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The Precautionary principle, its interpretation and application by the Indian judiciary: ‘When I use a word it means just what I choose it to mean-neither more nor less’ Humpty Dumpty

Gitanjali Nain Gill 

Professor of Environmental Law, Northumbria Law School, Northumbria University, UK

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Abstract

The precautionary principle is accepted in India as a fundamental tool to promote sustainable development and is employed within Indian environmental governance to promote better health and environmental decisions. Scientific uncertainty is at the core of the precautionary principle. The application of the precautionary principle is an open-ended issue. This article seeks to add to the limited empirical studies on the understanding, appreciation and application of the precautionary principle by key environmental actors, as differing legal responses and decisions may be irreversible before conclusive scientific knowledge and evidence become available. Building on researcher’s unique Indian data, and drawing on the theoretical insights developed by Charles Weiss, an explanatory environmental framework addresses the uncertainty of science by assembling a scale of legal standards arranged in a hierarchy of levels of increasing certainty familiar to lawyers and the judiciary. Reported Indian cases from the Supreme Court and the National Green Tribunal are selected to illustrate levels of scientific certainty or uncertainty and corresponding legal standards of proof constituting acceptable bases for legal decisions in practical context especially the precautionary principle. The article suggests India should develop a framework of guidelines that would provide an effective roadmap for decision-makers applying the precautionary principle.

Keywords

Empirical data and case law, legal standards of proof, precautionary principle in India, scientific uncertainty

Corresponding author:

Gitanjali Nain Gill, Professor of Environmental Law, Northumbria Law School, Northumbria University, Newcastle upon Tyne, NE1 8ST, UK.

Email: gita.gill@northumbria.ac.uk

Introduction

The pursuit of sustainable development goals is driven by evidence-based policy and decision-making based on scientific knowledge and supported by environmental governance and the rule of law.¹ Nevertheless, the 2019 UN Environmental Rule of Law: First Global Report states that limits on current scientific certainty and understanding mean environmental matters paradoxically can raise more questions than answers.² The preferred environmental approach adopted in some jurisdictions is based on the application of the precautionary principle as it helps decision-makers act promptly and determine if appropriate cost-effective measures have been put into place to prevent environmental degradation and damage to human health.³

The precautionary principle is accepted as a fundamental tool to promote sustainable development and has an important function at both international and national levels. It provides for action to avert risks of serious or irreversible harm to the environment or human health in the absence of scientific certainty about that harm and offers the ‘authority to take public policy decisions covering environmental protection in the face of uncertainty’.⁴ Where there is no uncertainty in the calculation of risks, there is no justification for the employment of the precautionary principle. Thus, scientific uncertainty is at the core of the precautionary principle.⁵

However, the international application of the precautionary principle is an open-ended issue. Some believe that its use helps make better health and environmental decisions. Whereas others think that employing the precautionary principle is inconclusive due to the difficulty in achieving a consensus that reflects appropriate responses to manage risks, benefits and costs.⁶ Excessive discretion tends to exacerbate unpredictable and inconsistent environmental decisions, distorts regulatory priorities, stifles technological

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1. UN Sustainable Development Goals Report (2019) 58. Available at: <https://unstats.un.org/sdgs/report/2019/The-Sustainable-Development-Goals-Report-2019.pdf>; International Institute for Applied Systems Analysis (IIASA) (2018) Transformations to Achieve the Sustainable Development Goals Report Prepared by The World in 2050 initiative. Available at: <http://pure.iiasa.ac.at/id/eprint/15347/>; and UN Environmental Rule of Law: First Global Report (2019). Available at: https://wedocs.unep.org/bitstream/handle/20.500.11822/27279/Environmental_rule_of_law.pdf?sequence=1&isAllowed=y (last accessed 2 November 2019).
 2. See UN Environmental Rule of Law: First Global Report (2019), above n. 1 at 12–13.
 3. H.S. Burnett, ‘Understanding the Precautionary Principle and its Threat to Human Welfare’ (2009) 26(2) *Social Philosophy and Policy* 378–410; K. Steele, ‘The Precautionary Principle: A New Approach to Public Decision-Making?’ (2006) 5 *Law, Probability and Risk* 19–31; J. Cameron and J. Abouchar, ‘The Precautionary Principle: A Fundamental Principle of Law and Policy for the Protection of Global Environment’, (1991) 14(1) *Boston College International Comparative Law Review* 1–27.
 4. J. Cameron, ‘The Precautionary Principle: Core Meaning, Constitutional Framework and Procedures for Implementation’ in R. Harding and E. Fisher (eds), *Perspectives on the Precautionary Principle* (Sydney, NSW: Federation Press, 1999) 29. Cameron notes ‘If both the probability of accidental pollution and the magnitude of the consequences of that pollution are known, the standards would be unprecautionary because the level of uncertainty is low . . . However, if the probability and magnitude are relatively unknown, because, for instance, it is not known what cause and effect relationships are involved, then the standards would be precautionary because of the relative uncertainties involved’. See also, F.B. Cross, ‘Paradoxical Perils of the Precautionary Principle’ (1996) 53 *Washington and Lee LR* 859; C. Stone, ‘Is there a Precautionary Principle?’ (2001) 31(7) *Environmental Law Reporter* 10790.
 5. R. von Schomberg, ‘The Precautionary Principle: Its Use Within Hard and Soft Law’ (2012) 3(2) *European Journal of Risk Regulation* 147–156.
 6. For a detailed discussion, see European Commission Science for Environment Policy, *FUTURE BRIEF: The Precautionary Principle: Decision-Making Under Uncertainty*, (2017: Issue 18). Available at: <http://ec.europa.eu/science-environment-policy>. Descriptors such as ‘risk’, ‘ignorance’, ‘indeterminacy’ and ‘uncertainty’ have made the concept of scientific uncertainty complex. The threshold of scientific evidence of harm which warrants precautionary action is debatable. For a detailed discussion, see B. Wynne, ‘Uncertainty and Environmental Learning: Reconceiving Science and Policy in the Preventive Paradigm’ (1992) 2(2) *Global Environmental Change* 111; R. Harding, and E. Fisher (eds) *Perspectives on the Precautionary Principle* (Sydney, NSW: Federation Press, 1999).

innovation and reverses the burden of proof reflecting uncertainty between science-based governance and the over or under application of the precautionary principle.⁷

In India, pollution produces complex environmental issues involving scientific uncertainty and imprecise health risks. These pollution matters are influenced by incomplete information, inconclusive evidence, ambiguous values and public controversy. For example, Spruijt's study identifies how such cases differ in the level and type of scientific uncertainty, the societal unrest they cause and the application of the precautionary principle.⁸ The study highlights the debate regarding particulate matter that concerns the health impact of different particle types, the underlying causal mechanisms of these health impacts and the nature of the exposure–response relationship for various health endpoints.⁹ It may result in varying judicial responses. This uncertainty creates governance challenges for regulatory and adjudicatory decision-makers concerning health, well-being and the environment.

At the outset, it is necessary to state that this article does not address the challenging issues pertaining to the precautionary principle at the international level involving its legal status, the consensual interpretation of core meaning, its different versions and the means for predictable and effective implementation. These matters are well-documented and have generated a body of active but discordant opinion and literature.¹⁰ Instead, this article offers a domestic account of the interpretative range of the principle and the legal uncertainty that it creates in India.

Building on the existing literature, this article carries unique Indian data that add to the limited empirical studies on the understanding, appreciation and application of the precautionary principle by key

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7. Ibid. European Commission (2017) at 6–7; D.C. Peterson, 'Precaution: Principles and Practice in Australian Environmental and Natural Resource Management' (2006) 50 *The Australian Journal of Agricultural and Resource Economics* 469–489.
 8. P. Spruijt, A.B. Knol, A.C. Petersen and E. Lebrecht, 'Expert Views on Their Role as Policy Advisors: Pilot Study for the Cases of Electromagnetic Fields, Particulate Matter, and Antimicrobial Resistance' (2019) 39(5) *Risk Analysis* 968–974.
 9. Ibid. at 969.
 10. K. Garnett and D.J. Parsons, 'Multi-Case Review of the Application of the Precautionary Principle in European Union Law and Case Law' (2017) 37(3) *Risk Analysis* 502–516; E. Persson, 'What are the Core Ideas Behind the Precautionary Principle?' (2016) 1(557–558) *Science of the Total Environment* 134–141; A. Stirling, 'Precaution in the Governance of Technology' (2016) SWPS 2016–14 (July): Working Paper Series, Science Policy Research Unit (University of Sussex, Brighton, UK); L. Hartzell-Nichols, 'From "the" Precautionary Principle to Precautionary Principles' (2013) 16(3) *Ethics, Policy & Environment* 308–320. Available at: <https://www.tandfonline.com/action/journalInformation?journalCode=cepe21>; C.E. Foster, *Science and the Precautionary Principle in International Courts and Tribunals: Expert Evidence, Burden of Proof and Finality* (Cambridge: CUP, 2011) 18–21; N.M. Sachs, 'Rescuing the Strong Precautionary Principle' (2011) 4 *University of Illinois Law Review* 1285–1310; P. Birnie, A. Boyle and C. Redgwell, *International Law and the Environment* (Oxford: OUP, 2009) 155; R. Dovers and J.W. Handmer, 'Ignorance, Sustainability, and the Precautionary Principle: Towards an Analytical Framework' in R. Harding and E. Fisher (eds), *Perspectives on the Precautionary Principle* (Sydney, NSW: Federation Press, 1999) 174; M. Ahteensuu, 'Defending the precautionary principle against three criticism' *TRAMES*, 2007, 11(61/56), 4, 366–381. Available at: <http://www.kirj.ee/public/trames/trames-2007-4-3.pdf> (accessed 1 November 2019); G.E. Marchant and K.L. Mossman, *Arbitrary and Capricious: The Precautionary Principle in the European Union Courts* (Washington, DC: American Enterprise Institute, 2004); J. Adler, 'The Precautionary Principle's Challenge to Progress' in Ronald Bailey (eds), *Global Warming and Other Eco-Myths* (Roseville, CA: Prima Lifestyles, 2002) 278–280; E. Fisher, 'Precaution, Precaution Everywhere: Developing a "Common Understanding" of the Precautionary Principle in the European Community' (2002) 9(1) *Maastricht Journal of European and Comparative Law* 7; G. Majone, 'The Precautionary Principle and its Policy Implications' (2002) 40(1) *JCMS: Journal of Common Market Studies* 89–109; J. Cameron, 'The Precautionary Principle' in G.P. Sampson and W.B. Chambers (eds), *Trade, Environment, and the Millennium* (Tokyo: United Nations University Press, 2002) 239–269; N. De Sadeleer, *Environmental Principles: From Political Slogans to Legal Rules* (Oxford: OUP, 2002) 92; P. Sandin, 'Dimensions of the Precautionary Principle' (1999) 5(5) *Human and Ecological Risk Assessment: An International Journal* 889–907; T. O'Riordan and J. Cameron, *Interpreting the Precautionary Principle* (London: Routledge, 1994); D. Freestone, 'The Road From Rio: International Environmental Law After the Earth Summit' (1994) 6(2) *Journal of International Environmental Law* 193; E. Hey, 'The Precautionary Concept in Environmental Policy and Law: Institutionalizing Caution' (1992) 4 *Georgetown International Environmental LR* 303; D. Bodansky, 'Law: Scientific Uncertainty and the Precautionary Principle' (1991) 33(7) *Environment* 4–44.

environmental actors, especially the Indian judiciary, as differing legal responses and decisions may be irreversible before conclusive scientific knowledge and evidence become available. The first section is the introduction. The second section offers a brief account of the application of the precautionary principle by the Indian judiciary through illustrative case law. The third section presents the methods (mixed methods and multiple case studies) employed in this pilot research that investigates challenges associated with scientific uncertainty and the application of the precautionary principle. The fourth section analyses the data from key environmental actors – the *Decision-Makers* (judicial and scientific judges) and the *Influencers* (Pollution Control Board members, environmental lawyers, scientists and think-tanks) involved in the National Green Tribunal (NGT). It also uses the theoretical framework of Charles Weiss to produce a common ‘scientifically legal’ lexicon of meaning intelligible and useable by both the scientific and legal communities. This is followed by the conclusion in the fifth section.

Precautionary principle and its judicial application in India

The role of the Supreme Court of India in recognising the precautionary principle as an essential feature of sustainable development and a part of customary international law promoted its derivative application from constitutional mandates namely Articles 21, 48A and 51A(g).¹¹ In 1996, Kuldeep Singh J in *Vellore Citizen Welfare Forum v Union of India*¹² declared that the principle involves three conditions:

- (1) State government and statutory authorities must anticipate, prevent and attack the causes of environmental degradation;
- (2) Where there are threats of serious and irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;
- (3) The ‘onus of proof’ is on the actor or developer or industrialist to show the actions are environmentally benign.

Additionally, the specialised environmental tribunal, NGT is a creation of a statute; its jurisdiction, powers and procedures are construed and applied according to the language of the National Green Tribunal Act 2010. The NGT interprets and applies the precautionary principle as mandated by s. 20 of the National Green Tribunal Act 2010.¹³ The NGT declared the precautionary principle to be an integral part of national environmental law:

The applicability of [the] precautionary principle is a statutory command to the Tribunal while deciding or settling disputes arising out of substantial questions relating to environment. Thus, any violation or even an apprehended violation of this principle would be actionable by any person before the Tribunal. Inaction

11. Article 21 of the Constitution of India states: ‘no person shall be deprived of his life or personal liberty except according to procedure established by law’. Article 48A obligates the state to ‘protect and improve the environment and to safeguard the forests and wildlife of the country’. Article 51A(g) places a duty on ‘every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wild life and to have compassion for living creatures’. See *MC Mehta v Union of India* (2004) 12 SCC 118; *Research Foundation for Science v Union of India* (2005) 13 SCC 186; *Karnataka Industrial Area Development Board v C Kenchappa* (2006) 6 SCC 371; *AP Pollution Control Board I v Professor MV Nayadu* (1999) 2 SCC 718; *AP Pollution Control Board II v Prof MV Nayadu* (2001) 2 SCC 62; *TN Godavarman Thirumalpad v Union of India* (2002) 10 SCC 606; *Tirupur Dyeing Factory Association v Noyal River Ayacutdars Protection* (2009) 9 SCC 737; *MC Mehta v Union of India* (2009) 6 SCC 142; *In re Delhi Transport Department* (1998) 9 SCC 250.

12. *Vellore Citizen’s Welfare Forum v Union of India* (1996) 5 SCC 647 at 658.

13. The National Green Tribunal (NGT) is empowered to decide cases relating to environmental protection and the conservation of forests and other natural resources (including the enforcement of any legal right relating to the environment) and to give relief and compensation for damages to persons and property. Section 20 states ‘The Tribunal shall, while passing any order or decision or award, apply the principles of sustainable development, the precautionary principle and the polluter pays principle’.

in the facts and circumstances of a given case could itself be a violation of the precautionary principle, and therefore bring it within the ambit of jurisdiction of the Tribunal, as defined under the NGT Act 2010.¹⁴

The NGT regards the precautionary principle as a determinative norm that allows the judges to examine the probability of environmental degradation and resulting harm that may occur from a proposed activity. This involves well-crafted scientific knowledge supporting precaution and prohibition of harm and a commitment to dealing with risks.¹⁵ To activate precaution, actions are based on scientific information and analysis of possible risks to human health and environment, albeit tentative, inconclusive or in dispute. Tentative, inconclusive or disputed scientific information creates uncertainty in relation to gaps in data and/or poor data, ignorance, faulty models, scientific inconsistency and disagreement on the nature of risk with low epistemic threshold of evidence and tend towards risk prevention.¹⁶

The availability of merit review to the NGT promotes judicial application of the principle. As a merit court, the NGT becomes the primary decision-maker and can undertake in-depth scrutiny that involves not only law but also the technical evaluation underpinning a decision.¹⁷ The precautionary principle is invoked and followed by judicial and expert members as a normative commitment. It thereby directs the judges, particularly the technical expert judges, to offer scientifically based structural solutions and policies that respond creatively to weak, ineffective regulation even in the absence of regulation. Adoption of a variety of procedures, including investigative,¹⁸ stakeholder consultation¹⁹ and appointment of specialised committees,²⁰ helps in the application of the precautionary principle. This improves active participation through dialogue, argument and norms for eliciting factual realities and expert knowledge to respond to environmental problems. Expert members by on-spot site inspection can evaluate contradictory claims, positions and reports filed by the parties.²¹ The stakeholder consultative process is applicable to cases of wider ramification involving major issues including river cleaning and air

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14. *Goa Foundation v Union of India* Judgment 18 July 2013, para. 42. See also *Dinesh Chahal v Union of India* Order 30 April 2019; *Anil Tharthare v The Secretary, Environment Department, Govt. of Maharashtra* Order 11 February 2019; *Saloni Ailawadi v Union of India* Order 7 March 2019; *Vimal Bhai v Tehri Hydro Development Corporation* Judgment 13 April 2017; *Krishan Kant Singh v M/s. Triveni Engg. Industries Ltd* Judgment 10 December 2015; *Vardhman Kaushik v Union of India* Judgment 10 November 2016; *Court on its Own Motion v State of Himachal Pradesh* Judgment 4 February 2014; *M/S Sterlite Industries Ltd v Tamil Nadu Pollution Control Board* Judgment 8 August 2013.
 15. For a detailed discussion, see G.N. Gill, *Environmental Justice in India: The National Green Tribunal* (Routledge, UK, 2016) 121–127.
 16. G.N. Gill, ‘The National Green Tribunal of India: Decision-Making, Scientific Expertise and Uncertainty’ (2017) 29(2–3) *Environmental Law and Management* 82–88.
 17. *Ibid.* In *M/S Sterlite Industries v Tamil Nadu Pollution Control Board*, the NGT stated ‘the Tribunal, in exercise of its power of merit-review and being an expert body itself has to examine all aspects of such cases whether they are factual, technical or legal . . . Furthermore, the scope of “merit review” by the Tribunal is not confined to the Wednesbury’s principle. Besides this, other considerations like no evidence, no specific and scientific data or abuse of authority can be additional grounds that can be considered by the Tribunal while determining such a controversy’ (Judgment 8 August 2013, para 143). See also *Hanuman Laxman Aroskar v Union of India* 2019 SCC OnLine 441 at paras 138 and 149.
 18. Above n. 15 at 167.
 19. *Ibid.* at 168.
 20. G.N. Gill, ‘The National Green Tribunal: Evolving Adjudicatory Dimensions’ (2019) 49(2–3) *Environmental Policy and Law* 153–162.
 21. *Court on its own motion v State of Karnataka* Order 6 December 2018; *Forward Foundation v State of Karnataka* Judgment, 10 September 2015. In *Ministry of Environment and Forests v Nirma Ltd* (Order of the Supreme Court 4 August 2014), the Supreme Court approved the procedure adopted by the NGT requiring two of its expert members to visit the site and make a report after carrying out a personal inspection.

pollution.²² The specialised committees promote the accountability of different authorities for the implementation of the rules under the National Green Tribunal Act 2010.²³

Thus, the precautionary principle in India mandates well-judged usage in favour of observing, preventing and mitigating potential threats. Indeed, modern risk factors have become more complex, far reaching and adversely affect public health and environment. The principle is employed as a tool within Indian environmental governance to promote better health and environmental decisions. However, the principle is both controversial and difficult to apply due to its inconsistency (normative aspects) and misapplication (legal standard of proof). In the fourth section, these issues are addressed in the Indian context.

Methods

Theoretical evidence exists how scientific experts when providing policy advice address the questions about scientific uncertainty²⁴ and limited evidence linked to the application of precautionary principle (measures) in cases of scientific uncertainty.²⁵ However, there is case law analysis about how the Indian judiciary applies the precautionary principle.²⁶

This article through mix methods and multiple case studies analyses unique evidence that addresses the complexities of scientific uncertainty and the legal standard of proof associated with the appropriate use of precautionary principle by the Indian judiciary.

Mixed methods and a purposive sampling approach were preferred to gather empirical data to have a broader perspective of the research in question.²⁷ Pilot fieldwork data were collected from 35 key environmental actors involved to varying degrees in the NGT from April 2019 to July 2019. Key environmental actors were the *Decision-Makers* (NGT judicial and scientific judges) and the *Influencers* (Pollution Control Board members, environmental lawyers, scientists and think-tanks). The *Decision-Makers* and

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22. *K.K. Singh v National Ganga River Basin Authority* Judgment 16 October 2014; *Manoj Mishra v Union of India* Judgment 13 January 2015 (referred to as the Maily se Nirmal Yamuna Revitalization Plan 2017); *Vardhama Kaushik v Union of India and Sanjay Kulshrestha v Union of India* Order 7 April 2015.
 23. In July 2018, the NGT under new chairmanship of Justice A.K. Goel refocused to pursue outcomes alongside the decision-making process. The Monitoring Committees neither replace nor release the regulatory authorities of their responsibilities but direct them to take meaningful actions that protect the citizens and the environment. See in *Compliance of Municipal Solid Waste Management Rules 2016* Order 31 August 2018; *'More river stretches are now critically polluted: CPCB'* by Jacob Koshy case Order 20 September 2018; *Stench Grips Mansa's Sacred Ghaggar River (Suo-Moto Case)* Order 7 August 2018; *Doaba Paryavaran Samiti v State of U.P* Order 8 August 2018; *Sobha Singh v State of Punjab* Order 24 July 2018; *News Item published by Vishwa Mohan* Order 8 October 2018.
 24. Above n. 8 at 968. The cited work includes J. Van der Sluijs, 'Uncertainty and Complexity: The Need for New Ways of Interfacing Climate Science and Climate Policy' in P. Driessen, P. Leroy and W. van Vierssen (eds), *From Climate Change to Social Change* (The Netherlands: International Book, 2010); J.A. Wardekker, J.P. van der Sluijs, P.H. Janssen, P. Klopogge and A.C. Petersen, 'Uncertainty Communication in Environmental Assessments: Views from the Dutch Science-Policy Interface' (2008) 11 *Environmental Science & Policy* 627–641.
 25. *Ibid.* at 970. See also P. Spruijt, A.B. Knol, E. Vasileiadou, J. Devilee, E. Lebreton and A.C. Petersen, 'Roles of Scientists as policy Advisers on Complex Issues: A Literature Review' (2014) 40 *Environmental Science & Policy* 416–425.
 26. A.D. Kumar and C. Jayakumar, 'From Precautionary Principle to Nationwide Ban on Endosulfan in India' (2019) *Business and Human Rights Journal* 1–7; M. John, 'Judicial Scrutiny of Environmental Risk and the Legislative Scheme of the Water Act: A Comment' (2017) 13 *Socio-Legal Review* 70–86; N. Chowdhury and S. Sabhapandit, 'The Legal Regime for Application of the Precautionary Principle in India: Future Directions for the GM Regulatory Regime' (2007) 7(3) *International Environment Agreements* 281–300; P.S. Jaswal, N. Jaswal and V. Jaswal, *Environmental Law* (Haryana, India: Allahabad Law Agency, 2019); G. Singh, *Environmental Law* (Lucknow, India: Eastern Book Company, 2006); S. Divan and A. Rosencranz, *Environmental Law and Policy in India* (India: OUP, 2001).
 27. The researcher admits that the database needs expansion. Nevertheless, being a pilot project the findings provide valuable insights to an under-researched empirical knowledge base.

Influencers regularly and productively contribute to environmental decision-making in the NGT. The *Influencers* either appear before the NGT or are appointed by the NGT to assist them in environmental matters as *amicus curie* or are qualified external experts on the tribunal appointed committees for fact-finding and scientific evaluation processes. The data were collected through questionnaires, interviews (semi-structured and open-ended) and five interactive specialist workshops.²⁸ All interviews were recorded and subsequently transcribed. Individual permission to use all recorded material was obtained. The workshops also focused on knowledge, awareness and capacity building by interactions between key actors to improve understanding of complex scientific uncertainties, economic and environmental challenges and corresponding legal responses in an adaptive manner.

Further, multiple case studies were used to analyse the Supreme Court of India and NGT judgments by identifying the usage of key precautionary terms: principle, approach, measure, value, burden of proof and relief granted. The SCC OnLine²⁹ was used as the primary database. It contains the most recent reported judgments. A data set was randomly selected of five judgments of the Supreme Court from 1996 to 2019 (the first case being reported in 1996) and five judgments of the NGT from 2011 to 2018 (the first case being reported in 2011). The theoretical framework of Charles Weiss is applied to unwrap and review the reported judgments presented in this article.³⁰ Weiss' framework provides levels of scientific certainty or uncertainty and corresponding legal standards of proof constituting acceptable bases for legal decisions in practical context especially the precautionary principle and the danger of serious or irreversible harm.

Main findings of the project

Mixed methods data

Effective regulation and decision-making relies on high-quality data to make informed decisions. A major concern in India is the paucity of effective data gathering projects. Incomplete and inaccurate information, inconclusive evidence and public controversy affects, constricts and possibly misdirects regulatory and judicial decision-making. For example, in the 2019 National Clean Air Programme (NCAP) Report,³¹ the Government of India acknowledges

in the field of environmental monitoring, the data quality is posing a major challenge as the reliability of such measurements needs to be ascertained . . . perplexing statistics in various reports, correlating air pollution with health impacts without the use of indigenous dose response functions, further complicates the issue by possibly creating an ambiguous public perception.³²

Ensuring data accuracy and precision advances scientific knowledge and certainty thereby providing evidence for decision-making and playing an important role in risk minimisation. This pilot project seeks to unwrap the challenges arising from scientific uncertainty through its multiple layers that result in the

28. The Workshops were organised at the Northumbria Law School, Northumbria University, UK (9 April 2019); Institute of Environment Education and Research, Bharati Vidyapeeth University Pune, India (20 July 2019); NTPC School of Business Noida, India (24 July 2019); National Green Tribunal Delhi, India (26 July 2019); and Symbiosis Law School Noida, India (27 July 2019).

29. Available at: <https://www.sconline.com/?login=true> (last accessed 15 August 2019).

30. C. Weiss, 'Expressing Scientific Uncertainty' (2003a) 2 *Law, Probability and Risk* 25–46; C. Weiss, 'Scientific Uncertainty and Science-Based Precaution' (2003b) 3 *International Environmental Agreements: Politics, Law and Economics* 137–166; C. Weiss, 'Can there be Science-Based Precaution?' (2006) 1 *Environment. Research Letter* 014003.

31. Ministry of Environment, Forest and Climate Change, Government of India. Available at: <http://cerca.iitd.ac.in/files/reports/NCAP%20Report%20Full.pdf> (last accessed 1 November 2019).

32. *Ibid.* at 57 and 2.

application of the default position being the precautionary principle that may bring with it stultifying outcomes for growth and negative economic consequences.

The pilot project data from the 35 key environmental actors regularly and productively contributing to environmental decision-making in the NGT were collected and analysed. Scientific uncertainty is central to understanding how and why the precautionary principle is applied. It resulted in the identification of the following five descriptors that constitute the normative aspects and contribute to the understanding and application of the precautionary principle and uncertainty: (1) defining the term; (2) invoking and applying the principle; (3) scientific uncertainty and its multiple layers; (4) interventionist strategy for applying the principle; and (5) threshold of harm.

The first descriptor, *defining the term*, resulted in 40.7 per cent of the respondents considering precaution as a principle (1998 Wingspread Statement on the Precautionary Principle), 53.1 per cent an approach (1992 Rio Declaration), 3.1 per cent an ethical value (2005 UNESCO Report on the Precautionary Principle World Commission on the Ethics of Scientific Knowledge and Technology (COMEST)) and 3.1 per cent failed to answer the question. These starkly varying answers to the definition of the precautionary principle create difficulties for environmental governance. The responses also reflect differing judicial understanding as evidenced in case law. For instance, in *Research Foundation for Science (18) v Union of India*,³³ the Supreme Court of India stated, ‘this principle is described as an *approach* to protection of environment or human health . . .’; whereas in *M C Mehta v Union of India*³⁴ described it as a ‘*principle* underlying environmental law’; and in *Jaipur Golden Gas Victims v Union of India*³⁵ as ‘*precautionary measures*’. Thus, the meaning of the principle is blurred through changing declaratory language.

The second descriptor being the *grounds for invoking* the precautionary principle showed differences in understanding the application of the principle. About 12.5 per cent responded that the principle be invoked in conditions of scientific certainty; 59.3 per cent in scientific uncertainty; 22 per cent in both scientific certainty and uncertainty; and 6.2 per cent failed to answer. A related question about relevance or irrelevance regarding the application of the principle with sound baseline data, robust operational standard, defined causal link between pollution and health and effective responsive enforcement showed surprising variation in the results. About 47 per cent answered as relevant, whereas 53 per cent found it irrelevant. These responses mirror the judicial approach taken in some cases where the court appears to have conflated the determinants uncertainty and absolute or reasonable certainty based on scientific information, data availability and analysis of risks.³⁶ These Indian decisions create confusion regarding the scope and application of the precautionary principle through the conflation of precaution and prevention. In India, the endorsement, invocation and application of the precautionary principle overrides if not absorbs the prevention principle.³⁷ This development in India’s environmental regime is supported by a judiciary that is

33. (2005) 13 SCC 186.

34. (2002) 4 SCC 356.

35. (2009) SCC OnLine Del 3357 (Delhi High Court).

36. *Sarang Yadwadkar v Commissioner, Pune Municipal Corporation* Judgment 11 July 2013; *M/S Sterlite Industries v Tamil Nadu Pollution Control Board* Judgment 8 August 2013; *Ajay Kumar Negi v Union of India* Judgment 7 July 2015. For example, in the 2013 *M/S Sterlite Industries* case, the NGT stated ‘these decisions should be based on *best possible scientific information* and analysis of risks. Precautionary measures may still have to be taken where there is *uncertainty* but potential risk exists . . . Precautionary principle should be invoked when the reasonable scientific data suggests that without taking appropriate preventive measure there is a plausible indication of some environmental injury or health hazard’ (paras 120 and 148).

37. See the interesting article concerning the relationship of precautionary and preventive principles. A. Trouwborst, ‘Prevention, Precaution, Logic and Law: The Relationship Between the Precautionary Principle and the Preventative Principle in International Law and Associated Questions’ (2009) 2(2) *Erasmus Law Review* 105–128. Also see, L. Rajamani, ‘The Precautionary Principle in the Indian Courts: Vanishing Line Between Rhetoric and Law’, in S. Ghosh (ed.), *Analytical Lexicon of Principles and Rules of Indian Environmental Law* (Delhi, India: Orient Black Swan, 2019).

proactive within a dynamic decision-making process wherein environment, health and public interests are given the utmost consideration.

The third descriptor concerning *scientific uncertainty and its multiple layers* produced mixed responses. About 84.6 per cent stated that the scientific uncertainty was due to data shortcomings whereas 15.6 per cent identified impacts. According to the key environmental actors, the uncertainty in data was because it was inadequate (78.2 per cent), ambiguous (12.5 per cent), ignorance (6.2 per cent) and a combination of the above (3.1 per cent).

Inadequate data resulted from the lack of a representative environmental baseline (59.38 per cent), lack of a critical pollutant analysis (6.25 per cent), inadequate sampling and analysis procedure (25 per cent) and inadequate analytical modelling (9.37 per cent).

Ambiguity in the data was a result of contested data sets (28.12 per cent), unvalidated models (25 per cent), disagreement between the specialists (15.6 per cent) and language and meaning (31.25 per cent).

Ignorance in data stems from scientific technological ignorance (22 per cent), lack of information sharing and coordination among stakeholders (43.7 per cent), gaps and surprises (18.3 per cent) and unanticipated impacts (16 per cent).

These results reflect concerns raised by the Indian judiciary about the quality of data needed to make informed decisions. For example, the Supreme Court in *Hanuman Laxman Aroskar v Union of India*³⁸ stated that incomplete information and inadequate data impacts on transparent, responsive and inclusion decision-making. The NGT in an air pollution case stated that the report submitted by the concerned 'lacked data and analysis'.³⁹ In *M/S Sterlite Industries v Tamil Nadu Pollution Control Board*,⁴⁰ the NGT emphasised the importance and need of reliable and cogent evidence or reasonable scientific data for decision-makers. In *Sant Akolner* case,⁴¹ the NGT noted that there was hardly any substantial ground water quality data which could be statistically relied upon from the regulatory agencies regarding ground water quality trends and characteristics before deciding the matter.

The fourth descriptor about the *interventionist strategy to apply the precautionary principle* produced the following results – 56.25 per cent for achieving and maintaining ambient environmental standards, 9.38 per cent for identifying significant polluters, 3.12 per cent for apportionment of pollution by individual pollution source and 31.25 per cent for causal linkage between the level of pollution and human health and ecology.

The fifth descriptor concerning the *threshold of harm* shows a trend towards risk prevention with a low epistemic threshold of evidence. About 59.4 per cent preferred the application of the principle to regulate threats of harm to human health or the environment, whereas 40.6 per cent responded to serious or irreversible harm. This result is unsurprising due to the influential role of the precautionary principle based upon the crucial link between life and a healthy environment as enshrined in Article 21 of the Constitution of India and its subsequent recognition in the preamble of the NGT Act 2010.⁴² For example, the Supreme Court in *MC Mehta v Union of India*⁴³ while explaining the scope of the precautionary principle stated 'the principle requires anticipatory action to be taken to prevent harm. The harm can be prevented even on a reasonable suspicion'. In *Ajay Kumar Negi v Union of India*,⁴⁴ the NGT opined 'the precautionary principle

38. (2019) SCC OnLine SC 441.

39. Available at: <https://www.indiatoday.in/india/story/air-pollution-iit-scientists-back-study-ngt-253755-2015-05-20>.

40. Judgment 8 August 2013.

41. *Sant Akolner v Indian Oil Corporation* Judgment 10 November 2014.

42. Above n. 11 and n. 14.

43. (2004) 12 SCC 118 at p. 168.

44. Judgment 7 July 2015.

is a tool for making better health and environmental decisions. It aims to prevent harm from the outset rather than manage it after the fact has occurred’.

The analysis of the data shows the key environmental actors (*Decision-Makers and Influencers*) involved in the NGT differ about their understanding and application of the normative aspects of the precautionary principle in advice and decision-making. Scientific uncertainty is endemic in environmental decision-making. It is argued that the normative aspects should be explicitly addressed in the process of environmental decision-making. This is due largely to the unclear formulation of the principle and the lack of an appropriate framework of guidelines. Elsewhere, those jurisdictions including EU,⁴⁵ UK,⁴⁶ Australia,⁴⁷ Canada⁴⁸ and New Zealand⁴⁹ with advanced environmental regulations have developed guidelines within frameworks of good regulatory practice.

Drawing on effective foreign regulatory practices and developing a framework of guidelines would help in addressing the normative challenges of precautionary principle and enhance the effectiveness of its application. Emphasis should be placed on ‘the nature of the risk, its level of uncertainty, magnitude and reversibility; who is exposed (for example, disproportionately affected or highly vulnerable communities); issues of technological and economic feasibility, benefits, proportionality and non-discrimination; preventability of the risk; social values’.⁵⁰ They should also take cognisance of factors including

weighing the costs and benefits of regulation to the community, through formal risk assessment and cost-benefit analysis, performance-and outcomes-focused, transparent and accountable, and targeted at achieving statutory objective, open to review and modification when new scientific information becomes available, adaptive management, involving monitoring, research, periodic evaluation and review, and efficient and effective compliance.⁵¹

Foreign judgments can be of comparative value to Indian environmental decision-makers.⁵²

The understanding and actions taken in applying precaution differ from country to country. Factors such as ‘attitudes to risk management, the role of science and scientists in decision-making processes, openness

45. Available at: <https://eur-lex.europa.eu/legalcontent/EN/TXT/PDF/?uri=CELEX:52000DC0001&from=EN> (last accessed 10 August 2019).

46. Available at: <http://www.hse.gov.uk/aboutus/meetings/committees/ilgra/pppa.pdf> (last accessed 12 August 2019).

47. Available at: <https://www.environment.gov.au/system/files/resources/5f3fdad6-30ba-48f7-ab17-c99e8bcc8d78/files/final-report-13-decision-making-under-act.pdf> (last accessed 12 August 2019).

48. Available at: <http://publications.gc.ca/collections/Collection/CP22-70-2003E.pdf> (last accessed 12 August 2019).

49. Available at: <https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/coastal-management/guidance/policy-3.pdf> (last accessed 14 August 2019).

50. United Nations Educational, Scientific and Cultural Organization (UNESCO) (2005) ‘The Precautionary Principle’. Available at: <http://unesdoc.unesco.org/images/0013/001395/139578e.pdf> (last accessed 18 August 2019). See also IUCN Guidelines for applying the precautionary principle to biodiversity conservation and natural resource management (2007).

51. See Peterson, above n. 7, for a detailed discussion.

52. For example, see *Telstra Corporation Limited v Hornsby Shire Council* [2006] NSWLEC 133. The Chief Judge of the NSW Land and Environment Court, Justice Preston in a thought-provoking judgment considered the precautionary principle in detailed. Preston CJ stated that ‘when determining whether a threat of serious or irreversible harm is present, the decision-maker should consider: the spatial scale of the threat, the magnitude of potential impacts arising from the threat, the perceived value of the threatened environment, the temporal scale of possible impacts in terms of timing and persistence of impact, the complexity and connectivity of impacts, the manageability of possible impacts (having regard to availability and acceptability of means), the level of public concern and the rationality of such concern based on the scientific or other evidentiary basis underpinning the concern, and the reversibility of possible impacts and if reversible, the time frame, difficulty, and expense associated with reversing possible impacts. When determining whether there is a lack of scientific certainty, decision-makers should consider the sufficiency of evidence that there might be a threat the level and of uncertainty and the potential to reduce the uncertainty having regard to what is possible in principle, economically and within a reasonable time frame’ (paras 141 and 148). See also *Sustain Our Sounds v the New Zealand Salmon Co* [2014] NZSC 40.

of decision-making processes, nation's economy including level of "development" and nature of "natural environment" affect the application of the precautionary principle'.⁵³ The complex and uncertain scientific risks with shared environmental externalities make it desirable for India to import good practice rules or principles into its legal system.

Multiple case studies

So far, the article has focused on the complex issues of interpretation and application of the precautionary principle by key environmental actors involved in the NGT. It now presents an alleviating framework offering a possible solution to the Gordian knot that binds the precautionary principle and scientific uncertainty. Mutual cognition, appreciation and association between disciplines, in this case science and law, is problematic. Environmental issues involving both disciplines require a common approach. Science and law demand a common vocabulary for a standard of proof that will promote the effective understanding of scientific uncertainty and the precautionary principle. In this context, Charles Weiss' theoretical framework may unpick the 'knot'.⁵⁴

Weiss seeks to increase the 'practical value of precautionary principle' as a legal principle by 'specifying the standard of proof to which the evidence for environmental danger is to be held'.⁵⁵ The standard of proof corresponds to the level of scientific certainty or uncertainty required to trigger precautionary intervention. The absence or failure to define the standard of proof is a denial to specify the evidence of environmental harm and risk. For example, the 'European courts, which consider the principle to be binding, have failed to arrive at a consistent statement of what it requires in any given situation'.⁵⁶

Weiss states the

framework [scale] makes it easier to convey to decision makers [judiciary] the level of uncertainty associated with any assertion of scientific fact, and to distinguish among the science, the uncertainty connected with that science, and the justification for action . . . the scale seeks to improve risk assessment for policy makers [judges], increase public understanding of the role of scientific uncertainty, undermine the most absurd arguments in the guise of scientific facts, and increase the level of honesty in presenting scientific advice and advocacy, and expert testimony.⁵⁷

Applying Weiss' scale to 10 randomly selected environmental judgments of the Supreme Court and the NGT helps 'increase the precision and rationality'⁵⁸ of the precautionary principle discourse. The focus is on three key issues: (1) level of scientific certainty or uncertainty; (2) standard of proof; and (3) outcome and relief. The scale provides an intelligible lexicon to address controversies and misconceptions where 'generalists untrained in natural sciences judge the merits of opposing arguments in dispute'.⁵⁹ The use of scale as a tool acts as a crossover template between scientific certainty(un) and legal standard of proof of the emerging science-intensive practices. There is a need for an 'accepted framework [scale] and vocabulary expressing the different levels of scientific uncertainty, the different levels of intervention, and the different approaches to precaution'.⁶⁰

53. See R. Harding and E. Fisher, above n. 6 at 14.

54. Above n. 30.

55. Ibid. (2003b) at 138.

56. Ibid. (2006) at 5.

57. Ibid. at 6 and (2003a) at 44.

58. Ibid. (2003a) at 25.

59. Ibid.

60. Ibid. (2003b) at 159.

Table 1. Source (Weiss, 2003a; 2006).

Level	Legal standard of proof	Informal levels of scientific certainty/uncertainty
10	Beyond any doubt (not a legal standard)	Fundamental theory of conclusion within well understood limits of validity
9	Beyond a reasonable doubt	Rigorously proven; excluding alternative explanations
8	Clear and convincing evidence	Substantially proven. A few details remain to be worked out. Reasonably certain
7	Clear showing	Very probable
6	Substantial and credible evidence	Probable. Evidence points in this direction but not fully proven
5	Preponderance of the evidence	More likely than not (more likely to be true than untrue)
4	Clear indication	Attractive but unproven. Evidence is beginning to accumulate in this direction
3	Probable cause: reasonable ground for belief	Plausible hypothesis, supported by some evidence
2	Reasonable, articulable grounds for suspicion	Possible, worth researching
1	No reasonable grounds for suspicion	Unlikely; available evidence is against it, but not entirely ruled out
0	Impossible	Against the known laws of physics or other sciences

Nevertheless, the frame is subject to criticism. For instance, a wide range of people may assign different meanings to the same words or introduce subjectivity in characterising uncertainty in given situations.⁶¹ Despite these shortcomings, the frame helps in making the disagreements precise and intelligible to the various interested parties. It offers a platform that constitutes an acceptable basis for reaching legal decisions.

Taking a position based on the established standard of proofs in civil, criminal and administrative proceedings in the US courts⁶² and legal literature, Weiss proposed an 11-point scale of scientific uncertainty⁶³ as presented in Table 1.

The precautionary principle places the burden of proof on the proponent but does not specify the standard of proof to which the scientific evidence be subjected. The Indian judiciary has highlighted this issue by stating ‘in recent times a serious challenge that has appeared before the courts more often than not, is the basis on which the precautionary principle is to be applied’⁶⁴; ‘the submission of scientific evidence that precludes the court from inquiring into the issue’⁶⁵; ‘the uncertainty of scientific proof may involve the tribunal to decide *on guess work* and use *of robust common sense*’.⁶⁶ Thus, as a broad approach and in an understandable form, the scale would ‘help to make the treatment of scientific uncertainties . . . more explicit, more precise, and more amenable to rational argument’.⁶⁷

Tables 2 and 3 comprise of selected reported cases of the NGT and Supreme Court (10 cases, evenly divided between the Tribunal and Supreme Court). They are evaluated and located on the Weiss scale of

61. *Ibid.*, (2003a) at 43. See also analysis of empirical data.

62. Similar standards of legal proof are applied in India. For example, beyond any doubt (*Earabhadrapa v State of Karnataka* (1983) 2 SCC 330); beyond reasonable doubt (*M.C. Mehta v Union of India* (1996) 5 SCC 647), and reasonable doubt (*H.P. Administration v Om Prakash* (1972) 1 SCC 249).

63. Above n. 30 (2003a and 2006).

64. *Ajay Kumar Negi v Union of India* 2015 SCC OnLine NGT 666.

65. *Biju J Balan v State of Maharashtra* 2019 SCC OnLine Bom 97.

66. *Gurprit Singh Bagga v Ministry of Environment and Forests* Order 18 February 2016; See above n. 38.

67. Above n. 30 (2003a) at 44.

Table 2. NGT cases; Source: Author (based on Table 1).

NGT case	Legal standard of proof and level	Level of scientific certainty/ uncertainty	Outcome
<i>Vardhman Kaushik v Union of India</i> (2016)	Beyond a reasonable doubt, Weiss (9)	Rigorously proven; excluding alternative explanations	Prohibition, banning and closure
<i>Satara Municipal Corporation v MoEF</i> (2017)	Clear showing, Weiss (7)	Very probable	Development of Environmental Management Plans; stop activities if detrimental
<i>Sant Akolner v Indian Oil Corporation</i> (2014)	Substantial and credible evidence, Weiss (6)	Probable. Evidence points in this direction but not fully proven	Regular monitoring (necessary treatment) plants/disposal facilities)
<i>Rayons-Enlightening Humanity v MoEF</i> (2013)	Preponderance of the evidence, Weiss (5)	More likely than not (more likely to be true than untrue)	Closure and prohibitory injunction
<i>Indian Council for Enviro-Legal Action v MoEF</i> (2015)	Reasonable, articulable grounds for suspicion, Weiss (2)	Possible, worth researching	Further research

Note: NGT: National Green Tribunal.

Table 3. Supreme Court cases; Source: Author (based on Table 1).

Supreme Court case	Legal standard of proof and level	Level of scientific certainty/ uncertainty	Outcome
<i>Vellore Citizen Welfare Forum v Union of India</i> (1996)	Beyond a reasonable doubt (9)	Rigorously proven; excluding alternative explanations	Closure and prohibition
<i>M C Mehta v Union of India (groundwater)</i> (1997)	Clear and Convincing evidence (8)	Substantially proven. A few details remain to be worked out. Reasonably certain	Establishment of a water authority (plan, implement, research)
<i>M C Mehta v Union of India (lakes)</i> (1997)	Clear showing (7)	Very probable	Restrictions
<i>A P Pollution Control Board v Prof M V Naydu (II)</i> (2001)	Substantial and credible evidence (6)	Probable. Evidence points in this direction but not fully proven	Restrictions
<i>Democratic Youth Federation v Union of India</i> (2011)	Reasonable, articulable grounds for suspicion (2)	Possible, worth researching	Interim ban and future research

certainty/uncertainty and legal standards of proof. In addition, the tables also reflect the nature of action (outcome) ordered by the judiciary. The practice of drawing precedents from case law is common in the reviewed cases. Table 2 refers to the NGT cases.

In *Vardhman Kaushik v Union of India*,⁶⁸ the legal standard of ‘beyond a reasonable doubt’⁶⁹ is assigned level 9 as the contributory sources of air pollution (vehicles, construction activities, burning of municipal solid waste (MSW) and agricultural residue, dust on roads, industrial and power house emissions including

68. Judgment 10 November 2016.

69. *Ibid.* at 30–31. Weiss states that ‘beyond a reasonable doubt’ the evidence must be so convincing that a reasonable person would not hesitate to rely and act upon it.

fly ash, and emissions from hot-mix plants and stone crushers) in Delhi were ‘firmly identified’.⁷⁰ The ‘convincing data’ showed that the ambient air quality was severe and adversely and hazardously affected the public health and persons of all generations without exception.⁷¹ Accordingly, the NGT ordered precautionary measures including banning 15 years old vehicles or older, closure of stone crushing units, implementing dust management plans, installing air purifiers, no burning of waste and preference to the use of public transport systems.

In *Satara Municipal Corporation v MoEF*,⁷² the standard of ‘clear showing’⁷³ assigns it level 7 as it is very probable that the ‘new and unforeseen conditions’⁷⁴ will cause serious harm or damage. The case involved the proposed reconstruction of a dam near the world heritage site of the Kas plateau. The proposed new reconstruction activity would adversely affect the sensitive ecology of the Kas plateau including ecological niches and habitats supporting various plant communities and high numbers of plant and animal species. The NGT applied the precautionary principle by requiring formulation of environmental safeguards, measures and management plans prior to the execution of the proposed project.

The next standard of proof ‘substantial and credible evidence’⁷⁵ being level 6 is associated with the *Sant Akolner* case.⁷⁶ The NGT considered the potential sources of groundwater pollution either by the presence of oil depots or industries in the surrounding areas. Applying the principle of proximity, the NGT was of the opinion based on available data, analysis, reports and documents that a strong co-relation existed between the type of contamination of the groundwater and oil storage depots. The NGT while applying the precautionary principle ordered regular monitoring of the groundwater including necessary treatment and disposal.

In *Rayons-Enlightening Humanity v MoEF*,⁷⁷ the standard of ‘preponderance of evidence’⁷⁸ level 5 is assigned. The location of an MSW plant near human habitation was a contested site. Based on a few maps and photographs as convincing evidence, the NGT found that the MSW plant was bound to have hazardous effects on the health of the residents in the area, some of them being adjacent to the contested site. The contested site in which the plant was located, was more likely and bound to cause groundwater pollution, which was relatively at a higher level through leaching. Accordingly, the NGT applied the precautionary principle and ordered the closure of the MSW plant and granted a permanent prohibitory injunction.

The standard of ‘reasonable, articulable grounds for suspicion’⁷⁹ is the least stringent standard with the lowest level of epistemic evidence. This is level 2 and is applied to *the Indian Council for Enviro-Legal Action v MoEF*⁸⁰ a case to determine whether HFC-23 emissions *per se* are a pollutant. HFC-23 forms part of greenhouse gases that have an impact on depletion of ozone layer and global warming, but there are concerns about their extent and degree. Accordingly, the NGT directed the regulatory and expert bodies to conduct a comprehensive data base study on HFC-23 and its impact on global warming.

Table 3 illustrates the judgments from the Supreme Court of India.

70. Above n. 68 at 5.

71. *Ibid.*

72. Judgment 9 February 2017.

73. Above n. 30 (2003a) at 33. Showing of reasonable probability that the action will succeed on its merit in cases where damage would be severe if stay or injunction is not granted.

74. *Ibid.*

75. *Ibid.* Such evidence as a reasonable mind accept as adequate to support a conclusion.

76. Above n. 41.

77. Judgment 18 July 2013.

78. Above n. 30 (2003a) at 30 and 32. Existence of a contested fact more probable than not.

79. *Ibid.* at 31 and 34. Suspicion based on objective, articulable facts; mere hunch.

80. Judgment 10 December 2015.

In *Vellore Citizen Welfare Forum v Union of India*,⁸¹ the Supreme Court was convinced 'beyond a reasonable doubt',⁸² therefore level 9, that leather tanneries operating in Tamil Nadu destroyed the ecology, degraded the environment and posed a health hazard. The technical reports evidenced the untreated effluents from nearly 900 industries polluted groundwater, contaminated agricultural lands and exposed the residents to serious diseases. Accordingly, the Supreme Court applied the precautionary principle and directed the closure of rogue tanneries, prohibition and restriction on the location of industries and installation of treatment effluent plants before the reoperation of industries.

The standard of 'clear and convincing evidence',⁸³ level 8 is applied in the *M C Mehta v Union of India*⁸⁴ (groundwater case) dealing with groundwater depletion. Evidence supported by technical reports convinced the court that there was a gradual depletion of groundwater levels, dwindling water resources, deterioration of groundwater and surface quality and a haphazard use of land. To assess the complex issues in water resource management, the Supreme Court directed the constitution of a water authority to operationalise the precautionary principle. The water authority was expected to plan, develop and implement research on sustainable water resource management.

In *M C Mehta*⁸⁵ (lakes case), the standard of 'clear showing',⁸⁶ is applied at level 7. The Supreme Court while applying the precautionary principle placed restrictions on the proposed new construction in the areas outside the greenbelt of the Badhkal and Surajkund lakes. Based on expert opinion, the new proposed large-scale construction near the lakes was bound to cause adverse impact on the local ecology. The proposed construction activity may disturb the rainwater drains thereby impacting on the water levels and water quality of the water bodies and disturbance to the aquifers and hydrology in the area.

The case of *A P Pollution Control Board v Prof M V Nayudu (II)*⁸⁷ is covered by the standard of 'substantial and credible evidence',⁸⁸ level 6. The Supreme Court considered whether the establishment of chemical industry carries with it the imminent danger of chemicals or chemical effluents polluting the waters of Himayat and Osman Sagar lakes. Based on exhaustive scientific evidence provided by expert organisations, the Supreme Court applied the 'reasonable person' test and concluded that there was every 'likelihood' of the industry affecting the sensitive catchment area of the lakes.⁸⁹ Accordingly, the court applied the precautionary principle and directed that the regulatory agencies should not permit any polluting industries within the radius of 10 kilometres of the lakes.

The standard of 'reasonable, articulable grounds for suspicion',⁹⁰ is applied to *Democratic Youth Federation v Union of India v Union of India*,⁹¹ level 2, considering the ill-effects of endosulfan on human beings and the environment. The differing reports presented to the court regarding the usage of endosulfan and its impact on human health and the environment led to the application of precautionary principle. Consequently, the court ordered the interim ban on the production, sale and use of endosulfan and an undertaking of a detailed scientific study on Endosulfan.

81. (1996) 5 SCC 647 at 658.

82. Above n. 69.

83. Above n. 30 (2003a) at 33. Leads to a firm belief or conviction that the allegations are true.

84. (1997) 11 SCC 312.

85. *M C Mehta v Union of India* (1997) 3 SCC 715.

86. Above n. 73.

87. (2001) 2 SCC 62.

88. Above n. 75.

89. Above n. 87 at paras 57 and 64. See also *A P Pollution Control Board v Prof M V Nayudu* (1996) 5 SCC 647.

90. Above n. 79.

91. (2011) 15 SCC 530.

Thus, the multiple case studies reflect Weiss' legal standard of proof scale that offers greater precision in defining the degree of scientific uncertainty. 'The level of this uncertainty, and the approach to that uncertainty, are important inputs into the risk assessment that enters into any decision'.⁹² Good environmental practices aim to evaluate scientific uncertainties and incorporate such evaluation in decision-making. Informed decisions based on precision in language and concept are the essence of an appropriate precautionary decision. The 'scientifically legal' lexicon offers an opportunity to express different levels of scientific uncertainty in a legal language facilitating precautionary interventions with greater certainty.

Conclusion

Court room cases are invariably decided by factual evidence offered by witnesses and experts. The evidence is mediated and presented by advocates speaking the language of law to the judiciary. However, in environmental cases, the role and status of science and technical expertise are increasingly important factors in decision-making by the court.

Academic literature recognises that current different understandings of the precautionary principle, informal scientific levels of certainty or uncertainty and legal standards of proof may introduce subjectivity into the judgments. This may result in vague and malleable formulations, over or under reaction to significant or insignificant risks and oppose technological innovation based on unproven intuition.

This article highlights two principal issues in environmental decision-making by the Indian judiciary. The first examines the meaning, appreciation and application of the precautionary principle by key environmental actors who are regularly involved in the presentation or resolution of environmental issues in the NGT. The unique pilot survey establishes that the range of key environmental actors differ in their definitions and usage of this principle. There exists limited common understanding between *Decision-makers* and *Influencers* about the normative aspects of the principle and related scientific uncertainty.

The second issue focuses on scientific uncertainty, the legal standard of proof and its impact on the precautionary principle. Weiss framework offers a pathway for the Indian judiciary by assembling a scale of legal standards of proof arranged in a hierarchy of levels of increasing scientific certainty. This tabular form transposes levels of scientific certainty into parallel legal terminology familiar to lawyers and the judiciary. It becomes a 'scientifically legal' lexicon of meaning for the judges and lawyers. Weiss does not claim the scale is absolute nor clearly defined but nevertheless it makes evidence more precise and therefore it is easier to understand the value of scientific evidence by categorising it as a helpful tool operating somewhere between 'beyond reasonable doubt' and 'impossible'.

The findings presented in the article encourage next-step thinking in India's environmental governance. There is a need to develop a framework of guidelines that recognises the normative aspects⁹³ and legal standard of proof for scientific uncertainty⁹⁴ in the application of the precautionary principle. Adapting from foreign regulatory guidelines and developing a 'scientifically legal' lexicon that expresses different levels of scientific uncertainty in a legal language, the framework would provide a roadmap regarding the usage of the precautionary principle. Such a framework would assist the Janus-faced precautionary principle to become a consistent, effective, accountable and transparent tool.⁹⁵ This would enable decision-

92. Above n. 30 (2003b) at 160.

93. Above n. 45–50.

94. Above n. 30.

95. The Indian judiciary is known for its proactive role and has made recommendations to improve environmental governance. It is suggested the judiciary could make a framework recommendation to the appropriate authorities to develop a legislative framework that would be helpful to a wide range of potential users including judiciary, regulators, scientists, think-tanks and lawyers.

makers to promote the environmental rule of law and further India's commitment to sustainable development goals.

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ORCID iD

Gitanjali Nain Gill  <https://orcid.org/0000-0001-5670-5796>