site visit by (i) ADB+CPMU, (ii) workshop participants	TR-12	Submitted
64	24-28.06.2016	Thai Nguyen: SP35 site visit – construction and planting	53	Submitted
65	27-29.06.2016	Son La: SP31 official start	54	Submitted
66	06-13.07.2016	Son La: SP31 construction supervision	-	
67	07-08.07.2016	Bac Kan & Thai Nguyen: monitoring	55	Submitted
68	18-22.07.2016	Son La: SP31 construction supervision	-	
69	05-06.08.2016	Thai Nguyen: SP35 progress	56	Submitted
70	08-14.08.2016	Son La: SP31 construction supervision	-	
71	19.08.2016	Thai Nguyen: SP35 progress	57	Submitted
72	01.09.2016	Thai Nguyen: SP35 visit by Transport University	-	
73	11-15.09.2016	Bac Kan & Thai Nguyen: SP4 and SP35 effectiveness audit	TR-14	Submitted
74	18-21.09.2016	Son La: SP31 and SP32 effectiveness audit	TR-14	Submitted
75	01-03.10.2016	Son La: SP31 construction supervision (planting)	-	
76	05.10.2016	Thai Nguyen & Bac Kan: SP35 and SP4 site visits by workshop participants	TR-13	Submitted
77	13-15.10.2016	Son La: SP31 construction inspection, SP32 maintenance inspection	58	Submitted
78	20-24.10.2016	Son La: SP31 construction supervision, SP32 finishing works, communications	59	Submitted
79	26-27.10.2016	Thai Nguyen & Bac Kan: SP35 and SP4 finishing works	60	Submitted
80	31.10-02.11.2016	Son La: SP31 – acceptance of road construction	61	Submitted
81	04.11.2016	Thai Nguyen: SP35 visit by UNDP review mission	-	
82	07-09.11.2016	Son La: SP31 & SP32 visit by UNDP review mission	-	
83	09.11.2016	Thai Nguyen: SP35 construction inspection	-	
84	17-18.11.2016	Bac Kan: SP4 maintenance inspection	-	
85	25-26.11.2016	Son La: SP31 visit by ADB review mission & SP32 maintenance inspection	-	
	2017			
86	26-29.03.2017	Son La: SP31 & SP32 inspection	62	Submitted
87	13-16.04.2017	Son La: SP31 social assessment; SP32 inspection	63	Submitted
88	15-17.05.2017	Son La: SP31 & SP32 inspection before rainy season	64	Submitted
89	18.05.2017	Bac Kan: SP4 inspection before rainy season	65	Submitted

No.	Date	Topic	RSV	Status
90	19.05.2017	Thai Nguyen: SP35 inspection before rainy season	66	Submitted

ANNEX 9. REPORTS AND DOCUMENTS

Table 13: Reports and documents: cumulative list

Year / Date of Submission	Type	Title / Description
2013		
31.01	Memorandum	MEM-1 Capacity Assessment
04.02	Record	RSV-01 Bac Kan
22.02	Miscellaneous	Capacity Assessment (revised) (English and Vietnamese)
26.02	Technical Report	TR-1 Launch Workshop
15, 21.03	Record	RSV-02 Son La
25.03	Record	RSV-03 Thai Nguyen
05.04	Progress Report	PR-1 Inception Report (draft)
26.04	Record	RSV-04 Bac Kan
10.05	Progress Report	PR-1 Inception Report (draft v2)
14.05	Technical Report	TR-2 Inception Workshop (English and Vietnamese)
13.06	Progress Report	PR-1 Inception Report (final)
16.07	Record	RSV-05 Hoa Binh
24.07	Record	RSV-06 Son La
24.07	Record	RSV-07 Bac Kan
25.07	Record	RSV-08 Son La
29.07	Progress Report	PR-2 Quarterly Progress Report for April to June 2013
02, 16.08	Record	RSV-10 Son La
12.08	Record	RSV-09 Bac Kan
17.09	Record	RSV-12 Son La
17.09	Record	RSV-13 Bac Kan
17.09	Record	RSV-14 Thai Nguyen
02.10	Record	RSV-11 Thai Nguyen
16.10	Progress Report	PR-3 Quarterly Progress Report for July to September 2013
12.11	Memorandum	MEM-2 Draft IWE Monitoring and Evaluation Criteria
19.11	Technical Report	TR-4 Vulnerability Assessment and Adaptation Response Workshop (English)
30.11	Technical Report	TR-3 Knowledge Development and Communications Plan (English)
20.12	Technical Report	TR-4 Vulnerability Assessment and Adaptation Response Workshop (Vietnamese)
27. 12	Technical Report	TR-5 Approaches to Building Climate Change Resilience in Rural Infrastructure (English)
2014		
07.01	Technical Report	TR-3 Knowledge Development and Communications Plan (Vietnamese)
17.01	Progress Report	PR-4 Quarterly Progress Report for October to December 2013
26.02	Record	RSV-15 Son La and Bac Kan
30.03	Memorandum	MEM-3 Notes on Procurement
14.04	Technical Report	TR-5 Approaches to Building Climate Change Resilience in Rural Infrastructure (Vietnamese)
14.04	Record	RSV 16 Son La
14.04	Record	RSV 17 Bac Kan
14.04	Memorandum	MEM-4 Position paper for ADB review mission (English)
17.04	Memorandum	MEM-4 Position paper for ADB review mission (Vietnamese)
21.04	Record	RSV 18 Bac Kan and Thai Nguyen
22.04	Progress Report	PR-5 Quarterly Progress Report for January to March 2014
12.05	Record	RSV-19 Son La
12.05	Record	RSV-20 Thai Nguyen
15.05	Memorandum	MEM-5 Mainstreaming Strategy (draft)
28.05	Technical Report	TR-6 Feasibility Study: Demonstration Measures at Sub-Project 4, Bac Kan, in English
23.06	Technical Report	TR-6 Feasibility Study: Demonstration Measures at Sub-Project 4, Bac Kan, in Vietnamese
28.06	Progress Report	PR-6 Quarterly Progress Report for April to July 2014/Mid-Term Report (draft)
16.07	Progress Report	PR-6 Quarterly Progress Report for April to July 2014/Mid-Term Report

Year / Date of Submission	Type	Title / Description
24.07	Memorandum	MEM-5 Mainstreaming Strategy
06.09	Technical Report	Revised TR-6 Feasibility Study: Demonstration Measures at Sub-Project 4, Bac Kan (Vietnamese)
15.10	Progress Report	PR-7 Quarterly Progress Report for July to September 2014
12.11	Technical Report	TR-7 Feasibility Study: Demonstration Measures at Sub-Project 32, Son La (Vietnamese)
11.12	Record	RSV-21 Thai Nguyen
2015		
28.01	Progress Report	PR-8 Quarterly Progress Report for October to December 2014
04.02	Contract Document	CD-1 SP4 Bac Kan
06.03	Record	RSV-22 Bac Kan
30.03	Contract Document	CD-2 SP32 Son La
02.04	Record	RSV-23 Bac Kan
06.04	Memorandum	MEM-6 Position Paper for Mid-Term Review
08.04	Record	RSV-24 Bac Kan
10.04	Record	RSV-25 Bac Kan
25.04	Record	RSV-26 Bac Kan
27.04	Record	RSV-27 Bac Kan
28.04	Record	RSV-28 Son La
27.05	Progress Report	PR-9 Quarterly Progress Report for January to March 2015
02.06	Record	RSV-29 Bac Kan
04.06	Record	RSV-30 Son La
28.06	Record	RSV-31 Thai Nguyen
30.06	Record	RSV-32 Bac Kan
30.06	Record	RSV-33 Son La
05.07	Record	RSV-34 Son La
10.07	Technical Report	TR-8 Bioengineering Workshop: Design & Construction (Riverbanks)
21.07	Record	RSV-35 Son La
25.07	Record	RSV-36 Son La
31.07	Progress Report	PR-10 Quarterly Progress Report for April to June 2015
10.08	Record	RSV-37 Bac Kan
19.08	Record	RSV-38 Son La
17.09	Record	RSV-39 Son La
24.09	Record	RSV-40 Bac Kan and Thai Nguyen
28.09	Record	RSV-41 Bac Kan and Son La
03.10	Record	RSV-42 Thai Nguyen
19.10	Record	RSV-43 Bac Kan
22.10	Progress Report	PR-11 Quarterly Progress Report for July to September 2015
10.11	Record	RSV-44 Thai Nguyen
12.11	Record	RSV-45 Thai Nguyen
27.11	Record	RSV-46 Bac Kan
17.12	Record	RSV-49 Son La
18.12	Technical Report	TR-9 Feasibility Study: Demonstration Measures at Sub-Project 34, Thai Nguyen (Eng. & Vietnamese)
21.12	Record	RSV-48 Son La
23.12	Record	RSV-47 Thai Nguyen
2016		
16.01	Technical Report	TR-10 Feasibility Study: Demonstration Measures at Sub-Project 31, Son La (Eng. & Vietnamese)
21.01	Progress Report	PR-12 Quarterly Progress Report for October to December 2015
03.03	Technical Report	TR-10 (revised)
06.04	Technical Report	TR-11 Initial Monitoring Report for Riverbank Bioengineering Demonstrations at SP4 Bac Kan and SP32 Son La
19.04	Progress Report	PR-13 Quarterly Progress Report for January to March 2016
13.05	Contract Document	CD-3 SP35 Thai Nguyen
30.05	Record	RSV-50 Thai Nguyen
31.05	Record	RSV-51 Thai Nguyen

Year / Date of Submission	Type	Title / Description
07.06	Memorandum	MEM-7 Guidelines for Management and Maintenance of Bioengineering Demonstration Measures in Thanh Mai, Bac Kan
09.06	Contract Document	CD-4 SP31 Bac Kan
20.06	Record	RSV-52 Bac Kan
27.06	Technical Report	TR-12 Bioengineering Workshop: Design & Construction (Roads)
07.07	Technical Report	TR-12 Bioengineering Workshop: Design & Construction (Roads) (Vietnamese)
07.07	Record	RSV-53 Thai Nguyen
13.07	Record	RSV-54 Son La
26.07	Progress Report	PR-14 Quarterly progress report for April to June 2016
31.07	Record	RSV-55 Bac Kan and Thai Nguyen
18.08	Record	RSV-56 Thai Nguyen
26.09	Record	RSV-57 Thai Nguyen
17.10	Record	RSV-58 Son La
17.10	Note	Progress Update
16.11	Technical Report	TR-13 Lessons Learned Workshop
17.11	Record	RSV-59 Son La
17.11	Record	RSV-61 Son La
18.11	Record	RSV-59 Son La (Viet)
18.11	Progress Report	PR-15 Draft Final Report (Eng)
2017		
31.05	Record	RSV-62 Son La
31.05	Record	RSV-63 Son La
31.05	Record	RSV-64 Son La
31.05	Record	RSV-65 Bac Kan
31.05	Record	RSV-66 Thai Nguyen
30.05	Technical Report	TR-14 Demonstration Effectiveness Audit
26.05	Technical Report	TR-15 Training Completion
31.05	Technical Report	TR-16 Construction Completion
26.05	Technical Report	TR-17 Technical Guidelines for Slope Protection
31.05	Technical Report	TR-18 Sample Drawings and Specifications for Slope Protection
26.05	Technical Report	TR-19 Training Course Content
26.05	Technical Report	TR-20 Wrap-up Workshop
26.05	Communications	Natural Solutions to Erosion Control in Vietnam
26.05	Communications	Posters
29.05	Progress Report	PR-15 Final Report

ANNEX 10. PHOTOS (JULY 2016 – MAY 2017)

ANNEX 10.1 SON LA PROVINCE, SUB-PROJECT 31 CONSTRUCTION

1. Roadside drain under construction

2. Inspecting ongoing roadworks

3. Planting vetiver grass lines

4. Watering grass lines by hand

5. Drain on berm

6. Gabion cascade

7. Photo-monitoring point

8. Photographing demonstration

9. Recording site conditions using drone

10. Deep slope failure on slope opposite demonstration

11. May 2017: blanket grass starting to grow and spread with onset of rainy season

12. May 2017: vetiver grass starting to grow with onset of rainy season

ANNEX 10.2 SON LA PROVINCE, SUB-PROJECT 32 MAINTENANCE

1. October 2016: vetiver grass lines damaged by livestock

2. November 2016: vetiver grass lines replanted and protected

3. May 2017: vegetated gabions using *Salix tetrasperma* cuttings remain in good condition

4. May 2017: additional *Homonoia riparia* lines planted in November 2016 have developed well

ANNEX 10.3 BAC KAN PROVINCE, SUB-PROJECT 4 MAINTENANCE

1. October 2016: trimming established vetiver grass lines

2. November 2016: vetiver in good condition

3. October 2016: planting additional vetiver grass lines

4. November 2016: commune residents watering new vetiver grass

5. May 2017: entire demonstration intact and in good condition 2 days after major flood

6. May 2017: *Homonoia riparia* cuttings growing strongly in the vegetated riprap at the toe of the slope

ANNEX 10.4 THAI NGUYEN PROVINCE, SUB-PROJECT 35 CONSTRUCTION AND MAINTENANCE

1. July 2016: preparing to plant Tiger grass in masonry frames on cut slope

2. Planting Tiger grass in frames

3. September 2016: Tiger grass well established

4. September 2016: Vetiver grass lines on cut slope growing well

5. July 2016: newly-installed palisades on cut slope

6. May 2017: brush layers on cut slope, growing well

7. July 2016: newly-installed bioengineering measures on fill slope

8. August 2016: short grass on fill slope well established

9. September 2016: fill slope measures growing well

10. May 2017: overview of fill slope with demonstration measures

11. May 2017: live fences of *Randia tomentosa* on fill slope, growing vigorously

12. May 2017: vetiver grass fully established on fill slope

13. May 2017: strong growth from fascines of *Randia tomentosa* on fill slope

14. November 2016: reinforcement of live mini-checkdam with additional live cuttings

15. November 2016: connection of roadside drain to gabion cascade

16. May 2017: gabion cascade at side of fill slope

ANNEX 10.5 EFFECTIVENESS EVALUATION, SEPTEMBER 2016 AND APRIL 2017

1. Men's focus group, SP4 Bac Kan

2. Community consultation, SP32 Son La

3. Women's focus group, SP32 Son La

4. Women's focus group, SP35 Thai Nguyen

5. Men's focus group, SP31 Son La

6. Women's focus group, SP31 Son La

ANNEX 10.6 LESSONS LEARNED WORKSHOP, HANOI, 04-06 OCTOBER 2016

1. Workshop banner

2. Workshop introduction, CPMU

3. Workshop introduction, ADB

4. Workshop participants

5. Workshop participants meeting with Thanh Mai Commune, SP4 demonstration

6. Workshop participants at SP35 demonstration, Thai Nguyen

7. Workshop participants

ANNEX 10.7 FINAL ADB REVIEW MISSION, 23-29 NOVEMBER 2016

1. Inspecting SP31 demonstration

2. SP31 demonstration: project signboard

3. SP 31 demonstration: view from north

4. Discussing SP31 demonstration with TA consultant and sub-contractor

ANNEX 10.8 WRAP-UP WORKSHOP, HANOI, 04 MAY 2017

1. Dr Jasper Cook introduces the workshop and delivers an overview of the project.

2. Mr Nguyen Dinh Ninh presents the results of bioengineered rural roadside slopes and riverbank protection demonstrations.

3. Questions and comments from participants.

4. Workshop break-out discussion groups.

5. Project reports were on display.

6. Workshop participant group discussion on how to take the project results forward.

7. Closing remarks: ICEM

8. Closing remarks: APMB-CPMU

9. Final Workshop participants.

ANNEX 11. STAFFING

ANNEX 11.1 INPUTS

106. The TA Consultant's team (see Annex 1) included both full-time and short-term positions. The only two full-time positions were those of the Deputy Team Leader and the Interpreter/Translator. All other positions, including that of the Team Leader, were based on short-term inputs. Most team members (except for four of the five international specialists - Team Leader, Social Specialist, Civil Engineer and Geotechnical Specialist/Trainer) were based in Hanoi, so actual inputs varied from solid blocks of time to intermittent inputs, as needed for delivery of the services.

107. Annex 4 shows the staff inputs during the entire TA. Note that (i) the total time allocated reflects the latest contractual position, and (ii) that for the purposes of calculating % unused, there are 22 days in a "Home" month and 30 days in a "Field" month.

ANNEX 11.2 STAFF REPLACEMENTS AND NEW STAFF SINCE JULY 2016

108. Staff replacement: the National Civil Engineer had to resign from the project due to family commitments; in July 2016 he was replaced by Mr. Nguyen The Hai.

109. New staff: the addition of an International Communications Specialist to the TA team was proposed in October 2016 to prepare a communication product for a wider audience. Formal approval is pending.

ANNEX 11.3 USE OF UNALLOCATED TIME

110. All unallocated time was approved for use as part of the inputs needed for the first project extension. The final position is as shown in the table below.

Table 14: Use of unallocated time

	Original (mo)	Allocated (mo)	Remaining (mo)
International	3	3	0
National	6	6	0

ANNEX 12. FACILITIES AND EQUIPMENT

ANNEX 12.1 FACILITIES

111. The project operated out of an office provided by the CPMU at 20 Thuy Khue Street, Hanoi. The space was shared by both the TA and the parallel UNDP components.

112. The CPMU had no budget for office rent for the overall GEF project in 2016, so the cost of renting the project office was shared by UNDP and the TA on a 2/3 – 1/3 basis. From December 2016 the project was run from ICEM's company office in Tay Ho.

ANNEX 12.2 EQUIPMENT AND DATA

113. A cumulative list of equipment requests and their status is given below. Equipment and data actually procured is also listed below.

114. The TA team holds various items of equipment purchased throughout the TA period (e.g. computers, printers, cameras, GPS units, survey equipment). All these items are recorded in an asset inventory. This equipment will be handed over to MARD at the end of the TA in accordance with ADB procedures.

115. The TA's work did not involve the development of any large datasets. However the project has generated or acquired a number of resources which could be useful to MARD staff and other interested parties. These include:

- The 20 Technical Reports prepared by the TA.
- The communications products developed by the TA (posters and glossy report).
- Reference materials on slope protection from round the world, as pdf files.

116. Digital copies of all these materials will be handed over to MARD on CD, and could easily be uploaded to the MARD website.

Table 15: Equipment requests

Date	Item	Status
22 Apr 2013	Equipment Purchase Proposal	Approved by ADB 03 June 2013
25 Jul 2013	Equipment Purchase Proposal	Approved by ADB 26 July 2013
19 Sep 2013	Data Purchase Proposal	Approved by ADB 23 Sep 2013
30 Jan 2015	Monitoring Equipment Proposal	Approved by ADB 05 Feb 2015

Table 16: Equipment purchases and status

No.	Item	Ordered	Received	Status / Condition
Batch 1				
1	1 Working desk - CD1800H	6/6/2013	13/6/2013	New
2	4 Work desks - CD1400H	6/6/2013	13/6/2013	New
3	5 Work chairs - Swivel chair GX06 Black	6/6/2013	13/6/2013	New
4	2 Fans - Benny BF-40ST	6/6/2013	11/6/2013	New
5	3 Desk lamps – Phillip 30507 Eco EYEFI	5/11/2013	05/11/2013	New

No.	Item	Ordered	Received	Status / Condition
6	1 Black and white laser printer - HP LaserJet Pro 400-M401dn (CF278A)	6/6/2013	13/6/2013	New
Batch 2				
1	01 Meeting table for 10 people - CM1820H	29/7/2013	13/8/2013	New
2	10 Chairs for meeting table - GQ02M	29/7/2013	13/8/2013	New
3	01 Cabinet Table - CC2220H	29/7/2013	13/8/2013	New
4	01 Filing cabinet - SM8450H	29/7/2013	13/8/2013	New
5	01 Book cabinet - SM4050H	29/7/2013	13/8/2013	New
6	01 Refrigerator - Sanyo SR125PN 125l (Silver)	29/7/2013	11/8/2013	New
7	01 Kettle - Tefal BF2731	29/7/2013	11/8/2013	New
8	02 Whiteboards - Glass Board, 8mm thick	29/7/2013	11/8/2013	New
9	02 Desktop screen - LED Monitor 23" UltraSharp	29/7/2013	30/8/2013	New
10	02 Laptop Del Vostro 3560 P33X47 (Intel® Core™ i7, 4 GB DDR3, 500 GB HDD, 15.6")	29/7/2013	30/8/2013	New
11	01 Portable HDD - WD500GB	29/7/2013	30/8/2013	New
12	01 Projector - Panasonic PT-LB3EA	29/7/2013	30/8/2013	New
13	01 Color Inkjet Printer A3 HP DeskJet Printer Officejet PRO 7000	29/7/2013	30/8/2013	New
14	01 Multi-function A4 printer/fax/copier/scanner HP LaserJet Pro M1536dnf	29/7/2013	30/8/2013	New
15	01 Phone system, mother + 2 child (cordless) Panasonic PX-TG6461 and KX TG A641	29/7/2013	30/8/2013	New
16	01 Speaker Phone - Panasonic TS 840	29/7/2013	30/8/2013	New
17	01 Camera, including memory chip and spare battery - Nikon Coolpix AW110	12/12/2013	12/12/2013	New
18	01 50 m measuring tape	26/7/2013	06/8/2013	New
19	Survey tools Axe, multifunctional axe, knife, trowel, scissors, broom, wooden saw, steel saw, hammer rubber hammer	29/7/2013	11/9/2013	New
20	01 First aid kit for office	29/7/2013	11/9/2013	New
21	02 First aid kit for fieldwork	29/7/2013	11/9/2013	New
22	01 Fire extinguisher for office	14/10/2013	14/10/2013	New
23	02 MS Office Home and Business	29/7/2013	Not in stock	
24	01 Adobe Acrobat Pro	29/7/2013	Not in stock	

No.	Item	Ordered	Received	Status / Condition
Batch 3				
1	01 Surveyor's automatic Dumpy Level (inc. tripod)	01/02/2015	09/02/2015	New
2	20 wooden survey ranging rods	01/03/2015	11/03/2015	New
3	04 metre boards	01/03/2015	11/03/2015	New
4	28 steel rebar	01/03/2015	11/03/2015	New
5	10 steel support stands	01/03/2015	11/03/2015	New
6	Small equipment for measurement of peak flows using an inexpensive crest stage gauge (peak water level recorder)	01/03/2015	20/03/2015	New
7	Monitoring equipment for SP4	27/05/2015		New
8	Monitoring equipment for SP32	30/06/2015		New
Data				
1	Projected Daily Rainfall for Climate Change Scenarios	23/9/2013	01/10/2013	Digital dataset
2	Historical daily rainfall data	23/9/2013	01/10/2013	Digital dataset

ANNEX 13. BUDGET

118. The TA consultant requested a number of Variation Orders to adjust the budget in keeping with the evolving TA work plan. The VOs and their status are listed below.

Table 17: Variation orders to date

Number	Date	Status
01	5/03/2013	Approved 11/03/2013
02	18/03/2013	Approved 17/05/2013
03	19/06/2013	Approved 15/07/2013
04	06/09/2013	Approved 01/10/2013
05	25/04/2014	Approved 19/05/2014
06	23/06/2014	Approved 02/07/2014
07	-	Approved 21/07/2014 (correction of VO6)
08	13/04/2015	Approved 21/04/2015
09	24/07/2015	Approved 17/09/2015
10	23/09/2015	Approved 06/10/2015
11	13/10/2015	Approved 16/10/2015
12	26/05/2016	Approved 06/06/2016
13	05/07/2016	Approved 11/07/2016
14	14/10/2016	Approved 03/01/2017
15	08/03/2017	Approved 29/03/2017
16	12/05/2017	Approved 18/05/2017

119. VO-13 covered replacement of the National Civil Engineer due to a resignation.

120. VO-14 covered adjustments to team inputs to match remaining tasks and deliverables, office rent, and the addition of an International Communications Specialist to the team (as discussed at the original contract negotiations) to prepare a high-quality communications product; and extend the project completion date from 2 December 2016 to 31 May 2017.

121. VO-15 covered final adjustments to team inputs, office operations and air travel.

122. VO-16 covered the addition of an International Knowledge Product Peer Reviewer – Mr. John Howell to the TA team for review of selected final project Technical Reports.

ANNEX 14. ADMINISTRATIVE ISSUES

ANNEX 14.1 ISSUES FACED DURING TA IMPLEMENTATION

123. In moving forward the project faced and overcame a number of challenges. For the record, these are listed in Annex 3.

ANNEX 14.2 UNDP TERMINAL EVALUATION, NOVEMBER 2016

124. From 31 October to 11 November 2016 UNDP undertook a terminal evaluation of the overall GEF project of which this TA is one component. The evaluation made six recommendations, including that the overall GEF project period should be extended for 6-12 months to give time for completion of activities aimed at (i) a well-tested model for integrating climate risk and vulnerability assessment into infrastructure planning, investment and maintenance processes in the pilot provinces; and (ii) an action programme within government to address the recommendations regarding policy directives and setting standards and norms for formal adoption of climate change adaptation measures in the design and approval systems for roads, embankments and irrigation facilities.

ANNEX 14.3 ADB REVIEW MISSION, NOVEMBER 2016

125. ADB undertook a review mission of the TA from 24-29 November 2016.

126. The Mission determined that it would not be possible for the TA consultant to complete all of the required deliverables and activities for closure by 02 December 2016, principally due to the delays associated with implementation of the demonstrations, particularly SP31. The TA consultant was requested to provide a detailed workplan identifying all remaining tasks and deliverables against time for submission to ADB by 30 November 2016. At ADB's subsequent request the workplan was submitted in December after approval of a second project extension (see below).

ANNEX 14.4 PROJECT EXTENSIONS

127. In September 2015 the TA project was granted an extension of 11 months by ADB, to 02 December 2016. On 09 December 2016 ADB granted the project a second extension, this time of 6 months, to 31 May 2017.

ANNEX 15. PROJECT ACTIVITIES

ANNEX 15.1 ACTIVITIES YEAR BY YEAR

128. **First-year activities (2013)** were completed successfully:

- The Launch Workshop was held in January 2013 and the Inception Workshop in April. The Inception Report was submitted in May and approved in June 2013.
- The proposed demonstration sites were reviewed and an alternative road site (SP34 in Thai Nguyen province) identified, proposed and formally approved.
- Baseline fieldwork and consultation were completed at all four sites.
- Technical surveys of all four sub-projects were carried out (geotechnical and hydrological).
- Concept designs for the demonstration measures were developed and the detailed design process for the two riverbank sites was initiated, with associated site-specific topographic and geotechnical surveys commissioned and completed.
- The TA's training framework was developed and reported (in **TR-3**, a contractual deliverable).
- The Technical Core Group was approved and established and the first formal training event was held in November 2013 involving core group members and others (Vulnerability Assessment and Adaptation Response Workshop) and an associated Technical Report prepared (TR-5, a contractual deliverable).
- Links were established with the parallel UNDP project and a project office shared with the UNDP components was provided by the CPMU and made operational.

129. **Second-year activities (2014)** centred on finalising designs, implementation (physical construction) of the bioengineering demonstration measures, and associated training events. The year's goals were (i) to implement the measures at the two riverbank sites, (ii) to implement the measures at one of the two roadside sites, the timing being dependent on progress by the road contractor, and (iii) to hold a related bioengineering training event. In practice one of the two riverside demonstrations was approved on the last day of 2014, the other remained in the MARD approval process, road construction was delayed, and no training was possible.

130. **Third-year activities (2015)** focused on construction of the two riverbank demonstrations, an associated training workshop, design of the two roadside demonstrations and planning for a project extension.

(i) **Riverbank sites: TR-6**, the feasibility study for the demonstration measures in Bac Kan, was approved by MARD on 31 December 2014. Contract finalisation and ADB approval were received in February 2015, with construction starting at the beginning of March and finishing in April 2015. **TR-7**, the feasibility study for SP32 in Son La, received formal MARD approval in March 2015 and installation of the demonstration measures was undertaken in May and June. This was followed by installation of biophysical monitoring systems at both sites (marker points for cross sections and repeat photography and related measurements).

(ii) **Roadside sites:** detailed design of the two roadside demonstration measures depended on completion of earthworks by the respective SRIDP contractors.

At SP34 Thai Nguyen the contractor had to re-design the earthworks on the section of road selected for the demonstration, following failure of slopes during the 2014 rainy season. This prevented detailed design of the TA's demonstration measures. However, site inspection by

the TA team and PPMU in early December 2014 found that the earthworks on the adjacent SRIDP sub-project, SP35, had been completed and were suitable for bioengineering demonstrations (see **RSV-21**). With support from the Thai Nguyen PPMU, in December 2014 a proposal was made to MARD to switch from SP34 to SP35. Following formal approval of the switch by PPMU Thai Nguyen and informal approval by CPMU, potential demonstration sites at SP35 were identified in late May 2015 (see **RSV-31**). This was followed by the commissioning of topographic and geotechnical services and then detailed design, with submission of the design report (**TR-9**) in December 2015.

At SP31 Son La the SRIDP road earthworks were delayed by land acquisition issues so no detailed design of the demonstration measures was possible in 2014. Earthworks on the relevant section of the road were largely completed in June 2015 and inspected by the TA in July. The detailed design process commenced in August 2015, starting with topographic and geotechnical surveys, and was completed with submission of the design report (**TR-10**) in January 2016. The situation at SP31 was complicated by a deep-seated landslide threatening a power line at the demonstration site. A decision was taken to restrict the demonstration to the opposite side of the road.

A training workshop on riverbank bioengineering was held in Bac Kan in April 2015. The workshop is recorded in Technical Report 8 (**TR-8**), July 2015.

In April 2015 the overall GEF project of which this TA is one component was subject to a Mid-Term Review (MTR). The MTR consultants considered the TA to be worthwhile, but effective completion would require a project extension. Following submission of a detailed proposal, in September 2015 ADB granted the TA an extension of 11 months, to 02 December 2016.

131. **Fourth-year activities (2016)** focused on construction of the two roadside demonstrations (SP35 in Thai Nguyen and SP31 in Son La), a roadside bioengineering training workshop, an effectiveness audit of the whole TA bioengineering programme and an associated "lessons learned" workshop, initial preparation of the TA's principal technical recommendations, and extensive technical and progress reporting.

132. Following conditional approval from MARD, both roadside demonstrations were installed and were completed in August (SP35 Thai Nguyen) and October (SP31 Son La). The demonstration in Thai Nguyen was planted in time for summer growth, but in Son La the planting is dormant until the 2017 growing season (from mid-March onwards).

133. A training workshop on roadside bioengineering was held in Thai Nguyen in June 2016 and a lessons learned workshop was held in Hanoi in October 2016. The workshops were recorded in Technical Reports 12 and 13 respectively (**TR-12** and **TR-13**), June 2016 and November 2016.

134. **Fifth-year activities (2017)** focused on technical reporting, knowledge products, final checks on the four demonstrations, and a wrap-up workshop.

135. Four technical reports describe project activities: (i) **TR-14**, a technical and social effectiveness audit of the demonstrations; fieldwork for these was carried out in September 2016 for SP4 Bac Kan, SP35 Thai Nguyen and SP32 Son La and in April 2017 for SP31 Son La, involving consultation with local stakeholders at community level as well as technical analysis of monitoring data; (ii) **TR-15** covering the TA's training activities – centred on the four demonstrations and focused on the Technical Core Group; (iii) **TR-16**, a construction completion report which records details of design and construction of the four demonstrations; and (iv) **TR-20**, a report on the May 2017 Wrap-up Workshop.

136. Preparation of the TA's final "knowledge products" began in August 2016 and continued through to May 2017. They are presented as technical reports **TR-17, TR-18** and **TR-19** covering,

respectively, Technical Guidelines for Slope Protection, Sample Drawings and Specifications for Slope Protection, and Academic Course Content.

137. Additional communications products completed in 2017 are (i) a glossy A5 booklet based on the TA's demonstrations entitled "Natural Solutions to Erosion Control in Vietnam", and (ii) posters on riverbank and roadside slope protection using low-cost techniques including bioengineering.

ANNEX 15.2 TRAINING EVENTS AND WORKSHOPS

138. The list of major training events and workshops for the whole project is given below.

Table 18: List of principal training events and workshops

	Event	Timing
	2013	
1	Launch Workshop	Jan. 2013
2	Inception Workshop	April 2013
3	Vulnerability & Adaptation Response Workshop	Nov. 2013
	2015	
4	Bioengineering: design and construction – riverbanks (including site visit)	April 2015
	2016	
5	Bioengineering: design and construction – roads (including site visit)	June 2016
6	Lessons Learned and Way Forward (including site visit)	Oct. 2016
	2017	
7	Wrap-up	May 2017

ANNEX 16. LIST OF PROGRESS REPORTS

Table 19: List of Progress Report

No.	Topic or Title	Date
PR-1	Inception Report	May 2013
PR-2	Quarterly Report	July 2013
PR-3	Quarterly Report	October 2013
PR-4	Quarterly Report	January 2014
PR-5	Quarterly Report	April 2014
PR-6	Quarterly Report/Mid-Term Report (draft)	June 2014
PR-6	Quarterly Report	July 2014
PR-7	Quarterly Report	October 2014
PR-8	Quarterly Report	January 2015
PR-9	Quarterly Report	May 2015
PR-10	Quarterly Report	July 2015
PR-11	Quarterly Report	October 2015
PR-12	Quarterly Report	January 2016
PR-13	Quarterly Report	April 2016
PR-14	Quarterly Report	July 2016
PR-15	Final Report (draft)	November 2016
PR-15	Final Report (revised draft)	December 2016
PR-15	Final Report	May 2017

ANNEX 17. LIST OF TECHNICAL REPORTS

Table 20: List of Technical Report

No.	Topic or Title	Date
TR-1	Launch Workshop	February 2013
TR-2	Inception Workshop	April 2013
TR-3	Knowledge Development and Communications Plan	November 2013
TR-4	Vulnerability Assessment and Adaptation Response Workshop	November 2013
TR-5	Approaches to Building Climate Change Resilience in Rural Infrastructure	December 2013
TR-6	Feasibility Study: Demonstration Measures at Sub-Project 4, Bac Kan	May 2014
TR-6	(revised) Feasibility Study: Demonstration Measures at Sub-Project 4, Bac Kan	September 2014
TR-7	Feasibility Study: Demonstration Measures at Sub-Project 32, Son La	October 2014
TR-8	Bioengineering Workshop: Design and Construction (Riverbanks)	July 2015
TR-9	Feasibility Study: Demonstration Measures at Sub-Project 34, Thai Nguyen	December 2015
TR-10	Feasibility Study: Demonstration Measures at Sub-Project 31, Son La	January 2016
TR-10	(revised) Feasibility Study: Demonstration Measures at Sub-Project 31, Son La	March 2016
TR-11	Initial Monitoring Report for Riverbank Bioengineering Demonstrations at SP4 Bac Kan and SP32 Son La	April 2016
TR-12	Bioengineering Workshop: Design and Construction (Roads)	June 2016
TR-13	Lessons Learned Workshop Report	November 2016
TR-14	Demonstration Effectiveness Audit	May 2017 (July 2015*)
TR-15	Training Completion Report	May 2017 (July 2015*)
TR-16	Demonstration Site Construction Completion Report	May 2017 (January 2015*)
TR-17	Technical Guidelines for Slope Erosion Protection (Part 1 of Recommendations for Integration into Training Curricula, Design Procedures and Contract Specifications)	May 2017 (September 2015*)
TR-18	Drawings and Specifications (Part 2 of Recommendations for Integration into Training Curricula, Design Procedures and Contract Specifications)	May 2017
TR-19	Training Course Content (Part 3 of Recommendations for Integration into Training Curricula, Design Procedures and Contract Specifications)	May 2017
TR-20	Wrap-up Workshop	May 2017

ADB

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