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Implementing cultural heritage conservation and energy sustainability in the UNESCO World Heritage site of Jaipur city, India

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World Heritage cities face the complex challenges of balancing cultural heritage protection with the UN Sustainable Development Goals, particularly reducing greenhouse gas emissions and achieving energy sustainability. However, implementing these commitments at the local level often presents challenges. Using the walled city of Jaipur, a UNESCO World Heritage site in India, as a case study, this article examines the impacts, opportunities, and challenges in implementing and applying international and national obligations to preserve cultural heritage in light of obligations to reduce energy use and greenhouse gas emissions in historic urban areas. This article is based on legal research, as well as 9 semi-structured interviews, which include one group interview with three municipal representatives and individual interviews with one state representative, five heritage professionals and consultants, and two heritage property owners. The results show that World Heritage status has enhanced cultural heritage protection while allowing measures toward energy sustainability. Traditional architectural practices, such as the passive climate design of havelis, are already energy efficient, while interventions, such as the integration of solar panels and adaptive re-use of havelis, demonstrate compatibility between heritage conservation and sustainability goals. However, there continue to be challenges, including limited expertise, capacity, and financial resources, while governance inefficiencies, commercialization pressures, inadequate support for residents, and limited community engagement further hinder progress. The study recommends strengthening the governance framework and enforcement mechanisms, providing targeted financial and technological support, and fostering inclusive collaboration and education among these actors to align heritage conservation with energy sustainability at the local level.

KEYWORDS

World Heritage cities, international law, local implementation, heritage governance, heritage conservation, energy sustainability

1 Introduction

A 2024 Indian Supreme Court judgment highlighted the necessity of balancing nature conservation with climate change mitigation (Ranjitsinh, 2024). This study, which uses the example of the World Heritage site of Jaipur city, highlights the similar necessity of balancing two conservation interests: cultural heritage conservation and the integration of energy efficiency and renewable energy measures. Both scenarios require a holistic

approach that respects and preserves the intrinsic value of natural habitats and cultural heritage while mitigating climate impacts and promoting energy sustainability.

The 1972 World Heritage Convention adopted by the General Conference of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the 2015 Paris Agreement adopted under the United Nations Framework Convention on Climate Change (UNFCCC), both ratified by India (UNESCO, 1972, 2024; UNFCCC, 2015; United Nations, 2024), mandate State Parties to protect heritage sites of outstanding universal value from present and future challenges and compel Member States to adopt measures to reduce greenhouse gas emissions and transition to renewable energy sources, respectively.

Projections by the International Energy Agency indicate that by 2050, more than 70% of the global population will reside in urban areas (IEA, 2024, p. 16). Although they occupy only 2–3% of the Earth's land area (IUCN, 2023), cities are responsible for nearly 75% of global energy consumption and generate over 70% of annual global CO_2 emissions (IEA, 2024, p. 10). According to the World Cities Report 2024, urban areas produced between 67 and 72% of global greenhouse gas emissions in 2020 (UN-Habita, 2024, p. 8). In 2022, the global building and construction sector alone accounted for 34% of final energy consumption and 37% of energy and process-related carbon emissions (UNEP, 2024, p. ix). In India, the building sector is responsible for about 40% of total CO_2 emissions (Nagar and Suman, 2022, p. 2).

As Indian cities expand, energy demand and greenhouse gas emissions are expected to rise, exacerbating climate change (MoHUA, 2021, pp. 1–5). Contrary to the common perception that old and historic structures have low-performance energy systems (Cho et al., 2020; Gonzalez et al., 2020; Tsoumanis et al., 2021), Jaipur havelis, a type of traditional building typical of the desert state of Rajasthan, demonstrate that the opposite can be true (Upadhyaya, 2017; Sharma, 2022, pp. 195–229; Kumhar et al., 2022; Verma et al., 2022). The vernacular architecture of Jaipur city, including the havelis, exhibits significant energy efficiency features and low-carbon traditional building practices (Upadhyaya, 2017; Sharma, 2022, pp. 195–229). These buildings, with their passive climate design principles—such as thick walls, courtyards, and *jharokhas* (overhanging enclosed balconies) designed to keep interiors cool—maintain comfortable indoor temperatures without air conditioning, and are energy efficient (Agrawal et al., 2006; Upadhyaya, 2017; Sharma, 2022, pp. 215–224; Verma et al., 2022; Jha and Dave, 2023).

The traditional urbanism of Jaipur city, continuing to this day, ensures its historic buildings offer climate resilience and sustainability (Sharma, 2022, p. 224). Reducing emissions from existing buildings often has a more favorable and immediate impact on mitigating greenhouse gases than constructing new high-efficiency buildings due to the large upfront carbon expenditure of new construction (ICOMOS, 2019, p. 49). It is therefore doubly important, from a climate perspective, to conserve energy-efficient older buildings rather than compromising them in pursuit of new development projects.

Additionally, it is important to consider not only the impact of climate change on historic buildings but also the need for historic cities such as Jaipur, like all other cities, to aim for energy efficiency. Preserving the energy efficiencies that already exist in haveli structures (and perhaps even emulating them in new construction) would help to integrate traditional and modern sustainable practices (Upadhyaya, 2017; Goswami et al., 2022). Given the rapid urbanization and economic growth in Jaipur and across India, improving the energy performances of historic buildings, particularly those not originally designed as efficiently as havelis, is critical for reducing their operational carbon footprint and enhancing climate resilience (Upadhyaya, 2017; ICOMOS, 2019; Goswami et al., 2022; Choudhary et al., 2022). This can be achieved through measures such as integrating passive cooling techniques inspired by traditional architectural designs, retrofitting with energy-efficient systems, and incorporating heritage-sensitive renewable energy solutions, while ensuring modern cooling systems comply with heritage guidelines to minimize visual and structural impact. Retrofitting less efficient historic buildings, along with the preservation of havelis and their traditional energy-efficient features, presents a practical opportunity to balance heritage conservation with energy sustainability (Upadhyaya, 2016, 2017; BEE, 2018; Garg et al., 2019; BEE, 2021b,a; Choudhary et al., 2022; Sharma et al., 2022). These efforts can contribute to India's broader goals of reducing greenhouse gas (GHG) emissions, advancing renewable energy adoption, and promoting sustainable development and climate resilience in culturally significant urban environments.

India's legal and policy framework supports the reduction of energy use and GHG emissions and heritage conservation, fulfilling its international commitments under the Paris and UNESCO treaties. This framework operates across multiple levels, including constitutional provisions, national and state laws and policies, and local regulations (Nagar and Suman, 2022, p. 8; MoHUA, 2016, p. 13; DRONAH, 2021, pp. 151–207). This article examines local implementation and governance in the World Heritage site of Jaipur walled city, where practical decisions directly impact heritage conservation and energy sustainability. Effective implementation and enforcement are critical to ensuring that laws and policies achieve their intended outcomes. Analyzing the governance of Jaipur walled city is therefore essential to understanding how heritage conservation, energy measures, and sustainable development goals are being integrated into local practice.

Research on the integration of energy efficiency and renewable energy measures in historic buildings, both in India and globally, underscores the need to balance heritage preservation with modern energy sustainability demands (Upadhyaya, 2016; Choudhary et al., 2022; Trovò, 2023; Bhati et al., Forthcoming). The importance of implementing tailored energy policies, such as the energy conservation building codes, is highlighted to reduce energy consumption and promote sustainability (Chedwal et al., 2015; Yu et al., 2015, 2017). Critiques of current building regulations, particularly in Jaipur, emphasize the lack of environmental responsiveness and call for frameworks that consider local socio-economic and geo-climatic conditions (Jawaid et al., 2017, 2018). The feasibility of integrating renewable energy solutions, such as rooftop solar systems, into Jaipur's historic buildings has been explored, along with advocacy for sustainable and energy-efficient development that aligns with heritage conservation, particularly for traditional havelis (Upadhyaya, 2016, 2017). Addressing the

challenges of balancing preservation with modern energy standards in Indo-Saracenic and historic buildings requires interdisciplinary collaboration and innovative policy and technical interventions (Choudhary et al., 2018, 2022).

This article builds on this literature and contributes to the literature on energy sustainability in World Heritage sites. This study uses doctrinal legal methods, complemented by case study approach and semi-structured interviews with public officials, heritage professionals, consultants and property owners, to address the research questions: (1) How do local decision makers at public authorities and individuals interpret and implement international and national obligations to preserve cultural heritage in light of obligations to reduce energy use and greenhouse gas emissions in Jaipur walled city, a UNESCO World Heritage site? (2) What are the impact and challenges in implementing, applying, and enforcing these obligations at the local level? (3) What challenges and opportunities arise in balancing the conservation of traditional energy-efficient features with the integration of modern sustainable practices in urban heritage areas such as Jaipur walled city?

2 Methods and materials

2.1 Description of the study site

This study focuses on the walled city of Jaipur, commonly known as the "Pink city," located in Jaipur, the capital of the state of Rajasthan, India (Figure 1). Throughout this article, the study area will be referred to as "Jaipur walled city" or simply "Jaipur city." Situated in a semi-arid climate zone, according to Jaipur Master Development Plan 2025, Jaipur experiences a mean maximum temperature of 22.5°C in January and a mean maximum temperature of 40.3°C in May (JDA, 2011b, p. 191). Originally designed for 60,000 people, the walled city now houses approximately 400,000 residents and around 200,000 transient individuals within a broader urban population exceeding 3 million in Jaipur (JMCH, n.d.,n). Inscribed on the World Heritage List in 2019 (Figure 2), Jaipur city is recognized as an "exceptional urban example of indigenous city planning and construction in South Asia" (UNESCO, 2019c).[1] According to the Statement of Outstanding Universal Value, "Jaipur is an expression of the astronomical skills, living traditions, unique urban form and exemplary foresighted city planning of an 18th century city from India" (UNESCO, 2019c).

Nestled in the Aravalli Mountain range and near the Thar Desert, Jaipur city was founded in 1727 by the Rajput ruler Sawai Jai Singh II and planned and designed by chief architect Vidyadhar Bhattacharya (UNESCO, 2019c; Jain and Jigyasu, 2019; Roy et al., 2023). The city's grid-iron plan, inspired by the *Vastu Shastra* (treatise of traditional Hindu architecture based on ancient Vedic scriptures dating from 1500 BCE to 500 BCE), features a nine-*chowkris* (nine-squares) layout with broad streets crossing at right angles, creating designated large public squares called *chaupar* (Sharma, 2022, pp. 196–198; UNESCO, 2019c). Wide streets, public squares, and a grid pattern enhance air movement, vital for Rajasthan's hot, dry climate (Sharma, 2022, p. 196). The city's layout was strategically rotated 15 degrees east to align with the Aravalli hills, establishing the site's ridge as the east–west axis (Sharma, 2022, pp. 199–200). This orientation, combined with street slopes toward the north and south, facilitated efficient drainage, optimal sun penetration, and natural shading (Sharma, 2022, pp. 196 and 199–200). Indigenous trees were planted for shade (Sharma, 2022, p. 196), and buildings were constructed using local red sandstone with lime mortar to adapt to the local climate (Sharma, 2022, pp. 161, 184, 204 and 215–216). Architectural uniformity is prominent along the main bazaar streets but less consistent in secondary and tertiary streets, referred to as inner lanes and craft streets in this study, within the *chowkris* (Sharma, 2022, p. 179).

Covering 710 hectares, with a 2,205-hectare buffer zone (Figure 1) (UNESCO, 2019b), Jaipur walled city includes the city wall, nine city gates, main bazaars, shops, royal spaces, temples, public buildings, and commercial and residential units (UNESCO, 2019c). The walled city blends ancient Hindu, Mughal, and contemporary Western architectural ideas, using local stone and other locally sourced materials for its havelis and historic buildings (UNESCO, 2019c). The residential units, called havelis, are multi-storied buildings with inner courtyards that provide resistance to the harsh climate (Sharma, 2022, pp. 181 and 217–218; Goswami et al., 2022, p. 134). The establishment of *chattis karkhanas* (36 industries or workshops) enhanced economic sustainability by developing specialized craft production and preserving traditional skills through colonial and modern times (Sharma, 2022, pp. 184–185; UNESCO, 2019c). Jaipur's economy continues to rely on historical trade practices supported by crafts and folk art, such as lapidary, lac jewelry, stone idols, and miniature paintings, each with designated streets and markets (UNESCO, 2019c). The tradition of craftsmanship is maintained through 11 surviving crafts, including the ongoing practice of traditional building crafts, with local craftsmen playing a vital role in conserving historic structures (UNESCO, 2019c). Besides the World Heritage site of Jaipur city, Jaipur houses two other UNESCO World Heritage sites: the Jantar Mantar (UNESCO, 2010), an astronomical observatory in the walled city, and the Amer Fort (UNESCO, 2013), a historic hill fort renowned for its Rajput-Mughal architecture. The city is part of the popular "Golden Triangle" circuit with Delhi and Agra, attracting up to 2.7 million domestic and international tourists annually as of 2019 (Roy et al., 2023, p. 468).

2.2 Methods

2.2.1 Legal methods

This study employs doctrinal legal research to analyze the legal frameworks governing heritage conservation and the mitigation of greenhouse gas emissions and energy use in Jaipur walled city. Doctrinal research, often referred to as "black letter law," involves the identification, interpretation, and analysis of legal rules and principles derived from primary sources of law such as constitutions, statutes, regulations, judicial decisions, and policy instruments (Hutchinson and Duncan, 2012, pp. 94 and 113).

1 Jaipur city was inscribed on the World Heritage List under criteria (ii), (iv), and (vi).

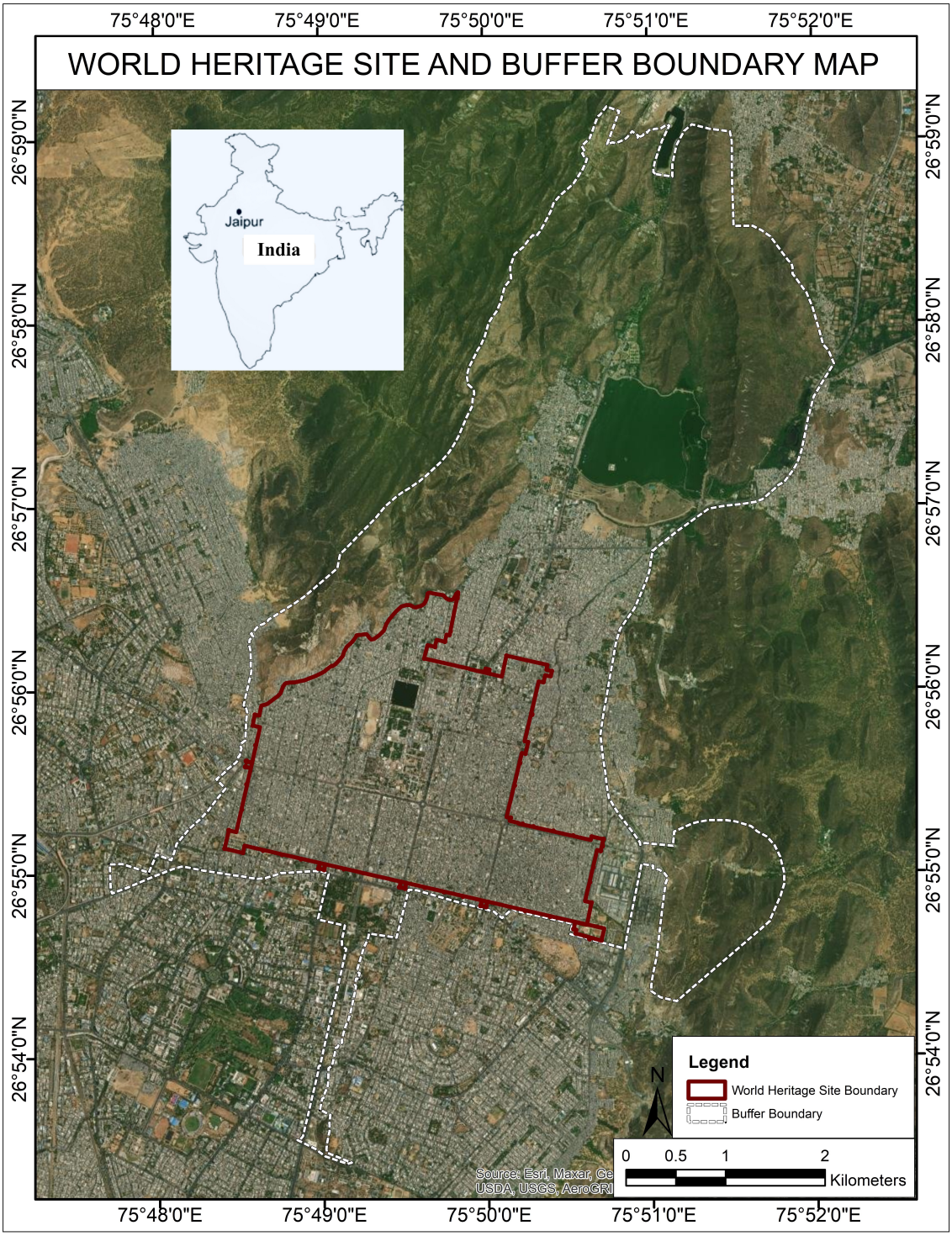

FIGURE 1
Map of the World Heritage site Jaipur walled city (red) and buffer boundary (white), with the inset showing the site's location in India (courtesy of the Jaipur Municipal Corporation Heritage).

Hutchinson and Duncan (2012, p. 101) explain doctrinal research entails the "systematic exposition of the rules governing a particular legal category, analyzes the relationship between rules, explains areas of difficulty and, perhaps, predicts future developments" in the law.

In this study, the doctrinal method is applied in a descriptive and analytical manner, grounded in the research questions that examine how local decision makers interact with existing national and international obligations. The analysis focuses on how international obligations concerning cultural heritage conservation

FIGURE 2
A World Heritage emblem, installed by the Jaipur Municipal Corporation Heritage, commemorates Jaipur city's inscription as a UNESCO World Heritage Site in 2019 (courtesy of the author).

and the reduction of energy use and greenhouse gas emissions are interpreted and implemented through national and local legal frameworks in Jaipur walled city. Primary materials used in this study include international treaties, national legislation, judicial decisions, state and local laws, and policy documents.

The doctrinal analysis identifies, interprets, and systematizes these legal texts to examine their scope, legal and institutional frameworks, and internal coherence, particularly concerning the conservation of traditional energy-efficient features and the integration of modern sustainable practices in historic urban environments such as Jaipur walled city. This mapping of institutional and legal frameworks provides the foundation for understanding the formal structures within which local decision makers operate, and clarifies the legal boundaries and opportunities for balancing heritage conservation with energy sustainability.

Moreover, the doctrinal findings serve to support the empirical inquiry of the study by providing a structured legal lens through which these actors' perceptions, interpretations, and practices, as elicited through interviews, can be assessed. This combined approach allows for a comprehensive and contextualized investigation of how international obligations are mediated through domestic law and engaged with, or at times contested, at the local level in Jaipur walled city.

2.2.2 Case study and interviews

In addition to doctrinal research, this study employs empirical legal research to investigate how international and national obligations concerning cultural heritage conservation and the reduction of energy use and greenhouse gas emissions are interpreted, implemented, and experienced at the local level in Jaipur walled city. Empirical legal research systematically collects, analyzes, and interprets facts "in relation to law and its functioning," and relies on observation and experience rather than purely theoretical reasoning (Bhat, 2020, pp. 303 and 304). While doctrinal research offers an internal perspective of the law, empirical legal research provides an external view by examining how these legal frameworks work in practice, including, how institutions function, how laws are applied and implemented, and how these laws impact the decisions, perceptions, and experiences of public officials and other relevant stakeholders (Argyrou, 2017, p. 97; Bhat, 2020, p. 304).

To collect empirical data, the study adopts a case study and interview approach. A case study design is appropriate to address "how" questions about the law's functioning, particularly where the researcher has little or no control over behavioral events, and where the focus is on contemporary practices situated in their real-world context (Yin, 2018, p. 33, Webley, 2016). Consistent with this approach, the study examines how international and national obligations for heritage conservation and energy sustainability—particularly aimed at reducing GHG emissions and energy consumption—are implemented and applied by local decision makers in Jaipur walled city.

This study on Jaipur walled city forms part of the author's doctoral research project at Uppsala University, which investigates the implementation and application of international, national, and local legal frameworks for cultural heritage conservation and energy sustainability in World Heritage cities. Additionally, as a recently inscribed UNESCO World Heritage site in a rapidly urbanizing global South context, Jaipur walled city, like all other historic towns and cities, provides a valuable setting to explore the local application and implementation of international and national obligations, alongside sustainability goals. The use of a case study approach allows for a detailed and contextualized investigation of how legal frameworks function in practice at the local level, and how these laws influence perception, decision making, and practices of public officials and relevant stakeholders, particularly in balancing heritage conservation with energy sustainability.

Semi-structured interviews were employed as a method of qualitative data collection in this study. Interviews are a well-established technique in empirical legal research and provide access to individuals' experiences, perceptions, and interpretations of law as it operates in practice (Webley, 2010). This method was chosen for its adaptability, enabling participants to express their perspectives and share detailed personal experiences (Webley, 2010).

Participants were selected through a mix of purposive and snowball sampling, in line with qualitative sampling

methods aimed at identifying individuals who could provide detailed and meaningful insights while ensuring diversity of perspectives (Webley, 2010, p. 934). Purposeful sampling targeted individuals with decision-making authority or significant expertise concerning heritage conservation, energy retrofits, and sustainable development in Jaipur walled city (Webley, 2010, p. 934). Snowball sampling further facilitated the identification of additional participants through recommendations from initial contacts, thus ensuring a comprehensive inclusion of knowledgeable public officials, professionals, and stakeholders (Webley, 2010, p. 934). Interviewees comprised representatives from state and municipal public authorities responsible for heritage conservation, along with conservation professionals, architects, consultants, and property owners with relevant expertise and experience.

An interview guide was developed to frame and tailor questions to different categories of participants (Appendix 1). This guide focused on participants' interpretations of international and national legal obligations, experiences with local legal and institutional frameworks, and perceptions of challenges and opportunities in balancing cultural heritage conservation with the mitigation of greenhouse gas emissions and energy use. Questions for public officials, professionals, and consultants concentrated on definitions of cultural value, tangible and intangible aspects of heritage, institutional roles, permit procedures, policy and legal implementation challenges, coordination among departments, the impact of World Heritage status on heritage management and sustainable development efforts, capacity building, and future directions for sustainability initiatives. Questions for property owners explored personal experiences with heritage management and ownership, awareness of legal requirements and permit procedures, experiences with energy efficiency and sustainable energy measures, and barriers or incentives encountered in practice for adopting sustainable practices. Open-ended questions allowed participants to elaborate on their experiences while maintaining focus on the study's research objectives.

The roles and responsibilities of these decision makers are further elaborated in the following section. A total of 9 in-depth semi-structured interviews were conducted, including one group interview involving three City Planners (Planners 1, 2, and 3), with each session averaging about 75 min. All interviews were conducted onsite in 2023 and audio recorded with the informed consent of the participants. Conducting interviews onsite allowed for direct observation of how cultural heritage is conserved, adapted, and negotiated in practice, complemented by walking the city and interacting with local community members through both formal and informal encounters during fieldwork.

Interviews were conducted primarily in English, with the exception of one interview conducted in Hindi. All interviews were transcribed into English written text by the author and systematically reviewed to identify emerging themes and patterns relevant to the research questions of this study. This transcription and analysis process was complemented by field notes taken during interviews and site visits, which were consulted repeatedly to provide to cross-validate emerging interpretations and provide additional context.

Identified themes include: the impact of World Heritage designation in light of international commitments to mitigate energy use and greenhouse gas emissions; interaction between laws and their implementation at the local level; challenges and opportunities in balancing heritage conservation with energy sustainability; the need and desire for integrating energy efficiency and sustainable energy measures; the importance of aligning traditional architectural practices and building techniques with sustainable strategies; voluntary and policy-driven measures to further support the conservation and sustainability for public officials and local residents; and future directions for law and policy reforms. These themes were identified through a systematic review of interview transcripts and field notes, closely aligned with the study's research objectives, and form the basis for the doctrinal and empirical analysis presented in the Results and Discussion section.

Thematic analysis focused on understanding how local decision makers and relevant stakeholders interpret and apply international and national legal obligations concerning cultural heritage conservation and the reduction of greenhouse gas emissions and energy use within Jaipur walled city; how these actors perceive and experience the impact of these legal frameworks on their actions and decisions; what practical challenges they encounter in local implementation and enforcement; and how they perceive tensions and opportunities in balancing the conservation of traditional energy-efficient architectural features with the integration of modern sustainable practices within the historic urban environment.

To build a comprehensive and context-sensitive analysis, this study draws on multiple sources of evidence, integrating doctrinal analysis of binding and non-binding legal norms, a systematic review of relevant policy documents and academic literature, and semi-structured interviews with local decision makers, to investigate both the legal norms and their on-the-ground application by local decision makers in Jaipur walled city. This triangulated approach strengthens the study's construct validity by allowing cross-verification of findings across distinct types of data, as well as allowing legal texts, policy developments, and lived experiences to be examined in relation to one another (Webley, 2010, 2016, p. 3; Argyrou, 2017, p. 105).

Key legal documents analyzed include local regulations such as the By-laws 2020 and Regulation 2022, as well as applicable state, national and international legal frameworks. The most important of these are explained in the next section, with local regulations enacted post-designation analyzed in greater detail in the Results and Discussion section. The doctrinal analysis of international and national obligation, as well as local by-laws and regulations, contextualizes the interview findings by examining the relationship between law and its application and implementation in practice. By integrating interview data with doctrinal and documentary analysis, this study aims to offer a holistic exploration of the research questions.

2.3 Researcher positionality and limitations of this study

The author of this study is an Indian- and U.S.-trained lawyer, currently pursuing doctoral research in environmental law at Uppsala University, Sweden. Prior to beginning doctoral studies, the author practiced law at the Rajasthan High Court in India and

worked with government departments in Jaipur, which provided direct exposure to the local legal, administrative, and cultural context. The author's background and familiarity with Indian legal systems, institutional frameworks, and local language (Hindi) facilitated meaningful and informed access to public officials and relevant stakeholders during fieldwork. Throughout the research process, particular care was taken to maintain a reflective and critical approach and to balance contextual familiarity with objective analysis.

This study also has certain limitations. As a qualitative empirical case study centered on Jaipur walled city, the findings provide in-depth, context-specific insights but are not intended for statistical generalization. Nevertheless, the findings provide relevant insights for other historic towns and cities, particularly those situated in rapidly urbanizing contexts and characterized by similar tensions between heritage conservation, sustainability goals, and evolving legal frameworks.

Although the interviews were designed to capture a diverse range of perspectives from public officials, conservation professionals, consultants, and property owners, the scope of the study necessarily focused on participants directly engaged in decision-making and governance concerning heritage conservation, energy transition, and sustainability in Jaipur walled city. Broader community viewpoints beyond these key groups are acknowledged but were not the focus of this investigation. Furthermore, given the dynamic nature of heritage governance and energy policy in India, legal and institutional frameworks may continue to evolve beyond the study period. This study captures the legal and practical context as it existed during fieldwork in 2023 and offers a grounded basis for understanding the challenges and opportunities present during this phase of Jaipur walled city's development.

2.4 Laws and decision makers

The management of Jaipur walled city as a World Heritage site involves a broad spectrum of stakeholders, ranging from international organizations to local-level participants. These include national, state, and municipal authorities, non-government organizations, heritage experts, consultants, and property owners or users. Together, these actors contribute to developing and implementing strategies for heritage preservation and sustainable urban development in Jaipur walled city.

This section provides an overview of the multi-tiered legal and policy frameworks—spanning international, national, state, and local levels—that guide heritage conservation efforts, GHG emissions reduction, and initiatives for energy efficiency and renewable energy integration. It also explains the roles and responsibilities of key decision makers responsible for interpreting and applying these frameworks.

2.4.1 The international legal framework

Adopted by UNESCO in 1972, the Convention concerning the Protection of the World Cultural and Natural Heritage, or World Heritage Convention (WHC), aims to identify, protect, and conserve cultural and natural sites of Outstanding Universal Value (OUV) (UNESCO, 1972). Ratified by 196 nations, including India (UNESCO, 2024), the WHC created the World Heritage List (WHL), which currently includes 231 natural, 952 cultural, and 40 mixed heritage sites, 43 of which are in India (UNESCO WHC, 2024).

Recognized as UNESCO's flagship program, the WHC links nature conservation with cultural heritage preservation (Ringbeck, 2022; Bhati and Epstein, 2023). To nominate a site to the UNESCO WHL, member states compile and submit inventories of properties that fulfill at least one of the ten criteria for OUV (UNESCO, 1972, arts. 1–3; UNESCO, 2023b, paras. 77–78 and 120–168; Bhati et al., Forthcoming). Once inscribed, state parties assume responsibility for protecting and transmitting the site's heritage to future generations. This involves incorporating heritage conservation into national planning frameworks and implementing comprehensive legal, technical, and financial strategies to ensure its protection (UNESCO, 1972, arts. 4–5; UNESCO, 2023b, paras. 4–9, 15 and 45–119). The WHC underscores the importance of international cooperation and support for conservation efforts (UNESCO, 1972, arts. 6–7), with parties required to report their progress, successes, and challenges through established monitoring mechanisms, including periodic reporting and reactive monitoring processes (UNESCO, 1972, art. 29; UNESCO, 2023b, paras. 169–176, 190–191 and 199–210). The WHC provides for international cooperation and assistance in the form of financial, technical, scientific, and educational aid to support national conservation efforts (UNESCO, 1972, arts. 6–7 and 15–19; UNESCO, 2023b, paras. 211–257 and 280–290).

In 2007, UNESCO recognized climate change as a significant and growing threat to World Heritage sites and their associated communities (UNESCO, 2007b,a). The Operational Guidelines for the implementation of the WHC emphasize the importance of the UNFCCC in protecting World Heritage sites (UNESCO, 2023b, para. 44). This acknowledgment emphasizes the crucial role of global initiatives in curbing GHG emissions and tackling the impacts of climate change. The 2015 Paris Agreement, established under the UNFCCC and signed by 195 parties, including India, sets ambitious goals, including limiting the global average temperature increase to well below 2°C above pre-industrial levels, with efforts to cap it at 1.5°C to mitigate climate risks (UNFCCC, 2015; United Nations, 2024). The Paris Agreement integrate goals for climate mitigation, adaptation, and sustainable development and underscores the importance of equitable implementation through the principle of common but differentiated responsibilities, taking into account varying national circumstances and capacities.

UNESCO has increasingly emphasized the integration of climate actions and sustainable development within its heritage conservation frameworks. The World Heritage Centre, which provides coordination and guidance on World Heritage matters, has issued several recommendations to harmonize heritage conservation with global climate and sustainability objectives. In 2015, UNESCO introduced a policy document that incorporated sustainable development into the WHC practices among member states, prioritizing environmental sustainability, inclusive social progress, and equitable economic growth (UNESCO, 2015; U. N. General Assembly, 2015). The 2023 updated UNESCO

Policy Document on Climate Action for World Heritage further encourages the adoption of low-carbon management strategies and climate-responsive practices at World Heritage sites, ensuring alignment with global agreements such as the UNFCCC, the Paris Agreement, and the 2030 Agenda for Sustainable Development (UNESCO, 2023a). Additionally, the World Heritage Centre highlights that renewable energy initiatives and World Heritage conservation can complement each other, provided such projects are carefully planned and implemented to safeguard the OUV of listed properties (UNESCO WHC, n.d.).

The World Heritage Convention and the Paris Agreement are legally binding international legal frameworks. However, under India's dualist approach to international law, treaties are not directly enforceable domestically unless incorporated through legislation by Parliament under Article 253 of the Constitution (Sehrawat, 2021). Indian courts, as seen in *Vishaka v. State of Rajasthan*, have affirmed that international norms can be used to construe domestic law when they do not conflict with domestic law and address a gap in the domestic legal framework (Hegde, 2010; Sehrawat, 2021). The Supreme Court of India has frequently referenced international law to interpret and expand the scope of constitutional rights and domestic law, particularly in environmental and human rights cases (Hegde, 2010; Chaturvedi, 2021).

The obligations of the Paris Agreement and the World Heritage Convention are not directly legally enforceable in India without corresponding domestic law. Nonetheless, Indian courts and officials may interpret statutory or constitutional provisions predating a treaty to ensure they are consistent with its requirements. In the recent *M.K. Ranjitsinh* (2024) judgment, the Indian Supreme Court acknowledged the absence of comprehensive legislation on climate change in India, despite existing government policies, rules, and regulations addressing its adverse effects. The Court affirmed that this absence does not negate the people's right to protection from climate impacts, declaring the right to be free from adverse effects of climate change a fundamental right under Article 21 (right to life and personal liberty) and Article 14 (right to equality) of the Indian Constitution (Ranjitsinh, 2024). This judgment suggests that obligations under the Paris Agreement, particularly those related to protection from adverse climate effects, could become enforceable through judicial interpretation. Similarly, the National Green Tribunal holds that the climate change issues are addressed during the impact assessment process carried out by authorities under the Environment (Protection) Act 1986 and observed that the Paris Agreement and other international protocols are reflected in the policies of the Government of India and are taken into consideration when granting environment clearances (Ridhima Pandey, 2019).

The Paris Agreement and the World Heritage Convention do not impose explicit or legally binding obligations regarding the implementation of energy efficiency or renewable energy measures in historic buildings within World Heritage sites (Lixinski and Tzevelekos, 2020; Bhati et al., Forthcoming). However, Indian courts have increasingly emphasized the importance of interpreting national laws in harmony with international legal commitments.

2.4.2 The national legal framework

India aligns its domestic laws and policies with global frameworks on heritage conservation, climate action, and sustainable development. The Indian Constitution mandates the State to protect important monuments and historic sites and to conserve the environment (India, 1950, arts. 48A and 49). The Constitution also outlines the fundamental duties of citizens and includes the duties to value and preserve cultural heritage and protect the natural environment [India, 1950, arts. 51A (f) and (g)]. Key legislation supporting international and constitutional mandates includes the Ancient Monuments and Archaeological Sites and Remains Act of 1958, which preserves ancient monuments and archaeological sites, regulates excavations, and protects nationally important artifacts.

India, as a party to the Paris Agreement, has pledged to Nationally Determined Contributions (NDCs) to reduce emissions and contribute to global climate goals. In 2022, India updated its NDCs for the period up to 2030, committing to reduce the emission intensity of its GDP by 45% from 2005 levels, achieve approximately 50% of cumulative electric power installed capacity from non-fossil fuel-based energy sources, and pursue the long-term goal of reaching net-zero emissions by 2070 (GOI, 2022).

To address climate change, India has introduced plans and policies such as the National Action Plan on Climate Change (NAPCC) (MoEF and CC, n.d.), State Action Plans on Climate Change (SAPCC) (MoEF and CC, n.d.1.), and the country's long-term low greenhouse gas emission development strategy (LT-LEDS) (MoEF and CC, 2022). The NAPCC, introduced in 2008, focuses on climate adaptation, mitigation, energy efficiency, and natural resource conservation through eight national missions (MoEF and CC, n.d.). Additionally, the Indian government's Welfare Schemes, such as the Smart Cities Mission, India Cooling Action Plan, and Heritage City Development and Augmentation Yojana integrate heritage conservation and sustainability into urban planning (MoHUA, n.d.; MoEF CC, 2019).

India lacks comprehensive umbrella legislation to address climate change concerns, relying instead on environmental and sectoral laws that predate climate change discourse. The Environmental (Protection) Act 1986 empowers the Central Government to prevent environmental pollution and address specific environmental issues. The Energy Conservation Act 2001 and its 2022 amendment promote energy efficiency, conservation, carbon trading, sustainable building practices, and renewable energy use. The Electricity Act 2003 restructures the power sector, promotes competition and renewable energy, protects consumer interests, and regulates the electricity industry. However, these laws lack an explicit focus on greenhouse gases and primarily emphasize environmental governance, regulation, and efficiency, leaving climate action and emission reduction as "incidental and peripheral" considerations (Bhushan and Gopalakrishnan, 2021, p. 56; Purkayastha and Sikka, 2024).

The Bureau of Energy Efficiency (BEE), established under the Energy Conservation Act, supports policy development and has promulgated the Energy Conservation Building Code 2017 for commercial buildings and the Residential Energy Conservation Building Code (Eco Niwas Samhita) Part I in 2018 and Part II in 2021 for residential buildings (BEE, 2018,

2021b,a). Sustainable design and construction practices are guided by the National Building Code 2016 (NBC) and Model Building Bye-Laws 2016 (MBBL). The NBC, by the Bureau of Indian Standards, sets national guidelines for construction safety, health, and environmental standards (BIS, 2016). Part 11 focuses on energy-efficient buildings and passive design for climate comfort. The MBBL, from the Ministry of Housing and Urban Affairs, provides guidelines for heritage conservation, energy efficiency, and cooling strategies for urban local bodies to adopt (MoHUA, 2016). Part 12 covers listing heritage sites, grading buildings, adaptive reuse, architectural harmony, forming a Heritage Conservation Committee, and preventing unauthorized changes. Parts 10 and 14 promote energy efficiency in HVAC systems and renewable energy use. An addendum to the MBBL, the Cooling Action Plan, outlines strategies to reduce energy demand for cooling and integrate passive cooling (MoHUA, 2016a).

2.4.3 State and local legal frameworks

The Rajasthan Monuments, Archaeological Sites and Antiquities Act of 1961 (with amendments in 2006 and 2007) and the Rajasthan Monuments, Archaeological Sites and Antiquities Rules of 1968 provide for the preservation, protection, and maintenance of, as well as regulate, ancient and historical monuments, archaeological sites, and antiquities at the state level. The architectural control on the urban character of Jaipur is guided and governed by the Jaipur (Building) By-laws 1970 and the Rajasthan Municipalities Act 2009 (with amendments). These laws have been instrumental in preserving the historical architectural form of the bazaars in Jaipur walled city (Jain and Jigyasu, 2019; UNESCO, 2019a). Additionally, DRONAH (Development and Research Organization for Nature, Arts and Heritage) and JVF (Jaipur Virasat Foundation) have developed specific architectural and façade control guidelines for the city's bazaars (Jain and Jigyasu, 2019; UNESCO, 2019a). The Jantar Mantar is protected and managed through the Interpretation, Use and Visitor Management Plan for Jantar Mantar, Jaipur, prepared by DRONAH for the Rajasthan Department of Archaeology and Museums (Jain and Jigyasu, 2019; UNESCO, 2019a). The forested buffer zone areas surrounding the walled city are regulated under the Rajasthan Forest Act 1953 and guided by the Rajasthan State Forest Policy 2010 and 2023.

Jaipur's Master Development Plan (MDP) 2025 designates the walled city as a special area, requiring a detailed heritage management plan for its conservation and development (JDA, 2011a, pp. 96–97). In 2007, the Jaipur Heritage Committee, established by the Rajasthan government, developed the Built Heritage Management Plan in collaboration with DRONAH and JVF (Jain, 2020, p. 52). Initially listing 1,096 heritage structures under this plan, this number grew to approximately 1,500 by 2019 during the World Heritage nomination process (Jain, 2020, p. 55).

The Jaipur Smart City Plan 2016 is developed under the national Smart City Mission (MoHUA, n.d.1; JSCL, n.d.). Jaipur's Smart City Plan, developed in consultation with its citizens, prioritized heritage planning for the walled city area (Jain and Jigyasu, 2019, pp. 293–294). The plan focuses on conserving and developing heritage buildings and areas while incorporating sustainable and smart solutions to improve visitor experiences (JSCL, n.d.).

While all these laws and plans have successfully protected heritage buildings and sites and "helped Jaipur walled city retain its authenticity in terms of material, color, spirit, and location" (Jain and Jigyasu, 2019, p. 287), they lack a specific focus on the entire walled city area. This includes numerous non-listed havelis and buildings in the inner lanes and craft streets that also merit protection, along with detailed guidelines for architectural control and micro-level building activities, such as incorporating energy efficiency and renewable energy measures.

Following Jaipur city's World Heritage designation, Jaipur Municipal Corporation Heritage enacted Jaipur Nagar Nigam Heritage (Walled City) Heritage Conservation and Protection Byelaws—2020 (By-laws 2020) and Nagar Nigam Jaipur Heritage Regulation—2022 (Regulation 2022) to conserve the cultural heritage of the UNESCO-designated entire walled city area and its buffer zone (JMCH, 2020, 2022). These local frameworks regulate property construction, usage, preservation, restoration, and modification, ensuring the protection of heritage buildings while promoting sustainable development in Jaipur walled city. The By-laws 2020 and Regulation 2022 will be discussed in greater detail in the Results and Discussion section.

2.4.4 Decision makers

This section outlines the key stakeholders involved in the governance, conservation, and sustainable development of Jaipur walled city. It includes national, state, and local agencies, as well as non-governmental organizations, private entities, and individuals.

- Archaeological Survey of India (ASI) (MoC, n.d.):

A national agency under the Ministry of Culture, ASI is responsible for archaeological research and the conservation of cultural monuments and sites. Currently, it maintains 163 monuments/sites in Rajasthan, including *Pundrik ji-ki* Haveli in Jaipur walled city, known for its mid-eighteenth-century murals and wall paintings.

- Rajasthan Department of Archaeology and Museums (GoR, n.d.):

This state-level department, headquartered in Jaipur, oversees the declaration, conservation, and management of archaeological sites, museums and historic buildings and spaces. It oversees a number of historic sites and museums in Jaipur, such as the city wall, city gates, Hawa Mahal, Jantar Mantar, Sawai Man Singh Town Hall, Amber Palace (outside the walled city), Nahargarh Fort (outside the walled city), and Albert Hall Museum (outside the walled city but within UNESCO buffer zone).

- Jaipur Nagar Nigam Heritage (Jaipur Municipal Corporation Heritage) (JMCH, n.d.2):

This municipal body is a heritage division of Jaipur Municipal Corporation, established following Jaipur city's World Heritage designation. Its role is to regulate, maintain, and conserve built heritage in Jaipur walled city and buffer zone areas,

while also managing administrative and civic responsibilities that extend beyond the walled city. Jaipur Municipal Corporation Heritage manages urban planning, implements national, state and local laws and regulations, and promotes heritage conservation alongside sustainable development. Jaipur Municipal Corporation Heritage, with its three-tier heritage management system, is the primary permit-granting authority for making changes in listed and other culturally valuable buildings in Jaipur walled city.

- Rajasthan Department of Town Planning (GoR, n.d.1):

The Town Planning Department, part of Rajasthan's Ministry of Urban Development and Housing, is led by the Chief Town Planner and oversees the state's urban planning. Its main objective is to guide the physical development of towns through master plans, sector plans, and technical advice, acting as a central coordinator between local municipal corporations and state government in matters of urban development and heritage management.

- Jaipur Royal Family Estate Management (JRFE, n.d.):

The Royal Family manages its properties, including the City Palace, Jaigarh Fort, Maharaja Sawai Man Singh II Museum, restaurants, schools, and other enterprises. The City Palace, located in the heart of the walled city, serves as both a royal residence and a tourist attraction, housing Maharaja Sawai Man Singh II Museum and other culturally valuable buildings. Supported by the Maharaja Sawai Man Singh II Museum Trust and the Jaigarh Public Charitable Trust, the Family conserves these historic sites and the city's craft and folk art independently of the government.

- Jaipur Smart City Limited (JSCL) (JSCL, n.d.):

The National Smart Cities Mission, implemented by the Ministry of Housing and Urban Affairs in collaboration with state governments, includes 100 selected cities, among which is Jaipur (MoHUA, n.d.1). JSCL aims to enhance the quality of life through innovative and inclusive solutions. Completed and ongoing projects include façade improvement in markets, restoration of façade work in Heritage Walk areas, traffic management, and the conservation of historic buildings and areas in Jaipur.

- Local Residents, Professionals, and Consultants:

In Jaipur walled city, the involvement of property owners, residents, users, experts, and consultants is essential to achieving a balance between heritage preservation and sustainable development. Property owners and residents make decisions on how to adapt and maintain havelis and other historic buildings, all while adhering to regulatory frameworks designed to protect the city's cultural and architectural heritage. Architects, urban planners, consultants, and conservation professionals contribute technical and legal expertise tailored to Jaipur's built heritage to ensure that traditional architectural designs and building materials are harmonized with contemporary needs. Jaipur city's conservation efforts are further supported by non-governmental organizations such as Indian National Trust for Art and Cultural Heritage (INTACH), DRONAH, and JVF. These organizations foster collaboration among stakeholders and advocate for holistic approaches to conservation that prioritize both community wellbeing and sustainable heritage management.

The study involved representatives from these groups as interviewees, and their details are presented in Table 1.

3 Results and discussion

3.1 Evolution of urban planning in Jaipur city: from historic design principles to modern framework and impact of world heritage listing

In the early 18th century, chief architect Vidyadhar, collaborating with experts in astronomy and Hindu astrology, designed Jaipur city using *Vastupurusha Mandala* principles tailored to the local climate (Sharma, 2022, p. 196). King Sawai Jai Singh II incentivized craftsmen and merchants with free plots and financial aid, resulting in the construction of havelis and buildings using local materials (Sharma, 2022, pp. 161, 184, 204, and 215–216). This uniformity in building materials minimized carbon footprint (Sharma, 2022, p. 179), integrating natural thermal comfort and enhancing energy efficiency (Sharma, 2022, p. 158). Initially, Vidyadhar's master plan mandated building plan approvals from him and specified local building materials and construction technologies to ensure standardized dimensions for streets, plinths, entrances, and windows (Sharma, 2022, p. 196).

Post-independence, the governance of heritage conservation in Jaipur city has shifted to multiple administrative and legislative bodies under the Rajasthan government. However, overlapping responsibilities among architects, planners, and civil servants created significant coordination challenges (City Planners, World Heritage Expert). National and state laws protecting cultural heritage covered only a limited number of monuments and protected historic structures and don't fully extend to the entire walled city area (City Planners). Simultaneously, state and local urban planning and municipal regulations focused on the conservation of street-facing façades and tourist-frequented spaces and overlooked broader sustainability concerns, such as energy conservation and urban heritage management, in Jaipur walled city (World Heritage Expert, Owner1, City Planners).

Efforts to integrate heritage management into urban planning, the Jaipur Master Development Plan 2025 called for the creation of a Special Area Master Development Plan and a Special Area Heritage Plan for special areas such as Jaipur walled city, which remains undeveloped (City Planners). Despite these shortcomings, non-governmental conservation organizations such as INTACH, DRONAH, and JVF have played a critical role in preparing management plans, architectural control guidelines, and World Heritage nominations. However, limitations remain, for example, the historic building inventories compiled by INTACH for the walled city area primarily serve as reference lists and do not offer adequate legal protection for these buildings (Architect and Heritage Consultant, World Heritage Expert, Owner1).

Before Jaipur walled city's UNESCO designation, heritage conservation and sustainable management efforts primarily focused on protecting individual buildings and monuments (City Planners). The World Heritage listing in 2019 prompted the enactment of the By-laws 2020 and Regulation 2022, which introduced detailed regulations and expanded protection to include the entire UNESCO-designated walled city and its buffer zone (City Planners). Additionally, the Jaipur Municipal Corporation established a dedicated heritage division, Jaipur

TABLE 1 Research participants.

Role/Job	Reference in text	
Additional Chief Town Planner, Jaipur Nagar Nigam Heritage (Jaipur Municipal Corporation Heritage)	Planner1	Combined as city planners
Retired Additional Chief Town Planner, Town Planning Department, Government of Rajasthan and coordinator at Jaipur Nagar Nigam Heritage (Jaipur Municipal Corporation Heritage)	Planner2	
Assistant Town Planner, Jaipur Nagar Nigam Heritage (Jaipur Municipal Corporation Heritage)	Planner3	
Superintendent, Albert Hall Museum, Department of Archaeology and Museums, Government of Rajasthan, Jaipur.	Museum1	
Director, Maharaja Sawai Mansingh II Museum, Jaipur, Director, Jaigarh Public Charitable Trust, Jaipur Managing Trustee, Jaipur Virasat Foundation, and Executive Committee President, ICOMOS India (2023–2026)	Museum2	
Assistant Director at the Jaigarh Public Charitable Trust (Jaigarh Fort) and former employee of Jaipur Municipal Corporation Heritage.	Architect and Heritage Consultant	
Director of DRONAH, Gurugram, Haryana, Vice President of ICOFORT State Convener for INTACH-Haryana Advised UNESCO offices across Asia Represented India on the UENSCO World Heritage Committee (2012, 2015, and 2023)	World Heritage Expert	
Conservation Advisor, Jaipur Smart City Limited, Jaipur, India and empaneled with State Archaeology and Museums, ASI (Archaeological Survey of India), Tourism Department, Rajasthan.	Conservation Architect and JSCL Advisor	
Private building conservation and energy efficiency consultant	Architect and Energy Consultant	
Long-term resident and owner of "Jaipur Haveli", also known as Haveli Patnawala—a listed heritage property located in Jaipur walled city.	Owner1	
Long-term resident and owner of "Khatu Haveli"—a listed heritage property located in Jaipur walled city. This haveli was featured in the 2016 BBC documentary "*The Real Marigold Hotel*."	Owner2	

Municipal Corporation Heritage, within Jaipur walled city. This new division significantly enhanced cultural heritage conservation and sustainable development initiatives, aligning them more closely with international objectives.

India follows a dualistic legal system, where the responsibility for incorporating international law into domestic practice lies with the parliament, and officials enforce Indian laws rather than international agreements directly. This approach is consistent with the practices of other World Heritage sites in countries with dualistic legal systems, such as Sweden (Bhati et al., Forthcoming). At the municipal level, the enactment of the By-laws 2020 and Regulation 2022, particularly following Jaipur walled city's World Heritage designation, reflects efforts to align local policies with the recommendations of the World Heritage Committee and UNESCO officials. Interviewed officials and heritage professionals frequently referenced international objectives related to heritage conservation and sustainable development, underlining the indirect influence of global frameworks on local governance. Additionally, the Indian Supreme Court has often interpreted constitutional and domestic legal provisions in ways that reflect international commitments, showcasing how international law indirectly yet significantly influences domestic legal interpretations in India.

The World Heritage listing has expanded local legal protection measures and initiatives by municipal authorities, particularly regarding the exterior appearance of buildings and renovation projects along the main bazaars and tourist-frequented areas (Owner1, City Planners, Conservation Architect and JSCL Advisor, Museum1). Increased awareness and responsibility among public officials, consultants, property owners, and local residents have enabled advocacy for heritage conservation (City Planners, Owner2, Architect and Heritage Consultant), though some argue that local heritage laws lack enforceability (Museum2, World Heritage Expert). City Planners acknowledged that the World Heritage designation entails responsibilities, requiring officials to report their heritage conservation efforts to central government departments and submit periodic and state of conservation updates to UNESCO.

While the listing has brought positive changes, it has also exposed underlying issues. World Heritage Expert noted that the goal behind Jaipur city's World Heritage designation is to spotlight its conservation needs at international heritage conservation platforms such as UNESCO, stating, "[World Heritage Listing] is really to get [Jaipur walled city] back to its original [state] or not lose more of its values." However, international influences have sometimes led local authorities to focus on preserving façades in main bazaars and monuments, overlooking the preservation of energy-efficient traditional practices in buildings situated in inner lanes and craft streets (Museum2, World Heritage Expert). The By-laws 2020 and Regulation 2022 have expanded the scope of heritage protection in Jaipur walled city, but their implementation has been marred by inconsistencies and misuse. Owner1 highlighted the disparity between the outward aesthetic improvements of the main bazaar areas and the lived experience within the walled city's core. Participants noted the neglect of the inner lanes away from tourist-frequented areas, which are vital to the city's living heritage and crafts and folk art traditions but are currently deteriorating

rapidly due to limited resources, inadequate maintenance, and a lack of prioritization in conservation efforts (Owner1, Museum2, World Heritage Expert, Architect and Heritage Consultant, City Planners). Additionally, residents and stakeholders raised concerns regarding post-inscription changes in the walled city, including parking restrictions, traffic congestion, and limitations for making changes to havelis and other buildings (Museum1, Museum2, Owner1, Owner2).

3.2 Complexity of applying and implementing laws in Jaipur city

International frameworks, such as the Paris Agreement and UNESCO treaties, shape the context within which Indian officials enforce domestic laws. In Jaipur walled city, as in other World Heritage sites (Bhati et al., Forthcoming), various property owners and officials make decisions about changes to buildings, navigating a range of national laws, policies, and local regulations. These include provisions for heritage buildings, heritage conservation, environment protection, building codes for climate-responsive designs and energy efficiency measures. The overlapping responsibilities and coordination required across multiple government departments often make these legal frameworks challenging to interpret and implement for both officials and property owners.

Jaipur Municipal Corporation Heritage is primarily responsible for the conservation and management of built heritage and public spaces within the walled city (Planner1, Planner3). Additionally, other key departments play crucial roles in preserving cultural heritage in Jaipur walled city, including the Department of Archaeology and Museums, responsible for archaeological sites and protected monuments and buildings; the *Devasthan* Department, managing and ensuring the smooth functioning of temples, monasteries, and religious sites; the Tourism Department, making policies and decisions pertaining to tourism management (World Heritage Expert). Conservation Architect and JSCL Advisor explained that Jaipur Smart City Limited, as part of India's Smart City Mission, implements specific projects. Citizens collectively voted for heritage planning in the walled city, leading to its selection for area-based development with a goal to preserve the historic urban character through a series of conservation and renovation interventions (Jain and Jigyasu, 2019, pp. 293–294).

The interplay between architects, planners, officials, advisors, and other agencies in Jaipur walled city reveals both opportunities and challenges for heritage conservation and management. While these stakeholders possess the technical expertise and authority to implement conservation measures, their overlapping responsibilities often lead to inefficiencies and misaligned priorities. Participants highlighted the coordination challenges among various agencies responsible for conserving historic buildings and ensuring sustainable management. For instance, Museum1 explained that while ownership of the fort wall within the walled city lies with JMCH, it falls under their jurisdiction as a protected monument. They stated that "any necessary paintwork or modification to the wall's gates requires permission from our department." Coordination failures have resulted in unsuccessful projects, such as the efforts to install solar panels at Albert Hall Museum through a smart city project which never progressed beyond the discussion (Museum1). Similarly, misaligned efforts disrupted heritage walk projects, with the Public Works Department installing water pipes shortly after cobblestones had been laid (Architect and Heritage Consultant).

According to Planner2, there is a need for improved coordination among different departments and authorities at both the state and national levels. Regulation 2022 mandates that all departments submit project applications to the Heritage Cell, a specialized heritage management committee within the Jaipur Municipal Corporation Heritage, to ensure compliance with UNESCO World Heritage norms (Planner3) (JMCH, 2022, § 2). However, Planner2 expressed concerns about the practical implementation of these measures, noting that public officials and departments continue to leverage overlapping responsibilities across agencies to shift blame and evade accountability.

Heritage assets (JMCH, 2020, § 3.9) in Jaipur walled city are categorized into three grades under the By-laws 2020: Grade I (national and state importance), Grade II (state and local importance), and Grade III (local importance) (JMCH, 2020, § 6). Grade I buildings are subject to stringent preservation measures, allowing only necessary interventions to extend their lifespan while preserving their visual integrity and surrounding environment. Grade II and III buildings permit internal modifications and adaptive reuse, provided the exterior remains unchanged. However, Architect and Heritage Consultant emphasized holistic conservation requires a broader perspective, acknowledging the subjective and community-driven nature of heritage value attribution. Simplistic grading assessments, while useful for categorization, may undervalue certain traditional structures, such as havelis, that lack formal grading or architectural distinction but hold important cultural and energy conservation values (Museum2). This oversight risks neglecting opportunities for adaptive reuse, which could repurpose these structures for contemporary needs while leveraging their energy-efficient design to support sustainable heritage management.

The By-laws 2020 established a three-tier heritage management system, comprising the State Heritage Committee, chaired by the Chief Secretary of the Government of Rajasthan; the Technical Heritage Committee, chaired by the Secretary of the Department of Local Self Government, Rajasthan; and the Heritage Cell Committee, overseen by the Additional Chief Town Planner, Jaipur Municipal Corporation Heritage (JMCH, 2020, § 4). These committees oversee the implementation of local laws, review permit applications, and conduct heritage impact assessments to align developments with heritage conservation goals. Decision-making regarding changes to heritage assets follows a hierarchical process. The State Heritage Committee oversees changes to Grade I and II assets, guided by the Technical Heritage Committee, while the Technical Heritage Committee, with advice from the Heritage Cell Committee, handles Grade III assets (JMCH, 2020, § 6).

According to World Heritage Expert, the designation of Jaipur walled city as a World Heritage site has unintentionally fostered complacency among local and state authorities. While the inscription came with strict management commitments to address existing issues, such as the enforcement of the

By-laws 2020 and Regulation 2022, these commitments have been overlooked. The authorities appear to have become overly satisfied with the prestige of the World Heritage tag, prioritizing its symbolic value over substantive action to meet conservation and management standards.

Jaipur's Master Development Plan (MDP) 2025 identifies a number of pressing challenges in the walled city area, including commercialization, climate impacts such as extreme weather events, waste management, infrastructure deficiencies, parking shortages, unauthorized constructions, encroachments, drainage issues, traffic problems, and the deterioration of historic structures (JDA, 2011b, p. 97). Jaipur Municipal Corporation Heritage struggles to manage and monitor Jaipur city's historic buildings due to competing priorities, as it is tasked with addressing the needs of a larger population and broader municipal responsibilities, which further stretches its limited resources (City Planners, World Heritage Expert, Museum2).

Despite the three-tier heritage management system, local heritage laws in Jaipur walled city lack enforceability due to structural and systemic challenges. First, the multiplicity of agencies and overlapping mandates creates ambiguity over responsibility and accountability. This leads to inefficiencies and delays, as different departments often operate in silos. Second, the Jaipur Municipal Corporation Heritage is underfunded and understaffed, lacking the capacity to enforce regulations effectively (City Planners, World Heritage Expert, Architect and Heritage Consultant). For instance, the Heritage Cell Committee, which oversees permit application and compliance, is designed to include a range of members, such as architects with expertise in urban planning and heritage conservation, alongside municipal officials (JMCH, 2020, § 4.5). However, positions for architects and heritage professionals remain vacant, which is necessary for interdisciplinary and informed decision-making (World Heritage Expert). Efforts to secure government approval for permanent positions are stymied by resistance from existing staff, including planners and engineers, who fear displacement (World Heritage Expert, Architect and Heritage Consultant). Frequent turnover of senior officials, such as the commissioner of the Jaipur Municipal Corporation Heritage and Principal Secretary, from departments such as tourism, culture and archaeology, further disrupts continuity in governance (World Heritage Expert). This lack of consistent leadership undermines sustained focus on heritage conservation initiatives.

Adding to these systemic issues, frequent political changes have disrupted long-term heritage strategies. Over the past two decades, recurrent shifts in state government between the Indian National Congress and the Bhartiya Janta Party have caused discontinuity in heritage conservation and sustainable development projects. Architect and Heritage Consultant highlighted a disconnect between political and development cycles, noting that projects initiated mid-political cycles often remain incomplete as subsequent administrations shift priorities or abandon initiatives altogether. This political instability, combined with an inadequately trained and understaffed civil service, has fragmented the governance of the walled city.

Political interference and collusion further exacerbate systemic inefficiencies and governance challenges. Some officials prioritize personal gains or political gains over conservation goals, undermining public trust and fostering a culture of impunity. For example, Conservation Architect and JSCL Advisor highlighted cases where powerful individuals with political connections bypassed local regulations to permit unauthorized changes. Such practices deter local officials from enforcing regulations against politically connected individuals or properties and normalize non-compliance with local conservation regulations (Conservation Architect and JSCL Advisor, Owner1, Owner2, Architect and Heritage Consultants). Corruption and bribery within public heritage management agencies further erode accountability and disrupt conservation efforts (Owner1, Conservation Architect and JSCL Advisor, Architect and Heritage Consultant).

Beyond systemic and political factors, resistance from local property owners and residents presents barriers to compliance. This resistance often stems from a lack of awareness about the importance of heritage preservation and the perceived financial and administrative burdens of compliance. Many property owners and residents view local regulations as restrictive, particularly those that limit their ability to develop or adapt properties for modern use (Owner1, Owner2). As noted by Architect and Energy Consultant, such restrictive property-use regulations often discourage owners from registering their buildings as heritage assets. Unauthorized changes to historic properties, often made in anticipation of stricter enforcement, further jeopardize conservation efforts. Owner1 highlighted how some property owners hastily make unauthorized changes, including demolitions and structural changes, to avoid future restrictions. These actions undermine preservation efforts and leave many properties with cultural and energy conservation values vulnerable to neglect or inappropriate use.

To address these challenges and ensure that development aligns with conservation goals, the By-laws 2020 and Regulation 2022 outline permit procedures and restrictions for development, reconstruction, and modernization of heritage properties. Development, reconstruction, and renovations require prior permission from Jaipur Municipal Corporation Heritage and other relevant competent authorities (JMCH, 2020, § 12). Prohibited activities include demolition, changes to exterior façades, and alterations to Grade I listed buildings (JMCH, 2020, § 12.1). Competent authorities may grant permits for retrofitting, renovations without altering original façades, adaptive reuse, and the installation of modern electrical, plumbing and sustainable energy solutions in historic buildings (JMCH, 2020, § 12.2). Regulation 2022 prescribes Architectural Control Regulations aimed at preserving the heritage character of the walled city while permitting modern interventions, such as air conditioning units and solar panels, subject to strict compliance with prescribed guidelines (JMCH, 2022, § 1). It applies to both new and existing installations, requiring the strategic placement of air conditioning units and coolers to minimize their visual impact. The Regulations 2022 further mandate the use of original materials and traditional building techniques to maintain the existing architectural volume and character of the area (JMCH, 2022, § 1). While these by-laws and regulations exist to guide development and heritage conservation, they are not meant to completely halt urban growth. Recognizing Jaipur city's status as a living and evolving urban center, Planner1 advocated the need for a balanced approach to development, stating, "We cannot stop [development], but we can definitely restrict [it]."

However, enforcement remains weak. Planner3 pointed out that while some individuals adhere to permit procedures, others bypass regulations using political influence. Unauthorized demolitions and changes compromise the energy benefits of havelis and other historic structures, not only within the walled city but also around buffer zone such as Amber and Nahargarh reserves (Conservation Architect and JSCL Advisor, Owner1, Architect and Heritage Consultant, Owner2, World Heritage Expert, Architect and Energy Consultant). Widespread non-compliance persists, particularly regarding air conditioning units and coolers installed before Regulation 2022, which complicates efforts to align modern amenities with conservation goals—a process that will require sustained time and effort (City Planners) (Figure 3). Additionally, legal issues such as ownership disputes, tenancy agreements, and absentee landlords further complicate the long-term heritage management and preservation of heritage assets (Planner1, Planner2).

Weak mechanisms for monitoring and penalizing violations further hinder compliance. UNESCO officials, during a site visit, expressed concerns about the deteriorating conditions of inner lanes and craft streets in the walled city area; however, unauthorized demolition, construction, and the use of cement—favored for its affordability—continue due to inadequate enforcement and monitoring (Architect and Heritage Consultant, Museum2, World Heritage Expert, Conservation Architect and JSCL Advisor). Architect and Heritage Consultant highlighted issues with unauthorized constructions and the prevalent use of cement, which continues to replace the use of traditional materials, even in restoration projects. For instance, during a façade repainting initiative along the main bazaars by Jaipur Smart City Limited and Jaipur Municipal Corporation Heritage, some property owners exploited the opportunity by hastily constructing additional rooms overnight, using the freshly painted façades to conceal these recent additions (Architect and Heritage Consultant, Conservation Architect and JSCL Advisor).

Architect and Heritage Consultant aptly summarized, "[Y]our local and state machinery fails when the number of people going against the law is too high." This systemic failure highlights the complexity of implementing and enforcing the By-laws 2020 and Regulation 2022 in Jaipur walled city, where overlapping responsibilities, political interference, public resistance, and weak enforcement mechanisms collectively hinder sustainable heritage management. These issues in Jaipur reflect broader governance challenges faced by Indian cities, where systemic corruption, insufficient financial and administrative autonomy, excessive state control, functional inefficiencies, overlapping jurisdictions, and inadequate public participation and capacity-building undermine the ability of urban local bodies for urban planning and sustainable management (Nanda, 2016; Ahluwalia, 2017; Verma et al., 2023). Additionally, rapid urbanization and conflicting jurisdictional responsibilities fuel tensions between heritage preservation and modernization. The absence of integrated heritage legislation and low public awareness contribute to the ongoing degradation of both natural and cultural heritage, as observed in Jaipur and other cities such as Surat (Udeaja et al., 2020; Roy et al., 2023).

To address these issues, participants suggested the establishment of a unified heritage authority for the Jaipur walled city to strengthen enforcement, streamline decision-making and align governance with UNESCO recommendations (City Planners, World Heritage Expert). The Government of Rajasthan is in the process of finalizing a notification to establish the Jaipur Heritage Authority (City Planners).[2] Such an entity could centralize responsibilities, reduce jurisdictional conflicts, and improve the overall efficiency of heritage management.

Participants also emphasized the need to amend local by-laws to better integrate heritage conservation with energy sustainability. Current regulations focus on operational aspects of buildings, overlooking the energy efficiency potential inherent in traditional materials and designs (Architect and Energy Consultant). Amending the By-laws 2020 and Regulation 2022 to incorporate national policies and energy conservation building codes could streamline the assessment of energy efficiency and renewable energy measures during renovations and retrofits from the outset (Architect and Energy Consultant, World Heritage Expert). Additionally, incorporating clear measures to safeguard traditional building crafts and encouraging adaptive reuse could further support sustainable heritage management (World Heritage Expert, Museum2, Architect and Heritage Consultant). Interviewees also proposed innovative approaches, such as classifying trees older than 50 years as "heritage trees" and creating provisions for planting and reviving parks to mitigate urban heat and improve air quality (Museum1, Planner3). These suggestions from interviewees could improve enforcement mechanisms and align heritage management with urban sustainability goals accord with recommendations from other studies and UNESCO (Tulsyan et al., 2013; Yu et al., 2015, 2017; Jawaid et al., 2017, 2018; Garg et al., 2019; Tarkar, 2022; Choudhary et al., 2022; UNESCO WHC, 2023).

3.3 Balancing heritage preservation and energy sustainability: traditional energy advantages, adaptive reuse, modern energy measures and challenges

Participants emphasized that Jaipur walled city's historical planning and architecture naturally support solar architecture and natural cooling, reducing reliance on modern energy-intensive systems (City Planners, World Heritage Expert, Museum2, Architect and Heritage Consultant, Conservation Architect and JSCL Advisor, Architect and Energy Consultant). Traditional building materials optimize heat distribution, reducing energy demands for cooling in summer and heating in winter (City Planners, World Heritage Expert, Museum2, Architect and Heritage Consultant, Conservation Architect and JSCL Advisor, Architect and Energy Consultant). Features such as haveli courtyards provide natural light, ventilation, and opportunities for social interaction (Museum2) (Figure 4) (Agrawal et al., 2006; Sharma, 2022, pp. 215–224; Verma et al., 2022; Jha and Dave, 2023).

2 According to the draft notification, the Jaipur Heritage Authority will oversee World Heritage decision-making processes by conferring municipal powers to manage conservation, preservation, protection, and development initiatives aimed at enhancing the OUV and heritage character of the walled city (not published).

FIGURE 3
Air conditioning units placed without adherence to the By-laws 2020 and Regulation 2022 in the main bazaars of Jaipur walled city (courtesy of the author).

While row housing with shared common walls minimizes sun exposure, maintaining cooler indoor temperatures (Architect and Heritage Consultant) (Sharma, 2022, p. 203). Traditional buildings, such as havelis, require less air conditioning than modern cement structures (Museum1, Owner1, Architect and Energy Consultant).

Building on these inherent advantages, adaptive reuse projects have emerged as a means to both conserve and revitalize traditional buildings. For instance, repurposing havelis into bed and breakfast accommodations while continuing as family homes conserves embodied energy and minimizes demolition waste (Owner1, Owner2, World Heritage Expert). However, this balance is not without its challenges. Haveli owners play a crucial role in maintaining their havelis and preserving intricate interior decorations, such as the mirror work and peacock mosaic found in Owner2's haveli—elements also seen in historic landmarks such as the *Sheesh Mahal* (Palace of Mirrors) at Amber Fort, Jaipur and the *Mor Chowk* (Peacock Courtyard) at City Palace, Udaipur (Figure 4). Owner1 explained, "[W]e are one of the very few havelis left like this where we are still conserving in its historic state and aesthetics." However, the growing trend of commercial repurposing can sometimes lead to unauthorized demolitions and changes, compromising the historical significance and traditional energy advantages of these buildings (World Heritage Expert, Architect and Heritage Consultant). This often happens because new owners or developers tend to prioritize financial returns over the preservation of traditional buildings such as a haveli, especially given the high land value and the complexity of managing properties with multiple owners—a common ownership structure in the walled city area—makes it easier to sell and repurpose properties for office or commercial use (Architect and Heritage Consultant, Owner1). Modern renovation practices also undervalue traditional design elements such as haveli courtyards, favoring space efficiency over historical and environmental significance (Owner1, Owner2).

World Heritage Expert noted that careful integration of energy efficiency and renewable energy measures in historic buildings is

FIGURE 4
Haveli courtyards, interior decorations, and wall murals at Owner1's **(top)** and Owner2's **(bottom)** havelis (courtesy of the author).

essential to preserve the city's OUV and visual integrity. Architect and Energy Consultant noted the city's immense potential for solar energy, given Rajasthan's abundant solar resources and the ideal design of buildings with flat terraces and parapets, which allows the possibility to place the panels on rooftops where they are not seen from the street without affecting the city's aesthetics and cultural values. Post-designation, there have been promising developments, with some private and public buildings adopting solar panels in the walled city.

An exemplary case is the solar panel installation at the City Palace complex, completed in 2021, which generates 150 kilowatts and meets 60% of the energy needs (Museum2) (Figure 5). The panels were strategically placed to minimize visual impact and roof damage, ensuring they are not visible from the street (Museum2). Beyond the City Palace, local authorities and state government have spearheaded solar initiatives. These include solar-powered lighting in public spaces and solarize new and existing buildings outside the walled city under state schemes such as rooftop solar subsidy (Museum2, City Planners, Museum1). Planner3 detailed the installation of rooftop solar panels on the Jaipur Municipal Corporation Heritage building, designed to blend seamlessly with nearby heritage sites such as the Hawa Mahal and Jantar Mantar (Figure 5).

Modern appliances and energy-efficient practices, such as LED lighting, upgraded air conditioning systems, double-glazed windows, and heavy fabric curtains, have resulted in energy savings while maintaining optimal thermal comfort for extended periods within the City Palace complex and havelis (Museum2, Owner1, Owner2). Although integrating these technologies into historic buildings poses challenges, successful examples demonstrate that balancing modern amenities with heritage preservation is achievable. For instance, Owner2 discreetly integrated over eighteen air conditioning units and other modern amenities into their haveli (Figure 6). Museum1 minimized the visual impact of modern amenities by relocating air conditioner units behind custom-made stone windows at the rear of the Albert Hall Museum and strategically placing solar panels on the rooftops of the Jaipur Wax Museum within Nahargarh Fort (outside the walled city). These installations demonstrate the feasibility of harmonizing the use of modern amenities and renewable energy solutions with heritage conservation, offering a model for broader adoption in line with the city's energy needs and sustainability goals (Museum1, Museum2, Owner2, World Heritage Expert, City Planners).

Despite these advancements, challenges remain. A key issue is the lack of technical resources and data tailored to the Indian context, in contrast to the extensive resources available in Europe (Architect and Energy Consultant, City Planners). This deficiency hampers accurate energy performance evaluations and requires substantial investment for research and data collection, which is challenging given limited government resources at the local level (Architect and Energy Consultant, World Heritage Expert, City Planners). While public buildings may accommodate solar energy systems, residential structures in the walled city face space constraints due to varying usage priorities of multiple owners (Architect and Energy Consultant, Owner1, Owner2). Sociocultural engagements, such as the annual Kite-flying festival,

FIGURE 5
Successful solar panel installations at City Palace complex **(top)** and Jaipur Municipal Corporation Heritage Building **(bottom)**, with no visual impact from public street view (courtesy of the author).

complicate solar panel installation as rooftops are extensively used for kite flying, leaving limited space for solar systems (Museum1, Architect and Heritage Consultant, City Planners, Owner1, Owner2). Additionally, the presence of monkeys, which can damage the wirings of solar energy systems, further adds to these challenges (Museum1, Architect and Heritage Consultant, City Planners, Owner1, Owner2).

Developing know-how guidelines, conducting localized research with state government support, and encouraging local officials to adopt interdisciplinary approaches are essential steps for integrating energy efficiency and renewable energy measures in a heritage-sensitive manner in Jaipur walled city (Museum1, Museum2, City Planners, World Heritage Expert, Architect and Heritage Consultant, Architect and Energy Consultant) (Yu et al., 2015; Upadhyaya, 2016; Jawaid et al., 2017; Choudhary et al., 2018; Garg et al., 2019; Choudhary et al., 2022; Trovò, 2023). Collaborations among local universities, international research institutions, non-governmental organizations, and government agencies could address specific technical and logistic challenges (Architect and Energy Consultant, Planner2). Solar system wiring can be protected with conduits, and adopting a coexistence approach to managing the monkey population is essential for Jaipur walled city (Architect and Heritage Consultant, Museum1, Museum2, World Heritage Expert). Addressing rooftop space constraints will require coordinated efforts among property owners and residents to balance solar panel installations with traditional cultural activities, such as kite flying. Additionally, exploring alternative solutions, such as establishing solar energy farms outside the walled city area and entrusting solar projects to private entities under a user payment model could expand access to renewable energy while preserving the cultural and architectural values of the walled city (Owner1, Museum1, Architect and Heritage Consultant).

3.4 Voluntary measures and policy-driven barriers

The By-laws 2020 introduce incentive mechanisms such as flexible land use, tax rebates, and a heritage fund aimed at

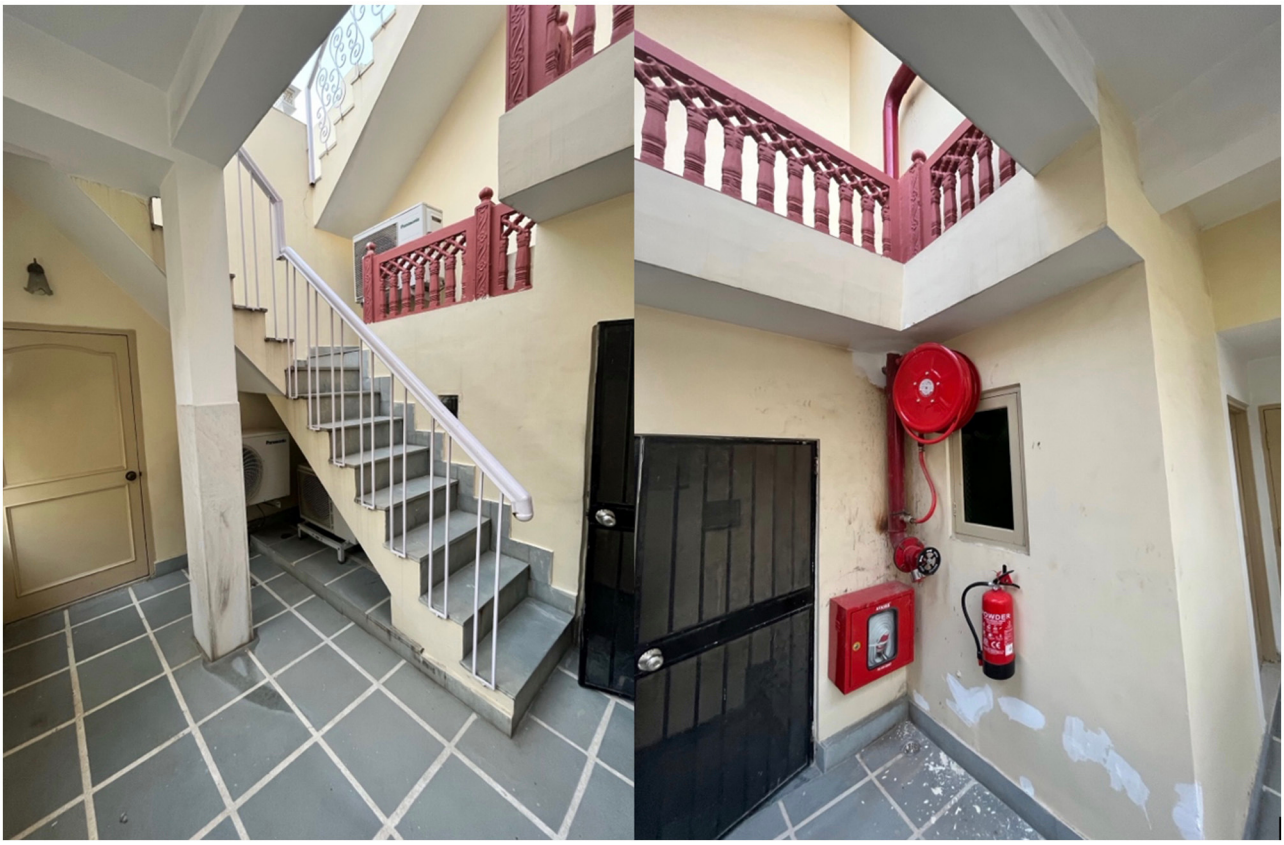

FIGURE 6
Discreet placement of air conditioning units and fire safety system at Owner2's haveli (courtesy of the author).

preserving cultural and architectural heritage while promoting sustainability in the walled city (JMCH, 2020, § 26). However, inconsistent compliance undermines their effectiveness. The flexibility in land use allows owners of listed buildings to convert properties for commercial purposes, provided they agree to maintain and preserve the structures [JMCH, 2020, § 26(1)]. While this flexibility can encourage preservation, it may also lead to increased energy consumption and carbon emissions. Architect and Heritage Consultant cautioned against potential misuse of this mixed-use status, particularly when commercial priorities, such as office conversions, result in the demolition of traditional buildings, thereby exacerbating environmental degradation.

The By-laws 2020 also established a Heritage Fund, but it is primarily limited to public buildings and municipal expenses [JMCH, 2020, § 26(4)]. Although the By-laws 2020 offer incentives such as tax rebates for listed buildings and heritage properties that contribute to tourism-related infrastructure [JMCH, 2020, § 26 (3) (a) and (b)], accessing this financial assistance remains challenging. According to Owner2, tax rebates for well-maintained historic buildings have yet to be approved, raising concerns about the financial accessibility of these measures for property owners.

For many residents in Jaipur walled city, who come from diverse socio-economic backgrounds, including different castes, tribes, income groups, and classes, the cost of maintaining historic properties or investing in sustainable energy measures is prohibitive. Many struggle with basic living expenses, leaving little room to prioritize heritage conservation or sustainability (City Planners, Owner1, Owner2). This economic disparity influences material choices, with residents often favoring modern materials such as cement over traditional options such as lime and red sandstone, which, although more environmentally friendly and historically accurate, are less affordable and harder to source (Architect and Heritage Consultant). Furthermore, joint ownership of buildings—a common feature in the walled city—adds another layer of complexity, as not all owners may have the means or willingness to invest in energy efficiency and renewable energy measures or heritage conservation efforts (Owner1, Owner2, City Planner).

Addressing the intersectionality of affordability, accessibility, and the socio-economic diversity of Jaipur walled city's residents is essential to ensure that energy sustainability and heritage conservation initiatives are inclusive and equitable. Without targeted financial support, these initiatives risk excluding significant portions of the population. To support both local authorities and property owners and users, practical measures could include financial assistance tailored to low-income groups, monetary support at the municipal level for hiring full-time heritage professionals, streamlined processes for accessing existing incentives such as tax rebates and subsidies, and support for affordable restoration materials and skilled workforce (City Planners, Owner1, Owner2, Architect and Heritage Consultant, World Heritage Expert) (Yu et al., 2015; Upadhyaya, 2016; Yu et al.,

2017; Garg et al., 2019; Nagar and Suman, 2022; Tarkar, 2022). For instance, partnerships with UNESCO or non-governmental organizations could focus on technical training programs to increase the availability of skilled craftsmen and promote the use of traditional materials in line with local regulations. Museum2 has already supported this approach by providing a list of craftsmen to Jaipur Municipal Corporation Heritage, enabling better access to expertise for property owners and residents. Additionally, public education and awareness campaigns about the cultural and economic benefits of conservation can encourage compliance with local heritage laws and guidelines (Museum2).

The By-laws 2020 mandate GIS-based inventorying, mapping, and valuation of all properties and heritage assets within Jaipur city, along with the compilation of heritage databanks by the Heritage Cell (JMCH, 2020, §§ 7 and 8). However, implementation faces challenges, as many property owners and users remain unfamiliar with organizations such as UNESCO or relevant local laws (Owner1, Architect and Heritage Consultant). Additionally, rapid changes in the walled city, coupled with resource constraints, have hindered the creation of a comprehensive database of historic buildings (World Heritage Expert, Conservation Architect and JSCL Advisor). INTACH's efforts to create a heritage asset database have raised awareness of conservation needs, but Owner1 noted the limitation of relying solely on inventories, citing the loss of at least 20 traditional buildings in the walled city area since 2022.

Education and capacity building through training programs and interdisciplinary collaboration are crucial for raising awareness and fostering compliance with conservation regulations (Museum2, Architect and Heritage Consultant, Owner1, World Heritage Expert) (Tulsyan et al., 2013; Yu et al., 2015, 2017; Choudhary et al., 2018; Garg et al., 2019; Choudhary et al., 2022). Physical surveys, including an architectural survey of the approximately 40,000 buildings in the walled city, are underway (Planner3). Architect and Energy Consultant, however, suggested streamlining these efforts by integrating energy efficiency assessments into a single comprehensive survey, rather than conducting separate inventories and evaluations. This approach could improve efficiency and ensure that energy sustainability is considered alongside heritage conservation. Existing collaboration frameworks among conservation professionals, heritage and energy experts, legal experts, and town planners could be expanded to involve local community members more actively in addressing the challenges of heritage conservation and energy sustainability (City Planners, Museum1, Museum2, Architect and Heritage Consultant, Owner1, Architect and Energy Consultant, World Heritage Expert, Owner2).

Unlike Liverpool—Maritime Mercantile City (United Kingdom), which was delisted in 2021 due to large-scale developments that irreversibly damaged its OUV, authenticity, and integrity, Jaipur city's challenges are governance inefficiencies, weak enforcement, and limited conservation capacity. Liverpool's delisting resulted from "inadequate governance processes, mechanisms, and regulations" that failed to prevent serious and irreversible deterioration of its heritage attributes (Committee UNESCOWH, 2021). In contrast, Jaipur walled city benefits from a local governance framework, including the Jaipur Municipal Corporation Heritage and the By-laws 2020 and Regulation 2022, which prescribes architectural controls and sustainable heritage management practices to balance conservation with modern development. Despite this framework, gaps in enforcement and capacity continue to hinder sustainable heritage management. However, these challenges are not irreversible and can be addressed by strengthening the governance framework and enforcement mechanisms, capacity building, and community engagement. Additionally, UNESCO continues to monitor Jaipur walled city's progress through periodic reporting and state of conservation reports. Notably, the World Heritage Committee has requested India to submit an updated state of conservation report for Jaipur city by 1 December 2024, which will be reviewed during its 47th session (UNESCO WHC, 2023).

4 Conclusion

This study of Jaipur's heritage underscores the role of law in finding the crucial balance between heritage conservation and the reduction of GHG emissions and energy use in a city renowned for its indigenous planning and cultural significance. The World Heritage designation has enhanced legal protection and awareness at the local level, providing a foundation for integrating sustainable heritage management practices. The findings of this study demonstrate significant potential for innovation such as the integration of solar energy and modern amenities and adaptive reuse of traditional buildings, demonstrating that heritage can coexist with energy sustainability while preserving traditional architecture and protecting the city's OUV. However, this balance requires meticulous implementation to ensure that interventions do not compromise the visual integrity of heritage sites.

Traditional planning and construction techniques, particularly those employed in havelis, showcase significant energy efficiency benefits and offer valuable lessons for contemporary building practices and sustainable urban development. Yet, practical implementation of local heritage laws, national policies and international objectives remains limited due to weak enforcement, government inefficiencies, insufficient funding and knowledge, and commercialization pressures. The challenges Jaipur city faces are not entirely unique in the Indian context; they stem from systemic governance issues pervasive in cities across the country. However, the UNESCO designation amplifies these challenges, as Jaipur walled city must navigate these systemic obstacles while adhering to international objectives.

Strengthening the enforceability of heritage laws and local governance requires addressing these systemic issues through improved coordination among agencies, capacity-building for Jaipur Municipal Corporation Heritage and the local community, and better monitoring mechanisms. Establishing a single, unified authority for the management of Jaipur walled city's heritage and amendments to the By-laws 2020—as recommended by interviewees—could streamline decision-making and enforcement. Financial incentives, public awareness and educational campaigns can also encourage voluntary compliance. Additionally, stricter penalties and fines for non-compliance, coupled with transparent and accountable governance practices, are essential to reversing the current trend of weak enforcement and unauthorized activities. This approach could support local authorities, property owners, and residents in making informed, sustainable choices that ensure

the conservation and adaptive reuse of traditional havelis and historic buildings.

UNESCO and the World Heritage Centre support adapting heritage sites to global threats while maintaining local identity and traditional practices. Bhati and Epstein (2023) highlight the necessity of integrating cultural practices and environmental sustainability in heritage management and conservation. Though their research focuses on biocultural heritage in natural and mixed sites, their insights are equally applicable to cultural sites such as Jaipur walled city, where cultural heritage is closely linked with local identity and urban needs. Inclusive conservation strategies that respect traditional knowledge and promote community involvement are essential. Adapting traditional building practices with modern, climate-resilient techniques and integrating traditional knowledge into urban planning could substantially benefit Jaipur city's pathway to a sustainable future. The adaptive reuse of traditional havelis and integration of renewable energy measures, such as solar panels, exemplify this potential for the coexistence of traditional and modern practices.

Integrating traditional knowledge with modern sustainability practices can position Jaipur city as a potential model for other historic urban areas. This study offers insights into the local governance framework in Jaipur walled city, incorporating perspectives from city planners, architects, heritage professionals, municipal officials, consultants, and property owners. Far from being an isolated case, Jaipur city's experiences reflect broader trends and challenges in heritage conservation faced by rapidly urbanizing regions worldwide. The challenges and opportunities addressed here hold relevance for planners, managers, and decision-makers in other historic cities and World Heritage sites. Future research focusing on the role of everyday users and community-based negotiations shaping urban heritage and amplifying the voices of those who have long engaged with and contributed to these cultural environments would be valuable to complement this study. By exploring grassroots perspectives, we can gain a deeper understanding of the complex dynamics between heritage conservation and sustainability and facilitate the exchange of local knowledge and practices among historic cities for more inclusive and sustainable heritage management.

Data availability statement

The data presented in this article are not available online because of ethical considerations and the confidentiality agreements established during data collection. All data are securely stored on Uppsala University's data storage system. A list of the interview questions is provided in Appendix 1. Any inquiries regarding the data should be directed to Harsh Vardhan Bhati, harsh.bhati@jur.uu.se.

Ethics statement

This study was conducted in accordance with ethical standards for research involving human participants. The ethics application for this study was reviewed and approved by the Swedish Ethical Review Authority (Dnr 2022-03761-01) and registered at Uppsala University (JUR 2022/945). For the fieldwork conducted in Jaipur walled city, formal approval was obtained from the Commissioner of the Jaipur Municipal Corporation Heritage. This authorization permitted the conduct of interviews and field research within the World Heritage site and also strengthened local institutional support and collaboration during the fieldwork. Prior to interviews, all participants received detailed information about the project and informed consent forms outlining the purpose of the study, intended use of data, and their rights, including the right to decline participation or withdraw at any stage without repercussions. Written informed consent was obtained from all participants for their participation in the study and for the publication of any potentially identifiable image or information included in this article.

Author contributions

HB: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The author(s) declare that no Gen AI was used in the creation of this manuscript.

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Appendix 1. Interview questions

The following questions were used as a guide for semi-structured interviews conducted with public officials, conservation professionals, architects, consultants, and property owners in Jaipur walled city. The questions were tailored to the role, expertise, and experience of each participant. Not all questions were asked of every interviewee, and some were adapted during interviews based on the participant's professional background, the flow of conversation, and emerging themes. The questions were designed to explore participants' interpretations of legal frameworks and sustainability challenges, and also allowed for reflection on practical issues such as governance, enforcement, bureaucratic hurdles, and institutional coordination in Jaipur walled city.

General background

- Please describe your professional role and main responsibilities related to heritage conservation, energy sustainability, or property ownership.
- How do you view the cultural and historical significance of havelis and historic buildings in Jaipur walled city?
- What are the most important interior and exterior features that should be preserved in havelis and historic buildings?

World heritage designation

- What is your perception of the impact of Jaipur's UNESCO World Heritage designation on the management and conservation of the city's historic building stock?
- Has the World Heritage status influenced approaches to heritage conservation, sustainability or energy efficiency measures in historic buildings?

Climate change and preservation challenges

- In your view, what are the current and future challenges facing the preservation of historic buildings in light of climate change?
- Are there any climate-related risks (e.g., increased temperature, humidity, pests) affecting heritage structures in Jaipur city?

Heritage conservation and energy sustainability

- To what extent do you consider energy efficiency measures or sustainable energy use compatible with preserving cultural and heritage values?
- What role do traditional architectural practices and building techniques play in improving energy performance?
- What challenges and opportunities exist in implementing sustainable energy solutions in historic buildings?

Legal and institutional frameworks

- What local, state, or national laws and regulations govern and guide heritage and energy conservation and sustainability efforts in Jaipur walled city?
- How do permit procedures address proposals for energy retrofits or renewable energy installations in historic buildings?

Governance and decision-making

- Who are the main stakeholders influencing decisions about heritage conservation and sustainable energy measures?
- Are there bureaucratic hurdles or institutional coordination challenges that affect the implementation of sustainability initiatives?

Incentives, support, and community involvement

- What financial incentives or support programs are available to promote sustainable practices, such as adaptive reuse, in havelis and historic buildings?
- Is the public meaningfully involved in decision making and guided regarding heritage-sensitive integration of energy efficiency and sustainability measures in World Heritage area?
- Are there informal institutions or initiatives supporting energy sustainability and heritage conservation in historic settings such as Jaipur walled city?

Personal experiences of property owners

- How did you acquire or come to live in your haveli or historic property?
- Does World Heritage status mean anything to you or your property?
- What measures have you taken to improve energy efficiency or sustainability in your building?
- Have you faced challenges in obtaining permits or implementing energy-saving upgrades?
- How do energy-efficient measures affect your experience of the cultural value of your property?
- How difficult or expensive is the management and conservation of your property? What kind of assistance would you like from the state and local government or regulatory authorities?

Future directions

- What changes or improvements would you recommend in existing laws, regulations, or policies to better support the integration of energy sustainability in heritage conservation?
- What future strategies or initiatives should local authorities prioritize to enhance both heritage protection and sustainable development in Jaipur walled city?