“Adaptation to Climate Change Impacts in Mountain Forest Ecosystems of Armenia”
UNDP/GEF/00051202 Project

Mission Report on the Visit to Syunik Pilot Project Sites from 14 to 16 April 2011

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1 Purpose of the Mission

1. A field visit to the ongoing reforestation pilot project sites in Syunik (Goris) and Kapan Forest Enterprises of “Hayantar” State Non-Commercial Organisation and “Arevik” National Park State Non-Commercial Organisation was organized to observe and assess the current reforestation practices in Syunik region under the UNDP/GEF/00051202 project “Adaptation to Climate Change Impacts in Mountain Forest Ecosystems of Armenia”. The three pilot project sites were visited by the participants of the mission (Project Task Leader Aram Ter-Zakaryan, UN Volunteer Sipi Jaakkola, UN Volunteer Essi Ulander and Monitor/Driver Vahan Mardirossian) between the 14th and the 16th of April, 2011. On the sites, the participants of the mission were accompanied by FE and “Arevik” National Park employees (Director and FE/NP workers) as well as by Project Local Expert and Project Local Monitor.

2. A joint evaluation of the implementation of the pilot projects was developed by the UN Volunteers Mr. Jaakkola and Ms. Ulander based on the observations made in the field, further elaboration of the observations, comments presented in previous documents developed by Project International Experts on the implementation of the pilot projects as well as discussions with Project Staff and specific stakeholders. The evaluation of the implementation of the pilot projects is presented in this field visit report. Furthermore, recommendations are made about the improvement of some aspects of pilot project implementation. The results of the mission will be taken into account in further analysis and assessment of the UNDP/GEF project implementation.

2 Forest Rehabilitation Pilot Project in Kapan Forest Enterprise

2.1 Pilot Project in Kapan

3. The pilot project site in Kapan is located in the Davit Bek Forest Area of Kapan Forest Enterprise of “Hayantar” SNCO. The goal of the pilot is rehabilitation of a juniper forest area affected by forest fire. In total the burned juniper forest area, within which the pilot site is located, is 90 hectares. The area was burned in 2006. The reforestation pilot site is located in the lower part of the burned area and covers 20 hectares. General information about the forest area is described in the pilot project strategy developed for the Kapan site. Some of this information, as well as relevant information from other sources, is described below.

4. Summers in the Davit Bek Forest Area are warm and comparatively humid. The second half of the summer period is dryer compared to the first half. July-August average temperature is 18 ºC and
precipitation in these months is 300 mm. Annual average temperature is 12 °C and annual precipitation 600 mm.

5. In general, soil quality on the northern slopes in the Davit Bek Forest Area is better than soil quality on the southern slopes. On the northern slopes, soil depth can be up to 1 metre. Soils below 800 metres above sea level are poorer with lower levels of nutrients and are described by higher levels of erosion.

6. Junipers grow between 600 and 2900 metres above sea level in the Davit Bek Forest Area. The two juniper species growing in the area are *Juniperus polycarpos* C. Koch. and *Juniperus foetidissima* Willd.. Natural forests of junipers occur as open forests with low density of scattered trees. Junipers are important in soil protection, and e.g. *Juniperus polycarpos* is resistant to frost and also relatively resistant to drought (Diavanshir 1974). Juniper species also withstands poor soil conditions relatively well. However, natural regeneration of junipers is very low or absent (Diavanshir 1974, Vardanyan 2000) and this has been recognised as one of the most important problems in the survival of *Juniperus* forests (Diavanshir 1974). It has been reported that in Iran the low level of natural regeneration of *Juniperus polycarpos* is caused by an unusually high proportion of hollow seeds produced (Diavanshir 1974). In the Armenian context, it has been reported that seeds of junipers are intensively damaged by pests and that this is the major reason for the absence of natural regeneration (Vardanyan 2000).

7. Other species growing in the lower parts of the forest belt (500-1400 m a.s.l.) in the Davit Bek Forest Area are e.g. oak, pomegranate, fig, almond, pistachio and walnut, and in the upper parts of the forest belt (1400-2300 m a.s.l.) oak, almond, wild pear etc. The sub-alpine zone consists of junipers and different bushes.

8. The Kapan pilot site is divided into four sectors (Map 1) with varying reforestation strategies. Sector 1 is 4 hectares and on average the sector is 1470 metres above sea level. The sector is located on a 30-35° north-eastern slope. According to the original pilot project implementation strategy, the sector is reforested with juniper seeds, which are planted in holes and trenches. Sector 2 is 6 hectares in area and is on average 1455 metres above sea level. The north, north-eastern slope varies between 30-35°. Juniper seedlings are planted in holes on this sector. Sector 3 is 4 hectares and is situated 1520 metres above sea level. The northern slope varies between 30-35°. The land preparation method on this sector is holes and the sector is reforested with juniper seedlings. Sector 4 is 6 hectares and is on average 1540 metres above sea level. The sector is located on a more gradual, 24° north-eastern slope. On this sector, juniper and oak seeds are planted in trenches.
9. The upper part of the pilot site is bordered by the burned juniper forest (Pictures 1 & 2) and the lower part by a road and a river. A natural juniper forest grows on the opposite slope across the river valley from the pilot site (Pictures 3 & 4).

10. The pilot project site in Kapan was visited on the 14th of April, 2011 by A. Ter-Zakaryan, S. Jaakkola, E. Ulander and V. Mardirossian. The Project Staff was accompanied by the Director of Kapan FE Volodya Mirzoyan, Project Local Expert Vladik Martirosyan, Project Local Monitor Arman Aleksanyan and foresters of Kapan FE.

Map 1. Reforestation sectors on the Kapan pilot project site (Hayantar 2010).
2.2 Kapan Pilot Project Activities

11. Activities on the Kapan pilot site begun in spring 2010 and they are described in detail in the pilot brief (Annex 1). Additional information was given by the FE employees and the Project Local Expert during the field visit. The land preparation and planting work have been carried out in two phases on the site with the first phase in April 2010 and the second in autumn 2010. Two methods of land preparation were used on the site. In spring 2010 holes for planting were made on 10 hectares on the site, and later in autumn 2010, trenches and holes were made on another 10 hectares on the site.
12. In spring 2010, a total of 7000 two- to three-year-old juniper seedlings were planted in the holes. The planting density is 650-700 seedlings per hectare. The seedlings were watered twice during the summer and agro-technical care was carried out (7000 seedlings). Grass mowing of 8700 m² was carried out on the site during summer 2010. Also a fence (2000 running meters) was established on the site (see Map 1). During the second phase of planting activities in autumn 2010, 8200 juniper seeds and 4200 oak seeds were sown in the holes and the trenches. Thus, two methods of regeneration, i.e. sowing and planting, were used on the Kapan pilot project site. 4200 of the sowed seeds were watered once and further agro-technical care was carried out in 8680 places on the site including both seedlings and seeds.

13. Monitoring of the survival rate has been conducted twice during the first growing season on the Kapan site. The average survival rate was about 36 % after the first monitoring (August 2010) and about 30 % after the second monitoring (November 2010).

14. Further activities have been carried out on the pilot site in March 2011. Some level of infilling with both seedlings and seeds has been carried out on the site. The FE employees reported during the field visit, that damage caused by rodents has been observed on some seedlings.

15. Planned activities for 2011 include agro-technical care, grass mowing and enlarging of the planting holes. Also monitoring is planned for 2011.

2.3 Comments about Kapan Pilot Project Implementation

16. Due to a lack of seeds and seedlings, a part of the juniper seedlings planted on the pilot site were collected from the natural juniper forest on the opposite slope from the pilot site (field visit notes, Kapp 2010) (Pictures 3 & 4). For this method to be successful, the root system of a seedling has to be dug out intact to a sufficient extent. This can be easier to perform with relatively young seedlings. In May 2010, it was assessed that the plantation would be successful with adequate watering (Kapp 2010).

17. However, as described above, the observed survival rate on the site after 2010 was low. For example, damage by rodents has been observed on the site. No specific monitoring results of the survival rate of the wild seedlings were reported. The survival rate after the infilling in March 2011 was reported to be high. This contradicted to some extent with the observations made during the field visit, as in a quick ocular survey of the pilot area, a large number of dead seedlings were found. Some variation was observed between the survival rates of different species. Oak seedlings were observed to be, in general, in better condition than juniper seedlings (ocular estimation only). However, it should be noted, that only a part of the pilot site was seen during the field visit.
Furthermore, the time elapsed since the infilling was short, and therefore it is too early to estimate the survival rate.

18. Soil conditions were observed to be good. It has been noted before, that soil conditions in parts of the pilot area are too good for juniper (Kapp 2010). If the relevance of Kapp’s note can be verified, and if it turns out to be true, it should be taken into account when planning further interventions on the site. No observations of soil depth were made.

19. Based on ocular estimations, the holes on the site were generally relatively small (note: only a part of the site was visited) (Picture 5). Larger holes (50x70 cm) would protect the seedlings longer from grass growing around the holes, which can suppress the seedlings. Grass mowing was carried out in 2010 and is planned also for 2011. This is recommendable in order to increase the survival of the seedlings. It is also planned that the holes will be enlarged in 2011. This will likely further increase the survival of the seedlings.

20. The pilot site has a tendency for grass growth and, hence, regular weeding is necessary. According to the FE employees and the Project Local Expert agro-technical care is planned to be carried out on a monthly basis by FE employees. It should be noted that this is very labour-intensive, and perhaps, costly management. This also applies to the plan to enlarge the holes. Furthermore, larger holes would likely reduce the need for weeding and agro-technical care and thus, holes of sufficient size should be made during initial land preparation. Some holes had mulching, which seemed to prevent the growth of weeds, but this was not the case for all holes.

21. The pilot project does not seem to include any assessment of the cost-efficiency of the activities. It should be added to the monitoring of the pilot projects. This is especially important when the sustainability of the chosen pilot forest management practices is evaluated and recommendations are developed based on the experiences of the UNDP/GEF project. Furthermore, some small-scale comparative studies using variable planting methods with variable costs and variable intensities of care after the planting should be added. This would help in the analysis of cost-efficiency, which is needed for the recommendations for large scale applications of the piloted measures as mentioned above.
Picture 5. Planting holes on the Kapan site were generally quite small. Larger holes (50x70 cm) would reduce the need for weeding.

22. The monitoring system on the pilot site should be reviewed. Currently monitoring is conducted by a line survey with temporary 100 m² (square) sampling plots, which are too large with a view to cost-efficiency (see Chapter 5). During each monitoring occasion 3-5 % of the pilot area is monitored. In 2010, monitoring was conducted twice on the site, and it is planned that monitoring will be more frequent in 2011.

23. Shorter monitoring intervals are not necessarily required, but the optimal timing and as well as an optimal interval of monitoring should be discussed. It is important to conduct monitoring after the harshest conditions, but not too close to them so that the actual rate of survival will be visible. This is necessary to avoid biased monitoring results and also to make correct analyses at a later date of the actual reasons of the survival or the death of seedlings.

24. Permanent monitoring plots should be considered to minimise variance and uncertainty and to maximise cost-efficiency of the monitoring results. Heterogeneity, i.e. different methods of land preparation and planting as well as variable intensities of care after planting in different sectors of the pilot area, should also be noted in the monitoring design in order to achieve representative monitoring results. Division of the pilot area to separate study areas should be considered, if homogeneity of the study area is not achievable in other manners. Additionally to the monitoring of
the survival rate of the seedlings, also other factors of the growing conditions should be included in
the data collection. This will be helpful when the results of the pilot measures are analysed and
recommendations are made based on the pilot projects. Comparability of the results of the three pilot
projects sites of the UNDP/GEF project should also be considered. Survival rate monitoring is
discussed in more detail in Chapter 5 of this report.

25. The resources of Kapan FE were discussed during the field visit. It was especially noted that the
personnel of the FE do not have specific forestry education. This is a serious weakness. Altogether,
the personnel of Kapan FE consists of a director, a chief forester, a forest protection engineer, a
forest culture engineer, a silviculture technician, administrative personnel, 6 heads of forest
sectors/areas and 38 forest workers. The forest area of the FE is 38 500 hectares. It should be noted
that V. Martirosyan, Project Local Expert has forestry training.

26. The reforestation of the burned area is important in terms of soil and biodiversity protection and the
pilot project is, overall, well implemented. It should be further discussed, what measures can be
taken in the future to increase the resilience of the forest area to climate change impacts. Issues such
as the connectivity of the forested area and natural regeneration on the upper and lower boundaries
of the pilot project reforested area, which may enable the adaptation of the forest to climate change
impacts, such as shifts in forest boundaries, as well as natural forest regeneration in other parts of the
burned area and further reduction of forest fragmentation are of key relevance.

3 Forest Rehabilitation Pilot Project in “Arevik” National Park

3.1 Pilot Project in “Arevik” National Park

27. The pilot project site in Meghri is located in the Nyuvadi-Shvanidzor sector of “Arevik” National
Park SNCO. The goal of the pilot is rehabilitation of an oak forest area affected by forest pests and
fire. The forest area, within which the pilot site is located, was affected in 1999-2001 by an outbreak
of leaf-eating pests and was later burned due to a severe forest fire in 2001. The fire spread from a
poorly managed fire from a nearby “datcha”. In total 80 hectares of forest was burned. The area is
mainly under oaks and is located in the south-eastern part of the forest. Natural regeneration is
observed on parts of the burned area and the sectors chosen for reforestation under the pilot project
are areas with no or lower levels of observed natural regeneration within the burned area. As a result
of this, the pilot project area comprises several smaller sectors of varying shapes and sizes (Map 2).
Altogether, the pilot project area is 20 ha. Land preparation and planting will be completed on the
site in 2011. The prior use of the forest area is grazing (note: not all sectors).
28. The forest belt in the Nyuvadi-Shvanidzor sector of ‘Arevik’ National Park is located between 500 and 2500 metres above sea level. The forests are predominantly oak forests. Araks oak dominates up to 1200 metres, Georgian oak up to 1500 metres and Eastern oak up to 2500 metres.

29. As described above, the Meghri pilot area consists of 5 sectors, which have been further divided into altogether 12 separate sub-sectors located on a partially forest covered, fragmented slope (Map 2; Pictures 6, 7, 8, 9 & 10). Different regeneration strategies are planned to be introduced in the different sectors. The sectors are described in more detail below following the descriptions provided in the pilot project strategy. Burned trees can be found on the site (Picture 11) and, on a few sectors, coppicing is planned to be introduced through the cutting of some burned trees.

30. Sector 1 is 3.4 hectares and is located between 1875 and 2025 metres above sea level. The sector is on a 28º south-eastern slope. The sector is described by medium erosion and medium rockiness and 20 to 40 percent of the surface area is covered with rocks. Sector 1 belongs to bonitet class V. The sector is a glade with some oak trees. The sector is regenerated by planting ash seedlings (1500 seedlings) and sowing oak seeds (15 kg) in holes (3000 holes). A low level of natural oak regeneration is observed on the sector.

31. Sector 2-1 is 0.2 hectares and is located between 1850 and 1865 metres a.s.l. The sector is on a 20º south-eastern slope. The sector is described by weak rockiness and weak erosion. 20 % of the surface area is covered with rocks. The sector belongs to IV bonitet class. The sector is a glade with no living trees. The sector is regenerated by planting and sowing Caucasian peer and Eastern apple seedlings and seeds in holes.

32. Sector 2-2 is 1 hectare and is located between 1870 and 1940 metres a.s.l. The sector is on a 25º south-eastern slope. The sector is described by medium rockiness and medium erosion. The area covered by surface rocks is between 20 to 40 %. The sector belongs to V bonitet class. Currently the sector is covered by an open forest (fullness 0.2) with oaks and maples (9:1). The regeneration method on the sector is support to natural regeneration through sowing of oak seeds (20 kg) in 1m x 1m plots. Natural regeneration of oak, and to some level, of maple is observed on the sector.

33. Sector 2-3 is 0.3 hectares and is located between 1950 and 2000 metres a.s.l.. The sector is on a 26º south-eastern slope. The sector is described by medium rockiness and medium erosion. The area covered by surface rocks is 20 to 40 %. The sector belongs to V bonitet class. Prior to the reforestation efforts, the sector was covered by an open forest (fullness 0.2) with mainly oaks and some maples (8:2). The regeneration method on the sector is support to natural regeneration through sowing of oak seeds (10 kg) in plots. Natural regeneration of oak, and to some level, of maple is observed on the sector.
34. Sector 2-4 is 1 hectare in area and is located between 2005 and 2080 metres a.s.l.. The sector is on a 32° south-eastern slope. The sector is described by severe erosion and a high level of rockiness. 40 to 60 % of the surface area is rocks. The sector belongs to bonitet class V. The sector is described in the pilot project strategy as a burned forest. Plots are established on the sector and 5 kg of oak seeds are planted in the plots. No natural regeneration is observed on the sector.

35. Sector 3-1 is 0.5 hectares and is located between 1880 and 1935 metres a.s.l.. The sector is on a 26° south-eastern slope. The sector has a medium level of erosion and rockiness and 20 to 40 % of the surface consists of rocks. The sector belongs to bonitet class V. The sector is a glade with no observed natural regeneration. The regeneration methods on the sector are planting and sowing. 300 holes are established and 150 ash seedlings are planted and 2 kg of oak seeds sown in the holes.

36. Sector 3-2 is 1.2 hectares and is located between 1950 and 2055 metres a.s.l.. The sector is on a 29° south-eastern slope. The level of erosion is low on the sector and it is described by medium rockiness with some 20-40 % of surface rocks. The sector belongs to bonitet class V and is a glade with very few living trees. Both trenches and holes are established on the sector. Ash seedlings (300 seedlings) are planted and oak seeds (18 kg) are sown on the sector. Half of the ash seedlings are planted in holes, half in trenches. Seeds are sown only in trenches.

37. Sector 3-3 is 0.7 hectares and is located between 2085 and 2120 metres a.s.l.. The sector is on a 23° south-eastern slope. The sector has a medium level of erosion and rockiness. Area of surface rocks is 20 to 40 %. The bonitet class of the sector is V and it is a glade with a few oaks. Oak seeds (10 kg) are sown in trenches. Additionally, some 80 burned trees are planned to be cut to introduce coppicing.

38. Sector 3-4 is 1.4 hectares and is located between 2100 and 2190 metres a.s.l.. The sector is on a 29° south-eastern slope. The sector is described by medium erosion and medium rockiness. The percentage of surface rocks is between 20 and 40. The sector belongs to bonitet class V. Sector 3-4 is an open oak forest with 0.4 fullness. No natural regeneration is observed. The sector is regenerated with oak seeds (10 kg) sown in trenches.

39. Sector 4-1 is 2.2 hectares and is located between 1865-1980 metres a.s.l.. The sector is on an eastern/south-eastern slope of 31°. The sector is described by a high level of erosion and rockiness. 40 to 60 % of the surface area comprises rocks. The sector belongs to bonitet class V and it is an open forest (fullness 0.2) with oaks, elms and hornbeams (8:1:1). A low level of natural regeneration of oak and hornbeam is observed on the sector. 7.5 kg of oak seeds and 300 seedlings of ash and hornbeam are planted in holes on the sector.
40. Sector 4-2 is 1.2 hectares and is located between 2000-2060 metres a.s.l. The sector is on a 28º eastern/south-eastern slope. Erosion and rockiness on the sector are of medium level and the surface area covered by rocks some 20 to 40 %. Some survived trees remain on the glade. The sector is regenerated with oak seeds (7.5 kg) and ash seedlings (100 seedlings) sown and planted in holes.

41. Sector 5 is a larger, 6.9 hectares open forest area (fullness 0.4) and it is located between 1850-2060 metres a.s.l. The sector is on a 34º eastern slope. The area is described by a high level of erosion and a high level of rockiness. 20 to 40 % of the surface area is rocks. The sector belongs to bonitet class V. The living trees remaining on the sector are mainly oaks with some hornbeams and maples. 2500 holes are established on the site. Regeneration with 25 kg of oak seeds and 1000 ash and hornbeam seedling is planned for the sector. Also natural regeneration of oak, maple and hornbeam is observed on the site.

42. The pilot project site in the “Arevik” National Park was visited on the 15th of April 2011 by A. Ter-Zakaryan, S. Jaakkola, E. Ulander and V. Mardirossian. The Project Staff was accompanied by the Director of “Arevik” NP Suren Hovhannisyan and foresters of “Arevik” NP.

43. “Arevik” National Park was established in 2010. Prior to this change, the area was a forest enterprise. The establishment of the national park was supported by environmentalists as well as the staff of the FE alike, but it has lead to a reduction in available funds. Correspondingly, “Arevik” NP SNCO has had to cut the number of employees by 6 workers.

44. “Arevik” National Park has a high level of biodiversity. Flagship species include e.g. panther, moufflon, bezoar goat and lynx. Other species include e.g. fox, wild boar, wild cat etc. The park management tries to protect and improve the conditions for biodiversity. Hunting is prohibited in the NP (illegal hunting is observed).
Picture 6. The Meghri pilot project site consists of reforestation sectors on a fragmented slope. Various soil preparation methods have been used and different species have been planted in the sectors. Note: all reforestation sectors are not visible in pictures 6 and 7 (see Map 2).

Picture 7. Another reforestation sector on the Meghri pilot project site. Note: all reforestation sectors are not visible in pictures 6 and 7 (see Map 2).
Map 2. Reforestation sectors on the Meghri pilot project site (FREC 2010). Sectors 3-1, 3-2, 4-2 and 5 are partly visible in pictures 6 and 7.
Picture 8. Holes for planting and sowing on the lower sectors of the Meghri pilot project site.
Picture 9. Trenches for planting and sowing are located on higher sectors of the Meghri pilot project site. The work will be completed in 2011.

Picture 10. Another sector in Meghri pilot project site with trenches.
3.2 “Arevik” NP Pilot Project Activities

45. Activities on the “Arevik” NP pilot project site begun in autumn 2010 and they are described in detail in the pilot brief (Annex 2). Additional information was given by the NP employees during the field visit.

46. Land preparation of 15.7 hectares was carried out in autumn 2010 on the site. 2000 running meters of trenches for planting and sowing, 3600 holes for planting, 4300 holes for sowing and 500 plots for sowing were prepared. A comparison of different regeneration methods can be thus carried out on the site.

47. 5300 seedlings were planted in trenches and in holes. The planted species included ash-tree (3790 seedlings), hornbeam (560 seedlings), maple (550 seedlings), wild apple (200 seedlings) and wild pear (200 seedlings). Furthermore, oak seeds were sown on the site (4300 in holes and plots, 107 kg in trenches). Different species were planted in separate sectors on the site.

48. Watering of seedlings and seeds is not included in the original implementation strategy of the pilot project. However, the seedlings and seeds were watered once in the summer of 2010.
49. Local school children participated in both planting and watering of the seedlings on a field day organised for them. The children also received “a payment” for their work in the form of a picnic. Further co-operation is also discussed between the “Arevik” NP SNCO and the local school. Notably, the children are supposed to be brought back to the pilot site to appreciate the results of their work and to better understand the opportunities and problems with forest regeneration.

50. During the field visit on the 15th of April 2011, tilling and enlarging of holes was underway. The planting (also land preparation including 700 rm of trenches) will be completed in 2011. A total of five interventions focusing on weeding, tilling and watering are planned for 2011. Furthermore, 320 running meters of fencing will be established between the pilot site and bordering community land to cut the access of domestic animals to the site (see Map 2). The fencing is planned so that it does not limit the access of wild fauna to the pilot site.

51. It is also planned that some of the burned oak trunks will be cut to introduce coppicing. An official permit for this action is yet to be obtained. This action is complementary to the pilot project implementation strategy, but represents another method of reforestation and, therefore, adds to the variety of piloted measures and can increase the success of the reforestation activities.

52. Monitoring has not been completed on the site, and monitoring is planned for 2011. The details of monitoring plans or design were not discussed. Project Local Expert, Vladik Martirosyan is in charge of monitoring on all pilot project sites, including “Arevik” NP. The NP employees reported that the survival rate was good.

3.3 Comments about “Arevik” NP Pilot Project Implementation

53. During the field visit, only a part of the site was visited, and thus no observations were made about the results of sowing in the holes or about planting and sowing in the trenches, which are located on higher parts of the site. A part of the 3600 holes for planting as well as a part of the planted oak and ash-tree seedlings were inspected. The vast majority of seedlings were alive – although no systematic survival analysis was possible during the visit. This coincides with the reports of the NP employees of good survival rate. A 60-70 % survival rate is expected on the site, provided that watering of the seedlings is carried out. There is a water source on the site (a spring), which can provide some amount of water for watering when the weather conditions are favourable. It is assumed, that the spring will dry out in the summer months.

54. Six different species are planted and sown in the separate sectors of the pilot site. This manner of planting will not result in a homogenous mixed forest. However, the chosen sites for each species
might represent suitable micro-sites for that particular species, thus potentially increasing the survival rate. To assess this, the design of the planting should be discussed in more detail with the Project Task Leader. Furthermore, when planting is carried out in this manner, more vigorous species will not suppress the growth of weaker species. The UN Volunteers evaluated, that the mixture of the different species planted on the site is suitable for improving the resilience of the forest stand, and the NP employees agreed to that.

55. Based on ocular estimations, the soil conditions on the site were good. The quality of the ongoing work on enlarging the holes and tilling was of good quality. Holes were observed to be of adequate size (approximately 50x70 cm), which will reduce the need for weeding (Picture 12). Terrain conditions on the site were demanding and the work very labour-intensive.

56. Some signs of rodents were observed on the site, and damage was observed on the wild apple and wild pear seedlings. Ecological ways to restrict the numbers of rodents were briefly discussed. Opportunities to introduce, for example, suitable nesting places for owls (e.g. tawny owl *Strix aluco* and long-eared owl *Asio otus*, (Acopian Center for the Environment 2010)) should be investigated.

![Picture 12. Ash-tree plant. Holes on the pilot project site in “Arevik” NP were generally of good size (approximately 50x70 cm).]
57. According to NP employees, the attitude of the local community towards the forests in the area is good. It was mentioned that the energy crisis of 1993-1995 did not lead to excessive cutting in “Arevik” NP. The healthy relationship between the local communities and the local nature was given as an explanation to this. Also the forest fire in 2001 was mainly extinguished by local community members. In total 250 people participated in extinguishing the fire, a mission that took 17 days. Furthermore, the people who participated in extinguishing the fire are now involved and invested in the reforestation project on the pilot site.

58. Positive public attitude can alleviate some of the anthropogenic stresses on forests, and further public awareness on the human impacts on forests should be built utilising this social environment. From this point of view, there should also be continuity in the involvement of the school children in the reforestation project. Reasons for good and poorer survival of the planted seedlings should be discussed with the youth, as well as other aspects of forest management and forest protection.

59. The monitoring method was not discussed in detail during the field visit. However, in general the comments and recommendations made about monitoring in Chapter 2.3 apply to this site as well. The monitoring design has to be specifically planned for the site, so that representative data of the different land preparation and planting methods, different levels of the subsequent care, different species and varying conditions of the various sectors is obtained. Monitoring is discussed in more detail in Chapter 5.

60. The resources of “Arevik” NP were discussed during the field visit. In total, the forest area is 34 400 ha. The personnel of the NP consists of the Director, 2 deputy directors (protection and scientific), 3 forest engineers for the 3 sectors of the NP, 19 permanent forest workers and administrative personnel. A salary of a forest worker is 100-110 USD per month. Additionally, the NP has a reserve of temporary forest workers, comprising mostly local community members. Although the employees of the NP might have long backgrounds in forestry, they do not have formal forestry education.

61. The advantages and disadvantages of changing the previous forest enterprise into a national park were briefly discussed, but not completely understood. However, the economic losses were tangible.

62. Adaptation to climate change is taken well into consideration in the implementation of the pilot project in Meghri. Fragmentation on the site is reduced, and selected species are targeted to improve the resilience of the forest. Connectivity of the forest area is improved, which may enable the adaptation of the forested area to climate change impacts (such as shifts in forest boundaries). It should be further considered and discussed how the reforestation design (species, species mixture, abundance of different species and their planting places in regards to micro-sites, elevation range, and aspect of the slope) can support adaptation (e.g. planting vigorously reproducing and resilient
species on the forest borders). The reforestation work is implemented well and quality of the work is good. Establishing an adequate monitoring system without delays is important.

4 Forest Rehabilitation Pilot Project in Syunik (Goris) Forest Enterprise

4.1 Pilot Project in Syunik (Goris)

63. The Goris pilot project site is located in Shurnukh Forest Area of Syunik (Goris) Forest Enterprise of “Hayantar” SNCO. The goal of the pilot project is rehabilitation of a fragmented mixed forest area.

64. The pilot project site is surrounded by natural oak forests, but the area reforested under the project has been without a forest cover for decades. Natural growth on the site was expected, yet no natural regeneration is evident up to date. A high level of land degradation prevails on the deforested parts of the forest area. Parts of the pilot site are now under steppe vegetation (Picture 13). The pilot project consists of reforestation of two separate areas, which are 15 hectares in total. The visited reforestation area (10 hectares) is presented in map 3.

65. The annual average temperature in the Shurnukh Forest Area is 8.8 °C and the annual average precipitation is 700-750 mm. The highest precipitation occurs in March and the lowest precipitation in June.

66. The lower parts of the forest belt (below 1200 m) in the Shurnukh Forest Area are dominated by oak (Eastern and Georgian oak). Other main tree species in the Shurnukh Forest Area include hornbeam, ash, maple, wild apple and wild pear. The most diverse belt is located between 1300 and 1600 metres above sea level.

67. The Goris pilot site is divided into 4 sectors. According to the original pilot project implementation strategy, the reforestation method on the sectors varies only in terms of planted species mixtures. The land preparation method on all four sectors is trenches. Two of the four sectors (sectors 1-1 and 1-2; Map 3) are on the main reforestation area and the two remaining sectors form the separate, 5 ha reforestation area. Sector 1-1 is 6 hectares and is on average 1460 metres above sea level. The aspect of the slope is south-west and the slope is 30°. According to the pilot project implementation strategy, 2500 running metres of trenches are established and seedlings of oak, elm and ash are planted on this sector (distance between seedlings 60 cm; planting density 4167 seedlings per ha). Sector 1-2 is 4 hectares and is on average 1480 metres above sea level. The sector is on a 30° southern slope. According to the original plan, also in this sector 2500 running metres of trenches are
established and seedlings of oak, wild apple and wild pear are planted in the trenches (distance between seedlings 50 cm; planting density 5000 seedlings per ha). Sectors 2 and 3, which were not visited during the field mission, are 1.7 and 2.3 hectares, respectively, and are 1475 metres above sea level. Sectors 2 and 3 are located on 15° south-eastern and southern slopes, respectively. According to the original plan, these sectors are reforested with oak, elm and ash seedlings.

68. The lower part of the 10 hectare reforestation area is bordered by a forest area with relatively high integrity and the reforestation area consists of the upper part of a slope restricted by a road (Pictures 14 & 15).

69. The pilot project site in Goris was visited on the 16th of April, 2011 by A. Ter-Zakaryan, S. Jaakkola, E. Ulander and V. Mardirossian. The Project Staff was accompanied by the Director of Syunik (Goris) FE Grisha Haurapetyan, Project Local Expert Vladik Martirosyan, Project Local Monitor Arman Aleksanyan and foresters of Syunik (Goris) FE. The 10 hectare reforestation area was visited and no observations were made on the separate 5 hectare reforestation pilot area, which is not adjacent to the main reforestation area.

Picture 13. The Goris pilot project site is located on a deforested area with high level of soil degradation.
Map 3. The 10 ha reforestation area on the Goris pilot project site (Hayantar 2009). The separate reforestation sectors can be seen on the map.
Picture 14. The Goris pilot project site is bordered by mixed forests with a relatively high rate of integrity.

Picture 15. The main reforestation area in Goris is located on the upper part of a slope.
4.2 Goris Pilot Project Activities

70. Activities on the Goris pilot project site begun in autumn 2009 and they are described in detail in the pilot brief (Annex 3). Additional information was given by the FE employees and Project Local Staff during the field visit.

71. Land preparation was carried out on the main part of the reforestation area (10 ha) in autumn 2009. 27,000 running meters of trenches were prepared manually (horses or ploughs are not at disposal) on the site. 45,000 seedlings were planted in the trenches. Oak seedlings (20,000), ash-tree seedlings (22,500) and elm-tree seedlings (2,500) were used.

72. In spring-summer 2010 land preparation was conducted on the separate 5 hectare reforestation area. 12,500 running meters of trenches were prepared on this site. 25,000 seedlings were planted in the trenches. The planted tree species were oak (10,000), ash-tree (9,800), maple (2,200) and wild apple (3,000).

73. 2,700 running meters of fencing was established on the pilot site (see Map 3).

74. In autumn 2010 infilling with 9,200 seedlings was conducted on the pilot site. 6,900 ash-tree seedlings and 2,300 wild apple seedlings were planted. Additionally, 620 kg of oak seeds were sown in the trenches.

75. The activities on the pilot site were continued in March 2011 with further infilling. In total, 24,000 seedlings (approximately 50 % of the original amount of planted seedlings) of maple, ash-tree and oak were planted on the site.

76. Planned interventions for 2011 include tillage, weeding and grass mowing. No watering is planned.

77. The observed survival rates between monitoring sectors on the site varied between 8 and 68 % (August 2010) and in the second monitoring between 36 and 51% (November 2010). Survival rate on the separate 5 ha area was 57 % (November 2010). Monitoring will be continued in 2011.

4.3 Comments about Goris Pilot Project Implementation

78. The reforestation area was described by the FE employees and Project Local Staff as very demanding. Soil conditions, although varying to some extent, are harsh. Rockiness is the main problem. Level of soil degradation due to deforestation is high.
79. The year 2010 witnessed what was described as the worst drought in the region in 5 to 6 years with five consecutive months without precipitation. This led to a low survival rate of seedlings in 2010. Without irrigation, the expected achievable survival rate on the site was estimated to be 60-65% by the local FE employees. Also in normal years, the area has very little precipitation in June-July.

80. Between trenches, different species are mixed. As assessed by others, this is likely to lead to appropriate mixture of species (Kapp 2010). However, this may also bear the risk of more vigorous species outgrowing less competitive species (Kapp 2010). It has been suggested that small groups (e.g. 3 to 4 trenches of one species matched to micro-sites) could result in a more secure and stable mixed stand when it reaches maturity (Kapp 2010). For a planting design described above, analyses of micro-sites would be required, but, if done, this could increase the survival rate. If further infilling is necessary, this should be taken into account. Certain species can also be favoured later on during thinning operations in order to obtain a resilient mixed forest. However, it should be noted that after the infilling activities, different species are also mixed within trenches. Future survival of seedlings of different species will affect the species mixture on the site.

81. The density of seedlings was very high. This was especially so after the infilling carried out in spring 2011 (Pictures 16 & 17). The high density was explained by the expected high rate of loss caused by the summer drought. If the survival rate is higher, the need for thinning at a later date is increased. Thinning is planned to be carried out later on to improve growing conditions and to regulate species distribution and abundance. To some extent, original seedlings were still alive in some trenches where also new seedlings had been planted. If seedlings have not developed buds before infilling, it might be difficult to distinguish without harming the seedling if a seedling is alive. If possible in terms of the best planting season, a small delay in the infilling work could help in assessing which seedlings are dead and which not.

82. Based on a quick survey on the site, mainly ash-tree seedlings were replaced during the infilling in March 2011. No records were recited of the infilling in 2010. Compared to some other tree species, ashes develop buds somewhat later. To favour root development, the tops of the new seedlings planted during infilling in 2011 were cut off.

83. The quality of seedlings was assessed to be good by FE employees and the Project Local Expert. However, it was not discussed in detail, how seedlings are transferred to the site and treated before and during planting. To increase the survival rate of the seedlings, it is necessary to check the physiological condition of the seedlings and to take necessary measures to secure the good condition of the seedlings during planting. This applies to all three pilot project sites. The experiences of certain NGOs, such as Armenia Tree Project, should be utilised when assessing best methods for local conditions. In the Goris pilot project site, the seedlings were acquired from a local nursery.
There is also a smaller, 1 hectare nursery in Goris. In general, nurseries and their capacities are a limiting factor in the region.

84. Seedlings have been planted on the pilot project site in both autumn and spring/summer. Further monitoring of the effects of the timing of planting and the prevailing seasonal weather conditions in regards to the survival of seedlings is necessary. Requirements of different tree species should be noted and evaluated in this regard.

85. Signs of rodents and rabbits were observed on the Goris site. Also some level of grazing took place in 2010 when there was a hole in the fence for some days. The fence was harmed during wiring work carried out on the roadside by a telecommunication company. Before the fence was repaired by the company, domestic animals were able to get to the site.

Picture 16. In spring 2011 new seedlings were planted mainly in trenches which had originally been planted with ash-trees.

Picture 17. The density of seedlings was relatively high, especially after the 2011 infilling. The tops of the new seedlings were cut off to favour root development.
86. Another reforestation area is established by “Hayantar” downhill from the pilot site. The growing conditions (soil and hydrology) on that site are said to be better compared to the pilot site and a higher survival rate is expected. This other reforestation project will further improve the integrity of the forest area, and, by reducing fragmentation, increases the adaptive capacities of the forest area.

87. As discussed in the previous chapters, assessment of cost-efficiency of the activities should be included in the pilot projects and their evaluation. Furthermore, the comments and recommendations made about survival rate monitoring earlier in this report, apply also to the Goris pilot project. It is necessary to establish a monitoring routine designed to the specific conditions of the Goris site. Some basis for further development of the monitoring system is described in Chapter 5.

88. The foresters named the lack of tools as a major problem to carry out the work on the pilot site. The harsh conditions of the site easily lead to breaking of tools. Hypothetically, if reforestation work was to be done on a considerably larger scale, factors such as adequate supply of seedlings, skilled labour (with experience in forestry or basic agricultural skills), the number of supervisory staff and foremen, establishment of adequate protection from grazing, and the supply of hand tools, were named as sensitivities and minimum factors.

89. The Goris pilot project addresses adequately the issue of forest fragmentation in the Shurnukh forest area. Establishing a forest cover on the site is important to restrict further land degradation. The pilot project reforestation measures are also targeted at the upper forest border, which can increase the adaptive capacity of the forests in the area. The targeted result is a mixed forest, which is also considered to be more resilient to climate change impacts as compared to a monoculture. To further improve the resilience of the pilot reforestation area to climate change impacts, the species mixture and abundance of different species should be analysed in regards to micro-sites, elevation range and aspect of the slope. The results should be utilised when further interventions and, later on, thinning activities are planned and executed. The chosen land preparation method seems correct for the site and land preparation is well conducted. Improved monitoring of species survival and gathering of complementary data is required.
5 Reforestation Survival Rate Monitoring

90. The objective of establishing forest rehabilitation pilot projects under the UNDP/GEF project is to pilot measures of mitigating the effects of the three main climate-induced threats to forest ecosystems, namely pest outbreaks, forest fires and increased fragmentation. It is further stated, that based on the project results and experiences, detailed case studies of adaptation options for forest ecosystems will be elaborated. It is also within the scope of project to share project experiences on implementing pilot adaptation measures with forest enterprises in the central and northern regions of Armenia. To achieve these objectives, a sufficient analysis of the pilot measures tested under the project has to be carried out.

91. A key element of conducting an accurate analysis of the piloted measures and pilot project results is the collection of representative data and the establishment of a sufficient reporting system of interventions on the pilot sites. In this manner, recommendations of cost-effective adaptation measures can be drawn from the pilot project experiences.

92. It is proposed by the UN Volunteers, that the monitoring system and study plot design on the pilot project sites be revised. A systematic line plot sampling survey, possibly with permanent study plots, should be established on each site with special consideration of the following factors:
   - Homogeneity of the study area
     - Growing conditions (soil, precipitation, hydrology, slope etc.)
     - Treatment methods (land preparation, planting/sowing, agro-technical and other care and interventions) and intensity of care/interventions
     - Planted species/mix of species
   - Systematic timing of monitoring (a monitoring plan for the entire duration of the pilot project)
   - The survey should cover about 1-3 percent of the area of each sector (study area) within the pilot site
   - A target level of the standard error of the accuracy estimate should be chosen

93. Furthermore, a detailed recording system of interventions should be established (time, method, costs). During each monitoring, signs of damage and conditions (health) of seedlings (specified to tree species) should also be recorded. Other factors, such as the quality of land preparation and seedling growth, should also be considered for monitoring. A monitoring template should be designed for systematic recording. Accurate, continuous recording of weather conditions is also necessary. Possibility to use suitably-located meteorological stations should be investigated in addition to other forms of weather data collection. A map of the meteorological monitoring network in Armenia is pictured below (Picture 18). Assessment of the representativeness of e.g. these stations
in relation to the pilot sites should be conducted. If a monitoring system using permanent sampling plots is established, it is important to secure unbiased data collection and treatment on the sites.

![Meteorological monitoring network in Armenia (Gevorgyan 2010).](image)

94. The sampling plots should cover a few percentage units (e.g. 1-3 %) of the study area (note: a pilot project site might be divided into several study areas). To determine the number of sampling plots per study area, existing methodology for forest regeneration monitoring based on best international experience should be utilised. As an example, methodology from a Finnish forestry company is presented below. For further development of the monitoring methodology and routine, the methodology already used in local conditions by e.g. “Hayantar”, Armenia Tree Project and the Botanical Garden in Yerevan should also be reviewed. Furthermore, universities such as AUA should be consulted.

95. The method for field inventory of seedling stands used by UPM (Schildt 2005) is described below.

- Systematic line sampling survey
- Circular 20 m² sampling plots (radius 2,52 m; coefficient 500)
- Number of sampling plots is defined by the size of the study area: larger sites have fewer sampling plots compared to the area than smaller sites. The target number of sampling plots by the area of the site is presented in table 1.
Table 1. Target number of sampling plots by the area (ha) of the study site

<table>
<thead>
<tr>
<th>Area</th>
<th>Number of sampling plots</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3 ha</td>
<td>15</td>
</tr>
<tr>
<td>3.1-10 ha</td>
<td>20</td>
</tr>
<tr>
<td>&gt; 10 ha</td>
<td>30</td>
</tr>
</tbody>
</table>

- The distance between sampling plots and lines is determined by the following equation:

\[ x = \sqrt{\frac{a \times 10^4}{b}} \]

where,
- \( x \) = distance between lines and between sampling plots,
- \( a \) = area of study site (ha) and
- \( b \) = target number of sampling plots.

- If the target amount of sampling plots is not achieved with the calculated distance between sampling plots and lines, the distance can be shortened. However, the distance should be the same on the entire site.
- Inventory lines are positioned against the longest diagonal of the site. The distance between the first sampling plot and the border or the study area is 50 % of the distance between sampling plots and lines.
- If over one third of a sampling plot is under unsuitable planting area (e.g. rock, road), the sampling plot will be moved forward or backward the shortest possible distance. The distance to the next sampling plot is measured from the original place of the sampling plot.
6 References


“Adaptation to Climate Change Impacts in Mountain Forest Ecosystems of Armenia”
UNDP/GEF/00051202 Project


### Annex 1: Forest Rehabilitation Pilot Project Brief - Kapan Forest Enterprise

**Title:** Forest Rehabilitation Pilot Project in Kapan Forest Enterprise  
**Pilot project site:** Davit Bek Forest Area of Kapan Forest Enterprise  
**Pilot Project Area:** 20 ha  
**Start date:** April 2010  
**Planned end date:** November 2011  
**Responsible party:** “Haynatar” (ArmForest) State Non-commercial Organisation  
**Implementing unit:** Kapan Forest Enterprise  
**Goal:** Rehabilitation of juniper forest area affected by forest fire  
**Background:** In Kapan forest lands, there are also many forest ecosystems degraded due to a variety of circumstances (burned, drying out pest-affested leaves forest, illegally cut, land erosion). The junipers of Davit Bek forest area, which was burned in 2006, have been selected as reforestation targets within the pilot project. The total burned area reaches 90 ha. The pilot project envisages to reforest 20 ha of the burned area’s lower part, located at 1600 m above sea level, on slope exceeding 45°.  
**Activities:** Spring-Summer 2010  
- land preparation (holes): on 10 ha
<table>
<thead>
<tr>
<th>Activity</th>
<th>Quantity/Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>planting: 7000 juniper seedlings</td>
<td></td>
</tr>
<tr>
<td>fencing: 2000 rm</td>
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<tr>
<td>watering: 7000 seedlings x 2 times</td>
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<tr>
<td>agrotechnical care: 7000 seedlings</td>
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<tr>
<td>grass mowing: 87000 m²</td>
<td></td>
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</tbody>
</table>

**Autumn 2010**

- land preparation (trenches and holes): on 10 ha
- sowing: 12400 seeds, including:
  - juniper: 8 200 seeds
  - oak: 4200 seeds
- watering: 4200 sowed seeds x 1 time
- agrotechnical care: 8680 places (seedlings and seeds)

### Survival monitoring data:

**As of 08 August 2010:**

**Monitoring sector #1 (6ha):**
- Monitoring plot #1: juniper s. – 15%
- Monitoring plot #2: juniper b. - 0%; juniper s. – 75%
- Monitoring plot #3: juniper s. – 43%
- Monitoring plot #4: juniper s. – 29%
- Monitoring plot #5: juniper b. – 100%; juniper s. -50%
- **TOTAL:** 37.14%

**Monitoring sector #2 (4ha):**
- Monitoring plot #1: juniper s. – 43%
- Monitoring plot #2: juniper b. - 0%; juniper s. – 17%
- Monitoring plot #3: juniper b. - 0%; juniper s. – 60%
### Monitoring plots:

- **Monitoring plot #4:** juniper s. – 33%
- **Monitoring plot #5:** juniper s. – 37.5%
- **TOTAL:** 34.3%

### As of 04 November 2010:

<table>
<thead>
<tr>
<th>Monitoring sector</th>
<th>Monitoring plot #1</th>
<th>Monitoring plot #2</th>
<th>Monitoring plot #3</th>
<th>Monitoring plot #4</th>
<th>Monitoring plot #5</th>
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</thead>
<tbody>
<tr>
<td>#1 (6ha)</td>
<td>juniper b. - 0%;</td>
<td>juniper s. – 43%</td>
<td>juniper b. - 0%;</td>
<td>juniper b. - 33%;</td>
<td>juniper s. -43%</td>
</tr>
<tr>
<td></td>
<td>juniper s. – 33%</td>
<td></td>
<td>juniper s. – 20%</td>
<td>juniper s. – 25%</td>
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<tr>
<td></td>
<td><strong>TOTAL:</strong> 31.4%</td>
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<table>
<thead>
<tr>
<th>Monitoring sector</th>
<th>Monitoring plot #1</th>
<th>Monitoring plot #2</th>
<th>Monitoring plot #3</th>
<th>Monitoring plot #4</th>
<th>Monitoring plot #5</th>
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<tr>
<td>#2 (4ha)</td>
<td>juniper b. - 0%;</td>
<td>juniper s. – 33%</td>
<td>juniper b. - 0%;</td>
<td>juniper b. - 100%;</td>
<td>juniper s. -28%</td>
</tr>
<tr>
<td></td>
<td>juniper s. – 43%</td>
<td></td>
<td>juniper s. – 20%</td>
<td>juniper s. -17%</td>
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<tr>
<td></td>
<td><strong>TOTAL:</strong> 28.6%</td>
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</tbody>
</table>

### Local community members involved/temporary jobs created:

- 37
2008, before pilot project start

Spring 2010, fence of the pilot project area

Summer 2010, watering of the pilot project area

Autumn 2010, seedling of Juniper
**Annex 2: Forest Rehabilitation Pilot Project Brief – “Arevik” National Park**

<table>
<thead>
<tr>
<th>Title:</th>
<th>Forest Rehabilitation Pilot Project in “Arevik” National Park</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot project site:</td>
<td>Nyuvadi-Shvanidzor Sector of “Arevik” National Park</td>
</tr>
<tr>
<td>Pilot Project Area:</td>
<td>20 ha</td>
</tr>
<tr>
<td>Start date:</td>
<td>November 2010</td>
</tr>
<tr>
<td>Planned end date:</td>
<td>November 2012</td>
</tr>
<tr>
<td>Responsible party:</td>
<td>“Arevik” National Park” State Non-commercial Organisation</td>
</tr>
<tr>
<td>Implementing unit:</td>
<td>“Arevik” National Park” State Non-commercial Organisation</td>
</tr>
<tr>
<td>Goal:</td>
<td>Rehabilitation of oak forest area affected by forest pests and fire</td>
</tr>
</tbody>
</table>

**Background:**

In the forest lands of Meghri, there are many forest ecosystems that are degraded due to a variety of circumstances. A part is destroyed by fire, others due to mass reproduction of pests or as a result of soil erosion. According to research findings, there are 2270 ha degraded forest areas within the forest lands of Meghri, including 2050 ha of forest with pest-affected leaves (on 540 ha leaves already dried out) and 220 ha burned by fires. Among degraded forest areas of Meghri, Shvanidzor forest area was selected as a target for reforestation. The target site of 20 ha to be reforested is affected by leaf-consuming pests (due to their mass reproduction in 1999-2001) and was then burned due to forest fires (in 2001). The area is mainly under oaks; it is located in the south-western part of the forest, on 30° slope, at

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“Adaptation to Climate Change Impacts in Mountain Forest Ecosystems of Armenia” UNDP/GEF/00051202 Project

Annex 2: Forest Rehabilitation Pilot Project Brief – “Arevik” National Park

Ministry of Nature Protection of the Republic of Armenia

Armenia
Adaptation to Climate Change Impacts in Mountain Forest Ecosystems of Armenia
UNDP/GEF/00051202 Project

<table>
<thead>
<tr>
<th>Activities:</th>
<th>Autumn 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>- land preparation on 15.7 ha:</td>
<td></td>
</tr>
<tr>
<td>- trenches: 2000 rm</td>
<td></td>
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<tr>
<td>- holes (for planting): 3600</td>
<td></td>
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<tr>
<td>- holes (for sowing): 4300</td>
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<tr>
<td>- plots: 500</td>
<td></td>
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<tr>
<td>- planting: 5300 seedlings in trenches and holes, including:</td>
<td></td>
</tr>
<tr>
<td>- ash-tree: 3790 seedlings</td>
<td></td>
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<tr>
<td>- hornbeam: 560 seedlings</td>
<td></td>
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<tr>
<td>- maple: 550</td>
<td></td>
</tr>
<tr>
<td>- wild apple: 200</td>
<td></td>
</tr>
<tr>
<td>- wild pear: 200</td>
<td></td>
</tr>
<tr>
<td>- sowing of oak seeds:</td>
<td></td>
</tr>
<tr>
<td>- 4300 in holes and plots</td>
<td></td>
</tr>
<tr>
<td>- 107 kg in trenches</td>
<td></td>
</tr>
</tbody>
</table>

Survival monitoring data:

Local community members involved/temporary jobs created: 28 local community members employed (male)
2008, before start of pilot project

Autumn 2010, plantings in pilot project area
**Annex 3: Forest Rehabilitation Pilot Project Brief - Syunik (Goris) Forest Enterprise**

**Ministry of Nature Protection of the Republic of Armenia**

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**Title:** Forest Rehabilitation Pilot Project in Syunik(Goris) Forest Enterprise

**Pilot project site:** Shurnukh Forestry Area of Syunik(Goris) Forest Enterprise

**Pilot Project Area:** 15 ha

**Start date:** November 2009

**Planned end date:** November 2011

**Responsible party:** “Haynatar”(ArmForest) State Non-commercial Organisation

**Implementing unit:** Syunik(Goris) Forest Enterprise

**Goal:** Rehabilitation of fragmented mixed forest area

**Background:** In the forest lands of Goris, there are many degraded areas. For instance, in the south-eastern part of the 15th and the 16th lots of the 21st square in Syunik (Goris) forest subenterprise, there are mixed natural sparse tree-growth areas (oak, hornbeam, ash-tree) as well as burned areas on 35-40° slope and with completeness/integrity 0.2. On the 13th lot of the 6th square in the same forest subenterprise, there are burned areas under 30 year-old species of pine-trees and oaks on 40° slope. On the 1st lot of the 31st square in Shurnukh forest area, areas with no natural recovery are notable. Among the above-mentioned degraded forest areas, Shurnukh forest area was selected as reforestation target within the pilot project. The target treeless area of 15 ha is located on the 1st lot of the 31st square and surrounded by fifth growth-class natural oak-wood (8 oaks to 2 hornbeams). The area is located in the south-west, on 20° slope, at 1450 m above sea level. According to afforestation projects, natural recovery on that area is expected since 1979, yet no natural growth is evident up to date.

**Activities:**

- Autumn 2009
  - land preparation (trenches): 27000 rm (on 10 ha)
## “Adaptation to Climate Change Impacts in Mountain Forest Ecosystems of Armenia”
**UNDP/GEF/00051202 Project**
**Mission Report 14.-16.4.2011**

### Planting:
- **Spring-Summer 2010**
  - **Planting:** 45000 seedlings, including:
    - oak seedling: 20000
    - ash-tree seedlings: 22500
    - elm-tree seedlings: 2500

### Land Preparation (trenches):
- **Spring-Summer 2010**
  - **Land preparation (trenches):** 12500 rm (on 5 ha)

### Planting:
- **Spring-Summer 2010**
  - **Planting:** 25000 seedlings, including:
    - oak seedlings: 10000
    - ash-tree seedlings: 9800
    - maple seedlings: 2200
    - wild apple seedlings: 3000

### Fencing:
- **Spring-Summer 2010**
  - **Fencing:** 2700 rm

### Agrotechnical Care:
- **Spring-Summer 2010**
  - **Agrotechnical care:** 146000rm x 3 times

### Grass Mowing:
- **Spring-Summer 2010**
  - **Grass mowing:** 32000 m²

### Autumn 2010
- **Infilling (planting):** 9820 seedlings, including:
  - ash-tree: 6900 seedlings
  - wild apple: 2300 seedlings

- **Infilling (sowing):** 620 kg of oak seeds

### Survival Monitoring Data:
**As of 08 August 2010:**
- **Monitoring sector #1 (4ha):**
  - Monitoring plot #1: oak – 0%
  - Monitoring plot #2: oak – 0%; ash-tree – 21%
  - Monitoring plot #3: ash-tree – 4.5%
- Monitoring plot #4: oak – 0%; ash-tree – 11%
- Monitoring plot #5: ash-tree – 3.8%
- TOTAL: 7.8%

Monitoring sector #2 (7ha):
- Monitoring plot #1: ash-tree – 59%
- Monitoring plot #2: wild apple – 65.3%
- Monitoring plot #3: oak – 100%; ash-tree – 70%
- Monitoring plot #4: oak – 33.3%; ash-tree – 52.2%
- Monitoring plot #5: oak – 2.4%; ash-tree – 48.2%
- TOTAL: 68.2%

As of 04 November 2010:

Monitoring sector #1 (4ha):
- Monitoring plot #1: oak – 44%, ash tree- 57%
- Monitoring plot #2: oak – 40%; ash-tree – 55%
- Monitoring plot #3: ash-tree – 41%
- Monitoring plot #4: oak – 37%; ash-tree – 60%
- Monitoring plot #5: oak – 33%, ash-tree – 48%
- TOTAL: 51%

Monitoring sector #2 (6ha):
- Monitoring plot #1: oak – 50%, ash tree- 30%
- Monitoring plot #2: ash-tree – 67%, wild apple – 51%
- Monitoring plot #3: oak – 0%, ash-tree – 29%
- Monitoring plot #4: oak – 42%; ash-tree – 33%
- Monitoring plot #5: oak – 12%, ash-tree – 34%
Monitoring sector #3 (5ha):

- Monitoring plot #1: oak – 54%, ash tree- 56%
- Monitoring plot #2: oak – 50%, ash-tree – 64%; wild apple – 100%
- Monitoring plot #3: oak – 62%, ash-tree – 70%; wild apple – 100%
- Monitoring plot #4: oak – 40%; ash-tree – 69%; wild apple – 100%
- Monitoring plot #5: oak – 33%, ash-tree – 23%

- TOTAL: 57%

Local community members involved/temporary jobs created:

42 local community members employed (29 male and 13 female).
<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>Before pilot project start</td>
</tr>
<tr>
<td>Autumn</td>
<td>Land preparation</td>
</tr>
<tr>
<td>Spring</td>
<td>Fence of the pilot project area</td>
</tr>
<tr>
<td>Spring</td>
<td>Seedlings of Wild Apple</td>
</tr>
</tbody>
</table>
## Annex 4: Field Visit Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Venue</th>
<th>Purpose</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thursday, 14 April 2011</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09:30-14:00</td>
<td>Transfer: Yerevan-Kapan</td>
<td></td>
<td>Aram Ter-Zakaryan, Project Task Leader, Sipi Jaakkola, Essi Ulander, Artur Ohanyan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:00-15:00</td>
<td>Kapan</td>
<td>Lunch</td>
<td>Aram Ter-Zakaryan, Sipi Jaakkola, Essi Ulander, Artur Ohanyan</td>
</tr>
<tr>
<td>15:00-17:00</td>
<td>Kapan Forest Enterprise</td>
<td>Visit to Kapan Forest Rehabilitation Pilot Site</td>
<td>Aram Ter-Zakaryan, Sipi Jaakkola, Essi Ulander, Artur Ohanyan, Volodya Mirzoyan, Vladik Martirosyan, Arman Aleksanyan, Foresters of Kapan FE</td>
</tr>
<tr>
<td>17:00-18:30</td>
<td>Transfer: Kapan-Meghri</td>
<td></td>
<td>Aram Ter-Zakaryan, Sipi Jaakkola, Essi Ulander, Artur Ohanyan</td>
</tr>
<tr>
<td><strong>Night to be spent in Meghri</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Friday, 15 April 2011</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:00-15:00</td>
<td>“Arevik” National Park</td>
<td>Visit to Meghri Forest Rehabilitation Pilot Site</td>
<td>Aram Ter-Zakaryan, Sipi Jaakkola, Essi Ulander, Artur Ohanyan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Suren Hovhannisyan, Director, Foresters of “Arevik” NP</td>
</tr>
<tr>
<td>15:00-16:00</td>
<td>Meghri</td>
<td>Lunch</td>
<td></td>
</tr>
</tbody>
</table>
### “Adaptation to Climate Change Impacts in Mountain Forest Ecosystems of Armenia”
UNDP/GEF/00051202 Project

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>16:00-18:00</td>
<td>Transfer: Meghri-Goris or Meghri-Kapan</td>
<td>Aram Ter-Zakaryan, Project Task Leader, Sipi Jaakkola, UNV, Essi Ulander, UNV, Artur Ohanyan, Logistic/Driver</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Night to be spent in Goris or Kapan</td>
</tr>
</tbody>
</table>

### Saturday, 11 Nov. 2010

<table>
<thead>
<tr>
<th>Time</th>
<th>Location</th>
<th>Activity</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00-13:00</td>
<td>Syunik(Goris)</td>
<td>Visit to Goris Forest Rehabilitation Pilot Site</td>
<td>Aram Ter-Zakaryan, Project Task Leader, Sipi Jaakkola, UNV, Essi Ulander, UNV, Artur Ohanyan, Logistic/Driver</td>
</tr>
<tr>
<td></td>
<td>Forest Enterprise</td>
<td></td>
<td>Grisha Hayrapetyan, Director, Syunik(Goris) FE, Vladik Martirosyan, Project Local Expert, Arman Aleksanyan, Project Local Monitor, Foresters of Syunik(Goris) FE</td>
</tr>
<tr>
<td>13:00-14:00</td>
<td>Goris</td>
<td>Lunch</td>
<td></td>
</tr>
<tr>
<td>14:00-18:00</td>
<td>Transfer Goris-Yerevan</td>
<td></td>
<td>Aram Ter-Zakaryan, Project Task Leader, Sipi Jaakkola, UNV, Essi Ulander, UNV, Artur Ohanyan, Logistic/Driver</td>
</tr>
</tbody>
</table>