Input Paper

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The PEOPLES Resilience Framework –

An Integrated Quantitative Measure and Modeling of

Sustainable Development and Disaster Risk Reduction

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Abstract

For the revision of the Hyogo Framework for Action 2 (HFA2), we propose to utilize HFA core components and to develop and implement additional process-based modeling tools that enable communities to effectively and quantitatively assess sustainable development as well as resilience, recovery and disaster risk reduction across international boundaries. The assessment of sustainable development and use of natural resources (e.g. increase crop yields with soil and water conservation) and disaster risk reduction (e.g. water harvesting with flood risk reduction and increase of biodiversity through wetlands) is currently hardly performed within the HFA. We propose to better integrate quantitative measures for resilience and sustainable development to account for the complexities of both across multi-cultural and multi-national boundaries. The so-called 'PEOPLES Resilience Framework' was successfully used to create partnerships and communicate pre- and post-disaster recovery of extreme events. PEOPLES can be combined with environmental, infrastructure, economic or any other quantitative model to assess future scenarios. The Geospatial Interface of the Water Erosion Prediction Project (GeoWEPP) is a state-of-the-art, quantitative, scenario-based watershed assessment model used by researchers and practitioners around the world. GeoWEPP and other quantitative, process-based models can support decision-makers to assess the functionality and response to changes in climate and land use. The example of the Cattaraugus Creek Watershed Strategy with the Seneca Nation of Indians and other stakeholders in Western New York, USA, illustrates how one can create win-win partnerships based on qualitative and quantitative measures among all stakeholders. This proposed integrated watershed management approach creates long-term partnerships, particularly those in communities exposed to the need for sustainable natural resources development and reduction of risks of natural and man-made hazards. Once future climate scenarios and policy agendas of natural resources use and risk management are defined, stakeholders can utilize the modeling tools to collaboratively assess the functionality in future and near real-time scenarios to visualize and to convert the systems' functionality to a regional and global, interdisciplinary language of measuring resilience with numbers, statistics and projections. Our aim is to propose to integrate the proposed PEOPLES resilience and recovery assessment framework and modeling capabilities into HFA2, which then other member and neighboring countries will be able to use to communicate and design win-win strategies for integrated natural resources and disaster management.

Geographic, Thematic and Sectoral Coverage

Geographic:	PEOPLES: globally applicable at scales ranging from local, regional to global; and
	WEPP/GeoWEPP: used since the mid 1990 for small watersheds by hundreds of users around the world
Thematic:	PEOPLES: Demography, engineering, infrastructure, utilities, economics, environment/ecosystem; and
	WEPP/GeoWEPP: Soil and water conservation, agriculture, forestry, rangelands
Sectors:	Governmental services, community

1. Introduction

The previous Hyogo Framework for Action (HFA) reports identified several major challenges and future considerations in the Research Area 6 (overlapping with 11 and maybe more) PFA4-CI5. The main challenge here is that multi-level governance arrangements (e.g. in watersheds/catchments) do not facilitate integrated management of risk drivers, especially when responsibilities for critical issues (e.g. on-site vs. off-site issues). Issues here are related to differences in "… environment policy, social protection mechanisms, disaster risk reduction, climate change adaptation, land tenure and rural development policy, housing, and urban development policy are entrusted to different governmental entities". The guiding principle of the call for papers to is that " … environmental management policies can have major impacts on Disaster Risk Reduction (DRR) … helping reduce underlying risk factors". The following are the points among them that are relevant to our proposal:

- Governments, such as for tribal nations and their neighbors, have been challenged to sustainably use water resources and factor disaster risk management against floods considerations into territorial, economic, infrastructural, social, and cultural development.
- Recognizing DRR as a driver of economic health and sustainability, there were calls by the tribal nations and other non-tribal watershed stakeholders for a more holistic approach that embraces land use/land cover management, disaster risk reduction and climate risk management as fundamental for poverty reduction and sustainable development.
- Freely available environmental modeling approaches at the watershed scale are capable of addressing both climate variability and climate change.
- Integration of climate and land use change adaptation into local, tribal and national disaster risk management frameworks could lead the way for national and international approaches. (Please note that the proposed climate change impacts analysis for smaller watersheds is particularly addressing the needs of coastal zone and hinterland/mountainous land management of Small Island Developing States (SIDS) to develop and implement more advanced strategies for addressing even drought risk and water harvesting in Africa and similarly affected regions).
- Environmental degradation (here: soil erosion by water), loss of biodiversity (here: land use and cover scenarios) and sensitivity to natural resource limits and environmental tipping points continue to be identified as pressing concerns in the context of integrated approaches to development (the tribal project addresses in particular social, cultural and environmental vulnerability assessments and accounting for the function and recovery of ecosystem services).

This paper reviews the current disaster preparedness / resiliency frameworks by the Hyogo Framework for Action 2005-2015 and by the United States (US) Federal Emergency Management Agency (FEMA) and assess their strengths and the areas of possible improvements for the Seneca Nation of Indians in Western New York, New York State, USA. This paper introduces then a methodology of a US National Institute of Standards and Technology (NIST)-funded study that could guide the revision of HFA2 towards a more integrated assessment: the PEOPLES Resilience Framework (Renschler et al., 2010) is a quantitative, scalable resilience framework, with the possibility to integrate process-based modeling capabilities for managing continuous use and extreme events at the watershed scale. We propose the PEOPLES as a methodology for the United Nations member countries to assess, monitor, model and communicate the functionality of systems, their performance and recovery after extreme events objectively and across scale in order to systematically collect a temporally variable global reference data set based on qualitative and quantitative data sources across national, regional and other local administrative borders. Modifications of PEOPLES application according to each country's capacity and local are necessary, but won't be discussed in detail in this paper.

2. Current Frameworks in the United States

The Hyogo Framework for Action (HFA) 2005-2015 is built on five action plans which extend from recognizing disaster reduction as a national priority to identification of disaster risks, utilization of knowledge / technology / culture for resilience building, risk factor reduction and disaster reduction preparedness. The framework is further categorized into core indicators for better understanding of the action plans. The review process of the actions plans was supplemented with ten essential questions. The HFA's approach is extensive and it is credited as a 'positive move' in strengthening resilience (Manyena, 2006) and the United Nations member countries have reviewed and revised their resilience planning according to the framework (Djalante et al. ,2012; Cutter et al. 2008). However, current adaptation is still in the concept and organizational adaption stage and many countries haven't achieved a systematic, modeling approach, if there are any.

In a disaster management cycle (response → recovery → mitigation → risk reduction → prevention → preparedness; or risk reduction → prevention) each stage requires a practical adaptation of reasonable measures based on the data and a future prediction derived from a past disaster. Without this step, the cycle of disaster management doesn't complete. Extensive and numerous categories of the HFA framework structure might need to be simplified to make it easier for the member countries to implement such practical measures.

In the United States, FEMA has established the National Planning Frameworks (FEMA, 2013a)[1] that consist of four sub frameworks - National Prevention Framework, National Mitigation Framework, National Response Framework and National Disaster Framework[2,3].

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[1] FEMA. 2013a. National Planning Frameworks. Federal Emergency Management Agency. September 12, 2013. Web. November 27, 2013. < http://www.fema.gov/national-planning-frameworks>.

[2] FEMA. 2013b. National Disaster Recovery Framework. Federal Emergency Management Agency. September 5, 2013. Web. November 27, 2013. <http://www.fema.gov/national-disaster-recovery-framework>.

[3] FEMA. 2013c. National Disaster Recovery Framework: Strengthening Disaster Recovery for the Nation. Federal Emergency Management Agency. September 2011. Web PDF. November 27, 2013. <http://www.fema.gov/pdf/recoveryframework/ndrf.pdf>.

Recovery The National Disaster Recovery Framework (NDRF) was established 'to ensure coordination and recovery planning at all levels of government before a disaster, and defines how we will work together, following a disaster.' (FEMA, 2013b, 2013c). NDRF's Recovery Support Function consists of six functions, in which, as of September 2011, 26 U.S. government agencies are involved. FEMA's National Preparedness efforts are very extensive and require the participation of national, state, local governments and volunteers. Although the plan is thorough, it is understandable that, considering the size of the United State government and its complexity, FEMA's frameworks are hierarchical and structured as agency based. Establishing a cross agency resilience and recovery assessment is always an issue in such a large organization.

3. Proposed Methodology: The PEOPLES Resilience Framework

The 'PEOPLES' acronym stands for a series of seven holistic, quantitative resilience dimensions and hierarchical lead indicators that stand for the state of functionality of systems in communities: Population and Demographics, Environmental/Ecosystem Services, Organized Governmental Services, Physical Infrastructure, Lifestyle and Community Competence, Economic Development, Social-Cultural Capital (figure 1; Renschler et al., 2010).

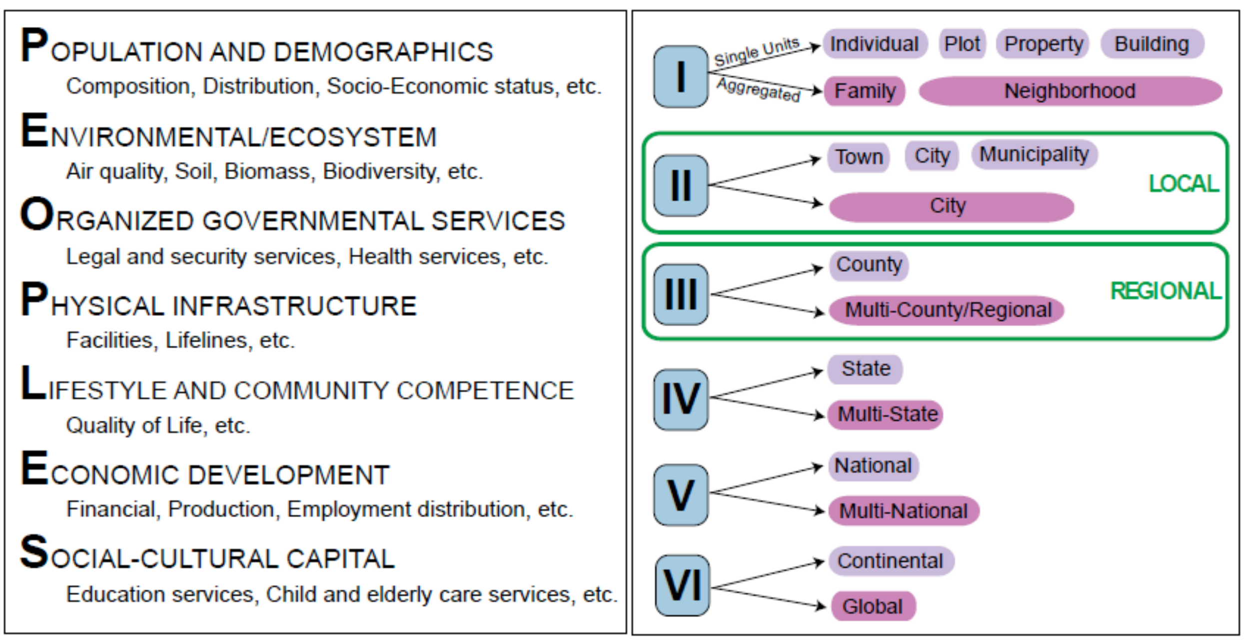


Figure 1: PEOPLES Resilience Framework description and its associated geographical scale

Dimension 1 - Population and Demographics

This dimension measures social vulnerability of a community. As described in Renschler et al. (2010), a measure of functionality of population and demographics Qp within a given community could be quantified by using the social vulnerability index (SoVI) proposed by Cutter et al. (2008). Social vulnerability (a counterpart of social resilience) is defined as the inability of people, organizations, and societies to withstand adverse impacts from multiple stressors to which they are exposed. These impacts are due in part to characteristics inherent in social interactions, institutions, and systems of cultural values. Social vulnerability is a pre-existing condition of the community that affects the society's ability to prepare for and recover from a disruptive event. It affects and is affected by both evolutionary occurrences (e.g., slow changes in median age) and transformative events (e.g., wholesale shifts in dominant ethnicity). A pre-disaster function (or current status-quo) is set as 100%, even if the pre-disaster function was not perfect. The United Nations member counties will quantify with values between 1 (100% functional) and 0 (0% or non-functional), the impacts and recovery progress in terms of functionality of lead indicators normalized by population and demographics. Examples for lead indicators are social vulnerability (a counterpart of social resilience), characteristics inherent in social interactions and institutions, cultural values, etc. Stakeholders of such information would be mostly public, but also include records at educational institutions, and others.

Dimension 2 - Environmental/Ecosystem

Ecological or ecosystem resilience is typically measured by the amount of disturbance an ecosystem can absorb without drastically altering its functions, processes and structures, or by the ability of an ecosystem to cope with disturbance. This dimension measures disturbance and recovery progress (resilience when combined) of environmental or ecological systems. In the context of the PEOPLES Resilience Framework, environmental and ecosystem resources serve as indicators for measuring the ability of the ecological system to return to or near its pre-event state or a state defined by the community. A special attention needs to be paid that disturbance and resilience depend on timescale and geographical scale. For example, ecosystem services could include net primary production of biomass (Frazier et al, 2013), quality of air, water, and/or soil, biodiversity, or organic matter content in the soil etc. Stakeholders for such information could be provided from public sources, local governments, scientists and researchers, energy and/or utility companies, waste processing facilities, and many others.

Dimension 3 - Organized Governmental Services

In contrast to the more or less spontaneous individual and neighborhood responses to extreme events, organized governmental services are designed to allow an orderly response (Renschler et al. 2010). Organized governmental services include traditional legal and security services such as police, emergency and fire departments and in extreme cases, the military. In this dimension, we also include the services provided by public health and hygiene departments as well as cultural heritage departments. Each of these organized government services plays a key role in sustaining communities both before and after extreme events. This dimension measures the level of functionalities of governmental services including such as police, emergency, and fire departments and the military. Each of these organized government services plays a key role in sustaining communities both before and after extreme events. Stakeholders for such information in any of the UN member nations could be local, state, federal government, national guards and/or army, government contractors, and many more qualitative and quantitative data sources.

Dimension 4 - Physical Infrastructure

The physical infrastructure dimension incorporates both facilities and lifelines. Within the category of facilities, we include housing, commercial facilities, and cultural facilities. Within the category of lifelines, we include food supply, health care, utilities, transportation, and communication networks. In terms of housing, key indicators may include proportion of housing stock not rated as substandard or hazardous and vacancy rates for rental housing (Tierney, 2009). In terms of communication networks, key indicators may include adequacy (or sufficiency) of procedures for communicating with the public and addressing the public's need for accurate information following disasters, adequacy of linkages between official and unofficial information sources, and adequacy of ties between emergency management entities and mass media serving diverse populations. This dimension measures the functionalities of physical infrastructure such as housing, commercial facilities, lifelines, and cultural facilities. Lifelines include food supply, health care, utilities, transportation, and communication network. Besides remotely sensed information that could be used on targeted and/or continuous remotely sensed imagery (van Aardt et al., 2011), stakeholders for this information in UN member nations could be from local, state and/or federal governmental sources, private business owners, the media, volunteers, shelters, national guards/armies, etc.

Dimension 5 - Lifestyle and Community Competence

This dimension measures the impact and recovery progress as a community. Community competence deals with actions and problem solving skills, flexibility and creativity, collective efficacy, empowerment, and political partnerships as a community. This dimension reflects the reality that community resilience is not simply a passive "bouncing back" to pre-disaster conditions but rather a concerted and active effort that relies on peoples' ability to creatively imagine a new future and then take the requisite steps to achieve that desired future. It captures both the raw abilities of the community (e.g., ability to develop multifaceted solutions to complex problems, ability to engage in meaningful political networks) and the community's perceptions of its ability to effect positive change. Communities that collectively believe that they can rebuild, restructure, and revive themselves are more likely to be persistent in the face of environmental, governmental, and other obstacles. Communities with positive experience dealing with extreme events may be more likely to possess high degrees of community competence. Lead indicators that are mostly qualitative of nature could capture the quality of life, community competence, happiness, community partnership and their relationships, but also community ethics, culture, and motivation. While social media could potentially play a role to gather/estimate these measures, stakeholders would mostly be community and/or cultural, religious groups and educational organizations.

Dimension 6 - Economic Development

This dimension measures a diverse array of products and services that are both produced in and available to the community. This dimension includes employment and financial services related to economic activities. Resilient communities are characterized by their involvement in a diverse array of products and services that are both produced in and available to the community. Diversity in production and employment is linked to a community's ability to substitute goods and services and shift employment patterns as the situation demands. Efficient redundancy in operations and information systems enables relatively swift reopening of critical employers. The PEOPLES Resilience Framework incorporates three illustrative subcategories within this dimension: industry – production, industry – employment distribution, and financial services. Primary indicators of this dimension include the proportion of the population that is employed within the various industries, and the variability that might characterize a community's industrial employment distribution. This dimension is closely interwoven with the Population and Demographics dimension. For example, key indicators of economic development beyond employment and industry distribution include literacy rates, life expectancy, and poverty rates. Disaster-specific indicators related to economic development include extent of evacuation plans and drills for high occupancy structures, adequacy of plans for inspecting damaged buildings following disasters, and adequacy of plans for post-disaster commercial reconstruction (Tierney 2009). Quantitative, but also qualitative data, could describe the functionality of the production and consumption of primary goods from an economic activity or development standpoint, the diversity of economic activity of a community, key employment figures or the status of the availability of financial services. Stakeholders such as local, state, and/or federal government, financial service institutions, producers and distributors of goods and services, or the transportation industry could provide such information.

Dimension 7 - Social-Cultural Capital

Measuring social/cultural capital requires acquisition of tallies, such as the number of members belonging to various civil and community organizations. It also requires surveys of community leaders and their perceptions (e.g., quality of life surveys). Communities with high degrees of social-cultural capital create "friction to exit" for their members, encouraging people to invest in those activities and organizations that make the community a "good place to live," and encouraging people to return and reinvest in their communities after an extreme event. Disaster-specific indicators include existence of community plans targeting transportation-disadvantaged populations, adequacy of post-disaster sheltering plans, adequacy of plans for incorporating volunteers and others into official response activities, adequacy of donations management plans, and the community's plans to coordinate across diverse community networks (Tierney, 2009). Social/cultural capital incorporates several subcategories, including education service, child and elderly services, cultural and heritage services, and community participation that could measure functionalities such as the availability and service levels of community services, social support, citizen participation, and place attachment. If not in the public domain, stakeholders for this data could be educational services, child and elderly services, cultural and heritage services and many others.

For more detailed information see Renschler et al. (2010) at http://peoplesresilience.org or directly at http://peoplesresilience.org/wp-content/uploads/2013/07/NIST_GCR_10-930.pdf

4. Policy Analysis of Infiltration & Wetlands vs. Harvest & Floods

The above-mentioned seven dimensions can be assessed independently or interdependently on fixed time intervals, on all dimensions or focusing on the interdependence of one particular dimension to others. Table 1 illustrates the use of the PEOPLES Framework dimensions and their interdependencies in a policy analysis (e.g. to promote infiltration through water harvesting and to delay of runoff through wetland creation or preservation) to reduce the risk of floods and its impacts on water management issues in the sustainable development and infrastructure investment in the Cattaraugus Creek Watershed (Boyer et al., 2013). The interdependencies can also be quantified by their relevance or weighted by their level of interdependencies with values between 1 (100% dependent) or 0 (0% or independent). Using data or imagery on a fixed or non-fixed time interval, the PEOPLES data can be monitored or analyzed for each dimension (figure 2) or modeled as overall sustainability and/or resilience.

Table 1: Interdependency assessment of water management issues in Cattaraugus Creek Project ('x' is minor and 'X' is major)

PEOPLES Dimensions	P	E	O	P	L	E	S
Promote water harvesting/ground water recharge		X	X	X	x	X	
Create wetland/nature reserve/impoundment		X	X	X	x	X	X
Sustained crop/timber/fishing harvest yields	x	X		x		X	X
Design resilient bridge/culvert against runoff/flood	X	x	x	x		X	X
Access to shelter/food/hospital/emergency facility	X	x	X	X	x	X	x

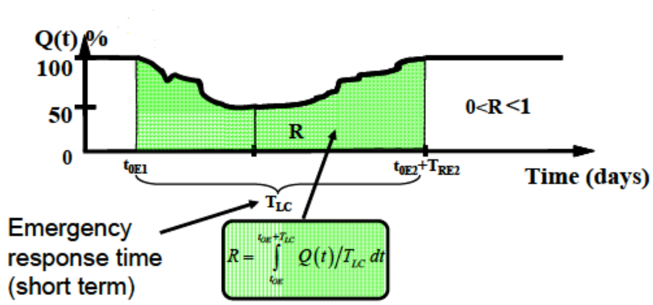


Figure 2: Quantitative Mathematical model of the PEOPLES Resilience Framework

Please note that Resilience (R) may be defined as a function indicating the capability to sustain a level of functionality or performance for a given service of an ecosystem, a building/bridge/lifeline network, an economic system, a community, etc., over a period defined as the control time TLC. The TLC is usually decided by a model planner and corresponds to the expected 100% functionality of infrastructure or a system. Resilience is defined graphically as the normalized shaded area underneath the functionality function of a system, defined as Q(t). Q(t) is a non-stationary stochastic process, and each ensemble is a piecewise continuous function as shown in Figure 2 where *Q(t)* is the functionality function of the region considered. The functionality is the combination of all functionalities related to different facilities, lifelines, etc.

5. Modeling Impact of Global Change on Community Resilience

Soil erosion by water on agricultural land and naturally vegetated landscapes (e.g. rangeland) is a major current and future environmental threat: both to the sustainability and productive capacity of agriculture, forestry, etc. (on-site impacts) and as a supplier of sediment and associated chemical pollutants to vulnerable water bodies (off-site impacts). Pimentel et al. (1995) suggest that, during the prior 40 years, nearly one-third of the world's arable land has been lost by erosion at a rate of more than 10 million hectares per year. The off-site sediment damages - include those of runoff volumes and peak runoff causing the flooding and destruction of downstream infrastructure - are estimated to be far greater than the on-site productivity effects of erosion (Guntermann et al., 1976). Global change (i.e. climate change and associated major land use) is likely to, in many locations worldwide, exacerbate both the on- and off-site impacts of erosion. Future shifts in the amount, intensity, and temporal distribution of rainfall will directly modify rates of soil loss in currently erosion-prone areas, along with rates of surface runoff (including peak flow discharge) and groundwater recharges (Favis-Mortlock and Savabi, 1996; Favis-Mortlock and Guerra, 1999; Nearing et al., 2005). In turn, these changes (in particular, shifts in the duration of time when unprotected soil is exposed before a protective plant cover is established) will also, more indirectly, modify runoff and soil loss. The changes and recovery of ecosystem service functions such as protective vegetative cover of managed and unmanaged lands can be monitored through satellite remote sensing imagery (Chandola and Vatsavai, 2011; Frazier et al., 2012).

WEPP – The Water Erosion Prediction Project

The Water Erosion Prediction Project (WEPP) (Laflen et al., 1991; Flanagan and Nearing, 1995) model is a continuous simulation, process-based model that allows simulation of small watersheds and hillslope profiles within those watersheds for assessing various soil and water conservation or Best Management Practices (BMPs; Renschler and Lee, 2005) and their economic yield productivity for agricultural, rangeland, and forest sites. Mathematical models, such as WEPP or the debris flow model Titan2D (Patra et al., 2005), are not only for scientific research. They can be used to effectively assess global change, extreme events and the impact of public policy on environmental processes (Renschler and Harbor, 2002), sustainable development, rural and urban infrastructure and ultimately community resilience.

GeoWEPP - The Geospatial Interface for WEPP

The Geo-spatial interface for WEPP (GeoWEPP) (Renschler, 2003) utilizes digital geo-referenced information such as digital elevation models (DEM) and topographical maps to derive and prepare valid model input parameters and defaults to start site-specific soil and water conservation planning for a small watershed with a single soil and land use for each sub-catchment. The goal of the GeoWEPP project is to provide a series of interfaces for users with different levels of GIS knowledge that are capable to utilizing these different data sources in a standard format either provided by GIS users, by precision farmers with Global Positioning Systems (GPS) databases and/or through accessing commonly readily available U.S.-nationwide data sets that are free of charge. However, any publicly available global and national spatial and temporal data sets including remotely sensed imagery; social media data and other crowd-sourcing activities could be used as input information to parameterize the model.

The examples of GeoWEPP applications in sub-watersheds of the Cattaraugus Creek Watershed illustrated below (figures 3 and 4), give an very good idea how these simulation scenarios enable groups of stakeholders to collaboratively assess the impact of global change, land cover change and land use policy for a more sustainable and resilient watershed management. The quantitative values for on-site ecosystem service functionality (e.g. infiltration, ground water recharge, biomass production, crop yields, carbon sequestration, etc.) and off-site changes (e.g. return periods of runoff volumes and peak discharges at the watershed outlet) on down stream infrastructure design and/or reinforcement can be directly used within the PEOPLES Resilience Framework or a revised HFA2 methodology.

Soil Loss for "Conservation Tillage" vs. Soil Loss for "Conventional Tillage"

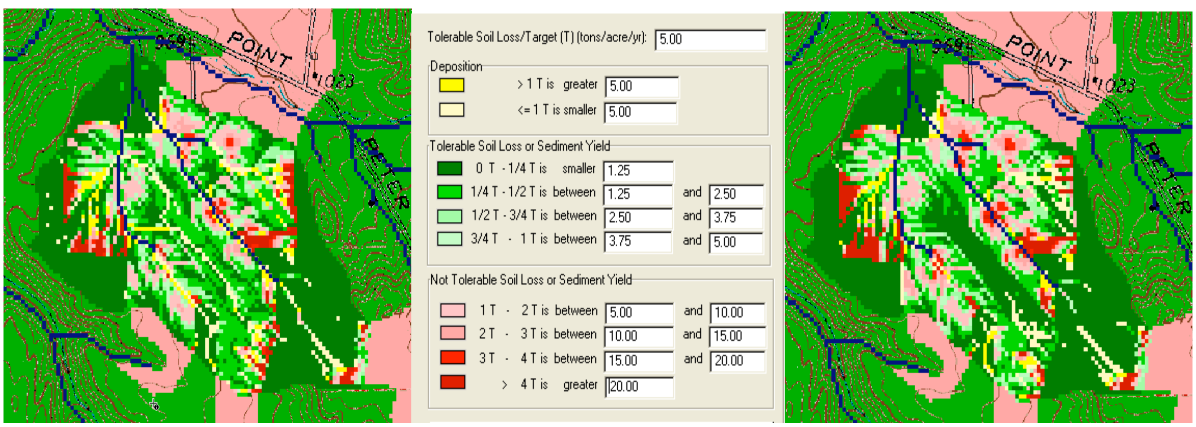
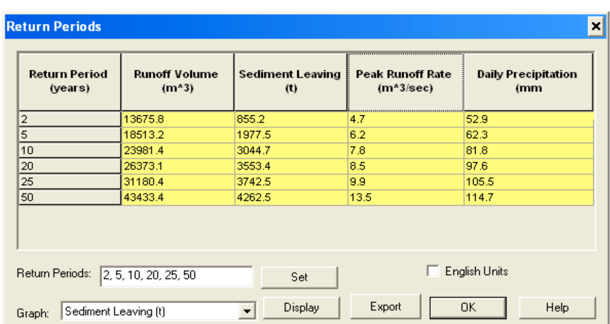


Figure 3: GeoWEPP on-site soil loss for land use change for a mixed used watershed (10m pixel size).

Please note that a 100-year simulation of the use of the policy promoted Best Management Practice (BMP) "Conservation Tillage" (on left map) instead of the "Conventional Tillage" (on right map), reduced the overall average on-site annual soil loss as well as the off-site sediment yield at the watershed outlet from 5.6 tons $acre^{-1}\ yr^{-1}$ (or about 12.5 t $ha^{-1}\ yr^{-1}$) to just 1.0 ton $acre^{-1}\ yr^{-1}$ (or about 2.2 t $ha^{-1}\ yr^{-1}$).



Return Periods

Return Period (years)	Runoff Volume (m^3)	Sediment Leaving (t)	Peak Runoff Rate (m^3/sec)	Daily Precipitation (mm
2	13675.8	855.2	4.7	52.9
5	18513.2	1977.5	6.2	62.3
10	23981.4	3044.7	7.8	81.8
20	26373.1	3553.4	8.5	97.6
25	31180.4	3742.5	9.9	105.5
50	43433.4	4262.5	13.5	114.7

Watershed Outlet	Runoff	Sediment Yield
Conventional Tillage		
Avg. Annual	+6%	+5%
2-year event	+1%	-8%
20-year event	-12%	+52%
Conservation Tillage + Grassed Waterway		
Avg. Annual	+6%	+10%
2-year event	-5%	-1%
20-year event	-3%	-8%

Figure 4: GeoWEPP off-site return periods for land use and climate change for a mixed used watershed

Please note that the analysis of a 100-year simulation of the "Conventional Tillage" simulation (table on the left) created a series of 2-, 5-, 10-, 20-, 25-, and 50-year return periods for daily precipitation, runoff volume, peak runoff rate and sediment yield leaving the watershed at it's outlet. A climate generator with climate change forcing of increased precipitation and temperatures enables a user to assess the combined impact of Best Management Practices (BMPs) such as comparing "Conventional Tillage" versus the "Conservational Tillage with a Grassed Waterway" on the average annual as well as return periods under a climate change scenario.

6. Conclusion and Recommendation

The PEOPLES Resilience Framework is a performance-based management framework applicable at scales ranging from individual, local, regional and national to global. It allows monitoring at each of those scales the performances on integration of disaster reduction measures and institutionalization of recovery providing parameters for the review of progress under the successor framework to the HFA. PEOPLES and any mathematical model can also be used with Geographic Information Systems (GIS) and remote sensing images or can be easily implemented using widely available viewing applications such as Google Earth. The data format consists of the respective PEOPLES dimension, functionality and interdependency percentages at a particular time and geographical scale. The HFA monitor with its mapping function (UNISDR, 2013) [4] could provide an excellent platform to further expand the PEOPLES dimensions and indicators. Together both frameworks would complement each other and provide information and access to various spatial and temporal scales of risk, resilience and recovery. Once entered, the data can be reviewed in a tabular format or in a graph, stored, shared and analyzed, enabling the a) sharing data among countries, agencies, groups, b) converting data to a tabular format, graphics (including maps and videos), c) converting data to other units, d) enabling statistical analysis, e) making easier to review and reproduce the analysis and/or modeling progress, and f) identifying strength/weakness of each dimension for a target region and necessary adjustment.

Considering the vast variety of social structure and culture among the United Nation's member countries, we suggest below considerations for application:

Concept: Keeping the seven baseline dimensions, PEOPLES, sub-categories of each dimension need to be reviewed by each country. According to each country's social structure, particular dimension(s) might be emphasized, deemphasized or eliminated through documented weighing factors (the individual emphasis and weighing is important for the acceptance and reproducibility of the analysis results).

Technology: The PEOPLES approach can integrate widely accepted, scientifically valid environmental, economic or other mathematical models such as WEPP/GeoWEPP, GIS and statistical services, satellite/aerial imagery and other data. Countries with limited technological capabilities could use customized platforms such as paper, standalone desktop or mobile applications.

Regional scale: The PEOPLES Resilience Framework is not only for a large, national scale disaster or only *after* disaster assessment. The United Nations might encourage the member countries to utilize PEOPLES for a town, village level hazard or for a pre-disaster drill to identify the weakness of their local communities.

[4] UNISDR, 2013. National HFA Monitor 2011-2013. UN Office for Disaster Risk Reduction. URL: http://www.preventionweb.net/english/hyogo/hfa-monitoring/national/.2013

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