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Monographic issue

Disaster risk profile of Popular Republic of North Korea

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Letter from the editors

The *Emergency and Disaster Reports* is a journal edited by the Unit for Research in Emergency and Disaster of the Department of Medicine of the University of Oviedo aimed to introduce research papers, monographic reviews and technical reports related to the fields of Medicine and Public Health in the contexts of emergency and disaster. Both situations are events that can deeply affect the health, the economy, the environment and the development of the affected populations.

The topics covered by the journal include a wide range of issues related to the different dimensions of the phenomena of emergency and disaster, ranging from the study of the risk factors, patterns of frequency and distribution, characteristics, impacts, prevention, preparedness, mitigation, response, humanitarian aid, standards of intervention, operative research, recovery, rehabilitation, resilience and policies, strategies and actions to address these phenomena from a risk reduction approach. In the last thirty years has been substantial progress in the above mentioned areas in part thanks to a better scientific knowledge of the subject. The aim of the journal is to contribute to this progress facilitating the dissemination of the results of research in this field.

This third number of 2016 of the *Emergency and Disaster Reports* covers the situation in the Popular Republic of North Korea. From the findings presented in this report it becomes clear that North Korea faces natural and man-made hazards and moreover is highly vulnerable to disaster. As North Korea does not seem capable of maintaining centralized total control particularly in disaster situations, governing bodies have to invest in the marketization of the economy as well as reforms that allow greater political and social freedoms. This in turn will open up opportunities for policy dialogue, interagency engagement as well as regional and global partnership working.

Although improvements have been made in the past with regards to Disaster Response and Risk Reduction in order to mitigate crisis and to address root causes of vulnerabilities emphasis must lie on emergency response but also on building resilience while addressing immediate and intermediate needs in nutrition, health, agriculture, water and sanitation.

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Abbreviations

CBDP	Community Based Disaster Preparedness Program
CBEW	Community-based evacuations and warning guidelines
CBHFA	Community based health and first aid
CDMC	Disaster Management Committee
CEA	China Earthquake Administration
CERF	Central Emergency Response Fund
CFSAM	Crop and Food Security Assessment Mission
CIA	Central Intelligence Agency
CRED	Centre for Research on the Epidemiology of Disasters
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization
CVD	Cardiovascular Disease
DEWATS	Decentralized waste water treatment systems
DM	Disaster Management
DPRK	Democratic People's Republic of Korea
DRR	Disaster Risk Reduction
ECHO	The European Commission's Humanitarian Office
EEMP	Environmental Education Media Project
EM-DAT	Emergency Events Database
EMOP	Emergency Food Operation
FAO	Food and Agriculture Organizations of the United Nations
GDP	Gross National Product
GFS	Gravity-fed water supply system
IDC	International Data Centre
IFRC	International Federation of Red Cross and Red Crescent Societies
IMR	Infant Mortality Rate
MASL	Metres above sea level
MMR	Maternity Mortality Rate
MoPH	Ministry of Public Health
NDRT	National Disaster Response Team
NGO	Non-governmental Organization
OCHA	Office for the Coordination of Humanitarian Affairs
OPEC	Organization of the Petroleum Exporting Countries
PDRT	Provincial Disaster Response Teams
PIINTEC	Pyongyang Internat Informat Centre on new Technology & Economy
RCS	Red Cross Society
TB	Tuberculosis
U.S.	United States
U5MR	Under 5 Mortality Rate
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
UNICEF	United Nations International Children's Emergency Fund
UNISDR	United Nations International Strategy for Disaster Reduction
USGS	US Geological Survey
VCA	Vulnerability and Capacity Assessment
Watsan	Water and Sanitation
WES	Water and Environmental Sanitation Program
WFP	World Food Program

1. Objective

This report provides a comprehensive risk analysis of the Democratic People's Republic of Korea (DRPK) with description of various hazards, vulnerabilities, damage and losses. It is particularly concerned with natural as well as man-made Disasters that happened in the DPRK in the last 50 years.

It presents a summary of their occurrence, frequency and their impact on the population. It also will assess the impact on health, economy, the environment and the development of the country. In doing so it will determine main hazards and vulnerability factors present in North Korea in the past up to today.

Such factors will be evaluated in order to identify structures and characteristics of the emergency and disaster response systems in place which serve to inform coping and adaptive strategies for communities at risk. Following this it will determine disaster prevention and response strategies implemented by authorities and stakeholders, local as well as governmental authorities.

Conclusion made from this report might serve as a reference for disaster risk reduction efforts and disaster management for practitioners, and agencies involved in disasters. Thereby findings might have the potential to strengthen policy planning as well as efforts to mitigate risks with regards to Disaster Prevention and Response in the DPRK.

2. Methodology

The Disaster Profile for DPRK presents secondary data retrieved from databases including EM-DAT, Reliefweb, the United Nations, (UN), the World Food Program (WFP) and the World Health Organization (WHO). It also includes emergency appeals, disaster reports, surveys and case studies that have been taken from the official International Federation of Red Cross and Red Crescent Societies (IFRC) website.

Other sources used were governmental and organizational mortality surveys, incidence reports, fact sheets, articles, guidelines and manuals from source such as WFP, WHO, United Nations International Children's Emergency Fund (UNICEF) as well as United Nations International Strategy for Disaster Reduction (UNISDR).

All collected information and data was critically selected and reviewed. The classification and statistics have been adopted from CRED disaster database EM-DAT, The European Commission's Humanitarian Office (ECHO) as well as from IFRC reports. Maps were obtained through exploring the Office for the Coordination of Humanitarian Affairs (OCHA), UNISDR, WHO, PreventionWeb, ReliefWeb and various academic research papers.

3. Introduction - Country Profile

The Democratic People's Republic of Korea (DPRK) is located on the northern part of the Korean Peninsula and covers 122,762 km². It borders in the north with China and Russia and in the south with the Republic of Korea (Figure 1) (1-3).

DPRK is intersected by three major rivers: the Amrok, the Tuman and the Taedong (on which the capital Pyongyang is located) (1). Over 80 percent of the country's terrain is mountainous. Those mountainous areas are separated by deep, narrow valleys. Coastal areas which are mainly situated in the west and east are plain, wide and discontinuous in parts (1;3;4). The lowest point of the country is the Sea of Japan with 0 meters above sea level (MASL), whereas the highest point is Mount Paektu-san with a respectable 2,744 MASL (3).

BASIC FACTS	
▪	Population: 24.1 million
▪	Estimated average annual growth rate: 0.85%
▪	Average life expectancy: 69.3 years Men: 65.6 years Women: 72.7 years
▪	Literacy rate: + 99%
▪	Urban population: 61%
▪	Under-five mortality rate: 25.7 per 1000 live births
▪	Maternal Mortality rate: 85 to 250 per 100,000 live births (depending on estimates)
▪	Number of chronic poor: 7.2 million (37%)
<i>Sources: 2008 DPRK Population Census, CBS & UNFPA (surveys/assessments), and agencies WFP/FAO, UNICEF, HMIS</i>	

Flat land which is often interspersed with un-terraced uplands spreads mostly through the central western coastal areas (1). Such areas are devoted to rice and maize cropping whereas lower hillsides are devoted to permanent crops.

Upper hills and mountains are mostly wooded. Although this indicates large areas of forestland, a great level of deforestation has occurred over the last years. This means that about as much as a quarter of the non-agricultural hilly and mountainous land is bare (1).

The DPRK is known for having long, cold, dry winters and short, hot, humid summers, with temperatures ranging between -8°C in December and 27°C in August (2). Approximately between 600mm and 1,400mm rainfall occurs each year. Approximately 60% of which falls between June and September (3).

The World Food Program (1) here has pointed out that uneven and unreliable distribution of rainfall together with a frost period lasting up 6 months makes any agricultural activity difficult (1). In 2014 the population of North Korea was estimated to be 24,851,627 with an approximate age distribution as followed (Figure 2):

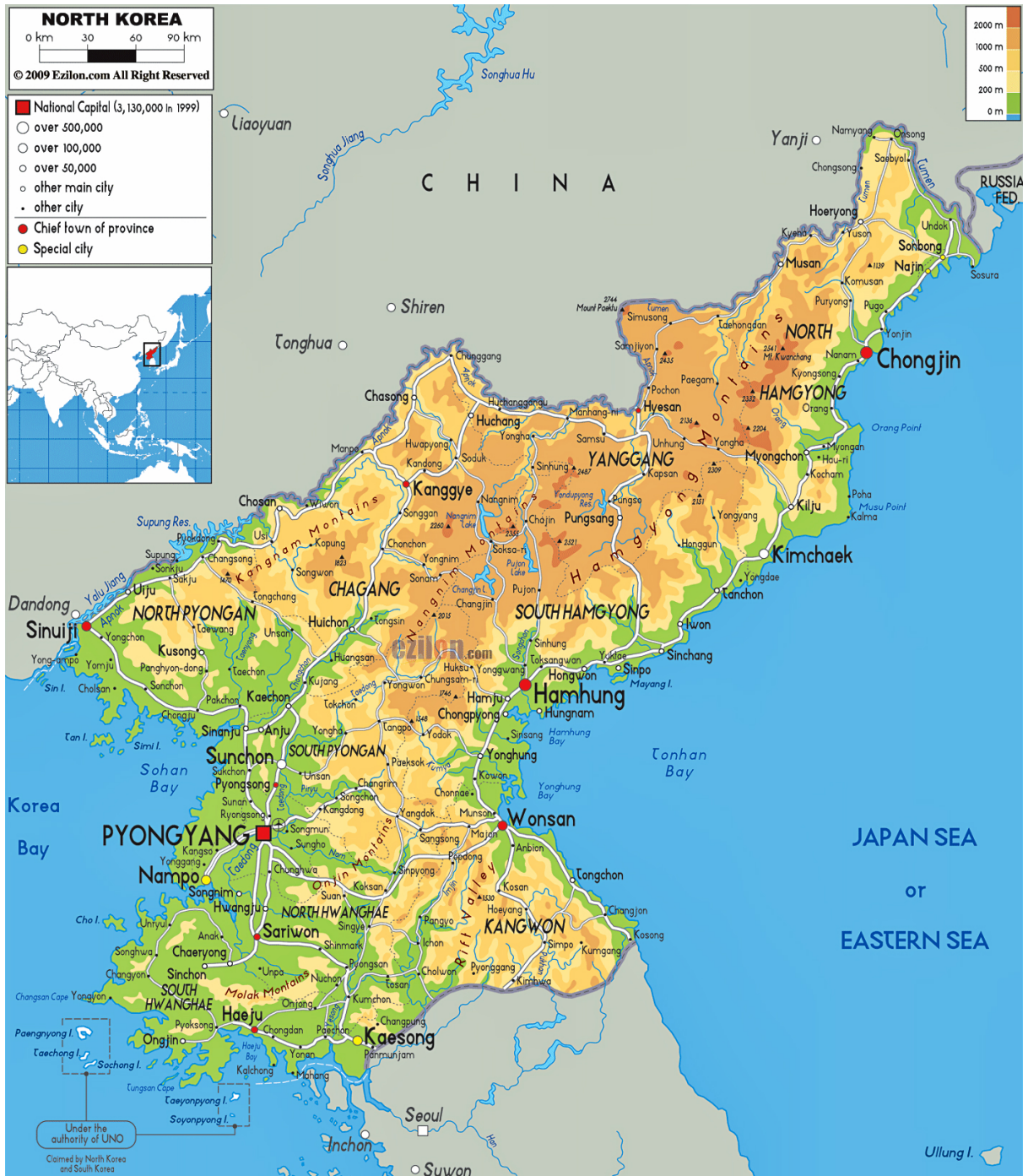


Figure 1: Physical map of North Korea; Source: Ezilon.com 2014

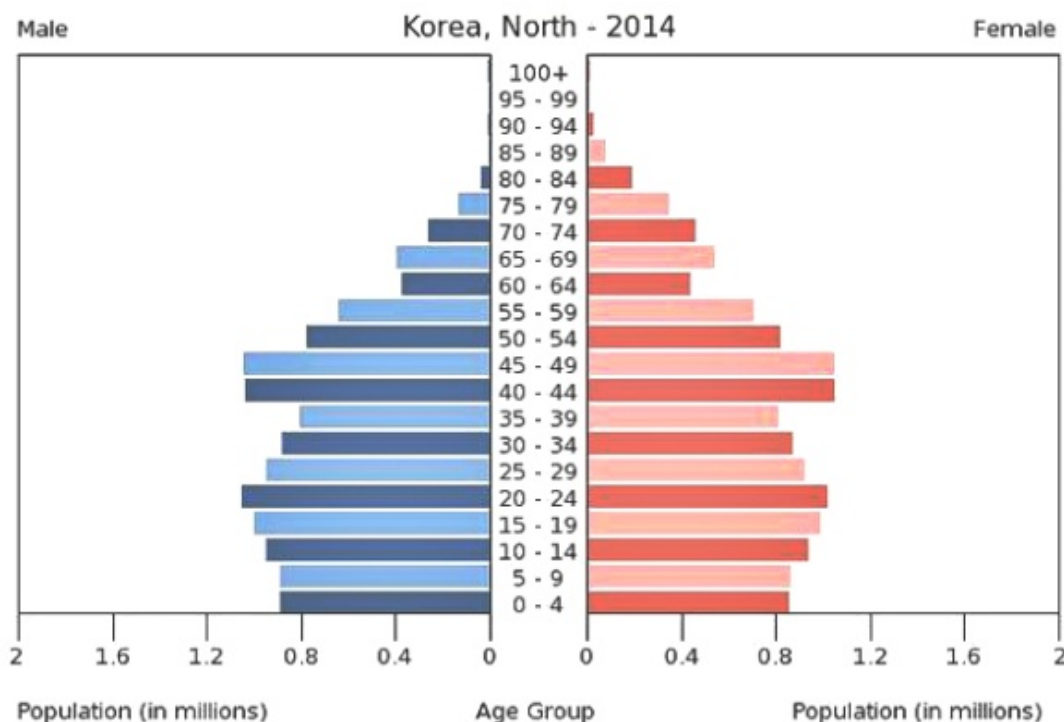


Figure 2: Demographics North Korea 2014; Source: CIA World Factbook 2014

About two-thirds of the population lives in urban areas, one-third in rural. According to the WFP (1) the active labour force is estimated around 11 million (about 50 percent of the population). About 35% of the active labour force works in agriculture, the remaining 65% in industry and services (2008 est.) (3).

The DPRK also has a traditional vocation for mining and heavy industry (2). Natural resources which are used for export include various metals and magnesite (1;3) whereas imports compose of crude oil, wheat, chemicals, transport equipment, high-grade iron and steel products and advanced machinery (1).

After the end of the Second World War in August 1945 Korea declared independence from Japan and divided into North and South Korea (5). Shortly after and with the end of the Korean War in 1953 North Korea adopted a policy of ostensible diplomatic and economic "self-reliance"(Juche) as a check against outside influence (3).

Under this concept the government consists of an authoritarian socialist; one-man dictatorship who is committed to an independent, isolated, centrally planned economy and socialist ownership of the means of production (5). This means that prices, wages, trade, budget, and banking are under strict government control and that private property only derives from socialist distribution (1;4).

Media censorship is enforced strictly, violators are subject to severe punishment, and reception of television systems are restricted to government broadcasts and all electronic media as well as print media is controlled by the state (3). North Korea

has a national medical service and health insurance system. Medical treatment is free of charge (2).

Although the Physicians bed density as well as Hospital bed density (3.29 physicians/1,000 population (2003)); 13.2 beds/1,000 population (2002)) indicate a sufficient health system it has been estimated that about 60 percent of children suffer from malnutrition, and 16 percent from acute malnutrition (3;4). UN statistics for the period between 1999 and 2001 reveal that North Korea's daily per capita food supply was one of the lowest in Asia, exceeding only that of Cambodia, Laos, and Tajikistan.

According to United Nations data, 27 percent of North Korea's population is at or below the absolute poverty level, living on less than US\$1 per day (3). 12.1% of the population only has access to unimproved sanitation facility, most of which are located in rural areas (2012 est.) (3).

Inequalities also seem to exist with regards to housing and food. According to the Central Intelligence Agency (CIA) (3) housing and food rations traditionally are heavily subsidized for the general population, whereas the party, state, and military elites seem to enjoy a much better welfare. It is believed that as much as 44.4 percent of the total government budget is spent on the military and defence of the country.

These geographical, topographical and particularity socio-economic factors highlighted above make North Korea extremely exposed and highly vulnerable to hazards (3). Major natural hazards reported include severe flooding as well as occasional typhoons during the early fall, which have greatly affected agriculture by causing water pollution, soil erosion and land degradation (1).

North Korea also has had a long history of Epidemics and ongoing Famines and had to deal with hazards such as Volcanic & Seismic Activity, Earthquakes and Industrial Accidents. A series of natural disaster in the 1990s caused a breakdown in food rationing and a rise in inequality of services such as health services and rural infrastructure, including irrigation and drainage systems (1). Besides all this, Deforestation & Desertification is causing environmental degradation, worsening the impact of any occurring hazard.

In order to avoid the present scale of losses and damages in the future it is crucial to address the context of vulnerability. Experiences from other countries have shown that such an objective requires a detailed mapping and assessment of the risk. Taking such measure has however proven to be a great challenge due to North Korea's political and economic self-reliance philosophy.

Although extreme events such as the famine in the 1990s have provided opportunities for collaboration and cooperation, North Korea seems to be one of the most difficult countries to reach out to. It is therefore vital to further explore underlying factor for Hazards and Vulnerabilities and to set up an effective and reliable Disaster Response and Management Systems that are able to mitigate crisis through surveillance and preparedness.

5. Disaster Hazards & Vulnerability

A Disaster has been defined as a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using their own resources (6).

The risk of a disaster occurring depends on the hazard and the level of vulnerability to the hazard. Hazards are defined as natural or man-made process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Natural hazards are proven to cause the greatest harm in combination with existing problems and vulnerability factors such as overpopulation, demographic imbalance, poor governance, endemic poverty, and lack of infrastructure (7). As Vulnerability factors also account: Physical, Social, Economic and psychological characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.

In an event of complex emergency or disaster high emphasis lies on the ability of people, organizations and systems, to collaborate, use available skills and coping strategies as well as manage resources. In recent years the importance of preventative measures with regards to risk reduction has been highlighted. Such suggest that not only through systematic efforts to analyse and manage the causal factors of the hazard but also by working on systems that effectively can reduce vulnerability factors and exposure, the severity of a disaster can tremendously be reduced (6).

5.1 The Hazards

A hazard with regards to disasters can be defined as a threatening event, or probability of occurrence of a potentially damaging phenomenon within a given time period and area. It can be distinguished between natural and man-made hazards. Natural hazards are naturally occurring physical phenomena caused either by rapid or slow onset events which can be geophysical (earthquakes, landslides, tsunamis and volcanic activity), hydrological (avalanches and floods), climatologically (extreme temperatures, drought and wildfires), meteorological (cyclones and storms/wave surges) or biological (disease epidemics and insect/animal plagues).

Technological or man-made hazards on the other hand include complex emergencies/conflicts, famine, displaced populations, industrial accidents and transport accidents. Those are events that are caused by humans and occur in or close to human settlements. This can include environmental degradation, pollution and accidents. It has been shown that in recent years there has been an increased risk of hazards in frequency, complexity and severity. Such development is ought to be due to changes in climate change as well as due to unplanned-urbanization, poverty and the spread of pandemics' (8).

In North Korea a total of 47 disasters have been reported between 1987 and 2013. 35 of which are natural disasters (Table 1). Em-Dat also found 8 industrial disasters and one complex disaster which can be related to the flooding in 1995/96. It also reported two incidences of epidemics, one of which is related to the Tuberculosis Epidemic of 2006 and the other related to Measles outbreaks in 2000. Data on the reported Earthquake was not found.

Total numbers of death related to natural disasters is approximated to 2171 people and 2808 injured. Although the number of people physically suffering appears relatively low the total number of people affected by natural disaster equates to 16,077,297 causing a total damage of \$23,653,310 (9).

TOTALS						
Occurrence	Deaths	Injured	Affected	Homeless	Total affected	Total damage ('000 \$)
35	2171	2808	14792262	1282227	16077297	23653310

Table 1: Impact of Natural Disasters from 1987-2013; Source: EM-DAT 2014

5.1.1 Floods

North Korea experiences episodes of up to six weeks concentrated heavy showers and scattered storms, particularly in July and August (approximately 85% of the annual rainfall happens in this period). Problems occur as the denuded landscapes of the DPRK have only a limited capacity to absorb water. This in turn exacerbates flooding and leads to soil erosion of both marginal and arable land (7).

It has been estimated that the frequency and intensity of natural disasters particularly in relation to flooding have increased during the last decades, causing severe damage to infrastructure, agricultural and forest resources (7;10). During the years of 1980 to 2013, 19 major floods have been reported in North Korea, making territorial heavy rains the greatest hazard the country faces up to date (9).

On average each event of flooding cost 96 lives and affected 597,449 people. The average economical damages were estimated at \$922,705.26 (11). Mortality rates in Floods are mainly related to Drowning, Traffic Accidents, Ischemic Heart Disease, Diarrhoea and Carbone Monoxide Poisoning. Morbidity rates are related to Injuries, infectious diseases such as Respiratory and rodent-borne cases as well as faecal-oral transmission. Historically, greatest impact had the floods of 1995 and 1996 (Figure 4) (10).

According to statistics from the government and foreign Aid organizations a total of 960,000 people were directly affected (12). As many as 89,000 people were left completely homeless, 200,000 people were displaced and more than 200 were killed (13). Besides this 60,000 homes and public buildings were partially or completely destroyed (13).

Estimations from EM-DAT however indicate total number of almost over 6million people being affected solely in 1995 (9). Lower estimations as indicated by the IFRC (12) might only cover certain areas, whereas high estimations might be more extensive, taking into account multifactor and long-term impacts for the whole population.

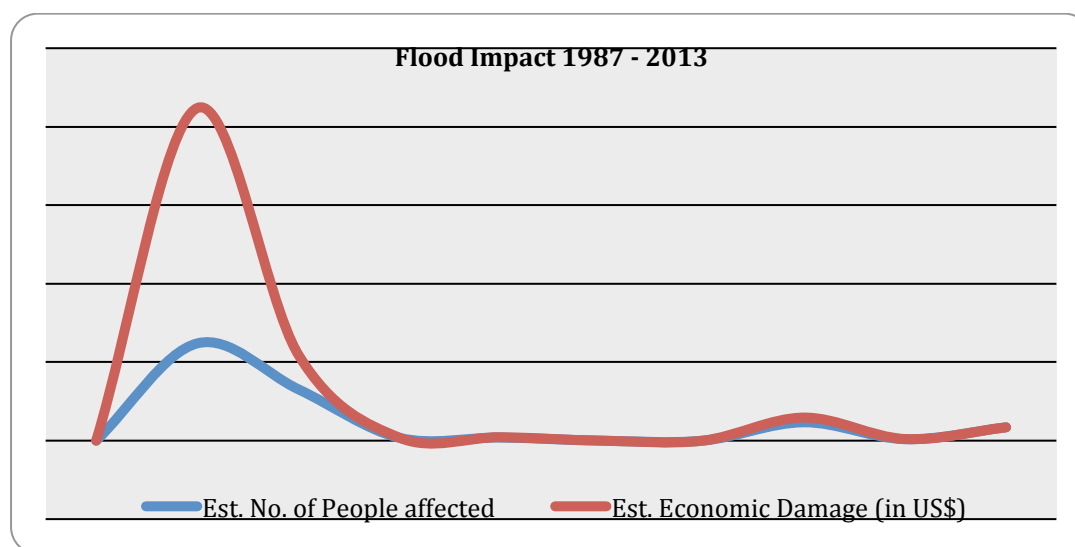


Figure 3: Flood Impact 1987-2013 (total numbers); Source: EM-DAT 2014

Besides many people being directly physically affected by the flood, most people however felt the absolute impact due to long term damages to infrastructure and agriculture.

According to IFRC (12) the greatest impact of the floods that hit North Korea in 1995 was suffered by the agricultural sector. 1.3 million hectares of agricultural lands were damaged and lost by inundation and sedimentation, accounting for a total of 11% of the country's rice, wheat, and corn crop. Such damage denoted costs of US\$ 1.038 billion in the agricultural sector and US\$ 2.271 billion in all economic sectors (12;14).

Infrastructural damaged included the destruction or damage of 30-40% of public health and educational facilities in affected areas causing a collapse of the regional health system (12;13;15). Access to affected areas and provision of aid was constrained due to the widespread damage to roads and bridges (15;16). Communications was constrained by extensive damage to telephone networks, making it difficult to collect reliable information relating to lost or insured casualties and the overall impact (15).

Many water supply systems were also affected causing about 36,000 families to be cut off access to clean water. Contamination due to overflow of pit latrines and open drainage, perpetuated the spread of waterborne diseases, diarrhoea as well as

abdominal problems (12;13;17). The scarcity of food, medical supplies and the poor hygiene conditions also meant an increase in acute respiratory, skin and eye infections, particularly in children, as well as widespread dehydration (17).

When looking at the last few years major floods were also registered for 2012 and 2013. Similar impacts on the country's infrastructure were recorded even though on a smaller scale compared to the 1995/95 flooding. Damage to crops, arable land, houses, infrastructure, public buildings, roads, water supply and sanitation systems were reported (Table2). These two years of flooding caused a total of 121 deaths, left 66.889 people homeless and displaced approximately 50.000 (18;19).

Whereas in previous years the provision of emergency aid in the event of flooding in North Korea has been rather successful with regards to political access granted by the government; in the years of 1995/96, such provision was still linked to tight restrictions and threats made in relation to North Korea's nuclear program.

Organizations such as the WFP were only granted permission to resume activities on a small scale which didn't allow any accurate damage assessment. Inter-agency assessments and monitoring was forbidden especially once aid reached the affected areas (16). This led to over, as well as underestimations of damages and caused difficulties in applying effective response measures particularly in rural and remote communities (17;19).

In recent years the provision of aid, access to investigate damages and direct collaboration between Governmental Organizations and NGOs has been much more open. With the direct involvement of the DPRK Red Cross in emergency response the mobilization of the national and provincial disaster response teams (NDRT) and more than 14.000 volunteers was possible (12). They were able to help support communities with evacuation, provide first aid, promote hygiene practices and assist in the distribution of relief items including blankets, water containers, plastic sheets and kitchen utensils and emergency medicines (12;13;19).

Funding for such was made available from the Disaster Relief Emergency Fund which had been set up in order to replenish relief stocks and respond to people's needs (12). Donors included the International Federation, the US, the European Union, South Korea and Finland (12). Teams were furthermore able to collect and assess valuable data to identify needs priorities of people in affected areas (18;19). In response to these flooding disasters the Red Cross (18) has set out seven operational priorities. Such include:

- Early warning and evacuation
- Search and rescue
- Rehabilitation and recovery of infrastructure
- Provision of emergency food to the affected people
- Repair of dams, embankments and damaged houses

With regards to shelter it has been highlighted that it is important to evacuate the affected population to public buildings, self-made temporary shelters. As floods destroy cropland and so have great long term impacts on Food security, nutrition and livelihood, inter-agency food and nutrition cluster need to be set up to monitor the situation.

Sanitation and submerged water supply systems need to be restored and alternative water sources like dug wells, hand pumps, boreholes and surface water which run high risk of contamination need to be controlled (19). Additionally it has been identified that it is of great importance to set up early warnings system besides radar and satellite forecast, which are able to monitor changes to water levels.

14 -15 July: Flash Floods in DPRK							
Statistics are only for Red Cross operational areas							
Province	South Pyongan			North Hwanghae	Kangwon	South Hamgyong	Total
County	Yandok	Songchon	Sinyang	Sinpyong	Kosan	Sudong	
Houses							
completely destroyed	1,300	1,900	3,491	439	269	108	7,507
partly damaged	2,700	2,500	3,102	NA	NA	NA	8,302
submerged	510	3,100	525	200	311	432	5,076
People							
Homeless families	1,810	5,000	4,016	639	580	540	12,585
No. of missing	91	0	36	0	0	0	127
No. of deaths	54	3	52	3	0	9	121
Infrastructure							
Arable land (hectares)**							
totally washed away	0	1,140	0	0	482	493	2,115
silted	0	1,030	314	0	276	636	2,256
submerged	0	3,888	0	1,212	2235	1584	8,919
Roads (km)							
damaged	17	30	8.3	18.6	2	25.4	101.3
Bridges							
damaged	4	8	4	3	3	49	71
Railways (km)							
damaged	4	5	22.5	0	NA	NA	31
Bridges damaged	0	0	7	NA	NA	NA	7
Tunnels damaged	0	3	1	NA	NA	NA	4
Public buildings							
damaged/destroyed	126	124	0	0	NA	49	299

** There is little or no rice paddy fields in Yangdok county, which specializes in maize grown on terraced hillsides

Table 2: Losses and damages in the counties where DPRK Red Cross is delivering family kits Source: IFRC 2006

The IFRC (19) identified that floods can be best monitored via radar as well as satellite real time monitoring. According to Myeong and Hong (20), flood vulnerability maps have been created for various areas in North Korea to develop proper early warning systems and efficient strategies for response to natural hazards. Those maps include five categories highlighting the degree of vulnerability (Figure 4). Recent mapping exercises found that one third of the study area was vulnerable to flooding.

Areas near the river and areas with high population density with low elevation are most affected by floods. Even though progress in response to flooding in North Korea has been made access to acquire ground truth data is limited, making mitigation and

prevention measures difficult. Emphasis must lie on data sharing and collaboration between organizations in order to get the full picture (20).

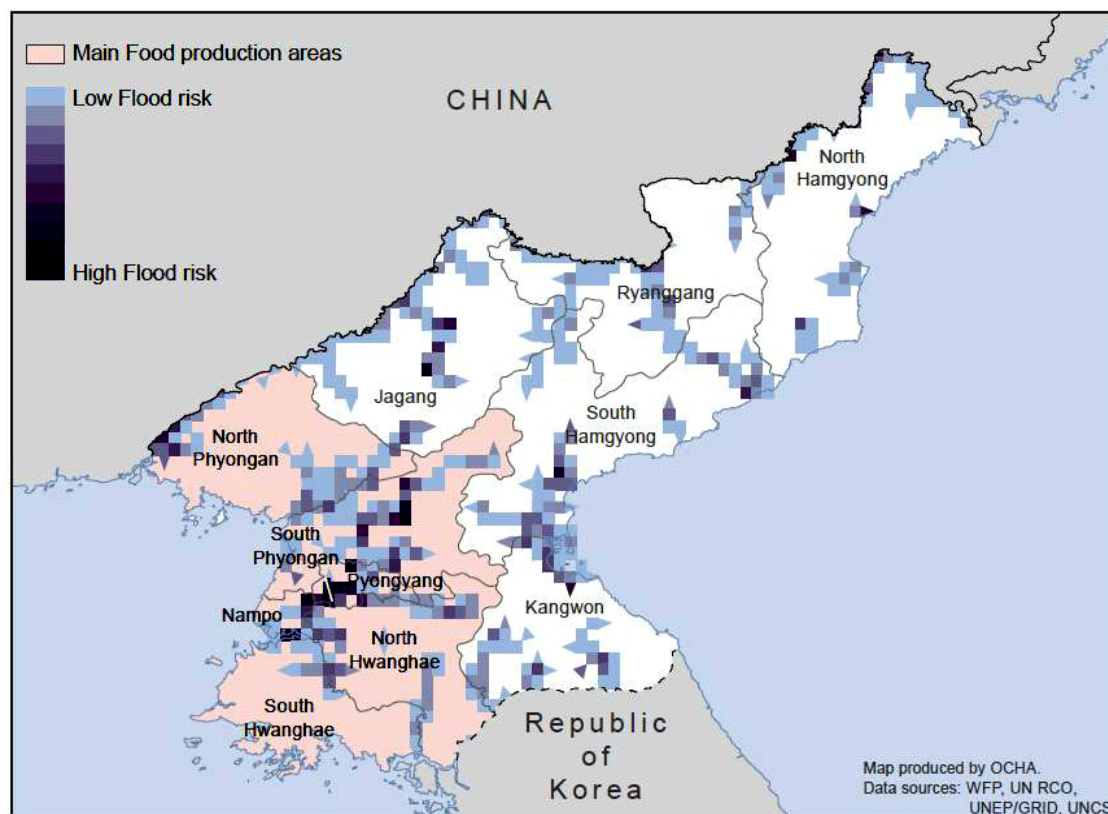


Figure 4: Flood Vulnerability Map; Source: OCHA 2014

5.1.2 Typhoons

Typhoons are non-frontal storm system that are characterised by a low pressure centre, spiral rain bands and strong winds, usually originating over tropical or subtropical waters. It is believed that higher ocean surface temperatures as well as a rise in sea level related to climate change has increased the annual number of typhoons particularly in coastal areas in North Korea (7;21).

Typhoons reach a speed of 119 km / h and more, making their onset extensive and destructive. During the event of a typhoon hitting an area, major damage is caused to infrastructure and housing (22). According to Doocy et al. (23) the impact of such storms can dramatically increase if the alert is not detected and preparation and evacuation measures for the population are not in place or poorly planned.

Typhoons are also more likely to cause greater destruction in areas with high population density. Mortality and morbidity is mainly related to trauma, drowning,

Injuries from falling objects and landslides, traffic accidents during evacuation and electrocutions.

According to EM-DAT (9) since 1993 eight major Typhoons have been recorded in the DPRK. With regards to dead casualties the typhoon of 2012 was the worse out of all the ones listed. In comparison the highest number of injuries was recorded in 2011, whereas in 2000 the greatest number of people were left homeless and an overall extensive damage of \$6.000.000 was caused (9).

According to the United Nations (24), the Typhoons that hit North Korea in June/July 2011 mainly affected North and South Hwanghae, Kangwon and South Hamgyong provinces. More than 2,900 houses were destroyed and about 60,000 hectares of farmland was submerged, buried or washed away. 170 industrial facilities and public buildings collapsed, and landslides and broken revetments severed roads and bridges making access to affected areas difficult.

The IFRC (15) additionally reported in relation/response to the 2006 so called "Typhoon No. 3, 16,960 families homeless. This typhoon generated torrential rains, induced extensive flooding and triggered landslides causing extensive damage to crops and infrastructure. Approximately 23,400 houses were destroyed and whole villages were swept away causing mass displacement and whole communities to be cut off from supplies food and help. Furthermore essential public facilities such as clinics were destroyed and many roads and bridges were damaged. For emergency response teams, this put great limitations on accessing affected locations.

Further constrains were put on communication and the collection of reliable casualty information due to a collapse of telephone networks (15). The UN (24) has acknowledged that factors such as severe weather, widespread deforestation, a lack of basic infrastructure as well as poor drainage systems majorly increase the countries vulnerability to Typhoons.

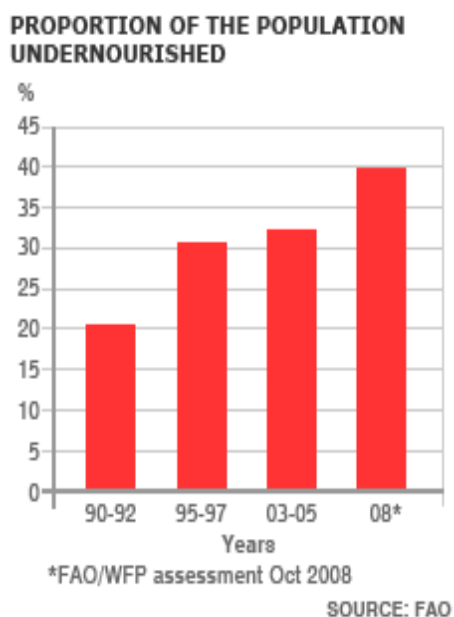
Response to such emergency has been slow and difficult to plan as foreign aid groups have had to wait for permission from the North Korean government to intervene. The lack of information on the extent of damage once permission was granted made appropriate response impossible. Organizations were relying on reports from state media which often were not reflecting the real situation. In response organizations have started to actively work with communities and community-based projects to prepare evacuation plans and develop ways to protect the people, their homes and their farmland in the event of a disaster (24).

5.1.6 Famines

Famines are defined as periods of severe food shortages as a result of failures of food systems and collapses of food production, trade, and transfers within an economic and political system (25;26). They are a consequence of a long, slow decline in access to food caused by natural disasters as well as man-made disasters and poor management of resources related to distribution systems and markets (27).

According to the UN a famine is declared when at least 20 percent of households in an area face extreme food shortages; more than two people in 10,000 are dying each day; and more than 30 percent of the population is experiencing acute malnutrition.

The Centre for Disaster Philanthropy (27) highlighted that the most vulnerable are people living in rural areas where malnutrition and food insecurity are higher than in urban areas. This is particularly due to a lack of sustainable access to enough safe, nutritious, food to support a healthy and productive life. In the case of North Korea natural hazard shocks exposed the underlying causes of such famine developing in the 1990s (26). Although scientists argued that food shortages and general economic crisis indicate an ongoing famine since the 1990 (Figure 5) (14), when looking at the history two major periods of extreme famines can be recorded (28). One is after the Korean War between 1952 and 1955 as a result of destruction and the government running out of food supplies. The other with also more reliable data on impact was the famine starting in the late 1980s. At this point in time North Korea had exhausted its possibilities for extensive development, defaulted on its international debts and had exceeded the inflow of new assistance (14). Together with a period of industrial decline, North Korea was unable to keep up with food production and began rationing food consumption. Soon the distribution channels began to collapse.



A major series of extreme floods between 1995 and 1998 devastated nearly 40% of farm land. This together with a triple increase of food prices led to starvation throughout the country, particularly in rural areas (14;29;30).

The impact was tremendous and cost about 15% of the population (4 million people) their lives between 1990 and 1998 (26;28;29). This famine furthermore caused a mass movement of thousands of North Koreans fleeing to China. Besides Haggard and Noland (26) acknowledged that the famine had the greatest impact on rural regions and poor population groups, because access to food was controlled by the Public Distribution System (PDS).

Figure 5: Proportion of Population Undernourished 1990-2008, Source: FAO

Such system allocated food not on the basis of need but along political criteria and social classification. Additionally, a currency revaluation plan developed in November 2009 put restriction on the use of foreign currency and forbid small-plot farming, encouraging the closing down of food markets (28).

These developments caused a great inflation that aggravated food shortages and sparked social unrest. Many people died of starvation and many others lost their entire savings. From this it becomes clear that North Korea vulnerability to famines is to a great part determined by public distribution failures and discretionary shifts in allocations of food as access to food is mediated by government allocations and politically stratified claims (26).

Due to the extreme food shortages and starvation experienced during the depression, bribery and corruption rose, facilitating the mass movement across the border to china. Many however were caught, publicly executed, tortured, imprisoned or severely punished for attempting to flee (5;7). People who succeeded in crossing the river to china often got caught, were sent back or sold into prostitution (7).

Although external organizations acknowledged the need for intervention and aid provision, North Korea did not recognizing food shortage and other complex problems deriving from such shortages at first. This made mobilization of humanitarian assistance and cooperation extremely difficult particularly in the onset of the famine (31).

As food shortages and widespread malnutrition not only caused starvations and mass movements, but triggered epidemics and mass outbreak of illnesses due to poor diet, it has been argued that any preventative efforts must take a long-term approach and emphasise on ongoing partnership working with those in the affected communities (28;32). It is also vital to ensure that food shortages are acknowledged and addressed within communities and that cooperation with donors leads to transparency, openness and unrestricted access to monitoring the distribution of food aid (28).

5.1.3 Epidemics

Epidemics are periods of an unusual significant increase of cases of an infectious disease in a certain region or population and can be the consequence of disasters such as typhoons, floods, earthquakes and droughts (33).

When looking at epidemics that occurred in North Korea the 2006 Measles Epidemic has to be mentioned. Measles is a highly communicable viral infection mainly affecting children and undernourished populations (34). In the case of North Korea in 2006 approximately 3.600 people throughout the whole country were affected (34). A total of 1,482 people were hospitalized and four people were reported to have died due to measles and related complications such as pneumonia and cardiac failure.

In a country like DPRK with an overall low health and nutritional status, economic constrains and bad infrastructure, a measles outbreak can have serious consequences for the whole population. In the case of North Korea however response to the outbreak was quick and effective (35).

A nationwide measles immunization and Vitamin A supplements distribution campaign was launched by UNICEF, MoPH, the Red Cross National Society as well as the Federation. Such campaign required all people between six months to 45 years of age to be immunized and administered with vitamin A (34;35). This accounted for about 16.2 million people in total. Drugs and medical materials were supplied by UNICEF, the WHO, the DPRK Red Cross and the Federation to all primary- and secondary-level health facilities (2,258 health institutions) (34). It was estimated that the whole campaign generated cost about US Dollar 2,007,345. This amount was

fully covered by UNICEF. The DPRK government covered the in-country transport and distribution costs of the immunization campaign.

The whole project was monitored by the MoPH, UNICEF and the WHO through its team of field monitors (35). In order to prevent any future outbreak the MoPH is working closely with the DPRK Red Cross and their country-wide household doctors. Over the last few years they have organized activities to increase public awareness and put emphasis on measles prevention through simple hygiene promotion, vaccinations and vitamin A supplementation programs (34). Regular meetings with all stakeholders are held to ensure effective coordination and planning of the programs between all concerned (35). The team has furthermore highlighted long-term needs such as the need to encourage social mobilization by motivating and mobilizing communities to increase routine immunization as well as educating health care workers, to improve early diagnosis and prevention (34). Finally the IFRC (35) has highlighted that it is also important to improve the overall health care infrastructure to guarantee uninterrupted availability of supplies.

Although EMDAT highlights an Epidemic outbreak of Tuberculosis, as it is an ongoing problem it will be discussed in further detail in the Health Section of this report (5.2.2.).

5.1.4 Deforestation and Land Degradation

Deforestation is the term that describes the cutting down or clearing of trees from a wooded area. Deforestation can be detrimental to the environment and cause widespread land degradation in form of loss of fertile land and biodiversity (36).

The DPR Korea has about 9 million hectares of forestland. This accounts for about 73% of the total land area (37;38). Most of the forest areas are concentrated in the northern inland regions with high mountains; whereas the western coastal areas with low-elevation flat lands have fewer forests (10).

The forest is dominated by three main types: broadleaved forest, coniferous forest and mixed forest (38). Over the last few decades there has been a great decline in forest areas which has had tremendous multilevel impacts causing increased degradation and desertification of land and an increase in vulnerability to natural hazards such as landslides and floods (Figure 6) (10;38).

These effects are further amplified by rises in annual temperatures caused by climate change (7). Of the total 9 million hectares of forestlands about 32% has been deforested between 1970 and 2008 (21;37). 160,515 hectares of forest were destroyed only between 2000 and 2013 (21), mainly in order to meet energy demands for fuel, energy and logging, and to use the bare land for agricultural purposes during economic depression (21;38).

Exploitation and consumption of forest resources currently exceeds the replacement capacity and hundreds of thousands of hectares have been lost because of irregular forest clearing and grazing (38).

Due to the fact that North Korea has been and still is highly vulnerable to natural hazards such as floods, farmer have sought to increase the availability of arable land, even on the slopes of steep hills and mountains, cutting down trees (10;14;38). This however created a vicious circle as the dramatic levels of deforestation and inappropriate land use aggravated the impact of floods, caused landslides and affected agricultural production, causing tremendous food shortages in the long run (2;21;38).

According to the United Nations Environment Program (UNEP) (38) deforestation also has major impacts on resources and habitats. Particularly in North Korea it has weakened the control function of the biosphere, created a loss of biodiversity and exacerbated flooding and soil erosion (14;37). This in turn has impacted negatively on agriculture production, fresh water resources and the recharging of ground water.

Given the relative scarcity and low fecundity of North Korean arable land, the drive to maximize output has involved the use of environmentally unsustainable techniques. Continuous cropping has led to land degradation and soil depletion.

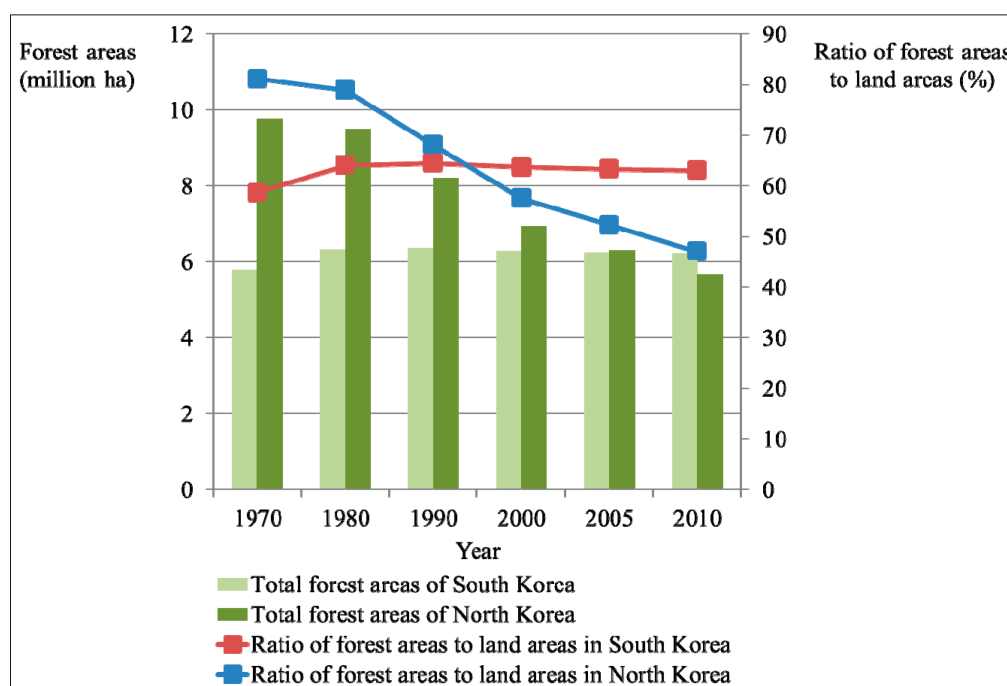


Figure 6: Forest Areas (in million ha) and Ratio of Forest Areas to land areas (in %) 1970-2010, Source: Mi Sun Park and Hyowon Lee 2014

The overuse of ammonium sulphate as nitrogen fertilizer has contributed to acidification of the soil and a reduction in yields diminishment of productivity and regeneration capacities of ecosystems (14). From this it becomes clear that deforestation and a rapid decline of forested area and stocks especially in areas with high population density induce negative impacts on overall socio-economic development and sustainable management of environmental resources (10;38).

Such development has highlighted the need for short- and long-term assistance and restoration.

It has been estimated that in order to restore the forest ecosystem of North Korea, about 30 billion dollars are required (20;21). Although making such an amount available for investment is not realistic, several other measures have been taken (38). Since 1994, the National Coordinating Committee on Environment (NCCE) manages national activities related to global environmental issues in North Korea.

Together with Civil society groups such as the North Korean Forest Conservation Association and the Green Asia Organization they developed a National Action Plan to address deforestation land degradation in DPRK (21;38;10). This plan includes a structured forest management program that aims to:

- Plant mixed forests
- Take part in activities for forest conservation and reforestation,
- Disseminates information to the community,
- Builds public awareness and organizes awareness workshop among stakeholder agencies on the concepts, issues and international activities of combating land degradation and forestation (38).

With regards to the land degradation trend in the country it would be important to:

- Build capacities for monitoring the impact of soil contamination from municipal waste and fertilizers
- Plan and design specific sites for the safe disposal of urban solid waste
- Implement programs to raise public awareness regarding land resource conservation
- Introduce slope management and agro-forestry to promote safe food production and efficient rural energy supply (38;10)

In order to achieve those goals and move towards sustainable land management at national and local level the DPR Korea has also worked in partnership with UNEP and UNDP.

Additional to the measures mentioned above Kang et al. (10) have argued that in order to maintain and rehabilitate viable ecosystems it is important to implement Effective Early Warning System and Planning for Natural Disaster Management. Critical issues with regards to this are insufficient financial resources, low technical capacities as well as incomplete and incomprehensive databases related to land use and degradation (10). Possible solutions to these problems include:

- Identifying criteria and indicators to assess land degradation
- Establishing an integrated information database related to land resources management
- Strengthening technical capacities
- Exchanging of information among relevant stakeholder agencies
- Monitor and evaluate degradation patterns

- Encouraging bilateral and multilateral international cooperation (10)

These measures as well as the protection and restoration of denuded forest lands are believed to be able to create a basis for preparing national policies and plans that encourage economic development and so also help stabilize other sectors such as agriculture and industries (38).

5.1.8 Earthquakes

The IFRC (39) describes Earthquakes as results of sudden break within the upper layers of the earth, sometimes breaking the surface, resulting in the vibration of the ground along the borders of tectonic plates. It has been argued that even though Earthquakes are impossible to prevent, potential damages can be reduced. This can be done by developing warning indicators, implementing building regulations for safer buildings, relocating communities away from epicentres and engaging in and promoting public awareness and education programs (39).

Historically there is no reliable data on the occurrences of major earthquakes in the DPRK. Events that were recorded are only dating back to 2006 and have been confirmed to be related to nuclear testing as earthquakes are rare in North Korea (40): 9 October 2006, North Korea (mb = 4.1); 25 May 2009, North Korea (mb = 4.5); and 12 February 2013 (mb = 4.9) (41). The epicentre coordinates were determined and reported by the International Data Centre (IDC) of the CTBTO and US Geological Survey (USGS) (42). All three events were located near the Punggye-ri Nuclear Test Site in the north east of the country (20;43;44).

There are also reports of seismic activity having occurred in 1952 (mb = 6.5), 1980 (mb = 5.0) and 1982 (mb = 5.1). On these events no additional information other than the date, location and magnitude was found. There were no immediate reports of damage or injuries reported (43). Nevertheless its seemingly minor impact, seismic signals detected have brought up questions regarding to what extent signals allow discrimination between an explosion caused by a nuclear test and an earthquake and its indications of the likelihood of false alarms (44).

The problem that particularly occurs in relation to nuclear testing is that it has had effect on aid provision (particularly food aid) and foreign assistance to North Korea. In those cases aid and aid sanctions made by foreign countries have been used to serve larger diplomatic goals. Being able to distinguish between a nuclear test and a minor earthquake could in the future help to allocate aid resources more effectively (40).

5.1.7 Volcanic and seismic activity

Volcanic disasters occur in an instant and cause massive human and physical damage across vast areas. Disasters that occur during a general volcanic eruption are

caused by direct damage such as pyroclastic flows, volcanic mudflows, and volcanic floods, and indirectly damaged by volcanic ash.

When looking at North Korea and its history of volcanic activity, ash layers have indicated a major eruption around 969 AD and several minor eruptions in 1668, 1702, and 1903 (45). Since 2002, increased ground activity has been recorded with approximately 10-15 minor earthquakes in the major volcanic area in the north of the country around mountain Paektu (46). Such activity was also accompanied by greater seismicity and inflation of the volcano with 100km wide globs of magma found lined up under the earth surface (46;47).

It is predicted that if a volcanic eruption as huge as the mega explosion in 969± 20 AD would happen again, it will have tremendous political, social, and economic impact. Researchers have found that the eruption of 969± 20 AD produced a total tephra volume of 96 ±19 cubic km. If this or similar eruption happens again, damage could be 10 to 100 times greater than that caused by the 2010 eruptions in Iceland. This together with pumice and ash will affect areas of northeast China, whole Korean Peninsula, Japan and Russia (48).

Experts predict that the ashes would not only hit the neighbouring areas, affecting more than 100.000 people, but also damage agriculture and cause serious disruptions in industrial activities and air traffic for the whole northeast Asian region (45;46). It is predicted that Mt. Paektus volcanic lava would flow downhill towards China and spread across the North and South Korea within eight to nine hours and will reach Japan in just 12 hours. After 18 hours, volcanic ash would likely spread beyond Japan (46). Besides this, an eruption would cause severe flood damage with at least 30km radius as the volcanic crater holds 2 billion tons of water (48).

The probability of a minor to moderate eruption in the next 100 years at Mount Paektu volcano is estimated to be 1 in 5 to 1 in 10, based on historical findings. The DPRK has in recent year acknowledged the danger and hazard of a volcanic eruption and has begun to take precaution measures. In 2011 it allowed volcanologists for the first time to enter the country and research the area around Mount Paektu. They were allowed to work at Paektu Bridge Volcano Research Station near DPRK's northern border where they were able to deploy the first broadband seismometer in the DPRK. The work was monitored and facilitated by two nongovernmental organizations: The Pyongyang International Information Centre on new Technology & Economy (PIINTEC), based in Pyongyang, and the Environmental Education Media Project (EEMP) in Beijing. In addition to this these measures taken, the CEA aims to build volcano observatories and hopes to install digital seismic and GPS stations in order to map the magma chamber.

Up to date North Korea has only used solar panels and car batteries to power their transmitters, which make secure and precise measures impossible especially in the harsh winter months (45). Although monitoring any seismic activity has been difficult for non-Korean organizations, due strict approval procedures set by the North Korean Earthquake Administration, nuclear testing activities currently serve as an even greater obstacle to the monitoring of Mount Paektu. (45). In the past, nuclear test on the one hand have caused a shut-down of seismometers in the country hindering the foresight of a volcanic eruption, and on the other hand could

act as a catalyst reactivating magma flows, causing an eruption (45;48). Therefore, there is an urgent need to firstly expand multinational and regional cooperative and comprehensive monitoring systems that are able to monitor seismic activity, geophysical parameters, deformation and changes in gas composition.

Secondly it is of great necessity to develop volcano disaster early response system that can measure and predict the amount of damage incurred and accumulated per hour as well as it is important to develop Emergency Response plans and Vigilance Networks for evacuation procedures for the community (45;46). Such systems will help to minimize any potential volcano damage in the future.

5.1.5 Transport and Industrial Accidents

In 2004, Ryongchon, in the North-West of DPR Korea near to the border with China was majorly affected by an explosion that occurred in the local railway station. It was believed that trains which were carrying Ammonium Nitrate and fuel were not handled properly and that also electrical connectors rained sparks on a car loaded with dynamite causing this blast (49). The explosion destroyed everything in a radius of 500m and caused major damage to buildings within a 1200m radius (Photo 1) (50).



Photo 1: Satellite Picture from affected area before and after the Disaster, Source: UNOSAT 2004

According to the IFRC (51) minor damages were still found within a 4km radius. The County Hospital, 8 educational facilities, a poly-clinic and as many as 1820 family homes were entirely destroyed leaving 160 people dead, 1300 people injured and thousands homeless (50). Additionally to this the water supply and electric power supply network were badly affected (51).

The first response to the emergency was an appeal for international aid launched by the DPR Korean authorities and ECHO. The appeal also brought support from USAID, AusAID and the American, Australian, Canadian, Japanese, Swedish and the Republic of Korea Red Cross (51). They were able to mobilize health workers from around the country which distributed First aid kits, supplementary medical kits, equipment for hospitals, kitchen sets, blankets, water purification tablets, tarpaulins, plastic sheeting and water containers, supplied from a Red Cross relief centre five kilometres from the disaster (51).

Problems however occurred with regards to hospital provision for injured patients. As mentioned above the Ryongchon county hospital was entirely destroyed, meaning that patients had to be treated in Sinuiju, 20km away. Generally in North Korea medical facilities do not provide food for their patients, meaning that relatives have to meet nutritional needs of their affected family members.

One of ECHO's major focus in this disaster was on the rehabilitation of health, education and child care facilities as well as recovering and supplying those facilities with medical and educational equipment. Problems however arose as needed tools and building materials such as windows and roof tiles and are short supply or not on side at all (50). This threatened to delay the repair and rehabilitation beyond the rainy season, which would bring further damage to the buildings.

As shown in previous chapters working in DPRK involves operational difficulties and constraints in terms of access to the population, possibilities of carrying out proper needs assessments and random monitoring and evaluation of the aid delivered. ECHO (52) indicates that DPRK authorities have created and are still often creating administrative difficulties for humanitarian agencies to operate in the country. Response in this instance of disaster however was collaborative, fast and effective.

Within 72 hours funds were made available to the Federation from donors such as South Korea, China, Germany, Ireland, Sweden, Czech Republic, France, Austria, Hungary, Greece as well as ECHO (50). Such funds were used to invest in Food Distribution Programs to Health Facilities and homeless people, emergency relief supplies including medical supplies, antibiotics, basic essential drugs and anaesthetics (51).

Nevertheless disaster, such as the one in Ryongchon, are still happening in North Korea and so cause a threat to the local community and infrastructure. Therefore it is firstly important to encourage the development of safety guidelines when dealing with hazards and secondly set up an emergency response network that is able to mitigate damage impact.

5.2 Vulnerability

Vulnerability can be defined as the diminished capacity of an individual or group to anticipate, cope with, resist and recover from the impact of a natural or man-made hazard. Although Vulnerability is most often associated with socio-economic factors, people differ in their exposure to risk as a result of their social group, gender, identity, age and other factors such as lack of education or surveillance systems in place (53;54).

It has been shown that resources available, income and standard of living impact greatly on the level of resilience and ability of people to recover from a hazard. In the DPRK most vulnerable groups include displaced populations, migrants, young children, pregnant women, elderly people, disabled persons as well as groups of marginalized, excluded and destitute people.

In order to assess the level of vulnerability of the population information from a variety of secondary sources, observations as well as evidence from international agencies need to be gathered (7). Key Factors that make North Korea particularly vulnerable to external hazards are its economical isolation, dependency on foreign energy and food aid, and unstable political environment

Particularly North Korea's structural and ideological rigid system impedes effective long-term crisis planning and immediate emergency response. Limited Information sharing capacities further reduce the ability of individuals, communities, and ultimately the state to react appropriately to crises. North Korea's passivity that comes from socialization pressures, informational controls, and outright coercion is an obstacle to innovation and new ideas and greatly limits efficient practices and North Korea's capacity to adapt to external shocks (7).

In order to counteract vulnerability, systems that are able to mitigate, predict and warn about possible hazards have to be developed. Further a level of preparedness has to be created that can reduce the impact of the hazard itself and that builds capacities to cope with hazards.

As vulnerability factors in North Korea have had a major impact on areas such as Food Security, Economics, and Health, great emphasis has to lie on tackling the root causes of vulnerability, such as poverty, poor governance, inequality and inadequate access to resources and livelihoods (54). This chapter will analyze and evaluate the three major areas of vulnerability for North Korea: Food Security, Health and Economy Factors.

5.2.1 Food security

Food insecurity exists when people lack secure access to enough, safe, nutritious food in order to maintain a healthy and active life. This can be caused by inadequate access to food as well as insufficient and uncertain supplies (7;55). The concept of food security includes both physical and economic access to food and is strongly linked to health, development, environment and trade (55).

It has been estimated that in the DPRK about 16 million people suffer from chronic food insecurity, high malnutrition rates, and deep-rooted economic problems related to food supply (56). Although North Korea's food insecurity seems predominantly caused by political and economic factors, geographical indicators have also been discovered.

Geographical Indicators

Food production in North Korea is hampered significantly by its mountainous geography and extreme climate (2). It has been estimated that only about 22.4 % of the land is arable and only 8 % is in permanent crops (4;7). Estimations by the CIA (3) in 2012 in comparison indicate that only 19% of North Korea's land is arable and only 1,7% is used for permanent crops.

Temperatures also place major constraints on crop production. Average temperatures range from -19°C during winter to 25°C in summer, limiting the length of the growing season and so severely limiting total cereal output which in the past has amplified famines (7). Uncertain rainfall in spring can make growing rain-fed crops difficult whereas extreme heavy rains in July and August damage crops and increase erosion.

A further major limit on cultivation in North Korea according to Habib (7) is its generally poor soil fertility due to soil being acidic particularly in northern regions. Josserand et al. (57) have shown that acidity impedes soil properties such as movement of air and water through the soil, plant nutrient uptake, microbial activity, and breaks-down contaminants, thus producing lower crop yields. According to Habib (7) this makes North Korea heavily reliant on fertilizers and foreign aid.

Political Indicators

As part of North Korea's 'self reliance' system a food security scheme was developed in 1957 (26). This scheme, called the Public Distribution System (PDS), can be defined as a centralized rationing scheme, in which the state organizes and regulates the food distribution to the whole population (7). Initially everyone was entitled to certain amounts of cereals depending on their type of job and societal group. For example the hard working class was entitled to as much as 900g cereals per person per day whereas students and retirees were only entitled to 300g.

At the same time as the PDS was launched, North Korean authorities started introducing rationing coupons while closing down all privately owned shops and private markets as part of their self-reliance philosophy and check against outside influences. Private trade in grain and maize throughout the country then became banned and was made a criminal offence (30). This caused a severe disruption to the already weak system.

Over the years it became apparent that neither equal access to food nor equal distribution of such existed. Certain social strata enjoyed privileged access to

existing food supplies at the expense of more-vulnerable segments of the society (7). In example the elite which were permitted to live in urban areas had greater chance of accessing the PDS ration and were entitled to more generous rations as well as goods of greater variety and quality (57;59).

The rest of the population however were solely reliant on the rationing coupons that allow for purchases of rice. Basic cereals such as meat and vegetables, however, were not affordable for the majority of the population (60). Such goods were only distributed through work units 2-3 times a year on special occasions, such as the dictator's birthday. According to Lankov (60) such development indicates that North Korea is using food supply as means of political control over its population and particular groups within the society.

As private agriculture was not permitted and economic growth began to decelerate in 1973, North Korea began to struggle to meet dietary needs for the whole population. This led to a downsizing of the rations. In the next 20 years the government halved the daily ration and only allowed two meals a day (60). The floods of 1995/1996 induced the total collapse of the economy and the PDS (Figure 7).

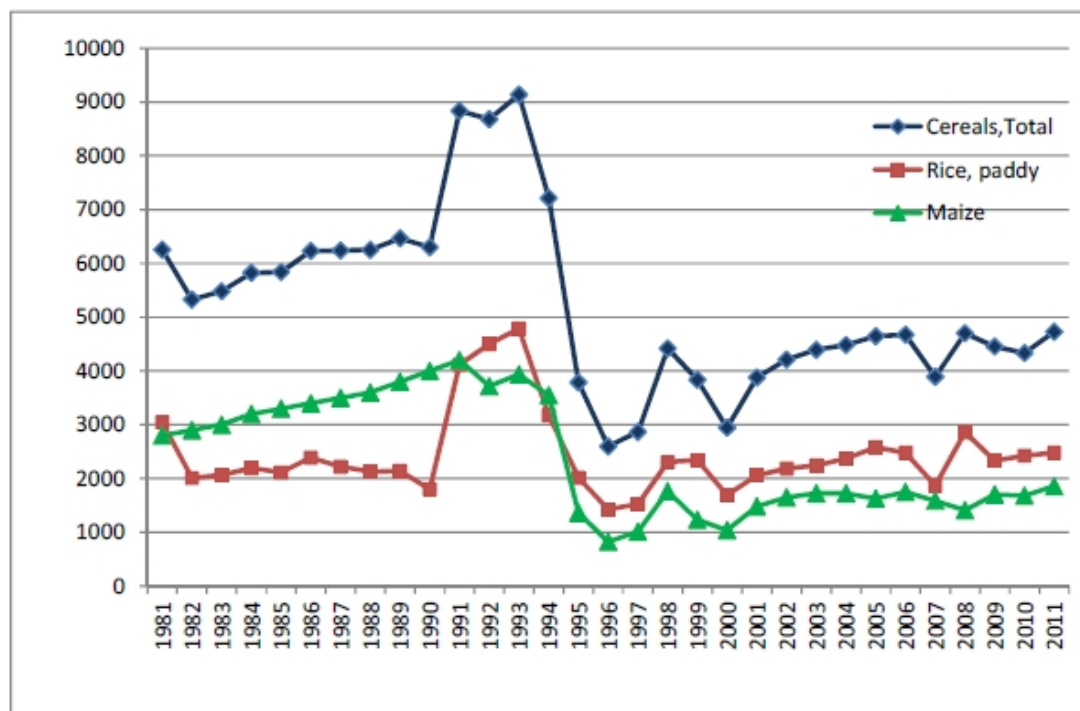


Figure 7: Cereal Production 1981-2011, Source: FAO/WFP 2011

This marks the beginning of North Korea's great famine which caused nationwide malnutrition, starvation, mass movement and led to approximately 4 million people's death (14). During this time particularly rural areas were affected as they were cut off any food supply and left to fend for themselves. In order to escape starvation small private gardens and farms were set up.

The government supported this movement and allowed up to 100 square metres for each household (7). Although food supply needs were still not met at this point, the formation of such private gardens facilitated the formation of small markets across the country and so created a scope for trade and self-sufficiency of private households (60).

At the same time however the government restricted international access and resisted reforms that would help pay for food imports (26;59). International cooperation and assistance were only accepted when donors agreed to offer aid without monitoring the shipments of such. These conditions limited any food aid operation in the country and so tremendously amplified the number of people suffering and dying (28).

Activities of the World Food Program and other relief agencies were shut down. This meant that only 27 per cent of the most vulnerable people received multi-micronutrient supplementation and food aid from aid organizations (61). Another series of flood in 2006/2007 however reversed aid limitations when local harvests declined and fertilizer fell short (30). With regards to this it has been argued that regime's restrictions for aid seem to be dependent on its desperation for outside food or equipment and that official pronouncements tend to exaggerate shortfalls when more assistance is needed (30;61).

At the same time however North Korea claims the right to restrict any monitoring activity with regards to aid delivery and distribution. The lack of monitoring of aid in the past also meant that large amounts of food were routinely diverted for resale in private markets or distributed to the upper classes and the military solely, leaving the poor starving (59;60).

Besides the tremendous shortfall in food during the collapse of the market and food supply system also meant that food prices tripled (30). Together with rising world prices due to the world food crisis in 2010 importing grain became extremely difficult for North Korea. At the same time multilateral and bilateral aid organizations also experienced difficulties in accessing grain to meet their commitments to North Korea (Figure 8) (30).

Up to date 12.5 a total million metric tons of food aid have been donated (59). According to Manyin et al. (59) main providers included China, South Korea, and the United States, with major actors being UNICEF and WHO, contributing to over 75% of the total food assistance since 1995.

Since 2009, however, donations from the USA and also other donors have declined and some fully cut due to nuclear threats made by North Korea. This created a yearly average gap of 1 million metric tons of cereal for the country (37). The Crop and Food Security Assessment Mission (CFSAM) from the WFP highlighted a deficit of 1,786,000 metric tons of cereal in 2009. This has reduced to a deficit of 507,000 in 2013. Although numbers indicate improved harvest since 2013 a chronic deficit of cereal is apparent and malnutrition is still a major issue especially in children from rural areas in the northern parts of the country (37).

United Nations Convention to Combat Desertification (UNCCD) (37) has argued that this significant gap cannot be met under current agricultural practices and that the level of food insecurity in North Korea can only be tackled if strong links to areas

such as health, water and sanitation are made. Therefore programs were developed that predominantly focus on child malnutrition and the supply of food aid to other vulnerable groups.

Furthermore in the last two years North Korea has adopted greater leniency in allowing non-governmental organizations (NGOs) to provide aid and allowed investments in infrastructure (61). Particularly trade with China has been increasing dramatically, creating a dense business and enterprise network.

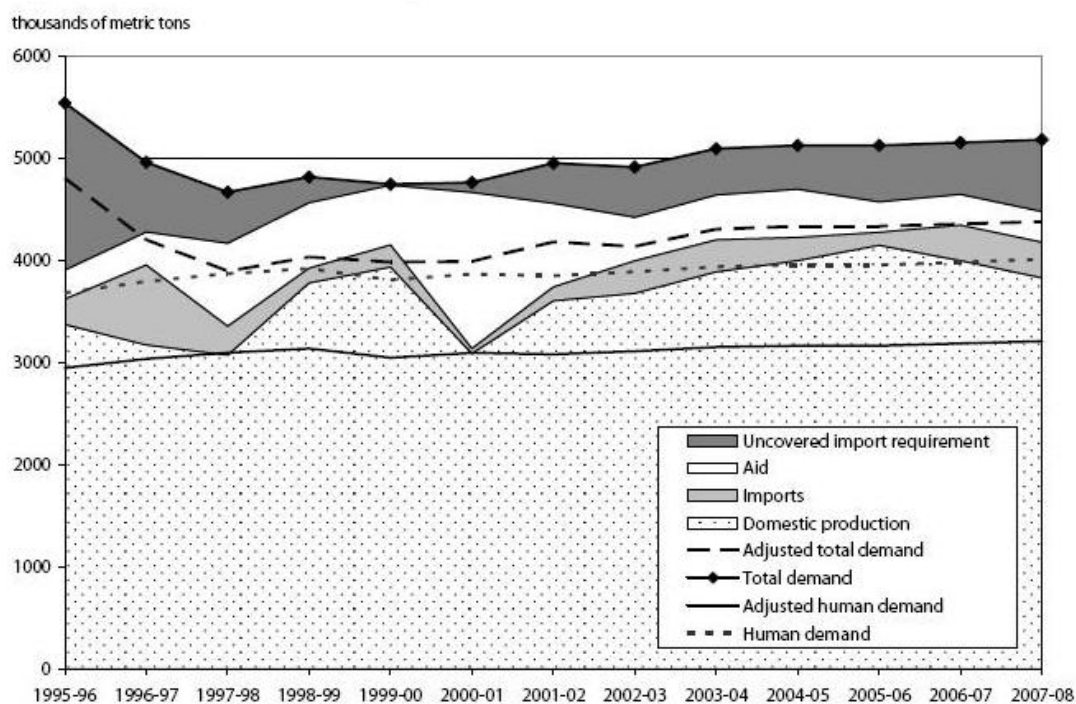


Figure 8: North Korea Food Balance 1995-2008, Source: North Korean Economy Watch 2008

The major land ports on the North Korean side of the border have become not only trading centres but major distribution hubs for the rest of the country (30). North Korea's willingness to build up networks with China as well as asking for and accepting food aid seems to be linked to China not insisting on any or only limited monitoring or data collection with regards to the people affected and the use and distribution of resources (59).

Nonetheless North Korea's weariness for cooperation, Haggard and Noland (30) have indicated that North Korea's markets seem to become more and more integrated with global markets. This means that external developments will increasingly affect North Korea's economy and so food security. From this becomes clear that emphasis must lie on building up North Korea's adaptive capacities. Habib (7) however identified that a system's adaptive capacity with regards to food security is dependent on:

- Economic resources,
- Access to appropriate technology,
- Availability of information and skills
- Infrastructure
- Equitable access to resources

As most factors are negatively affected and often even inaccessible for North Korea's population, its adaptive capacity to food insecurity can be defined as very weak. Therefore it has been recommended to support majorly affected communities and develop coping mechanisms (7).

As the North Korean system does not seem to be able to reduce exposure to food insecurity, North Korea has been relying heavily on foreign food aid and support. This together with agricultural inputs, such as fertilizers and plastic sheeting still will remain a major area of concern for aid organizations.

Continued provision of targeted nutrition support by WFP as well as other donors is therefore vital (61). UNICEF (61) has also highlighted that the provision of vegetable and legume seeds, as well as fertilizer is important in order to increase the production of nutrient rich food such as vegetables to enhance and secure dietary diversity.

Besides political, climate and geographical factors, the distribution as well as access to food in many parts of the country is also limited due to poor infrastructure and transport systems (7). This makes distribution of food difficult particularly in emergency situations when food aid is needed. Another factor impacting on low levels of food security are nationwide energy shortages. Such make it impossible to use any farm machinery or to power electric pumps for farm irrigation (7). Therefore most heavy farm labour is done by humans and draught animals, limiting the rate at which harvested land can be turned over for fresh cultivation (62).

Heavy and continuous crop rotation also increases the risk of crop losses from pests and diseases (7). Although there is only little accurate knowledge on local harvests, UNICEF (61) indicates that production of rice and maize in recent years has actually increased.

The production of vegetables and the main protein source for the people, soybean, however has reduced by 35 percent compared to 2011, contributing to inadequacy in food diversity. Such development further amplifies the still existent problem of nationwide malnutrition.

Although poor soil quality, frequent weather-related crop failures, insufficient fertilization, and persistent shortages of tools, machinery and fuel has led to a great dependency on international aid (1;3), it also becomes clear that many problems in relation to food shortages in the DPRK seem to be related to inequities in the distribution system and governmental priorities (59). Therefore it appears important not only to invest in collaborative efforts with the DPRK's government but also develop systems that support the local community in building up self-sufficient food supplies.

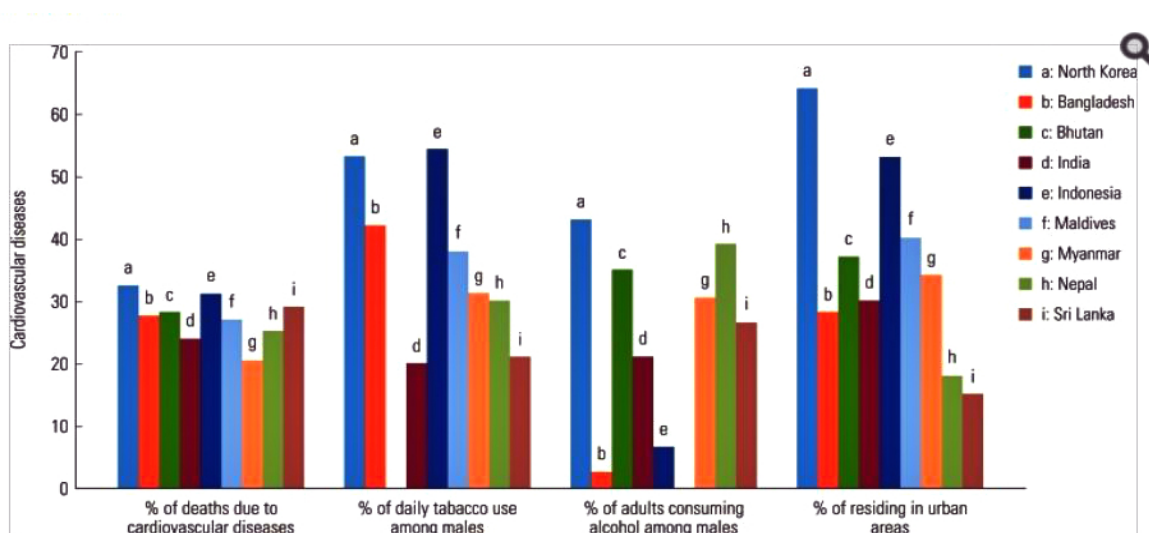
5.2.3 Health

Another major Vulnerability factor affecting the impact of disasters is populations' health and health care provision. The level of vulnerability is determined by and depending on the access to healthcare, treatment options and prevention measures available in the country. Up to date the Health Sector is one of the largest sectors contributing to North Korea's vulnerability and so also serves as the largest sector in need of intervention. It has been argued that a clear understanding of the health status and disease burden is necessary in order to plan aid and ensure human security.

Difficulties arise as reliable data is lacking and assessments and estimations of the countries health care situation are often sparse. Most information is based on regional data collected by international organizations, non-governmental organizations, refugee studies, and press reports (63).

Disease Burden

When looking at the disease burden of North Korea great disparities become clear. Whereas the north of the country experiences more deaths related to malnutrition and communicable diseases, urban areas in the southern regions seem to be burdened by non-communicable diseases (Figure 9) (63).



Mortality and prevalence of non-communicable diseases risk factors among member states of World Health Organization-designated South-East Asia region.

Figure 9: Mortality and prevalence of non-communicable diseases risk factors among member states of world Health Organisation designated South-East Asia regions, Source: WHO 2011

Cardiovascular disease (CVD) as a single disease group was the largest cause of death in North Korea in many urban regions (3 times higher than in South Korea) while in poorer areas in the north 29% of people are dying from communicable diseases such as acute respiratory infections and malnutrition (63). Particularly women, the elderly and under five year olds are affected in these poorer areas (56;63).

Although research has found that between 1990 and 2008 the Under-five Mortality Rate (UMR) reduced from 45 to 33/1000, the Infant Mortality Rate (IMR) likewise increased from 23 to 26/1000 during same period (63). Neonatal death account for 51% of under-five mortality (global average 40%) (56). As these rates are still respectively high a closer picture has to be created with regards to the extent of the disease burden in North Korea.

The WHO (32) calculated the major causes of death for <5 year olds in 2103 with prematurity accounting for 22%, Acute lower respiratory infection: 16.7%, Congenital Abnormalities: 13.2%, Birth trauma: 10.6%, Injuries: 7.9%, Sepsis and other infections: 5.9% and Diarrhoeal diseases accounting for 5.4%. Many of those causes of death can be directly related to the high levels of malnutrition. National averages of <5 malnutrition have been estimated to range between 4.7-17.4 per cent for moderate malnutrition and between 0.5-2.8 per cent for severe acute malnutrition (56;63). In many of the worse areas in the northeast affected by malnutrition, 19-25% of children were underweight and 32-45% were stunted (Figure 10; Table 3) (63;64).

Stunting Prevalence by Province

Moderate and Severe (-2 SD) stunting rate amongst children under 5 years of age (MICS 2009)

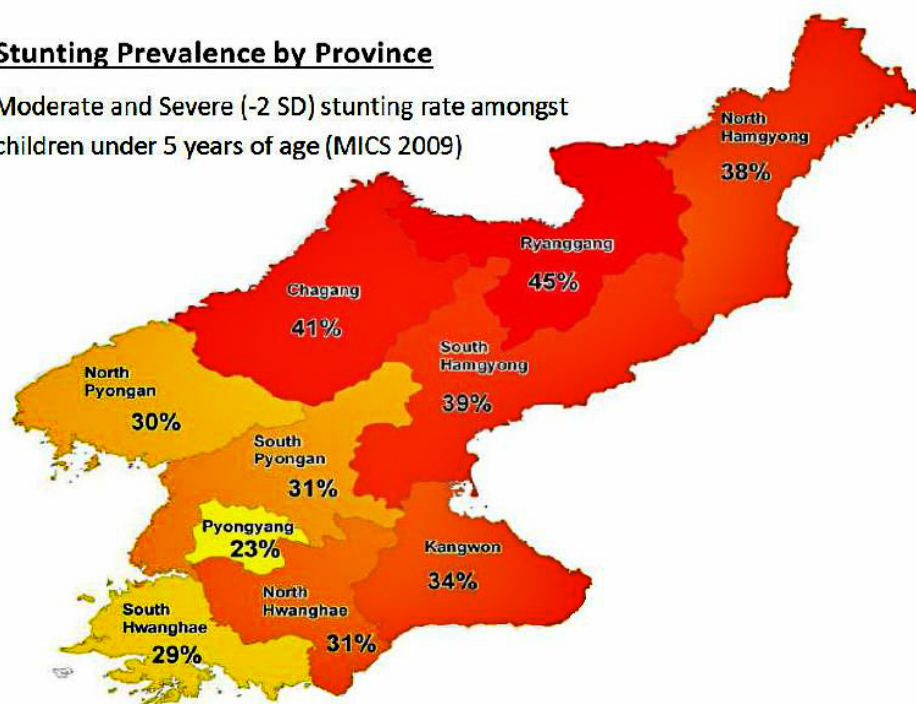


Figure 10: Stunting Prevalence by Province 2009. Source: United Nations 2012)

In such areas Infectious disease are high and pneumonia and diarrhoea are the leading cause of child death. Besides, over one third of the school-age children are suffering from diseases caused by intestinal parasites (63;65). As well as high Mortality Rates among children, Maternity Mortality Rates (MMR) have also increased particularly in rural areas in North Korea since the 1990s.

The United Nations (56) points out that between 1990 and 2008 MMR has increased by 36.5% now standing at 85 per 100.000 live births for whole North Korea and 105/100.000 for rural areas. Differences in the disease burden are ought to be related to differences in food security among different regions (63). This also would account for Mortality Rates being much higher in rural areas than urban areas (63). In those rural areas already simple infectious diseases are particularly difficult to treat as access to drugs and antibiotic treatment is limited.

This leads to the conclusion that deficiencies in the health system combined with high rates of malnutrition are among the major contributors to the high rates of maternal and child mortality (63). The fact that prevalence, incidence and absolute cases of diseases are high also indicates that the health system and current aid provision is insufficient for the magnitude of the crisis.

Nutritional status of children under five in North Korea by province for the year 2009

Province	Stunting (%)			Wasting (%)			Underweight (%)		
	Total	Moderate	Severe	Total	Moderate	Severe	Total	Moderate	Severe
Ryganggang	44.9	29.1	15.8	7.9	7.4	0.5	25.4	20.0	5.4
North Hamgyong	38.0	27.6	10.4	7.2	6.2	1.0	21.0	16.2	4.8
South Hamgyong	38.5	27.1	11.4	7.3	6.3	1.0	21.5	16.9	4.6
Kangwon	34.2	25.0	9.2	5.7	5.7	0.0	19.4	15.1	4.3
Jagang	40.9	27.9	13.0	6.9	5.9	1.0	22.0	16.9	5.1
North Pyongan	30.4	21.9	8.5	4.9	4.9	0.0	18.0	14.1	3.9
South Pyongan	30.5	25.1	5.4	4.4	3.9	0.5	17.7	14.4	3.3
North Hwanghae	30.8	22.1	8.7	4.5	4.0	0.5	18.0	14.4	3.6
South Hwanghae	29.2	22.0	7.2	4.0	3.6	0.4	17.4	14.1	3.3
Pyongyang	22.5	18.2	4.3	2.3	2.3	0.0	14.4	11.6	2.8
Overall	32.4	24.0	8.4	5.2	4.7	0.5	18.8	14.9	3.9

Modified from United Nations Children's Fund. Democratic People's Republic of Korea multiple indicator cluster survey 2009; 2010

Table 3: National Status of children under five in North Korea by provision for the year 2009, Source: UNCF 2010

Tuberculosis and Malaria

Besides malnutrition, Tuberculosis (TB) and Malaria have also received a large proportion of international attention, being another major health issue in North Korea. Although TB mortality rates have continuously declined in the past 15 years, annual incidences are still estimated at 3.45/1000 with a prevalence of 4.22/1000 reported in 2011 (Table4) (56;63). It is important that TB is approached at a

national level covering the total population in order to prevent an increase in the resistance to the drugs and treatment (66).

Due to North Korea's restrictions such an approach has however not been successful in previous years, leading to more than 3,900 cases of drug-resistant TB patients. Lack of treatment has led to unwarranted deaths and high transmission in the community, particularly among women who are care-givers and their children (61). In 2008 the US started greater collaboration with North Korea's Ministry of Public Health (MoPH) establishing links to Stanford University and setting up a TB reference laboratory in Pyongyang.

In order to improve diagnostic capacity and identify multi-drug resistant strains of Tuberculosis laboratory material and equipment worth \$1.7 million was shipped via Beijing to North Korea (67). The laboratory opened in 2010 and since then held several workshops to train staff in TB culturing methods and laboratory practices (66;67).

Since 2010 the Global Fund together with the WHO has joined the effort to control, treat and eradicate tuberculosis and other infectious diseases in North Korea. Its funding role comprised of aid for medication supply and basic testing for multi-drug resistance equating to a total of 21 million US dollars (67;68).

Overall it can be stated that although national as well as international efforts have led to a treatment success rate over 85 % in 2010 and 90 % in 2011, Tuberculosis and particularly drug resistance to such is still a major problem in North Korea (56).

Trends in the disease burden of tuberculosis in North Korea and comparison groups over the period 1995 to 2011

	World	South-East Asia region ¹	South Korea	North Korea
Mortality (per 100 000 population)				
1995	24	44	5	20
2000	22	43	4	17
2005	19	37	4	14
2011	14	26	4	6
Prevalence (per 100 000 population)				
1995	269	468	202	738
2000	257	445	184	669
2005	221	370	167	582
2011	170	271	149	422
Incidence (per 100 000 population)				
1995	148	217	101	344
2000	148	218	79	344
2005	142	212	88	344
2011	125	189	100	345

Modified from World Health Organization. Global tuberculosis report 2012; 2012 [Internet] [5]

¹ Bangladesh, Bhutan, North Korea, India, Indonesia, Maldives, Myanmar, Nepal, Sri Lanka, Thailand, Timor-Leste.

When looking at Malaria on the other side, disease containment has been more successful. Approximately 200,000 North Koreans were affected by a Malaria outbreak between the mid 1990s and early 2000s. Since, then the total number of patients has been decreasing and the number of new incidences has dropped since the start of 2005 respectively.

Although Lee et al. (63) report that the current incidence of malaria in North Korea is found to be one of the lowest in Southeast Asia, the WHO (69) has recorded a 28% increase in cases between 2011 and 2012. This development highlights the need for further investigation.

Table 4: Trends in the disease burden in Tuberculosis in North Korea and comparison groups between 1995 and 2011, Source: WHO 2012

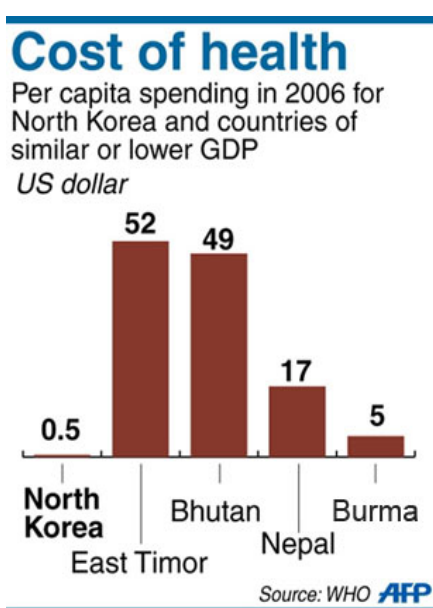
Health Infrastructure

Although adequate public health information are difficult to access, an overall increase in vulnerability due to financial constrains has become apparent. Such constrains have predominantly impacted on North Korea's Health Infrastructure. While it has been recognized that North Korea professes to have a universal and free health care system with a strong health professionals workforce of 300,000 (70), the majority of the population seems to endure poor health, malnutrition and lacks access to necessary drugs and health services.

The data presented with regards to DPRK disease burden highlights the population's high vulnerability particularly to malnutrition. North Korea seems to fail to appropriately and systematically address the underlying risk factors of food insecurity, sanitation and safe water access (56). It has also been shown that North Korea has one of the lowest levels of per capita funding for health care, making it impossible for the country to provide basic health care and sufficient medical supplies and equipment (Figure 11) (28;56).

The United Nations (56) has shown that only 30% of essential drug such as analgesics and antibiotics needs are met and that 40-70% of county hospitals and clinics lack basic medical equipment. Besides the lack of drugs and equipment, health facilities are rundown and operate with frequent power cuts and no heat while sanitation, water supply and heating systems continue to fall into disrepair (28;56). Moreover, training for medical staff has not been modernized or been updated since the 1980s (62).

In the last few years medical personnel also often did not receive salaries and so started illegally and privately charging for their services. This in turn meant that a majority of the population could not access full medical care including important medicines and surgery services (28).



Although in recent years emergency obstetric care was introduced at national, provincial and county levels, the system lacks safe blood transfusion practises as well as ambulance services and resuscitation equipment, hindering sufficient service with regards to referrals and emergency care.

This is particularly obstructing appropriate response to medical emergencies and increases the chances of complications and mortality among newborns, children under-five and women in delivery (56;70). It is believed that this is due to a chronic lack of funding and the costly and logistically challenging task of distribution. This in turn means that North Korea is majorly dependent on outside help in form of foreign aid

(62).

Figure 11: Per Capita spending in 2006 for North Korea, Source WHO 2006

Access to Water and Sanitation

Access to clean water, safe sanitation and hygiene is poor, particularly in the northern parts of the country and in rural areas. UNICEF (58) points out that most of the piped systems are in ailing condition, are not or partially functioning and so 22% of the population are forced to supplement their water consumption from dug wells and tube wells which are often close to sources of contamination. The piped system which was put in place in the 1980s has suffered from destruction caused by natural disaster and bad maintenance causing a significant amount of water getting lost or contaminated (72).

Shortage of electricity, no means of funding and the reoccurrence of natural disasters make it difficult for North Korea to rehabilitate the water system (58). When looking at sanitation it becomes clear that even though almost all households have access to some form of sanitation facility, latrines are predominantly rudimentary and therefore remain ineffective in preventing faecal materials from entering into the human environment. This, so OPEC and UNICEF (58;72), increases the risk of diarrhoea, waterborne diseases and epidemics particularly among under-five year olds. From this it becomes also clear that access to clean water, safe sanitation and hygiene education is deeply linked to disease and especially prevalent among children in rural areas (61).

In recent years efforts were made by various stakeholders, including UNICEF, IFRC, OPEC together with North Korea's Ministry of City Management and Public Health in replacing derelict and defunct pumping water supply systems with low-cost and sustainable gravity-fed water supply system (GFS) and introducing decentralized waste water treatment systems (DEWATS) (58;61). Such undertaking was supported by the WASH program implemented by UNICEF which combined nutrition, and health interventions in the 25 most food-insecure counties in four Northern Provinces (56).

At the same time UNICEF together with OPEC has begun to support the Water and Environmental Sanitation Program (WES) which aims to secure safe access to water supplies, improve sanitation facilities and promote hygiene in vulnerable provinces in the east and northeast, particularly focussing on schools and children's homes (72).

To strengthen all those actions, training is planned to be provided to local water authority management teams with regards to water and sanitation assessments, rehabilitation planning, leak detection and water testing. This is ought to be accompanied by a Country-wide information dissemination campaign to educate communities on hygiene practices (72).

With regards to disaster it is also important that the Community Based DisCBDP programme draws on the expertise of the water and sanitation programme to improve emergency preparedness and response capacity and ensure access to safe drinking water to disaster-affected populations (5;58)

Interventions and Recommendations

In recent years there has been a great emphasis on information and education campaigns to provide accurate and comprehensive information on prevalent infections and diseases; their causes, symptoms and treatment; and the importance of medical diagnosis and effective use of medicine (28).

According to the United Nations (56) four major actors are present with regards to continuous involvement in providing support: UNICEF, WHO, IFRC and UNFPA. UNICEF, WHO and UNFPA are concentrating their efforts on addressing needs in the health sector, including case management of acute malnutrition, child and maternal health and emergency care. This includes distribution of equipment and drugs to address acute shortages of life-saving medicines for the treatment of diarrhoea and pneumonia, and prevention of maternal mortality.

In counties affected by acute food shortages nutrition deficiencies 'Community Management of Acute Malnutrition' (CMAM) interventions have also been implemented. The areas of responsibilities of the UN agencies are as followed:

- WHO focuses on raising awareness and increasing the competency of health care providers through various training in evidence based cost effective interventions and focus on the prevention of disease through immunization (56;74). The expanded programme on immunization includes measures against tuberculosis and tetanus as well as malaria, influenza, viral hepatitis B, viral hepatitis C (61).
- UNFPA updates essential health equipment and supplies; conducts basic emergency obstetric and neonatal care training; delivers education programs and disseminates information and promotion materials to health professionals, stakeholders and the public (18; 56).
- UNICEF major focus lies on providing essential drugs and micronutrients to vulnerable groups (56).

Besides all this effort, the three UN agencies are also supporting pilot projects on new approaches, methods and tools for management and delivery of cost effective and quality health services in line with international standards in order to demonstrate better results.

To tackle the high number of maternal and postnatal deaths, the country has introduced strategies for basic emergency obstetric care along with essential newborn care countrywide (70). Such not only ought to promote hospital based delivery with trained birth attendants, it also aims to integrate management of childhood illnesses. Even though great efforts have been made, the WHO (70) acknowledges that difficulties have occurred with regards to availability and capacity of services at rural level.

From this it becomes clear that, improving availability and reliability of health data, understanding root causes and factors affecting the disease burden while developing essential preventative interventions is crucial (56). Although process has been made and project evaluations have been set out, it is difficult to locate and evaluate the results and put them into perspective.

When looking at the forth major actor with regards to health in North Korea, Rode (71) has found that the IFRC and DPRK RCS are the only organization in the DPRK

which have carried out regular drug distributions to primary health care facilities in a non-emergency setting, while particularly focussing on improving the health of women and children (71). Its unique historical position makes the Red Cross the primary government-controlled agency, coordinating activities that usually fall under the responsibility of the Ministry of Public Health (MoPH) (71). Up to date around 8.25 million people in total have benefited from the supply of medical instruments and essential medicines such as antibiotics to treat acute respiratory infections (56).

Community Doctors, health professionals' university students and volunteers have received training with relation to prevention and particularly focus on health in emergencies through Community Based Health & First Aid (CBHFA) programmes (56;71). These campaigns and programs moreover aim to raise awareness on disease outbreaks and newly emerging diseases. Particularly successful were vaccination efforts for communicable diseases which have reached the level of the developed countries (63). In 2013 more than 90 per cent of children were reported to have full immunization.

Nationally routine immunization coverage for measles in 2013 stood at 99 % and Hepatitis B at 96% (56;74). Despite the IFRCs supporting efforts, it has been recognized that it is important to further scale up the first aid programme at the national level in order to improve the populations' health status. Emphasis must also lie on reliable data collection to develop statistics to be able to quantify the impact (56;71).

5.2.5 Economic Factors

The country's past economic development was characterized by fast industrialization during the mid to late 1950s (1). It particularly embarked on a program in heavy industry, which achieved extreme growth rates in the range of 30-40 percent per annum. In the 1960s, annual growth rates of around 13 percent were still attained in industry and DPRK seemed successful in meeting people's basic needs and was on its way of eliminating absolute poverty (1).

From 1990, the economy suffered a slowdown and the DPRK had difficulties meeting planned targets. With ageing industrial plants, little new investments, loss of most of its traditional trading partners, and economic sanctions from the Korean War still in place, the economy has been under severe strain.

The collapse of the former USSR in 1990, the economic liberalization of China, years of economic mismanagement and resource misallocation, compounded by several years of heavy natural disasters and food shortages led to the economic collapse of the DPRK in the mid 1990 (1-3;31;60). Access to petroleum products, capital goods, technology as well as foreign aid was cut and many import and export routes cancelled (1;60).

Trade at this point in time was conducted on barter terms between national trade organizations operating through trade monopolies. Within a decade the country's GDP shrank by 50%. In response the North Korean Government increased prices of

basic goods and services dramatically to approximate the market prices (60). While rice prices increased up to 500%, wages only rose by 25% on average (Figure 12).

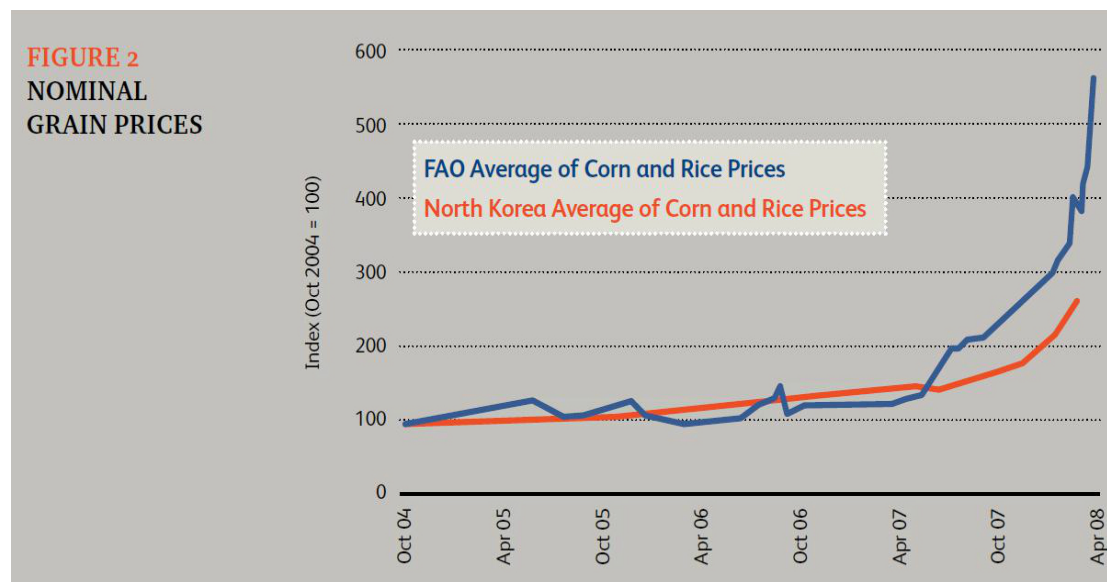


Figure 12: Nominal Grain Prices in North Korea 2004-2008, Source: Haggard & Noland 2008

These changes lowered productivity and output in all sectors as well as trigger a tremendous rise in poverty. Particularly agriculture, domestic production and imports of inputs such as fertilizers, pesticides, fuel and spare parts, as well as of raw materials for production, were affected (1). This negative progress aided the development of parallel economies private markets that operate outside the official central planning mechanism (7;60). Such development took great effect on the economy, causing a shift in sectors contributing to the national GDP. Up to the year of 1996 agriculture was given a high priority as it contributed 37 percent of the national economy (1).

Since then agriculture is believed to have declined by about 50 percent. The CIA (3) has estimated that in 2012 the GDP of \$40 billion was composed by agriculture: 23.4%, industry: 47.2% and services: 29.4%. Those numbers indicate that North Korea's Economy shifted from one based on agriculture to one based on industry, which had a tremendous effect on rural areas which were depending on agriculture for survival.

Besides the agricultural sector, Habib (7) believes that the military accounts as the most important parallel economy in North Korea. It ought's to account for up to 70% of North Korea's domestic economic output and is thought to occupy about 75% of all economic activities related to the production, distribution, and consumption of materials (7;16) This in turn means that civilian resource consumption it extremely low and a great level of poverty exists (2;3).

Poverty levels within North Korea are further amplified as access to resources, particularly jobs, education and food is majorly determined through social

stratification (7). The three-tiered system divides the population into the central class (regime elite) uncertain class (small business persons, landholder and families) and hostile class (designated enemies of the state) (7).

According to Habib (7) approximately one-quarter of the North Korean population belongs to the hostile class and is therefore denied access to most basic needs such as food and fuel. Besides North Korea's acute food shortage problem which has been explored in section 5.2.3, particularly fuel shortages have caused major issues to the country. Habib (7) points out that because North Korea does not have an indigenous petroleum reserves it imports 90% of its oil from China and smaller fractions from Russia. Fuel supplies from China are however often intermittent, forcing the country to use forestry products for fuel. This in turn causes great levels of damage to the land and so exacerbating the impact of disaster, especially that of floods (7;69).

Infrastructural issues are further amplifying the issue of shortages and access to goods as over 90% of North Korea's roads are unpaved and poorly maintained (3). This creates a major challenge to the transportation of goods, fuels and materials particularly the transportation of aid during a disaster. Further challenges for the humanitarian organizations involved with aid in DPRK arise due to the financial sanctions against the country which make any bank transfer of funds impossible and lead to delays in the implementation of activities (73).

The military also is thought to serve as a major obstacle with regards to food aid. It is believed that over 30% of the aid from foreign donors in the past has been deployed to the military and political elites or sold on the black market instead of being distributed to the public in need (7;26).

Economic sanctions further deteriorate the already weak economy and limit access as well as the deployment of various goods (59). According to Manyin and Nikitin (59) sanctions were primarily made in the past with regards to North Korea's history of regional military provocations and long-range missile development, which in turn had tremendous impact on energy assistance and food security.

Although over the last few years greater access was granted and some sanctions were alleviated in exchange for about \$400 million dollar in oil and aid, North Korea's foreign affairs stay unpredictable and nuclear threats still serve as a means of political control (59).

Habib (7) here rightly identifies North Korea's weak coping and adaptive capacity, as the regime is unable to generate funds by producing goods for export and also does not have the means to provide equitable access to resources such as food. Its capacity is further diminished by its inability to import, supply, repair and replace equipment for the agricultural, healthcare as well as other public sectors. This makes the DPRK reliant on foreign aid including technologies, equipment and food. From this it becomes clear that to maintain a socio-political system, governing institutions and populations must have access to an adequate energy, resource, and manpower base. If this is not given the system cannot be preserved at the desired level of complexity and institutional breakdown is likely, leading to failure or collapse of the economic system (7).

As it stands now North Korea does not seem capable of maintaining centralized total control. This in turn might in the long run push the governing bodies to invest in the

marketization of the economy as well as reforms that allow greater political and social freedoms (3). A first step was made by the government allowing private "farmers' markets" within the country to begin selling a wider range of goods. Since last year it also engaged more actively with foreign investors, setting up 14 new Special Economic Zones (3). Although indications exist that North Korea is opening its economic borders, up to today firm political control remains the government's overriding concern, inhibiting changes to the current economic system.

6. Disaster Preparedness and Risk Reduction

Despite North Korea high levels of vulnerability to disasters and seemingly even greater limits of coping capacities (75), over the last couple of years, the Government of DPR Korea has more openly recognised its own humanitarian needs arising from natural disasters and increasingly shown an interest in working closer with the international community on addressing these needs. This has created opportunities for policy dialogue and engagement with the government as well as regional and global partnerships.

Attention has been drawn to interventions that have the ability to strengthen both national and local preparedness and risk reduction capacities, while incorporating effective data collection, monitoring and evaluation measures in order to improve needs assessments. It has been highlighted that this is ought to be achieved through advocacy, communication and resource mobilisation (61).

The United Nations (56) here has argued that in order to mitigate crisis and to address root causes of vulnerabilities emphasis must not only lie on response but also on building resilience while addressing immediate and intermediate needs in nutrition, health, agriculture, water and sanitation.

In 1998 the DPRK Red Cross established under the National Disaster Coordinating Commission (NDCC) a disaster management department which oversees the coordinated response in major emergencies (4;73). Internationally, it works with other Red Cross and Red Crescent societies in the IFRC's disaster management working group for East Asia (73).

In recent years the DPRK Red Cross has shifted its focus from disaster preparedness and response towards the development of a disaster management (DM) programme which focuses on reducing the risks and effects of natural disasters and helps communities protect themselves from disasters (71). These objectives are ought to be achieved through Community-based early warning and evacuation guidelines (CBEW) with support from relevant stakeholders including National Academy of Science, Ministry of People's Security, National Disaster Management Bureau and Central Hydro-meteorological Bureau (4;73).

Activities which are run under those guidelines are ought to raise awareness, focus on structural as well as non-structural mitigation measures including early warning systems, contingency planning, and risk mapping (4). Since 2005 the programme has implemented community-based disaster preparedness which particularly focuses on:

Disaster management planning and organizational preparedness

- Predicting and planning of disaster to mitigate their impact on vulnerable communities
- Developing response and coping mechanisms to disaster consequences
- Ensure sufficient capacity in skilled human resources
- Securing financial and material capacities for effective disaster management

Community preparedness and disaster risk reduction

- Increasing self-reliance of individuals and communities to reduce vulnerability
- Improving livelihoods
- Raising public awareness on risk reduction

Disaster response and recovery

- Improving the disaster response capacity to meet the immediate needs of people affected
- Improving the capacity to restore or improve pre-disaster living conditions and reduce the risk of future disasters (build-back-better)

Activities are deployed between the 12 staff strong National Disaster Response Teams (NDRT), six Provincial Disaster Response Teams (PDRTs) and three Water Rescue Teams which are operating along Beaches and main rivers. Those teams are supported by the Red Cross county branches and thousands of trained volunteers in the communities (4).

The NDRT operates its activity from a centre in Pyongyang. From there the team is deployed to disaster-affected provinces where it carries out assessments and plans emergency responses. In disasters where less than 200 households are affected response is carried out by the PDRT. Those teams work closely with Community-based disaster management committees (CDMCs).

CDMC members are representatives from different public institutions within the community (such as the health centres, schools and cooperative farms), which have received extensive training on disaster preparedness and response (4). Although Province-level DM working groups are meeting for reviews on an annual basis it has been acknowledged that there is still a great need for provincial contingency plans and greater emphasis on working in coordination with local players, such as the CDMC, government, health centres (including first aid posts) and others.

Special water rescue teams are set up to respond to a range of challenges particularly with regards to flooding. According to the IFRC (4) the river rescue team, for example consists of 15 trained staff which operate from a building near the Taedonggang River and on a 24h basis during flood season. In addition two sea rescue teams operate during June and September at the two most popular beaches on the east coast of the country. Each team consists of ten volunteers, who are mobilized in case of emergencies and disasters.

Not only has the Red Cross developed a disaster response structure it has also put emphasis on mitigation measure and pre-positioned emergency stocks for approximately 27,000 families in seven warehouses, for immediate deployment in case of disaster. Such stock includes kitchen sets, jerry cans, tarpaulins and blankets. Although logistical and procurement minimum standards were being met it was highlighted that storage practices and refurbishment of the warehouses were lacking.

Besides IFRC active involvement in DM, in 2013 also the UN Office for the Coordination of Humanitarian Affairs (OCHA) organised workshops on Disaster Management and Risk Reduction for Government officials and their partners in Pyongyang. Through joint and cooperative contingency planning and exchange of experiences via disaster simulation exercises a communication and advocacy strategy was developed which set the basis for a consolidated UN humanitarian action plan (61).

6.1 Early Warning Systems & Mitigation

Specific community-based disaster preparedness programs (CBDP) which have been implemented in the most vulnerable communities have particularly proven to be successful in introducing mitigation measures such as early warning systems and evacuation plans (73). Such are coordinated by the CDMC which is chaired by representatives of different social groups in the community, such as farmers', women's and youth associations, health clinics and schools.

With a particular focus on floods the program centres around safeguarding livelihood and food security. Mitigation works are concerned with the construction of stone and concrete erosion walls or dykes as well as the performance of drill exercises in order to improve disaster risk reduction (DRR) (4).

6.2 Needs Assessment

In 2007 the IFRC developed an inter-agency rapid common assessment tool called vulnerability and capacity assessment (VCA). Such assessment plans are updated annually and supported by the Regional Office of the UN Office for the Coordination of Humanitarian Affairs (OCHA) in Bangkok (56).

Hazard and multi-risk analysis and vulnerability assessments are carried out to accurately assess the actual needs in the CDBP communities and to increase the resilience and ownership of disaster preparedness to self governing bodies within vulnerable, disaster prone communities (71;4).

Committee members in each community carry out these assessments via collaborative and participatory approaches involving all different social groups (4). From this the main hazards in a community and the most effective means to mitigate the related risks are identified (71). Findings serve the development of interactive preparedness activities and training workshops, which introduce the concept of risk mapping and disaster contingency planning at national, provincial, and county levels (56;71).

It has been argued that assessing the needs from the community level can help ensure that the provision of humanitarian assistance is based on need and is not subject to political conditions or driven by political interest (28). The application of this assessment tool has proven to be particularly successful in flood scenarios (4).

6.3 Health Interventions

When looking at health with regards to disaster in the DPRK it becomes clear that the system is very fragile and in great need of interventions that reduce the health consequences of emergencies and minimize the social and economic impact (56). Over the last few years the DPRK RCS and IFRC have closely been cooperating with local and international partners such as the MoPH, Education as well as organization such as WHO and UNICEF and have developed community health interventions that are ought to mitigate disaster impact on health (73).

Together with the WHO a 'National Action Plan on Emergency Preparedness and Response to Disasters' was implemented which not only strengthened the ministries capacity to deal with disasters but also helped to maintain mitigation and preventative public health activities. Such activities particularly respond to emergencies, epidemic outbreaks and infectious diseases and encompass health training sessions and emergencies courses organized by IFRC and DPRK RCS (73). Such courses address local branch trainers and focus on improving the skills on training, organization and facilitation, while integrating technical aspects on emergency responses in health.

This is ought to create a joint effort that supports the development of the national network of health institutions at provincial level for preparedness, response and early recovery after emergencies (56;73). Besides this, current focus lies on building in-country stocks of emergency supplies such as health and hygiene kits, food and water purification tablets in order to enable a swift and effective local response in case of a disaster (56).

WatSan: When looking at CDBP programs which prioritize Water and Sanitation, it has been found that focus lies on the protection of key water sources, to ensure access to safe drinking water. Those programs have however not yet fully been linked to the DM department and its interventions. Integration of community-based

programs has therefore been suggested, particularly as contamination of water sources due to flooding poses serious health risks and therefore can develop to a major problem in disaster situations (4).

6.4 Reforestation Interventions

As flood impacts are directly interlinked with levels of deforestation, landslides and erosion CBDP also work in collaboration with governmental reforestation programmes, establishing tree nurseries and taking part in tree-planting events to prevent human suffering (4;71)

The Red Cross as well as UNDP and FAO have developed ecosystem-based adaptation strategies such as sustainable land management and watershed forest management to reduce soil erosion, water retention, promote sustainable natural resource management and livelihoods (56). In 2014 eight target communities established tree nurseries and planted 567,000 seedlings provided by the Red Cross and 300,000 seedlings produced by community nurseries on 651 hectares of surrounding bald mountains.

Moreover, a total of 2,000 copies of agro forestry guideline and 1,000 flipcharts of agro-forestry practice have been printed and distributed to sloping land user groups in other target communities (73). Likewise, Global Forestry Services set up by UNICEF's encourage communities via promotion campaigns and interactive workshops to protect their forest and their water sources and reduce the carbon footprint in the atmosphere (56).

6.5 Measuring and documenting impact

According to the IFRC (4), only about 50% of the branches involved in Disaster Management have implemented hazard mitigation measures. The remaining 50% have received training and planning support but have had no formal input to help construct physical measures, indicating inconsistency in approaches. Within those 50% of branches who implemented hazard mitigation measures indicators are not in place to measure and document the impact of their efforts on communities and stakeholders (4).

It is however vital to measure changes in knowledge and practice as a result of community training, or how flood erosion walls improve people's safety and livelihoods in order to ensure that the program is effective and targets the most vulnerable communities.

Although some county and provincial Red Cross branches have begun to draft disaster impact evaluations, the data presented in such evaluations remain off limits to international IFRC staff, thus creating an information gap that impedes appropriate and transparent decision-making on strategic issues within the programme (4).

Besides this, data gathered is predominantly of quantitative nature. Qualitative indicators are absent. This limits in depth information about complex issues and so abates detailed impact evaluation on disaster situations when needed. Therefore the IFRC (4) highlights that emphasis must lie on developing and implementing more detailed indicators that measure performance using qualitative approaches.

6.6 Donors, Access Restrictions & the Funding Gap

Together with the WFP and UNICEF the IFRC is one of three most significant international humanitarian actors in DPRK (31). Besides governmental actors, such as South Korea, China and Russia the Red Cross Society is the only non-governmental agency having a mandate in disaster response and disaster management within the country (2).

This is exceptionally as aid in the past has been majorly depended on political relations and sanctions made against and by North Korea with regards to its Nuclear Program. Particularly U.S. organizations and agencies have based their energy assistance and food aid on North Korea's willingness to dismantle its nuclear program which in turn has had tremendous impacts on the affected communities (59).

Over the years the IFRC has mobilized aid through its Disaster Relief Emergency Fund. Such fund however has limited resources it is unable to meet the totality of needs in DPR Korea. In order to ensure that most vulnerable people continue to be reached it is therefore vital for IFRC as well as any agent involved in disaster relief to set out Emergency Appeals to other donors such as Central Emergency Response Fund (CERF) under OCHA and request additional funding (61).

In the past and up to today much of the aid has been delivered without credible monitoring and evaluation systems in place, making it very difficult to estimate its actual impact and effectiveness (60). Data collected and or provided by the Government is often incomplete and opportunities to verify data are sparse due to limitations in access (61).

The United Nations (56) has argued that UN agencies and international NGOs are also given differential access based on their operating conditions and the amount of resources being brought into the country. Generally a seven-day notification for all monitoring missions has to be given.

Some organizations such as UNICEF however have been able to monitor missions with a four day notice in special circumstances. Even though some organizations have been able to expand access in conjunction with the Emergency Food Operation (EMOP), allowing Korean-speaking international staff 24 hours' notice, conditions are subject to re-negotiation for every new emergency which in turn creates inconsistency and difficulties with regards to resource mobilization (56).

In addition to access restrictions of physical nature many UN agencies also have been unable to use their regular banking routes due to sanctions being made against North Korea. This has created operational obstacles and limitations in availability and access to essential services and lifesaving interventions (61).

Political restrictions as well as limitations with regards to monitoring have not only adversely affected in-country procurement, monitoring visits, effective programme delivery, capacity building programmes, and general operating expenditures, such as office rental and utility payments (fuel, telecommunication, staff salaries and maintenance) they also have created an acute annual funding gap for North Korea (61).

As Table 5 indicates, only 37.8% of the total funding need was met in 2012 (56). For 2013 that equated to \$97,920,341 that were still required to respond to the key priorities of food and nutritional assistance, agricultural support, health and water, sanitation and hygiene interventions (61). Those numbers indicate the need for longer-term economic investment and development support, especially in agriculture, rural energy and health systems and particularly disaster risk reduction efforts.

It has been suggested that diplomatic and humanitarian” linkages as well as improvements in access and monitoring might be possible to establish by conditioning food aid on progress in negotiations regarding North Korea's nuclear programs (59).

Overview of funding needs per sector in 2012

Agency	Sector	Total Needs (US\$)	Funding Gap (US\$)	% received
FAO	Agriculture	13,000,000	9,200,000	29.2%
WHO	Health	22,022,000	15,792,000	28.3%
UNFPA	Health	2,200,000	1,500,000	31.8%
WFP	Food Security	136,649,562	78,441,000	42.6%
UNICEF	WASH, Health & Nutrition	24,195,000	18,238,000	24.6%
Total (US\$)		198,066,562	123,171,000	37.8 %

Table 5: Overview of funding needs per sector in 2012, Source: United Nations 20120

7. Discussion

North Korea today and over the past not only faces and has faced serious events of disaster, it is and also has been confronted with tremendous geographical, topographical as well as socio-economic challenges that make the country extremely exposed and highly vulnerable to hazards.

Over the past 50 years the DPRK has been exposed to major natural hazards such as flooding and typhoons. Those have precipitated Epidemics and Famines which are still ongoing in parts of the country up to today. Minor hazards have included volcanic & seismic activity, earthquakes and industrial accidents. Such hazards have

served as serious disruption of the functioning of the North Korean society, causing widespread human, material, economic and/or environmental losses, particularly impacting negatively on food security, health infrastructure, economy and the environment.

Extremely temperature with long cold try winters in the DPRK are limiting the length of the growing season whereas uneven and high levels of rainfall during July and August exacerbate flooding and so cause damage to crops. In the past such development has been exaggerated by climate change and the lack of appropriate machinery or fuel to power them.

High levels of deforestation which occurred as a result of fuel shortages over the years have increased degradation and desertification of hundreds of thousands of hectares of land. Such development was caused by as well as was causal to the impact of flooding and landslides, increasing the countries vulnerability to natural hazards and food shortages. This created a vicious circle that has particularly negatively affected the poorest and most isolated of the population and exacerbated poverty and starvation.

Although deforestation efforts have been made and structured and sustainable forest management program have been introduced insufficient financial resources, low technical capacities as well as incomplete and incomprehensive databases related to land use and degradation are hindering an effective response to the problem at hand.

As only a fraction of North Korea's land is arable and production, trade, and transfers within the DPRK are controlled by the government, nationwide food insecurity exists. Poor management of resources related to poor distribution between markets within the country together with several years of disasters have caused collapses of the food supply. Access to food seems to be allocated along social classification and political criteria.

Restriction to use foreign currencies within markets together with a tremendous increase in cereal prices over the last few years has forced the closing of food markets and so has contributed nationwide starvations, malnutrition and mass movement. With the government in the past not being able to acknowledge food shortages, aid distributions through donor organizations were unsuccessful and the population was left suffering.

High levels of food insecurity meant that malnutrition levels rose (up to 60% moderately and 16% severely malnourished) causing a tremendous increase in under five mortality and maternity mortality numbers especially in rural and isolated areas of the northern part of the country. This development together with limited access to water and sanitation also triggered the spread of epidemics and mass outbreaks of illnesses such as waterborne disease and diarrhoea.

The lack of medical supplies and drugs meant that particularly communicable diseases outbreaks were almost impossible to manage. Although North Korea holds a high health professional density, virtually no money or training has gone into such workforce since the 1980s. With an estimated annual spending of \$0.5 per capita on health it is no wonder that North Korea's disease burden is high. While mortality rates in urban areas are mostly related to communicable diseases, malnutrition,

respiratory infection and other, non-communicable diseases are the number one factor of mortality in rural areas. Such differences are ought to be related to differences in food security and stratification among different regions. Particular focus in recent years has lied on measles and tuberculosis.

Drug resistances which have developed with regard to many tuberculosis cases as well as outbreaks of measles in rural areas have been hard to manage due to medical and technical constrains. Due to the fact that governmental health spending is almost nonexistent, doctors have started to charge for their services. This in turn has greatly limited the already sparse access to healthcare particularly for people from rural regions.

Although several efforts have been made to provide aid support to North Korea, the provision of such has been limited due to access restriction caused by North Korea's insisting on self-sufficiency, as well as political sanctions made with regards to North Korea's Nuclear Program. This together with a nationwide poor road infrastructure has not only created delays in the implementation of activities but also cause cancellations of aid provision and whole agency operations in the country. Up to date there is still a massive annual aid gap that cannot be met due to limitations mentioned above.

While great efforts to Disaster Risk Reduction have been made, climate change, access restriction, Informational controls, economical isolation and the unpredictable development of the political situation impede effective long-term crisis planning and immediate emergency response as well as greatly limit North Korea's capacity to adapt to external shocks.

Limitations with regards to disaster preparedness and response further arise as North Korea restricts access to ground truth data or presents false situation reports. This limits any data collection operation or monitoring activity that is vital to provide effective emergency relief in disaster situation. Such restrictions have not only adversely affected early warning, response and recovery but also influenced in-country procurement, monitoring visits, effective programme delivery, capacity building programmes, and general operating expenditures, such as office rental and utility payments (fuel, telecommunication, staff salaries & maintenance).

From those findings it becomes clear that North Korea is highly vulnerable to disasters, as abilities of people, organizations and systems, to manage resources, collaborate, use available skills and coping strategies in an event of a disaster is hampered. In recent years the importance of preventative measures with regards to risk reduction has been highlighted. Such suggest that not only through systematic efforts to analyse and manage the causal factors of the hazard but also by working on systems that effectively can reduce vulnerability factors and exposure, the severity of a disaster can tremendously be reduced.

In order to avoid the present scale of losses and damages in the future it is crucial to address the deeper context of vulnerability. Experiences from other countries have shown that such an objective requires a detailed mapping and assessment of the risk. Taking such measure has however proven to be a great challenge due to North Korea's political and economic self-reliance philosophy.

Although extreme events such as the famine in the 1990s have provided opportunities for collaboration and cooperation, North Korea seems to be one of the most difficult countries to reach out to.

Disaster Response and Management systems that have been set to explore underlying factors for Hazards and Vulnerabilities have been proven to lack coordination and linkage with local as well as governmental players. Implementations of hazard mitigation measures as well as indicators to measure and document the impact of efforts are still not in place in more than half of the branches set out for Disaster Management.

Although some county and provincial Red Cross branches have begun to draft disaster impact evaluations, the data presented in such evaluations remain off limits to international IFRC staff, thus creating an information gap that impedes appropriate and transparent decision-making on strategic issues within programs. Such gap is further widening as UN agencies and international NGOs access to disaster related data is based on their operating conditions and the amount of resources being brought into the country. Limited Information sharing capacities reduce the ability of individuals, communities, and ultimately the state to react appropriately to crises.

8. Conclusions

From the findings presented in this report it becomes clear that North Korea faces natural and man-made hazards and moreover is highly vulnerable to disaster. As North Korea does not seem capable of maintaining centralized total control particularly in disaster situations, governing bodies have to invest in the marketization of the economy as well as reforms that allow greater political and social freedoms. This in turn will open up opportunities for policy dialogue, interagency engagement as well as regional and global partnership working.

Although improvements have been made in the past with regards to Disaster Response and Risk Reduction in order to mitigate crisis and to address root causes of vulnerabilities emphasis must lie on emergency response but also on building resilience while addressing immediate and intermediate needs in nutrition, health, agriculture, water and sanitation. Such capacities can be built through the establishment of surveillance in the community via education and training.

Due to North Korea's ongoing limited capacities to respond to disaster situations, any operation that is established within the country should plan for longer-term economic investment and development support. Such, as well as other preventative efforts must call attention to ongoing partnerships and collaborative working with those in affected areas.

Attention has moreover been drawn to DM programs that have the ability to strengthen both national and local preparedness and risk reduction capacities, while incorporating effective data collection, monitoring and evaluation measures in order to improve needs assessments. It has been highlighted that this is ought to be achieved through advocacy, communication and resource mobilisation. In order to

establish diplomatic and humanitarian linkages as well as improvements in access and monitoring during a disaster, it further seems to be necessary to strengthen technical capacities, exchange information among relevant stakeholder agencies and encourage bilateral and multilateral international cooperation.

Health measures to tackle the high levels of disease burden and overall vulnerability mainly have to focus on improving access to healthcare, treatment options and available prevention measures. From this it becomes clear that, improving availability and reliability of health data, understanding root causes and factors affecting the disease burden while developing essential preventative interventions is crucial. As in North Korea essential drugs and medical equipments are lacking, community intervention for managing acute malnutrition and maternity cases should invest in the equal distribution of equipment and drugs throughout the country.

Focus must lie on the treatment of those malnourished and the provision of basic emergency obstetric as well neonatal care training. As high levels of food insecurity and dietary needs are tightly interlinked with health, it is firstly important to invest in the provision of vegetable and legumes seeds, as well as fertilizer.

Secondly it is necessary to secure safe access to water supplies, improve sanitation facilities and promote hygiene practises in vulnerable provinces in the east and northeast. Sanitation and submerged water supply systems need to be restored and alternative water sources like dug wells, hand pumps, boreholes and surface water which run high risk of contamination have to be controlled. At the same time GFS as well as DEWATS need to be introduced in order to improve the overall water supply.

As deforestation has strong links to the impact of hazards with regards to food security as well as damage to land and infrastructure, improvements within the agricultural sector have to be made in order to secure food supply.

In the future prominence must be given to efforts that support the establishment of integrated information database related to land resources management. Measures must be put in place, which are able to assess and monitor land degradation and regional impact of soil contamination.

The next step in order to promote safe food production and secure efficient rural energy supply is to introduce slope management and agro-forestry networks as well as implement programs to raise public awareness regarding land resource conservation. Moreover, the implementation of early-warning systems such as radar and satellite forecast or the generation of vulnerability maps has been proven to be an efficient strategy for monitoring and responding to natural hazards.

Overall it can be said that despite North Koreas limited scope for collaboration, systems that are able to mitigate, predict and warn about possible hazards have to be developed in order to counteract vulnerability factors. Further a level of preparedness needs to be reached that can reduce the impact of the hazard itself and that builds capacities to cope with hazards effectively.

As emphasised above, great importance has to lie on tackling the root causes of vulnerability, such as poverty, poor governance, inequality and inadequate access to resources and information. This will provide the grounding for positive progress in

the field of sustainable development as well as it opens a scope for effective Disaster Risk Reduction measures in the future.

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