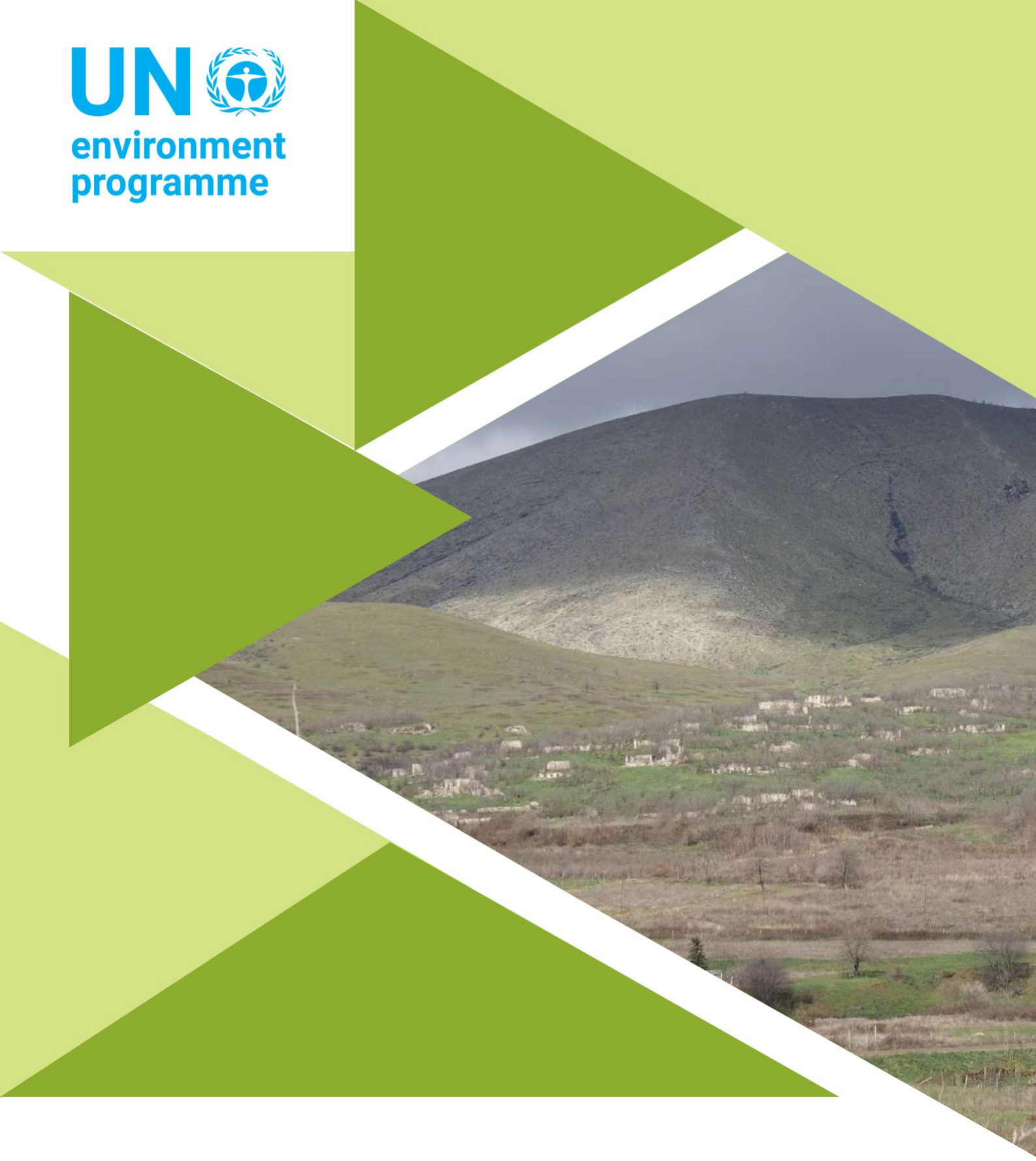
UN environment programme



Report of the UNEP Environmental Scoping Mission to the Conflict-Affected Territories of Azerbaijan

Report prepared in April 2022.

Disclaimers

This environmental scoping report is submitted by the United Nations Environment Programme to the Government of Azerbaijan on request basis and does not constitute an official publication.

The designations employed and the presentation of the material in this report do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory or city or its authorities, or concerning the delimitation of its frontiers or boundaries.

The views expressed in this report are those of the authors and do not necessarily reflect the views of the United Nations Environment Programme. We regret any errors or omissions that may have been unwittingly made.

Unless otherwise credited, the photographs in this report were taken by the UNEP assessment team.

Contents

I. Context

Soon after the cessation of hostilities in the Karabakh region with the signing of a tripartite statement by the leaders of Armenia, Azerbaijan, and the Russian Federation on 10 November 2020, the Government of Azerbaijan initiated a major reconstruction programme of the conflict-affected territories over which it had regained control. Recognizing the importance of establishing a sustainable development pathway for this large and ecologically sensitive area of around 11,784 Km_2 – accounting for around 15% of the country's total area – the Government of Azerbaijan requested technical advisory assistance from the UN Environment Programme (UNEP) to help strengthen the integration of environmental rehabilitation, management and protection considerations in its reconstruction vision and plans.

To discuss this request, a senior UNEP team and the UN Resident Coordinator in Azerbaijan met with the Ambassador of Azerbaijan to the United Nations in Geneva and officials of the Azerbaijan Ministry of Ecology and Natural Resources in November 2021. As an outcome of this meeting, it was agreed that UNEP would undertake a rapid scoping mission to the conflict-affected territories of Azerbaijan to review the environmental dimensions of recovery and identify priority areas for action.

Major road and infrastructure works are progressing at remarkable speed in the conflict-affected territories.

An international airport was built in eight months.

At the outset, it is important to acknowledge the uniqueness of Azerbaijan's situation compared to other post-conflict countries where UNEP has engaged over the past twenty years to help governments understand and address the key environmental impacts of conflict and promote sustainable recovery and reconstruction.

- First, Azerbaijan is a middle-income country with considerable financial resources and has a strongly centralized administrative structure and well-developed technical and engineering capacities that are typically weak or absent in many post-conflict contexts.
- Second, Azerbaijan has progressed at remarkable speed since retaking control of the conflict-affected territories in developing detailed reconstruction plans and executing major infrastructure works. This rapid pace of development raises its own challenges in terms of the opportunities to properly deliberate on and integrate environmental safeguards and best practices into recovery planning.
- Third, most of the conflict-affected territories have been largely depopulated and abandoned for nearly 30 years, and as such there is a unique opportunity to start with a clean slate in designing the region's recovery and development in an environmentally sustainable manner.
- Finally, the international dimension of the conflict adds a layer of complexity in dealing with some of the shared transboundary environmental issues in the region[1].

1 While noting UN Security Council resolutions (822/853/874/884) and UN General Assembly resolution 62/243 reaffirming "continued respect and support for the sovereignty and territorial integrity" of Azerbaijan "within its internationally recognized borders", UNEP's analysis is limited to environmental issues and does not take a position regarding existing territorial claims.

II. Objectives

The objectives of the scoping mission as agreed with the Government of Azerbaijan were to:

1. **Understand the Government's vision:** through meeting with officials of the Government of Azerbaijan to discuss the Government's request for support from UNEP and its plans for ecosystem recovery in conflict-affected territories.
2. **Understand potential synergies with the UN system's support:** through meetings with the UN Resident Coordinator and UN Country Team to discuss ongoing support and the potential for building synergies and joint efforts on ecosystem recovery and environmental protection.
3. **Obtain first-hand information on environmental recovery needs:** through a field visit to conflict-affected territories, to meet with key officials and understand the issues and logistical challenges they are facing.

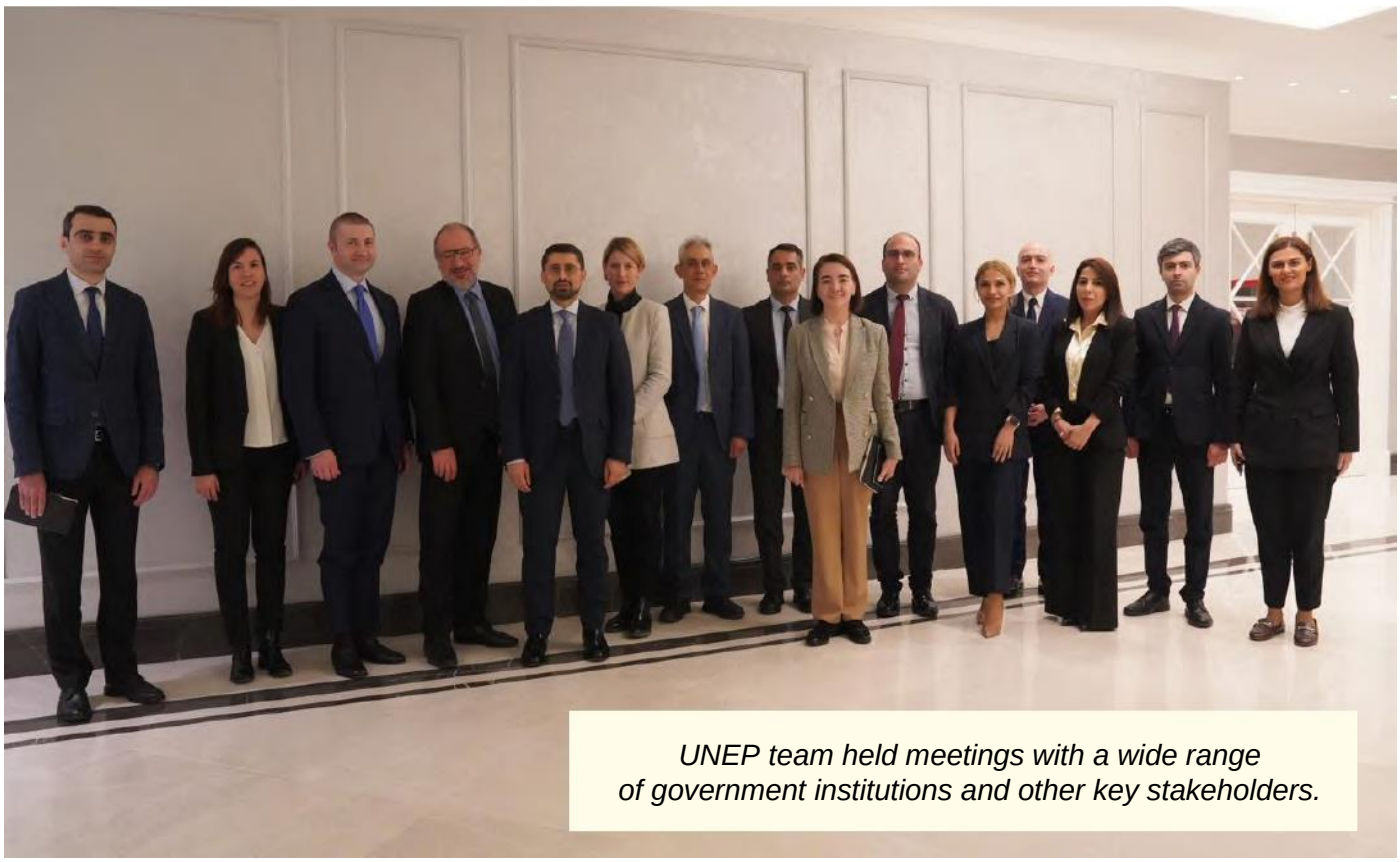
It was further agreed that the main output of the mission would be an environmental scoping report consolidating the key findings, identifying environmental risks with potentially serious implications, and making recommendations on the type of activities which could be undertaken to address those risks. The overall aim being to advise the Republic of Azerbaijan on the development of programmes and projects that could support the recovery, management, and protection of the environment in the conflict-affected territories.

III. Assessment Approach

The assessment approach comprised of the following key activities:

i. A desk review of documentation provided by the Ministry of Ecology and Natural Resources (MENR) and information available in the public domain. This included baseline data on environmental conditions prior to the conflict in the early 1990s, recent government statistics, photographic archives, and satellite imagery.

ii. Multilateral and bilateral meetings in Azerbaijan with around 75 people from 11 government institutions and other key stakeholders involved in the reconstruction and environmental management of the conflict-affected territories from 9 to 18 March 2022. This included presentations, focus group discussions and unstructured interviews with senior government officials and heads of technical departments both in the capital Baku and at the local level in the Karabakh region. Furthermore, meetings were held with representatives of parliament, civil society organizations, private sector entrepreneurs and UN agencies to obtain a wide range of views and perspectives.



UNEP team held meetings with a wide range of government institutions and other key stakeholders.

iii. A four-day field reconnaissance mission (11 to 14 March 2022) to obtain a firsthand appreciation of the key environmental issues – both in terms of severity and scale – in the conflict-affected Karabakh and East Zangazur regions of Azerbaijan was conducted by the UNEP team in cooperation with MENR staff. In terms of geographic scope, the mission focused on the so called "adjacent districts" which were most accessible.

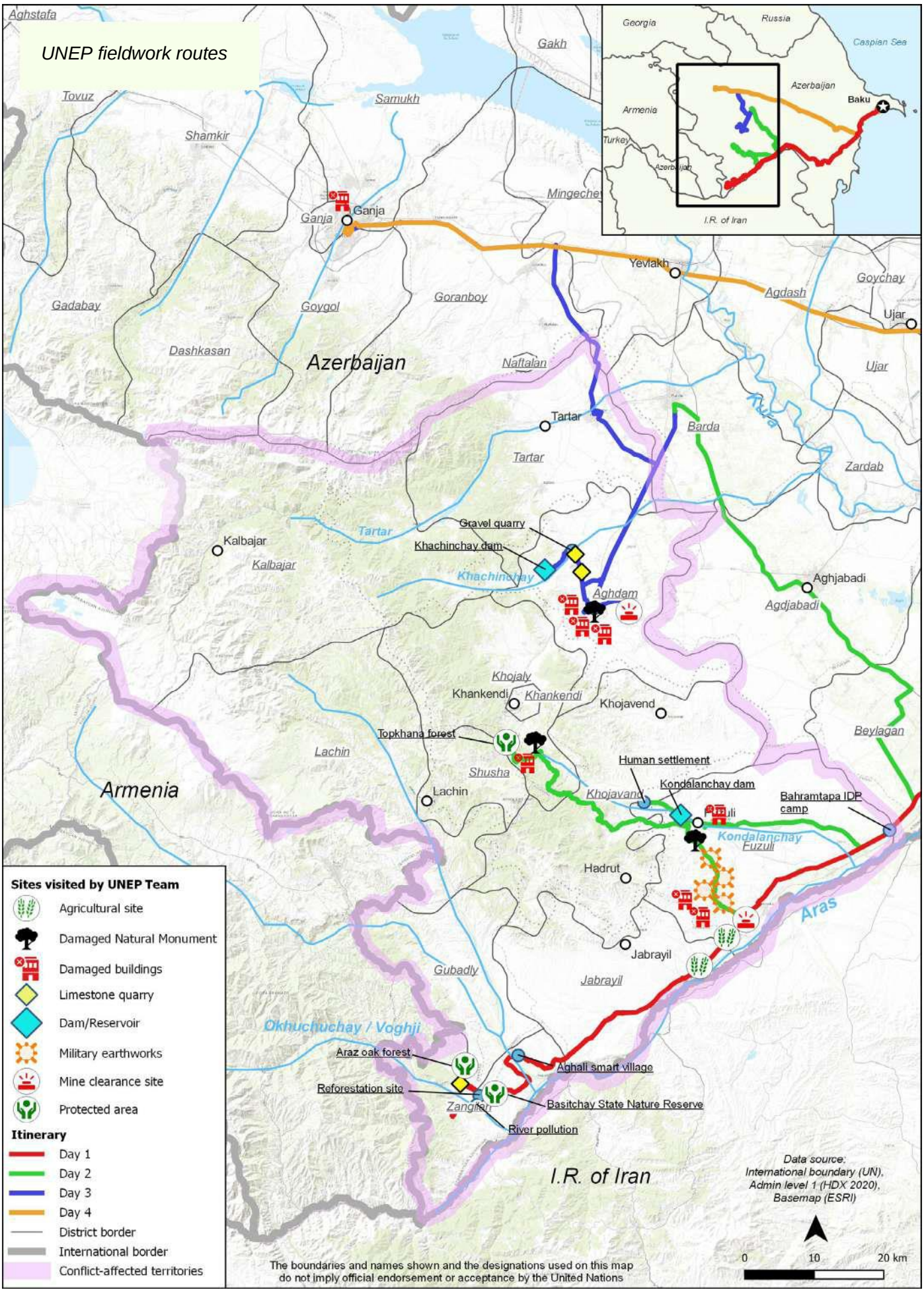
UNEP expert examining a damaged monumental tree.

Fieldwork comprised of rapid walkover surveys to physically observe environmental issues in 25 sites including different habitat types, economic activities, and human settlements. Travelling over a total distance of around 1,200 kilometers within and near the conflict-affected territories, the team visited sites selected by the MENR as having been significantly impacted by the conflict. It is important to note that the sites chosen by the MENR are meant to provide a general overview of the different environmental impacts of the conflict and are not indicative of the full scale or technical depth of the issues. Key themes included agriculture, forestry, protected areas, water resources, human settlements, mining, military activities, and transboundary environmental issues relating mainly to river pollution. The field mission also had the opportunity to observe reconstruction works underway in the region, namely the first 'smart village' built to house returning populations and transport infrastructure.

Damaged forests could only be observed at a distance.

The UNEP mission team comprised of:

1. Bruno Pozzi, Director, Europe Office (High-level meetings on closure of mission; did not partici-pate in field visits)
2. Mahir Aliyev, Regional Coordinator, Europe Office (Liaison and facilitation)
3. Hassan Partow, Environmental Affairs Officer, Disasters and Conflict Branch (Technical team leader)
4. Silja Halle, Programme Officer, Disasters and Conflicts Branch (Climate security, transboundary environmental management)
5. Jacqueline Henrot, UNEP external expert (Forestry and protected area management)
6. Paula Padrino Vilela, Project Coordinator (Planning and logistics).


UNEP fieldwork routes
Aghstafa
Tovuz
Shamkir
Gadabay
Dashkasan
Samukh
Gakh
Ganja
Mingechevir
Goygol
Goranboy
Yevlakh
Agdash
Goychay
Ujar
Azerbaijan
Naftalan
Tartar
Barda
Kura
Zardab
Kalbajar
Gravel quarry
Khachinchay dam
Khachinchay
Aghdam
Aghjabadi
Agdjabadi
Khojaly
Khankendi
Khojavend
Topkhana forest
Lachin
Shusha
Armenia
Human settlement
Kondalanchay dam
Bahramtapa IDP camp
Fuzuli
Kondalanchay
Hadrut
Aras
Jabrayil
Gubadly
Okhuchuchay / Voghji
Araz oak forest
Aghali smart village
Reforestation site
Zangilan
Basitchay State Nature Reserve
River pollution
I.R. of Iran
Beylagan
Georgia
Russia
Caspian Sea
Armenia
Turkey
Baku
Sites visited by UNEP Team
Agricultural site
Damaged Natural Monument
Damaged buildings
Limestone quarry
Dam/Reservoir
Military earthworks
Mine clearance site
Protected area
Itinerary
Day 1
Day 2
Day 3
Day 4
District border
International border
Conflict-affected territories
Data source:
International boundary (UN),
Admin level 1 (HDX 2020),
Basemap (ESRI)
0
10
20 km
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations

Throughout the mission, the UNEP team was accompanied by staff of the MENR who organized all meetings and facilitated access to sites.

Constraints and Limitations

Field visits were significantly constrained by the heavy contamination of the conflict-affected areas with mines and explosive remnants of war (ERW), which in many cases precluded the possibility of conducting close-up inspections and observations. Indeed, environmental survey campaigns by MENR teams are still in many cases awaiting mine clearance authorization to start. Weather and security conditions also led to the cancellation of several site visits. Furthermore, the lack of environmental data collection over the nearly thirty-year conflict period means that there is limited baseline information available against which to measure environmental impacts. Installation of the first environmental observation stations in the conflict-affected territories by the MENR are expected during this year.

Heavy contamination with landmines and ERW limited the ability of the UNEP team to assess environmental impacts.

IV. Key Findings

This section presents an overview of the main environmental issues identified during the UNEP field reconnaissance mission. It focuses on the environmental impacts of the conflict – both direct and indirect – to help paint a general picture of the situation and the main challenges that have arisen as a result. The findings presented herein are limited to the specific objectives of the mission and should not be taken as a review of the state of the environment in the conflict-affected territories. Furthermore, the findings are not presented in any specific order of priority.

1. Collapse of the agricultural system and land degradation

The conflict-affected areas were one of the main agricultural production centers in Azerbaijan, particularly of fruits and cereals. These comprised of two main agricultural zones: i) the Aras River flood plain stretching around 130 kilometers along the border with Iran; and ii) the Karabakh lowland areas irrigated by rivers originating in the nearby mountains.

Irrigated agricultural schemes in the conflict-affected territories have virtually collapsed due to land abandonment, and lack of operation and maintenance services. Consequently, several thousand kilometers of irrigation canal network and over one-hundred traditional kahriz underground aqueducts have reportedly silted up and have practically disappeared or are unusable. A total of 180,000 - 200,000 hectares of agricultural lands have been abandoned or degraded as a result, according to Azerbaijan government sources.

Stark contrast in agricultural development along the frontline between Tartar and Aghdam regions: barren conflict-affected land (left) and densely cultivated fields in areas not impacted by conflict (right). (Source: Google Earth)

These losses include extensive farmlands along the Aras River bordering Iran, where vineyards, mulberry orchards, cotton and cereals were previously cultivated. Abandoned vineyard farms could be observed over wide areas, which reportedly covered several thousand hectares. In Jabrayil district alone, there were reportedly 1,000 hectares of mulberry gardens with an estimated 15,000 trees that were used to produce around 180 tonnes of silk per year. Both overgrown and felled mul-berry trees were observed during the site visits, while others had died due to lack of irrigation. In the Karabakh lowlands, vast tracts of agricultural land that were previously cultivated with wheat, cotton, vineyards, and vegetables, were also abandoned. Nevertheless, it was possible to observe some mechanized rainfed farming of cereal crops taking place in certain locations.

Derelict grape vine support stakes attest to a once flourishing wine industry in Jabrayil district, which remain inaccessible due to the risk of mines as marked by the red sticks.

In some cases, the cessation of active land management over large areas also led to the loss of perennial vegetation cover with consequent impacts in terms of land degradation and soil erosion, notably in the Aras River floodplain. Furthermore, in the Karabakh lowlands and to a lesser extent along the Aras floodplain, large tracts of agricultural land were situated directly along the former frontline. As a result, substantial areas of farmland were spoiled and fragmented by the construction of trenches, tunnels, defensive works and fortifications. These military engineering activities have not only caused significant land disturbance impacting vegetation cover, water infiltration, and surface water flows, but have also rendered large areas of valuable farmland inaccessible due to mines and other unexploded ordnance (UXO).

Valuable agricultural land lost and fragmented by military defensive works.

At the same time, it should be noted that extensive areas of the conflict-affected territories were entirely depopulated, and therefore out of bounds for the dominant form of human activity in the region, which was agriculture. The resulting decline in agricultural activity may have inadvertently supported some ecological benefits in terms of ecosystem services and biodiversity. Certain areas, for example, that were “rested” could have returned to a state prior to agricultural establishment. In some locations, this has visibly provided an opportunity for vegetation and wildlife to re-establish themselves, as was observed within and around many abandoned settlements. Further investigations are needed to identify the nature and extent of the natural rehabilitation that may have taken place, but which overall is expected to be relatively limited and localised.

2. Dysfunctional water management system

The conflict-affected territories are an important headwater region that is traversed by many rivers and streams. The principal rivers include the Tartar, Khachen and Karkar, which flow east into the Kura River, and the Ishkhan and Hakari, which flow southeast into the Aras River. The mainstem of the Aras River is also an integral part of the region’s hydrological network, defining its southern limit along the border with Iran. In addition, the region has significant groundwater reserves, including springs which have been exploited for centuries. In total, an estimated two billion cubic meters of renewable water resources are generated within the whole Karabakh region which represents a strategic asset for Azerbaijan and the region, noting the former’s reliance for around 70% of its freshwater supply from outside its borders. Moreover, the region’s topography also means that these rivers hold a substantial hydropower generation potential.

Management of the region’s water resources is complicated by the fragmentation and lack of adequate coordination in operating the dams and hydropower plants based on established procedures and in accordance with their intended purposes when first constructed, including in terms of water allocations and timing of water delivery. Furthermore, poor operation and maintenance of nine reservoir dams, *kahriz* underground irrigation systems and associated hydraulic infrastructure, has caused a significant deterioration in the capacity to manage water resources in a coherent and optimal manner. Rational management of water resources has also been seriously undermined by the lack of reliable water monitoring data due to the breakdown of all

hydrometeorological measurement stations in the conflict-affected territories over the past nearly thirty years.

The valves of the intake tower of the Khachinchay dam are damaged and the dam's operator injured by an antipersonnel mine.

Management of the Sarsang reservoir - a centerpiece of the water supply network in the Kara-bakh region with a storage capacity of 565 million cubic meters and which is located in the zone where the Russian peacekeepers have been temporarily deployed – is a significant challenge for operating the water system in a planned and effective manner. Specifically, large irrigation schemes in the Karabakh lowlands have reportedly been disrupted by the lack of a reliable sched-ule of water releases from the Sarsang reservoir, which as a result is no longer aligned with the agricultural calendar. Concerns over flood risks and other extreme events have also increased including due to questions of dam safety. The resultant shortfall in water supplies has had multiple adverse ramifications including pursual of maladapted strategies to compensate for the water deficit; particularly overexploitation of groundwater resources to compensate for the reduction in irrigation water supply. This depletion has also reportedly led to a buildup of mineral concentrations in the aquifers.

The Kondalanchay -1 reservoir has completely silted-up.

In certain cases, deliberate damage to dams is reported, but these claims require further technical verification. Notably, the Khachinchay earth-fill dam has suffered partial damage, namely inability to control the sluice gates and visible underground seepage. Inspection of dam structure integrity is needed to eliminate the potential risk of future failure. Operation of certain dams, irrigation canals and other hydraulic structures is also constrained by concerns over the presence of mines. The storage capacity of the Kondalanchay reservoirs, a system of three cascading basins which are the main source for water supply in Fuzuli district, has been significantly reduced due to siltation and lack of maintenance.

Finally, mineral water springs that were commercially exploited prior to the conflict, as well as several thermal water sanatoriums in lower and upper Istisu in Kalbajar district, were physically damaged during the conflict as per the photographic evidence shared with the UNEP team. It remains unclear whether the discharge from the springs may have been adversely affected or even lost because of the damage sustained. This will require further assessment.

3. Deforestation in Forest Fund managed areas and protected areas

The forests of the conflict-affected territories are located in one of the world's biodiversity hotspots and are home to rare, endangered, and endemic fauna and flora species. They are predominantly temperate broadleaf and mixed forests, with oaks, beech, and hornbeam as main species, often located on steep mountain slopes at altitudes ranging from 400 to 1,800 meters.

The forests are state-owned and managed by the MENR. They are not officially exploited for timber; their primary functions are soil stabilization, biodiversity conservation and climate regula-tion. In 1988, the extent of the forests in the Forest Fund was estimated at close to 230,000 hectares, covering 19% of the conflict-affected territories.

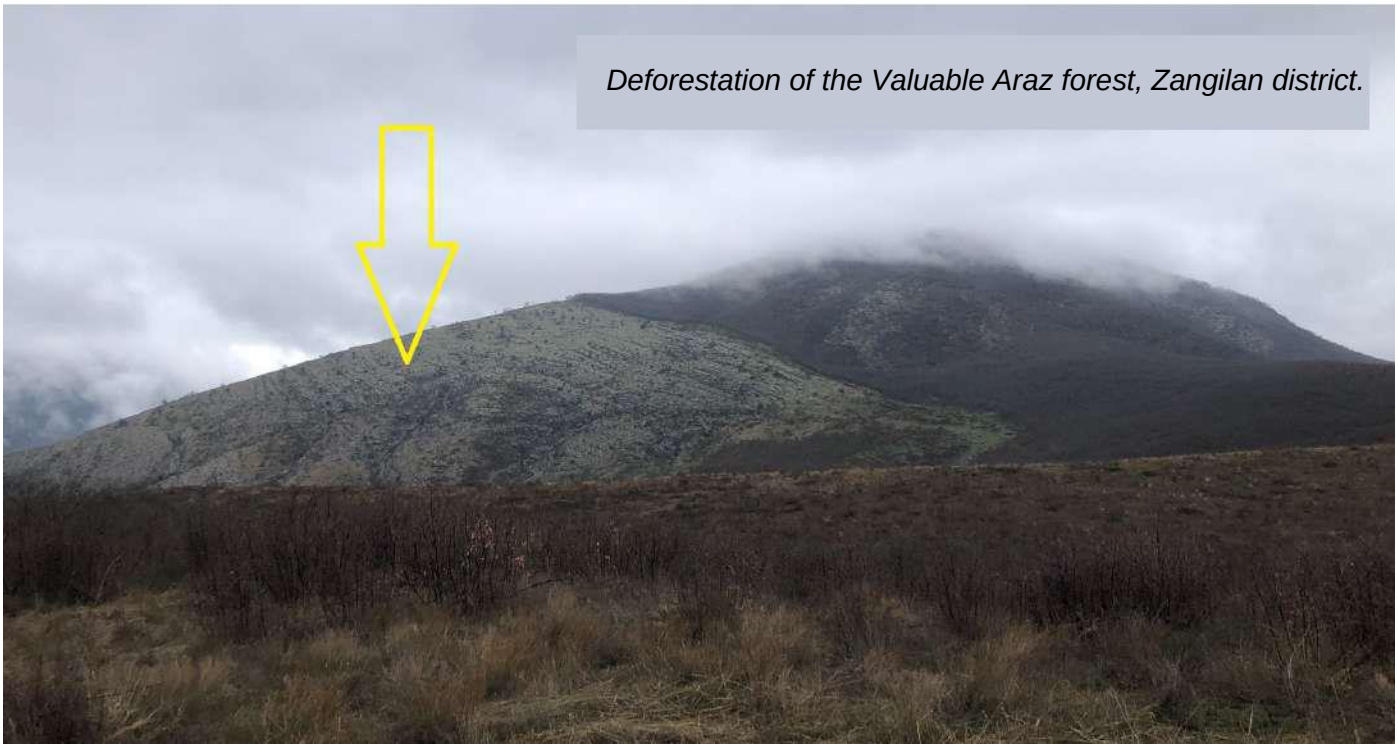
Preliminary estimates by the MENR indicate that around 50,000 hectares of the Forest Fund were damaged during the conflict period, accounting for 22% of the Forest Fund size in 1988. The mountainous district of Kalbajar, covered at 90% by forests in 1988, is reported as being the most affected: with a reported loss of 16,500 hectares, forest damages in Kalbajar amount to around 33% of the total destroyed forest area.

The location of most of these forests on steep slopes means that removal and degradation of tree cover could accentuate soil erosion and land degradation, and ultimately disaster risks such as landslides and rockfalls.

Several high-value forest areas in the conflict-affected territories have experienced negative impacts. The MENR estimates that over 7,000 hectares of specially protected and valuable forests, such as State Nature Reserves, Nature Sanctuaries, and Nature Monuments, were damaged, accounting for around 14% of the total protected nature areas in the territories. Some of these reserves were established to protect extremely rare and fragile ecosystems, such as a rare natural Oriental plane forest in the Basitchay River valley.

Rare Oriental plane trees in the Basitchay Reserve were reportedly cut down but could not be observed directly by the UNEP team due to the presence of mines.

On the ground assessment of forest areas by the UNEP scoping mission was limited by the presence of landmines and bad weather conditions. Damages to the Basitchay State Nature Reserve, to a valuable Araz Oak forest in Zangilan district and to the Topkhana forest were observed at a distance only. Except in the Araz Oak forest where the deforestation appeared to be significant, it was not possible to qualify the nature and scale of damage sustained. A snowstorm pre-vented a visit to Kalbajar district, where forests are reportedly most impacted. Further assessment is therefore needed to ascertain the extent of the damage sustained by the forests and protected areas of the conflict-affected territories, including verification with satellite image analysis and ground truthing after demining operations are completed.



Deforestation of the Valuable Araz forest, Zangilan district.

On the other hand, deforestation, and forest degradation from mining and quarrying operations, which reportedly expanded during the conflict period, appear to have had a substantial impact on tree cover, as was for example observed at the Chobandag and Shakhbulag lime quarries in Aghdam district. Further investigations are needed to assess the impact of mining on forest cover loss. New road construction – launched as part of the reconstruction drive in January 2021 – is also having a significant impact on forest cover; particularly the approximately ~80-kilometer highway segment between Fuzuli and Shusha.

Reforestation efforts

The Republic of Azerbaijan has a large-scale National Programme for Forest Expansion and Restoration. In the conflict-affected territories, the MENR has set a goal to reforest or afforest 29,000 hectares between 2021 and 2025, which is slightly over half (53%) of the forest area reportedly damaged during the conflict period. The main reforestation efforts will be carried out in the districts of Kalbajar (5,200 ha), Lachin (4,000 ha), and Zangilan (4,100 ha). During the UNEP scoping mission, ongoing reforestation was observed on a 55-hectare area of pine forest plantation on the outskirts of the town of Zangilan that was damaged during the conflict period. Eldar pines and a mix of broadleaf species were planted on terraces equipped with drip irrigation.

Eldar pine plantation rehabilitation on 55 hectares of terraces equipped with drip irrigation near the city of Zangilan.

Monumental trees and vegetation regrowth in and near human settlements

Monumental trees, some aged up to 2,000 years, were reportedly cut down and occasionally burnt in the conflict-affected territories. Of the 45 officially registered Natural Monuments[2], 34 (~75%) are reported as destroyed. This amounts to a total of 148 registered “ancient trees”, of whom 131 are classified as destroyed according to surveys by the MENR and which represents around 88% of the trees.

Remains of felled ancient and Natural Monument trees in Aghdam town.

These very large trees, predominantly Eastern planes, are typically around 30 meters tall and 2.5 meters in diameter. In addition to their role in microclimate regulation and in conserving biodiversity, these monumental trees have a high cultural significance.

At the same time, in and around settlements that were unoccupied for 30 years, spontaneous vegetation development was observed, with fruit trees, landscaping trees and wild species growing even within damaged houses. Thereby, demonstrating a good potential for natural vegetation regeneration.

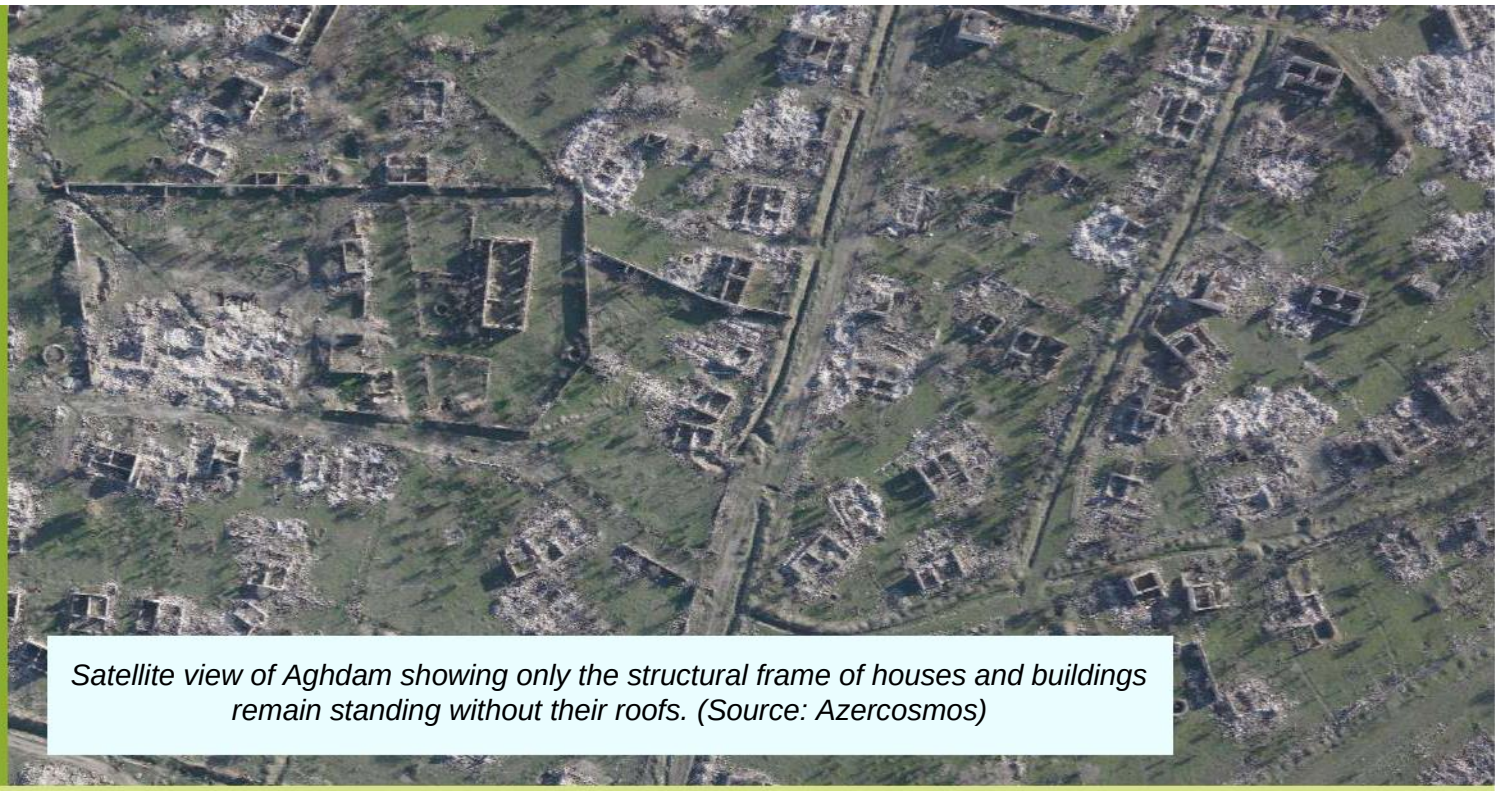
4. Destroyed human settlements and management of demolition waste

Seven administrative district centers – most notably Aghdam and Fuzuli – and around 800 villages were heavily damaged and abandoned during the conflict in the early 1990s, resulting in the displacement of around one million people. Over the course of the past thirty years, these towns and villages have fallen into a completely derelict state, with typically only the structural frame of houses and buildings remaining as lighter construction materials (e.g. doors, window panes and frames, roofs) were reportedly looted. Many of the ruined towns and villages are presently overgrown with trees and bushes, which are visibly protruding from within former buildings. Most of the houses are built of local stone (mainly limestone), while large concrete buildings were constructed in the main towns.

2 A Natural Monument can consist of several trees.

Previously the main urban center of the seven regained districts, Aghdam today lay's in complete ruin. (Photo: MENR)

According to the State Service on Property Issues (SSPI) of the Ministry of Economy, the building stock in the conflict-affected areas consists of 162,234 buildings (mainly residential houses and other civil infrastructure), as derived from a detailed inventory of Soviet era aerial pho-tos and settlement maps. Based on satellite image analysis and field surveys, the SSPI has classi-fied 154,441 of the buildings and infrastructure assets – or around 95% of the total building stock – as completely destroyed and unrepairable.



Satellite view of Aghdam showing only the structural frame of houses and buildings remain standing without their roofs. (Source: Azercosmos)

Millions of tonnes of debris (stone, concrete, mortar and plastering, bricks) will be generated from the planned demolition of these damaged buildings, which requires proper planning and management. A large amount of dust and fines also appears to be present in the debris piles of collapsed buildings, requiring special management. It is important to underscore here that debris does not include household waste that is produced daily by homes, markets, and commercial premises, which is a different waste stream with its own separate management system.

Millions of tonnes of demolition waste will be generated from the removal of buildings.

The presence of landmines and unexploded ordnance in the settlements is a major constraint limiting building demolition and debris recovery operations. UXO clearance by demining actors under Azerbaijan National Agency for Mine Action (ANAMA) supervision needs to be carried out as a pre-condition before undertaking any structural demolition and handling of the debris.

Other potential hazards include asbestos, which is known to have been used in some of the relatively newer administrative and apartment buildings, and may also have been used in other infrastructure works (e.g. water supply pipelines).

According to local authorities in different areas of the conflict-affected territories, demolition waste from ongoing reconstruction activities is currently being disposed of in local landfills. This has led to some of the landfills rapidly filling up and to their untimely closure. In other cases, the demolition waste has reportedly been reused as fill and levelling material for construction foundations. While reusing the demolition waste as fill material without any processing may be feasible for non-structural engineering purposes, it needs to be carefully controlled as it is liable to subsidence and as such much may not be suitable for future building construction.

Proper processing of the debris is needed to ensure it meets minimum engineering standards.

5. Environmental impacts of military activities

The landscape along the approximately 300-kilometer long and up to 7-kilometer-wide frontline zone has been heavily disturbed by the conflict. The construction of military trenches, tunnels, dugouts, earthen berms or mounds, and observation outposts at regular intervals ranging from 200 to 500 meters is estimated to have impacted around 4,000 hectares of mainly agricultural land, according to satellite imagery analysis by the Azerbaijan Spatial Agency (Azercosmos). Large quantities of spoils have visibly been generated from such excavations and earthworks. Putting back the spoil to fill the trenches and hollows will be a substantial and complicated undertaking but may be necessary to help return the land to a state like that prior to the conflict and facilitate the re-start of agricultural activities.

The land along the 300-kilometer frontline is heavily disturbed by the construction of trenches (left), protective berms and military outposts (right).

Ground movement and maneuvering of heavy military equipment (tanks, excavators, mobile artillery etc.) has also had detrimental effects, especially by removing vegetation cover and compacting the soil as machinery and troops stepped over it. Cratering from bombs and landmines is another visible impact in areas that experienced heavy fighting, which can affect soil properties. Not only have these military actions led to vegetation damage and loss of valuable agricultural land, but the resulting disturbance in terrain topography and soil structure deterioration will also impair ecosystem functioning, including causing excessive runoff and erosion.

The extent of mine and ERW contamination in the conflict-affected areas is not known but is considered to be significant. While this contamination started during the first war in 1988-1994 and lasted throughout the entire period of the “frozen conflict”, it followed in the 2020 conflict, resulting in a large and complex explosive ordnance threat comprising mainly anti-tank and anti-personal mines, as well as cluster munitions. Since the end of the conflict in November 2020, 206 people have been killed or injured by landmines according to ANAMA.

ANAMA demining worker combs a minefield in Fuzuli district; over 206 people have been killed or injured by landmines so far.

Demining activities, while a precondition for the return of the civilian population, also disturb the landscape and vegetation cover and can cause soil erosion. Landmines are known to have killed livestock and wildlife, and reportedly caused local wildfires. Furthermore, landmines and ERW may corrode and degrade over time, releasing heavy metals and explosive residues. Contaminants from explosive residues may also accumulate to significant concentrations, especially in areas that sustained heavy shelling, and at artillery positions that were used for prolonged periods of time (e.g. several weeks/months). Typical contaminants include RDX, TNT and heavy metals, which may not be biodegradable and may leach into surface and groundwater resources. Abandoned tanks and military vehicles may also be a source of oil and lubricant pollution, while the military scrap will require special disposal.

Abandoned military equipment will require special procedures for disposal

6. Mining and quarrying impacts

A significant expansion in mining and quarrying activities reportedly took place during the conflict period, based on satellite imagery evidence provided by the Government for several sites. From the site visits, it is evident that mining development has had one of the largest physical footprints on the region's environment. Of the 151 mineral and quarrying deposits identified in the territories prior to the conflict, 52 mining and quarrying sites were reportedly exploited for the first time during the conflict period from 1993 – 2020. Furthermore, several of the pre-conflict mining operations were expanded and intensified. The main mineral deposits in the region include gold, copper, cadmium, mercury, molybdenum, lead, silver, tantalum and zinc. Quarry materials comprise mainly of lime-stone, gravel, sand, clay, and gypsum.

The deforestation footprint of mining and quarrying is substantial as shown in the satellite image of Qizilbulagh mine in Tartar district (right, source: MENR) and the Chobandag limestone quarry in Aghdam district (left).

From the limited environmental management measures observable at the sites visited and discussions with experts, it appears that mining and quarrying operations were generally conducted with inadequate environmental oversight and supervision, including a lack of effluent treatment and site rehabilitation. This has created environmental impacts at three levels:

i) deforestation and land degradation;

ii) suspended sediment pollution (turbidity) in rivers; and

iii) chemical pollution of water, soil, and biota.

Of specific note in terms of environmental damage is instream quarrying of gravel and sand, which is one of the most aggressive and destructive forms of quarrying. Instream gravel and sand mining destabilizes river channel morphology, and ravages valuable riverbanks, as was observed near Gizilli Kangarli village near the Khachinchay River in Aghdam district. It may also involve rerouting of rivers and tributaries, which can substantially degrade riverine and wetland habitats. This may cause loss in fishery resources and lower the water table, thereby impacting water supplies. The recreational value of these rivers may also be spoiled.

Quarry processing facility near Khachinchay River in Aghdam. Highly destructive instream quarrying of gravel and sand has cleared riparian vegetation and caused a lowering of the water table.

Chemical pollution may be significantly aggravated by the fact that minerals in the region generally occur as sulphide ores (gold sulphide, copper sulphide), which has a high potential of generating acid mine drainage. This acidic water can leach heavy metals from rocks that come into contact with it. The resulting fluids may be highly toxic and – when mixed with groundwater, surface wa-ter and soil – can have harmful effects on people, animals, and plants. In this regard, the Soyudlu gold mine is one of the hotspots requiring priority assessment. Furthermore, this pollution can undermine the integrity of strategic water reservoirs located within the catchment of mining operations.

Even though mining operations have currently ceased and are pending a decision by the Government to restart activities, they still pose environmental risks as “abandoned” sites with limited or no controls. Of special concern are the tailing impoundments located in mountainous terrain, which are particularly risky given the region’s significant seismicity. Furthermore, periods of heavy rains and snowmelt also pose a risk to the structural stability of tailings, especially as their frequency and intensity are likely to be aggravated by climate change.

7. Concerns over transboundary river pollution

The Okhchuchay River is an 83 km long tributary of the Aras River that originates in the Zangazur range of Armenia and crosses into Azerbaijan in Zangilan district. Water quality analysis of the Okhchuchay River undertaken by the Government of Azerbaijan in early 2021 shows extremely high concentrations of heavy metals including cadmium, lead, nickel, iron, molybdenum, and zinc in surface water and sediment. This finding was illustrated by photographic and video materials shared with the UNEP assessment team, as well as a laboratory report[3].

Recurring pollution incidents in the Okhchuchay River have been reported as is visible in this MENR photo taken in 2021.

While no visible signs of pollution were observed at the time of the UNEP site visit, the contamination has reportedly led to episodic fish die-offs and had a negative impact on the ripa-rian ecosystem. Poor water quality is of significant potential concern, as the Okhchuchay is a key source of drinking and irrigation water for Zangilan district, where returning populations are expected to resettle in coming months. The UNEP team did not collect water or sediment samples during the mission.

No visible signs of pollution were observed during the UNEP visit to Okhchuchay River, which are reportedly episodic events.

3 Laboratory report shared by the Government of Azerbaijan dated from 28 January 2021

The pollution is suspected to result from the release of wastewater from copper and molybdenum mining sites located further upstream in the Okhchuchay River basin, as well as some domestic effluent. Contamination of the Okhchuchay – known as the Voghji in Armenia – has also been a matter of concern for at least a decade on the Armenian side of the border. Armenian environmental and civil society organizations have regularly expressed alarm over the river's contamination with heavy metals and other pollutants,[4] and research by Armenian scientists has revealed worsening conditions.[5]

As mechanisms for cooperation over monitoring and remediation of contamination in the Okhchuchay River are currently limited – including because not all riparian countries are party to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (or 1992 "Helsinki Convention") – the Government of Azerbaijan has appealed to international organizations for support in identifying solutions.

8. Lack of data on current and projected impacts of climate change

An indirect impact of conflict in the Karabakh region has been the prevention of regular environmental monitoring, including the collection of hydrometeorological data, such as temperature and precipitation measurements, as well as the tracking of extreme weather-related events, such as flooding and forest fires. As a result, critical datasets are lacking to analyse the extent to which climate change has already impacted the region's resources and ecosystems, or to model climate trends with the desired precision.

Such information is critical to support effective planning for post-conflict recovery and to ensure its long-term sustainability, especially as according to available regional climate scenarios, several areas of Karabakh are particularly vulnerable to the impacts of climate change, with higher than average predicted increases in temperature and greater expected decreases in precipita-tion by 2070.[6] Water stress from climate change and other pressures could for example have a significant negative impact on agricultural productivity. Further, while data is lacking for Karabakh, climate-related hazards (flooding, landslides and mudslides) already cost Azerbaijan an estimated USD 70–80 million annually.[7]

The Government of Azerbaijan has started installing new monitoring equipment in Karabakh, including 11 hydrological and five new meteorological stations that are expected to be functional by end 2022, as well as early warning systems for forest fires and floods.

4 See for example: http://armecofront.net/en/news/another-illegal-mining-in-armenia-this-time-by-a-german-company/; https://www.ecolur.org/en/news/?keyword=Voghji.

5 Gabrielyan, A., Shahnazaryan, Gayane and Minasyan, Seyran. Distribution and Identification of Sources of Heavy Metals in the Voghji River Basin Impacted by Mining Activities (Armenia). Journal of Chemistry. Vol. 2018: 1-9.

6 https://www.greenclimate.fund/sites/default/files/document/21370-enhancing-climate-information-and-multi-hazard-early-warning-resilience-azerbaijan.pdf.

7 USAID. Climate Change Risk Profile for Azerbaijan (2017).

V. Recommendations for Strengthening Environmental Recovery in Reconstruction Planning

The Government of Azerbaijan has established “Coordination Headquarters” under the Presidential Administration to develop a reconstruction programme, with the overall goal of ensuring safe and dignified return of internally displaced persons to the conflict-affected territories. The fact that the areas regained by the Government of Azerbaijan have been almost entirely depopulated for a nearly thirty-year period provides a unique opportunity for a new beginning and creating the foundations for a “green recovery”.

The environment is one of the stated priority areas in the government’s reconstruction vision. A dedicated inter-ministerial working group on the environment headed by the MENR has been created under the Coordination Headquarters. Highly progressive objectives have been set for the conflict-affected region, including achieving “zero emissions” and “zero waste” by 2050, and promoting the application of circular economy principles. Another key element is the construction of human settlements based on “smart cities and smart villages” concepts. This approach places special emphasis on renewable energies and energy efficiency, digital connectivity, water saving technologies, and waste recycling. Important strides have already been made including the construction of a “smart village” at Aghali in Zangilan district, and at least 22 other villages are in the design or planning phase.

Energy efficient buildings is one of the hallmarks of the first “smart village” in Aghali, Zangilan.

Reconstruction planning is taking place at three levels of scale: i) a general development plan for the region as a whole; ii) master plans for cities and settlements; and iii) detailed plans for cities and villages. Allocating sufficient time for proper planning is a major challenge due to growing pressure to accelerate the return of displaced persons to their areas of origin. As a result, the three aforementioned levels of planning are proceeding in parallel, and not in a phased manner as would normally be expected. This poses special challenges for ensuring that environmental safeguards and oversight are integrated in all stages of the recovery process, especially at the operational project level.

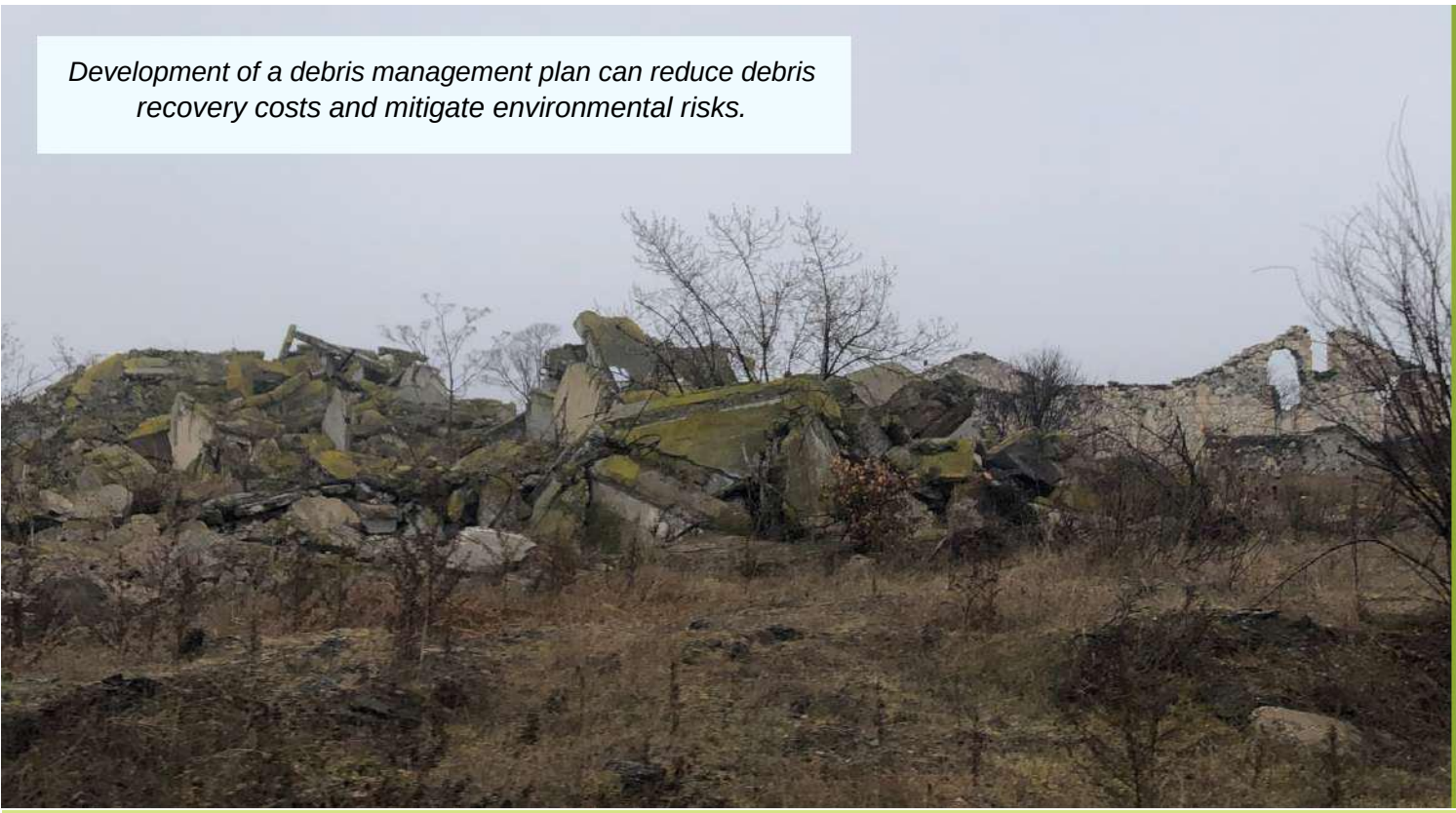
The Karabakh Revival Fund was established by the Government in January 2020 as a public entity to provide financial support and mobilize investments to support the reconstruction of the conflict-affected territories. Environmental restoration is one of the areas supported by the Fund, and a Memorandum of Understanding has been signed with the MENR to facilitate cooperation in this area. To date, environmental restoration projects supported by the Fund are comprised of tree plantation activities within and near urban areas. To help advance the Fund's commitment to supporting environmental restoration and best practices, it will be important that environmental investment criteria are developed to systematically screen investments and help ensure that they are aligned with and contribute towards the goals of carbon neutrality and zero waste, as well as the sustainable development of the Karabakh region.

This section discusses a range of actions that can be taken to improve the environmental performance of the reconstruction process currently underway in the conflict-affected areas, and to mitigate the potential risks that may undermine its sustainable development. Actions are grouped at two levels: i) short-term environmental solutions addressing identified risks and challenges on the ground; and ii) mainstreaming environmental dimensions in recovery and development planning over the longer-term.

i) Short-term environmental solutions

a) Debris management and recycling

As with landmines and unexploded ordinance, the demolition of damaged buildings and disposal of the arising debris is a prerequisite step for reconstruction and the return of internally displaced persons. Given the scale of the planned demolition, comprising around a dozen towns and hundreds of villages spread over a large area and generating millions of tonnes of debris, it is critical that a debris management master plan for the conflict-affected territories be developed. This is important to reduce debris recovery costs and resource requirements, as well as to mitigate risks to the natural environment.



Development of a debris management plan can reduce debris recovery costs and mitigate environmental risks.

Recycling of debris from conflicts and disasters is the recommended international best practice based on circular economy principles, with significant environmental and economic benefits. These include to: i) create jobs through cash-for-work schemes to recover and recycle the debris; ii) reduce natural resource depletion from quarrying; iii) cut greenhouse gas emissions from trucking the debris; and iv) minimize waste quantities requiring disposal at a landfill. There are numerous global examples demonstrating the applicability of debris recycling that can be drawn upon.

The fact that the demolition of buildings and disposal of the debris will be a centralized and government-led operation – and not individually driven by households as is the case in many post-conflict contexts – also means that there is a good potential for economies of scale in debris recycling when planned at the level of the conflict-affected territories as a whole. This further underscores the need to develop a debris management master plan right at the start of the reconstruction process to maximize cost savings and help avoid mistakes that may create future environmental liabilities.

The large-scale road and infrastructure construction programme currently underway in the conflict-affected territories places a significant burden on finite natural raw materials, particularly aggregates from quarries. The transport of this aggregate also causes significant emissions, thereby adversely impacting the zero-emission goal for the region. By reducing the demand on natural raw materials and transport emissions through recycling the debris, the climate and environmental impacts of planned roads and large-scale development works will be lessened.

Debris recycling can significantly reduce the demand on natural raw materials that will be needed for large-scale road construction works.

While more detailed assessments including materials testing to ensure compliance with national engineering standards is required, the general observation from the field visits is that the debris appears to be of overall good quality, with extensive use of local limestone. Moreover, the debris appear generally “clean” as it is hardly mixed with other wastes, which will facilitate its recycling.

Therefore, the potential for producing recycled aggregate material that fulfills engineering standards for road and other construction applications is expected to be good.

In larger towns with modern buildings where asbestos is known to have been used, a pre-demolition asbestos survey should be conducted by qualified experts, and training provided to ensure safe handling and management. Special measures will need to be taken to ensure that the asbestos is carefully separated and does not contaminate the main debris waste stream.

b) Forest restoration for disaster resilience

Large-scale reforestation activities by the MENR are both planned and ongoing in the conflict-affected territories. Disaster risk reduction should be an important consideration in prioritizing forestry activities. Potential weather-related extreme events (heavy rainfall, drought), combined with vulnerabilities arising from the conflict (deforested mountain slopes and presence of mines in otherwise intact forests) could lead to landslides, flooding and wildfires. Landslide and flood risks can be mitigated in the long term by prioritizing reforestation on steep terrain and near settlements. To mitigate forest fires, forest protection plans should be established, taking into account the potential needs to implement firebreaks, monitor risks and build capacity to fight forest fires.

Planting of tree species requiring long-term irrigation like pine should be avoided.

The choice of tree species used in the reforestation and afforestation efforts is paramount in establishing resilient forests capable of providing adequate ecosystem services, including capacity to reduce disaster risk. Tree species that require long-term irrigation should be avoided. Not only does this deplete a scarce natural resource needed for agriculture, but the trees dependance on irrigation makes them vulnerable to water stress, insect pests and wildfires. Native Karabakh tree species well adapted to local soil and weather conditions and reflecting the composition of the nearby natural forests should be the favored options. In locations where no such tree species are possible candidates, reforestation and afforestation may not be the best choice of land cover. Shrublands or grasslands may be better suited alternatives especially where they are the climax vegetation and should be valued as such.

Environmental Impact Assessments (EIA) should be applied to all major forestry projects; particularly proposals for afforestation or conversion of grasslands into agricultural lands, as these may wipe out or fragment valuable steppe ecosystems. Site-specific assessments of damages

related to the conflict (e.g. impact of mining and quarrying operations on forests, water pollution and change in hydrology on fragile riparian ecosystems) will help determine the type of remediation measures required and their priority.

c) Green landscaping with local flora

Choosing native Karabakh flora with horticultural potential (e.g. Paliurus spina-christi) for “green landscaping” in and around the new settlements and infrastructure has many advantages. The native plants are well adapted to the local soil and weather conditions and do not require irrigation. They host local fauna (food and shelter for native bees, native birds etc.) and give a unique character to the region. Initial acceptance by the public may require a change of mindset and awareness-raising to appreciate local species. Plants that have grown spontaneously in the last 30 years in the uninhabited settlements (wild fruit trees, wild species, ornamentals) form a spontaneous ready-to-use nursery and are also good candidates for “green landscaping”.

Diverse local vegetation flourishing in abandoned settlements without irrigation are good candidates for ‘green landscaping’.

d) Reducing environmental risks and safe management of mining operations

As mines and quarries in the conflict-affected territories no longer have a designated operator, they may at least temporarily be qualified as “abandoned” sites. Responsible management of these legacy mining and quarry sites in compliance with national regulations is a major undertaking that will require adequate resources. To protect Karabakh’s strategic water assets and people’s health, an immediate priority is to assess and monitor the extent of contamination around high-risk mining sites. Clean-up plans can then be developed and implemented based on the findings. In addition, emergency preparedness plans should be developed to respond to chemical pollution incidents.

Soyudlu gold mine is one of the contamination hotspots requiring priority assessment. (Photo: MENR)

Given the limited knowledge on the status of mine tailing facilities, technical assessments of tailing dam stability should be carried out to evaluate the level of risk. Based on the findings, risk reduction measures should then be taken to enhance tailing facility safety and minimize the risk of structural failures. In this regard, a key measure is to prevent and separate water from contact with tailings, given its effectiveness in reducing dam instability and the generation of effluents contaminated with dissolved heavy metals. Emergency preparedness and response plans to deal with potential tailing facility failures should also be developed. The Global Industry Standard on Tailings Management provides useful guidance on this issue.

Plans will also need to be developed to ensure proper closure of mining and quarry operations that will not be continued. This can begin with pilot remediation projects, including those that capitalize on assisted natural regeneration processes. Land rehabilitation of abandoned quarry pits and drainage ponds will also need to carried out, especially those within and along mountain streams and river systems, to help support hydrological cycles and ecosystem services. It is equally important that any new mining projects are based on sustainable mining practices and a life cycle approach, including explicit mine-closure provisions as an integral part of pre-mine planning and development.

e) Addressing and preventing transboundary river pollution

Further assessment of water and sediment quality in the Okhchuchay River is critical to ensure food and drinking water safety for human and animal health in future settlements in Zangilan district, and further downstream along the Aras River, as well as to guarantee the ecosystem services provided by the Okhchuchay. A comprehensive comparative analysis should be conducted at different points along the river, including in locations upstream of the suspected sources of the contamination.

Remediation options for river water pollution should be identified based on the specific pollutants analysed, as well as the levels and frequency of the contamination. Where possible, nature-based solutions should be preferred (e.g. phytoremediation through ecological floating beds, construced

wetlands, riparian buffers) due to their cost efficiency, ecological and environmental benefits, and their ease of maintenance. An emergency preparedness and response plan to manage future chemical pollution incidents should also be developed.

Furthermore, technical cooperation with relevant authorities and entities in Armenia should be explored to establish joint water quality monitoring initiatives, discuss preventive measures – such as improved management of wastewater from industrial and domestic sources – and to identify common solutions for remediation. In the absence of a legal framework for cooperation, a neutral third party can support the convening of technical exchanges if both sides express an interest.

ii) Mainstreaming environmental dimensions in recovery and development planning

a) Strategic environmental assessment

One of the main challenges that could jeopardize the environmental sustainability of the reconstruction currently underway in the conflict-affected territories is the high speed at which it is taking place. To provide the needed assurance that the environment receives the best protection and that disaster resilience and climate change considerations are adequately factored in reconstruction planning, an integrated strategic environmental assessment (SEA) should be carried out to guide development activities to the most suitable locations. It is critical that such an assessment is carried out as soon as possible to identify and preempt potentially adverse effects and support the development of higher quality plans.

Development of an SEA is a process that is dependent on data integration from all key stake-holders. The Karabakh geospatial database, developed by the State Service on Property Is-sues (SSPI) of the Ministry of Economy to provide a detailed inventory of building and in-frastructure damage, provides a good platform to integrate data from multiple sources. Furthermore, all government ministries and agencies involved in the reconstruction of the conflict-affected territories have been granted access to contribute and upload their data sets on this data platform. This includes, inter alia, forestry, mines, and water resources data from MENR. It is recommended that the Karabakh geospatial database is further strengthened, including by linking it with data-sharing infrastructure at the district level, and that capacity development and training of stakeholders to use the information in a constructive manner is carried out.

By integrating these various data sets using a standardized format, it would be possible for the concerned stakeholders to jointly develop an “opportunity map” that considers environmental criteria and sensitivity analysis in identifying the best places to locate new development and agree on optimal land uses. This could, for example, include defining the best route for a new road, help determine optimal siting of quarries for construction, avoid development in disaster-prone areas, establish protected areas and ecological corridors and preserve archeological sites.

A dedicated SEA for the transport sector would be particularly valuable given the scale of the planned road construction scheme currently underway, comprising of 15 major roads and highways spanning around 720 kilometers, railways, and airports. There are several examples of SEAs conducted in post-conflict contexts that can provide important insights and lessons learned, including from Northern Province in Sri Lanka.

A Strategic Environmental Assessment of the reconstruction programme, particularly of the extensive road and highway network development, is recommended.

While appreciating the urgency to rebuild fast and resettle the affected, it is equally important that the development and approval of environmental impact assessments (EIA) at the individual project level are given due consideration and are not subject to undue pressures. While mechanisms to accelerate the EIA process could be considered given the special circumstances, it is important to ensure that EIAs meet certain minimum requirements in accordance with national regulations. Otherwise, reconstruction projects may create new or aggravate existing environmental problems, thereby undermining progress towards a "green recovery", and the capacity of environmental assets to continue generating sustainable growth and income.

b) Integrating climate change adaptation and disaster risk reduction approaches

Integrating climate change adaptation measures for agriculture and water resource management in recovery and reconstruction planning for the Karabakh region is critical to its long-term success. Even in the absence of longitudinal climate data and detailed forecasting/modelling for the region, "climate-proofing" sectors such as agriculture and livestock production is a "no regrets" strategy that will protect livelihoods, food security and economic productivity.

This includes, as detailed under point d) below, careful selection of crops and crop varieties, and nature-based solutions to counter soil degradation and improve water conservation. Detailed adaptation planning is notably required for irrigated crops, as models suggest production will be at significant risk from projected water stress, and higher temperatures will require increased irrigation to maintain yields.[8]

In this respect, it is critical that Azerbaijan's National Adaptation Plan, currently under development, informs recovery and reconstruction planning in the Karabakh region. At the same time, the regeneration of the region is of strategic importance as a testing ground for innovations in climate change adaptation, including nature-based solutions.

Regional cooperation for adaptation planning at river basin/catchment scale is also needed to

8 USAID. Climate Change Risk Profile for Azerbaijan (2017).

address water shortages facing the Karabakh region that are linked to pressures on transboundary rivers and water sources beyond Azerbaijan's territory, which are likely to worsen considerably with climate change.

Similarly, disaster risk reduction measures should be integrated as a matter of priority into recovery and development planning for the Karabakh region, including to mitigate risks linked to extreme climate-related events. Where possible, nature-based solutions should be prioritized. Forest fire prevention is of particular importance for this region, given that the majority of its forest cover is comprised of vulnerable altitude forests; mitigation measures should for example be implemented in all reforestation projects undertaken as part of reconstruction, as noted under point b) above. Regional cooperation for information exchange and early warning should also be explored, and where possible, accelerated.

c) Biodiversity strategy and action plan for the conflict-affected territories

The diversity in ecosystems in the conflict-affected territories, from steppes, dry moutain scrublands, lowland and mountain forests to alpine ecosystems, is reflected in its rich variety of flora and fauna. The current state of these ecosystems and of their plant and animal populations is unknown, including that of the 64 fauna and 74 flora classified as rare and endangered species in the Red Book of the Republic of Azerbaijan. The last 30 years of conflict have had a mixed impact on the region's biodiversity which requires further study. On the one hand, flora and fauna species have been subjected to pressures (deforesta-tion, water pollution, hunting, mining operations, etc.); on the other hand, they have been relieved of certain factors (fragmented agricultural landscapes, livestock grazing, pesticides, human presence) and had the opportunity to recolonize suitable habitats, including uninhabited settlements and cities. Over the course of time, ecosystems may have regained the capacity to support a wide range of plants and animals including iconic species, like the Goitered gazelle[9], or threatened species, like the Striped hyena.[10]

Baseline biodiversity inventory of the conflict-affected territories and updating of Azerbaijan's Red Book are critical for conducting effective environmental impact assessments of development projects.

9 Journal of Life Sciences & Biomedicine, vol. 3(76), No 2, p. 33-40 (2021)

10 Two Striped hyenas were officially recorded in 2010 at the Armenian border, less than 50 km of Zangilan. Folia Zool. 60 (3): 253–261 (2011)

Resumption of human activities and developing infrastructure while valuing and nurturing the biodiversity that matured during the conflict period and its ecological services – for example, pollination and biological pest control – is a large and complex task that requires a dedicated biodiversity strategy and action plan. This plan should set conservation targets and goals in terms of species and ecosystems. Protected areas and wildlife corridors will need to be reassessed and readjusted in the conflict-affected territories, which together with an updated Red Book, will provide the necessary benchmarks for future EIAs and longer-term biodiversity monitoring.

Although the baseline biodiversity inventory phase is complicated by the presence of mines, modern technologies offer opportunities to assess and monitor ecosystems, habitats, and wildlife species remotely or with minimal incursion into the area to be surveyed. Ecosystem health, habitat structure, and biodiversity potential can be evaluated with technologies such as satellite imagery, aerial photography, lidar[11], radar vision[12], and drones. In locations where the presence of key wildlife species (top predator, large grazer, endemic, or threatened species[13]) is conceivable, au-tomated continuous biodiversity sampling stations equipped with sensors[14] (and possibly captors) can be installed. Other indirect survey techniques include audio recorders for the identification of specific mammals, birds, insects, frogs, and bats via bioacoustics[15], and visual sensors (cam-era traps, infra-red optical sensors) for image recognition of mammals and insects[16]. Captors for specific insects, e.g., pheromone traps, could also be deployed. Wildlife residents and visitors of the freshwater bodies (fish, frogs, mammals, etc.) can be detected by the DNA they incidentally leave in the water[17]. Automated water sampling stations for environmental DNA collection could be placed in strategic locations. Developing the methodologies, the reference data banks (sounds, images and DNA of the species that are to be monitored in Karabakh), and the algorithms for the machine-based data analysis would be best done in collaboration with institutes or private sector companies with expertise in the field[18].

Where demining operations are completed, citizen science can substantially supplement the biodiversity inventory and monitoring conducted by professionals. Using platforms such as iNaturalist (available in Turkish), for example, non-biologists equipped with a smartphone can record observations of all kinds of animals and plants. The species photographed are identified via picture recognition, assessed, and validated. The records are then uploaded and shared in the open-access Global Biodiversity Information Facility database. In the Netherlands, for example, 80% of the data in the national flora and fauna database are contributed by citizens.

11 Applications of airborne lidar for the assessment of animal species diversity. Methods in Ecology and Evolution. 5(8):719-729 (2014). https://doi.org/10.1111/2041-210X.12219

12 Radar vision in the mapping of forest biodiversity from space. Nat Commun 10, 4757 (2019). https://doi.org/10.1038/s41467-019-12737-x

13 Indicators for Monitoring diversity: a hierarchical approach. Conservation Biology 4(4):355-364 (1990). https://www.jstor.org/stable/2385928

14 Towards a multisensor station for automated biodiversity monitoring. Basic and Applied Ecology, 59: 105-138 (2022). https://doi.org/10.1016/j.baae.2022.01.003

15 https://e360.yale.edu/features/listening-to-nature-the-emerging-field-of-bioacoustics

16 https://diopsis.eu/en/

17 A Review of Environmental DNA Field and Laboratory Protocols Applied in Fish Ecology and Environmental Health. Front. Environ. Sci., 25 February 2022 | https://doi.org/10.3389/fenvs.2022.725360

18 Audio and visual recordings do not need to wait for the development of the data banks and algorithms; they can be saved and analyzed at a later date.

d) Building resilient agricultural systems

Rehabilitation of the agricultural sector provides opportunities for designing and implementing agricultural systems that are more resilient to climate change and market vagaries than previous models from the Soviet era. Significantly, the vast expanses of agricultural land left fallow for the past 30 years and not treated with pesticides and other agrochemicals provide an ideal ground for establishing climate-smart and biological agriculture. In addition to providing access to the niche market for organic products including exports, biological agriculture preserves the key elements essential to making agriculture viable in the long-term such as soil health and the ecosystem services provided by biodiversity (e.g. biological pest control and pollination).

Water availability for irrigation is and will remain a key concern for the agricultural sector. Droughts, dependence on irrigation water and long-term salinization of soils can be mitigated by selecting water-efficient and drought-tolerant crops and crop varieties.

Monocultures, especially when practiced on a large scale, are highly susceptible to pest and disease outbreaks and lead to soil degradation, making them difficult to manage without chemical pest control and fertilizers. Over the long term, the use of phytosanitary products and the monotonous landscape created by monocultures are responsible for a significant reduction in biodiversity. Agricultural production systems based on complementary crops (mixed cropping, agroforestry) and/or mixed crop and livestock husbandry not only strengthen economic resilience by generating a variety of market products, but are also more ecologically resilient (less prone to drought, pests and diseases) and use resources (water, nutrients, space) more efficiently. As the choice of crops and agricultural practices will have profound implications on the future of the conflict-affected territories, the best alternatives and novel approaches (e.g. mulberry orchard with extensive poultry farming) deserve careful study.

VI. Way Forward

Developing these recommendations into operational proposals and bringing them to scale requires a sequenced and incremental approach. Some interventions can be implemented in relatively short time frames and with limited budgets on a “pilot” basis to help tailor actions to the local context and address specific needs. As successful results are demonstrated and lessons learned, additional resources can be mobilized to promote scale-up. Other actions will require longer preparatory periods including additional detailed assessments to address more complex and longer-term issues.

It should be emphasized that other UN agencies and development partners may be better suited then UNEP to support the government in implementing several of the proposed recommendations. In all cases, the UN’s contribution to the recovery and reconstruction effort will be guided and channelled through the UN Resident Coordinator Office as an integral part of the ‘Delivering as One’ commitment. Actions will also be aligned with the strategic development priorities agreed with the Government of Azerbaijan under the UN Sustainable Development Cooperation Framework (UNSDCF) for the period 2021 to 2025. Furthermore, the findings and recommendations from this scoping assessment will be actively shared with the UN, European Union, and World Bank Group joint recovery needs assessment of the conflict-affected territories that is currently underway. This had identified ‘environmental recovery and sustainable energy transition’ as one of the priority areas in its initial mission in March 2022. It will therefore be important to promote greater coherence and synergy across proposed approaches and interventions to ensure coordinated action.

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Finally, we would like to recognize the professionalism of the logistical organisation of the scoping mission led by Mr. Nizami Hesenov and his team which was equally critical to ensuring a successful outcome.

Annex I – Key stakeholders consulted

Name	Position and Organisation
Mr. Mukhtar Babayev	Minister of Ecology and Natural Resources
Mr. Jeyhun Bayramov	Minister of Foreign Affairs of Azerbaijan
Mr. Elchin Amirbayov	Assistant to the First Vice-President, Presidential Administration
Ms. Vladanka Andreeva	UN Resident Coordinator (UNRC)
Mr. Sadig Gurbanov	Chairman of the Committee for Natural Resources, Energy and Environment
Ms. Sevinj Fataliyeva	Deputy Chairman of the Committee on International Affairs and Interparliamentary Relations
Mr. Tural Ganjaliyev	Member of Parliament
Ms. Fatma Yildirim	Member of Parliament, Committee on International Affairs and Interparliamentary Relations
Mr. Hikmet Hajiyev	Head of Foreign Policy Affairs Department of the Presidential Administration
Mr. Eldar Salahov	Head of International Cooperation and Protocol Department State Committee on Urban Planning and Architecture of the Republic of Azerbaijan
Mr. Rasim A. Hasanov	Deputy Director State Committee on Property Issues Information Technologies and Data Management Centre
Mr. Rashad Allahverdiyev	Chief of Staff Ministry of Ecology and Natural Resources
Mr. Kamran Seyfullayev	Third Secretary Permanent Mission of Azerbaijan in Geneva
Ms. Umayra Taghiyeva	Head of National Hydro Meteorological Service Ministry of Ecology and Natural Resources
Mr. Verdiyev Rafig	Deputy Chief, National Hydro Meteorological Service Ministry of Ecology and Natural Resources
Mr. Ali Aliyev	Head of the Geological Prospecting Service Ministry of Ecology and Natural Resources,
Mr. Emin Garabaghli	Head of International Cooperation Department Ministry of Ecology and Natural Resources
Mr. Faiq Mutallimov	Head of Department on Ecological Policy Ministry of Ecology and Natural Resources
Mr. Ragub Mirzayev	Head of Sector Ministry of Ecology and Natural Resources
Mr. Amin Mammadov	Chairman of the Public Council, under the Ministry of Ecology and Natural Resources
Mr. Hafiz Imanov	Regional Representative Ministry of culture

Mr. Aydin Karimov	Special representative of the President to Shusha
Mr. Elshad Iskandarov	Assistant to the representative of the office of the president to Shusha
Mr. Emin Huseynov	Special representative, Aghdam city
Mr. Umid Isazade	Assistant to the special representative to Aghdam city
Mr. Faig Hajiyev	Specialist, Aghdam city
Mr. Jeyhun Rzayev	Deputy Chairman, ANAMA
Mr. Ramin Aliyev	Head of Operational Division, ANAMA
Mr. Nijat Karimov	Head of International Relations and Donors Department; ANAMA
Mrs. Gular Mustafa	Senior Specialist of International Relations and Donors Department; ANAMA
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