Research Terms of Reference
Service Functionality and Damage Assessment

UKR2213
Ukraine

April 2022
Version 1.0

REACH Informing more effective humanitarian action

1. Executive Summary

Country of intervention	Ukraine						
Type of Emergency	□	Natural disaster	**X**	Conflict			
Type of Crisis	**X**	Sudden onset	□	Slow onset	**X**	Protracted	
Mandating Body/Agency	GAC, SDC						
Project Code	97AUD, 97AUW						
Overall Research Timeframe	01/04/2022 to 31/03/2023						
Research Timeframe	1. Start collect data: 01/04/2022			5. Preliminary presentation: N/A			
	2. Data collected: N/A			6. Outputs sent for validation: weekly for the map / biweekly for factsheet			
	3. Data analysed: N/A			7. Outputs published: weekly for the map / biweekly for factsheet			
	4. Data sent for validation: N/A			8. Final presentation: 15/03/2023			
Number of assessments	□	Single assessment (one cycle) in multiple geographies: conflict-affected areas in North, East, and South of Ukraine					
	X	Multi assessment (more than one cycle)					
Humanitaria nmilestones	**Milestone**			**Deadline**			
	□	Donor plan/strategy					
	□	Inter-cluster plan/strategy					
	□	Cluster plan/strategy					
	□	NGO platform plan/strategy (3P Consortium)					
	X	Other (Specify): High-level donor meetings		ongoing			
Audience Type &Dissemination	**Audience type**			**Dissemination**			
	X Strategic **X** Programmatic □ Operational			□ General Product Mailing (e.g., mail to NGO consortium; HCT participants; Donors) □ Cluster Mailing (DRR working group) **X** Presentation of findings □ Website Dissemination (Relief Web & REACH Resource Centre) **X** Bilateral dissemination to local authorities			
Detailed disseminationplan required		Yes		**X**	No		
General Objective	Inform humanitarian actors (specifically Shelter, WASH, and Health clusters) by promoting a better understanding of conflict's impact on the key infrastructure and highlighting the categories of this infrastructure with highest damage proportion given a specific conflict-affected settlement.						

Specific Objective(s)	1. Analyse damage to key infrastructure and key service providers (facilities) in urban settlements affected by hostilities.[1] 2. Summarize the analysed data at localized level for prioritized areas to communicate on the actual / possible service disruptions in the area. 3. Connect assessment findings with local humanitarian needs and a capacity of humanitarian actors.						
Research Questions	1. How has key infrastructure in urban settlements under ongoing conflict been impacted (key services type defined via cluster consultations)? a. What healthcare and education facilities are damaged? b. What utility network hubs/stations are damaged? c. What transport hubs/stations and bridges are damaged? d. What logistics and industrial objects are damaged? e. What is damage to grocery stores and pharmacies? 2. What are the features of revealed damage in specific areas? a. What absolute and relative estimates of damage to infrastructure in specific areas? b. What is damage density at settlement level in specific areas? c. What spatial focus should be given by humanitarian actors in specific areas? 3. How to connect revealed findings with needs and humanitarian actors? a. What infrastructure category with revealed damage is the most threatening for a specific settlement? b. What humanitarian actors and how can respond on the revealed damage estimates in specific settlement?						
Geographic Coverage	Conflict affected urban settlements in East, North and South of Ukraine.						
Secondary data sources	Open Street Map, OCHA for administrative boundaries, ESA Sentinel-1 and Sentinel-2 imagery, ESA WorldCover (2020), MAXAR (Geo-Eye, WorldView), Google Maps, UNOSAT (damage data)						
Population(s)	□	IDPs in camp		□	IDPs in informal sites		
	X	IDPs in host communities		□	IDPs [Other, Specify]		
	□	Refugees in camp		□	Refugees in informal sites		
	□	Refugees in host communities		□	Refugees [Other, Specify]		
	X	Host communities		**X**	Returnees		
Stratification	**X**	Geographical #: 3 Population size per strata is known? □ Yes **X** No	□	Group #: _ _ _ Population size per strata is known? □ Yes □ No	□	*[Other Specify]* #: _ _ Population size per stratais known? □ Yes □ No	
Data collection tool(s)	**X**	Secondary data review	**X**	Satellite remote sensing			
Data management platform(s)	**X**	IMPACT	□	UNHCR			
	□	[Other, Specify]					
Expected output type(s)	□	Situation overview #: _ _	□	Report #: _	□	Profile #: _ _	
	□	Presentation (Preliminary findings) #: _ _	□	Presentation (Final) #: _ _	**X**	Factsheet #: 5[2]	
	□	Interactive dashboard #: _	□	Web-map #: _ _	**X**	Map #: 5[3]	
Access	**X**	Public (summary factsheets will be available on IMPACT resource center and other humanitarian platforms)					
	X	Restricted (bilateral dissemination only upon agreed dissemination list, no publication on IMPACT or other platforms for large-scale settlement-level maps with detailed specification of damaged facilities locations)					
Visibility	IMPACT, ACTED, UNOSAT						

[1] Business facilities (trade, retail, catering), educational, healthcare facilities, industrial and logistic objects, cultural and entertainment, official and social infrastructure, transport and utilities infrastructure, hotels.

[2] One factsheet on damaged non-residential infrastructure summary for specific regions.

[3] One map dedicated for a specific settlement per each week of assessment (accounting for image availability).

2. Rationale

2.1. Background info

The escalation of hostilities in Ukraine, on 24 February 2022, has led to a rapid expansion of conflict-affected areas in the East, North and South of Ukraine. Multiple settlements, including large cities with dense built-up cover, were severely damaged between the end of February – April. Additional threats arise from natural disasters for ecosystems located in conflicted-affected areas with cascading negative effects on environment and human well-being.

Numerous incidents of building damage were reported for both living houses and infrastructure in impacted settlements. While in the first week since the beginning of escalation direct locations and type of damaged objects were transparently revealed, currently such reports in media are forbidden due to security reasons. That led to uncertainty in the understanding of the extent of damage to economics, transport, healthcare, and educational infrastructure in the areas of both ongoing and stopped hostilities.

Remote sensing data is an efficient and safe tool to estimate the occurrence and severity of damage to infrastructure in affected settlements. While acquisition of 3D images by unmanned aerial vehicles (with possibility to visually examine all types of damage to buildings and structures) is rather impossible due to security concerns, high-resolution satellite imagery can be a relevant source of reliable data of conflict impact. Visual interpretation of conflict and post-conflict images in previously known locations of facilities and infrastructure can support a robust assessment of conflict impact on infrastructure in affected urban areas.

Close cooperation with UNOSAT on the analysis of high-resolution optical satellite imagery is crucial to derive robust estimates of the damage of various infrastructure types. These estimates will be an essential part of further assessments of conflict impact on markets, healthcare, educational system, transport connection, industry in affected regions.

2.2. Intended impact

This assessment aims to report locations where damage to key infrastructure and service providers (facilities) should be the highest priority for humanitarian actors and local authorities. Estimation of damage to non-residential infrastructure by categories and relative proportions to total infrastructure in region is aimed for indirect assessment of economical loss (e.g., for Area Based Assessments conducted by REACH), and for revision by humanitarian clusters (e.g., Health Cluster, WASH Cluster, Shelter Cluster). Additionally, translations of project products to Ukrainian are intended to inform local policy makers and authorities for more robust planning and management in conflict-affected areas.

3. Methodology

3.1. Methodology overview

To estimate conflict impact on the key infrastructure and facilities in urban settlements directly affected by ongoing hostilities, IMPACT will assess the visually detected damage using high-resolution optical satellite images in close cooperation with UNOSAT. UNOSAT initiative uses images provided by MAXAR company (World-View and Geo-Eye satellites with 50 cm spatial resolution) acquired during and after the conflict in several locations of Ukraine. Visual inspection of such scenes allows to detect most of the severe damage to buildings in urban settlements and is successfully applied for Rapid Damage Assessment (e.g., Kharkiv; Sumy; Mariupol maps) and Detailed Building Damage Assessment (e.g., Irpin, Bucha map).

Estimation of conflict impact on the infrastructural objects and facilities requires a visual check of possible damage on buildings which are assigned to previously known objects from a georeferenced database. We will prepare this data set of infrastructural objects using freely available sources. At first, layers prepared by OpenStreetMap (OSM) contributors will be used to extract a set of objects within urban settlements affected by conflict in the East, North and South of Ukraine. Where necessary, this data set will be expanded by adding missing data presented in Google Maps and media sources. A validation will be conducted to avoid the double presence of the same facilities and structures.

Georeferenced database of such objects will include two main categories: infrastructure and service providers, as well as business facilities. Data for the first category will be mainly extracted from the layers prepared by OSM contributors and will include: healthcare, education, social and administrative facilities. As well, it will include important transport hubs (such as railway stations), bridges, and locations of utility network objects (such as power substations). The second category of business facilities will rely also on a specific knowledge of local retail and food shop networks. Alongside with mapping the large industrial objects in conflict-affected areas, there will be an imputation of different shops (food, medicine, veterinary, clothes, etc.) and supermarkets as an important element of local economies.

It is intended that all objects from the prepared georeferenced database will be visually inspected in close cooperation with UNOSAT using high-resolution optical satellite imagery. These objects will be assigned to the one of four categories according to UNOSAT methodology: 'possible damage' (visible debris near building or indirect signs of damage on roofs or walls), 'moderate damage' (visible damage of walls and roofs), 'severe damage' (substantially damaged walls, destroyed roof), and 'destroyed' (only a few remnants of walls with no roof). Shops and other small facilities located on the ground floor of multi-apartment living houses will be assigned to the "visible damage" or "severe visible damage" categories according to the visual damage type of the whole building.

Although remote sensing satellite data cannot fully capture the damage caused by conflict hostilities, it illustrates general trends while field (ground or drone) surveys are restricted or impossible.

To analyze what are the features of revealed damage in specific areas, IMPACT will select specific areas within conflict-affected regions where several urban settlements are located close to each other and with rural settlements in vicinity can be considered as agglomerations. IMPACT will focus on North-West Kyiv suburb area, agglomerations of Chernihiv, Sumy, Kharkiv, Mykolaiv cities, and selected agglomerations in Dnipropetrovska, Donetska, and Luhanska oblasts. Absolute and relative estimates of damaged key infrastructure and facilities will be examined and reported in sharable form suitable for humanitarian actors, area-based assessments, and local authorities. Additionally, settlement-level (in form of summarized hexagonal grids, without direct mapping of damaged infrastructure due to security reasons) damage density hotspots will be mapped and presented to better inform spatial patterns of conflict impact and areas to prioritize the response.

To connect revealed findings of damage with humanitarian needs and humanitarian actors' capacity, IMPACT will communicate with humanitarian actors and local authorities through cluster platforms. Settlement-level maps with estimated damage to infrastructure will be shared bilaterally and agglomeration-level factsheets (for specific areas) will be shared publicly. Sharing of revealed damage data in geospatial (both SHP and KML extensions for users with different GIS capacity) and table formats by request will be essential part of efforts to incorporate research findings into humanitarian actors' workflow. Revealed findings are intended to be presented at humanitarian cluster meetings to better understand the gaps between the actual needs and response capacity.

3.2. Population of interest

The population of interest in this study includes host community members, IDPs and returnees in the urban settlements impacted by damage in response to the Russian invasion on February 24, 2022, in the East, North and South of Ukraine.

3.3. Secondary data review

Data provided by OSM contributors for the regions of interest directly affected by conflict escalation will be in a core of georeferenced data set of infrastructure (healthcare, social, education, transport) and business facilities (shops, supermarkets, large industry). Database will be manually enriched with data extracted from Google Maps and other freely available sources where geographical locations can be accurately referenced. This data set will be collected for the urban settlements with first priority given for urban settlements with large previously reported damage to buildings and where most of hostilities are rather stopped as for April 2022 (North of Ukraine). Then, all objects in georeferenced database will be visually inspected using provided World-View and Geo-Eye images for specific conflict-affected areas.

UNOSAT damage data will be used as main data source of damaged structures (key infrastructure and facilities) for the following analysis of non-residential infrastructure by categories.

Sentinel-1 and Sentinel-2 imagery are additional data sources to map land cover / land use and their changes. Locations of fire spots will be examined using FIRMS data of thermal anomalies. Data provided by OSM contributors and ESA WorldCover

(2020) land cover / land use data set also will be used. These raster layers based on remote sensing data will be used to supplement the mapping and geospatial analysis if necessary.

Table 1. List of open data sources to be utilized

Data source	Short description	Area	Available data and comment
Sentinel-1	Remote sensing	Global	Radar imagery (10 m)
Sentinel-2	Remote sensing	Global	Multispectral imagery (10 m)
World-View and Geo-Eye	Remote sensing	Specific locations of interest	RGB-composites of visible bands (50 cm)
FIRMS	Remote sensing	Global	Thermal anomaly detection (500 m)
OCHA Settlement Boundaries	Administrative boundaries	Ukraine	Admin boundaries
OSM buildings network	Vector layer	Global	raw OSM
OSM road, electricity network	Vector layer	Global	raw OSM
OSM facilities	Vector layer	Global	raw OSM
Google Maps	Locations of facilities and structures	Global	Locations to impute into the main database
ESA WorldCover 2020	Raster layer	Global	Land cover / land use (10 m)
NHS, EDEBO databases	Vector layer	Ukraine	Locations of healthcare and educational facilities
UNOSAT damage data	Vector layer	Ukraine	Locations of damaged structures

3.4. Primary Data Collection

No primary data collection will be conducted as part of this assessment.

3.5. Data Processing & Analysis

Georeferenced database of infrastructure and business facilities will be created (compiling the OSM and Google Maps data) and inspections for damage (visual checks using World-View and Geo-Eye satellite images) will be done rather manually. A database with unified infrastructure / facility type and damage category will be prepared in GIS software in vector formats.

Settlement-level maps (A0 format) will be produced with labeled detected damaged key infrastructure objects and facilities. Agglomeration-level factsheets (A3 format) will be produced to inform the wider audience and thus will not contain any sensitive information: damage estimates will be summarized within hexagonal grids.

Table 2. Summary of data processing and analysis.

Section name	Process/analysis
Damage of infrastructure and facilities due to the conflict escalation	Manual inspection of georeferenced facilities and objects using World-View and Geo-Eye imagery in specific conflict-affected areas.
Additional data for mapping	Using medium-resolution (Sentinel-1, 2) remote sensing data, global land cover raster products, OSM data to supplement geospatial analysis.

4. Roles and responsibilities

Table 3. Description of roles and responsibilities

Task Description	Responsible	Accountable	Consulted	Informed
Research Design	GIS Specialist	Country Coordinator	3P Consortium partners, GIS/Database Manager, IMPACT HQ Research Design & Data Unit (RDDU)	
Secondary Data Review	GIS Specialist, Climate & Resilience Unit Lead	Climate & Resilience Unit Lead	Country Coordinator, IMPACT HQ RDDU	
3rd Party Data Requests	GIS Specialist	Climate & Resilience Unit Lead	Country Coordinator	
Data Processing (Checking, Cleaning)	GIS Specialist, GIS Officer	Climate & Resilience Unit Lead	IMPACT HQ RDDU	
Data Analysis	GIS Specialist, GIS Officer	Climate & Resilience Unit Lead	IMPACT HQ RDDU	
Map Production	GIS Specialist, GIS Officer	Climate & Resilience Unit Lead	IMPACT HQ Reporting Unit (GIS)	
Factsheet Writing	GIS Specialist	Climate & Resilience Unit Lead	IMPACT HQ Reporting Unit	
Factsheet Design	GIS Specialist	Climate & Resilience Unit Lead	Country Coordinator, IMPACT HQ Reporting Unit	
Dissemination	GIS Specialist	Country Coordinator	3P Consortium partners	
Monitoring & Evaluation	GIS Specialist	Country Coordinator	IMPACT HQ Research Department	IMPACT Head of Research
Lessons Learned	GIS Specialist	GIS Specialist	IMPACT HQ Research Department	IMPACT Head of Research

Responsible: *the person(s) who executes the task*
Accountable: *the person who validates the completion of the task and is accountable for the final output or milestone*
Consulted: *the person(s) who must be consulted when the task is implemented*
Informed: *the person(s) who need to be informed when the task is completed*

5. Data Management Plan

Data Management Plan is available upon request.

6. Monitoring & Evaluation Plan

IMPACT Objective	External M&E Indicator	Internal M&E Indicator	Focal point	Tool	Will indicator be tracked?
Humanitarian stakeholders are accessing IMPACT products	Number of humanitarian organizations accessing IMPACT services/products Number of individuals accessing IMPACT services/products	# of downloads of x product from Resource Centre	Country request to HQ	User_log	
		# of downloads of x product from Relief Web	Country request to HQ		
		# of downloads of x product from Country level platforms	Country team		
		# of page clicks on x product from REACH global newsletter	Country request to HQ		no
		# of page clicks on x product from country newsletter, sendingBlue, bit.ly	Country team		
		# of visits to x webmap/x dashboard	Country request to HQ		
IMPACT activities contribute to better program implementation and coordination of the humanitarian response	Number of humanitarian organisations utilizing IMPACT services/products	# references in HPC documents (HNO, SRP, Flash appeals, Cluster/sector strategies)	Country team	Reference_log	DRR Working Group publications
		# references in single agency documents			
Humanitarian stakeholders are using IMPACT products	Humanitarian actors use IMPACT evidence/products as a basis for decision making, aid planning and delivery Number of humanitarian documents (HNO, HRP, cluster/agency strategic plans, etc.) directly informed by IMPACT products	Perceived relevance of IMPACT country-programs	Country team	Usage_Feedback *and* Usage_Survey template	no
		Perceived usefulness and influence of IMPACT outputs			
		Recommendations to strengthen IMPACT programs			
		Perceived capacity of IMPACT staff			
		Perceived quality of outputs/programs			
		Recommendations to strengthen IMPACT programs			
Humanitarian stakeholders are engaged in IMPACT programs throughout the research cycle	Number and/or percentage of humanitarian organizations directly contributing to IMPACT programs *(providing resources, participating to presentations, etc.)*	# of organizations providing resources (i.e. Staff, vehicles, meeting space, budget, etc.) for activity implementation	Country team	Engagement_log	□ Yes
		# of organizations /clusters inputting in research design and joint analysis			**X** Yes
		# of organizations /clusters attending briefings on findings;			**X** Yes