COMMUNITY SMALL SCALE AFFORESTATION/REFORESTATION PROJECT IN LORI, ARMENIA

Project Design Document

09 November 2006

Prepared by
Fichtner GmbH & Co. KG
& TACIS Regional Project Office of Armenia
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SECTION A. General description of the proposed small-scale A/R CDM project activity:

A.1. Title of the proposed small-scale A/R CDM project activity:

- The title of the project activity is Community Small Scale Afforestation/Reforestation Project in Lori, Armenia
- The version number of the document is Version 01
- The date of the document is October 05 2006

A.2. Description of the proposed small-scale A/R CDM project activity:

The proposed project activity aims to facilitate and promote the implementation of community afforestation and reforestation activities in Armenia and particularly in the Lori region. This is one of the few regions of the country with a high poverty and unemployment rate where the natural and climatic conditions are favorable for forest establishment without artificial irrigation. The proposed A/R project activities are to promote growing of forests on grassland and cropland consistent with the simplified baseline and monitoring methodologies for SSC-CDM-A/R activities. The country has a scarcity of forest resources, which are currently under strong pressure. Any carbon sequestration benefits through the proposed A/R activities will facilitate the establishment of forests, so contributing to sustainable development of low-income communities.

At the beginning of the 90s, immediately after gaining independence, Armenia faced a severe energy crisis, which has also left a severe negative impact on the country’s forest resources. Fuelwood consumption by urban and rural populations has increased greatly, leading to illegal mass-tree felling practices. Vast forest areas in the vicinity of settlements have been cut down since for many people fuelwood was the only available energy source during that time. Several thousand hectares of forest have been both clear-cut and seriously damaged. Unfortunately, nowadays in spite of the urgency to restore the affected forests, the lack of domestic funds and new technology transfer hamper the implementation of extensive forest regeneration operations. In addition, since most of the forest felling took place after 1990, many clear-cut areas are not eligible for recognition as CDM A/R activities.

The forest sector of Armenia currently faces numerous challenges to achieve sustainable forest management, which is closely linked to the generally unfavorable socio-economic situation driven by the country’s economy in transition. The proposed small-scale CDM A/R project is the first concrete step to encourage good practice in forest management. It is an important step forward to overcome existing technological and other barriers hampering successful implementation of A/R activities in the country.
Armenia is nowadays characterized by low forest cover (~10%), due to historical anthropogenic modification of vegetation cover and land use change. According to the First National Communication\textsuperscript{1}, the country possesses a major potential to double the current forest cover to achieve an optimal forestation rate (20.1%), which is a win-win solution from adaptation and mitigation points of view, to tackle adverse climate change. The proposed SSC-AR-CDM project activity is one of the first steps to meet the long term national target and at the same time provide benefits for local communities.

Various socio-economic and ecological benefits are expected from the community-based SSC-AR-CDM activity:

- employment generation,
- poverty reduction,
- development of community forest,
- carbon sequestration,
- erosion control, especially in hilly areas,
- regulation of watersheds,
- enhancement of biodiversity,
- improvement of the communities’ general microclimate,
- utilization of forest by-products.

### A.3. Project participants:

The project participants are the poorest and low-income communities and individual landholders in the Lori region of Armenia. The following table provides an overview of the preliminary selected communities for the project activity.

**Table A-1. List of project participants**

<table>
<thead>
<tr>
<th>Name of party involved (*)</th>
<th>Private and/or public entity(ies), project participants (*)</th>
<th>Kindly indicate if the party involved wishes to be considered as project participant (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Republic of Armenia (host country)</td>
<td>Communities: Bovadzor, Gyulagarak, Stepanavan, Dorband (Sverdlov), Chkalov, Arevatsag, Mghart, Nghotis, Shnogh, Atan, Shamlugh, Tumanyan, Odzun, Spitak, Geghasar, Gogaran, Lusaghbyur,</td>
<td>No</td>
</tr>
</tbody>
</table>

\textsuperscript{1} First National Communication of the Republic of Armenia under the UNFCCC, UNDP/GEF, Yerevan, 1998
The communities and individual farmers will provide their lands as equity in return for a stake in profits, and the identified carbon buyer/investor will fund coordination of the project, production of planting stock, forest plantation tending and management, training and forest carbon monitoring.

Income from forest products and CER transactions will be allocated based on shares according to the contractual arrangements. Agreement on that has not been made yet.

Figure A-1. Institutional arrangements for the SSC A/R CDM community project activity

The Project Implementation Unit (PIU) is responsible for coordination of all the activities among the project participants, providing overall technical guidance, as well as facilitating communication with the project investors and other relevant stakeholders. It is a prerequisite for
successful implementation of the proposed community SSC-A/R-CDM project, since community forest institutional structures are not yet established in the country.

In addition, the PIU will take on overall responsibility for arranging the provision of planting stock by coordinating nursery management, forest planting and tending, as well as for periodic (every 5 years) carbon monitoring and, last but not least, play a key role in strengthening the local capacities of the project participants through a series of training courses, including for the selected low income communities and individual landholders.

Figure A-2. Areas of technical assistance by the PIU for implementation of the proposed project activity

A.4. Technical description of the small-scale A/R CDM project activity:

A.4.1. Location of the proposed small-scale A/R CDM project activity:

The proposed SSC A/R CDM project activity is located in the Lori region in northern Armenia.
**A.4.1.1. Host Party(ies):**
Republic of Armenia

**A.4.1.2. Region/State/Province etc.:**
Lori region

**A.4.1.3. City/Town/Community etc:**
Table A-2. Selected communities in Lori region

<table>
<thead>
<tr>
<th>City/Town</th>
<th>Community</th>
<th>City/Town</th>
<th>Community</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spitak</td>
<td>Spitak city</td>
<td>Stepanavan</td>
<td>Bovadzor</td>
</tr>
<tr>
<td></td>
<td>Geghasar</td>
<td></td>
<td>Gyulagarak</td>
</tr>
<tr>
<td></td>
<td>Gogaran</td>
<td></td>
<td>Stepanavan city</td>
</tr>
<tr>
<td></td>
<td>Lusaghbyur</td>
<td>Alaverdi</td>
<td>Dorband (Sverdlov)</td>
</tr>
<tr>
<td></td>
<td>Tsaghkaber</td>
<td></td>
<td>Chkalov</td>
</tr>
<tr>
<td></td>
<td>Katnajur</td>
<td></td>
<td>Arevatsag</td>
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<tr>
<td></td>
<td>Hartagyugh</td>
<td></td>
<td>Mghart</td>
</tr>
<tr>
<td></td>
<td>Shenavan</td>
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<td>Neghorts</td>
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<td></td>
<td>Saralanj</td>
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<td>Shnogh</td>
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<td></td>
<td>Saramej</td>
<td></td>
<td>Atan</td>
</tr>
</tbody>
</table>
A.4.1.4. Detail of geographical location and project boundary, including information allowing the unique identification(s) of the proposed small-scale A/R CDM project activity:

The project boundaries and geographical locations will be indicated in the second stage of project development. The specific geographical positions (longitude, latitude) at the corners of each of the land parcels will then be determined using topographic and cadastral maps, as well as a GPS receiver for identification of the geographical coordinates.

Table A-3 Details of geographic location and project boundary

<table>
<thead>
<tr>
<th>Tashir</th>
<th>Qaradzor</th>
<th>Shamlugh town</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apaven</td>
<td></td>
<td>Tumanyan town</td>
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<tr>
<td>Blagodarnoye</td>
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<td>Odzun</td>
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<td>Metsavan</td>
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<td>Paghaghbyur</td>
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<td>Lernapat</td>
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<tr>
<td>Saratovka</td>
<td>Vanadzor</td>
<td>Vahagnadzor</td>
</tr>
</tbody>
</table>
### Lori region

<table>
<thead>
<tr>
<th>Sub-region</th>
<th>Community</th>
<th>Latitude (N, degree)</th>
<th>Longitude (E, degree)</th>
<th>Project area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spitak</td>
<td>Spitak city</td>
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<td>Geghasar</td>
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<td>Gogaran</td>
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<td></td>
<td>Lusaghyur</td>
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<td>Tsagkhaber</td>
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<td>Qaradzor</td>
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<td>Tashir</td>
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<td>Blagodarnoye</td>
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<td>Paghaghyur</td>
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<td></td>
<td>Saratovka</td>
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<tr>
<td>Stepanavan</td>
<td>Bovadzor</td>
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<td></td>
<td>Gyulagarak</td>
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<td></td>
<td>Stepanavan city</td>
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<td>Dorband</td>
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<td>Tumanyan</td>
<td>Chkalov</td>
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<td>Arevatsag</td>
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<td>Tumanyan town</td>
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<td>Lernapat</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Vahagnadzor</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>937.0</td>
</tr>
</tbody>
</table>

#### A.4.1.5. A description of items on present environmental conditions of the area, which include information on climate, soils, main watershed, ecosystems, and the possible presence of rare or endangered species and their habitats:

The lands to be reforested in the Lori region exhibit a range of environmental conditions due to mountainous terrain, change of climate with altitude, slope expositions etc.
Climate

In spite of its small size, the Lori region possesses various areas with distinctive climatic conditions. Annual precipitation is distributed unevenly in the watershed of the Debed River, which is a result of general atmospheric cycles and complex mountainous terrain. The latter influence the inflowing air masses, modifying them to some extent. Within the same region, annual precipitation ranges from 430 mm to 835 mm and even more. The first snow cover appears during the second half of November, but a stable cover forms at the end of December.

Site elevation is one of the most important factors for distribution of precipitation. As a rule, this increases with altitude. However; other aspects such as mountain location, exposition, etc. have also to be taken into account when choosing appropriate sites for the project activity.

The mean daily and annual temperatures in Lori are very changeable from year to year, influencing evapotranspiration rates. Like the distribution of annual precipitation, evapotranspiration is also closely linked to mountainous relief, its exposition and slope angle. The highest annual evaporation is recorded in the lowest downhill zones of the northeastern part of Lori region with 500-550 mm, in contrast to high mountain elevations, where it is just 200-250 mm.
Thermo-pluviometric diagram of city Vanadzor

Thermo-pluviometric diagram of town Tumanyan

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Soils

Thermo-pluviometric diagram of town Tashir

Thermo-pluviometric diagram of city Stepanavan

Soils
The Lori region belongs to the Caucasian vegetation/geographical climatic zone characterized by a mesophilic vegetation. The lowest mountainous elevations of the Debed River basin feature dry steep slopes up to an altitude of 700-800 m and are characterized by grey and light grey soils types. The higher elevations (typical steep slopes particularly in the Lori and Pambak valleys) from 900-2300 m are characterized by either dark grey or black soils.

Nearly 24.9% of Lori is covered by forest, ranging from 600 m to 2200 m. In the western and northwestern parts of Lori, forests are almost totally absent. The most typical soils under forest formations are the following types: forest grey soils up to 1400-1500 m altitude and forest brown soils from 1500 m to 1900 m. The latter is richer, with humus and usually formed under more moist conditions compared with grey soils.

**Vegetation**

The common native forest species in Lori are oriental beech (*Fagus orientalis*), oak (*Quercus iberica, Q. macranthera*), maple spp, lime spp, hornbeam (*Carpinus caucasica, C. orientalis*), ash spp. etc. The coniferous species occupy rather small areas, mostly as forest plantations (*Pinus pallasian, P. sosnowskyi*) with the purpose of soil stabilization and water regulation. They are usually located on southern mountain slopes. Open juniper woods and shrubs grow on the left bank of the Debed River, mostly in steep terrain.

**Land use of envisaged project area**

The land chosen for the A/R project activity is of the following types: grassland, including hay fields; pasture; and cropland, including arable, perennial crops and other agricultural lands.

**Main watersheds**

The mean river net density is 0.84 kn/km², which has the trend to increase with rising altitude. One of the main features of the rivers in the Lori region is mixed water infeed from both rainwater and melting snow, and partly from underground aquifers. The main watershed of the Lori region is that of the Debed River, which occupies an area of 3790 km². This river has a length of 176 km, and more than 1300 small rivers and creeks flow into it. 52 of these have a length 10 km and more. The water catchment area is quite developed, but it is distributed unevenly.

**Rare or endangered species and their habitats** .........
A.4.2. Species and varieties selected:

Species diversity for the proposed activity has been determined according to available scientific recommendations for the establishment of new forest in forest/vegetation regions in Armenia. The recommendations are based on dendrological, climatic, soil and topographic (slope exposition, elevation, etc) characteristics. It has been updated taking into account the results of local trials and experience with similar sites, ecological risks (such as wind or snow breaks, pests and disease outbreaks, drought and fire), living biomass growth rates of species, biodiversity considerations, promotion of natural forest, stand mosaics and value of forest products to local communities. Invasive species have been excluded from consideration.

The following table demonstrates the species chosen for the proposed activity which might be enriched by other relevant tree/shrub species. However the inclusion of a great number of species can create certain complications for the assessment of carbon sequestration. For this reason the list of species has been kept as simple as possible. When finalizing the selection of the species, the specific preferences of communities/landowners will also be taken into consideration to match their project aims, too.

Table A-4. List of selected species for proposed project activity in Lori region

<table>
<thead>
<tr>
<th>English Name</th>
<th>Latin Name</th>
<th>Northern Forest Region/ Elevation, m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>600 - 1100</td>
</tr>
<tr>
<td>I. TARGET FOREST SPECIES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coniferous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Pallas pine</td>
<td>Pinus pallasiana Lamb.</td>
<td>+</td>
</tr>
<tr>
<td>2. Caucasian pine*</td>
<td>Pinus sosnowskyi Nakai</td>
<td>-</td>
</tr>
<tr>
<td>II. OTHER FOREST SPECIES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broadleaf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Iberian oak</td>
<td>Quercus iberica Stev.</td>
<td>+</td>
</tr>
<tr>
<td>4. Oriental oak*</td>
<td>Quercus macranthera Fisch.</td>
<td>-</td>
</tr>
<tr>
<td>5. Sharp-fruit ash*</td>
<td>Fraxinus oxicarpa Willd.</td>
<td>+</td>
</tr>
<tr>
<td>7. Persian walnut</td>
<td>Juglans regia L.</td>
<td>+</td>
</tr>
<tr>
<td>III. UNDERSTOREY SPECIES/BUSHES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broadleaf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Cornelian cherry</td>
<td>Cornus mas L.</td>
<td>+</td>
</tr>
<tr>
<td>Shrub</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Saint John’s wort-leaf spirea*</td>
<td>Spirea hyperofolia L.</td>
<td>+</td>
</tr>
</tbody>
</table>

Notes
* Unverified translation guesses are marked, where an equivalent English name could not be found.
+ Species are recommended under the described natural-climatic conditions

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All listed species are native except for Pallas pine. Pallas pine was introduced into Armenia during the Soviet period and has been widely planted in the country for several decades, including in the Lori region. Until now, it has not exhibited invasive characteristics. Pallas pine was chosen for several reasons: it shows high ecological flexibility to grow under harsh conditions such as in dry, poor soils and it is more resistant to insect and disease attacks, driving snow or high wind compared with the native pine.

Since pine (P. pallasiana/P. sosnowskyi) grows fast in comparison to the above listed broadleaved species it is nominated to generate most of the CERs for the first crediting period (20 years). For this reason, it is selected as target forest species. Mixing of coniferous and broadleaved species enhances stand biodiversity and creates long-term benefits, since after the end of the crediting periods (60 years) the stands can gradually transform into natural forest cover, dominated by oak mixed with pine and other species.

A.4.3. **Specification of the greenhouse gases (GHG) whose emissions will be part of the proposed small-scale A/R CDM project activity:**

The greenhouse gas (GHG) that is expected to be emitted as a result of the implementation of the proposed project activity is CO₂. The application of fertilizers which could result in nitrous oxide emission is not envisaged since the selected species are well adapted for the sites chosen.

Grasslands or croplands will not be ploughed before the plantations are established. No machinery will be used in soil preparation, planting, weeding or during the pruning/thinning activities.

A.4.4. **Carbon pools selected:**

Carbon pools selected are above ground biomass (AGB) and below ground biomass (BGB) as shown in the table below:

<table>
<thead>
<tr>
<th>Carbon pools</th>
<th>Selected (yes/no)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above ground biomass</td>
<td>Yes</td>
</tr>
<tr>
<td>Below ground biomass</td>
<td>Yes</td>
</tr>
<tr>
<td>Dead wood</td>
<td>No</td>
</tr>
<tr>
<td>Litter</td>
<td>No</td>
</tr>
<tr>
<td>Soil organic carbon</td>
<td>No</td>
</tr>
</tbody>
</table>

For this reason, the project meets the criteria of the simplified baseline and monitoring methodologies for small-scale A/R project activities.
A.4.5. Assessment of the eligibility of land:

The preliminary selected communities have provided oral/written declaration that the sites envisaged for the project activity have been non-forested since 1 January 1990. Nevertheless this will be confirmed according to Appendix A, Simplified Baseline and Monitoring Methodologies for Selected Small-Scale Afforestation and Reforestation (A/R) CDM project activities (FCCC/KP/CMP/2005/4/Add.1) in the second stage of project development.

A.4.6. A description of legal title to the land, current land tenure and land use, and rights of access to the sequestered carbon:

All proposed project sites are located within the administrative boundaries of the low-income communities of the Lori region, which include the following land use categories and types:

- grassland: hay fields, pasture, shrubs
- cropland: arable, perennial crops and other agricultural lands.

The final identification of the project boundaries has not been completed as at this stage it is too early to be sure of ownership or tenure rights. However; community, state and private land ownership and tenure rights were taken into account during the identification of the community’s potential for the proposed SSC-AR-CDM project activity.

Rights of access to the sequestered carbon are not regulated yet by the relevant state authorities of the RA (Ministry of Nature Protection, Ministry of Agriculture etc).

A.4.7. Type(s) of small-scale A/R CDM project activity:

The proposed project activity is the conversion of grassland and cropland into forest land and is categorized as SSC-AR-CDM. The participating communities are considered as the poorest communities in Armenia as confirmed by the Social Trend Analyses of the Lori region and are therefore considered as low-income communities.

The proposed Community SSC-AR-CDM project will result in Net Anthropogenic GHG Removal by Sinks of less than 8 kton CO₂ per year.

A.4.8. Technology to be employed by the proposed small-scale A/R CDM project activity:

For the proposed activity, which will be implemented in mountainous areas, the proper choice of species as described under A.4.2 is taken into account. The technology to be implemented includes techniques for soil preparation, production of planting stock, planting, tending, pruning/thinning and plantation maintenance and training.

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3 Irina Grigoryan “Analysis of the ten poorest communities in Lori marz” in Armenia Social Trends, Information-Analytical Bulletin December 2002, UNDP report
Production of Planting Stock

Before 1990 the forest nursery system was quite well developed in Armenia, covering extended areas. A number of permanent and temporary nurseries were available and distributed to allow the production of planting stock for all natural-climatic regions of the country. Nowadays, management of state and private nurseries is quite disorganized, which hinders implementation of extensive afforestation and reforestation activities. The main goal of these operating nurseries is the production of seedlings or saplings for planting of greenery or orchard establishment. High quality planting stock is either lacking or offered in very limited quantities and for unjustifiably high prices. Under these circumstances, the implementation of the proposed project activity might not be successful due to the limited quantity and insufficient quality of the planting stock, resulting in low survival rates and high transaction cost for forest plantation establishment.

Therefore, in order to successfully implement the project, the establishment of a forest nursery of about 10 ha in size is envisaged. Two to three years after nursery establishment, planting stock to an adequate quantity and quality will then be provided. The nursery is envisaged for establishment in the Stepanavan sub-region, because of its favorable natural-climatic conditions.

For choosing suitable nursery sites, the following criteria are considered:

- 1500-1600 m above sea level
- flat area, less than 5° slope angle
- land use: arable, irrigable
- soil characteristics: favorable physical-mechanical properties, fertility, etc
- sufficient labor resources for nursery operations
- good road access
- minimum risks of pest and disease outbreaks.

In addition, the legal aspects of land use will be carefully considered, such as ownership, tenure rights etc., so as to make the necessary contractual arrangements with the selected party(ies) in terms of establishment cost and maintenance of the forest nursery.

Soil Preparation

The choice of method for soil preparation techniques in mountainous areas depends on soil quality, slope angle and the application of machinery. The use of machinery, as well as general manual land tillage is not envisaged. Soil preparation will be conducted by excavating trenches with the following dimensions envisaged:

- 9 m x 0.5 m x 0.35 m with 1 m gaps between rows
- Trenches are spaced 3.0 m apart between the nearest (lower and upper) rows, keeping their horizontal position on the slopes
In total, 3000 linear meter (lm) per ha will be established.

For spring planting, soil preparation is usually done in autumn (September - October).

**Planting Technique**

Forest plantations will be established by planting 2-3 year-old seedlings of pine and broadleaf species and by sowing oak acorns. Special attention will be paid to the use of high quality planting stock. It is envisaged to undertake planting in early spring, immediately after the snow thaws, which will ensure a high survival rate for the seedlings.

The seedlings of 2-3 years old pine and other supporting species will be planted in previously prepared trenches. The planting pattern will be 3.0 m x 0.5 m, so the spacing between the nearest (upper and lower) rows is 3.0 m and spacing of seedlings within the row is 0.5 m. In total, the planting density is 6000 unit/ha. Acorns (3-5) will be sown in small ditches in the gaps between the trenches at a spacing within the row of 0.5 m.

Walnut will be planted with a density up to 400 seedlings/ha, as it needs more space for growing than pine. It will be mixed with Cornelian cherry, which will be planted at least 2.5 m away from walnut seedlings planted within the rows. This allows efficient land usage as well as harvesting of non-timber forest products, like cornelian cherry fruit, before the start of the walnut fruit bearing period.
Mixing example I (Elevation 600 - 1100m)

- Pallas pine (Pinus pallasiana) - 88% of total area.
- Iberian oak (*Quercus iberica*);
- Caucasian pear-tree (*Pirus caucasica*);
- Sharp-fruit ash (*Fraxinus oxycarpa*);
- Shrub (*Spirea hypericfolia*).

Mixing example II (Elevation 600 - 1100m)

- Pallas pine (Pinus pallasiana) - 88% of total area.
- Iberian oak (*Quercus iberica*);
- Sharp-fruit ash (*Fraxinus oxycarpa*);
- Cornelian cherry (*Cornus mas*);
- Shrub (*Spirea hypericfolia*).

Mixing example III (Elevation 600 - 1600m)

- Pallas pine (Pinus pallasiana) - 88% of total area.
- Area allocated for pine - 88% of total
- Area allocated for other species - 12% of total, to enrich biodiversity

Figure A-5 Mixture of pine with other species
- Persian walnut (Juglans regia L.);
- Cornelian cherry (Cornus mas).

**Mixing example IV** (Elevation 1101-2000m)

- Caucasian pine (Pinus sosnowskyi) - 88% of total area.

The remaining area will be planted with:
- Oriental oak (*Quercus macranthera*);
- Caucasian pear-tree (*Pirus caucasica*);
- Shrub (*Spirea hypericfolia*).

**Figure A - 6** Proposed pine forest plantation scheme

During planting the “root neck” (part of the connection of stem with the root) should be 2 cm below the soil surface and the root of the seedling. The local experience shows that in case of seedling planting, if bending of pine roots occurs in the ground, the results of such plantings are mostly unsatisfactory. Therefore attention should be paid for proper planting applying special technique.
Detailed instructions on planting will be provided in advance by the coordination group to responsible persons in the community who will organize forest planting.

Additional planting campaigns for completion must be planned for the second and third years.

**Tending**

Tending (soil grubbing or tillage and weeding) in forest plantations is carried out continuously on the surface occupied by trenches at a density of 1500 m²/ha (3000 linear meter x 0.5 m width) over the 5 year period, particularly during the first year with 5 times, then the second year with 4, the third year with 3, the fourth year with 2, and the fifth year once, for a total of 15 times. First grubbing is done immediately after planting, the second after the appearance of the first weeds.

**Table A-5 Indicative timetable by months and number of tending actions for forest plantations up to 5 years**

<table>
<thead>
<tr>
<th>Age of forest plantation since establishment, year</th>
<th>Schedule by months and number of tending actions by year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>April</td>
</tr>
<tr>
<td>2</td>
<td>May</td>
</tr>
<tr>
<td>3</td>
<td>May</td>
</tr>
<tr>
<td>4</td>
<td>May</td>
</tr>
<tr>
<td>5</td>
<td>May</td>
</tr>
</tbody>
</table>

**Pruning/Thinning**

Pruning and thinning as manual operations are envisaged only for pine species at 9 and 16 years after forest planting, and done at the end of autumn to avert possible fungal infections.

During pruning, first dead and living branches should be removed up to half the tree height, without damaging the bark of the standing tree. The intensity of thinning should be low, by removing fallen or standing dead trees, and up to 15% of the above-ground living biomass.

**Plantation Maintenance**

For the whole project period the forested sites should be protected against illegal grazing, tree felling or other violations, damage by fire or insect infestations and outbreaks of diseases. The guard(s) assigned by the communities will be responsible for looking after the A/R sites and will regularly report any relevant information or cases of violations to the PIU.
Training

Capacity building is an integral part of the community project. Both the CDM A/R projects and community forest management are prevailing practices for the country; therefore there is a great need to strengthen the skills and the competence of the community project participants for successful implementation of the project. From this aspect, the role of the Project Implementation Unit is very important for providing overall technical assistance, facilitated by training courses to upgrade the skills of the project participants in selected local communities, which will enable them to properly conduct forest planting and plantation maintenance operations.

A.4.9. Approach for addressing non-permanence:

In order to address the non-permanence issue, project participants have chosen the issuance of ICERs for the net anthropogenic GHG removals by sinks achieved by the proposed SSC A/R CDM project activity.

A.4.10. Duration of the proposed small-scale A/R CDM project activity / Crediting period:

The duration of the proposed project activity is expected to be 60 years.

A.4.10.1. Starting date of the proposed small-scale A/R CDM project activity and of the (first) crediting period, including a justification:

N/A

A.4.10.2. Expected operational lifetime of the proposed small-scale A/R CDM project activity:

60 years

A.4.10.3. Choice of crediting period and related information:

The crediting period chosen for the project is 20 years, with renewals for two further 20-year periods for a total crediting period of 60 years.

A.4.10.3.1. Renewable crediting period, if selected:

20 years plus extension of 20 years for a total of 40 years.
A.4.10.3.1.1. Starting date of the first crediting period:

N/A

A.4.10.3.1.2. Length of the first crediting period:

20 years, zero months

A.4.10.3.2 Fixed crediting period, if selected:

N/A

A.4.10.3.2.1. Starting date:

N/A

A.4.10.3.2.2. Length:

N/A

A.4.11. Brief explanation of how the net anthropogenic GHG removals by sinks are achieved by the proposed small-scale A/R CDM project activity, including why these would not occur in the absence of the proposed small-scale A/R CDM project activity, taking into account national and/or sectoral policies and circumstances:

In the absence of the proposed small-scale A/R CDM project activity, no net anthropogenic GHG removal by sinks would occur due to barriers hampering the implementation of such practices. These barriers are related to investment, technology and other factors in Armenia.

**National Circumstances**

The National Forest Policy and Strategy of Armenia was endorsed by the Government of Armenia, with its aim of restoring its degraded forest ecosystems, emphasizing the conservation and development of environmental, social and economic attributes of forests, for the benefit of the people and the prosperity of the country. Subsequently, the National Forest Program, too, was approved, which envisages the implementation of CDM Afforestation/Reforestation activities to promote forest establishment.

Afforestation/reforestation projects will have a major, positive environmental and socio-economic impact on Armenia, helping it to achieve sustainable development. By creating local
employment opportunities for communities, A/R projects can make an important contribution to poverty alleviation and improvement of rural livelihoods. The development of forestry projects under the CDM promotes sustainable development in the forestry sector and attaining a balance of consumption of wood products in the long run, so avoiding forest degradation and deforestation. Furthermore, they will help to generate additional incomes from the environmental services performed by newly planted forest plantations.

According to the latest available forest inventory data of Armenia, the present forest cover is far from optimal for the country. Expanding the forest cover area to 20.1% of the land area, as proposed in the First National Communication\(^1\), will make an essential contribution to mitigating anthropogenic climate change, absorbing heat trapping carbon dioxide from the atmosphere and storing carbon as a key constituent of forest biomass and soil organic matter.

However, the domestic funds allocated for such activities are very limited, and generally insufficient to meet current needs. The low quality of forest planting practices and plantation design and management, without proper monitoring of timber growth and cost benefit analyses, mean that such activities are very inefficient. In addition, the disorganization of the forest nursery system in the country hampers the production of planting stock to an adequate quality and quantity. Therefore, technology transfer in the fields of nursery management and forest seed handling as well as forest management practices, considering the forest carbon sequestration balance and its continuous monitoring, are key elements for the successful development and implementation of CDM A/R projects in the country.

<table>
<thead>
<tr>
<th>A.4.11.1. Estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period:</th>
</tr>
</thead>
</table>

For the estimation of the net anthropogenic GHG removal by sinks over the chosen 20 year renewable period, national factors reviewed for the Land Use, Land-Use Change and Forestry (LULUCF) sector of the national GHG inventory under the UNDP/GEF regional project\(^4\) have been applied and adjusted to the regional conditions of Lori.

Table A-6. Estimated amount of net anthropogenic GHG removals by sinks over the first crediting period (20 years)

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\(^4\) Artur Gevorgyan – Land Use, Land-Use Change and Forestry (Chapter 5), M. Tsarukyan, A. Gevorgyan and others, “National GHG Inventory Manual of Procedures”, Capacity Building for Improving the Quality of GHG Inventory UNDP/GEF Regional Project, Yerevan, 2006 (in Armenian)
CDM – Executive Board

PROJECT DESIGN DOCUMENT FORM
FOR SMALL-SCALE AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES
(CDM-SSC-AR-PDD) - Version 01

A.4.12. Public funding of the proposed small-scale A/R CDM project activity:

The project implementation costs would be covered by the carbon buyer/investor. The contribution of the local communities/landholders would be agreed at the next contractual stage with the project participants and the project investor. No public funds are involved in the project.

A.4.12.1. Confirmation that the small-scale A/R CDM project activity is not a debundled component of a larger project activity:

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.
The proposed small-scale A/R CDM project activity is the first in the Lori region and in Armenia itself up to now. Furthermore, it will become established practice for the whole Caucasus Region. This confirms that the small-scale A/R CDM project activity is not a debundled component of a larger project activity.
SECTION B. Application of a baseline and monitoring methodology:

B.1. Title and reference of the approved baseline and monitoring methodology applied to the proposed small-scale A/R CDM project activity:

The proposed project applies the Simplified Baseline and Monitoring Methodologies for Selected Small Scale Afforestation and Reforestation (A/R) Project Activities, FCCC/KP/CMP/2005/4/Add.1

B.2. Justification of the choice of the methodology in Appendix B of the CDM simplified modalities and procedures for small-scale A/R project and its applicability to the proposed small-scale A/R CDM project activity:

The proposed A/R CDM project activity complies with the conditions as set out in the simplified small scale methodologies; i.e.:

1. Prior to implementation of the project activity, the land is used as grasslands and croplands, which will not be ploughed before the plantation is established;

2. Displacement of households or activities, due to the implementation of the SSC A/R CDM project activity, is estimated to be less than 50%;

3. Land to be reforested shall be demonstrated to have been non-forest since 31 December 1989, using the temporary forest definition thresholds developed for project development (crown coverage – 30%, tree height – 3m, minimum area – 0.1 ha, and in addition minimum width – 10 m).

However, an official forest definition needs to be selected by the designated national authority (DNA) of Armenia and subsequently reported to the UNFCCC secretariat prior to registration of the SSC-AR-CDM project.

4. The project activities are Afforestation/Reforestation types:
   i. For afforestation project activities, the land must have been below the forest national thresholds with regard to crown cover, tree height and minimum land area for forest definition under Decision 11/CP.7, for a period of at least 50 years;
   
   ii. For reforestation project activities, the land must have been below the forest national thresholds between 31 December 1989 and project start with regard to crown cover, tree height and minimum land area for forest definition under Decision 11/CP.7.

5. The land is eligible for small-scale A/R CDM project activity according to the following supporting evidence:
   (a) Aerial photographs or satellite imagery complemented by ground reference data;
(b) Ground-based surveys (land-use plans and land registry cadastral information).
Proving of land eligibility will be undertaken should a carbon buyer/project investor be found during the final project development stage.

B. 3. Application of baseline methodology to the proposed small-scale A/R CDM project activity:

B. 3. 1. Description of how the actual net GHG removals by sinks are increased above those that would have occurred in the absence of the registered small-scale A/R CDM project activity:

In the absence of the registered small-scale A/R CDM project activity, the actual net GHG removals by sinks will not increase, since under the current condition the sites are used as grassland and cropland, while under the proposed project activity they will be converted into forest land. As a result of the land use change through conversion of grassland/cropland into forest land, the actual net GHG removals by sinks will be increased.

The project activity is additional due to the following identified barriers:

a. **Investment barriers, other than economic/financial barriers,**
   - **Debt funding not available for this type of project activity:**
     Available funding for communities for forest establishment through state budget allocations is very limited, and individual farmers have no access to such funding at all. Taking into account the fact that establishment of forest is generally regarded as not economically viable in the country without obtaining carbon benefits, it is apparent why communities and individual farmers are not interested in conversion of their agricultural lands into forest land through afforestation/reforestation activities.
   - **Lack of access to credit:**
     Opportunities for getting loans from banks to fund such project activities are negligible in Armenia, due to high market risk and economic unattractiveness.

b. **Institutional barriers,**
   - **Lack of enforcement of legislation relating to forest or land-use:**
     The new Forest Code was endorsed in 2005, which was an improvement on the previous one. However, several forest laws regulating forest land use and afforestation/reforestation activities are still lacking, although thanks to the ongoing FAO National Forest Program Facility – Armenia Partnership project, most of these
will be developed by “Hayantar” (Armforest) State Non Commercial Organizations (SNCO) within a year.

c. Technological barriers,

- **Lack of access to planting materials:**
  
The forest nursery system in the country, which formerly had the potential to supply sufficient planting stock for the establishment of 5000 – 6000 ha of forest per year, has not yet been fully restored after the collapse of the Soviet Union. Currently, the state forest nurseries are not organized to supply adequate planting stock for the proposed project activity. Several private nurseries now operating are mainly focused on the production of fruit trees or planting of greenery tree/bush species, rather than silvicultural species. For the successful implementation of the proposed SSC-AR-CDM project, new forest nurseries of appropriate size must be established to provide the project activity with adequate planting materials.

- **Lack of infrastructure for implementation of the technology:**
  
As noted above, the forest nursery and forest seed handling infrastructure is inadequate, so the latter must be encouraged by adopting new technologies.

d. Barriers due to prevailing practice,

- **The project activity is the “first of its kind”. No project activity of this type is currently operational in the host country or region.**
  
The proposed project activity is the “first of its kind” for the Lori region and for Armenia as a whole. Furthermore, no projects of this type are currently operating in the neighboring Caucasus countries.

e. Barriers due to local ecological conditions,

- **Degraded soil (e.g. water/wind erosion, salination)**
  
  Mostly the community sites envisaged for the proposed project activity are located on mountain slopes with poor, low productivity land prone to water erosion.

- **Unfavorable meteorological conditions (e.g. early/late frost, drought)**
  
  In comparison with other regions of Armenia, the Lori region is generally characterized by a mild climate favorable for natural forest cover, but in spite of the small size of the region (?) there is a wide variation in climatic conditions, depending on elevation, mountain exposition, slope angle etc. Therefore some of the project areas might suffer from unfavorable meteorological conditions. Nevertheless the project developers will minimize the risks by proper selection of the project sites, species and plantation management techniques.
Pervasive opportunistic species preventing regeneration of trees (e.g. grasses, weeds)

Competition between the naturally growing grasses and the planted forest seedlings is severe, especially at the early stage of plantation establishment. The suggested forest tending practice, such as soil grubbing and weeding, aims to reduce the negative impacts and the promotion of forest plantation growth during the first 5 years of forest establishment.

f. Barriers due to social conditions,

- Widespread illegal practices (e.g. illegal grazing, non-timber product extraction and tree felling):

Special attention should be paid to protect the planted forest from illegal grazing or fodder collection. The communities/individual landholders will be responsible for the protection of the stands. Stands within areas that are subject to continuous grazing will be fenced if they cannot be protected by other means.

For other areas, planting of thorny bushes on the stand border lines is proposed, which will serve as “green fencing”. Nevertheless at least one person – a guard from each community – will need to be assigned for taking responsibility for the afforested/reforested sites. In addition, the guard has to monitor the health and vitality of the forest stand, protecting it from fire and possible forest violations.

Illegal tree felling and grazing practices are widespread not only in the Lori region but throughout Armenia, because of poverty and for commercial reasons. Therefore proper forest guarding should be envisaged for the success of the proposed project activity.

- Lack of skilled and/or properly trained labor force:

Capacity building of local communities/landholders will be an integral component of the proposed project implementation, enabling upgrading of the necessary skills and the knowledge of the project participants to handle the SSC-CMD-AR project activity with the Community. In addition, training courses will be implemented for the personnel engaged in nursery management and carbon monitoring.

- Lack of organization of local communities:

Due to lack of community forestry capacities, the role of the Project Implementation Unit (PIU), consisting of highly qualified staff for the proposed activities, is a major one. Inadequate coordination among the project participants handling multiple A/R sites, nursery management and overall project management could seriously hamper the implementation of the SSC-AR-CMD project activities and consequently only unsatisfactory results might be obtained.
B.3.2. Detailed baseline information, including the date of completion of the baseline study and the name of person(s)/entity(ies) determining the baseline:

A detailed baseline study has not yet been undertaken, because the project sites have still not been selected, due to lack of time and available resources. Since most of the sites suggested by the communities/landholders lack perennial vegetation cover, for the rough calculation of the net anthropogenic GHG removal by sinks, the baseline was set to zero.

A complete baseline study will be done during the next project development stage once carbon buyers/investors are identified.

B.4. Application of monitoring methodology and plan to the small-scale A/R CDM project activity:

The monitoring plan has been developed based on reviewed literature\(^5\), adapting it to Armenian conditions.

**Stratification**

To facilitate fieldwork and increase the accuracy and precision of measuring and estimating carbon, the project area has been divided into strata that form relatively homogenous units. Usually the tools for defining strata include ground-verified maps from satellite imagery, aerial photographs and maps of vegetation, soils or topography.

The size and spatial distribution of the land area do not influence site stratification. Whether one large contiguous block of land or many small parcels are considered, they can be stratified in the same manner. Stratification has been carried out applying criteria that are directly related to the variables to be measured and monitored.

Based on the site investigation and assessment, the project area is categorized into the following strata. The stratification has been built into a GIS that has been used to produce stratification maps. Applied stratification options might include:

1. Soil type: (gray soils, brown soils, black soil “chernozem” etc),
2. Elevation: (low 600-1100m, medium 1101-1600m, high 1601-2000),

**Permanent plots, their shape and size**

The recommended type of sampling is permanent plots for trees, which is regarded as statistically more efficient in estimating changes in forest carbon stocks, than temporary plots.

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because there is high covariance between observations at successive sampling events. Moreover, permanent plots permit efficient verification at relatively low cost: a verifying organization can find and measure permanent plots at random to verify, in quantitative terms, the design and implementation of the carbon monitoring plan. Marking of trees to measure the growth of individual ones at each time interval is critical, so that growth of survivors and mortality can be tracked. Changes in carbon stocks for each tree are estimated and summed per plot. Statistical analyses can then be performed on net carbon accumulation per plot and losses due to mortality.

Nested plots containing smaller sub-plots (sub-units) of various shapes and sizes are envisaged, which are usually the most cost-efficient types, compared with single plots. Nested plots are composed of two sub-plots, each of which should be viewed as separate. The plots can take the form of nested rectangles.

When trees attain the minimum size (measured by diameter at breast height, or dbh) for a nested plot, they are measured and included. When they exceed the maximum dbh size, measurement of the tree in that nest stops and begins in the next larger nest.

Recommended sample plot characteristics, such as their shape and size, are derived from the Canadian National Forest Inventory Ground Sampling Version 1.0, 2002, which has been tested for the assessment of forest carbon sequestration in the northeastern region of Armenia.6

Table B-1. Proposed sample plot characteristics

<table>
<thead>
<tr>
<th>Stem Diameter</th>
<th>Plot size</th>
<th>Square Plot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 cm &lt; 5 cm dbh</td>
<td>50 m²</td>
<td>7.07 m x 7.07 m</td>
</tr>
<tr>
<td>≥ 5 cm dbh</td>
<td>400 m²</td>
<td>20 m x 20 m</td>
</tr>
</tbody>
</table>

The schematic below represents a two-nest sampling plot in square forms (Fig. B-1.)

Figure B-1. Layout of the sample plots

6 Artur Gevorgyan “Assessment of carbon sequestration of Pallas pine in northeastern region of Armenia” PhD thesis manuscript, Yerevan 2006, Armenia
Data and analyses at the plot level are extrapolated to the area of a full hectare to produce carbon stock estimates. Extrapolation occurs by calculating the proportion of a hectare (10,000 m$^2$) that is occupied by a given plot using expansion factors. A series of nested rectangles measuring 7.07 x 7.07 m and 20 m x 20 m is used, with their areas equal to 50 m$^2$ and 400 m$^2$ respectively (using expansion factors of 200.0 for the small plot and 25.0 for the large one to convert the plot data to a hectare basis).

Because all carbon measurements are reported on a horizontal projection basis, plots on sloping lands must use a correction factor. This correction factor accounts for the fact that when distances measured along a slope are projected onto the horizontal plane, they are smaller. If the plot is split between level and sloping ground, it is simpler to move the plot so that it is either entirely level or entirely sloping. If the plot falls on a slope, then the slope angle should be measured using a clinometer. Where the plot is located on a slope that is greater than 10%, the slope should be measured so that an adjustment can be made to the plot area at the time of analysis.

True horizontal length is calculated using the formula:

\[ L = L_s \times \cos S \]

Where:

\[ L = the \ true \ horizontal \ plot \ length, \]
\[ L_s = the \ standard \ length \ measured \ in \ the \ field \ along \ the \ slope, \]
\[ S = the \ slope \ in \ degrees, \ and \]
\[ \cos = the \ cosine \ of \ the \ angle. \]

Correcting for slope after returning from the field results in a rectangular plot of area:

\[ Area = \text{Plot width} \times \text{calculated true plot length (L)} \]

**Number of Plots**

It is important that sampling is carried out with statistical rigor to identify the number of plots required to reach the desired precision in the results.

The Winrock Sampling Calculator tool\(^7\) was applied with input data on the desired precision and the number, area, mean carbon density and co-efficient of variation for each stratum for calculating number of plots. For L strata, the number of plots (n) needed will be calculated according to the formula below:

Where:

Location of Plots and Measurement Frequency

To maintain statistical rigor, plots must be located without bias. The entirety of the project site should be sampled. The location of plots has been randomly selected, following the procedures below:

- A map of the project is prepared, with the project boundaries of strata within the project clearly delineated.
- Plots should be distributed randomly within the strata.
- The living aboveground biomass pool of the plots should be measured every five years.

Field Measurements

Effective planning of fieldwork is essential to reduce unnecessary labor costs, avoid safety risks and ensure reliable carbon estimates. The equipment used for fieldwork should be accurate and durable to withstand the rigors of use under adverse conditions.

Table B-1. List of forest field equipment

<table>
<thead>
<tr>
<th>List of equipment</th>
<th>Use</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>– Compass</td>
<td>for measuring bearings</td>
<td>Compass with a declination adjustment is preferred.</td>
</tr>
<tr>
<td>– Fiberglass meter tapes (30 m)</td>
<td>for measuring distances</td>
<td></td>
</tr>
<tr>
<td>– Global Positioning System (GPS)</td>
<td>for locating plots</td>
<td></td>
</tr>
</tbody>
</table>
– Tree dbh tape for measuring trees

Steel dbh tapes are recommended and not cloth ones, which can stretch and result in inaccurate measurements.

– Clinometers for measuring tree height and slope

Clinometer with degree scale

– Colored rope and pegs for marking plot boundaries

For square plots, the four corners should be pegged out. During measurement, flagging tape is run between the corner pegs to delineate the edges.

Technique for using a dbh tape

It is important that a dbh tape is used properly to ensure consistency of measurement:

- Be sure to have a staff or pole measuring 1.3 m in length so the dbh location on the tree can be accurately identified, or use a sturdy stick (at least 2 cm in diameter). Alternatively, each member of the team should measure the location of dbh (that is, 1.3 m above ground) on their own bodies and use that location to determine the placement of the tape.

- Dbh tapes often measure diameter on one side and circumference on the other. It is important that all measurers know which measurements to record.

- If the tree is on a slope, always measure on the uphill side.

Figure B-2. DBH measurement locations for normally shaped and irregular trees

- If the tree is leaning, the dbh tape must be wrapped according to the tree’s natural angle (not straight across, parallel to the ground).

- If the tree is forked at or below the dbh, measure just below the fork point. If it is impossible to measure below the fork, then measure as two trees. Traditional forestry dictates that forked stems be measured as two separate trees but when the focus is on biomass, it is more accurate to measure as a single tree wherever possible.

- If the tree has fallen but is still alive, then place the measuring stick towards the bottom and measure at dbh just as if the tree was standing upright. Trees are considered alive if there are green leaves present.

Data Analysis
Stem volume (SV) can be calculated, once the basal area, mean tree height and the fone factors for the stand forming species are available, by the following formula:

\[ SV = g \times h_{\text{mean}} \times f \]

Where:
- \( g \) – basal area of the stand by species (m\(^2\));
- \( h_{\text{mean}} \) – mean height of trees by species (m);
- \( f \) – fone factor of the stand by species (dimensionless)

The basal area of a single tree can be calculated by the formula below:

\[ g = \pi \times \frac{d^2}{4} \]

Where:
- \( d_3 \) – diameter of the tree at breast (1.30 m) height (cm);
- \( \pi \) – is equal to 3.1416

The mean height of the trees by species can be calculated by the formula below:

\[ h_{\text{mean}} = \frac{h_1 \times g_1 + h_2 \times g_2 + h_3 \times g_3 + \ldots + h_n \times g_n}{\Sigma G} \]

Where:
- \( h_1, h_2, h_3 \ldots h_n \) – heights of different trees of a certain species;
- \( g_1, g_2, g_3 \ldots g_n \) – basal areas of different trees of a certain species;
- \( \Sigma G \) – the sum of the basal areas of different trees of a certain species.

The fone factor (\( f \)) of the trees by species can be obtained from local volume tables. However, the most accurate values with non-destructive sampling might be obtained by application of Shpiegel relaskop (metric scale), measuring the diameter of the stem at different heights (e.g. at \( h_{1/2} \)). Then \( f \) can be calculated from the formulas below:

\[ f = 0.66 \times q_2^2 + 0.32 / q_2 \times h + 0.140; \quad q_2 = d_{1/2} / d_{1.3} \]

Where:
- \( d_{1/2} \) – diameter of tree at the mid-height of certain species (cm);
- \( d \) – diameter of tree at breast height (cm).

Further calculations should be prepared following the requirements set out in section C.
### B.4.1 Data to be monitored: Monitoring of the actual net GHG removals by sinks and leakage.

#### B.4.1.1. Actual net GHG removals by sinks data:

<table>
<thead>
<tr>
<th>Data variable</th>
<th>Source of data</th>
<th>Data unit</th>
<th>Measured (m), calculated (e) or estimated (e)</th>
<th>Recording frequency</th>
<th>Proportion of data to be monitored</th>
<th>How will the data be archived? (electronic/paper)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of the areas where the project activity has been implemented</td>
<td>Field survey or cadastral information or aerial photographs or satellite imagery</td>
<td>Latitude and longitude</td>
<td>Measured</td>
<td>5</td>
<td>100 per cent</td>
<td>Electronic, paper, photos</td>
<td>GPS can be used for field survey</td>
</tr>
<tr>
<td>Slope angle of the areas</td>
<td>Field survey</td>
<td>° degree</td>
<td>Measured</td>
<td>Once</td>
<td>Each sample plot</td>
<td>Electronic, paper, photos</td>
<td>Clinometer can be used for field survey</td>
</tr>
<tr>
<td>Ai - Size of the areas where the project activity has been implemented for each type of strata</td>
<td>Field survey or cadastral information or aerial photographs or satellite imagery or GPS</td>
<td>ha</td>
<td>Measured</td>
<td>5</td>
<td>100 per cent</td>
<td>Electronic, paper, photos</td>
<td>GPS can be used for field survey</td>
</tr>
<tr>
<td>Location of the permanent sample plots</td>
<td>Project maps and project design</td>
<td>Latitude and longitude</td>
<td>Defined</td>
<td>5</td>
<td>100 per cent</td>
<td>Electronic, paper</td>
<td>Plot location is registered with a GPS and marked on the map</td>
</tr>
<tr>
<td>Metric</td>
<td>Source</td>
<td>Unit</td>
<td>Method</td>
<td>Frequency</td>
<td>Notes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>-------------------------</td>
<td>------------</td>
<td>-------------</td>
<td>-----------</td>
<td>-----------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diameter of tree at breast height (1.30 m)</td>
<td>Permanent plot</td>
<td>cm</td>
<td>Measured</td>
<td>5</td>
<td>Each tree in the sample plot</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Electronic, paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Measure diameter at breast height (DBH) for each tree that falls within the sample plot and applies to size limits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height of tree</td>
<td>Permanent plot</td>
<td>m</td>
<td>Measured</td>
<td>5</td>
<td>Each tree in the sample plot</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Electronic, paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Measure height (H) for each tree that falls within the sample plot and applies to size limits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basal area</td>
<td>Permanent plot</td>
<td>m²</td>
<td>Calculated</td>
<td>5</td>
<td>Each sample plot</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Electronic, paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculate the basal area at breast height (DBH) for each sample plot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fone factor</td>
<td>Literature, permanent plots, (dimensionless)</td>
<td></td>
<td>Estimated or Measured</td>
<td>5</td>
<td>Each sample plot</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Electronic, paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Data might be obtained by searching literature or calculated based on field measurements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic wood density</td>
<td>Permanent plots, literature</td>
<td>tons of dry matter per m³ fresh volume</td>
<td>Estimated</td>
<td>Once</td>
<td>3 samples per tree from base, middle and top of stem of three individuals</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Electronic, paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total CO₂</td>
<td>Project activity</td>
<td>Mg</td>
<td>Calculated</td>
<td>5</td>
<td>All project data</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Electronic</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Based on data collected from all plots and carbon pools</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### B.4.1.2 Data for treatment of leakage (if applicable)

#### B.4.1.2.1. If applicable, please describe the data and information that will be collected in order to monitor leakage of the proposed small-scale A/R CDM project activity:

<table>
<thead>
<tr>
<th>Data variable</th>
<th>Source of data</th>
<th>Data unit</th>
<th>Measured (m), calculated (c) or estimated (e)</th>
<th>Recording frequency</th>
<th>Proportion of data to be monitored</th>
<th>How will the data be archived? (electronic/ paper)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of families/households of the community involved in or affected by the project activity displaced due to implementation of the project activity</td>
<td>Participatory survey</td>
<td>Number of families or households</td>
<td>Estimated</td>
<td>5</td>
<td>per cent</td>
<td>Electronic</td>
<td></td>
</tr>
<tr>
<td>Percentage of total production of the main produce (e.g. meat, corn) within the project boundary displaced due to the CDM A/R project activity.</td>
<td>Survey</td>
<td>Quantity (volume or mass)</td>
<td>Estimated</td>
<td>5</td>
<td>per cent</td>
<td>Electronic</td>
<td></td>
</tr>
</tbody>
</table>
B.4.2. Qualitative explanation of how quality control (QC) and quality assurance (QA) procedures are undertaken:

Consistent with GPG LULUCF, monitoring requires provisions for quality assurance (QA) and quality control (QC), to be implemented through a QA/QC plan. This plan will become part of project documentation and cover the procedures described below.

### Procedures to ensure reliable field measurements

Collecting reliable data from field measurements is an important step in the quality assurance plan. The coordination group responsible for the measurement work should be trained in all aspects of field data collection and analysis following standard operating procedures (SOPs) for each step of the field measurements. To ensure the collection and maintenance of reliable field data, the following are essential:

- Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible;
- Field teams install test plots if needed in the field and measure all pertinent components using the SOPs to estimate measurement errors;
- The document will list all names of the field team members and the project leader will certify that the team is trained;
- New staff is adequately trained.

### Procedures to verify field data collection

To verify that plots have been installed and the measurements taken correctly, they will be re-measured independently every 10 plots, comparing the measurements. The following quality targets should be achieved for the re-measurements, compared to the original measurements:

- Missed or extra trees: no error within the plot
- Tree species or groups: no error
- DBH: $< \pm 0.1 \text{ cm or } 1\%$, whichever is greater
- Height: $< \pm 5\%$
- Sides of rectangular plot: $< \pm 1\%$ of horizontal (angle adjusted)

At the end of the field work, 10% of the plots shall be checked independently. Field data collected at this stage will be compared with the original data. Any errors found should be corrected and recorded. Any errors discovered should be expressed as a percentage of all plots that have been rechecked to provide an estimate of the measurement error.
Procedures to verify data entry and analysis

In order to obtain reliable estimates, data must be entered into the data analysis spreadsheets correctly. Errors in this process will be minimized by crosschecking of data in advance and conducting internal tests for the spreadsheets to ensure that the results of calculations are realistic. All personnel involved in measuring and analyzing data will be consulted to resolve any apparent anomalies before the final analysis of the monitoring data is completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot should not be used in the analysis.

Data maintenance and storage

Data archiving (maintenance and storage) will be an integral part of the project documentation and an important component of the A/R project activities under the CDM work. Data archiving will be undertaken with the appropriate forms done by PIU and copies of all data will be presented to each project participant, including the following:

- Copies (electronic and/or paper) of all field data and analyses, estimates of the changes in carbon stocks and corresponding calculations;
- Hardcopies of the maps, produced by GIS;
- Copies of the measuring and monitoring reports.

It is envisaged that the electronic copies of the data and the report will be updated periodically or converted to a format that could be accessed by any future software application by the project coordination unit.

B.4.3. Please describe briefly the operational and management structure(s) that the project operator will implement in order to monitor actual GHG removals by sinks by the proposed small-scale A/R CDM project activity:
B.4.4. Name of person/entity determining the monitoring methodology:

Artur Gevorgyan, National GHG Inventory Expert - Land Use, Land-Use Change and Forestry, Armenia; E-mail: arturgev@freenet.am
SECTION C. Estimation of net anthropogenic GHG removals by sinks:

C.1. Formulae used:

C.1.1. Description of formulae used for estimation of the actual net GHG removals by sinks due to the project activity within the project boundary:

The carbon stocks within the project boundary are calculated with the following formula:

\[ N(t) = \sum (N_{A(t)} + N_{B(t)}) \times A_i \]

where:

- \( N_{A(t)} \) = carbon stocks in above-ground biomass at time \( t \) of stratum \( i \) under the project scenario (t C/ha)
- \( N_{B(t)} \) = carbon stocks in below-ground biomass at time \( t \) of stratum \( i \) under the project scenario (t C/ha)
- \( A_i \) = project activity area of stratum \( i \) (ha)

For above-ground biomass - \( N_{A(t)} \) is calculated as follows:

\[ N_{A(t)} = T(t) \times 0.5 \]

where:

- \( T(t) \) = above-ground biomass at time \( t \) under the project scenario (t dm/ha)
- 0.5 = carbon fraction of dry matter (t C/t dm)

\[ T(t) = SV(t) \times BEF \times WD \]

where:

- \( SV(t) \) = stem volume at time “\( t \)” for the project scenario (m³/ha)
- \( WD \) = basic wood density (t dm/m³) local estimates from the national GHG inventory source for LULUCF sector (pine spp. - 0.418 tdm/m³; oak - Quercus iberica - 0.544 tdm/m³, Quercus macranthera – 0.560 tdm/m³; Caucasian pear tree (Pyrus Caucasica) - 0.552 tdm/m³; ash – 0.639 tdm/m³ (Fraxinus oxycarpa); walnut (Juglans regia)- 0.473 tdm/m³, bush species - 0.499 tdm/m³.
- \( BEF \) = biomass expansion factor (over bark) from stem volume to total volume (dimensionless) from the regional forest estimation sources for different ages were applied for pine; otherwise Table 3A.1.10 of the IPCC GPG for LULUCF – 1.2 factor were used for the broadleaved species.
Year | Derived BEFs for pine species<sup>8</sup>  
--- | ---  
1 | 2.080  
2 | 2.060  
3 | 2.040  
4 | 2.020  
5 | 2.000  
6 | 1.905  
7 | 1.810  
8 | 1.715  
9 | 1.620  
10 | 1.505  
11 | 1.485  
12 | 1.465  
13 | 1.445  
14 | 1.425  
15 | 1.415  
16 | 1.405  
17 | 1.395  
18 | 1.385  
19 | 1.375  
20 | 1.365

\[ \text{BEF} = 1 + K_{cr} \]

where:

\[ K_{cr} = \text{ratio of crown mass to stem wood mass (dimensionless)} \]

For below-ground biomass, \( N_{B(t)} \) is calculated as follows:

\[ N_{B(t)} = T(t) \times R \times 0.5 \]

where:

\( R = \text{root to shoot ratio (dimensionless) from table 3A.1.8 of the IPCC GPG for LULUCF - for coniferous species 0.23, for oak 0.35, for other broadleaved species 0.26.} \]

\[ 0.5 = \text{carbon fraction of dry matter (tC/t dm).} \]

---

C. 1.2. Description of formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale A/R CDM project activities under CDM:

The leakage has been estimated from the displacement of activities or people by considering the following indicators:

- Percentage of families/households of the community involved in or affected by the project activity displaced due to the project activity;
- Percentage of total production of the main produce (for example, meat or corn) within the project boundary displaced due to the project activity.

If the value of both these indicators is less than 10%, then \( L(t) = 0 \); if the value of either of these indicators is greater than 10% and less than or equal to 50%, then leakage is equal to 15% of the actual net GHG removals by sinks, that is:

\[
L(t) = N_t * 0.15
\]

where

\( L(t) \) = leakage attributable to the project activity within the project boundary at time \( t \)

\( N(t) \) = carbon stocks in the living biomass pools within the project boundary at time \( t \) under project scenario (t C)

As indicated in paragraph 3 of the *Annex II Simplified baseline and monitoring methodologies for selected small-scale A/R project activities under the CDM*, if the value of either of these indicators is greater than 50%, net anthropogenic removals by sinks will not be estimated.

The use of fertilizers is not envisaged by the project participants, therefore \( N_{2O} \) emissions have not been estimated.

C. 1.3. Description of formulae used to estimate net anthropogenic GHG removals by sinks, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale A/R CDM project activities under CDM:

Net anthropogenic greenhouse gas removals by sinks is the actual net GHG removals by sinks minus the baseline net GHG removals by sinks minus leakage.

The resulting long-term certified emission reductions (ICERs) at the year of verification \( t_v \) are calculated as follows:

\[
ICER(t_v) = \frac{44}{12} * [(N(t_v) - N(t_v-\kappa)) - L(t_v)]
\]

\[
L(t_v) = 0.15 * (N(t_v) - N(t_v-\kappa))
\]

\( N(t_v-\kappa) = N(t=0) \) for the first verification

where:
ICER(tv) = ICERs emitted at time of verification tv (t CO₂)

N(tv) = carbon stocks in the living biomass pools within the project boundary at time of verification tv under project scenario (t C)

B(tv) = carbon stock in the living biomass pools within the project boundary at time of verification tv that would have occurred in the absence of the project activity (t C)

L(tv) = leakage attributable to the project activity within the project boundary at time of verification tv (t C)

tv = year of verification

κ = time span between two verifications

44/12 = conversion factor from t C to t CO₂ equivalent (t CO₂/t C)

### C. 2. Estimate of the actual net GHG removals by sinks:

The actual net GHG removals by sinks is estimated to be about 159998.11 t CO₂-e at the end of the first crediting period, being conservative. It would require planting of about 937 ha of forest in the selected communities. For detailed estimation of actual net GHG removals by sinks, starting from strata level is necessary.

It has not yet been possible to apply it, because the sites have not been finally identified and consequently stratification was not applied at this stage.

### C. 3. Estimated baseline net GHG removals by sinks:

The baseline net GHG removals by sinks is estimated to be 0 t CO₂-e at the end of the first crediting period, assuming planting of forest on the lands lacking perennial woody vegetation. The detail baseline study will be undertaken at the final stage of the PDD development, based on actual sites chosen for the proposed project activity, especially for shrub land.
C. 4. Estimated leakage:

The leakage attributed to the proposed SSC-AR-CDM project has been assumed as equal to 15% of actual net GHG removals by sinks, which is estimated to be about 28234.96 t CO$_2$-e at the end of the first crediting period, and so is conservative. The assumption is that the sum of the percentage of affected families/ households of the community and the percentage of the total of the main produce displaced due to project activity equals 50%. However, there might be cases of less leakage than calculated for some of the communities.

C. 5. The sum of C.2. minus C.3 minus C.4 representing the net anthropogenic GHG removals by sinks of the proposed small-scale A/R CDM project activity:

The net anthropogenic GHG removals by sinks of the proposed SSC-A/R-CDM project activity would be about 159998.11 t CO$_2$-e for the first crediting period.

C. 6. Table providing values obtained when applying formulae above:

<table>
<thead>
<tr>
<th>Years</th>
<th>Estimation of baseline net GHG removals by sinks (tons of CO$_2$ e)</th>
<th>Estimation of actual net GHG removals by sinks (tons of CO$_2$ e)</th>
<th>Estimation of leakage (tons of CO$_2$ e)</th>
<th>Estimation of net anthropogenic GHG removals by sinks (tons of CO$_2$ e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0</td>
<td>635.15</td>
<td>95.27</td>
<td>539.88</td>
</tr>
<tr>
<td>2</td>
<td>0.0</td>
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<td>5778.52</td>
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<td>14</td>
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<tr>
<td>16</td>
<td>0.0</td>
<td>72659.53</td>
<td>10898.93</td>
<td>61760.60</td>
</tr>
</tbody>
</table>
SECTION D. Environmental impacts of the proposed small-scale A/R CDM project activity:

D. 1. If any negative impact is considered significant by the project participants or the host Party, a statement that project participants have undertaken an environmental impact assessment, in accordance with the procedures required by the host Party, including conclusions and all references to support documentation:

No significant negative impacts have been identified due to the environmentally-sound techniques applied for the proposed SSC A/R CDM project activity, e.g., soil preparation – trench technique, proper choice of tree species, tree planting schemes etc.

SECTION E. Socio-economic impacts of the proposed small-scale A/R CDM project activity:

E. 2. If any negative impact is considered significant by the project participants or the host Party, a statement that project participants have undertaken a socioeconomic impact assessment, in accordance with the procedures required by the host Party, including conclusions and all references to support documentation:

No significant negative impacts have been identified due to the proposed SSC A/R CDM project activity.

SECTION F. Stakeholders’ comments:

F. 1. Brief description of how comments by local stakeholders have been invited and compiled:

Stakeholders consulted during project preparation included community officials, Lori marzpetaran (local government) officers and community leaders. These were consulted throughout the whole period of development of the draft PDD through focus group meetings and community social surveys. Respondents were informed of key elements of the proposed project and asked to state preferences and issues of concern.

The questionnaire was developed and distributed through the local government to express the intention of the communities to participate in the proposed project activities, as well as to self-
evaluate the lands available for the A/R activities, using the list of general criteria for land eligibility.

**F. 2. Summary of the comments received:**

Local government officers and community leaders greatly support the project, emphasizing the broad benefits to be generated by the proposed activity, ensuring sustainable development of the communities. Overall, comments of community leaders were also enthusiastic. Respondents to the questionnaires highlighted the range of socio-economic and environmental benefits expected as a result of the proposed A/R activity for their communities. It is clear that the prospect of employment and other environmental benefits is perceived very positively and with anticipation. Most of the communities surveyed are willing to take part in the project, with only a small number not interested in A/R activities, mainly due to a shortage of community agricultural lands to be allocated for the project purpose. Up to September 2006, 25 communities in total have signed the Memorandum of Cooperation (see Annex).

In response to the question “what are the main environmental outcomes (impacts) expected from the realization of an afforestation/reforestation project in your community” the following common answers were compiled:

- Combating land degradation (erosion),
- Regulation of water sources and surface flows,
- Improvement of general microclimate of the community,
- Forest biodiversity conservation etc.

In response to the question “what are the main socio-economic outcomes expected from the implementation of the afforestation/reforestation project in your community” the following general answers were compiled:

- Creation of local employment opportunities,
- Alleviation of poverty,
- Development of the community forestry,
- Exploitation of forest by-products,
- Establishment of forest recreational sites etc.
F. 3. Report on how due account was taken of any comments received:

Community/individual landholders’ contributions were not discussed at this stage of project development. In all likelihood, many of the comments by project participants will be received during the next contracting stage, once the potential carbon buyer/investor is identified. Then, community meetings will be held to clarify the forms and the size of their contributions. To meet the local inhabitants’ needs, fruit-bearing trees with non-timber economic values such as Persian walnut, Caucasian pear-tree, cornelian cherry etc will be introduced wherever appropriate from a silvicultural point of view.
### Annex 1

**CONTACT INFORMATION ON PARTICIPANTS IN THE PROPOSED SMALL-SCALE A/R CDM PROJECT ACTIVITY**

<table>
<thead>
<tr>
<th>Organization:</th>
<th>Project Participant: Community Representative (still to be nominated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street/P.O.Box:</td>
<td></td>
</tr>
<tr>
<td>Building:</td>
<td></td>
</tr>
<tr>
<td>City:</td>
<td></td>
</tr>
<tr>
<td>State/Region:</td>
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</tr>
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<tr>
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<tr>
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### Organization:
Armenian Project Office of Tacis-Project "Technical Assistance to Armenia, Azerbaijan, Georgia and Moldova with respect to their Global Climate Change Commitments" Project Number: EuropeAid/115123/C/SV/Multi/Lot No. 2 carried out by Fichtner/Linden/Fraunhofer ISI/CESI consortium

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<td><a href="mailto:arturgev@freenet.am">arturgev@freenet.am</a></td>
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

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