APPENDIX 1

QUANTITATIVE DEFINITIONS

Eq. No.	NAME	SYMBOL	FORMULA
1	Area	A	$A = \int_A da$

Part of a region where the evaluation of the impact of a disaster is to be conducted. Conveniently subdivided into parcels (a) that may be considered as having constant property values for the components of interest.

Eq. No.	NAME	SYMBOL	FORMULA
2	Surface of the area	S_A	$S_A = \int_A s_a da$

To obtain the actual surface of the area (S_A), each parcel must be multiplied by the surface of the parcel (s_a). Units: hectares (ha) or square kilometres (km^2).

Eq. No.	NAME	SYMBOL	FORMULA
3	Milieu of a parcel	C_A	$C_A = \int_A \int_{C_a} dc_a da$

Milieu of an area (C_A) includes all natural and socio-economic (human) components that are of interest for the impact assessment in the area. Component (c_a) is a part of the milieu of a parcel, which can be delimited and considered as distinct from the rest; the sum of all components over all parcels forms the milieu of the area (C_A).

Eq. No.	NAME	SYMBOL	FORMULA
4	Damage to a component	D_{c_a}	$D_{c_a} = V_{c_a} \cdot L_{c_a}$

The value loss for the component when “recording” an *event* is given by the product of the *value* (V_{c_a}) and the *percentage loss* (L_{c_a}) for that component.

Eq. No.	NAME	SYMBOL	FORMULA
5	Recovery factor	$F^n_{c_a}$	

The recovery factor is the % of the damage mitigation ($F^n_{c_a} > 1$) or increase ($F^n_{c_a} < 1$) in the lag time between two subsequent events.

Eq. No.	NAME	SYMBOL	FORMULA
6	Damage to a component after N events	$D^N_{C_a}$	$D^N_{C_a} = V_{C_a} \cdot \prod_{n=1\to(N-1)} \left[F^{n-1}_{C_a} \cdot \left(1-L^n_{C_a}\right)\right] \cdot L^N_{C_a}$

The damage (loss of value) of a component after N contiguous disastrous events. The loss of the actual value after each disaster event multiplied by a recovery factor ($F^n_{C_a}$).

7	Damage in the parcel	D_a	$D_a = \int_{C_a} D_{C_a} dc_a = \int_{C_a} \left(V_{C_a} \cdot L_{C_a}\right) dc_a$

The sum of the damage of all components of the *milieu* of a *parcel*.

8	Damage to the area by an event	D_E	$D_E = \int_A \int_{C_a} \left(V_{C_a} \cdot L_{C_a}\right) dc_a da$

The damage to the area due to an event (subscript E) is given by the integral of the value multiplied by its percentage loss over all parcels over all components of the milieu of each parcel. The damage of the area corresponds to the *toll*, that is the negative *impact*, produced by the event in that area.

9	Magnitude of an event and local magnitude of an event	M_E M_{la}	$M_E \le \int_A M_{la} da$

The local magnitude (M_{la}) of an event measures the energy of the event that is locally associated with the event. It is a function of the local duration and amplitude of the event. Note that the integral over the area of the local magnitude is usually more than the magnitude of the event (M_E).

10	Intensity of an event	i_{C_a}	

Empirical quantitative measure of the degradation produced by the event in any given parcel. The component intensity (i_{C_a}) is defined in general for each component of the milieu of a parcel (subscript c) for each parcel (subscript a).

Eq. No.	NAME	SYMBOL	FORMULA
11	Intensity of the event in a parcel	I_a	$I_a = \frac{1}{C_a} \int_{C_a} w_{c_a} i_{c_a} dc_a$

The weighted average of the component intensities for that parcel, where w_{c_a} is the component weight of any given parcel.

12	Magnitude-Intensity relation	$\Phi_{M \to I}$	

The local magnitude (M_{la}) is related to the intensity of an event in a parcel (I_a) by transfer function ($\Phi_{M \to I}$) that is based on past experience (when both quantities are known in each parcel), by calibrated modelling or by more empirical functions that relate local event energy to parcel milieu degradation.

13	Intensity of an event and percentage loss	$\Psi_{I \to L}$	

The intensity of an event is related to the percentage loss for each component (L_{c_a}) by empirical transfer functions ($\Psi_{I \to L}$) that are based on past experience (or modelling). I_η is a dummy variable that can take the value of either I_a (the intensity of the parcel) or i_{c_a} (the intensity of each component of the parcel) depending on how the value of intensity is obtained. Note that the percentage loss must be obtained for each component of each parcel (subscript c_a). Thus, if one directly measures the component intensity i_{c_a} (for instance, by visiting the disaster area), then the percentage loss for each component L_{c_a} is going to be computed with high accuracy. In contrast, if one obtains the intensity of the parcel I_a from the local magnitude of the event M_{la} (Eq. 12), the percentage loss for each component is going to be computed less accurately, because I_a is used in Eq. 13 as a surrogate for the actual i_{c_a}.

14	Hazard	H_{EM}	$H_{EM} = \prod_{j=n-0} \chi H_{Ej}$ where χ is a correlation function between the events that is equal to 1 if there is no correlation.

The potential or probability of occurrence of an event (E), of a given magnitude (M), in a defined region and time interval, is called the hazard of the event. Frequently, an event may trigger another event or a chain (actually a tree) of indirect events. The relation between the hazard of direct and indirect events may be described by a probability tree θ_{E}, in which the "trunk" element (order 0)

Eq. No.	NAME	SYMBOL	FORMULA

contains the probability of occurrence of the direct event (that is, its hazard). The first set of "branch" elements contains the probability of occurrence of the first set of indirect events (order 1), that are triggered by the direct event. The second set of "branch" elements contains the probability of occurrence of the second set of indirect events (order 2) that are triggered by the first set of indirect events, and so forth. Thus, the hazard of an indirect event of order n (E_n) along the "branch" chain is given by the product of all elements along the same branch chain going backwards from E_n to the direct event included.

15	Vulnerability	W_{c_a}	

The vulnerability W_{c_a} of a component of a parcel is defined as the potential percentage loss of value of each component of the milieu of a parcel, for an event of given type and magnitude. Once an event has occurred, the vulnerability is substituted by the actual percentage loss of value (L_{c_a}).

16	Risk	R_{EM}	$R_{EM} = H_{EM} \int_A \int_{C_a} \left(V_{c_a} \cdot W_{c_a} \right) dc_a da$

The risk (R_{EM}) is a measure of the prospective damage of a potential event (E) of magnitude (M) in a given area and time interval. It is the integral over all components of each parcel in the area of the potential loss and has the same units as the value. Once the event happens, the hazard becomes 1 and the potential percentage loss (W_{c_a}) is replaced by the actual percentage loss (L_{c_a}). Thus, Eq. 16 reduces to Eq. 8.

17	Errors	$\sigma_{xi}\ \ \sigma_{xj}$	$y = f(x) = f(x_1, x_2, x_3, \ldots, x_N)$ $\sigma_y = \left[\sum_i \sum_j r_{\sigma_{x_i} \sigma_{x_j}} \sigma_{x_i} \sigma_{x_j} \left(\frac{df(x)}{dx_i} \right) \left(\frac{df(x)}{dx_j} \right) \right]^{\frac{1}{2}}$

A set of parameters x_i is affected by errors σ_{xi}.
The quantity y has an error σ_y that is obtained by error propagation of the x_i.
$r_{\sigma_{xi}\,\sigma_{xj}}$ is the correlation coefficient between the errors σ_{xi} and σ_{xj}