

Method for Environmental Risk Rapid Estimation



Motivation and Context

In Chile, the recently created (2011) Superintendence of the Environment (SOE) is responsible for ensuring environmental compliance of all projects in have environmental permits. In order to do so, the SOE needs to inspect more than a thousand projects per year throughout the whole country. A task force of inspectors visits the installations periodically, assessing their environmental compliance, and the status of the surrounding environment.

If a project is found to be in non-compliance, or if there are indications of environmental impacts, a decision has to be made whether to take precautionary actions, that might include stopping the operation of the plant or project. This can have high social impacts. On the contrary, if no action is taken, environmental damage might ensue.

This work presents a method developed to perform a rapid risk assessment suitable to be applied on the field by the inspectors of the SOE, in order to support their decision-making. This work was part of a broader project, into which the magnitude of the potential environmental damage was estimated.

Media and Receptors

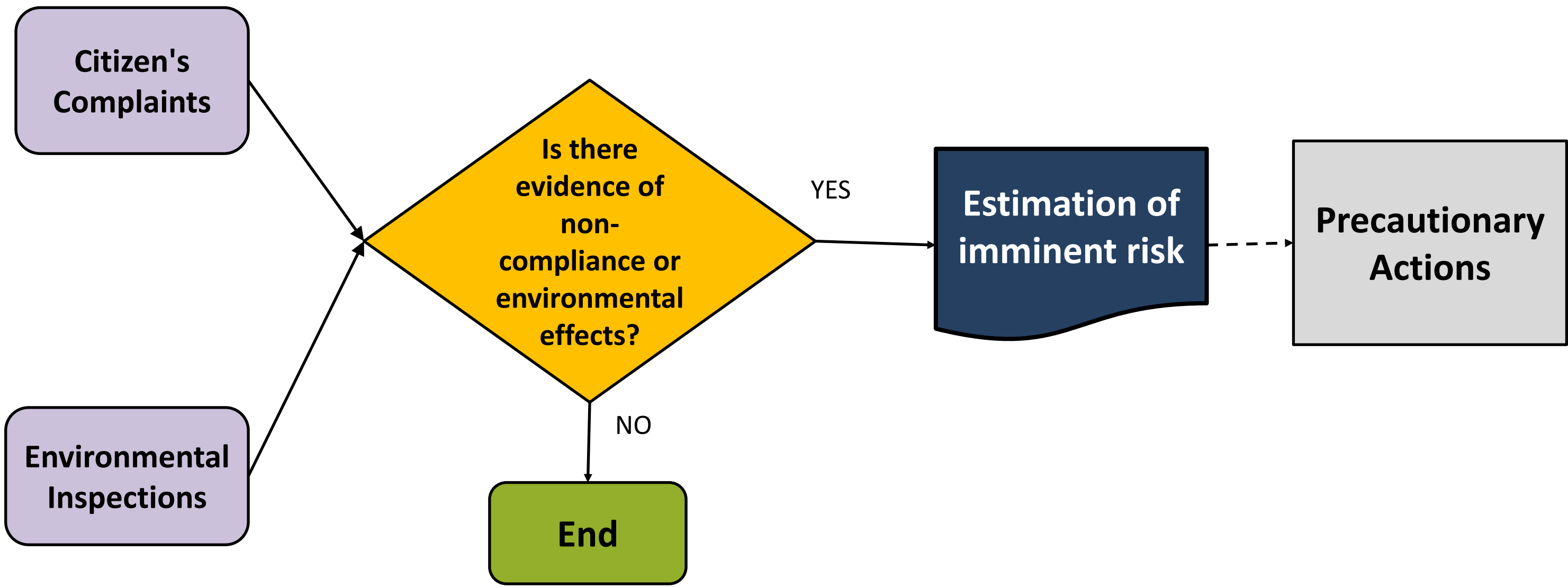
Chilean environmental law recognizes three categories of receptors, which are the components of the environment susceptible to suffer environmental damage.

Public Health	Biodiversity and Renewable Resources	Socio-cultural Patrimony
<ul style="list-style-type: none">Human HealthHuman wellbeing	<ul style="list-style-type: none">PopulationsCommunitiesEcosystemsEcosystem servicesLandscape	<ul style="list-style-type: none">Material HeritageIntangible HeritageSocio-cultural servicesEconomic services

Media considered are air, water and soil, as well as physical and energy impacts.

Inspection Process

The following figure summarizes the inspection process into which this method is inserted. Our work focuses on the estimation of the imminent risk component.



Experts Validation

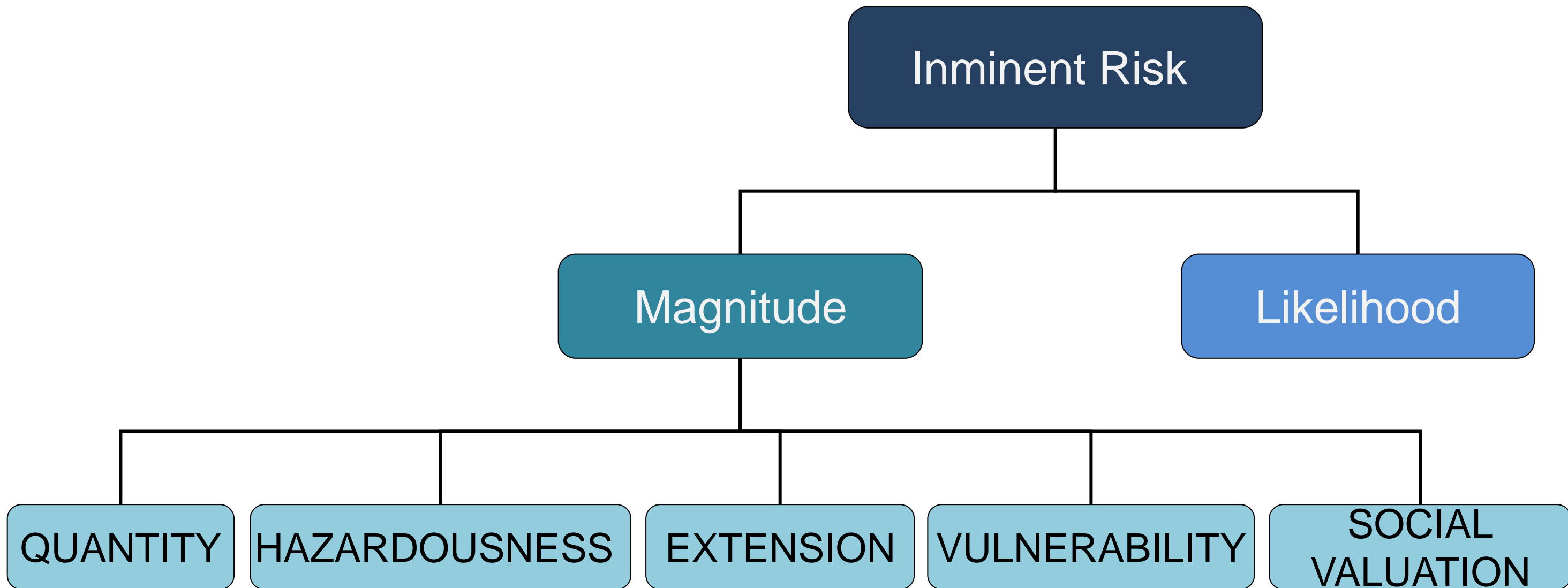
A one day workshop to validate the method was conducted with 42 experts from academia and state agencies with environmental responsibilities. Participants were presented with a fictitious case, and were asked to classify the risk to each component. Results are shown below.

Table 4 Number of experts characterizing the risks to each type of receptors, and the average score resulting.				
Score	Characterization of risk	Public Health	Biodiversity and Renewable Resources	Socio-cultural Patrimony
5	Extremely serious	6	11	4
4	Serious	9	10	10
3	High	12	14	17
2	Medium	6	7	7
1	Low	9	0	4
Average score		2.9 (high)	3.6(high/very high)	3.1 (high)

Participants were then trained in the method, and were asked to apply it to the case. The consulting team and the counterpart from the SOE also participated on the exercise. The results were mixed. Although there was agreement between the scores produced by the experts and the consulting + counterpart team (not shown), there was not such a good agreement between the initial estimation of the risk by the experts and the estimation using the proposed method (Tables 4 and 5). The estimated risk for public health was much higher using the method, while the risk for the other two components were similar.

Method

The imminent environmental risk comprises both the magnitude of the possible consequences and their likelihood of occurrence. The magnitude of the possible consequences is determined by the quantity and hazardousness of the source, and by the extension, vulnerability and social valuation of the receptors affected. The risk for each class of components is estimated in a 3 step sequence, as described below.



Step 1: Estimating the magnitude of the consequences.

The magnitude of the consequences is estimated by qualifying five dimensions, in four levels: low, medium, high and very high. The total score is the average of the individual scores.

Table 1 Scores for the estimation of the consequences

Factors of Magnitude	Score			
	Low	Medium	High	Very high
Quantity: Amount of risk agent released or subtracted from the environment	1	2	3	4
Hazardousness: Dangerous factors of the substances or actions impacting	1	2	3	4
Extension: Area of influence affected or number of people exposed	1	2	3	4
Vulnerability: Environmental and heritage conservation, or human vulnerable groups	1	2	3	4
Social Loss: Loss of ecosystem services or productive capital	1	2	3	4

Step 2: Estimating the likelihood of imminent consequences

The score for the likelihood of imminent consequences is determined according to the expected time of occurrence of the events, according to Table 2

Table 2 Scores for the likelihood of imminent consequences

Expected time of affection	Score
Already occurred or is ongoing (certainty)	5
Expected to happen at any time (very likely)	4
Expected to happen within a month (likely)	3
Expected to happen within a year (possible)	2
Not expected to happen within a year (unlikely)	1

Step 3: Estimating the Imminent Risk

An ad-hoc scale is used to characterized the imminent risk in in terms of the product of the Likelihood and Magnitude scores, as shown in Table 3.

Table 3 Risk Characterization according to magnitude and likelihood scores

Likelihood	5	5	10	15	20	25		Extremely high
	4	4	8	12	16	20		Very high
	3	3	6	9	12	15		High
	2	2	4	6	8	10		Medium
	1	1	2	3	4	5		Low
		1	2	3	4	5		
		Magnitude						

Table 5 Scores obtained from the application of the method by the 42 experts for each of the receptors potentially affected.

		Public Health	Biodiversity and Renewable Resources	Socio-cultural Patrimony
Is the receptor potentially affected?		Yes	Yes	Yes
Likelihood Score	a	3.7	2.7	2.9
Magnitude				
Quantity	b	3.1	2.8	2.9
Hazardousness	c	2.7	1.9	2.5
Extension	d	2.8	2.6	1.6
Vulnerability	e	3.5	2.4	3.2
Social Valuation	f	3.4	2.6	3.4
Score	(b+c+d+e+f)	15.5	12.3	13.5
Characterization		High	Medium	Medium
Points	g	4	3	3
Risk Score	a*g	15	8	9
Characterization		Very high	High	High

Conclusions

This work proposes an approximate method to assess the imminent environmental risk of a project during an environmental compliance inspection process. The method proposed lets inspectors take a more informed decision. The method can be improved in many ways, but represents the first attempt to make the inspection decision process more objective, by considering the most important dimensions in a pre-defined way. By advancing in improving the method, the environment can be better protected.

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