

ISBN 978-93-5779-472-5



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***Book Chapters on***

**INTELLECTUAL PROPERTY RIGHTS IN  
ENVIRONMENTAL SCIENCE:  
A GLOBAL SUSTAINABLE FUTURE**

*Chief Editor*

**Dr. Y. SREELATHA**

**Principal**

**M.A., Ph. D**

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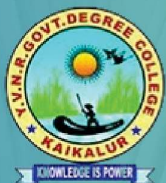
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**NAAC grade A [CGPA 3.13 in 3rd Cycle]**

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**Published: March 2026**

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## Preface

The rapid advancement of science and technology has brought significant opportunities as well as challenges for achieving global sustainability. In this context, *Intellectual Property Rights (IPR)* play a vital role in promoting innovation, protecting novel ideas, and encouraging the development of environmentally sustainable technologies. The integration of intellectual property frameworks with environmental science is increasingly important for addressing global issues such as climate change, pollution control, waste management, renewable energy, and sustainable resource utilization.

The *International Webinar on “Intellectual Property Rights in Environmental Science: A Global Sustainable Future”* ( 19<sup>th</sup> & 20<sup>th</sup> of February, 2026) was organized with the objective of creating a platform for academicians, researchers, scientists, innovators, and students from across the world to share their knowledge, research findings, and perspectives on the importance of intellectual property in advancing environmental sustainability.

This edited volume presents selected chapters contributed by participants and experts who took part in the webinar. The chapters cover diverse themes including green technologies, sustainable bioprocessing, environmental innovations, waste valorization, carbon reduction strategies, and the role of patents and other intellectual property tools in promoting sustainable development. The contributions highlight how scientific research combined with appropriate intellectual property protection can accelerate the development and dissemination of eco-friendly technologies. We sincerely hope that this book will serve as a valuable resource for researchers, policymakers, academicians, and students interested in the intersection of *Intellectual property and environmental sustainability*. The insights presented in these chapters are expected to inspire further research and innovation towards building a cleaner, greener, and more sustainable future.

We express our heartfelt gratitude to all the distinguished speakers, contributors, reviewers, and participants whose support and cooperation made both the webinar and this publication possible. We also extend our sincere thanks to the organizing committee, faculty members, and institutional leadership for their encouragement and guidance.

It is our hope that this compilation will contribute meaningfully to the global dialogue on protecting environmental innovations and promoting sustainable development for the benefit of present and future generations.

*Editorial Board*



## **Acknowledgements**

The successful organization of the **International Webinar on “*Intellectual Property Rights in Environmental Science: A Global Sustainable Future*”** and the publication of this book of chapters would not have been possible without the encouragement, cooperation, and support of many individuals and institutions.

We express our sincere gratitude to Dr. Narayana Bharath Gupta IAS, Director of Collegiate Education, Mangalagiri, Andhra Pradesh, Dr C. Krishna Joint Director, and Dr P.V. Krishnaji, Regional Joint Director of Collegiate Education for their continuous encouragement and guidance in promoting academic and research activities in our institution.

We extend our heartfelt thanks to our respected Principal, Dr. Y. Sreelatha, whose constant motivation, leadership, and support greatly contributed to the successful conduct of the webinar and the preparation of this publication. We express our sincere gratitude to Sri. Vallabhaneni Butchiah Chowdary, Secretary & Correspondent, and to Dr A. Hari Krishna, Principal, S.V.R.M. College (Autonomous), Nagaram, Bapatla District for their encouragement and timely help. We are deeply grateful to all the distinguished keynote speakers, resource persons, and experts from India and abroad who shared their valuable knowledge and insights on the role of Intellectual Property Rights in promoting environmental innovations and sustainable development. Their contributions enriched the discussions and inspired participants from various academic and research backgrounds.

We also acknowledge with appreciation the efforts of the organizing committee, faculty members, and technical team, whose dedication, planning, and coordination ensured the smooth conduct of the webinar sessions. Our sincere thanks are due to all the authors and contributors who submitted their valuable research chapters for this volume. We are equally grateful to the reviewers and editorial team for their careful evaluation, suggestions, and support in maintaining the academic quality of the publication.

Finally, we thank all the participants, researchers, and academicians who actively took part in the webinar and contributed to making it a meaningful platform for intellectual exchange and collaboration.

We hope that the ideas and research presented in this volume will contribute to the advancement of environmental science, sustainable technologies, and intellectual property awareness for a better and sustainable future.

***Editorial Board***

*Intellectual Property Rights in Environmental Science: A Global Sustainable Future*



## INDEX

<b>Chapter</b>	<b>Author (s)</b>	<b>Page No</b>
<b>Chapter-1</b>		
Climate Policy, Clean Energy, and Intellectual Property Rights in India	<i>Dr. K.A. Emmanuel S. V. G. V. A. Prasad N. Srinivasa Rao Dr. Y. Sreelatha</i>	1 - 4
<b>Chapter-2</b>		
Green Financial Inclusion Driven by AI	<i>Dr. P. Paul Divakar K. Anil Kumar D. Sreenu Dr. Y. Sreelatha</i>	5 - 8
<b>Chapter-3</b>		
International Treaties and Conventions on Environmental IPR	<i>Dr. T. V. Nagalakshmi Dr. K. A. Emmanuel Dr. R. Jalababu Dr. P. Paul Divakar</i>	9 - 10
<b>Chapter-4</b>		
Sustainable Future and Intellectual Property	<i>P. Sobha Rani V. Sandhya V. Nagalakshmi K. Sreelatha</i>	11 - 14
<b>Chapter-5</b>		
COP 16 Advances DSI Rules to Combat Virtual Biopiracy in Digital Era.	<i>Dr. K. A. Emmanuel Dr. M. Vijaya Kumar Dr. V. Sandhya Dr. R. Jalababu</i>	15 - 17
<b>Chapter-6</b>		
Balancing Patent Protection and Urgent Flood Relief in Kaikaluru Kolleru with Trips Compulsory Licensing Frameworks	<i>Dr. V. Sandhya Dr. M. Vijaya Kumar <b>Dr. K.V.S Koteswara Rao</b> Dr. Narasaiah Muppuri</i>	18 - 21
<b>Chapter-7</b>		
Intellectual Property Rights and Clean Agriculture: Rethinking Innovation, Equity, And Environmental Justice in Contemporary Agrarian Systems	<i>Ravulapati.Venkaiah Ravulapati.Chaturvedi</i>	22 - 25
<b>Chapter-8</b>		
Patenting Environmental Innovations and Clean Technologies	<i>Dr. T. V. Nagalakshmi Dr. K. A. Emmanuel Dr. R. Jalababu Dr. P. Paul Divakar</i>	26 - 29
<b>Chapter-9</b>		
IPR-Driven Strategies for Energy Efficiency and Sustainable Growth	<i>Dr. K. Sreelatha, Dr. C. S. Ananda Kumar Dr. R.Jalababu, P. Anusha</i>	30 - 34
<b>Chapter-10</b>		
Impact of IPRs at the Firm Level: Patents, Trademarks Designs and Future Recommendations.	<i>Dr. P. VaraLakshmi Dr. D. Ramanjineyulu</i>	35 - 42

<b>Chapter-11</b> Green Energy Innovations: A Vision for Future Generations	<i>Dr. L Malleswara Rao Dr. APV Appa Rao Ch Sundar Singh P Ramakrishna Rao</i>	43 - 47
<b>Chapter-12</b> IPR-Supported Bioremediation Strategies Empowering Kaikaluru Patent Protection and Technology Transfer for Heavy Metal Cleanup in Kolleru Lake	<i>Dr. M. Vijaya Kumar Dr. R. Jalababu Dr. Narasaiah Muppuri Dr. K.V.S Koteswara Rao</i>	48 - 50
<b>Chapter-13</b> Green Innovation and Intellectual Property Rights: Legal Pathways Toward Sustainable Development	<i>Dr. K.A. Emmanuel Dr. T.V. Nagalakshmi Dr. V. Sandhya Dr. M. Hariprasad</i>	51 - 53
<b>Chapter-14</b> Green Innovation in Green Chemistry for Carbon - Neutral and Circular Sustainability	<i>S. Radha Tejaswi</i>	54 - 56
<b>Chapter-15</b> Hybrid Solar–Wind Energy System for Sustainable Power Generation	<i>M. Jaya Lakshmi Devi Ch. Anitha</i>	57 - 60
<b>Chapter-16</b> BMI Survey in Selected Villages of Eluru	<i>S. Pratima Kumari R. Indira K. S.V. K. S. Madhavi Rani L. Prasanna</i>	61 - 67
<b>Chapter-17</b> Green Innovations in Chemical Sciences: Emerging Sustainable Technologies and Future Perspectives	<i>Racheeti. Prasanna Babu</i>	68 - 74
<b>Chapter-18</b> Innovation Climate and Green Sustainability	<i>Dr. K. Suresh Babu</i>	75 - 80
<b>Chapter-19</b> Traditional Knowledge - Turmeric Patent Battle Case Review	<i>Pushadapu Venkatanarayana</i>	81 - 83
<b>Chapter-20</b> Kaikaluru's Green Leap Proposal Can Transform Municipal Waste into Renewable Energy while Protecting Wetlands.	<i>Dr. M. Vijaya Kumar Dr. V. Sandhya Dr. K. A. Emmanuel Dr. R. Jalababu</i>	84 - 87
<b>Chapter-21</b> Nanostructured Catalysts at the Chemistry-Physics Frontier: Revolutionizing Electrocatalysis for Sustainable Energy (2020–2025).	<i>A. Padmavathi K. Durga Rao V. Sanjeeva Kumar S.V.G.V.A. Prasad</i>	88 - 91
<b>Chapter-22</b> Powering the Future: Green Energy Sources and the Path to Sustainability	<i>K. Jyothsna, K. Sirisha K. Sreelatha</i>	92 - 95
<b>Chapter-23</b> Sustainable Power Transitions: IPR and Distributed Renewable Energy	<i>C. A. Jyothirmayee A. Himasri Bindu Deepthi Bhargav</i>	96 - 100

<b>Chapter-24</b> Biodiversity Conservation and Intellectual Property Regimes	<i>Dr. T.V. Nagalakshmi Dr. K.A. Emmanuel Dr. R. Jalababu Dr. V. Sandhya</i>	101 - 103
<b>Chapter-25</b> Green Energy Resources, Non-Fossil Fuels and Their Role in Environmental Protection – A Study	<i>L. Narasimha Rao Dr.VKJ. Prasuna Dr Meruva Vijayakumar Nunna Srinivasa Rao D.V.V.CH Satyanarayana</i>	104 - 107
<b>Chapter-26</b> Solid Waste Management and Sustainable Development in Emerging Economies	<i>Sridevi Ambati</i>	108 - 113
<b>Chapter-27</b> The Role of Hydropower in Sustainable Development	<i>B. Durga Prasanna P. Radhika</i>	114 - 117
<b>Chapter-28</b> Intellectual Property Rights in the Era of Climate Change and Global Sustainability	<i>Dr. G. Jyothi Olivia</i>	118 - 121
<b>Chapter-29</b> Copyright Protection for Environmental Research and Data	<i>Dr. T.V. Nagalakshmi Dr. K.A. Emmanuel Dr. R. Jalababu Dr. M. Vijaya Kumar</i>	122 - 124
<b>Chapter-30</b> IPR and Green Innovation: Routes to a Sustainable Future	<i>Dr. K.A. Emmanuel Dr. P. Paul Divakar Dr. V. Sandhya K. Sreelatha</i>	125 - 128
<b>Chapter-31</b> Clean Agricultural Practices for Sustainable and Safe Food Systems	<i>Sajja Srinivasa Rao</i>	129 - 133
<b>Chapter-32</b> A study on Biodiversity of Avian Fauna in selected Villages of Eluru and West Godavari Districts	<i>R. Indira KS.V.K.S. Madhavi Rani S. Pratima Kumari N. Lakshmi Prasanna</i>	134 - 140
<b>Chapter-33</b> Waste Management Systems and their Role in Sustainable Environmental Development	<i>B.V. Ramya Sri</i>	141 - 143
<b>Chapter-34</b> Intellectual Property Rights and Green Innovations: A Review from a Physical Sciences Perspective	<i>P. Srinivasa Rao B. Venkateswara Rao</i>	144 - 149
<b>Chapter-35</b> Green Innovation: A Pathway to a Sustainable Future	<i>B. Vijayalakshmi</i>	150 - 152
<b>Chapter-36</b> Clean Agricultural Practices in India: Impacts on Sustainability, Soil Health, and Food Security	<i>Mahangi Rajya Lakshmi I</i>	153 - 156

<b>Chapter-37</b> Protection of Trademarks in Environmental Innovation	<i>K. Sreelatha</i> <i>V. Nagalakshmi</i> <i>K. Sreelekha</i> <i>N. Madhuri Rose</i>	157 - 161
<b>Chapter-38</b> Patterns of Allergic Disorders: Across Age Groups Selected Areas of Eluru District	<i>Dr. K. S. V. K.S.Madhavi Rani</i> <i>Dr. R .Indira</i> <i>N. Lakshmi Prasanna</i> <i>Dr. S. Pratima Kumari</i> <i>Dr. D. Alekhya</i>	162 - 165
<b>Chapter-39</b> Environmental Monitoring and its Resource and Environmental Management	<i>B. Sailaja</i>	166 - 171
<b>Chapter-40</b> Green Energy in the Post-COVID Era: Pathways to Sustainable Recovery	<i>Dr. P. Paul Divakar</i> <i>Dr. K Sree Latha</i> <i>Dr. T.V. Naga Lakshmi</i> <i>Dr. K. A. Emmanuel</i> <i>Dr. R. Jalababu</i>	172 - 174
<b>Chapter-41</b> Role of Intellectual Property Rights in Environmental Science	<i>Katuri Ramesh</i> <i>Dr. Y. Srilatha</i> <i>Dr. K. A. Emmanuel</i> <i>Dr. R. Jalababu</i>	175 - 177
<b>Chapter-42</b> Renewable Energy for Environmental Protection	<i>Katuri Ramesh</i> <i>Dr. R. Jalababu</i> <i>Dr. K. A. Emmanuel</i> <i>Dr. G. Giri Babu</i>	178 - 180
<b>Chapter-43</b> Air Pollution Control for Environmental Sustainability	<i>Katuri Ramesh</i> <i>Dr. M. Vijay Kumar</i> <i>Dr. K. A. Emmanuel</i> <i>Dr. R. Jalababu</i>	181 - 183
<b>Chapter-44</b> Water Pollution Control for Environmental Safety	<i>Katuri Ramesh</i> <i>Dr. P. R. Kavasree</i> <i>Dr. K. A. Emmanuel</i> <i>Dr. R. Jalababu</i>	184 - 186

*Chapter -6*

## Balancing Patent Protection and Urgent Flood Relief in Kaikaluru Kolleru with Trips Compulsory Licensing Frameworks

\*V. Sandhya<sup>1</sup>, M. Vijaya Kumar<sup>2</sup>, Dr. K.V.S Koteswara Rao<sup>3</sup>, Dr. Narasaiah Muppuri<sup>4</sup>

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### ABSTRACT

The Kolleru Lake region, including Kaikaluru in Andhra Pradesh, faces escalating flood risks due to siltation, encroachment, and reduced lake capacity, exacerbating groundwater contamination and ecological degradation. Recent assessments highlight how anthropogenic pressures like aquaculture expansion and agricultural runoff have diminished the lake's flood-buffering role, leading to frequent inundation and saltwater intrusion. Green technologies, such as AI-monitored drainage systems, smart embankments, and wetland restoration techniques, offer promising solutions for resilience, but their dissemination is hindered by intellectual property rights (IPR) exclusivity. This chapter examines compulsory licensing under the TRIPS Agreement (Article 31) as a mechanism to balance patent holders' R&D recoupment with urgent public access during climate emergencies. Drawing on 2020–2025 studies, including CEC reports on Kolleru pollution and flood zonation analyses, it analyzes how compulsory licensing can enable rapid adoption of innovations like geospatial flood mapping and eco-friendly desilting, while ensuring fair remuneration. Case examples from US clean air mandates and India's pharmaceutical precedents illustrate feasibility, despite challenges like innovation disincentives. The discussion advocates for TRIPS flexibilities to declare climate-induced floods as "extreme urgency," facilitating technology transfer to vulnerable regions. By integrating IPR reforms with ecosystem-based strategies, such as macrophyte restoration, this approach can safeguard livelihoods, restore lake capacity, and mitigate groundwater threats, promoting equitable sustainable development in flood-prone wetlands like Kolleru.

**Keywords:** *Compulsory licensing, TRIPS Agreement, green technologies, flood resilience, Kolleru Lake, Kaikaluru, groundwater contamination, IPR exclusivity, climate emergencies, wetland restoration.*

### Introduction

Kolleru Lake, recognized as India's largest freshwater body and a designated Ramsar wetland of international importance, lies strategically between the Krishna and Godavari river deltas in Andhra Pradesh. Spanning historically vast contours, it functions as a natural flood buffer, biodiversity hotspot, and lifeline for thousands of local households in Kaikaluru (Eluru District) and surrounding villages.

These communities depend heavily on the lake for fisheries, irrigation water for paddy cultivation, and domestic supply. However, over the past three decades, unchecked anthropogenic pressures, including large-scale aquaculture encroachments, agricultural runoff laden with fertilizers and pesticides, untreated domestic sewage, and sporadic industrial discharges, have severely degraded its ecological integrity.

Siltation, weed infestation, and illegal pond construction have dramatically reduced the lake's effective storage capacity, shrinking its functional area and diminishing its ability to absorb monsoon inflows. Recent satellite and field assessments (2019–2025) reveal that lake levels frequently exceed the plus 5 ft contour during heavy rains, resulting in widespread inundation of low-lying agricultural lands and villages in Kaikaluru. Concurrently, heterogeneous heavy metal pollution, particularly chromium (Cr: 4.5–80 µg/L), lead (Pb), cadmium (Cd), and others, has been documented in water and sediments, primarily linked to agricultural and aquaculture effluents. This contamination not only threatens aquatic life and migratory birds but also leads to groundwater salinization and heavy metal seepage, posing long-term health risks to residents through drinking water and fish consumption.

Flood events between 2019 and 2025 caused significant damage to crops, infrastructure, and livelihoods, prompting the Central Empowered Committee (CEC) to repeatedly flag the urgent need for desilting, pollution control, and integrated management. In this context, environmentally sound technologies (ESTs) such as AI-monitored drainage systems for real-time water-level prediction, adaptive permeable embankments, geospatial flood-hazard mapping, and nature-based solutions like macrophyte planting offer practical, low-cost pathways to restore resilience. Yet, the development and deployment of these advanced green innovations are often protected by intellectual property rights (IPR), particularly patents, which can restrict access in resource-limited developing regions like Andhra Pradesh.

The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), under Article 31, provides a critical mechanism, compulsory licensing, to address this tension. It allows governments to authorize the use of patented

technologies without the patent holder's consent in situations of national emergency or extreme urgency (such as recurrent climate-induced flooding), provided fair compensation is paid to the rights holder. This chapter explores the application of compulsory licensing to facilitate the rapid dissemination of flood-resilient green technologies in the Kaikaluru–Kolleru region, while ensuring that R&D incentives remain intact for innovators. By examining recent pollution data, policy precedents, and TRIPS flexibilities, it proposes a balanced framework to mitigate flood vulnerability and groundwater contamination in this ecologically and socially sensitive wetland ecosystem.

## 1. RESULTS & DISCUSSION

Kolleru Lake's flood resilience has declined sharply due to siltation, weed growth, and widespread encroachments by aquaculture ponds. Historical and recent geospatial data show its effective area has reduced significantly, from about 901 km<sup>2</sup> at the plus 10 ft contour to much smaller fragments in dry periods, severely limiting its ability to store and regulate monsoon runoff. This has led to frequent overtopping of the plus 5 ft contour, causing prolonged flooding in low-lying villages and farmlands of Kaikaluru and nearby areas.

Groundwater quality is further degraded by saltwater intrusion from the Bay of Bengal and leaching of heavy metals. Lead (Pb) concentrations in water exceed WHO drinking limits by 2.8–3.5 times in several samples. Seasonal monitoring in 2024 showed pre-monsoon levels of Pb, Hg, and Cd already above WHO thresholds in many locations, with post-monsoon spikes in Cr and as driven by agricultural runoff. These pollutants accumulate in lake sediments, forming a persistent source of toxicity that continues to release into both surface water and groundwater through seepage and tidal action.

Geospatial flood mapping identifies high-risk zones around Kaikaluru, where

repeated flooding disrupts livelihoods, destroys crops, and increases waterborne disease exposure.

Environmentally sound technologies offer effective solutions:

- **AI-monitored drainage systems** with real-time sensors, IoT, and predictive models can optimize water flow and prevent overflow.
- **Adaptive embankments** using permeable, nature-based materials help control erosion while allowing regulated infiltration.
- **Macrophyte restoration**, *Eichhornia crassipes* and *Salvinia auriculata* supports desilting, nutrient removal, and heavy metal phytoextraction, improving overall water quality.

However, intellectual property rights (IPR), especially patents on AI algorithms, sensor technology, and optimized restoration methods, often restrict access in developing regions. While strong patent protection ensures recovery of high R&D investment, it creates delays when rapid deployment is critical in climate-vulnerable areas like Kolleru.

The TRIPS Agreement (Article 31) provides a solution through, compulsory licensing, allowing governments to authorize use of patented technologies without the patent holder's consent in situations of national emergency or extreme urgency. Recurrent climate-driven flooding

can be classified under this category. Real-world precedents include India's compulsory licenses for essential medicines during public health crises and the US Clean Air Act's provisions for mandating licensing of pollution-control technologies.

In the Kolleru context, compulsory licensing could enable fast transfer and local adaptation of AI-drainage and smart flood-management tools, with fair royalties paid to patent holders to maintain innovation incentives. Potential drawbacks, such as reduced motivation for future R&D, can be addressed through patent pools, voluntary licensing schemes, and public-private partnerships.

Combining licensed technologies with ecosystem-based measures (macrophyte planting, community-led desilting) and local governance creates a practical, cost-effective, and socially accepted pathway to restore the lake's flood storage capacity, protect groundwater quality, and build long-term climate resilience in the Kaikaluru region.

## 2. CONCLUSION

Balancing IPR exclusivity with TRIPS compulsory licensing offers a pathway to deploy flood-resilient technologies in Kaikaluru-Kolleru, addressing reduced lake capacity and contamination. Urgent policy reforms, including climate emergency declarations, can ensure equitable access while sustaining innovation.

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