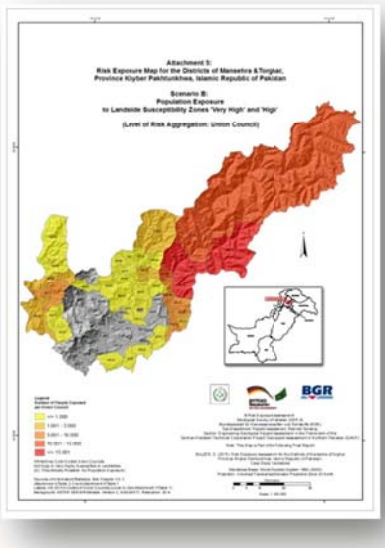
PROJECT OF TECHNICAL COOPERATION

'GEOHAZARD ASSESSMENT IN

NORTHERN PAKISTAN (GANP)'

RISK EXPOSURE ASSESSMENT FOR THE DISTRICTS OF MANSEHRA & TORGHAR, PROVINCE KHYBER PAKHTUNKHWA, ISLAMIC REPUBLIC OF PAKISTAN: CASE STUDY 'LANDSLIDES'



-FINAL REPORT-

HANNOVER & ISLAMABAD/FEBRUARY, 2015

Risk Exposure Assessment

for the Districts of Mansehra & Torghar,

Province Khyber Pakhtunkhwa,

Islamic Republic of Pakistan:

Case Study 'Landslides'

-Final Report-

This Final Report was Elaborated Within the Framework of the

Project of Technical Cooperation

'Geohazard Assessment in Northern Pakistan (GANP)'

Between

Geological Survey of Pakistan (GSP)

and

Bundesanstalt für Geowissenschaften und Rohstoffe (BGR),

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Table of Used Abbreviations

Abbreviation	Plain Text
ASTER GDEM	Advanced Spaceborne Thermal Emission and Reflection Radiometer Global Digital Elevation Model
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe (Federal Institute for Geosciences and Natural Resources)
BHU	Basic Health Unit
BMZ	Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (German Federal Ministry for Economic Cooperation and Development)
CH	Civil Hospital
DM	Disaster Management
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EaR	Element (s) at Risk
GANP	(Project) Geohazard Assessment in Northern Pakistan
GIS	Geographical Information System
GRASP	Georisk Assessment System Pakistan
GSP	Geological Survey of Pakistan
HDMD	Health Department of Mansehra District (No Official Abbreviation)
HMIS	Health Management Information System
IBO	International Brotherhood Organization
JICA	Japan International Cooperation Agency
KPK	(Provinz) Khyber Pakhtunkhwa
MITI	Ministry of Economy, Trade, and Industry (Japan)
NASA	National Aeronautics and Space Administration (United States of America)
NDMA	National Disaster Management Authority (Government of Pakistan: Ministry of Climate Change)
NDMP	National Disaster Management Plan (Pakistan)
NGO	Non-Governmental Organization
NIH	National Institute of Health (Pakistan)
PBS	Pakistan Bureau of Statistics
REA	Risk Exposure Assessment
RHU	Rural Health Unit
SH	Special Hospital (No Official Abbreviation/Term)
UC	Union Council
UN-OCHA	United Nations Office for the Coordination of Humanitarian Affairs
WGS	World Geodetic System

Executive Summary

Within the scope of the German-Pakistani Project of Technical Cooperation 'Geohazard Assessment in Northern Pakistan (GANP)' a landmark study to assess the risk exposure to the landslide 'hazard' for the Districts of Mansehra & Torghar, Province Khyber Pakhtunkhwa, Islamic Republic of Pakistan has been performed.

Basically, any risk (exposure) assessment outcomes facilitate a focused alignment of DRR stakeholders at the respective administrative level to particularly assign risk mitigation policies and strategies.

The objective of the risk exposure assessment for the Districts of Mansehra & Torghar was to exemplarily quantify the endangered population and selected infrastructural elements at risk exposed to the landslide 'hazard' and thereby subject to potential losses.

All risk exposure findings have been aggregated at the administrative level of 'Union Council' (UC; administrative level 5). The single hazard risk exposure appraisal links spatial and attributive information about the district-wide five graded zonation of the landslide susceptibility (GANP product), selected land cover (GANP product) items, further officially accessible demographic information as well as information about critical infrastructure objects (road network and health facilities).

Unfortunately, due to the lack of further high-resolution hazard information (e.g. flooding hazard) a multi-hazard approach has not been accomplished yet.

The common risk exposure data processing was executed applying combined database and GIS tools, previously developed and successfully performed by BGR geoscientists in several countries.

In total, ten different population and infrastructure related risk exposure scenarios have been exemplified. All results are presented as risk exposure choropleth maps supplemented by corresponding statistics and explanatory notes.

The most critical Union Councils with peak values of population exposure to the landslide susceptibility zones 'Very High' and 'High' are Garlat UC, Hangrai UC, Mohandri UC, and Ghanool UC. The population exposure values of these Union Councils are ranging from 16.000 to 17.000 people.

The exposure of roads of national importance (1. Order) to the landslide susceptibility zones 'Very High' and 'High' mainly concentrates on the Union Councils Kaghan UC, Ghanool UC, Kawai UC and Mohandri UC. These Union Councils display road (1. Order) exposure values between 8 and 30 km. Union Council Kaghan UC is the most critical one.

Pertaining to the exposure of health facilities to the landslide susceptibility zones 'Very High' and 'High' the number of Union Councils is limited to six, whereas the quantity of health facilities per Union Council does not exceed two.

The most seriously threatened health facilities are situated in the Union Councils Hangrai UC (one Basic Health Unit/BHU in the landslide susceptibility zone 'Very High') as well as Kawai UC, Shohal

Mazullah UC, Ghanool UC, Mohandri UC and Pairan UC in each case with one BHU placed in the landslide susceptibility zone 'High'.

Based on the exposure assessment results some initial risk mitigation suggestions with special emphasis on possible GSP hazard assessment activities in the future have been submitted. These examples might only provide initial incentives to foster a comprehensive and prompt discussion about the risk exposure assessment results within the DRM community at Union Council, District, and Province level.

1 Inducement and Objectives

Due to its geotectonic and geographic-geomorphologic setting the Islamic Republic of Pakistan is one of the most hazard-prone countries in the southern Asian region. Subject to the existing high vulnerability and the spatial exposure of all types of elements at risk (e.g. people, infrastructure, property), this region is frequently affected by damaging events or catastrophes triggered by earthquakes (e.g. the 2005 Kashmir earthquake or in Balochistan 2013) and/or the periodically returning floods during the monsoon season (e.g. the 2010/2012/2013/2014) very often accompanied by daunting landslides. It is expected that due to climate change the situation will deteriorate dramatically within the next few decades.

Besides the direct consequences for the livelihood of the affected population of Pakistan these natural (hydrological and/or geological) events pose an enormous threat to the economic development of the country and thereby a challenge for poverty alleviation in the long run.

In seeking to also advice the government of Pakistan in the field of *Disaster Risk Management (DRM)* the scope of international development cooperation focuses on both to foster the capability of the *Disaster Management (DM)* (response, recovery) and to effectively increase the capacity of *Disaster Risk Reduction (DRR)* at all intervention spheres (prevention, mitigation, preparedness) (see Chapter 4, Figure 29).

Under the impression of the 2005 Kashmir earthquake event with more than 84.000 people reported killed, the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) Hannover/Germany was entrusted by the Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (BMZ) to implement a bilateral project of technical cooperation, called 'Geohazard Assessment in Northern Pakistan (GANP)'.

In collaboration with the Geological Survey of Pakistan (GSP), a scientific-technical line authority of the Pakistan Ministry of Petroleum and Natural Resources, the GANP project has been operating since November 2009. According to the German development cooperation focal areas, the GANP

project pilot area is geographically concentrated on the District of Mansehra (Province of Khyber Pakhtunkhwa/KPK) in the north-west of the country (total population according to PBS 2000: 1.152.839).

Basically, the GANP project emphasizes the advisory service of relevant governmental DRR bodies in their efforts to mitigate disaster risks. This may be achieved by integrating reliable geoscientific information about hazardous phenomena and risk related impacts thereof into existing spatial and development planning processes, among others.

The particular emphasis of the topic ‚landslide susceptibility/hazard' is due to the steadily increasing impact of mass movements in Pakistan affecting manifold aspects of human life and causing economic damage and loss, respectively (Figure 1). In order to respond this omnipresent geological menace in the long-term, the GSP is explicitly mandated in the National Disaster Management Plan (NDMA 2012) to assess the relative spatial likelihood for the occurrence of landslides and the resulting impact country-wide.

Figure 1: Landslide along the road from Islamabad to Muzaffarabad (left); on the right: cracks in the ground slab of a house immediately placed below the road level (Source: D. BALZER, taken 2014).

In this particular GANP project manner the joint elaboration and the implementation of a pragmatic workflow using validated datasets and resilient methods to assess the regional susceptibility to landslides at District level has been successfully pursued. The application of this workflow enables GSP to obtain geoscientifically validated products (e.g. GSP 2012 and 2015) that have been purposefully socialized to the DRM policy-makers and other stakeholders (e.g. Mansehra District Deputy Commissioner) under the format of 'round tables of debate' several times (Figure 2).

Figure 2: 'Round table of debate' between Mansehra District Deputy Commissioner and GANP project representatives, Mansehra-City, 11/2013 (Source: D. WEGGENMANN).

The significance of this hazard-driven project approach is apparent from the fact that based on the gained regional landslide 'hazard' information the corresponding risk exposure for different elements at risk may exemplarily be judged in a tangible way for the District of Mansehra (and Torghar as well) by now.

Basically, the outcomes of such a landmark study enable the respective DRM authorities to update their strategies, policies and countermeasures comprehensively and sustainably. This is achieved through the:

- comparability of levels of risk exposure among the assessed administrative units;
- identification of priority areas at risk;
- initiation of cooperation between neighboring administrative units;
- elaboration of fair and transparent DRM allocation budgeting schemas fulfilling good governance rules.

Chapter 4 addresses in an exemplary manner the practical benefit of REA outcomes for the Districts of Mansehra & Torghar with regard to the overall DRM concept.

The final report at hand discusses all relevant topics that are needed to understand and to comprehend the risk exposure procedure for the Districts of Mansehra & Torghar. All used input information and resulting findings are hosted at GSP and BGR. This report refers to a previous technical report (BALZER 2011) broaching the issue of a data concept designed for a risk exposure assessment to geological hazards tailored to the Pakistan needs (Georisk Assessment System Pakistan/GRASP).

It should be pointed out that the accomplishment of this risk exposure assessment has been defined as one key indicator to measure the outcome of the GANP project as a whole.

2 Rationale of Risk Exposure Assessment (REA)

Definition

Risk Exposure Assessment (REA) quantifies all endangered elements (elements at risk) within a certain area, e.g. population, infrastructure facilities or all kinds of life lines that are exposed to a hazard and thereby subject to potential losses.

REA Information Sources and Processing

Consistent with the definition, any risk exposure assessment is governed by the availability of both spatial and attributive information about the hazard(s) and elements at risk within the area under consideration. This type of information is supplemented by so-called baseline information encompassing, for instance administrative areas/borderlines. All information used has to be featured by the same spatial reference system.

It is worth underlining that the absence of any hazard or element at risk related information entails the failure of any risk exposure assessment.

Basically, to increase the public perception and the acceptance of the REA findings the deployment of officially authorized and therefore quality-assured input data is mandatory.

Both, governmental authorities or in some cases accredited Non-Governmental Organizations (e.g. United Nations Office for the Coordination of Humanitarian Affairs/UN-OCHA) are suitable contact points to retrieve the relevant information. In the event of total absence of official information other trustworthy sources can be screened, e.g. Open Street Map (OSM) by GEOFABRIK (2014).

The availability of and the accessibility to REA relevant thematic information is of crucial importance. Experiences from different countries have shown that subject to the mandates and accountabilities several (re)sources have to be involved. In most cases instances like ministries, e.g. public works, health or education and several scientific-technical authorities, such as (geo-)scientific institutions and statistics offices are points of contact. Therefore, a harmonized DRM data policy at all administrative level is an indispensable requirement to gain risk assessment progress.

The processing and management of information to assess the risk exposure is based on GIS and relational database procedures. Due to the performance of modern IT tools a versatile processing of georeferenced information applying a logical data model/structure is not an obstacle anymore. An essential item regarding risk-related geospatial data objects is to always store information about the length (perimeter) and/or the area of objects as managed, for instance as *feature class* of ESRI's geo-

database format. These attributes need not be calculated separately and thereby may effectively be used during the REA.

To ensure a smooth information processing and especially to operate the risk exposure assessment without any data conflicts, the strict application of an unambiguous numerical coding system for all involved thematic items is highly recommended. In case of already existing codes, e.g. for different administrative units officially issued by statistics offices, the corresponding coding schemas ought to be applied during the REA procedure to remain consistent.

Spatial Assignment/Reference and Compatibility of REA Results

In order to achieve the highest possible impact in terms of risk-sensitive spatial planning, the regional REA results should be designed in full spatial conformity with other regional planning relevant features. For this, administrative units are predominantly used. In practice, it means that any risk exposure is totaled to planning compliant administrative units (e.g. all Union Councils inside a District or all Districts inside a Province).

The degree of risk exposure details is exclusively determined by the resolution of available (accessible) baseline, hazard and vulnerability related information. Accordingly, the more detailed this input information is, the more precise the REA findings and the associated spatial (administrative) assignment will be.

> *Example 'Inundation exposure': It is <u>not</u> recommended to assess the exposure of population to any inundation hazard zone at District/Union Council level applying a country-wide inundation hazard layer with a low level of resolution. This is because the resolution of the hazard inundation zonation is too low or not sufficiently sensitive in comparison to the chosen administrative level. It may be expected that only one inundation hazard zone covers the whole District.*

REA Scenario Based Approach

Generally, regarding the 'hazard' either a single- or a multi-hazard REA approach can be performed. The single-hazard methodology highlights the exposure of a set of elements at risk to one spatial hazard only. In contrast to this, the multi-hazard approach requires the spatial superimposition of at least two hazards (e.g. flooding hazard and landslide 'hazard'/susceptibility).

Based on the variability of the spatial and temporal probability, hazard information is often subdivided into several zones (e.g. low, moderate, high). Such a zoning facilitates a much more sensitive and

scenario-driven REA procedure (e.g. the determination of the population exposure to the flooding hazard zones 'High' and 'Very High').

In terms of information about the elements at risk (or vulnerability indicators) numerous thematic subjects may be the distinguished. Of utmost importance is the exposure assessment of the population based on population figures. In addition, the exposure of critical infrastructure elements, such as roads, bridges, schools, hospitals, mosques and prayer houses, gasoline stations or storage facilities for disaster response items is often evaluated.

The respective elements at risk are supposed to be selected in line with the needs of the respective administrative unit. This also depends not least from the disposability of and accessibility to authorized information.

The various combinations of graded hazard information and diverse elements at risk related information implies the definition of REA scenarios representing the most realistic assumptions for the particular administrative unit to be appraised. A further REA scenario expansion can flexibly be performed tailored to suit a DRM need at the respective administrative level.

Detailed Presentation of REA Results

Any risk exposure assessment generates manifold outcomes which mutually complement each other. The most common way is to visualize the risk exposure applying choropleth maps.

According to WIKIPEDIA (2014) 'a choropleth map (from Greek χώρο ('area/region') + πλήθος ('multitude')) is a thematic map in which areas are shaded or patterned (*or color-coded – editior's note*) in proportion to the measurement of the statistical variable being displayed on the map, such as population density or per-capita income. The choropleth map provides an easy way to visualize how a measurement varies across a geographic area or it shows the level of variability within a region.' These choropleth maps are based on statistical calculations. In case of any risk exposure assessment the resulting figures are mapped (displayed) in an aggregated format subject to the administrative level to be assessed. The resulting risk exposure maps are mostly underpinned by corresponding statistical tables or other ways of statistical presentations, e.g. diagrams (not used in this context).

As a rule, choropleth maps are reduced to a minimum of information. Additional topographic information is not common to be displayed on such maps (see Chapter 3.5).

3 REA Mansehra & Torghar District: Case Study 'Landslides'

3.1 Used Data Sources and Related GRASP Code Assignment

For the REA of the Districts Mansehra & Torghar following thematic sets of information have been considered:

- Baseline information;
- Hazard/Susceptibility information;
- Elements at Risk/Vulnerability related information.

Along with the remarks in chapter 2 (second sub-topic: *REA Information Sources and Processing*) GANP project pursued the utilization of independently elaborated sets of information (internal source), e.g. land cover or landslide susceptibility information or officially accessible information from other sources (external). Nevertheless, GANP does not warrant that external information meets the requirements of accuracy and completeness. Necessary adjustments are explained and documented in detail.

Apart from the administrative information subset (inside baseline dataset, see Chapter 3.1.1), which has been provided by UN-OCHA (2009) and extended by population figures of the Pakistan Bureau of Statistics (PBS 2000), the majority of this geospatial information has been encrypted according to the GRASP coding guideline (see BALZER 2011: 12ff).

Attachment 14 (Part 1-5) gives a full overview of all applied GRASP codes. The chosen coding procedure assumes that the District level will be the highest level of resolution of baseline, hazard/susceptibility and element at risk related information.

In order to meet the requirements of a risk exposure assessment at a lower level of resolution (e.g. at Province level) the GRASP coding schema already takes into account this possible future activities by offering respective code suggestions.

3.1.1 Baseline Information

Baseline information comprising:

- Administrative areas and boundaries;
- Land cover (and subsequently derived settlement areas);
- Demographic information (population figures).

Please note: in the following chapter 3.1.1 all smaller map-like views/sections have been illustrated without geodetic reference system. In this respect, it is referred to the respective maps fully designed and georeferenced (Attachments 2-13).

Administrative Areas/Boundaries

Administrative areas and their boundaries (vector and attributive[2] information) as well as the numerical codes for all entities of the administrative levels (2-5) are provided by UN-OCHA (2009). The corresponding subsets for the Districts of Mansehra & Torghar within the Province of Khyber Pakhtunkhwa have been deduced from these sources. The UN-OCHA coding approach is delineated in Table 1. Figure 3 illustrates the administrative assignment of Mansehra & Torghar Districts as part of Pakistan.

Administrative Level	Administrative Codes Issued/Applied by UN-OCHA (2009)	
	Code Type	Example
Country: Level 1	-	No code, only of interest in case of a transnational REA
Province: Level 2	1-digit code (consecutive)	Inside Pakistan 1 Khyber Pakhtunkhwa (KPK)
District: Level 3	3-digit code (consecutive)	Inside Province 1 135 Mansehra
Tehsil: Level 4	4-digit code (consecutive)	Inside District 135 1351 Bala Kot
Union Council (UC): Level 5	5-digit code (internally **unambiguous** and consecutive with breaks, but no logical continuation to level 4)	Inside Tehsil 1351 40426 Kaghan UC

Table 1: Coding schema of administrative units of Pakistan according to UN-OCHA (2009).

At this point it shall be stated that through conclusion by analogy (geographical situation of health facilities, see Chapter 3.1.3) an incorrect attribution (names of Union Councils) of the geometries of Kathai UC and Shamdara UC was identified. Such errors may lead to serious misjudgments, since this information constitutes the basis for all REA-related data processing steps, the resulting outcomes and hence also for the DRM related conclusions to be drawn and decisions to be taken. Table 2 shows the details of the modifications made in the respective data file (see Chapter 3.2 and Attachment 1).

[2] The spelling of all administrative designations in this report completely corresponds to the UN-OCHA (2009) dataset.

UN-OCHA (2009) UC Codes	UN-OCHA (2009) Name UC	**Name UC Applied for REA**
40483	Shamdara UC	**Kathai UC**
40537	Kathai UC	**Shamdara UC**

Table 2: Overview of modifications concerning the attribution of names of two UC codes in the context of this REA.

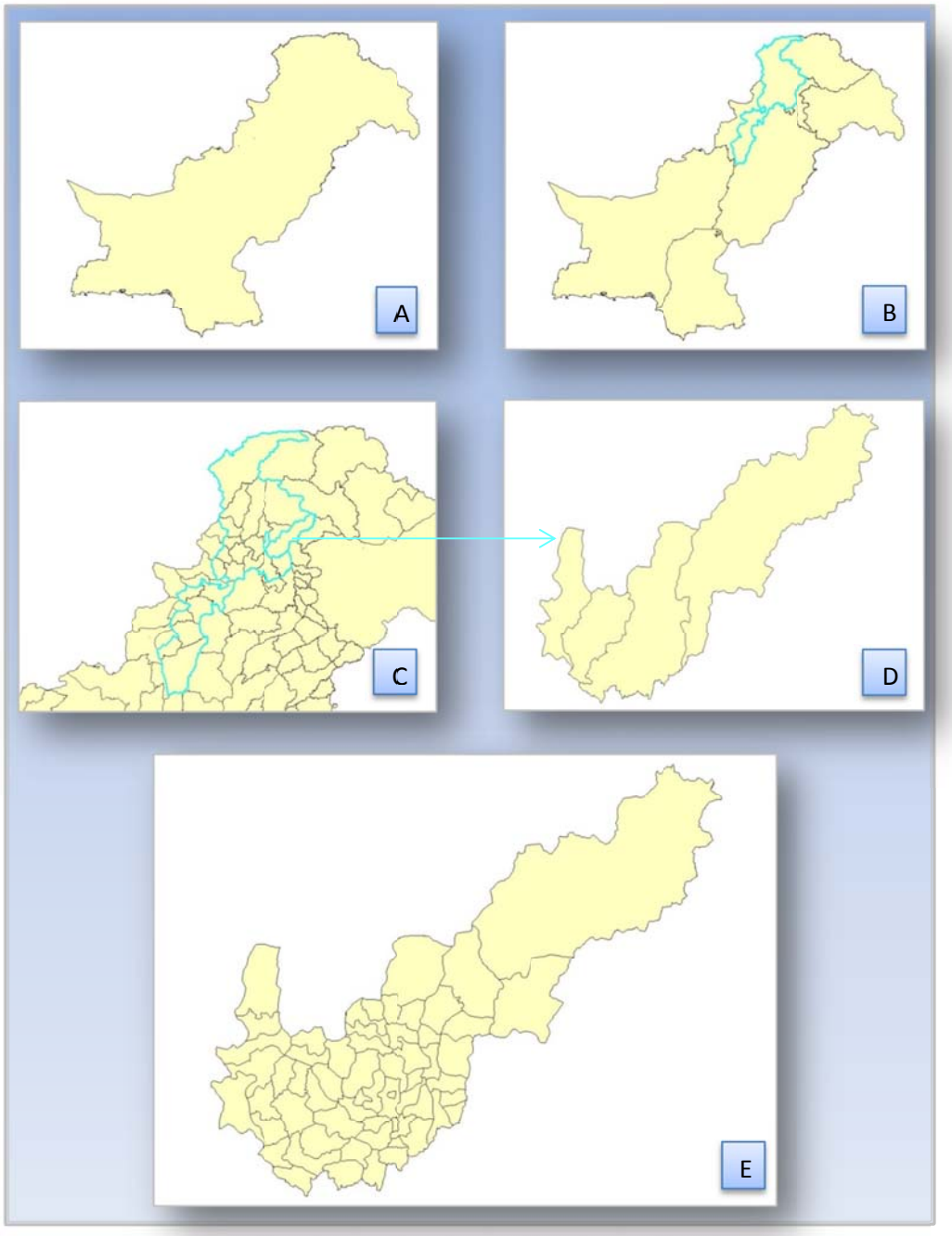

Figure 3: Administrative assignment of Mansehra & Torghar Districts; A: Country (Level 1); B: Provinces (Level 2; turquoise highlighted: KPK); C: Districts (Level 3) insides Province KPK (turquoise highlighted: KPK with Districts Mansehra & Torghar); D: Tehsils (Level 4) inside Districts Mansehra & Torghar; E: Union Councils (Level 5) inside Districts/Tehsils Mansehra & Torghar.

It is important to note that due to the latest Pakistani administrative reform on January 2011 the District of Mansehra has been subdivided into two Districts: Mansehra & Torghar. The newly appointed District Torghar (= Black Mountain) only comprises the former Tehsil Kala Dhaka (official terminology: *Tribal Area Adjoining Mansehra District*) previously divided into five Union Councils (now called: Sections). However, up to now the related geospatial datasets and associated administrative codes (level 3-5) have not been updated by UN-OCHA/PBS or are not officially available yet, respectively. For that reason, the original UN-OCHA administrative codes for the District, the Tehsils and the Union Councils (UC) have been continuously used for this REA purposes (Table 2). Figure 4 illustrates this administrative matter in detail.

Administrative Structure of Torghar District								
UN-OCHA Province Code	Name Province	UN-OCHA District Code	Name District: Old	Name District: New	UN-OCHA Tehsil Code	Name Tehsil: Old	UN-OCHA UC Codes for REA	Name UC (= Section)
1	KPK	135	Mansehra	Torghar	1352	Kala Dhaka	40425	Mada Khel
		135	Mansehra	Torghar	1352	Kala Dhaka	40464	Bassi Khel
		135	Mansehra	Torghar	1352	Kala Dhaka	40466	Nusrat Khel
		135	Mansehra	Torghar	1352	Kala Dhaka	40471	Hassan Khel
		135	Mansehra	Torghar	1352	Kala Dhaka	40880	Akazai

Table 3: Overview of used administrative codes (level 2-5) of Torghar District applied for REA (UC = Union Council).

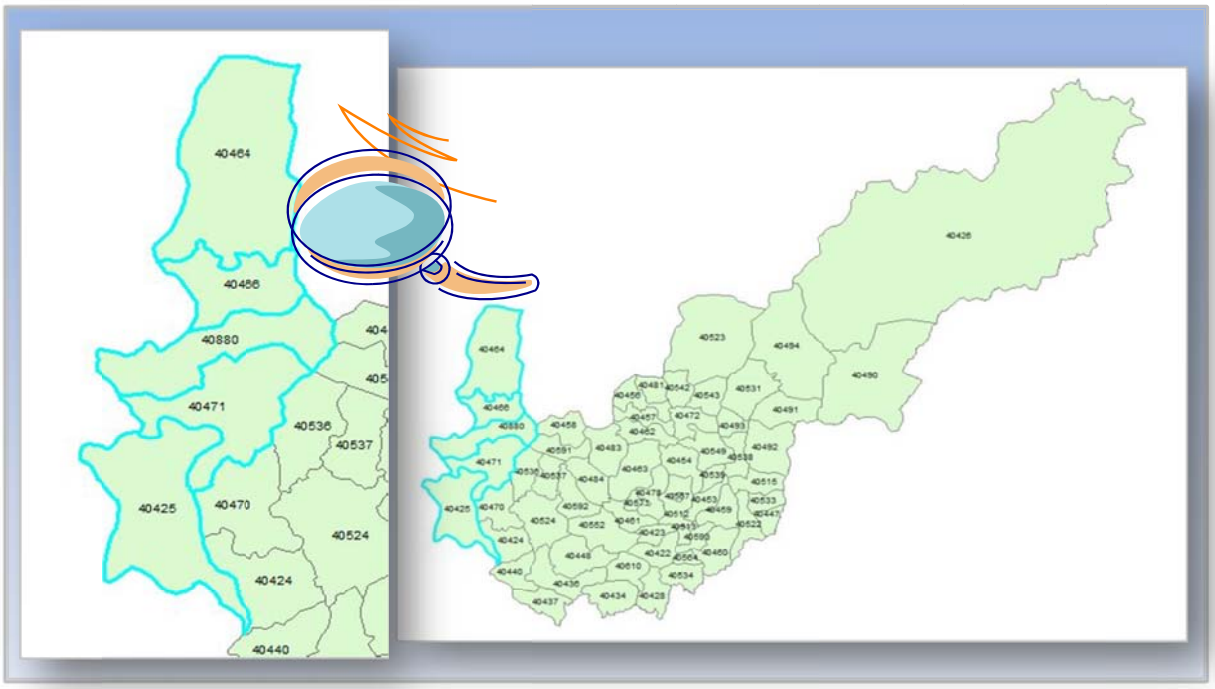

Figure 4: Map sections showing the code-labeled Union Councils (UC) of Mansehra & Torghar Districts (on the left side: enlarged view of Torghar UC's); the Union Councils (= Sections) used for REA of Torghar District are additionally highlighted in turquoise.

A further issue influencing the administrative structure (and related codes) of the District of Mansehra raised from the fact that population figures (PBS 2000) for the Union Council of Mansehra City-4 (UC) (inside Tehsil Mansehra: UN-OCHA code 1353) were quantified with 'zero (0)'.
However, since area-wide population figures for the administrative level to be considered are essential for assessing the population exposure, following assumption was made: based on spatial merging of areas and boundaries of all *four Mansehra City Union Councils* the corresponding population figures were summed up to one total population figure representing the virtually unified *Mansehra City (1-4) Union Council (UC)*. This merged Union Council was coded with '40422' (former code of Mansehra City-1 UC) and edited (attributed) resulting in a total population figure of 49534 people.

Due to this necessary procedure the number of Union Councils has been diminished by three (from 64 to 61). Table 4 recapitulates the administrative readjustments of the Mansehra City Union Councils. Figure 5 visualizes this issue.

District/ UN-OCHA Code	Tehsil/ UN-OCHA Code	Union Councils (UC)/ UN-OCHA Codes **Before** Spatial Readjustment		Union Council (UC)/ Used REA Code (Virtual) **After** Spatial Readjustment	
		Name *Population (PBS, 2000)*	UN-OCHA Code	Name *Population*	Used REA Code
Mansehra 135	Mansehra 1353	Mansehra City-1 UC *16956*	40422	Mansehra City (1-4) UC *49534*	40422
		Mansehra City-2 UC *12731*	40565		
		Mansehra City-3 UC *19847*	40443		
		Mansehra City-4 UC *0*	40611		

Table 4: Spatial and code-related readjustment of previously four different Mansehra-City Union Councils merged to a single (virtual) Mansehra City (1-4) Union Council applied for REA purposes.

Table 5 outlines the number of relevant administrative units after the necessary readjustments of the relevant geospatial files (see also Chapter 3.2). Additionally, Attachment 1 pools all code-related administrative information in detail that has been employed to perform the risk exposure assessment for the Districts of Mansehra & Torghar.

Figure 5: Visualization of spatial and code-related readjustment of previously four different Mansehra-City Union Councils (left; turquoise highlighted) merged to a single (virtual) Mansehra City (1-4) Union Council (right; turquoise highlighted); see also Figure 4 to identify the location of Mansehra City (1-4) Union Council (UN-OCHA code: 40422) within Mansehra District.

Number of Administrative Units Applied for REA of Mansehra & Torghar Districts			
Province	District(s)	Tehsil(s)	Union Councils
1	2 (1+1)	4 (3+1)	61

Table 5: General overview of administrative units relevant for the REA of Mansehra & Torghar Districts (see also Attachment 1 containing administrative information in depth).

Land Cover (and Derived Settlement Areas)

Land cover is a key factor, which significantly influences a region to be differently prone to landslides. Hence, to qualitatively ameliorate a regional landslide susceptibility assessment, information about the factor (or parameter) 'land cover' is very valuable.

Due to the lack of resilient land cover information for the Districts of Mansehra & Torghar the GANP project made considerable efforts to survey the land cover of this area for the first time ever.

This survey is based on remote sensing information and methods applying a combination of unsupervised classification, decision rules, and visual interpretation. The preliminary outcomes were validated by a ground check and finally adjusted. All necessary technical steps to elaborate the 'Land Cover Map 1: 200.000 – reduced to print scale of 1: 300.000[3]' (Figure 6) were systematically discussed by FUCHS & KHALID (2015). The subsequent regional landslide susceptibility assessment for the Districts of

[3] The scale validity can be estimated to 1: 200.000. The land cover map is plotted on a scale of 1: 300.000.

Mansehra & Torghar and the resulting 'Landslide Susceptibility Map of Mansehra and Torghar Districts, 1: 200.000' (GSP 2015) has comprehensively taken into account this invaluable 'land cover' data set (see Chapter 3.1.2).

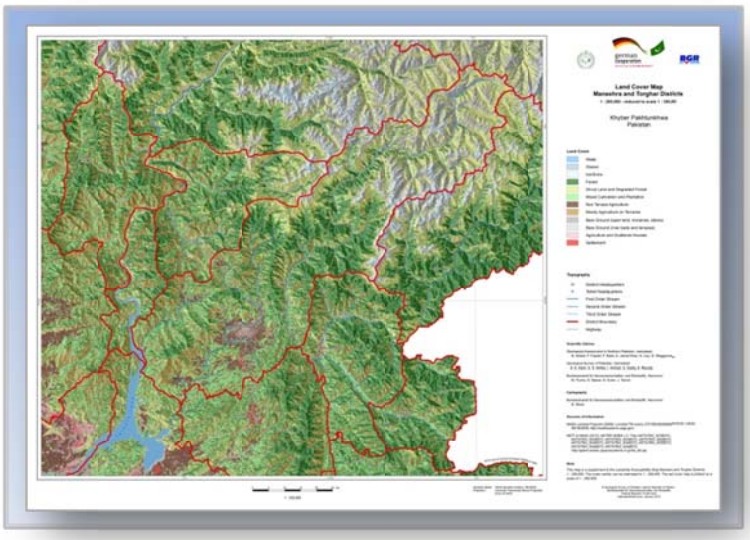

Figure 6: 'Land Cover Map Mansehra and Torghar Districts' (draft) after FUCHS & KHALID (2015); in print.

However, this district-wide land cover information layer is also of utmost importance for the risk exposure assessment of Mansehra & Torghar Districts. Basically, land cover information may contain numerous geospatially related vulnerability information or indications, such as populated areas or different kinds of economic activities. According to the performed land cover survey twelve land cover classes have been distinguished (Table 6). A full description of these land cover classes is delivered by FUCHS & KHALID (2015).

Land Cover Classes According to FUCHS & KHALID (2015)	Assigned GRASP Codes
Water	4300101
Glacier	4300102
Ice/Snow	4300103
Forest	4300104
Shrub land and degraded forest	4300105
Mixed cultivation and plantation	4300106
Non terraced agriculture	4300107
Mostly agriculture on terraces	4300108 (see Table 7)
Bare ground (open land, moraines and debris)	4300109
Bare ground (river beds and terraces)	4300110
Agriculture and scattered houses	4300111 (see Table 7)
Settlement	4300112 (see Table 7)

Table 6: Land cover classes for the Districts of Mansehra & Torghar according to FUCHS & KHALID (2015) and assigned GRASP codes. The orange highlighted land cover classes & codes are of relevance for the assessment of the population risk exposure to zones of different landslide susceptibility (see also Table 7 and Attachment 14, Part 2 & 3).

Regarding the risk exposure assessment of Mansehra & Torghar Districts those land cover classes are of particular benefit, which offer valuable clues to the spatial size and distribution of settled/populated areas. According to FUCHS & KHALID (2015) three distinct land cover classes fulfil these demands (see Table 6):

A) Land cover class 'Mostly agriculture on terraces':

This class is featured by settlements and agricultural activities on valley terraces.

B) Land cover class 'Agriculture and scattered houses':

This class comprises a higher density of village structures with preferred agricultural activities in the immediate surroundings.

C) Land cover class 'Settlement':

This class represents typical settlement areas in Pakistan (rural/countryside and urban).

According to the population dataset (PBS 2000), population figures of villages (Mouzas) und urban areas inside the different Union Councils vary considerably from several hundred up to 10.000 people. Figure 7 clearly exemplifies these three land cover classes.

Figure 7: Settlement of Banda Balola in the Kuhnar river valley, view to the north;

(Source: M. FUCHS, taken 2013; extracted from FUCHS & KHALID 2015).

Due to the need of applying vector data for exposure assessment purposes, the raster data based land cover layer was converted into a vector layer. Based on this, all geospatial objects related to

these particular land cover classes have been selected and stored separately as discrete datasets featured by their shape length and perimeter (Figure 8; see also Chapter 3.2).

Since a further distinction of these settlement-related land cover classes is not required, all geospatial objects, called 'settlement areas' were assigned to the theme group 'infrastructure' and coded accordingly (GRASP code: 5320101) (Table 7 and Attachment 14, Part 2 & 3). The automatic allocation of all settlement areas to the respective Union Councils has been achieved by GIS procedures (see Chapter 3.3, Figure 16 and Attachment 3/Table 1).

Settlement/Population Related Land Cover Classes According to FUCHS & KHALID (2015)		Assigned GRASP Code
Land Cover Class	REA GRASP Terminology	
Mostly agriculture on terraces	Settlement areas	5320101
Agriculture and scattered houses		
Settlement		

Table 7: Overview of population related land cover classes and assigned GRASP code applied for the population exposure assessment of Mansehra & Torghar Districts (see also Attachment 14, Part 2 & 3).

In compliance with the REA concept the derived information about the size and distribution of settled (populated) areas can be versatility used for any single or multi-hazard population exposure assessment in the future.

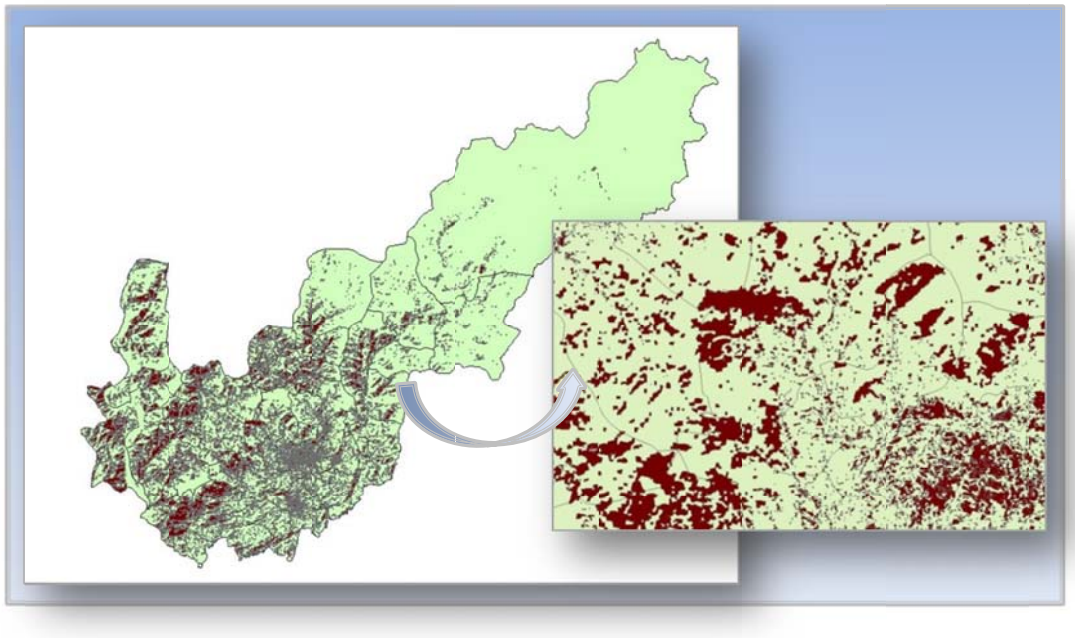

Figure 8: Distribution of geospatial land cover objects 'settlement areas' based on selected land cover classes relevant for the population exposure assessment of Mansehra & Torghar Districts (left; compare Table 7); on the right: enlarged map section view from the central part of Mansehra District showing exemplarily the distribution of 'settlement areas'.

Demographic Information

Demographic information is essential for any population exposure assessment independent from the hazard(s) to be contemplated. In accordance to the chosen spatial (administrative) assignment population figures of the corresponding Union Councils are essential for a REA of Mansehra & Torghar Districts.

At PBS web site population census information from 1951 until 1998 are legitimately available for the administrative level 1-4. In contrast, level 5 (Union Council) population figures for Mansehra & Torghar Districts have not yet been published. The used UC census-like information was provided by PBS (status: year 1998) for GANP project on request (PBS 2000). As already mentioned, the GANP project cannot warrant or guarantee for the accuracy of this UC population numbers.

This population information is required to be able to calculate both the regular and the corrected population density for the Union Councils inside Mansehra & Torghar Districts (see Chapter 3.1.3). Attachment 3 (Table 1 and Population Density Map/3A and Corrected Population Density Map/3B) summarizes/visualizes Union Council's population and associated population density figures.

3.1.2 Hazard Information

For Mansehra & Torghar Districts hazard-related information meeting the requirements of full spatial coverage of respective administrative units and sufficient resolution (scale) are restricted to the 'hazard' landslide.

Owing to this limitation only a single hazard approach may currently be pursued (see Chapter 2, subtopic '*REA Scenario Based Approach'*). The availability of any additional spatial related hazard information (e.g. flooding) fulfilling the aforementioned constraints would thereby open up a multi-hazard exposure assessment as well.

It should be noted that due to the lack of temporal probability information in case of landslides the 'susceptibility' as the relative spatial likelihood for the occurrence of landslides of a particular type and volume (v. WESTEN et al. 1997) has been adopted.

The single hazard related REA procedure could only be initially accomplished through the effort of the GANP project to assess the regional landslide susceptibility for both Districts. The elaborated 'Landslide Susceptibility Map for Mansehra & Torghar Districts, 1: 200.000' (GSP 2015) (Figure 9) is based on a bivariate-statistical analysis taking into account following five independent parameters (factors): lithology, land cover, slope angle, slope curvature, and distance to faults.

Resulting from the assessment five zones of different spatial (regional) susceptibility can be distinguished:

- Very High;
- High;
- Moderate;
- Low;
- Very Low.

All individual steps to facilitate the analysis as well as a thorough description of the defined susceptibility zones are carefully delineated in the corresponding map annotation report (GSP 2015).

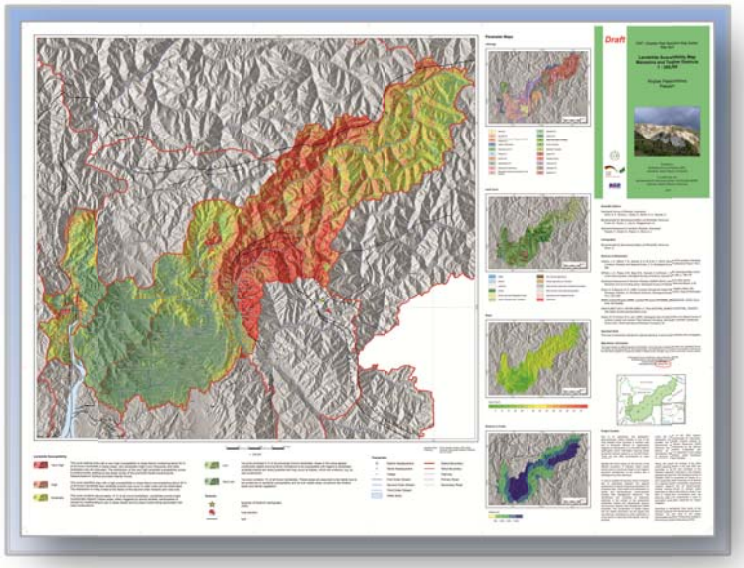

Figure 9: 'Landslide Susceptibility Map of Mansehra and Torghar Districts 1: 200.000' (draft) after GSP (2015); in print.

For subsequent REA purposes the raster-based landslide susceptibility information was converted into vector files and coded in accordance to the GRASP coding schema (Table 8 and Attachment 14, Part 5).

Landslide Susceptibility Zones of Mansehra & Torghar Districts (GSP 2015)	Assigned GRASP Code
Very High	6300101
High	6300102
Moderate	6300103
Low	6300104
Very Low	6300105

Table 8: Landslide susceptibility zones assigned to the Districts of Mansehra & Torghar according to GSP (2015) and allocated GRASP codes (see Attachment 14, Part 5).

3.1.3 Elements at Risk (EaR)/Vulnerability Related Information

Three types of EaR/Vulnerability related information has been implemented for the REA procedure of Mansehra & Torghar Districts:

A) Road network;

B) Health facilities;

C) Corrected population density.

The thematic information A and B represents both topographic and critical infrastructure elements. Once again, GANP project is neither able to assess the accuracy nor the completeness of this EaR-related information.

Further reliable EaR related information, such as schools, mosques/prayer houses, bridges or power supply lines covering both Districts is currently not available/accessible for GANP project (see Chapter 2).

A) GANP has currently no access to road network related information published by any Pakistan authority. For this reason, an Open Street Map (OSM) line feature dataset of GEOFABRIK (2014) was incorporated. Due to the larger spatial extent of this downloaded dataset, the road network information had to be clipped pursuant to the 'biscuit cutter' of Mansehra & Torghar District's borderlines.

The resulting geospatial objects represent two types of roads for the Districts of Mansehra & Torghar (Table 9; Figure 10 & 11; Attachment 2A: Road Type Inventory Map; Attachment 14, Part 1):

- 1. Order: Roads of national importance (e.g. N35: Karakoram Highway);
- 2. Order: Roads of sub-national or regional importance (e.g. Siran Valley Road).

Types of Roads Within Mansehra & Torghar Districts (GEOFABRIK 2014)	Assigned GRASP Code
1. Order (National Importance)	1300102
2. Order (Sub-National/Regional Importance)	1300101

Table 9: Types of roads within the Districts of Mansehra & Torghar and assigned GRASP codes (see also Attachment 2A and Attachment 14, Part 1).

Figure 10 illustrates two examples of 2. Order road type.

Figure 10: Examples of 2. Order road type: Kaghan valley near Paras (left) and close to Bala Kot (right); (Source: D. WEGGENMANN, taken 2013).

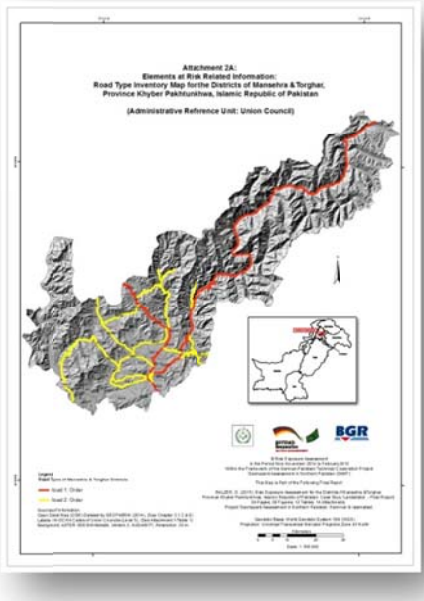

Figure 11: Thumbnail image of 'Road Type Inventory Map' of Mansehra & Torghar Districts (Note: image not drawn to scale; see Attachment 2A).

B) Pertaining health facilities a Mansehra & Torghar District dataset[4] from the Health Management Information System (HMIS) submitted by the Pakistan National Institute of Health (NIH 2011) has been integrated. This point feature dataset separates three categories of health facilities:

- Civil Hospital (CH);
- Rural Health Unit (RHU);
- Basic Health Unit (BHU).

[4] It is assumed that the NIH (2011) dataset was established prior to the administrative reform on January 2011 and therefore this dataset also contains information about health facilities with regard to the present Torghar District.

Caused by an obviously incorrect spatial assignment of some health facilities this dataset was cross-checked by up-to-date information (without any coordinates) delivered by the HEALTH DEPARTMENT OF MANSEHRA DISTRICT (HDMD 2015) and supplemented by GANP Google Earth studies.

In addition to the NHI (2011) dataset the final REA dataset contains a further category of hospitals that has been tagged as 'Special Hospitals (SH)'. This (unofficial) category encompasses the *King Abdullah Teaching Hospital* located in Tehsil Mansehra (UN-OCHA code: 1353) and the *Tehsil Headquarter Hospital* of Tehsil Bala Kot (UN-OCHA code: 1351).

Due to the lack of reliable geospatial information 11 health facilities could not be georeferenced and were therefore neglected from the *current* REA procedure. 'Civil Dispensaries' were excluded from the assessment. In total, 57 health facilities were subjected to the REA (Figure 12; Table 10; Attachment 2B/Table 1-2; Attachment 14, Part 3).

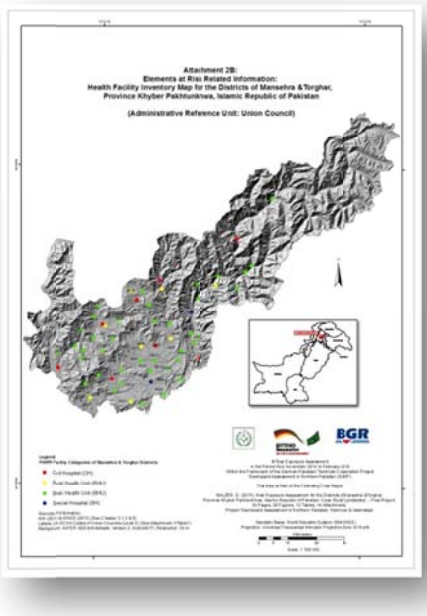

Figure 12: Thumbnail image of 'Health Facility Inventory Map' of Mansehra & Torghar Districts (Note: image not drawn to scale; see Attachment 2B).

Categories of Health Facilities of Mansehra & Torghar Districts according to NIH (2011) and HDMD (2015)		
Categories	Number of Health Facilities Applied for REA	Assigned GRASP Code
Civil Hospital (CH)	8	5310101
Rural Health Unit (RHU)	8	5310102
Basic Health Unit (BHU)	39	5310103
Special Hospital (SH)	2	5310104

Table 10: Features of health facilities within the Districts of Mansehra & Torghar according to NIH (2011) and HDMD (2015), supplemented by GANP Google Earth© studies and assigned GRASP codes (see also Attachment 2B; Attachment 14, Part 3).

Regrettably, a standard definition of these different types of health facilities is not officially provided. According to their geographical position it is assumed that 'Civil Hospitals (and Special Hospitals)' are mostly situated in urban areas rendering (probably) full medical service. 'Rural Health Units' obviously serve as a regional drop-in center located in the countryside. The majority of health facilities are 'Basic Health Units', which are spread over the whole district (s) and possibly related to selected village structures (Mouzas) exclusively. BHU's and RHU's possibly perform basic health care. Figure 13 illustrates an example of a Basic Health Unit in Bala Kot UC after the 2010 flood reconstruction by the NGO 'International Brotherhood Organization (IBO)' in the year 2011.

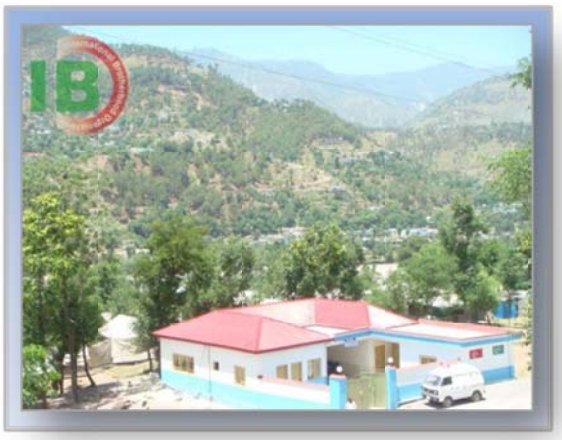

Figure 13: Basic Health Unit of Bala Kot UC, District Mansehra (Source: **http://ibo.org.tr/bhu/**).

C) The determination of the so-called corrected population density is of highest significance for the population exposure assessment.

In contrast to the regular population density of any Union Council expressed as (see upper box):

$$\frac{\text{Total Population Union Council (People)}}{\text{Total Area Union Council (km}^2\text{)}} = \text{People/km}^2\text{ (Union Council)}$$

the calculation of the corrected population density represents the density of people living in surveyed settlement areas inside the respective Union Council. Consequently, the corrected population density of a Union Council must be much higher in contrast to the regular population density. That is because the sum of settlement areas is significantly lesser in comparison to the total area of a Union Council. The corrected population density for a given Union Council can be calculated as (see lower box):

$$\frac{\text{Total Population Union Council (People)}}{\text{Total Settlement Areas Union Council (km}^2\text{)}} = \text{People/km}^2\text{ (Union Council)}$$

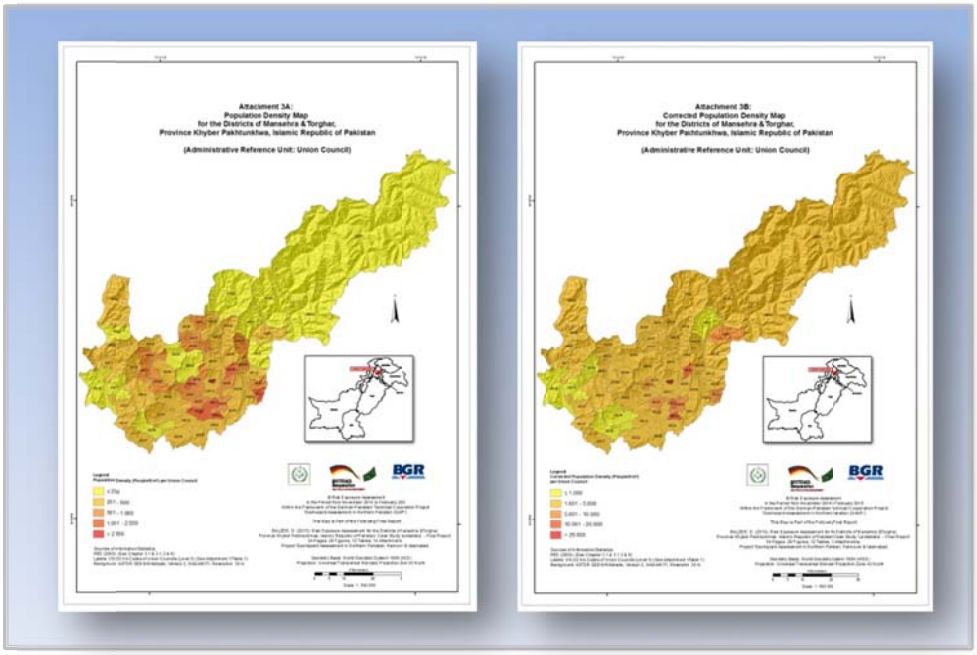

Figure 14: Thumbnail images of 'Population Density Map' (left) and 'Corrected Population Density Map' (right) of Mansehra & Torghar Districts (Note: images not drawn to scale; see Attachment 3A & 3B).

The corrected population density is a direct measure for a community's vulnerability. By joining this specific information with spatial landslide hazard (susceptibility) zoning information the total number of people exposed in a given Union Council can be finally estimated (see Chapter 3.5.1).

Attachment 3/Table 1 indicates both the regular and the corrected population density figures as well the corresponding calculation bases (total population, total area UC's and total settlement area of UC's) for the considered Union Councils. Additionally, the population density and the corrected population density have been mapped (Figure 14 and Attachment 3A: Population Density Map & Attachment 3B: Corrected Population Density Map).

3.2 REA GRASP Geodatabase: Data Repository

The GRASP geodatabase (format by ESRI©), called 'georisk' is the master data repository that contains all geospatial objects related to the risk exposure assessment (baseline, hazard, elements at risk/vulnerability) of Mansehra & Torghar Districts. This geodatabase is supplemented by a coding database (called 'look_up') to manage the code-based attributes of the respective geospatial objects. All necessary items delineating technical-, code-, and syntax-related issues regarding these databases are being specified in BALZER (2011: 18ff).

According to the GRASP concept the 'georisk' database is structured into feature datasets and feature classes.

Feature datasets act as thematic file folders encompassing corresponding (subordinated) feature classes representing thematic layers. Additionally, some so-called stand-alone tables have been included that contain attributive information like health facility names or population figures. Table 11 shows all defined feature datasets and corresponding feature classes by now (status: February 2015). The geodetic basis of all integrated geospatial information stored in feature datasets/classes is the World Geodetic System 1984 (WGS) while the Universal Transversal Mercator Zone 43N Projection is applied.

Structure of GRASP Geodatabase Status: February 2015		
Description (Plain Text)	Name Feature Dataset	Name Feature Class
Administrative boundaries: Country	general_items	fc_pak_admin_level_1_country
Administrative boundaries: Provinces		fc_pak_admin_level_2_provinces
Administrative boundaries: Districts		fc_pak_admin_level_3_districts
Administrative boundaries: Tehsils		fc_pak_admin_level_4_tehsils
Administrative boundaries: Union Councils		fc_pak_admin_level_4_5_tehsils_uc_Mansehra (contains all codes of level 2-5 of KPK/Mansehra)
Topographic items	topography_1000	fc_roads_1300
Hydrological items	hydrology_2000*	-
Geoscientific items	geosciences_3000*	-
Land use (land cover) items	landuse_4000	fc_landuse_4300
Infrastructure items	infrastructure_5000	fc_health_stations_5310
		fc_settlement_areas_5320
Landslide hazard items (susceptibility)	landslide_6000	fc_landslides_6300
Seismic hazard items	seismic_hazard_7000*	-
Inundation hazard items	inundation_hazard_8000*	-

Table 11: Overview of all feature datasets and feature classes (fc) of the GRASP geodatabase (status: February 2015); * No information entry yet, therefore GRASP coding schema not applied.

3.3 REA Data Processing

The data processing to estimate the risk exposure is an iterative procedure combining GIS and database functionalities comprehensively. Based on the resulting assessment, the findings can be provided as maps or as statistical statements (see Chapter 3.5).

Regarding the REA procedure of Mansehra & Torghar Districts, following two types of assessments have been executed:

A) Population exposure to a single;
B) Infrastructure exposure to a single hazard (both line & point geometry).

A) This procedure is based on the linkage of the corrected population density (see Chapter 3.1.3: subtopic C) with spatial hazard information (zonation). This is achieved by multiplying the corrected population density (people/km²) with the area size of settlement areas (km²) that overlaps with one or more particular hazard zone(s). The result is the number of people living in or exposed to this zone (or these zones) inside the administrative unit to be considered. Figure 15 elucidates yet this conceptual idea graphically.

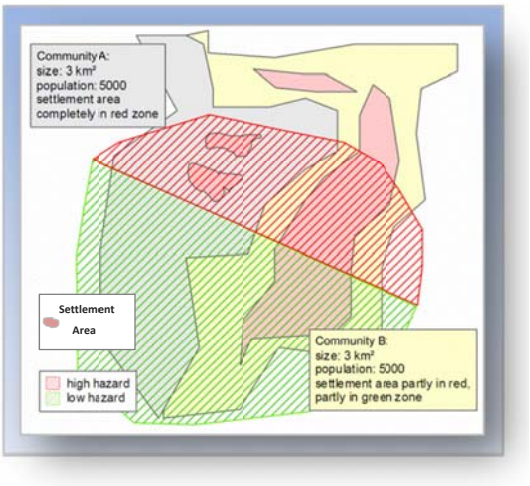

Figure 15: Illustration of the conceptual approach of population exposure assessment: single hazard; figure taken from BALZER et al. (2010). Remark: 'Community' can be replaced by any other administrative unit, e.g. Union Council.

Figure 16 summarizes the applied workflow to assess the population exposure to landslide susceptibility zones in the Districts of Mansehra & Torghar.

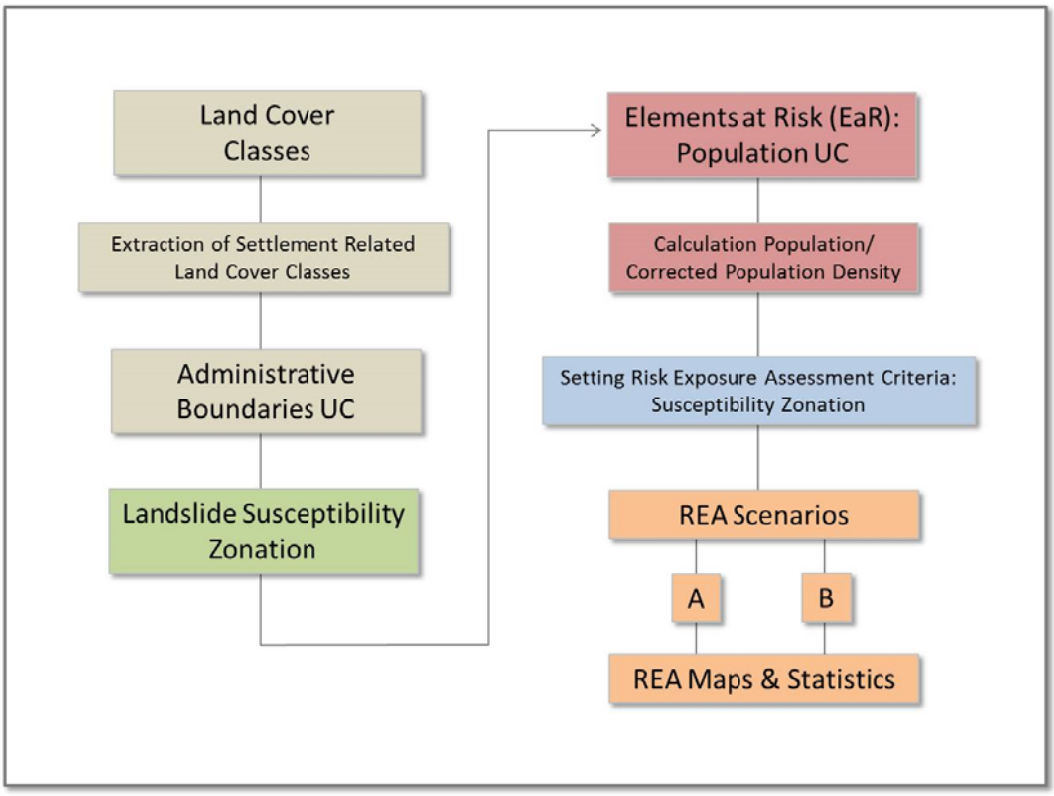

Figure 16: Simplified workflow to assess the population exposure to landslide susceptibility zones in the Districts of Mansehra & Torghar; UC = Union Council; EaR = Element(s) at risk; Explanation of REA Scenarios A and B see Chapter 3.4.

B) This procedure rests upon the linkage of relevant infrastructure elements at risk in relation to spatial hazard information (zonation). The overlap of a specific element at risk is measured (e.g. length of exposed roads) or counted (e.g. number of health facilities or schools exposed). The degree of exposure is being displayed for the respective administrative unit in the aggregate. Figure 17 portrays yet this concept.

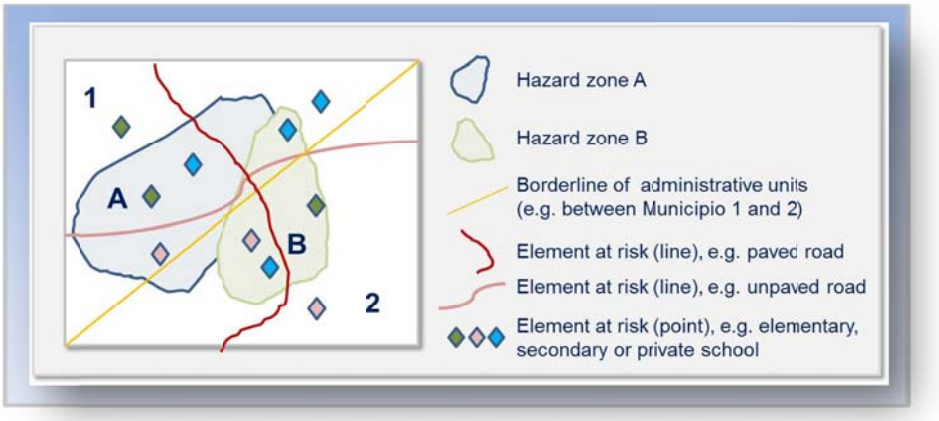

Figure 17: Illustration of the conceptual approach of infrastructure (facilities) exposure assessment: single hazard; figure taken from BALZER & KUHN (2013 & 2014). Remark: 'Municipio' can be substituted by any other administrative unit, e.g. Union Council.

Figure 18 displays the workflow applied to estimate the risk exposure of infrastructure elements (roads and health facilities).

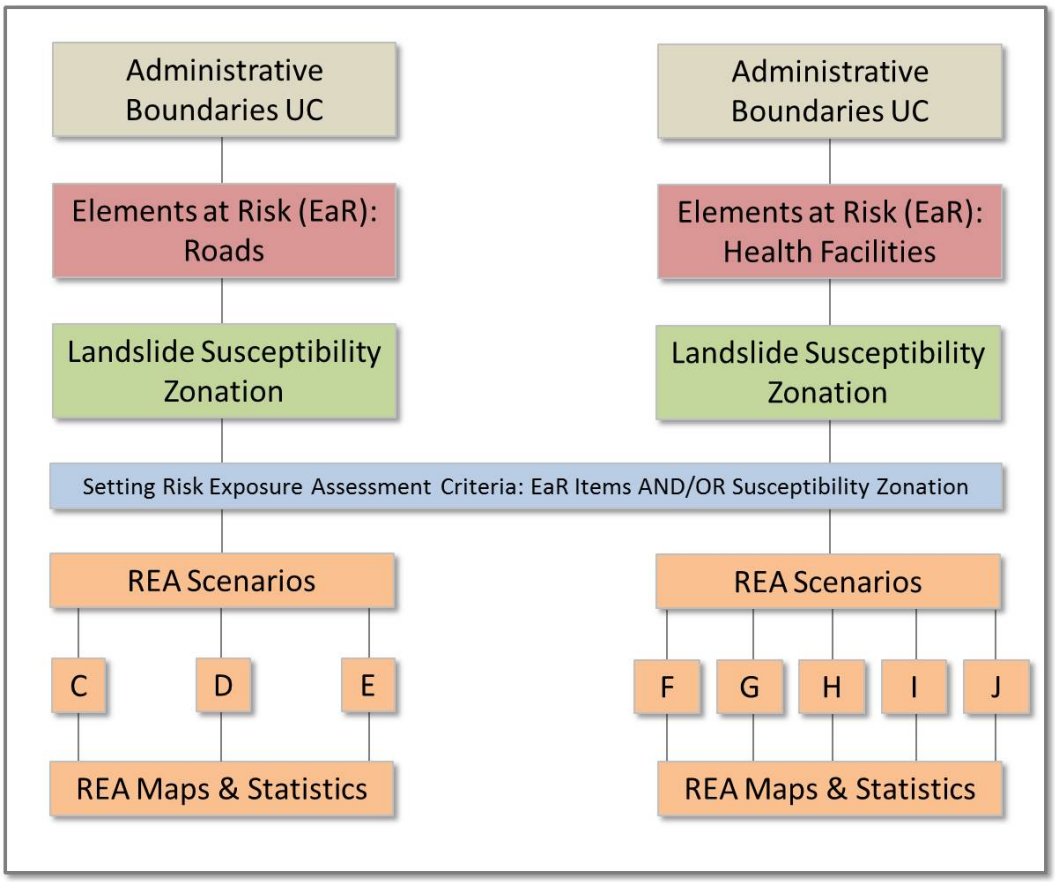

Figure 18: Simplified workflow to assess the infrastructure exposure of selected EaR to landslide susceptibility zones in the Districts of Mansehra & Torghar; UC = Union Council; EaR = Element(s) at risk; Explanation of REA Scenarios C-E and F-J see Chapter 3.4.

3.4 REA Scenarios: Definition

In Chapter 2 (sub-topic *'REA Scenario Based Approach'*) the motivation to perform a scenario-based REA approach has already been discussed. It is worth mentioning again that the pool of chosen REA scenarios may be extended on demand (customer-focused).

Taking into account all presented information, following REA scenarios for the Districts of Mansehra & Torghar have initially been studied:

Population Exposure Assessment

A) Population exposure to landslide susceptibility zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low';
B) Population exposure to landslide susceptibility zones 'Very High' and 'High'.

Infrastructure Exposure Assessment I 'Roads'

C) Road (undifferentiated) exposure to landslide susceptibility zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low';
D) Road (1. Order) exposure to landslide susceptibility zones 'Very High' and 'High';
E) Road (2. Order) exposure to landslide susceptibility zones 'Very High' and 'High'.

Infrastructure Exposure Assessment II 'Health Facilities'

F) Health facility (undifferentiated) exposure to landslide susceptibility zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low';
G) Health facility (undifferentiated) exposure to zones 'Very High' and 'High';
H) Health facility (Civil Hospital & Special Hospital) exposure to zones of landslide susceptibility 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low';
I) Health facility (Rural Health Unit) exposure to zones of landslide susceptibility 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low';
J) Health facility (Basic Health Units) exposure to zones of landslide susceptibility 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'.

The REA outcomes for the Districts of Mansehra & Torghar will be presented and discussed in chapter 3.5 and related attachments 4-13 offering risk exposure choropleth maps, related statistic overviews and explanatory remarks.

3.5 REA Scenario Findings: Visualization, Statistical Facts, and Discussion

Introductory remarks:

- It should be noted, that each risk exposure map representing one scenario will appear inside the text as a thumbnail image (figure) that is not drawn to scale. It is derived from the respective 1: 500.000 scale map as shown in the Attachment 4-13. The risk exposure map at a scale 1: 500.000 results from the adjustment to the standard A3-sized paper of the final map printout and can be adapted flexibly/needs-oriented.
- Legend related risk exposure classes like 'Very High', 'High' or 'Low' have not been adopted because of the lack of officially predefined/published class breaks (thresholds) for Pakistan.
- Due to the large span among the estimated population exposure values the corresponding exposure map legend classes were modelled as a five-tier approach applying absolute values (mapping of relative values is possible at any time!).
- Pertaining to the road exposure the relevant map legend classes have also been structured using a five-tier style.
- The map legends broaching the issue of risk exposure of health facilities are represented by one-, two-, and three-tier classes.
- In all cases a color ramp from 'yellow' (means lower exposure) to 'red' (means higher exposure) was chosen. In several cases Union Councils are color-coded 'white/gray'. Such administrative units are either not exposed to the particular selected landslide susceptibility zone(s) or the considered elements at risk (population/road/health facility) are not allocable. The latter may also be caused by the limitation of the resolution of source information like satellite images to be used to survey relevant features, such as land cover.
- All mapped Union Councils are labeled with the respective UN-OCHA code.
- It has been deliberately avoided to add any geographic items on the different exposure maps. This is not common on choropleth maps!
- The only exception from this rule: each risk exposure map shows a hillshade of ASTER GDEM, Version 2 provided by NASA/MITI with 30 m resolution in the background.
- For reasons of clarity all attached maps can be removed individually.
- At the end of selected scenario statements some basic suggestions in terms of possible mitigation measures with special emphasis of possible hazard assessment activities by GSP are proposed. However, these recommendations do not claim to be exhaustive. A capacious judgment of the REA findings ought to involve relevant target groups (see Chapter 4).

3.5.1 Assessment of Population Exposure

Scenario A (see Figure 19 and Attachment 4: Risk Exposure Map and Tables 1-3):
Population exposure to zones of landslide susceptibility 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'.

The risk exposure map and related statistics indicate that about 100% of district's and consequentially of the Union Council's population is exposed to any landslide susceptibility zone (Attachment 4/Table 1). Thus, all 61 Union Councils are at threat to a varying extent. This is due to the fact that the landslide susceptibility has been determined for the total area of both districts.

The 2 Union Councils with the maximum exposure figures are Bassi Khel UC (Torghar District; UN-OCHA code: 40646) with approximately 75.000 people and Mansehra City (1-4) (UN-OCHA code: 40422) with roughly 49.500 people, respectively. It is striking to note that 4 of the 5 Union Councils (= Sections) of the Torghar District are among those with the peak population exposure figures of the entire region (Figure 19).

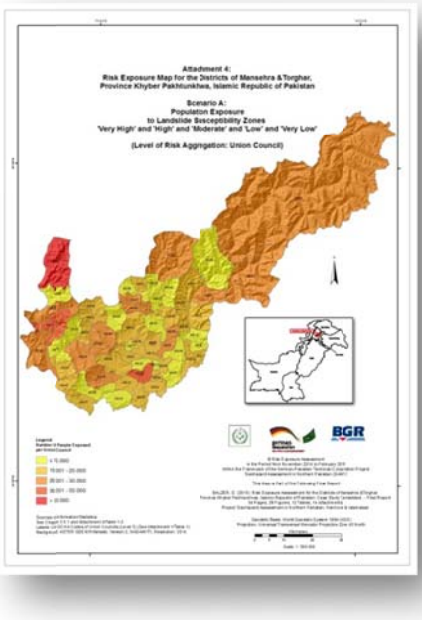

Figure 19: Thumbnail image of Risk Exposure Map, Scenario A (Note: image not drawn to scale; see Attachment 4).

The lowest population exposure values are recorded for the Union Councils Malik Pur UC (UN-OCHA code: 40571) with around 12.300 people and Nusrat Khel UC (Torghar District; UN-OCHA code: 40466) with nearly 11.000 people.

However, in the assessment context the significance of these undifferentiated exposure figures is limited. For that reason, the summarized exposure values have been discriminated with regard to the different landslide susceptibility zones. These figures specify much more sensitive the exposure values in relation to each susceptibility zone and facilitates the identification of critical Union Council

exposure hot spots (= densely populated Union Councils situated in highly or very highly susceptible areas).

Attachment 4/Table 2 (absolute number of people exposed) and Table 3 (relative number of people exposed in %) illustrate the distribution of exposed people to the different landslide susceptibility zones. The sensitive effect is immediately apparent having in mind the 2 Union Councils Bassi Khel UC (UN-OCHA code: 40646) and Mansehra City (1-4) UC ('UN-OCHA code': 40422).

These 2 Union Councils have been surveyed as those with the highest exposure rate in case of an undifferentiated approach (see Attachment 4/Table 1). The differentiation has revealed a comparable share of population exposure of Bassi Khel UC to the susceptibility zones 'Low' (almost 34.000 people/45%) and 'Very Low' (nearly 31.000 people/41%) and a minor share of the population is exposed to the susceptibility zone 'Moderate' (roughly 9.000 people/12%). The sum of people exposed to the susceptibility zones 'High' and 'Very High' is negligible (< 1.000 people/1,0%).

The assessment of Union Council Mansehra City (1-4) UC indicates that the vast majority of the population of this urban area is predominantly exposed to the susceptibility zones 'Very Low' (49.000 people/99%) and 'Low' (< 200 people/0,4%). Therefore, both Union Councils can be appraised as non-critical, although the total sum of exposed people is 100%. The really critical exposure hot spots will be illuminated in scenario B.

Scenario B (see Figure 20 and Attachment 5: Risk Exposure Map and Table 1):
Population exposure to landslide susceptibility zones 'Very High' and 'High'.

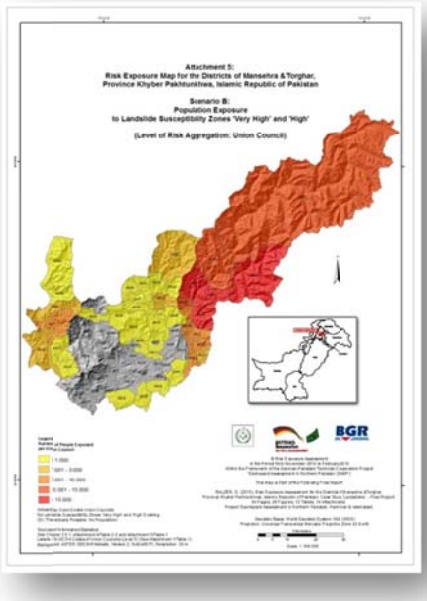

Figure 20: Thumbnail image of Risk Exposure Map, Scenario B (Note: image not drawn to scale; see Attachment 5).

Scenario B was implemented to identify and to map the population exposure per Union Council to the landslide susceptibility zones 'High' and 'Very High'.

The assessment has unveiled that in total 38 of 61 Union Councils meet this constraint (see Attachment 5/Table 1). But it also means that 23 Union Councils indicate no population exposure to at least one of these most critical susceptibility zones. The highest exposure rates (sum of 'High' and 'Very High' exposure figures; see also Attachment 4/Table 2) range between 16.000 and 17.000 people (4 Union Councils; see also Attachment 5/Table 1). The Union Council with the peak exposure figure is Garlat UC (UN-OCHA code: 40492) with around 17.000 people, followed by Hangrai UC (UN-OCHA code: 40531), Mohandri UC (UN-OCHA code: 40490), and Ghanool UC (UN-OCHA code: 40491) each with more than 16.000 people exposed. However, it is very clear that all mentioned Union Councils are situated in the tectonically characterized Hazara-Kashmir Syntaxis. According to this exposure figures, these 4 Union Councils stand out on the risk exposure map as red color-coded (see Figure 20 and Attachment 5: Risk Exposure Map, Scenario B).
These 'hot spots' are surrounded both to the north (Union Councils: Kaghan/UN-OCHA code: 40426, and Kawai/UN-OCHA code: 40494) and to the south-east (Union Councils: Sat Bani/UN-OCHA code: 40493) by Union Councils with exposure values corresponding to the selected susceptibility zones between higher than 10.000 and less than 12.000 people. The remaining Union Councils are featured by exposure rates stretching from less than 1.000 to less than 10.000 people.

In conclusion of the scenario A and B assessment findings it is evident that the level of population risk exposure varies substantially district-wide. For that reason it is recommended to pay particular attention to the Union Council 'hot spots' (see Attachment 5/Table 1). Initially, this can be tackled by a priority GSP landslide survey program (inventory) as a major step to identify and to estimate the current site specific slope instability potential. Subsequently, these results should be commonly discussed with District and/or Province DRM stakeholders to streamline ongoing structural/non-structural mitigation measures. This should also include the selection and specification of most critical slope sites that are supposed to be monitored regularly.

3.5.2 Assessment of Infrastructure Exposure

Infrastructure Exposure Assessment I 'Roads'

Scenario C (see Figure 21 and Attachment 6: Risk Exposure Map and Table 1-2):
Road (undifferentiated) exposure to landslide susceptibility zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'.

The risk exposure map and corresponding statistics reveal that the exposure of roads of 1. & 2. Order to any landslide susceptibility zone is restricted to 52 of 61 Union Councils (Attachment 6/Table 1). Conversely, this means that 9 Union Councils are obviously not crossed by these types of roads. Noticeable is the complete absence of 1. & 2. Order roads inside District Torghar.

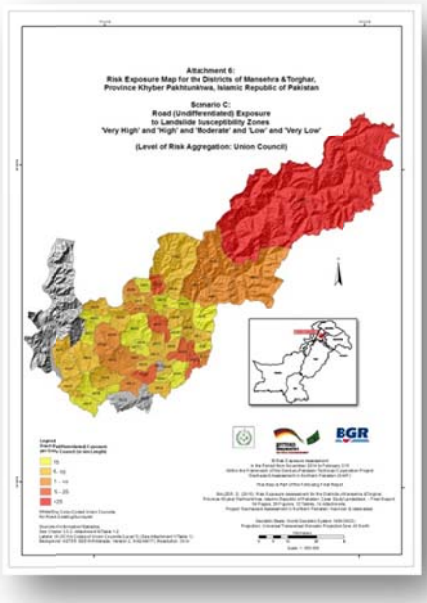

Figure 21: Thumbnail image of Risk Exposure Map, Scenario C (Note: image not drawn to scale; see Attachment 6).

A rational reason for the absence could be that all concerned Union Councils are only traversed by roads of lower order (e.g. seasonal/unpaved roads). Another possible explanation might be an incomplete survey of roads of 1. & 2. Order (incomplete road dataset).

The Union Council with the maximum road exposure is Kaghan UC (UN-OCHA code: 40426) with a total length of 103 km. The discrimination of Union Council related road exposure to the different landslide susceptibility zones offers further possibilities of a sensitive interpretation (Attachment 6/Table 2).

In case of Kaghan UC (UN-OCHA code: 40426) the distribution is marked by almost equal sharing of road exposure between the susceptibility zones 'Very High'/'High', 'Moderate' and 'Low/Very Low' (Table 12).

Roads Exposure (km-Length) to Landslide Susceptibility Zones: Example Kaghan UC (UN-OCHA Code: 40426)				
Very High	High	Moderate	Low	Very Low
9,4	20,4	29,7	27,3	16,3

Table 12: Distribution of road exposure (km-length) among the different landslide susceptibility zones: example Kaghan UC.

Scenario D highlights the exposure of 1. Order roads to the landslide susceptibility zones 'Very High' and 'High' explicitly.

Scenario D (see Figure 22 and Attachment 7: Risk Exposure Map and Table 1):
Road (1. Order) exposure to landslide susceptibility zones 'Very High' and 'High'.

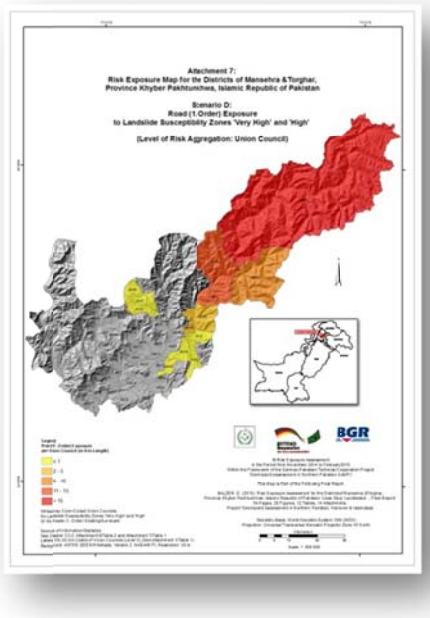

Figure 22: Thumbnail image of Risk Exposure Map, Scenario D (Note: image not drawn to scale; see Attachment 7).

Scenario D was elaborated to identify Union Councils encompassing roads of national importance (1. Order), which are partly or fully exposed to the landslide susceptibility zones 'Very High' and 'High'. Representing a major life line, this type of road is of utmost importance particularly in case of any disaster response operation and recovery activity. In total, only 13 of 61 Union Councils are fulfilling the aforementioned criteria (Attachment 7/Table 1). The largest exposure figures are ranging between 8 and 30 km (4 Union Councils: Kaghan UC/UN-OCHA code: 40426; Ghanool UC/UN-OCHA code: 40491; Kawai UC/UN-OCHA code: 40494; Mohandri UC/UN-OCHA code: 40490).

The Union Council with the maximum exposure rate is Kaghan UC (UN-OCHA code: 40426) with approximately 30 km-length of exposed 1. Order roads. This is represented by the Mansehra-Naran-Jalkhad-Chilas Road (N15) crossing the Union Council from SW to NE (see also Scenario C above).
Apart from the 4 Union Councils with the highest exposure figures the remaining ones are characterized by values fluctuating between less than 3 km and negligible shares.

Based on the 1. Order road exposure assessment results, DRR related mitigation activities are supposed to focus on Kaghan UC (UN-OCHA code: 40426). The Mansehra-Naran-Jalkhad-Chilas Road (N15) as Union Council's lifeline should be surveyed in detail by GSP experts along the entire length (~30 km). This enables geologists to recognize potential slope failure hot spots and to determine selected slope spots, which should be monitored periodically.
Such hot spots should be prioritized concerning structural slope reinforcement investments within the scope of preventive regional planning processes.

Scenario E (see Figure 23 and Attachment 8: Risk Exposure Map and Table 1):
Road (2. Order) exposure to landslide susceptibility zones 'Very High' and 'High'.

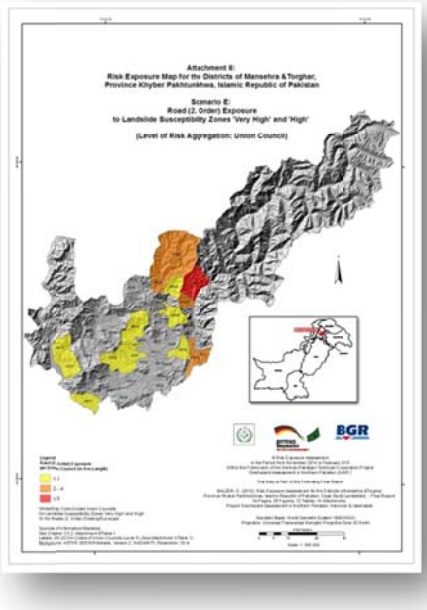

Figure 23: Thumbnail image of Risk Exposure Map, Scenario E (Note: image not drawn to scale; see Attachment 8).

Scenario E was executed to figure out Union Councils with shares of sub-national/regionally important roads (2. Order) exposed to landslide susceptibility zones 'Very High' and 'High'. In the event of occurrences of damage or disasters those roads might be life-saving for local people living in rural areas and facilitate response emergency authorities to provide help in need. It has been observed that 16 of 61 Union Councils are potentially at threat (Attachment 8/Table 1).

The Union Council with the highest exposure share of 2. Order roads is Hangrai (UN-OCHA code: 40531) with an exposed km-length of about 10 km, followed by 5 Union Councils with exposure figures between 2 and 3 km. The remaining 10 Union Councils show only a minor share with less than 1 km-length of exposed 2. Order roads.

Infrastructure Exposure Assessment II 'Health Facilities'

Scenario F (see Figure 24 and Attachment 9: Risk Exposure Map and Table 1-2):
Health facility (undifferentiated) exposure to landslide susceptibility zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'.

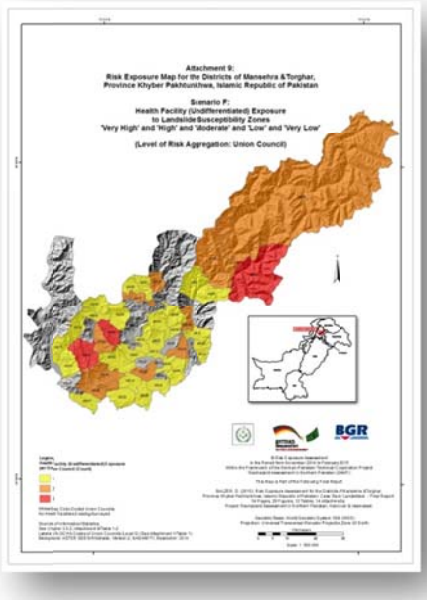

Figure 24: Thumbnail image of Risk Exposure Map, Scenario F (Note: image not drawn to scale; see Attachment 9).

Scenario F is intended to provide a general overview about the exposure distribution of all 57 surveyed and still undifferentiated health facilities for the Districts of Mansehra & Torghar with regard to the different landslide susceptibility zones. Additionally, the health care capacity was, at least to an extent, evaluated. It is worth remembering that due to the missing geospatial attribution 11 health facilities could not be taken into account in the assessment (Attachment 2B/Table 2).
Basically, the 57 health facilities safeguard medical support to the people of Mansehra & Torghar. Moreover, in case of damaging events or disasters these facilities might play a vital role to medicate injured persons. This requires that health facilities itself are located outside landslide prone areas or at least to be resilient to sliding events of lower magnitude in zones of increased likelihood for the occurrence of landslides. Furthermore, it has to be ensured that health facilities are also easily approachable.

The assessment has shown that all 57 health facilities exposed to different susceptibility zones are only scattered over 41 Union Councils (Attachment 9/Table 1). In turn this means, 16 Union Councils are currently deprived of any reliable health care (see Attachment 9/Risk Exposure Map)!

To better estimate the capacity of Mansehra & Torghar Districts in terms of health care, a so-called 'landslide exposure health care index' was introduced (Attachment 9/Table 1).

This index is calculated by dividing the number of people exposed to all different zones of landslide susceptibility by the number of exposed health facilities of the corresponding Union Councils (this index can also be reckoned for other constraints, such as for the exposure to zones 'High' and/or 'Very High' solely). It can be noted that even for Union Councils with more than one health facility the index is larger than 7.000 people/health facility. The peak index values occur, where only one health facility per Union Council exists (ranging between larger than 12.000 and about 23.000 people/health facility). Taking into account that about half of the Union Councils are featured by a total shortage of health facilities, the index is locally expected to be significantly higher. This is because a number of exposed people of Union Councils that are critically undersupplied have to commute to the health facilities in the surrounding Union Councils.

The Union Councils with the largest number of exposed health facilities are Karhori UC (UN-OCHA code: 40524), Mohandri UC (UN-OCHA code: 40490), and Oghi UC (UN-OCHA code: 40484) each with 3, followed by 10 Union Councils each with 2 health facilities (see also Attachment 2B). All other Union Councils are possessing 1 health facility only.

The discrimination of Union Councils with regard to the peak number of exposed health facilities to several landslide susceptibility zones detects an inhomogeneous scatter with a slight tendency to be concentrated in the susceptibility zone 'Very Low' (Karhori UC/UN-OCHA code: 40524 and Oghi UC/UN-OCHA code: 40484). Mohandri UC (UN-OCHA code: 40490) is featured by an equal distribution to the zones 'Low', 'Moderate' and 'High' (Attachment 9/Table 2).

Scenario G emphasizes solely the exposure of health facilities to the susceptibility zones 'Very High' and 'High'.

Scenario G (see Figure 25 and Attachment 10: Risk Exposure Map and Table 1):

Health facility (undifferentiated) exposure to landslide susceptibility zones 'Very High' and 'High'.

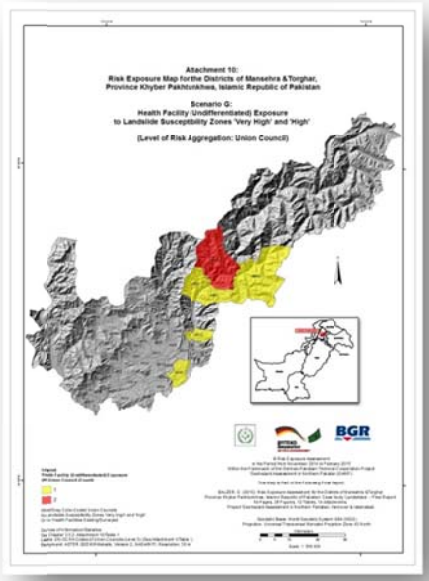

Figure 25: Thumbnail image of Risk Exposure Map, Scenario G (Note: image not drawn to scale; see Attachment 10).

The exposure of health facilities (undifferentiated) to the landslide susceptibility zones 'Very High' and 'High' is limited to 6 Union Councils (Attachment 10/Table 1).

In the respective Union Councils the number of exposed health facilities does not exceed more than two. Therefore, it would be conducive to scrutinize these 6 health facilities in terms of their surrounding landslide threat potential and as far as necessary to design possible structural (geotechnical) mitigation strategies and countermeasures.

The following scenarios H, I and J illuminate the exposure of the three different health facility types to all five landslide susceptibility zones.

Scenario H (see Figure 26 and Attachment 11: Risk Exposure Map and Table 1-2):

Health facility (Civil Hospital/CH and Special Hospital/SH) exposure to landslide susceptibility zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'.

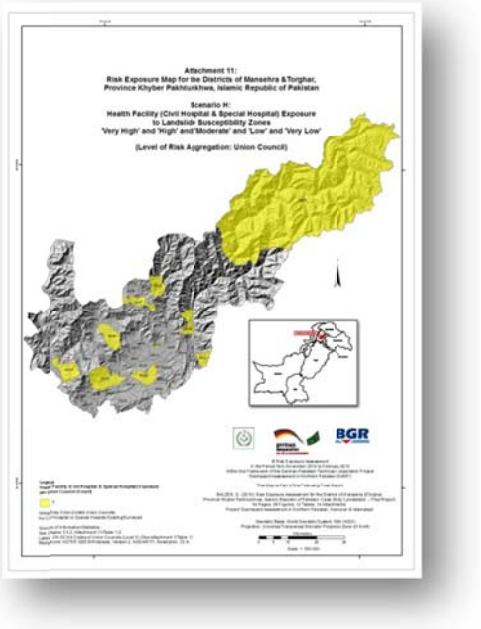

Figure 26: Thumbnail image of Risk Exposure Map, Scenario H (Note: image not drawn to scale; see Attachment 11).

A total of 10 Civil (8)/Special (2) Hospitals exposed to any landslide susceptibility zone are distributed over 10 different Union Councils (Attachment 11/Table 1). Apart from the Civil Hospital Kaghan (Kaghan UC/UN-OCHA code: 40426), which is exposed to the zone 'Moderate' the majority of Civil/Special Hospitals (9) is positioned in the zone 'Very Low' (Attachment 11/Table 2).

Summarizing this observation, it can be concluded that the exposure of the Civil/Special Hospitals of Mansehra & Torghar Districts seems to be uncritical pertaining to the landslide threat at first glance.

Scenario I (see Figure 27 and Attachment 12: Risk Exposure Map and Table 1-2):

Health facility (Rural Health Unit) exposure to landslide susceptibility zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'.

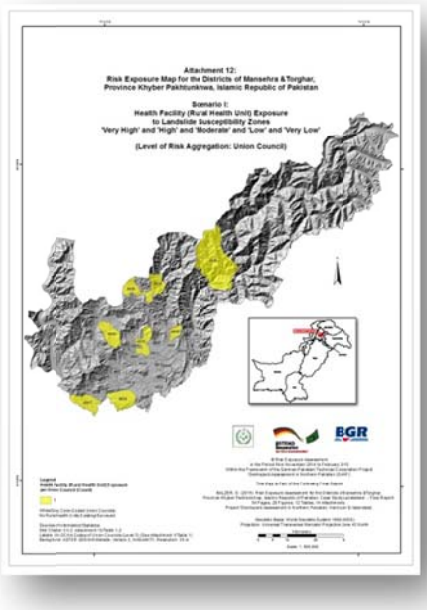

Figure 27: Thumbnail image of Risk Exposure Map, Scenario I (Note: image not drawn to scale; see Attachment 12).

All in all 8 Rural Health Units (RHU's) are exposed to any landslide susceptibility zone and are dispersed over 8 different Union Councils (Attachment 12/Table 1). Irrespective of RHU Kawai (Kawai UC/UN-OCHA code: 40494), which is exposed to the susceptibility zone 'High', the majority of Rural Health Units (7) is situated in the zone 'Very Low' (Attachment 12/Table 2).

Owing to the fact that RHU Kawai is placed in the landslide susceptibility zone 'High' it is suggested to pay particular attention to this RHU. A GSP reconnaissance mission should be entrusted to assess the surroundings of that RHU concerning slope stability. The exposure of all other RHU's of Mansehra & Torghar Districts appears to be unsuspected concerning the landslide threat at first sight.

Scenario J (see Figure 28 and Attachment 13: Risk Exposure Map and Table 1-2):

Health facility (Basic Health Unit) exposure to landslide susceptibility zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'.

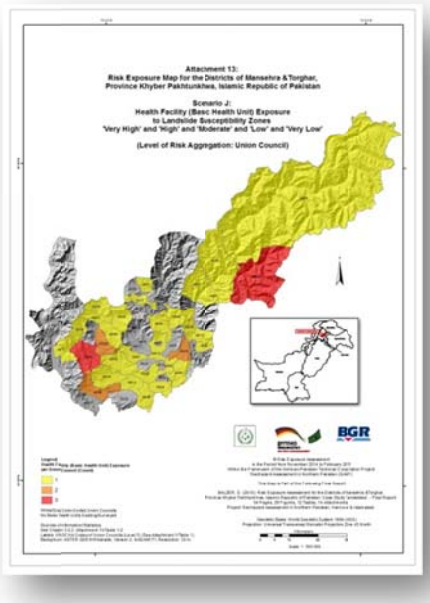

Figure 28: Thumbnail image of Risk Exposure Map, Scenario J

(Note: image not drawn to scale; see Attachment 13).

A total of 39 Basic Health Units (BHU's) exposed to any landslide susceptibility zone are spread over 32 Union Councils (Attachment 13/Table 1). There are only 2 Union Councils possessing 3 BHU's each: Mohandri UC (UN-OCHA code: 40490) and Karhori UC (UN-OCHA code: 40524). Concerning Mohandri UC the corresponding BHU's are evenly distributed to the susceptibility zones 'High', 'Moderate' and 'Low' (Attachment 13/Table 2). By contrast, all BHU's of Karhori UC are exposed to the zone 'Very Low'. Union Councils with 2 BHU's are restricted to Attar Shisha UC (UN-OCHA code: 40459), Sher Garh UC (UN-OCHA code: 40592) and Swan Mera UC (UN-OCHA code: 40436). All of these 6 BHU's were constructed in the susceptibility zone 'Very Low'. The remaining Union Councils are outfitted with 1 BHU, respectively. The overwhelming majority of these BHU's is exposed to the susceptibility zone 'Very Low' (20) and subordinated to the zones 'Low' (2) and 'High' (4). There are only a few exceptions: BHU Hangrai (Hangrai UC/UN-OCHA code: 40531) was erected in the susceptibility zone 'Very High', whereas in each case one BHU in Kawai UC, Shohal Mazullah UC, Ghanool UC, Mohandri UC, and Pairan UC is placed in the landslide susceptibility zone 'High'.

Since only 1 BHU's is exposed to the susceptibility zone 'Very High' it is proposed to appraise the current landslide potential in the surroundings of BHU Hangrai by GSP geologists and to commission them to provide appropriate advisory service to the BHU operator and to the Mansehra District Deputy Commissioner.

A similar concept might be pursued with regard to the few BHU's located in the susceptibility zone 'High'.

4 DRM Related Use of REA Outcomes for Mansehra & Torghar Districts

In order to increase the public perception, detailed REA outcomes should be published and jointly discussed by policymakers, other stakeholders, people concerned and geoscientists towards Disaster Risk Management (DRM) actions. Only this concerted effort enables the responsible bodies to draw the correct conclusions and to elaborate best practice recommendations and guidance.

According to the overall DRM concept (Figure 29; BALZER et al. 2012) both focal points Disaster Risk Reduction (DRR) and Disaster Management (DM) may benefit from an assessment of risk exposure to landslides (see also Chapter 1). Based on the REA outcomes for the Districts of Mansehra & Torghar following *few* examples are cited to clarify this. The given examples do not claim to be exhaustive.

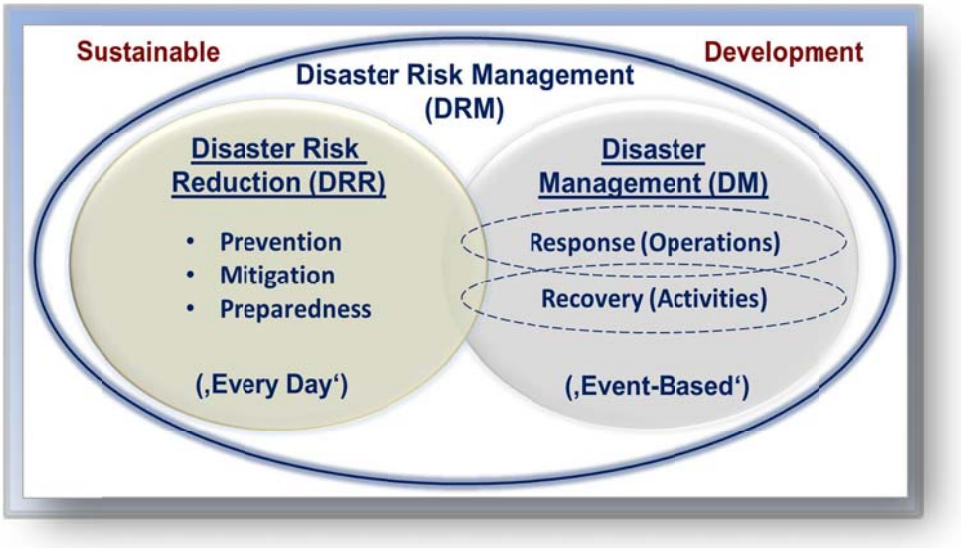

Figure 29: Overall concept of Disaster Risk Management (DRM) according to BALZER et al. (2012).

'Disaster Management' including Contingency Planning:

- Support of disaster managers/communities to be optimally prepared and to better coordinate response operations or recovery activities based on the population exposure potential:
  - Compilation of a priorities list of Union Councils with the largest population exposure potential;
  - Creation of a priorities list of Union Councils in terms of aid supplies stock keeping (e.g. food, shelters/tents, medications, construction materials) based on the popula-

tion figures expected to be potentially affected. This list could serve as a basis to discuss/to estimate following issues:

- What amounts of aid supplies are potentially necessary at which Union Council(s)?
- Are there sufficient stock capacities at the potentially most affected Union Council(s)?
- Are there ample haulage capacities to transport goods to the potentially most affected Union Council(s)?
- Is there enough heavy equipment (e.g. shovel dredgers) to rescue people at the potentially most affected Union Council(s)?
- And so on…

- Support of disaster managers/communities to be better prepared and to better coordinate response operations or recovery activities according to the road exposure potential:
  - Compilation of a priorities list of Union Councils with the road exposure potential taking into account the anticipated exposure extent (km-length) of different road types/landslide susceptibility zones. This compilation can serve as a background to deliberate/to evaluate following subjects:
    - Is there adequate heavy equipment deposited at the relevant Union Councils to remove road obstacles caused by landslides?
    - Is there adequate construction material (sand/gravel, cement, etc.) deposited at the relevant Union Councils to reconstruct road damages?
    - What amount of costs are expected for recovery/rehabilitation at the Union Councils concerned (can be calculated applying GRASP)?
    - And so on…

- Support of disaster managers/communities to be better prepared and to better coordinate response operations or recovery activities focused on health facility exposure potential:
  - Compilation of a priorities list of Union Councils with the health facility exposure potential taking into consideration different types of health facilities/landslide susceptibility zones. This detailed record can be used to consider topics like:
    - Are there enough medical capacities (health facilities) situated particularly in highly or very highly landslide prone Union Councils?
    - Are there possible alternative health facilities outside highly or very highly landslide prone administrative units?

- Are there medical capacities of health facilities at the potentially most affected Union Council(s) to medicate a sizeable number of injured people?
- Are sufficient medical rescue teams kept in stand-by mode for the immediate recovery of affected population in case of emergency at the right places?
- And so on…

Disaster Risk Reduction:

- Applying REA results to elaborate a strategic DRR plan concerning non-structural mitigation measures on District level focusing on:
  - Development of a transparent DRR budgeting schema based on the number of potentially exposed population/km-length of roads/number of specific health facilities depending on different landslide susceptibility zones to streamline risk-sensitive development/land use planning or structural mitigation measures (see below);
  - Design of 'legislative' rules focusing on the incorporation of landslide hazard/risk related topics influencing existing/future land use (planning) issues and insurance problems;
  - Setting up priorities list (s) for action: designation of Union Councils to be assessed in detail as to landslide threats and resulting risk exposure;
  - Identification of possible DRR related cooperation between neighboring Union Councils or Districts where it is deemed economically reasonable;
  - Strengthening of awareness of people concerned to the hazards/risks they are exposed to using relevant hazard and risk exposure maps;
  - And so on…

- Applying REA results to develop a strategic DRR plan in terms of structural measures on District level aiming at:
  - Identification/Designation of construction areas for settlement areas and critical infrastructure sites (e.g. schools, hospitals) to avoid/prevent uncontrolled development outside designated construction zones, e.g. in Union Councils that are highly or very highly susceptible to landslides;
  - Elaboration of site specific recommendations in consideration of engineering works (slope stability), safe building design/construction or safety measures at home for Union Councils partly or fully exposed to zones of high or very high landslide susceptibility;
  - Designation of slope monitoring sites to be considered as instable;

- And so on…

5 Outlook

The exemplary assessment of the risk exposure for the Districts of Mansehra & Torghar to the landslide 'hazard' highlights the possibilities of a joint processing of harmonized baseline, hazard and vulnerability related information to streamline appropriate DRM activities.

According to the different natural/geological threats Pakistan is facing, it is inevitable to take into account a multi-hazard risk exposure assessment approach. Thus, the elaboration and integration of other high-resolution hazard assessment information, such as flooding or seismic hazard is sine qua non.

Furthermore, the incorporation of additional EaR related information like schools, bridges or power supply lines is an urgent need to achieve an added value in terms of a long-term risk mitigation strategy. This should explicitly include cost-related approaches (e.g. to assess reconstruction costs of roads or bridges).

Based on BGR experiences in previous technical cooperation projects (e.g. in Central America, see BALZER et al. 2010) it is worth adapting the gained assessment outcomes in a more customer-friendly way. A simple database application could enable the potential user to search for assessment findings (maps, statistics), e.g. for any Union Council, in detail and on-demand. At a later date, these findings could also be made accessible to the public via web services.

Basically, to extend such assessments to other Districts of Pakistan it would be of highest importance to elaborate a legally binding guideline how to assess the risk exposure at District level and if there is a demand to all administrative levels in Pakistan. Such a guideline can serve as a tool that delineates the respective data requirements, all issues of non-redundant data storage and all steps of data processing. However, the design of such a guideline implies to launch a paradigm shift in Pakistan's overall risk related data policy. This is an obvious, yet fundamental premise to strengthen the DRM capacity and to be successful in the practical implementation of Pakistans National Disaster Management Plan 2012-2022 (NDMA 2012).

In order to increase the benefit of further risk exposure assessments it appears to be suitable to establish a participative platform for addressing all risk exposure assessment issues. This platform should comprise experts from national, sub-national and local (Districts/UC's) DRM authorities and the civil society. It would be of major relevance if this platform:

- evaluates the assessment outcomes;
- discusses potential consequences in terms of DRM with a special emphasis on DRR related structural/non-structural mitigation measures;
- deliberates ongoing steps regarding funding issue and the practical implement of mitigation measures.

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Attachments 1-14

Table of Attachments

Attachment 1: Detailed overview of the administrative units and related UN-OCHA codes of Mansehra & Torghar Districts.

Attachment 1/Table 1:
Detailed Overview of Administrative Units and Related UN-OCHA Codes of Mansehra & Torghar Districts
(Listed in Ascending Order of UN-OCHA Tehsil Codes)

Name Province	UN-OCHA Province Code	Name District	UN-OCHA District Code	Name Tehsil	UN-OCHA Tehsil Code	Union Council (UC)	UN-OCHA UC Code
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	BALA KOT	1351	KAGHAN UC	40426
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	BALA KOT	1351	GARHI HABIBULLAH UC	40447
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	BALA KOT	1351	MOHANDRI UC	40490
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	BALA KOT	1351	GHANOOL UC	40491
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	BALA KOT	1351	GARLAT UC	40492
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	BALA KOT	1351	SAT BANI UC	40493
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	BALA KOT	1351	KAWAI UC	40494
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	BALA KOT	1351	SHOHAL MAZULLAH UC	40515
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	BALA KOT	1351	KARNOL UC	40522
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	BALA KOT	1351	HANGRAI UC	40531
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	BALA KOT	1351	TALHATA UC	40533
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	BALA KOT	1351	BALA KOT	40538
KHYBER PAKHTUNKHWA	1	TORGHAR (MANSEHRA)	135	KALA DHAKA	1352	MADA KHEL (= SECTION)	40425
KHYBER PAKHTUNKHWA	1	TORGHAR (MANSEHRA)	135	KALA DHAKA	1352	BASSI KHEL (= SECTION)	40464
KHYBER PAKHTUNKHWA	1	TORGHAR (MANSEHRA)	135	KALA DHAKA	1352	NUSRAT KHEL (= SECTION)	40466
KHYBER PAKHTUNKHWA	1	TORGHAR (MANSEHRA)	135	KALA DHAKA	1352	HASSAN KHEL (= SECTION)	40471
KHYBER PAKHTUNKHWA	1	TORGHAR (MANSEHRA)	135	KALA DHAKA	1352	AKAZAI (= SECTION)	40880
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	MANSEHRA CITY (1-4) UC	40422
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	HAMSHERIAN UC	40423
KHYBER	1	MANSEHRA	135	MANSEHRA	1353	BEHALI UC	40428

Attachment 1/Table 1:

Detailed Overview of Administrative Units and Related UN-OCHA Codes of Mansehra & Torghar Districts

(Listed in Ascending Order of UN-OCHA Tehsil Codes)

Name Province	UN-OCHA Province Code	Name District	UN-OCHA District Code	Name Tehsil	UN-OCHA Tehsil Code	Union Council (UC)	UN-OCHA UC Code
PAKHTUNKHWA							
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	LASSAN THUKRAL UC	40434
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	SWAN MERA UC	40436
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	LASSAN NAWAB UC	40437
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	PHULRA UC	40448
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	DHODIAL UC	40453
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	TANDHA UC	40454
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	CHATER PIAIN UC	40456
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	BATTAL UC	40457
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	ATTAR SHISHA UC	40459
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	PAIRAN UC	40460
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	BHEER KUND UC	40461
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	ICHHERIAN UC	40462
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	SHOUKAT ABAD UC	40463
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	BHOGAR MANG UC	40472
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	TARANGRI SABAR SHAH UC	40478
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	HILKOT UC	40481
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	INAYAT ABAD UC	40512
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	LABAR KOT UC	40513
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	DEVLI JABBAR UC	40523
KHYBER	1	MANSEHRA	135	MANSEHRA	1353	DATTA UC	40534

Attachment 1/Table 1:
Detailed Overview of Administrative Units and Related UN-OCHA Codes of Mansehra & Torghar Districts
(Listed in Ascending Order of UN-OCHA Tehsil Codes)

Name Province	UN-OCHA Province Code	Name District	UN-OCHA District Code	Name Tehsil	UN-OCHA Tehsil Code	Union Council (UC)	UN-OCHA UC Code
PAKHTUNKHWA							
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	SHANKIARI UC	40539
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	SACHA KALAN UC	40542
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	JABORI UC	40543
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	SUM ELAHI MANG UC	40549
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	PARHANA UC	40552
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	MANSEHRA RURAL UC	40564
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	BAFFA TOWN UC	40567
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	MALIK PUR UC	40571
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	SANDA SAR UC	40593
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	MANSEHRA	1353	JALLOO UC	40610
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	OGHI	1354	DAR BAND UC	40424
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	OGHI	1354	DARA SHANAYA UC	40440
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	OGHI	1354	DILBORI UC	40458
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	OGHI	1354	NIKKA PANI UC	40470
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	OGHI	1354	KATHAI UC	40483
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	OGHI	1354	OGHI UC	40484
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	OGHI	1354	KARHORI UC	40524
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	OGHI	1354	BANDI SHUNGLI UC	40536
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	OGHI	1354	SHAMDARA UC	40537
KHYBER	1	MANSEHRA	135	OGHI	1354	BELIAN UC	40591

Attachment 1/Table 1:

Detailed Overview of Administrative Units and Related UN-OCHA Codes of Mansehra & Torghar Districts

(Listed in Ascending Order of UN-OCHA Tehsil Codes)

Name Province	UN-OCHA Province Code	Name District	UN-OCHA District Code	Name Tehsil	UN-OCHA Tehsil Code	Union Council (UC)	UN-OCHA UC Code
PAKHTUNKHWA							
KHYBER PAKHTUNKHWA	1	MANSEHRA	135	OGHI	1354	SHER GARH UC	40592

Attachment 2: Elements at Risk/Vulnerability related information of Mansehra & Torghar Districts: 'Road Type Inventory Map' (Attachment 2A), 'Health Facility Inventory Map' (Attachment 2B) and related health facility inventory (Table 1-2).

Attachment 2B/Table 1:
Health Facilities of Mansehra (& Torghar) Districts Applied for REA
(Listed in Alphabetic Order of Tehsil Names)

Category of Health Facility	Administrative Assignment/UN-OCHA Codes				Name of Health Facility
	Tehsil	Tehsil Code	Name UC	UC Code	
Basic Health Unit (BHU)	BALA KOT	1351	SHOHAL MAZULLAH	40515	JABRI KALEESH
Basic Health Unit (BHU)			TALHATA	40533	TALHATTA
Basic Health Unit (BHU)			KARHORI	40524	DOGA
Basic Health Unit (BHU)			BALA KOT	40538	SHOHAL NAJIF KHAN
Basic Health Unit (BHU)			KAGHAN	40426	NARAN
Basic Health Unit (BHU)			KAWAI	40494	PARAS
Basic Health Unit (BHU)			MOHANDRI	40490	JARAID
Basic Health Unit (BHU)			GHANOOL	40491	SANGAR
Basic Health Unit (BHU)			HANGRAI	40531	HANGRAI
Basic Health Unit (BHU)			MOHANDRI	40490	MOHANDRI AT KHANIAN
Basic Health Unit (BHU)			MOHANDRI	40490	BHOONJA
Civil Hospital (CH)			KAGHAN	40426	KAGHAN
Civil Hospital (CH)			GARHI HABIBULLAH	40447	GARHI HABIBULLAH
Rural Health Unit (RHU)			KAWAI	40494	KAWAI
Special Hospital (SH)			BALA KOT	40538	TEHSIL HEADQUARTER HOSPITAL BALA KOT
Basic Health Unit (BHU)	MANSEHRA	1353	DATTA	40534	DATTA
Basic Health Unit (BHU)			MANSEHRA CITY (1-4)	40422	PANO DEHRI
Basic Health Unit (BHU)			INAYAT ABAD	40512	GHANDIAN
Basic Health Unit (BHU)			BHEER KUND	40461	BHEER KUND
Basic Health Unit (BHU)			TANDHA	40454	KOTLI BALA
Basic Health Unit (BHU)			BATTAL	40457	JAL GALI
Basic Health Unit (BHU)			HILKOT	40481	HILKOT
Basic Health Unit (BHU)			ATTAR SHISHA	40459	JABBA
Basic Health Unit (BHU)			PAIRAN	40460	PAIRAN KHAIRABAD
Basic Health Unit (BHU)			SANDA SAR	40593	SANDA SAR
Basic Health Unit (BHU)			PHULRA	40448	KANDAR
Basic Health Unit (BHU)			SUM ELAHI MANG	40549	DHERYAL
Basic Health Unit (BHU)			ATTAR SHISHA	40459	ATTAR SHISHA
Basic Health Unit (BHU)			SWAN MERA	40436	MOHAR
Basic Health Unit (BHU)			JALLOO	40610	BIO BANDI
Basic Health Unit (BHU)			BEHALI	40428	BEHALI

Attachment 2B/Table 1: Health Facilities of Mansehra (& Torghar) Districts Applied for REA (Listed in Alphabetic Order of Tehsil Names)					
Category of Health Facility	Administrative Assignment/UN-OCHA Codes				Name of Health Facility
	Tehsil	Tehsil Code	Name UC	UC Code	
Basic Health Unit (BHU)			SWAN MERA	40436	TRAPPI
Basic Health Unit (BHU)			PARHANA	40552	PARHANA
Civil Hospital (CH)			PHULRA	40448	PHULRA
Civil Hospital (CH)			SACHA KALAN	40452	NAWAZABAD
Civil Hospital (CH)			BAFFA TOWN	40567	BAFFA
Civil Hospital (CH)			BATTAL	40457	BATTAL
Special Hospital (SH)			MANSEHRA CITY (1-4)	40422	KING ABDULLAH TEACH-ING HOSPITAL MANSEHRA
Rural Health Unit (RHU)			SACHA KALAN	40542	SACHA KALAN
Rural Health Unit (RHU)			LASSAN NAWAB	40437	LASSAN NAWAB
Rural Health Unit (RHU)			CHATER PIAIN	40456	CHATER PIAIN
Rural Health Unit (RHU)			TARANGRI SABIR SHAH	40478	TARANGRI SABIR SHAH
Rural Health Unit (RHU)			LASSAN THUKRAL	40434	KHAWARI
Rural Health Unit (RHU)			SHANKIARI	40539	SHANKIARI
Basic Health Unit (BHU)			BANDI SHUNGLI	40536	BANDI SHUNGLI
Basic Health Unit (BHU)			DILBORI	40458	DILBORI
Basic Health Unit (BHU)			BELIAN	49591	BELIAN
Basic Health Unit (BHU)			KATHAI	40483	KATHAI
Basic Health Unit (BHU)			SHER GARH	40592	SHER GARH
Basic Health Unit (BHU)			OGHI	40484	ARBORA
Basic Health Unit (BHU)	OGHI	1354	SHER GARH	40592	GALI BADRAL
Basic Health Unit (BHU)			KARHORI	40524	BANDI PAROW
Basic Health Unit (BHU)			KARHORI	40524	KARHORI
Basic Health Unit (BHU)			NIKKA PANI	40470	CHAKAL
Civil Hospital (CH)			OGHI	40484	OGHI
Civil Hospital (CH)			DAR BAND	40424	DAR BAND
Rural Health Unit (RHU)			OGHI	40484	CHARBAGH OGHI

Attachment 2B/Table 2: Health Facilities of Mansehra (& Torghar) Districts Neglected for REA (Based on HEALTH DEPARTMENT OF MANSEHRA DISTRICT, 2015)			
Category of Health Facility	Location		Name of Health Facility
	Tehsil	UN-OCHA Tehsil Code	
Special Hospital (SH)	BALA KOT	1351	LEPROSY HOSPITAL BALA KOT
Rural Health Unit (RHU)	BALA KOT	1351	CHOWKI
Basic Health Unit (BHU)	BALA KOT	1351	KOT GALI
			RAJWAL
			KHOLA
	MANSEHRA	1353	LASSAN THUKRAL
			CHANDOOR
			KHAMARI
	OGHI	1354	KHABBAL
			ILAWA GALI
			NAMBAL

Attachment 3: Demographic information of Mansehra & Torghar Districts: 'Population Density Map' (3A) and 'Corrected Population Density Map' (3B) and related statistics (Table 1).

Attachment 3/Table 1:

Mansehra & Torghar Districts: Demographic Information of Union Councils (UC)

(Listed in Ascending Order of UN-OCHA UC Codes; See Attachment 1 for UC Names)

UN-OCHA UC Code	Total Area (km^2)	Total Settlement Area (km^2)	Population	Population Density	Corrected Population Density	GRASP Code
40422	37,23	10,117	49.534	1.330	4.896	5320101
40423	19,4	1,908	14.407	743	7.551	5320101
40424	44,68	14	15.634	350	1.117	5320101
40425	111,26	39,51	26.842	241	679	5320101
40426	1590,3	10,581	22.548	14	2.131	5320101
40428	38,22	7,364	16.761	439	2.276	5320101
40434	48,45	7,987	13.176	272	1.650	5320101
40436	62,38	21,979	13.009	209	592	5320101
40437	40,76	6,966	15.484	380	2.223	5320101
40440	37,71	13,281	15.152	402	1.141	5320101
40447	18,54	3,784	19.306	1.041	5.102	5320101
40448	64,36	26,392	20.633	321	782	5320101
40453	26,11	4,657	21.046	806	4.519	5320101
40454	45,09	6,986	12.395	275	1.774	5320101
40456	36,24	8,895	14.229	393	1.600	5320101
40457	28,16	8,583	20.708	735	2.413	5320101
40458	39,64	12,598	16.208	409	1.287	5320101
40459	37,11	6,03	13.879	374	2.302	5320101
40460	47,98	9,792	12.590	262	1.286	5320101
40461	29,67	6,452	17.047	575	2.642	5320101
40462	34,71	13,116	21.375	616	1.630	5320101
40463	69,76	13,238	15.509	222	1.172	5320101
40464	153,23	32,537	75.155	490	2.310	5320101
40466	50,63	6,866	10.713	212	1.560	5320101
40470	50,7	20,366	12.395	244	609	5320101
40471	82,75	11,972	32.117	388	2.683	5320101
40472	38,34	12,797	12.907	337	1.009	5320101
40478	35,12	8,642	17.614	502	2.038	5320101
40481	23,54	7,043	15.560	661	2.209	5320101
40483	53,93	9,993	13.182	244	1.319	5320101
40484	44,19	6,701	21.674	490	3.234	5320101
40490	268,98	7,962	22.597	84	2.838	5320101
40491	60,46	2,545	20.274	335	7.966	5320101
40492	76,02	11,593	18.466	243	1.593	5320101

Attachment 3/Table 1:

Mansehra & Torghar Districts: Demographic Information of Union Councils (UC)

(Listed in Ascending Order of UN-OCHA UC Codes; See Attachment 1 for UC Names)

UN-OCHA UC Code	Total Area (km^2)	Total Settlement Area (km^2)	Population	Population Density	Corrected Population Density	GRASP Code
40493	22,28	7,549	15.949	716	2.113	5320101
40494	205,22	13,685	13.788	67	1.008	5320101
40512	44,59	14,63	16.346	367	1.117	5320101
40513	7,27	1,014	13.376	1.840	13.191	5320101
40515	35,22	3,933	13.277	377	3.376	5320101
40522	35,93	4,868	17.806	496	3.658	5320101
40523	215,3	12,499	21.862	102	1.749	5320101
40524	76,2	16,244	23.600	310	1.453	5320101
40531	74,19	19,276	18.252	246	947	5320101
40533	21,45	3,095	13.112	611	4.237	5320101
40534	33,59	5,134	15.501	461	3.019	5320101
40536	39,5	17,877	13.621	345	762	5320101
40537	31,56	11,927	15.833	502	1.327	5320101
40538	27,73	7,062	19.255	694	2.727	5320101
40539	14,94	1,874	22.826	1.528	12.180	5320101
40542	30,83	10,169	14.024	455	1.379	5320101
40543	37,07	6,161	13.521	365	2.195	5320101
40549	45,84	5,596	16.675	364	2.980	5320101
40552	65,2	17,777	18.328	281	1.031	5320101
40564	9,79	1,23	16.883	1.725	13.726	5320101
40567	2,95	0,713	23.117	7.836	32.422	5320101
40571	9,73	1,495	12.329	1.267	8.247	5320101
40591	33,55	9,525	18.664	556	1.959	5320101
40592	43,46	8,821	22.589	520	2.561	5320101
40593	20,91	2,613	15.629	747	5.981	5320101
40610	36,17	4,467	16.740	463	3.747	5320101
40880	73,92	19,675	29.855	404	1.517	5320101

Attachment 4: Risk Exposure Map… Scenario A and related statistics (Table 1-3).

Attachment 4/Table 1: Scenario A: Population Exposure to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low' (Listed in Descending Order of Sum of Exposed People (Absolute)[5] ;			
UN-OCHA UC Code	Name UC	Sum Exposed People (Absolute) per UC	Sum Exposed People (Relative in %) per UC
40464	BASSI KHEL	75.121	99,95
40422	MANSEHRA CITY (1-4) UC	49.499	99,93
40471	HASSAN KHEL	32.089	99,92
40880	AKAZAI	29.824	99,89
40425	MADA KHEL	26.808	99,88
40524	KARHORI UC	23.582	99,93
40567	BAFFA TOWN UC	23.344	100,98
40539	SHANKIARI UC	22.898	100,31
40592	SHER GARH UC	22.588	100
40490	MOHANDRI UC	22.562	99,85
40426	KAGHAN UC	22.525	99,89
40523	DEVLI JABBAR UC	21.846	99,92
40484	OGHI UC	21.701	100,12
40462	ICHHERIAN UC	21.370	99,98
40453	DHODIAL UC	21.058	100,07
40457	BATTAL UC	20.702	99,98
40448	PHULRA UC	20.637	100,02
40491	GHANOOL UC	20.313	100,19
40447	GARHI HABIBULLAH UC	19.285	99,88
40538	BALA KOT UC	19.252	99,99
40591	BELIAN UC	18.650	99,94
40492	GARLAT UC	18.463	100
40552	PARHANA UC	18.321	99,95
40531	HANGRAI UC	18.249	99,98
40522	KARNOL UC	17.850	100,24
40478	TARANGRI SABAR SHAH UC	17.629	100,08
40461	BHEER KUND UC	17.067	100,11
40564	MANSEHRA RURAL UC	16.747	99,19

[5] Absolute population exposure figures slightly lower or larger than population figures and relative exposure figures in % slightly lower or larger than 100% are due to lowest spatial inaccuracies caused by intersection of susceptibility zones and settlement areas and respective rounding rules; for REA Mapping purposes smoothed class breaks have been applied. This note is also valid for Attachment 4/Table 2-3.

Attachment 4/Table 1: Scenario A: Population Exposure to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low' (Listed in Descending Order of Sum of Exposed People (Absolute)[5] ;			
UN-OCHA UC Code	Name UC	Sum Exposed People (Absolute) per UC	Sum Exposed People (Relative in %) per UC
40610	JALLOO UC	16.712	99,83
40428	BEHALI UC	16.707	99,68
40549	SUM ELAHI MANG UC	16.659	99,9
40512	INAYAT ABAD UC	16.341	99,96
40458	DILBORI UC	16.191	99,91
40493	SAT BANI UC	15.931	99,88
40537	SHAMDARA UC	15.831	99,98
40424	DAR BAND UC	15.638	100,03
40593	SANDA SAR UC	15.610	99,87
40481	HILKOT UC	15.595	100,22
40463	SHOUKAT ABAD UC	15.517	100,05
40534	DATTA UC	15.488	99,91
40437	LASSAN NAWAB UC	15.471	99,91
40440	DARA SHANAYA UC	15.152	99,99
40423	HAMSHERIAN UC	14.423	100,11
40456	CHATER PIAIN UC	14.240	100,08
40542	SACHA KALAN UC	14.025	100,01
40459	ATTAR SHISHA UC	13.858	99,85
40494	KAWAI UC	13.779	99,95
40536	BANDI SHUNGLI UC	13.617	99,97
40543	JABORI UC	13.500	99,85
40513	LABAR KOT UC	13.455	100,59
40515	SHOHAL MAZULLAH UC	13.268	99,94
40483	KATHAI UC	13.176	99,95
40434	LASSAN THUKRAL UC	13.166	99,93
40533	TALHATA UC	13.051	99,54
40436	SWAN MERA UC	13.007	99,99
40472	BHOGAR MANG UC	12.916	100,08
40460	PAIRAN UC	12.578	99,91
40454	TANDHA UC	12.418	100,2
40470	NIKKA PANI UC	12.399	100,03
40571	MALIK PUR UC	12.371	100,33
40466	NUSRAT KHEL	10.702	99,9

Attachment 4/Table 2:

Scenario A: Population Exposure (Absolute Number of People) Specified to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'

(Listed in Ascending Order of UN-OCHA UC Codes)

UN-OCHA UC Code	Name UC	Landslide Susceptibility Zone				
		Very High	High	Moderate	Low	Very Low
40422	MANSEHRA CITY (1-4) UC	0	0	0	196	49.303
40423	HAMSHERIAN UC	0	0	0	0	14.423
40424	DAR BAND UC	0	101	715	1.921	12.901
40425	MADA KHEL	14	2.879	8.793	9.683	5.439
40426	KAGHAN UC	277	10.634	7.480	2.301	1.833
40428	BEHALI UC	23	319	1.798	4.916	9.651
40434	LASSAN THUKRAL UC	0	16	50	2.854	10.246
40436	SWAN MERA UC	0	0	0	30	12.977
40437	LASSAN NAWAB UC	0	0	44	2.556	12.871
40440	DARA SHANAYA UC	0	0	0	479	14.673
40447	GARHI HABIBULLAH UC	255	2.653	7.653	5.306	3.418
40448	PHULRA UC	0	0	0	258	20.379
40453	DHODIAL UC	0	0	1.265	1.898	17.895
40454	TANDHA UC	0	18	284	1.650	10.466
40456	CHATER PIAIN UC	0	16	64	3.088	11.072
40457	BATTAL UC	0	24	627	7.142	12.909
40458	DILBORI UC	0	0	77	2.497	13.617
40459	ATTAR SHISHA UC	0	0	1.105	2.233	10.520
40460	PAIRAN UC	0	64	1.839	4.257	6.418
40461	BHEER KUND UC	0	0	26	925	16.116
40462	ICHHERIAN UC	0	16	1.500	5.542	14.312
40463	SHOUKAT ABAD UC	0	12	703	2.918	11.884
40464	BASSI KHEL	0	947	9.332	33.772	31.070
40466	NUSRAT KHEL	0	62	312	1.295	9.033
40470	NIKKA PANI UC	0	30	798	2.436	9.135
40471	HASSAN KHEL	54	5.983	9.471	3.273	13.308
40472	BHOGAR MANG UC	91	1.191	757	6.357	4.520
40478	TARANGRI SABAR SHAH UC	0	20	2.283	2.894	12.432
40481	HILKOT UC	0	22	287	4.904	10.382
40483	KATHAI UC	0	13	725	4.458	7.980
40484	OGHI UC	0	0	65	453	21.183
40490	MOHANDRI UC	5.250	11.097	4.626	1.504	85
40491	GHANOOL UC	717	15.295	3.027	1.115	159
40492	GARLAT UC	12.585	4.747	319	48	764
40493	SAT BANI UC	359	11.051	2.958	887	676

Attachment 4/Table 2:

Scenario A: Population Exposure (Absolute Number of People) Specified to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'

(Listed in Ascending Order of UN-OCHA UC Codes)

UN-OCHA UC Code	Name UC	Landslide Susceptibility Zone				
		Very High	High	Moderate	Low	Very Low
40494	KAWAI UC	5.504	6.421	1.552	282	20
40512	INAYAT ABAD UC	0	11	257	1.463	14.610
40513	LABAR KOT UC	0	0	0	0	13.455
40515	SHOHAL MAZULLAH UC	3.106	3.849	2.262	1.553	2.498
40522	KARNOL UC	3.512	1.902	4.755	4.243	3.438
40523	DEVLI JABBAR UC	175	1.487	2.414	9.882	7.888
40524	KARHORI UC	0	0	0	58	23.524
40531	HANGRAI UC	9.044	7.709	1.203	265	28
40533	TALHATA UC	2.712	4.195	2.457	890	2.797
40534	DATTA UC	0	121	876	2.355	12.136
40536	BANDI SHUNGLI UC	0	0	0	99	13.518
40537	SHAMDARA UC	0	0	0	0	15.831
40538	BALA KOT UC	191	8.426	5.072	3.027	2.536
40539	SHANKIARI UC	0	0	4.385	6.090	12.423
40542	SACHA KALAN UC	0	138	1.834	6.330	5.723
40543	JABORI UC	44	746	2.810	6.651	3.249
40549	SUM ELAHI MANG UC	0	447	1.848	5.632	8.732
40552	PARHANA UC	0	0	10	928	17.383
40564	MANSEHRA RURAL UC	0	0	549	3.432	12.766
40567	BAFFA TOWN UC	0	0	0	324	23.020
40571	MALIK PUR UC	0	0	0	825	11.546
40591	BELIAN UC	0	20	274	1.175	17.181
40592	SHER GARH UC	0	0	0	0	22.588
40593	SANDA SAR UC	0	0	0	299	15.311
40610	JALLOO UC	0	0	0	37	16.675
40880	AKAZAI	15	2.033	5.385	3.550	18.841

Attachment 4/Table 3:

Scenario A: Population Exposure (Relative Number of People in %) Specified to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'

(Listed in Ascending Order of UN-OCHA UC Codes)

UN-OCHA UC Code	Name UC	Landslide Susceptibility Zone				
		Very High	High	Moderate	Low	Very Low
40422	MANSEHRA CITY (1-4) UC	0	0	0	0,4	99,5
40423	HAMSHERIAN UC	0	0	0	0	100,1
40424	DAR BAND UC	0	0,6	4,6	12,3	82,5
40425	MADA KHEL	0	10,7	32,8	36,1	20,3
40426	KAGHAN UC	1,2	47,2	33,2	10,2	8,1
40428	BEHALI UC	0,1	1,9	10,7	29,3	57,6
40434	LASSAN THUKRAL UC	0	0,1	0,4	21,7	77,8
40436	SWAN MERA UC	0	0	0	0,2	99,8
40437	LASSAN NAWAB UC	0	0	0,3	16,5	83,1
40440	DARA SHANAYA UC	0	0	0	3,2	96,8
40447	GARHI HABIBULLAH UC	1,3	13,7	39,6	27,5	17,7
40448	PHULRA UC	0	0	0	1,2	98,8
40453	DHODIAL UC	0	0	6	9	85
40454	TANDHA UC	0	0,2	2,3	13,3	84,4
40456	CHATER PIAIN UC	0	0,1	0,4	21,7	77,8
40457	BATTAL UC	0	0,1	3	34,5	62,3
40458	DILBORI UC	0	0	0,5	15,4	84
40459	ATTAR SHISHA UC	0	0	8	16,1	75,8
40460	PAIRAN UC	0	0,5	14,6	33,8	51
40461	BHEER KUND UC	0	0	0,2	5,4	94,5
40462	ICHHERIAN UC	0	0,1	7	25,9	67
40463	SHOUKAT ABAD UC	0	0,1	4,5	18,8	76,6
40464	BASSI KHEL	0	1,3	12,4	44,9	41,3
40466	NUSRAT KHEL	0	0,6	2,9	12,1	84,3
40470	NIKKA PANI UC	0	0,2	6,4	19,6	73,7
40471	HASSAN KHEL	0,2	18,6	29,5	10,2	41,4
40472	BHOGAR MANG UC	0,7	9,2	5,9	49,2	35
40478	TARANGRI SABAR SHAH UC	0	0,1	13	16,4	70,6
40481	HILKOT UC	0	0,1	1,8	31,5	66,7
40483	KATHAI UC	0	0,1	5,5	33,8	60,5
40484	OGHI UC	0	0	0,3	2,1	97,7
40490	MOHANDRI UC	23,2	49,1	20,5	6,7	0,4
40491	GHANOOL UC	3,5	75,4	14,9	5,5	0,8
40492	GARLAT UC	68,2	25,7	1,7	0,3	4,1
40493	SAT BANI UC	2,2	69,3	18,6	5,6	4,2

Attachment 4/Table 3:

Scenario A: Population Exposure (Relative Number of People in %) Specified to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'

(Listed in Ascending Order of UN-OCHA UC Codes)

UN-OCHA UC Code	Name UC	Landslide Susceptibility Zone				
		Very High	High	Moderate	Low	Very Low
40494	KAWAI UC	39,9	46,6	11,3	2	0,2
40512	INAYAT ABAD UC	0	0,1	1,6	9	89,4
40513	LABAR KOT UC	0	0	0	0	100,6
40515	SHOHAL MAZULLAH UC	23,4	29	17	11,7	18,8
40522	KARNOL UC	19,7	10,7	26,7	23,8	19,3
40523	DEVLI JABBAR UC	0,8	6,8	11	45,2	36,1
40524	KARHORI UC	0	0	0	0,2	99,7
40531	HANGRAI UC	49,6	42,2	6,6	1,4	0,2
40533	TALHATA UC	20,7	32	18,7	6,8	21,3
40534	DATTA UC	0	0,8	5,6	15,2	78,3
40536	BANDI SHUNGLI UC	0	0	0	0,7	99,2
40537	SHAMDARA UC	0	0	0	0	100
40538	BALA KOT UC	1	43,8	26,3	15,7	13,2
40539	SHANKIARI UC	0	0	19,2	26,7	54,4
40542	SACHA KALAN UC	0	1	13,1	45,1	40,8
40543	JABORI UC	0,3	5,5	20,8	49,2	24
40549	SUM ELAHI MANG UC	0	2,7	11,1	33,8	52,4
40552	PARHANA UC	0	0	0	5,1	94,8
40564	MANSEHRA RURAL UC	0	0	3,2	20,3	75,6
40567	BAFFA TOWN UC	0	0	0	1,4	99,6
40571	MALIK PUR UC	0	0	0	6,7	93,6
40591	BELIAN UC	0	0,1	1,5	6,3	92,1
40592	SHER GARH UC	0	0	0	0	100
40593	SANDA SAR UC	0	0	0	1,9	98
40610	JALLOO UC	0	0	0	0,2	99,6
40880	AKAZAI	0	6,8	18	11,9	63,1

Attachment 5: Risk Exposure Map… Scenario B and related statistics (Table 1).

Attachment 5/Table 1: Scenario B: Population Exposure to Landslide Susceptibility Zones 'Very High' and 'High' (Listed in Descending Order of Sum of Exposed People)			
UN-OCHA UC Code	Name UC	Sum Exposed People (Absolute)/UC	Sum Exposed People (Relative in %)/UC
40492	GARLAT UC	17.332	93,87
40531	HANGRAI UC	16.753	91,79
40490	MOHANDRI UC	16.347	72,34
40491	GHANOOL UC	16.012	78,98
40494	KAWAI UC	11.925	86,49
40493	SAT BANI UC	11.410	71,54
40426	KAGHAN UC	10.911	48,39
40538	BALA KOT UC	8.617	44,75
40515	SHOHAL MAZULLAH UC	6.955	52,38
40533	TALHATA UC	6.907	52,67
40471	HASSAN KHEL	6.037	18,8
40522	KARNOL UC	5.414	30,4
40447	GARHI HABIBULLAH UC	2.908	15,06
40425	MADA KHEL	2.893	10,78
40880	AKAZAI	2.048	6,86
40523	DEVLI JABBAR UC	1.662	7,6
40472	BHOGAR MANG UC	1.282	9,94
40464	BASSI KHEL	947	1,26
40543	JABORI UC	790	5,85
40549	SUM ELAHI MANG UC	447	2,68
40428	BEHALI UC	342	2,04
40542	SACHA KALAN UC	138	0,98
40534	DATTA UC	121	0,78
40424	DAR BAND UC	101	0,65
40460	PAIRAN UC	64	0,51
40466	NUSRAT KHEL	62	0,58
40470	NIKKA PANI UC	30	0,24
40457	BATTAL UC	24	0,12
40481	HILKOT UC	22	0,14
40478	TARANGRI SABAR SHAH UC	20	0,11
40591	BELIAN UC	20	0,11
40454	TANDHA UC	18	0,15
40462	ICHHERIAN UC	16	0,07
40456	CHATER PIAIN UC	16	0,11

Attachment 5/Table 1: Scenario B: Population Exposure to Landslide Susceptibility Zones 'Very High' and 'High' (Listed in Descending Order of Sum of Exposed People)			
UN-OCHA UC Code	Name UC	Sum Exposed People (Absolute)/UC	Sum Exposed People (Relative in %)/UC
40434	LASSAN THUKRAL UC	16	0,12
40483	KATHAI UC	13	0,1
40463	SHOUKAT ABAD UC	12	0,08
40512	INAYAT ABAD UC	11	0,07

Attachment 6: Risk Exposure Map… Scenario C and related statistics (Table 1-2).

Attachment 6/Table 1: Scenario C: Road (Undifferentiated) Exposure to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low' (Listed in Descending Order of Sum of Exposed Roads)		
UN-OCHA UC Code	Name UC	Sum of Exposed Roads (in km-Length)
40426	KAGHAN UC	103,05
40422	MANSEHRA CITY (1-4) UC	24,56
40459	ATTAR SHISHA UC	20,74
40542	SACHA KALAN UC	16,00
40522	KARNOL UC	15,94
40454	TANDHA UC	15,46
40491	GHANOOL UC	14,90
40610	JALLOO UC	14,50
40462	ICHHERIAN UC	14,14
40494	KAWAI UC	13,73
40461	BHEER KUND UC	13,24
40484	OGHI UC	12,90
40552	PARHANA UC	12,71
40456	CHATER PIAIN UC	11,38
40447	GARHI HABIBULLAH UC	11,24
40531	HANGRAI UC	10,38
40490	MOHANDRI UC	10,30
40592	SHER GARH UC	10,04
40538	BALA KOT UC	9,99
40457	BATTAL UC	9,54
40549	SUM ELAHI MANG UC	9,49
40523	DEVLI JABBAR UC	9,29
40424	DAR BAND UC	9,11
40512	INAYAT ABAD UC	9,05
40524	KARHORI UC	8,92
40448	PHULRA UC	8,04
40593	SANDA SAR UC	7,85
40483	KATHAI UC	7,65
40515	SHOHAL MAZULLAH UC	7,62
40440	DARA SHANAYA UC	6,76
40470	NIKKA PANI UC	6,60
40458	DILBORI UC	6,24
40453	DHODIAL UC	6,23
40534	DATTA UC	5,79

Attachment 6/Table 1: Scenario C: Road (Undifferentiated) Exposure to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low' (Listed in Descending Order of Sum of Exposed Roads)		
UN-OCHA UC Code	Name UC	Sum of Exposed Roads (in km-Length)
40423	HAMSHERIAN UC	5,03
40543	JABORI UC	5,02
40537	SHAMDARA UC	4,76
40571	MALIK PUR UC	4,46
40539	SHANKIARI UC	4,43
40492	GARLAT UC	4,22
40493	SAT BANI UC	3,88
40472	BHOGAR MANG UC	3,84
40460	PAIRAN UC	3,58
40437	LASSAN NAWAB UC	3,27
40591	BELIAN UC	3,14
40436	SWAN MERA UC	3,04
40567	BAFFA TOWN UC	2,40
40478	TARANGRI SABAR SHAH UC	2,21
40463	SHOUKAT ABAD UC	1,82
40481	HILKOT UC	1,05
40533	TALHATA UC	0,40
40564	MANSEHRA RURAL UC	0,33

Attachment 6/Table 2:

Scenario C: Road (Undifferentiated) Exposure (in km-Length) Specified to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'

(Listed in Ascending Order of UN-OCHA UC Codes)

UN-OCHA UC Code	Name UC	Landslide Susceptibility Zone				
		Very High	High	Moderate	Low	Very Low
40422	MANSEHRA CITY (1-4) UC	0	0	1	1,6	22
40423	HAMSHERIAN UC	0	0	0	0	5
40424	DAR BAND UC	0	0,3	1,9	1,1	5,9
40426	KAGHAN UC	9,4	20,4	29,7	27,3	16,3
40436	SWAN MERA UC	0	0	0	0	3
40437	LASSAN NAWAB UC	0	0,1	0,3	1	1,9
40440	DARA SHANAYA UC	0	0	0	0,1	6,7
40447	GARHI HABIBULLAH UC	0,4	2,1	1,1	0,8	6,9
40448	PHULRA UC	0	0	0,1	0,1	7,8
40453	DHODIAL UC	0	0	0	0	6,2
40454	TANDHA UC	0	0	0,7	1,4	13,4
40456	CHATER PIAIN UC	0	0,1	1,4	2	7,9
40457	BATTAL UC	0	0	0,2	0,5	8,8
40458	DILBORI UC	0	0	0,2	0,8	5,3
40459	ATTAR SHISHA UC	0,1	0,3	1,8	2,9	15,6
40460	PAIRAN UC	0	0	0	0,2	3,4
40461	BHEER KUND UC	0	0,2	0,4	0,9	11,8
40462	ICHHERIAN UC	0	0,2	1,3	2,8	9,9
40463	SHOUKAT ABAD UC	0	0,1	0,2	0,6	0,9
40470	NIKKA PANI UC	0	0	0,3	2,5	3,8
40472	BHOGAR MANG UC	0	0	0	0	3,8
40478	TARANGRI SABAR SHAH UC	0	0	0	0	2,2
40481	HILKOT UC	0	0	0	0,2	0,8
40483	KATHAI UC	0	0	0,2	0,2	7,3
40484	OGHI UC	0	0	0	0	12,9
40490	MOHANDRI UC	5,1	3,5	1,4	0,3	0,1
40491	GHANOOL UC	12,8	1,9	0,1	0,1	0
40492	GARLAT UC	2,7	0,1	0,3	0,8	0,4
40493	SAT BANI UC	3,1	0,4	0	0	0,3
40494	KAWAI UC	11,3	2,3	0,2	0	0
40512	INAYAT ABAD UC	0	0	0	0	9,1
40515	SHOHAL MAZULLAH UC	0	0,9	1,3	1,9	3,5
40522	KARNOL UC	0,2	2,3	2,7	2,6	8,1
40523	DEVLI JABBAR UC	1,6	0,4	0,8	2,4	4,3
40524	KARHORI UC	0	0	0	0	8,9

Attachment 6/Table 2:

Scenario C: Road (Undifferentiated) Exposure (in km-Length) Specified to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'

(Listed in Ascending Order of UN-OCHA UC Codes)

UN-OCHA UC Code	Name UC	Landslide Susceptibility Zone				
		Very High	High	Moderate	Low	Very Low
40531	HANGRAI UC	8,3	1,9	0,2	0,1	0
40533	TALHATA UC	0	0	0	0	0,4
40534	DATTA UC	0	0	0	0,3	5,5
40537	SHAMDARA UC	0	0	0	0	4,8
40538	BALA KOT UC	1,3	1,6	1,6	2	3,5
40539	SHANKIARI UC	0	0	0	0	4,4
40542	SACHA KALAN UC	0,2	2	3,7	5,1	4,9
40543	JABORI UC	0,1	0,5	1,2	0,7	2,6
40549	SUM ELAHI MANG UC	0	0,2	1	0,9	7,4
40552	PARHANA UC	0	0,2	0,3	0,6	11,7
40564	MANSEHRA RURAL UC	0	0	0	0	0,3
40567	BAFFA TOWN UC	0	0	0	0	2,4
40571	MALIK PUR UC	0	0,1	0,3	0,4	3,7
40591	BELIAN UC	0	0	0	0	3,1
40592	SHER GARH UC	0	0	0	0	10
40593	SANDA SAR UC	0	0,2	0,2	0,5	7
40610	JALLOO UC	0	0	0	0	14,5

Attachment 7: Risk Exposure Map… Scenario D and related statistics (Table 1).

Attachment 7/Table 1: Scenario D: Road (1. Order) Exposure to Landslide Susceptibility Zones 'Very High' and 'High' (Listed in Descending Order of Sum of Exposed Roads)		
UN-OCHA UC Code	Name UC	Sum of Exposed Roads (in km-Length)
40426	KAGHAN UC	29,79
40491	GHANOOL UC	14,70
40494	KAWAI UC	13,53
40490	MOHANDRI UC	8,56
40538	BALA KOT UC	2,88
40492	GARLAT UC	2,80
40515	SHOHAL MAZULLAH UC	0,89
40522	KARNOL UC	0,22
40462	ICHHERIAN UC	0,15
40593	SANDA SAR UC	0,15
40456	CHATER PIAIN UC	0,13
40459	ATTAR SHISHA UC	0,09
40457	BATTAL UC	0,009

Attachment 8: Risk Exposure Map… Scenario E and related statistics (Table 1).

Attachment 8/Table 1: Scenario E: Road (2. Order) Exposure to Landslide Susceptibility Zones 'Very High' and 'High' (Listed in Descending Order of Sum of Exposed Roads)		
UN-OCHA UC Code	Name UC	Sum of Exposed Roads (in km-Length)
40531	HANGRAI UC	10,17
40493	SAT BANI UC	3,53
40447	GARHI HABIBULLAH UC	2,47
40522	KARNOL UC	2,31
40542	SACHA KALAN UC	2,28
40523	DEVLI JABBAR UC	1,92
40543	JABORI UC	0,58
40459	ATTAR SHISHA UC	0,27
40424	DAR BAND UC	0,27
40549	SUM ELAHI MANG UC	0,22
40461	BHEER KUND UC	0,17
40552	PARHANA UC	0,15
40463	SHOUKAT ABAD UC	0,12
40437	LASSAN NAWAB UC	0,07
40571	MALIK PUR UC	0,06
40470	NIKKA PANI UC	0,03

Attachment 9: Risk Exposure Map… Scenario F and related statistics (Table 1-2).

Attachment 9/Table 1:

Scenario F: Health Facility (Undifferentiated) Exposure to Landslide Susceptibility Zones

'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'

(Listed in Descending Order of Sum of Exposed Health Facilities)

UN-OCHA UC-CODE	Name UC	Sum of Exposed Health Facilities	Sum of Exposed People	Landslide Exposure Health Care Index
40524	KARHORI UC	3	23.582	7.861
40490	MOHANDRI UC	3	22.562	7.521
40484	OGHI UC	3	21.701	7.234
40422	MANSEHRA CITY (1-4) UC	2	49.499	24.750
40592	SHER GARH UC	2	22.588	11.294
40426	KAGHAN UC	2	22.525	11.263
40457	BATTAL UC	2	20.702	10.351
40448	PHULRA UC	2	20.637	10.319
40538	BALA KOT UC	2	19.252	9.626
40542	SACHA KALAN UC	2	14.025	7.013
40459	ATTAR SHISHA UC	2	13.858	6.929
40494	KAWAI UC	2	13.779	6.890
40436	SWAN MERA UC	2	13.007	6.504
40567	BAFFA TOWN UC	1	23.344	23.344
40539	SHANKIARI UC	1	22.898	22.898
40491	GHANOOL UC	1	20.313	20.313
40447	GARHI HABIBULLAH UC	1	19.285	19.285
40591	BELIAN UC	1	18.650	18.650
40552	PARHANA UC	1	18.321	18.321
40531	HANGRAI UC	1	18.249	18.249
40478	TARANGRI SABAR SHAH UC	1	17.629	17.629
40461	BHEER KUND UC	1	17.067	17.067
40610	JALLOO UC	1	16.712	16.712
40428	BEHALI UC	1	16.707	16.707
40549	SUM ELAHI MANG UC	1	16.659	16.659
40512	INAYAT ABAD UC	1	16.341	16.341
40458	DILBORI UC	1	16.191	16.191
40424	DAR BAND UC	1	15.638	15.638
40593	SANDA SAR UC	1	15.610	15.610
40481	HILKOT UC	1	15.595	15.595
40534	DATTA UC	1	15.488	15.488
40437	LASSAN NAWAB UC	1	15.471	15.471
40456	CHATER PIAIN UC	1	14.240	14.240
40536	BANDI SHUNGLI UC	1	13.617	13.617

Attachment 9/Table 1: Scenario F: Health Facility (Undifferentiated) Exposure to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low' (Listed in Descending Order of Sum of Exposed Health Facilities)				
UN-OCHA UC-CODE	Name UC	Sum of Exposed Health Facilities	Sum of Exposed People	Landslide Exposure Health Care Index
40515	SHOHAL MAZULLAH UC	1	13.268	13.268
40483	KATHAI UC	1	13.176	13.176
40434	LASSAN THUKRAL UC	1	13.166	13.166
40533	TALHATA UC	1	13.051	13.051
40460	PAIRAN UC	1	12.578	12.578
40454	TANDHA UC	1	12.418	12.418
40470	NIKKA PANI UC	1	12.399	12.399

Attachment 9/Table 2:

Scenario F: Health Facility (Undifferentiated) Exposure (Count) to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'

(Listed in Ascending Order of UN-OCHA UC Codes)

UN-OCHA UC Code	Name UC	Landslide Susceptibility Zone				
		Very High	High	Moderate	Low	Very Low
40422	MANSEHRA CITY (1-4) UC	0	0	0	0	2
40424	DAR BAND UC	0	0	0	0	1
40426	KAGHAN UC	0	0	1	1	0
40428	BEHALI UC	0	0	0	0	1
40434	LASSAN THUKRAL UC	0	0	0	0	1
40436	SWAN MERA UC	0	0	0	0	2
40437	LASSAN NAWAB UC	0	0	0	0	1
40447	GARHI HABIBULLAH UC	0	0	0	0	1
40448	PHULRA UC	0	0	0	0	2
40454	TANDHA UC	0	0	0	1	0
40456	CHATER PIAIN UC	0	0	0	0	1
40457	BATTAL UC	0	0	0	0	2
40458	DILBORI UC	0	0	0	0	1
40459	ATTAR SHISHA UC	0	0	0	0	2
40460	PAIRAN UC	0	1	0	0	0
40461	BHEER KUND UC	0	0	0	0	1
40470	NIKKA PANI UC	0	0	0	0	1
40478	TARANGRI SABAR SHAH UC	0	0	0	0	1
40481	HILKOT UC	0	0	0	0	1
40483	KATHAI UC	0	0	0	0	1
40484	OGHI UC	0	0	0	0	3
40490	MOHANDRI UC	0	1	1	1	0
40491	GHANOOL UC	0	1	0	0	0
40494	KAWAI UC	0	2	0	0	0
40512	INAYAT ABAD UC	0	0	0	0	1
40515	SHOHAL MAZULLAH UC	0	1	0	0	0
40524	KARHORI UC	0	0	0	0	3
40531	HANGRAI UC	1	0	0	0	0
40533	TALHATA UC	0	0	0	0	1
40534	DATTA UC	0	0	0	0	1
40536	BANDI SHUNGLI UC	0	0	0	0	1
40538	BALA KOT UC	0	0	0	0	2
40539	SHANKIARI UC	0	0	0	0	1
40542	SACHA KALAN UC	0	0	0	0	2
40549	SUM ELAHI MANG UC	0	0	0	0	1

Attachment 9/Table 2:

Scenario F: Health Facility (Undifferentiated) Exposure (Count) to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'

(Listed in Ascending Order of UN-OCHA UC Codes)

UN-OCHA UC Code	Name UC	Landslide Susceptibility Zone				
		Very High	High	Moderate	Low	Very Low
40552	PARHANA UC	0	0	0	0	1
40567	BAFFA TOWN UC	0	0	0	0	1
40591	BELIAN UC	0	0	0	0	1
40592	SHER GARH UC	0	0	0	0	2
40593	SANDA SAR UC	0	0	0	0	1
40610	JALLOO UC	0	0	0	0	1

Attachment 10: Risk Exposure Map… Scenario G and related statistics (Table 1).

Attachment 10/Table 1: Scenario G: Health Facility (Undifferentiated) Exposure to Landslide Susceptibility Zones 'Very High' and 'High' (Listed in Descending Order of Sum of Exposed Health Facilities)		
UN-OCHA UC Code	Name UC	Sum of Exposed Health Facilities (Count)
40494	KAWAI UC	2
40531	HANGRAI UC	1
40515	SHOHAL MAZULLAH UC	1
40491	GHANOOL UC	1
40490	MOHANDRI UC	1
40460	PAIRAN UC	1

Attachment 11: Risk Exposure Map… Scenario H and related statistics (Table 1-2).

Attachment 11/Table 1: Scenario H: Health Facility (Civil Hospital/CH and Special Hospital/SH) Exposure to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low' (Listed in Ascending Order of UN-OCHA Codes)		
UN-OCHA UC Code	Name UC	Sum of Exposed Health Facilities (Count)
40422	MANSEHRA CITY (1-4) UC	1
40424	DAR BAND UC	1
40426	KAGHAN UC	1
40447	GARHI HABIBULLAH UC	1
40448	PHULRA UC	1
40457	BATTAL UC	1
40484	OGHI UC	1
40538	BALA KOT UC	1
40542	SACHA KALAN UC	1
40567	BAFFA TOWN UC	1

Attachment 11/Table 2: Scenario H: Health Facility (Civil Hospital/CH and Special Hospital/SH) Exposure (Count) to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low' (Listed in Ascending Order of UN-OCHA UC Codes)			
UN-OCHA	Name	Landslide Susceptibility Zone	
UC Code	UC	Moderate	Very Low
40422	MANSEHRA CITY (1-4) UC	0	1
40424	DAR BAND UC	0	1
40426	KAGHAN UC	1	0
40447	GARHI HABIBULLAH UC	0	1
40448	PHULRA UC	0	1
40457	BATTAL UC	0	1
40484	OGHI UC	0	1
40538	BALA KOT UC	0	1
40542	SACHA KALAN UC	0	1
40567	BAFFA TOWN UC	0	1

Attachment 12: Risk Exposure Map… Scenario I and related statistics (Table 1-2).

Attachment 12/Table 1: Scenario I: Health Facility (Rural Health Unit/RHU) Exposure to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low' (Listed in Ascending Order of UN-OCHA UC Codes)		
UN-OCHA UC CODE	Name UC	Sum of Exposed Health Facilities (Count)
40434	LASSAN THUKRAL UC	1
40437	LASSAN NAWAB UC	1
40456	CHATER PIAIN UC	1
40478	TARANGRI SABAR SHAH UC	1
40484	OGHI UC	1
40494	KAWAI UC	1
40539	SHANKIARI UC	1
40542	SACHA KALAN UC	1

Attachment 12/Table 2: Scenario I: Health Facility (Rural Health Unit) Exposure (Count) to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low' (Listed in Ascending Order of UN-OCHA UC Codes)			
UN-OCHA UC Code	Name UC	Landslide Susceptibility Zone	
		High	Very Low
40434	LASSAN THUKRAL UC	0	1
40437	LASSAN NAWAB UC	0	1
40456	CHATER PIAIN UC	0	1
40478	TARANGRI SABAR SHAH UC	0	1
40484	OGHI UC	0	1
40494	KAWAI UC	1	0
40539	SHANKIARI UC	0	1
40542	SACHA KALAN UC	0	1

Attachment 13: Risk Exposure Map… Scenario J and related statistics (Table 1-2).

Attachment 13/Table 1: Scenario J: Health Facility (Basic Health Unit/BHU) Exposure to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low' (Listed in Descending Order of Sum of Exposed Basic Health Units)		
UN-OCHA UC Code	Name UC	Sum of Exposed Health Facilities (Count)
40490	MOHANDRI UC	3
40524	KARHORI UC	3
40459	ATTAR SHISHA UC	2
40592	SHER GARH UC	2
40436	SWAN MERA UC	2
40483	KATHAI UC	1
40481	HILKOT UC	1
40470	NIKKA PANI UC	1
40461	BHEER KUND UC	1
40460	PAIRAN UC	1
40422	MANSEHRA CITY (1-4) UC	1
40457	BATTAL UC	1
40454	TANDHA UC	1
40448	PHULRA UC	1
40428	BEHALI UC	1
40426	KAGHAN UC	1
40458	DILBORI UC	1
40491	GHANOOL UC	1
40610	JALLOO UC	1
40494	KAWAI UC	1
40512	INAYAT ABAD UC	1
40515	SHOHAL MAZULLAH UC	1
40531	HANGRAI UC	1
40533	TALHATA UC	1
40534	DATTA UC	1
40536	BANDI SHUNGLI UC	1
40538	BALA KOT UC	1
40549	SUM ELAHI MANG UC	1
40552	PARHANA UC	1
40591	BELIAN UC	1
40593	SANDA SAR UC	1
40484	OGHI UC	1

Attachment 13/Table 2:

Scenario J: Health Facility (Basic Health Unit/BHU) Exposure (Count) to Landslide Susceptibility Zones 'Very High' and 'High' and 'Moderate' and 'Low' and 'Very Low'

(Listed in Ascending Order of UN-OCHA UC Codes)

UN-OCHA UC Code	Name UC	Landslide Susceptibility Zone				
		Very High	High	Moderate	Low	Very Low
40422	MANSEHRA CITY (1-4) UC	0	0	0	0	1
40426	KAGHAN UC	0	0	0	1	0
40428	BEHALI UC	0	0	0	0	1
40436	SWAN MERA UC	0	0	0	0	2
40448	PHULRA UC	0	0	0	0	1
40454	TANDHA UC	0	0	0	1	0
40457	BATTAL UC	0	0	0	0	1
40458	DILBORI UC	0	0	0	0	1
40459	ATTAR SHISHA UC	0	0	0	0	2
40460	PAIRAN UC	0	1	0	0	0
40461	BHEER KUND UC	0	0	0	0	1
40470	NIKKA PANI UC	0	0	0	0	1
40481	HILKOT UC	0	0	0	0	1
40483	KATHAI UC	0	0	0	0	1
40484	OGHI UC	0	0	0	0	1
40490	MOHANDRI UC	0	1	1	1	0
40491	GHANOOL UC	0	1	0	0	0
40494	KAWAI UC	0	1	0	0	0
40512	INAYAT ABAD UC	0	0	0	0	1
40515	SHOHAL MAZULLAH UC	0	1	0	0	0
40524	KARHORI UC	0	0	0	0	3
40531	HANGRAI UC	1	0	0	0	0
40533	TALHATA UC	0	0	0	0	1
40534	DATTA UC	0	0	0	0	1
40536	BANDI SHUNGLI UC	0	0	0	0	1
40538	BALA KOT UC	0	0	0	0	1
40549	SUM ELAHI MANG UC	0	0	0	0	1
40552	PARHANA UC	0	0	0	0	1
40591	BELIAN UC	0	0	0	0	1
40592	SHER GARH UC	0	0	0	0	2
40593	SANDA SAR UC	0	0	0	0	1
40610	JALLOO UC	0	0	0	0	1

Attachment 14: GRASP coding schema, Part 1-4 (as to overall theme group structure see BALZER 2011).

Following assumption with regard to a nationwide risk (exposure) assessment has been made: District level (level 3) shall be deemed as the highest level of resolution of hazard assessment and selected elements at risk related information to be coded. Please keep in mind: for this REA study only District related GRASP codes have been applied.

Attachment 14: GRASP Coding Schema, Part 1: Theme Group 'Topography'						
Theme Group		Theme		Value Code		Theme Value Code (GIS)
Topic	Code	Sub-Topic	Code	Sub-Topic Feature	Code	Composite Code
Topography	1000	National Level: Level 1		**Example: Road Type Classification, e.g. 100-200**		
			1100	2. Order	101	1100101
				1. Order	102	1100102
Topography	1000	Provincial Level: Level 2		**Example: Road Type Classification, e.g. 100-200**		
			1200	2. Order	101	1200101
				1. Order	102	1200102
Topography	1000	District Level: Level 3		**Example: Road Type Classification, e.g. 100-200 Applied for REA of Mansehra & Torghar Districts in Accordance to GEOFABRIK (2014)**		
			1300	2. Order	101	1300101
				1. Order	102	1300102

Attachment 14: GRASP Coding Schema, Part 2: Theme Group 'Land Cover'						
Theme Group		Theme		Value Code		Theme Value Code (GIS)
Topic	Code	Sub-Topic	Code	Sub-Topic Feature	Code	Composite Code
Land Use/Cover	4000	National Level: Level 1		**Example: Land Cover Classes, e.g. 100-200**		
			4100	Agriculture	101	4100101
				Forest	102	4100102
				Water	103	4100103
Land Use/Cover	4000	Provincial Level: Level 2		**Example: Land Cover Classes, e.g. 100-200**		
			4200	Agriculture	101	4200101
				Forest	102	4200102
				Water	103	4200103
Land Use/Cover	4000	District Level: Level 3		**Example: Land Cover Classes, e.g. 100-200 Applied for REA of Mansehra & Torghar Districts in Accordance to FUCHS & KHALID (2015): see Chapter 3.1**		
			4300	Water	101	4300101
				Glacier	102	4300102
				Ice/Snow	103	4300103
				Forest	104	4300104
				Shrub Land and Degraded Forest	105	4300105
				Mixed Cultivation and Plantation	106	4300106
				Non-Terraced Agriculture	107	4300107
				Mostly Agriculture on Terraces	108	4300108 (5320101, See Part 3)
				Bare Ground Type I	109	4300109
				Bare Ground Type II	110	4300110
				Agriculture and Scattered Houses	111	4300111 (5320101, See Part 3)
				Settlement Areas	112	4300112 (5320101, See Part 3)

Attachment 14: GRASP Coding Schema, Part 3: Theme Group 'Infrastructure'						
Theme Group		Theme		Value Code		Theme Value Code (GIS)
Topic	Code	Sub-Topic	Code	Sub-Topic Feature	Code	Composite Code
Infrastructure	5000	National Level: Level 1		**Example: Health Facility Classification, e.g. 100-200**		
			5110	Civil Hospital	101	5110101
				Teaching Hospital (University)	102	5110102
			5120	**Example: Settlement Areas, e.g. According to Population Figures: 100-200**		
				Settlement Areas (> 500.000)	101	5120101
				Settlement Areas (> 1.000.000)	102	5100102
Infrastructure	5000	Provincial Level: Level 2		**Example: Health Facility Classification, e.g. 100-200**		
			5210	Civil Hospital	101	5210101
				Teaching Hospital (University)	102	5210102
				Rural Health Unit	103	5210103
			5220	**Example: Settlement Areas, e.g. According to Population Figures: 100-200**		
				Settlement Areas (> 100.000)	101	5220101
				Settlement Areas (> 500.000)	102	5220102
				Settlement Areas (> 1.000.000)	103	5220103
Infrastructure	5000	District Level: Level 3		**Example: Health Facility Classification, e.g. 100-200** **Applied for REA of Mansehra & Torghar Districts in Accordance to NIH (2011) & HDMD (2015)**		
			5310	Civil Hospital (CH)	101	5310101
				Rural Health Unit (RHU)	102	5310102
				Basic Health Unit (BHU	103	5310103
				Special Hospital (SH)	104	5310104
			5320	**Example: Settlement Areas, e.g. Undifferentiated: 100-200** **Applied for REA of Mansehra & Torghar Districts**		
				Settlement Areas (Undifferentiated)	101	5320101 (See Part 2)

Attachment 14: GRASP Coding Schema, Part 5: Theme Group 'Landslide Hazard (Susceptibility)'						
Theme Group		Theme		Value Code		Theme Value Code (GIS)
Topic	Code	Sub-Topic	Code	Sub-Topic Feature	Code	Composite Code
Landslide Hazard (Susceptibility)	6000	National Level: Level 1		**Example: Landslide Susceptibility Zonation, e.g. 100-200**		
			6100	High	101	6100101
				Moderate	102	6100102
				Low	103	6100103
Landslide Hazard (Susceptibility)	6000	Provincial Level: Level 2		**Example: Landslide Susceptibility Zonation, e.g. 100-200**		
			6200	High	101	6200101
				Moderate	102	6200102
				Low	103	6200103
Landslide Hazard (Susceptibility)	6000	District Level: Level 3		**Example: Landslide Susceptibility Zonation, e.g. 100-200 Applied for REA of Mansehra & Torghar Districts in Accordance to GSP (2015)**		
			6300	Very High	101	6300101
				High	102	6300102
				Moderate	103	6300103
				Low	104	6300104
				Very Low	105	6300105