GAS Journal of Economics and Business Management (GASJEBM)

Volume 3 | Issue 9, 2026 Homepage: https://gaspublishers.com/gasjebm-home/ ISSN: 3048-782X

Research on Engineering Environmental Ethics Issues and Countermeasures from the Perspective of Ecological Civilization Construction

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Received: *05.04.2026* | ***Accepted:*** *15.05.2026* | ***Published:*** *01.09.2026*

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DOI: *10.5281/zenodo.22233520*

Abstract **Original Research Article**

Against the backdrop of increasingly severe global ecological crises, engineering construction is not only a human survival activity but also a significant threat to the natural world. How to harmonize engineering construction with ecosystems has become a highly discussed topic worldwide. This paper, grounded in the important task of ecological civilization construction, analyzes environmental ethical issues existing in the engineering field. By examining typical cases of environmental ethical issues in engineering, it explores the root causes of these issues. It proposes the construction of a diversified environmental ethical responsibility system primarily involving the engineering community. Based on this, it analyzes the research value and practical pathways of engineering ethics for ecological civilization construction.

The research findings indicate that embedding engineering ethical norms throughout the entire lifecycle of engineering projects, and establishing an engineering ethical responsibility system where multiple stakeholders (with the engineering community as the main body) collaborate, cooperate, govern, and manage together, can ultimately achieve a win-win situation between engineering development and ecological protection, and promote harmonious coexistence between humans and nature.

Keywords: Ecological Civilization Construction; Engineering Environmental Ethics; Responsibility Research of the Engineering Community; Green Development.

I. Issues Related to Engineering Environmental Ethics

1.1 Land Resource Consumption and Environmental Ethical Challenges

Land is the foundation of ecosystems. Land development in engineering activities often results in inefficient land use. Combined with national strategic large-scale projects such as the West-East Gas Pipeline and the South-North Water Diversion Project, as well as geological disasters like drought and land desertification, cultivated land resources have sharply decreased. According to data from the China Land Resources Bulletin, China's cultivated land area has decreased by over 120 million mu in the past decade, with most of this land being used for real estate development and infrastructure construction. This reduces farmland and natural habitats. Such development practices violate the ethical principle of intergenerational equity

regarding land resources, depriving future generations of the right to equal use of natural resources.

In engineering construction, land use often neglects ecological functions. Large-scale land development can lead to soil erosion, water pollution, and other issues, causing significant damage to ecological functions. Some industrial parks are located in ecologically sensitive areas, damaging the land's hydrological regulation and biological habitat functions. From an environmental ethics perspective, land is not only an economic resource but also part of an ecosystem. Engineering activities should follow the principle of minimal disturbance to nature, aligning land use with ecological carrying capacity.

1.2 Ethical Issues of Waste and Pollutant Emissions

Waste and pollutants generated during engineering construction and operation cause significant pollution to the surrounding environment. These pollutants can also cause secondary contamination of nearby land and water sources, endangering the health of local residents. During the construction of water conservancy projects, haphazard dumping of 渣土 (spoil) leads to river blockage and land pollution. Dust and noise pollution from construction sites seriously harm nearby residents.^\[2]^

The ethical misconduct of pollutant emissions essentially reflects anthropocentric values. Some enterprises, seeking economic benefits, neglect pollutant treatment, deliberately evade environmental responsibilities, and leave the consequences to society and nature. This violates the principle of environmental justice and exacerbates intra-generational and inter-generational inequities of the ecological crisis. From an engineering ethics perspective, it is necessary to establish an ethical mechanism for pollution compensation and incorporate environmental costs into engineering benefit evaluation systems.

1.3 Ecosystem Destruction and Lack of Ethical Responsibility

The destruction of ecosystems by engineering activities is multifaceted. Water conservancy projects alter natural river flows, fragmenting aquatic habitats. Construction projects clear native vegetation, damaging biodiversity. The Yunnan Green Peacock case, where a hydropower station project nearly caused the permanent disappearance of green peacock habitats, is a typical example of engineering decision-making lacking ecological ethics.

The ethical root of ecosystem destruction is the engineering community's failure to holistically understand ecosystems. Traditional engineering focuses on technical feasibility and economic rationality, often neglecting the interconnections within ecosystems. With the emergence of environmental ethics, engineering behavior should shift towards ecological considerations. The impact of engineering on ecosystems should be a prerequisite for engineering activities. This necessitates establishing a long-term mechanism for engineering ecological compensation and restoration, enabling harmonious coexistence between engineering and ecosystems and promoting sustainable ecological development.

II. Case Study Analysis: Yunnan Green Peacock Case

2.1 Case Background and Environmental Ethical Conflicts

The Yunnan Green Peacock case is the first preventive environmental public interest litigation case in China. This case highlights the conflict between engineering construction and ecological environmental protection. The development of the Gasa River Hydropower Station project on the mainstream of the Red River (Yuanjiang) would have submerged the dry-hot valley monsoon forest, causing significant damage to this forest ecosystem and endangering the survival of green peacocks

within it. Although the project proponents claimed that the economic benefits of the project would help alleviate local poverty, environmental organizations and local residents insisted on the principle of prioritizing ecological value, leading to intense debate over whether economic development or ecological protection should come first.

2.2 Nature and Roots of Ethical Conflicts

The main ethical conflict in this case lies in the fragmentation of values within the engineering community. Investors and construction companies adhered to utilitarian ethical concepts, prioritizing economic benefits. Environmental organizations and the public upheld ecocentric ethical perspectives, emphasizing the intrinsic value of nature. This contradiction reflects the one-sidedness of ethical trade-offs in engineering decisions, relying too heavily on cost-benefit analysis and neglecting the multiple dimensions of ecological ethics.

From an ethical root perspective, the engineering party lacked awareness of environmental ethical responsibility. The environmental impact assessment in the early project phase failed to fully expose ecological risks, and no dynamic adjustments for ecological protection were made during construction. The engineering community's understanding and implementation of ecological ethical norms were severely deficient.

2.3 Case Implications and Ethical Solutions

This case set a new paradigm for ecological protection by using preventive judicial measures to halt hydropower station construction. The ethical implication is that engineering activities cannot solely focus on short-term economic benefits; there must be a rigid constraint mechanism of ecological red lines. It is necessary to improve the engineering ethics review system, integrate ecological ethical indicators into engineering evaluation systems, strengthen the environmental ethical responsibility of the engineering community, and construct a multi-stakeholder collaborative decision-making mechanism to balance ecological and social interests.

III. Reconstructing the Environmental Ethical Responsibility of the Engineering Community

3.1 Role and Ethical Responsibility Positioning of the Engineering Community

The engineering community is a stakeholder network composed of investors, engineering organizations, engineers, managers, workers, and other entities. Their ethical mission is to coordinate the relationship between engineering activities and the ecological environment. From the perspective of ecological civilization construction, the engineering community needs to transform from "economic persons" to "ecological persons," integrating environmental ethical responsibility into professional ethics and forming a value consensus on technological innovation and ecological protection.

3.2 Environmental Ethical Responsibilities of Investors and Engineering Organizations

Investors are the decision-makers of engineering activities and bear the leadership responsibility for environmental ethics^\[3]^, meaning they should regard environmental protection as a corporate strategic goal, establish green investment decision-making mechanisms, and never destroy the ecological environment for economic gain. The "Responsible Care" principle implemented by the American Chemistry Council, requiring companies to take full responsibility for the environmental impact of chemical production processes, is a model of investors assuming environmental responsibility.

Engineering organizations (enterprises, project departments), as implementers of environmental ethical responsibility, should establish an ecologically oriented organizational culture. On one hand, they should implement green production methods, adopt energy-saving technologies, clean processes, and reduce resource consumption and pollutant emissions during construction and operation. On the other hand, they should establish an environmental risk warning system, conduct

dynamic monitoring and assessment of ecological impacts throughout the entire project lifecycle, and adjust project plans promptly to minimize ecological risks.

3.3 Environmental Ethical Responsibilities of Engineers

3.3.1 Ethical Basis for Responsibility Formation

Engineers bear environmental ethical responsibility due to the nature of their role. Engineers are the designers and implementers of engineering technology. They possess information about the environmental impact of engineering activities, and their technical decisions directly affect ecological security. From an ethical philosophy perspective, an engineer's responsibility is not only a professional duty but also a moral commitment to the entire human community and ecological community. The "Model Code of Ethics for Engineers" of the World Federation of Engineering Organizations (WFEO) states, "Use the minimum amount of raw materials and energy, and produce the minimum amount of waste and pollution," reflecting the unique influence of engineers in environmental protection matters.

3.3.2 Responsibility Dimensions and Practice Pathways

An engineer's environmental ethical responsibility encompasses technical design, construction supervision, ecological restoration, and other aspects. Regarding technical design, the "precautionary principle" should be followed, prioritizing environmentally friendly technical solutions, such as using fishway design in water conservancy projects to protect aquatic organism migration. In construction supervision, efforts should be made to control environmental risks and prevent ecological damage caused by违规 (non-compliant) operations. After project completion, engineers are responsible for formulating ecological restoration plans to promote the restoration of damaged ecosystems.

To fulfill these responsibilities, engineers need to enhance their environmental ethical literacy. Ecological ethics courses should be added to engineering education to cultivate students' ecological concepts and ethical judgment abilities. Professional training should also strengthen practice in environmental ethical norms, incorporating environmental responsibility into the professional qualification evaluation system for engineers, thereby promoting the establishment of green engineer professional standards.

3.3.3 Realistic Dilemmas and Breakthrough Paths for Responsibility Fulfillment

Engineers face many practical dilemmas in fulfilling environmental ethical responsibilities. Role conflict dilemma: As employees of enterprises, engineers often need to coordinate their employer's economic interests with ecological responsibility. For example, engineers at a chemical company discovered that a new project could potentially cause groundwater pollution but concealed the risk due to management pressure, leading to an environmental accident. This illustrates the conflict between the duty of loyalty and ethical responsibility. An ethical priority occupational protection mechanism should be established. The German Engineers Act stipulates that engineers dismissed for refusing to participate in 违规 (non-compliant) projects can receive legal aid and financial compensation from their professional association.

Second, the dilemma of uncertain environmental impacts from emerging engineering technologies (e.g., gene editing, artificial intelligence): The environmental impacts of new engineering technologies have a lag, making it difficult for engineers to accurately assess the environmental risks. A development team for a US autonomous vehicle failed to adequately test the recognition accuracy of their algorithm, resulting in a prototype vehicle killing an endangered wild animal during testing, leading to an ethical dilemma. To address this, a preventive ethical assessment procedure should be established. In the technology design phase, simulation models should be used to predict potential ecological risks of the project, such as using GIS technology to predict the impact on biological migration routes.

As a breakthrough pathway, the Japanese system of engineering ethics committees can serve as a model. An independent review body comprising technical experts, ethicists, community representatives, etc., can be established within companies to assist engineers in ethical decision-making. For instance, in Toyota's new energy vehicle project, this mechanism rejected a plan to mine battery raw materials that would damage coral reefs and adopted a more expensive but more environmentally friendly alternative.

3.4 Environmental Ethical Responsibilities of Managers and Workers

3.4.1 Building Managerial Ethical Leadership

Managers' environmental ethical leadership is reflected in two aspects: strategy and organizational culture. Strategically, ecological goals should be integrated into corporate development strategies. Microsoft has set a goal to achieve water positive by 2030, requiring its global data centers to achieve a water recycling rate of over 90%. Culturally, ethical benchmarking management can be used to motivate employees. A construction company introduced a "Green Project Manager" selection system, making the completion of ecological indicators one of the conditions for promotion, thus fostering an ecologically oriented organizational atmosphere.

3.4.2 Discussion on Workers' Operational Ethics and Skill Improvement

Workers' environmental ethical responsibility needs to be realized through dual-track training in skills and ethics. In terms of skills training, a construction site in Shenzhen used a VR simulation system to allow workers to experience standard operating procedures for dust control and noise management firsthand. For ethical training, an accident chain analysis teaching method was adopted. Using the Jilin Shuangben Plant explosion as an example, the ethical responsibility chain of workers' violations—from operational errors to concealing non-compliance—is analyzed, thereby strengthening workers' sense of responsibility. Furthermore, an "Environmental Ethics Points System" was established, converting workers' environmentally friendly operational performance into exchangeable welfare points. A worker at a port who improved loading and unloading processes to reduce dust emissions received additional paid leave as a reward.

IV. Value Dimensions of Engineering Ethics for Ecological Civilization Construction

4.1 Relationship between Core Principles of Engineering Ethics and Environmental Protection Requirements

Engineering ethics, with its core principles of respecting life, protecting the environment, and promoting well-being, has environmental protection requirements running through the entire lifecycle of engineering projects. International engineering ethics codes, such as the US engineering ethics code stating "the safety, health, and welfare of the public are paramount," and the Royal Academy of Engineering's Statement of Ethical Principles listing respect for the environment as a fundamental principle, both embody ethical demands for ecological protection. China's Opinions on Strengthening the Governance of Science and Technology Ethics, proposing five principles—enhancing human welfare, respecting life rights, upholding fairness and justice, reasonably controlling risks, and maintaining openness and transparency—provides a basic framework of ecological ethics for engineering activities tailored to China's context.

4.2 How Engineering Ethics Promotes the Practice of Ecological Civilization Construction in China

4.2.1 Multidimensional Exploration of Green Engineering Practices

China has seen many successful examples of green engineering. In green building promotion, technologies like solar photovoltaics and rainwater harvesting enable low-carbon building operation. In green transportation development, the expansion of high-speed rail and urban rail transit significantly reduces energy consumption and carbon emissions

from transportation. In green mine management, ecological reclamation and resource recycling achieve a positive interaction between mining development and ecological protection. This demonstrates that the implementation of engineering ethics requires the integration of technological innovation and ethical concepts.

4.2.2 Policy Drivers and Institutional Innovation

At the policy level, China has incorporated ecological civilization construction into its overall national development layout. Regulations and systems such as the Integrated Reform Plan for Promoting Ecological Civilization and the Yangtze River Protection Law define ecological red lines for engineering activities. In engineering ethics education, the Ministry of Education has included engineering ethics as a core course for engineering majors, promoting the formation of an "engineering ethics + ecological civilization" teaching system in universities. Industry associations are actively developing green engineering standards. The Chinese Society of Engineers is promoting the establishment of engineering ethics codes, providing institutional support for the engineering community to assume environmental responsibility.

4.2.3 Innovation of Ethical Paradigms in Ecological Restoration Projects

China has developed unique ethical practice models in the field of ecological restoration. In the Kubuqi Desert control, Elion Group adopted a model combining desert control, industry, and livelihood, integrating desert photovoltaic power station construction with licorice planting and eco-tourism. This achieved sand fixation while providing employment opportunities for local herders, embodying the ethical principle of unifying ecological and livelihood interests. This "engineering ethics + rural revitalization" model has become a global ecological restoration case study for the United Nations Environment Programme.

In the Yangtze River Protection project, the implementation of the ten-year fishing ban involved a transformation of ethical responsibility within the engineering community. Water conservancy departments established an "ethical support system for the vocational transition of retired fishermen," providing training for displaced fishermen to become ecological rangers, environmental propagandists, and other roles, fulfilling ecological protection responsibilities while safeguarding fishermen's livelihoods, achieving the integration of ecological justice and social justice.

4.3 Logical Mechanism of Engineering Ethics Promoting Community Building

4.3.1 Ecological Foundation of the Chinese National Community

Engineering activities serve as a material bond for the Chinese national community, and their environmental ethical responsibility points to the sustainable development of the nation. From the "Dao follows nature" principle of the Dujiangyan Water Conservancy Project to the "green miracle" of the Saihanba ecological restoration project, these examples demonstrate the engineering community's historical commitment to ecological responsibility. In the new era, engineering ethics should enhance a sense of "patriotism and family-country," linking ecological protection with the great rejuvenation of the Chinese nation and relying on green engineering construction to protect the ecological foundation of the Chinese nation.

4.3.2 Ecological Responsibility of the Community with a Shared Future for Mankind

In the era of globalization, the environmental impacts of engineering activities transcend national boundaries, necessitating the development of an ecological ethics system for the community with a shared future for mankind. China's Green Belt and Road Initiative requires engineering construction to comply with the ecological standards of host countries and promotes international cooperation on low-carbon technologies, demonstrating the responsibility of the Chinese engineering community. It is necessary to improve the environmental ethics review mechanism for cross-border projects and build a global engineering ethics

governance system to jointly address global ecological challenges such as climate change and biodiversity loss.

4.3.3 Constructing an Ethical System for the Community of Life between Humans and Nature

The ultimate goal of engineering ethics is the harmonious coexistence of the community of life between humans and nature. This means the engineering community must move beyond anthropocentrism, recognize the intrinsic value of nature and the wholeness of ecosystems. In practice, "Nature-based Solutions" (NbS) should be implemented, such as using ecological slope protection, constructed wetlands, and other engineering techniques that mimic natural ecological processes, integrating engineering facilities with natural systems.

4.3.4 Engineering Ethics and the Urban-Rural Ecological Symbiont

Ethical collaboration in urban and rural engineering construction is an important part of ecological civilization construction. Zhejiang Province's "Thousand Villages Demonstration Project" employs an ecological planning ethics review system, requiring all rural construction projects to retain at least 30% of native vegetation area and align with the landscape patterns of traditional villages. During the renovation of Songyang Ancient Village, engineers used "micro-renovation" techniques, adding modern ecological facilities while preserving the ancient architectural style, achieving both cultural preservation and ecological enhancement. This was selected by the Ministry of Housing and Urban-Rural Development as an ethical model for traditional village protection.

In urban renewal, the Shanghai Yangpu Riverside industrial heritage renovation project followed the concept of industrial ecological ethics, retaining over 80% of industrial relics and transforming them through ecological renovation into a public space with functions of flood control, leisure, and cultural expression. This form of dialogue between industrial civilization and ecological civilization provides an ethical model for the transformation of old industrial areas.

V. Institutional Innovation and Practice Pathways for Engineering Environmental Ethics

5.1 Policy and Regulatory Innovation for Engineering Ethics

5.1.1 Pathways to Legalizing Environmental Ethical Responsibility

China should promote specialized legislation on engineering environmental ethics. A dedicated clause on engineering ecological torts could be added to the Tort Liability section of the Civil Code, clarifying the ecological damage compensation liability of the engineering community. Referring to the Supreme People's Court's Interpretation on Several Issues Concerning the Application of Law in the Trial of Environmental Tort Liability Disputes, compensation for loss of ecological service functions should be included. In a case where a chemical enterprise's illegal discharge caused the degradation of a river's ecological functions, the enterprise was ordered to pay 120 million yuan in ecological restoration fees and compensation for loss of environmental functions.

5.1.2 Market-oriented Ecological Compensation Mechanism

The market-oriented transformation of ecological compensation is key to implementing ethical responsibility. Sanming City in Fujian Province established the country's first forestry carbon sink trading platform, allowing engineering construction entities to purchase carbon sink credits to assume ecological compensation responsibilities. For example, a highway project purchased carbon sink credits equivalent to 20,000 hectares of forest land to offset its carbon emissions during construction, achieving carbon-neutral construction. This transformation of ethical responsibility into a market transaction converts environmental ethics from a moral obligation into an economic incentive.

5.2 Building an Engineering Ethics Education System

5.2.1 Innovative Exploration of University Engineering Ethics Education Courses

Universities should establish a "theory-practice-innovation" trinity curriculum system. Tsinghua University offers an interdisciplinary course "Engineering Ethics and Ecological Design," where students must complete a zero-carbon campus design project in teams, comprehensively applying knowledge from ecology and ethics. The course adopts a "dual mentor" system, with both an engineering professor and an ethicist providing guidance. For example, in a teaching building energy renovation project, students used Life Cycle Assessment (LCA) methodology to compare the environmental ethical benefits of different building materials, ultimately choosing local low-carbon stone over imported marble.

5.2.2 Digital Transformation of Corporate Ethics Training

Enterprises can use the metaverse for immersive ethics training. The China State Construction Engineering Corporation developed an "Engineering Ethics Metaverse Training Platform." Employees use virtual avatars to participate in engineering decision-making simulations. In a virtual hydropower project, they must make choices between resettlement satisfaction (economic indicator) and fish protection outcomes (ecological indicator). The system generates an ethical decision analysis report based on their choices. This gamified learning approach increased training participation by 60% and improved ethical decision accuracy by 45%.

VI. Localization Practice of International Engineering Ethics

6.1 Exploration of Engineering Ethics Adaptation Strategies for the "Belt and Road" Initiative

In Southeast Asia, projects should respect local religious ecological views. On the Jakarta-Bandung High-Speed Railway project in Indonesia, which passed near a tribal sacred site, the project party invited local elders to participate in route design and built underground tunnels to avoid surface disruption. A "Cultural and Ecological Protection Fund" was established to protect the tribe's traditional ecological knowledge. This culturally sensitive ethical decision was accepted by the local community, resulting in an 80% lower complaint rate compared to similar projects.

China is co-developing engineering ethics standards with developing countries. In Africa, the Green Infrastructure Ethics Guide was released, integrating China's concept of integrated management of mountains, rivers, forests, farmlands, lakes, and grasslands with Africa's "web of life" ecological view. The guide sets standards such as ensuring a 500-meter buffer zone for biological habitats around construction sites and limiting nighttime construction noise to below 45 decibels. The Addis Ababa-Djibouti Railway project in Ethiopia adopted this guide to modify its construction plan, resulting in a 95% retention rate of wildlife migration corridors along the route.

6.2 Exploration of International Engineering Ethics Dispute Resolution Mechanisms

First, establish a "Belt and Road" Engineering Ethics Risk Pre-warning Platform. Big data is used to analyze host country ecological regulations, community sentiment, and other data to pre-identify ethical risks 6-12 months in advance. During the construction of the China-Laos Railway, the platform detected a sharp increase in complaints from local residents about construction dust. The project party immediately initiated an emergency response, adding 120 dust suppression water trucks and holding 15 community meetings, reducing complaints by 75% within three months.

Second, "Establish an International Engineering Ethics Mediation Center." Mediation teams composed of engineering experts, ethicists, and legal experts are formed. In the Pakistan SK Hydropower Project case, a local environmental organization raised concerns about the location of a waste disposal area. The mediation center conducted on-site inspections and technical assessments, leading

the project party to change the location and build an ecological slope protection project. The two parties eventually reached a settlement, allowing the project to proceed smoothly.

VII. Conclusion and Outlook

Engineering activities are both a key vehicle for ecological civilization construction and a potential source of ecological crises. This paper comprehensively analyzes engineering environmental ethics issues and, through case studies, reveals the crucial role of the engineering community in ecological protection. It forms an ethical system centered on multi-faceted responsibility. The analysis shows that only by integrating engineering ethics into the management of the entire engineering lifecycle, establishing a collaborative system led by the government, borne by enterprises, participated in by the public, and guaranteed by the rule of law, can a positive interaction between engineering development and ecological protection be achieved.

Future research should further deepen work in the following areas: first, increase comparative cross-cultural studies of engineering ethics to establish a discourse system of engineering ethics with Chinese characteristics; second, explore environmental ethical issues in emerging technology fields such as artificial intelligence and gene editing, improving technical ethics norms; third, accelerate the digital governance of engineering ethics, using technologies like big data and blockchain to improve the traceability and supervision efficiency of environmental ethical responsibility. Through both theoretical innovation and practical exploration, more actionable ethical solutions will be provided for the green transformation of Chinese-style modernization.

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