

Brownfield regeneration in emerging policy contexts: applying the PIB framework in Iran

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Abstract

Purpose – This paper aims to explore how integrated policy frameworks can advance brownfield regeneration in emerging policy contexts characterized by fragmented governance. Drawing on Iran as an illustrative case, it assesses institutional, legal and policy readiness, identifies barriers to effective land reuse, and offers insights for developing context-sensitive and cross-sectoral strategies for sustainable urban redevelopment.

Design/methodology/approach – The study adopts a qualitative, comparative research design grounded in the Policy Integration for Brownfields (PIB), an analytical tool for assessing integration between environmental and urban policy domains. Drawing on documentary analysis and semistructured interviews, the PIB framework is applied to identify five barriers to brownfield regeneration: institutional misalignment across governance levels; regulatory conflicts between municipalities and developers; a narrow policy focus on deteriorated housing; the absence of a legislative framework for brownfields; and technical limitations in existing soil quality guidelines.

Findings – Through the analytical lens of the PIB, five key barriers to brownfield regeneration were identified: institutional misalignment across governance levels, regulatory conflicts between municipalities and developers, a narrow focus on deteriorated housing, absence of legislative frameworks for brownfields and technical limitations of soil quality guidelines. These challenges create a fragmented, reactive policy environment dominated by short-term economic priorities, limiting sustainable land reuse and environmental protection.

Originality/value – This study contributes to research on brownfield regeneration in emerging policy contexts by applying the PIB framework to Iran, where contaminated land remains conceptually unclear,



legally undefined and institutionally fragmented. The findings offer both theoretical contributions to PIB and practical guidance for policymakers seeking to develop context-sensitive brownfield strategies.

Keywords Brownfield regeneration, Policy development, Policy integration, PIB, Iran

Paper type Research paper

1. Introduction

Urbanization has emerged as a transformative global force, reshaping not only physical landscapes but also economic systems, governance structures and environmental conditions. While cities have become engines of innovation and productivity, generating over 80% of global GDP, they have also produced significant environmental externalities, including resource depletion, land degradation and urban pollution (UNDESA, 2018). Among the most pressing, yet frequently overlooked, challenges in this context are the issue of brownfield regeneration (Thornton *et al.*, 2007). Brownfields, frequently burdened by contamination from former industrial or military activities, represent a critical convergence of environmental risk, spatial planning shortcomings and socioeconomic decline (Alker *et al.*, 2000; Mehdipour and Rashidi Nia, 2013). In many developed contexts, brownfield regeneration has become a core component of sustainable urban policy (Berman *et al.*, 2022). However, in much of the Global South and particularly in Iran, brownfields remain conceptually vague, legally undefined and institutionally marginalized (Laghai *et al.*, 2012; Zekavat and Motamedi, 2015; Ghabouli *et al.*, 2023). This paper addresses this gap by examining the barriers to brownfield regeneration in Iran through the analytical lens of the Policy Integration for Brownfields (PIB) framework.

Addressing the complexity of brownfield regeneration requires more than isolated environmental or spatial planning solutions. It demands an analytical approach that recognizes the multidimensional nature of the issue and integrates legal, institutional, economic and governance considerations across different levels of decision-making (Van der Valk, 2002; Domorenok *et al.*, 2021; Wong Villanueva *et al.*, 2022). In contexts such as Iran, where brownfield issues are not yet embedded in policy or planning practice and institutional responsibilities remain fragmented, a more integrated analytical approach becomes essential (Ramezani *et al.*, 2023). Decades of economic sanctions have accelerated the abandonment of industrial and postmilitary sites across the country, leaving behind extensive areas of vacant land that are frequently contaminated yet increasingly attractive for redevelopment across major cities. These abandoned sites now sit under mounting redevelopment pressure, creating both risks and opportunities that can only be addressed through more integrated environmental and planning governance.

From an international perspective, the need for integrated approaches to brownfield regeneration has been consistently highlighted across academic literature and policy debates over the past three decades (Alker *et al.*, 2000; Thornton *et al.*, 2007; De Sousa *et al.*, 2023). Since the 1990s, scholars and practitioners have emphasized the importance of moving beyond fragmented, sector-specific responses to urban environmental degradation (Espey *et al.*, 2023). In many countries, this has led to the institutionalization of brownfield strategies that bring together legal, financial, spatial and environmental tools under unified policy frameworks (Berman *et al.*, 2022). These efforts often hinge on Environmental Policy Integration (EPI), a governance principle promoting the incorporation of environmental concerns across all domains of policymaking (Jordan and Lenschow, 2010; Bogers *et al.*, 2022). However, the translation of such integrative models into developing or transitional governance systems remains uneven and under-explored. In Iran, for example, while urban regeneration programs have expanded, particularly targeting deteriorated housing and

informal settlements, contaminated or abandoned industrial lands have received little systematic attention (Zekavat and Motamedi, 2015). This reflects limited awareness of brownfield risks as well as structural and institutional weaknesses. Addressing this gap requires an analytical framework that can identify the key drivers, actors and governance mechanisms shaping brownfield regeneration in Iran's political and regulatory context.

Iran's limited engagement with brownfield regeneration therefore represents not merely a technical shortcoming, but a structural weakness in its broader environmental and urban policy framework. As Iranian cities face growing pressures from industrial land abandonment, population growth and urban densification, national and local authorities continue to prioritize physical redevelopment and land value over environmental health, social equity and long-term resilience (Mehdipour and Kellett, 2025). Key governmental actors, including the Ministry of Roads and Urban Development (MRUD), the Department of Environment (DoE) and local municipalities, operate in isolation, with no clear legal definitions, defined mandates or formal mechanisms for coordinating the identification, assessment and remediation of brownfield sites (Mehdipour, 2020). As a result, redevelopment frequently proceeds without adequate environmental assessments or cleanup obligations, exposing urban populations to hidden health risks and foreclosing opportunities for sustainable land reuse.

Against this backdrop, this paper examines the institutional, legal and policy conditions shaping brownfield regeneration in Iran. It applies the PIB framework (Mehdipour *et al.*, 2024) to identify the structural barriers that constrain effective regeneration. The study uses a qualitative, comparative design. It combines policy and document analysis with cross-national comparison across five international cases (the USA, the European Union, the UK, Japan and China) and draws on 54 semistructured expert interviews conducted between 2019 and 2022. By applying the PIB framework to Iran, the paper provides one of the first systematic assessments of brownfield governance in the country. It also shows how PIB can be used as an analytical tool to identify structural barriers and policy gaps in fragmented or emerging governance systems. The findings reveal significant institutional misalignment, regulatory ambiguity and limited integration between planning and environmental domains, highlighting the need for coordinated governance reform and a more coherent brownfield policy framework in Iran.

2. Literature review

Brownfields have been widely examined in international urban and environmental scholarship as complex sites where environmental risk, spatial restructuring and socioeconomic transformation intersect. Since the late twentieth century, the concept of brownfields has shifted from a narrow focus on industrial contamination to a broader planning and policy issue linked to sustainable urban development, land recycling and urban regeneration (Thornton *et al.*, 2007; Mehdipour and Rashidi Nia, 2013; Hou *et al.*, 2023). Early definitions, particularly in North American contexts, emphasized contamination and public health risks, framing brownfields as environmentally impaired sites requiring remediation prior to reuse (Adams *et al.*, 2010; De Sousa *et al.*, 2023). Over time, European approaches, initially led by the UK, broadened the definition to include vacant, derelict or underused urban land, even where contamination is not confirmed, framing brownfields as opportunities for urban restructuring and sustainable land use (Alker *et al.*, 2000; Adams *et al.*, 2010). This definitional shift reflects a broader transition from viewing brownfields solely as environmental liabilities to recognising them as strategic instruments of urban policy and land management.

International practice reflects this conceptual diversity. In the USA, brownfield policy has historically been driven by environmental regulation and liability frameworks, resulting in remediation-focused programs and incentive mechanisms designed to reduce risks for developers and landowners (Berman *et al.*, 2022). In contrast, many European countries, such as the UK, Germany and the Netherlands, have embedded brownfield regeneration within spatial planning systems, emphasizing land recycling, compact urban growth and the reuse of previously developed land (PDL) (Thornton *et al.*, 2007; Jacek *et al.*, 2022). In East Asian contexts, particularly Japan and China, brownfield regeneration has emerged more recently, shaped by rapid urbanization, strong state involvement in land development and growing concern about environmental and public health risks associated with former industrial sites (Cheng *et al.*, 2011; Otsuka *et al.*, 2013; Sun *et al.*, 2022). Despite these contextual differences, the international literature consistently recognizes brownfields as multidimensional policy challenges that extend beyond technical remediation to encompass governance, planning and institutional coordination (De Sousa, 2021).

A central theme emerging from the international literature is the importance of policy integration in enabling effective brownfield regeneration (Mehdipour *et al.*, 2024). Studies from different governance contexts show that fragmented institutions, unclear responsibilities and weak coordination between environmental authorities and planning agencies often hinder remediation and redevelopment efforts (Newig and Koontz, 2014; Rizzo *et al.*, 2015). Conversely, more successful brownfield outcomes are associated with integrated policy frameworks that align environmental regulation, spatial planning instruments, economic incentives and liability mechanisms across governance levels (Wernstedt *et al.*, 2013; Hou *et al.*, 2023). Comparative evidence from the USA, the European Union and Japan shows that clear liability rules, coordinated planning and environmental mandates and targeted financial incentives ensure redevelopment certainty and environmental protection (Thornton *et al.*, 2007; Dixon *et al.*, 2011; Berman *et al.*, 2022). This insight has been closely linked to the broader concept of EPI, as discussed by Jordan and Lenschow (2010), which advocates the systematic incorporation of environmental considerations into all areas of policymaking rather than their treatment as a separate or sectoral concern.

Building on these insights, a growing strand of international research has focused on the development of analytical frameworks and assessment tools designed to evaluate the governance conditions underpinning brownfield regeneration (Nijkamp *et al.*, 2002; Cheng *et al.*, 2011; De Sousa *et al.*, 2023). Rather than concentrating solely on site-level contamination or design outcomes, these approaches emphasize the interaction between policy drivers, institutional actors and operational instruments. Comparative studies from different countries show how differences in legal frameworks, institutional mandates and coordination mechanisms shape brownfield outcomes (Adams *et al.*, 2010; Dixon *et al.*, 2011; Sun *et al.*, 2022). Within this line of scholarship, the present study applies a governance-oriented analytical approach through the PIB framework, designed to diagnose integration gaps and institutional barriers across diverse policy contexts. For analytical clarity, this study treats the European Union and the UK as distinct cases: the former representing a supranational environmental governance framework, and the latter a national contaminated land and planning regime.

Within the broader international scholarship, research on brownfields in Iran remains fragmented and conceptually underdeveloped. Much of the existing literature focuses on environmental engineering aspects of soil and groundwater contamination, including site assessment, pollutant behavior and remediation techniques (Solgi *et al.*, 2012; Mohammadi *et al.*, 2022; Amiri *et al.*, 2022; Faraji *et al.*, 2023; Rouhani *et al.*, 2023). These studies

provide valuable technical insights into contamination processes and clean-up methods, yet they rarely engage with the institutional, regulatory and governance structures that shape redevelopment outcomes. Meanwhile, more recent research has begun to address the planning and policy dimensions of brownfields, examining legislative frameworks, design strategies and redevelopment models (Laghai *et al.*, 2012; Zekavat and Motamedi, 2015; Soveyzi *et al.*, 2023; Ghabouli *et al.*, 2023). While this emerging strand reflects growing recognition of brownfields as governance and spatial planning issues, it remains limited in scope. Most studies focus on specific cities or individual sites and do not assess brownfield regeneration within a broader national governance framework or across multiple levels of decision-making (Ghabouli *et al.*, 2023; Soveyzi *et al.*, 2023). As a result, the relationships between national policy structures, institutional coordination and local implementation remain insufficiently examined. A comprehensive assessment of brownfield regeneration as an integrated, multilevel policy challenge is therefore still lacking in the Iranian context.

Addressing this analytical gap requires situating Iran's experience within broader international debates on brownfield governance, EPI and urban regeneration. Comparative research shows that effective brownfield regeneration depends not only on remediation capacity but also on clear legal definitions, defined institutional mandates, coordinated planning frameworks and appropriate incentive mechanisms (Adams *et al.*, 2010; Otsuka *et al.*, 2013; Mehdipour *et al.*, 2024). Placing Iran within this comparative perspective allows for a more systematic diagnosis of institutional misalignment and policy fragmentation. This governance gap forms the central focus of the present study. The following section outlines the research design and methodological framework through which the PIB tool is applied to assess integration deficits and institutional barriers in Iran's brownfield policy landscape.

3. Research method

This study adopts a qualitative, comparative research design to examine how brownfield regeneration is conceptualized and governed in Iran in relation to five international cases: the USA, the European Union, the UK, Japan and China. Case selection follows a purposeful maximum-variation strategy (Seawright and Gerring, 2008), enabling a diverse representation of policy approaches across different political, regulatory and socioeconomic contexts. The selected cases reflect distinct models and stages of brownfield governance. The USA represents a mature liability-driven regime; the European Union embodies supranational EPI; the UK illustrates planning-led contaminated land regulation at the national level; Japan demonstrates centralized technical remediation governance; and China represents an emerging, state-led redevelopment context shaped by rapid urbanization. These cases collectively provide a robust empirical foundation for cross-national policy learning and serve as referential benchmarks for assessing Iran's readiness to develop integrated brownfield governance. Figure 1 presents the selection criteria underpinning each of the international cases.

The study draws on both primary and secondary data sources to provide a comprehensive analysis of brownfield regeneration in Iran. Secondary data include academic publications, government reports, policy documents, regulatory frameworks and international guidelines related to brownfield management obtained from official institutional websites and publicly accessible repositories. These include environmental and planning authorities across the selected cases, such as the US Environmental Protection Agency (USEPA), the European Commission (EC), the UK Environment Agency, Japan's Ministry of the Environment and China's Ministry of Ecology and Environment. In the Iranian context, relevant materials were obtained from the DoE, the MRUD, and associated national planning bodies. Additional documents were retrieved from international organizations and databases, including the World

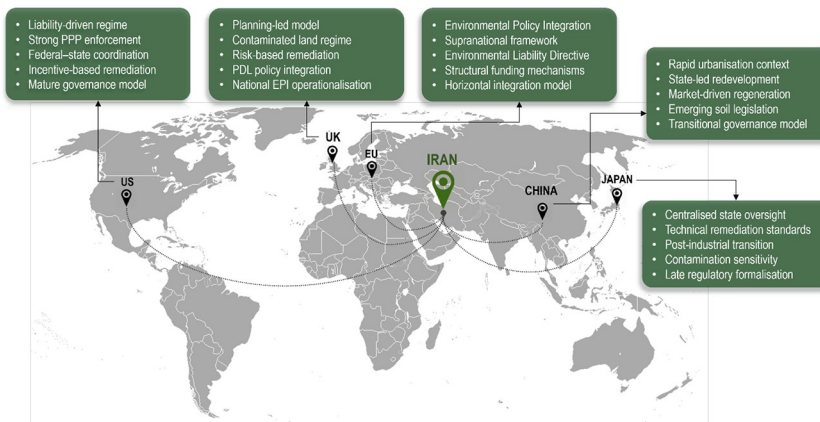


Figure 1. Selection criteria for international case studies

Source: Authors' own work

Bank and the Organization for Economic Co-operation and Development. These sources were selected to ensure consistency, reliability and comparability across cases.

Due to the limited availability of publicly accessible data on contaminated or underused land in Iran, primary data collection played a crucial role in addressing empirical gaps. Accordingly, 54 semistructured interviews were conducted between 2019 and 2022 with three groups of participants: urban scholars and academics, government officials and industry stakeholders. Participants were initially selected through purposeful sampling based on their institutional roles, professional expertise and direct involvement in land-use planning or environmental protection and were subsequently expanded through snowball sampling to access additional relevant stakeholders. Approximately 80 potential participants were contacted, of whom 54 agreed to participate. Detailed information on the participants, including their institutional affiliation, professional role and years of experience, is presented in a table in the [Appendix](#).

Interviews were conducted in Persian, either face-to-face or online, depending on participant availability and contextual constraints during the study period, and typically lasted between approximately 45 and 90 min. All interviews were audio-recorded with informed consent, transcribed *verbatim*, and subsequently translated into English for analysis where necessary. The interview protocol was structured around the core dimensions of the PIB framework, enabling focused discussions on institutional roles, legislative gaps, coordination mechanisms and operational practices. Questions explored participants' perceptions of institutional coordination, regulatory effectiveness, liability allocation and practical challenges in brownfield redevelopment. The interview guide consisted of open-ended, semistructured questions and was iteratively refined during the early stages of data collection. Semistructured interviews were selected to allow flexibility while ensuring consistency across participants, a widely adopted approach in qualitative governance research.

In addition to documentary analysis and interviews, the research included exploratory site visits to several former industrial and potentially contaminated brownfields in Iran to gain contextual familiarity with redevelopment conditions and governance practices. These sites included the former Nassaji Mazandaran Textiles Factory No. II in Qaemshahr (Mazandaran

Province), the former Khoshnoosh Carbonated Drinks and Plastic Packaging Factory in Sari (Mazandaran Province), the former Shiraz Textiles Manufacturing site in Shiraz (Fars Province). These visits were observational and informal in nature and did not constitute formal site-based case studies or pilot projects. Rather, they served to contextualize interview findings and enhance understanding of institutional dynamics on the ground. Some interview participants were directly associated with these sites in managerial, regulatory or planning capacities, further strengthening the triangulation between policy narratives and practical realities. These qualitative insights were instrumental in interpreting official documents and understanding the real-world dynamics of brownfield governance in Iran. By triangulating interview findings with policy texts and international cases, the study ensures analytical rigor and contextual sensitivity.

Data analysis followed a thematic content approach, guided by the three dimensions of the PIB framework:

- (1) policy and legislative drivers;
- (2) institutional actors and governance domains; and
- (3) regeneration tools and operational mechanisms.

Interview transcripts and documentary sources, including policy documents and regulatory frameworks obtained from official institutional sources (e.g. environmental and planning authorities across the selected case study contexts), were coded iteratively to identify recurring themes and patterns. Thematic saturation was reached when successive interviews no longer generated substantively new insights within or across the three PIB analytical dimensions. Each case was analyzed individually before being subjected to cross-case comparison, highlighting convergences, divergences and potential lessons for Iran. To ensure analytical rigor, all findings were triangulated across multiple data sources and validated through expert feedback and review of relevant policy developments up to early 2025. [Figure 2](#) provides a schematic representation of the research methodology, illustrating the sequence and interaction between research design, data collection, processing and thematic analysis, as well as the subsequent cross-case comparison.

3.1 Methodological framework

This research is grounded in the PIB, an analytical tool developed by [Mehdipour et al. \(2024\)](#) to assess the extent and quality of integration between environmental and urban policy domains in the context of brownfield regeneration. PIB was selected for this study because it provides an integrative analytical structure capable of diagnosing governance fragmentation and policy misalignment in contexts where brownfield regulation remains underdeveloped ([Domorenok et al., 2021](#); [Mehdipour et al., 2024](#)). PIB builds upon the broader literature on EPI, a governance principle widely adopted in environmental studies since the 1980s, particularly within the European Union, to ensure that environmental considerations are mainstreamed across all sectors of policymaking ([Jordan and Lenschow, 2010](#)). By adapting the core tenets of EPI to the specific challenges of land recycling and urban redevelopment, the PIB framework enables a more context-sensitive assessment of integration practices, shedding light on both procedural mechanisms and substantive outcomes ([Mehdipour et al., 2024](#)). This theoretical foundation allows the present study to critically interrogate the institutional arrangements, planning instruments and stakeholder interactions that shape brownfield regeneration efforts in diverse urban settings.

The PIB framework operationalizes EPI by focusing specifically on the governance challenges posed by brownfields, sites that simultaneously demand environmental

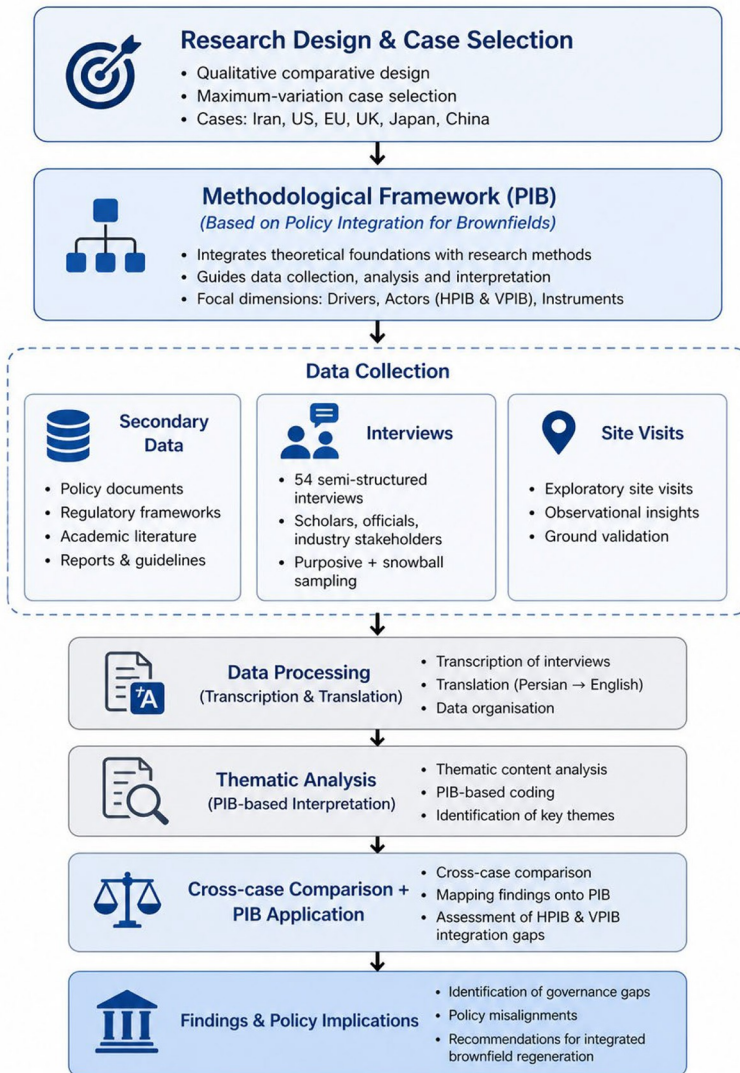


Figure 2. Research methodology flowchart illustrating data collection, processing and thematic analysis

Source: Authors' own work

remediation, spatial planning and socioeconomic revitalization. Unlike conventional planning models that tend to treat these domains in isolation, PIB foregrounds the importance of cross-sectoral integration, institutional coordination and vertical alignment across governance levels. It provides a holistic analytical lens to assess how diverse actors, policy instruments and regulatory frameworks interact in shaping the regeneration trajectory of brownfield sites. By moving beyond narrow sectoral mandates, the framework facilitates a

more nuanced understanding of the synergies and trade-offs inherent in multi-objective planning processes (Mehdipour *et al.*, 2024). The development of the PIB framework was informed by comparative insights drawn from five cases, including the USA, EU, the UK, Japan and China, each selected as an international benchmark due to its distinctive approach to brownfield governance. These case studies were instrumental in shaping the structure of the framework, allowing it to capture variations in institutional design, policy integration practices and implementation mechanisms across different governance contexts. Through this internationally grounded structure, PIB offers both analytical rigor and practical relevance for evaluating and improving brownfield regeneration policies worldwide. As shown in Figure 3, PIB is structured around three interrelated analytical dimensions:

- (1) *Policy and legislative drivers*: This dimension examines the underlying motivations that shape brownfield policies, including environmental protection, public health and safety, spatial planning imperatives and economic viability. The relative weight of these drivers varies across countries and determines the framing and prioritization of brownfield issues.
- (2) *Policy actors and domains*: PIB identifies two primary actor groups in brownfield governance, Land-Use Planning Agencies (LPAs) and Environmental Protection Agencies (EPAs). It assesses the degree of vertical and horizontal policy integration among these entities, including communication, collaboration, accountability and decision-making authority. Within this second dimension, institutional coordination is assessed along two integration axes: Horizontal Policy Integration for Brownfields (HPIB) and Vertical Policy Integration for Brownfields (VPIB). HPIB examines cross-sectoral coordination between land-use planning authorities and EPAs operating at the same level of governance. VPIB evaluates the alignment of brownfield-related mandates and implementation responsibilities across different governance levels, from national ministries to provincial and municipal authorities.
- (3) *Regeneration instruments and mechanisms*: The third dimension evaluates the tools available to support brownfield regeneration, including legal definitions, risk assessment protocols, financial incentives, liability frameworks, land-use planning instruments and monitoring systems. This component also explores whether the regulatory environment enables public-private cooperation, stakeholder participation and evidence-based redevelopment.

In applying PIB as a theoretical framework, this study does not merely describe policy outputs but seeks to critically assess the structural and procedural integration within Iran's brownfield policy landscape. The framework enables a diagnostic analysis that highlights institutional misalignments, legal voids and implementation gaps, while also offering a comparative lens to draw actionable insights from international experiences. As a flexible and scalable framework, PIB supports both explanatory depth and practical relevance, making it particularly suitable for analyzing countries like Iran where brownfield policy is still in its formative stages framework (Mehdipour *et al.*, 2024). By applying PIB, this study moves beyond surface-level analysis to uncover systemic barriers to sustainable land reuse.

4. Analysis of brownfield regeneration in Iran

This section applies the PIB framework to systematically examine the governance, legal and operational conditions shaping brownfield regeneration in Iran. Building on the international conceptual foundations outlined in Section 2 and the methodological approach presented in

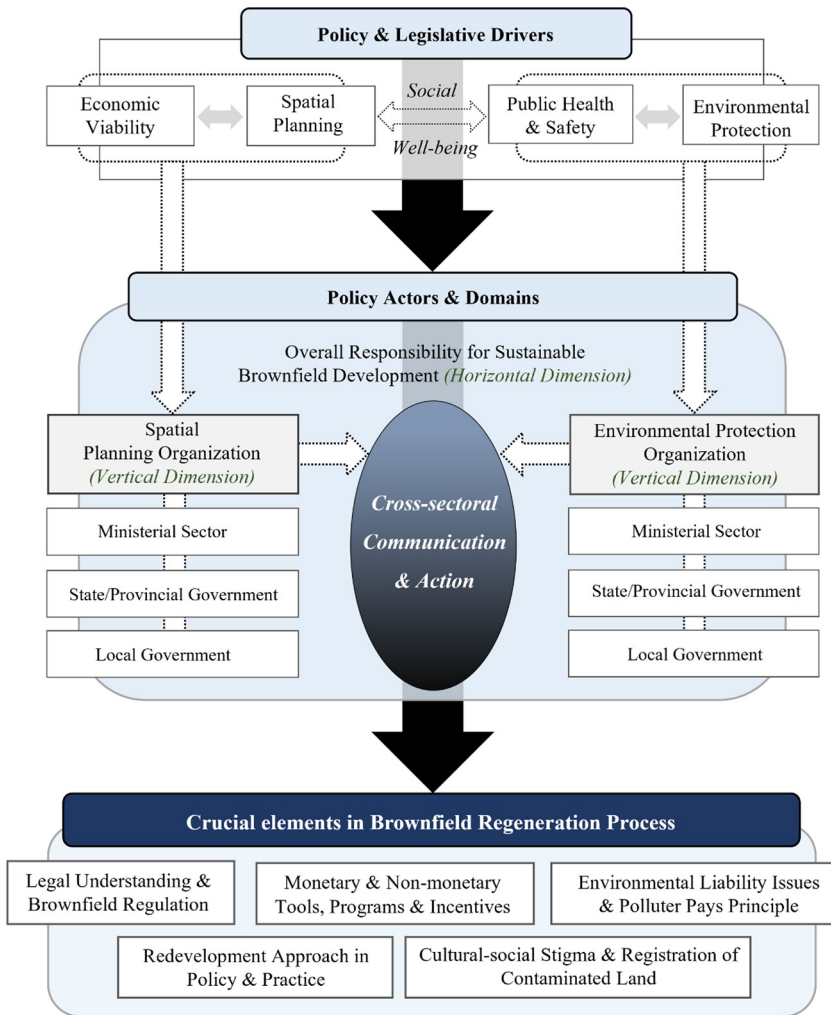


Figure 3. Analytical framework of PIB
Source: Mehdipour et al. (2024)

Section 3, the analysis evaluates Iran’s policy landscape across the three interrelated dimensions of PIB:

- (1) policy and legislative drivers;
- (2) institutional actors and governance domains; and
- (3) regeneration instruments and operational mechanisms.

By interpreting the empirical findings through this structured analytical lens, the section identifies institutional misalignments, regulatory gaps and coordination deficiencies that constrain the development of a coherent brownfield regeneration strategy. Instead of offering

a purely descriptive account, the analysis compares Iran's experience with established international governance models to identify where policy integration is weak and where structural reform is needed. The following subsections examine each of these analytical dimensions in detail, providing a systematic assessment of the strengths, weaknesses and integration gaps within Iran's brownfield governance framework.

4.1 PIB – dimension I; policy and legislative drivers

A comparative analysis of international approaches to brownfield regeneration reveals how policy drivers vary significantly based on historical, institutional and economic contexts. In the USA, brownfield regeneration is primarily motivated by concerns over environmental protection and public health, often triggered by high-profile pollution cases like the Love Canal disaster, which catalyzed strong legislative action (Tiesdell, 2008). The European Union, on the other hand, tends to frame brownfields through a spatial planning lens, integrating them into broader urban restructuring strategies aimed at land recycling and compact development (Berman *et al.*, 2022). In China, economic development has emerged as the dominant driver, with brownfield policies focusing on redevelopment potential rather than environmental risks, particularly in the aftermath of high-profile contamination events (Cheng *et al.*, 2011; Sun *et al.*, 2022). These variations underscore how the weighting of policy drivers, whether environmental, spatial, public health or economic, shapes both the design and implementation of brownfield strategies. In contrast, Iran lacks a coherent policy framework or legislative recognition of brownfields. There is no formal definition of brownfield sites, no dedicated remediation laws and little integration of soil contamination into urban planning decisions. Interview findings indicate that land value incentives drive redevelopment decisions, without corresponding safeguards for public health or environmental protection. The Iranian case illustrates a significant policy vacuum where market forces operate without regulatory constraints, leading to redevelopment practices that often overlook contamination risks. The PIB framework makes clear that effective regeneration requires a balance across all four policy drivers, a balance that Iran has yet to pursue.

In Iran, the lack of understanding about brownfield issues and the associated environmental and planning risks impedes the development of effective brownfield regeneration policies. Current housing and urban development policies do not adequately address environmental protection and public safety. The MRUD and local municipalities, which oversee urban development, have not yet fully recognized the importance of brownfield regeneration in managing the challenges of urban expansion. In addition, Iran's legal and regulatory framework falls short in addressing soil contamination issues related to brownfields. Unlike the USA and China, Iran has not faced a major pollution incident that would heighten public awareness and drive coherent policy development for managing contaminated sites. Nonetheless, the economic benefits of brownfield regeneration, particularly in terms of land value and marketability, are significant. Unclear government policies combined with strong market forces have made land a highly valuable asset, creating substantial opportunities for landowners and developers. This is especially true for old postindustrial brownfields located in economically advantageous inner-city areas. In Iran, economic viability, much like in China, plays a central role in brownfield decision-making; however, a focus on land value has not translated into consistent attention to environmental and spatial considerations in legislative decisions. The PIB indicates that optimal outcomes, especially regarding site clean-up, are achieved when all four driving factors, economic viability, spatial planning, environmental stewardship and public health, are integrated. This comprehensive approach has not yet been fully implemented in Iran.

4.2 PIB – dimension II; policy actors and domains

Brownfield regeneration sits at the intersection of environmental protection and spatial planning, demanding close coordination between institutional actors across both vertical (national-local) and horizontal (cross-sectoral) axes. From the perspective of the PIB framework, these coordination requirements correspond to the horizontal (HPIB) and vertical (VPIB) integration axes introduced in Section 3.1. HPIB concerns collaboration between planning and environmental domains at the same governance level, while VPIB captures the consistency of brownfield-related mandates across national, ministerial and municipal structures. The following analysis assesses how deficiencies in both axes shape brownfield governance in Iran. In successful international models, such as those in the EU and the USA, LPAs and EPAs operate with shared mandates, legal frameworks and communication mechanisms that enable collaborative decision-making (Newig and Koontz, 2014; Fiedler, 2018). However, in Iran, the governance structure surrounding brownfield regeneration remains fragmented and siloed. Key actors, including MRUD, DoE and local municipalities, function with poorly defined roles, overlapping jurisdictions and limited interagency coordination (Farhoodi *et al.*, 2009; Zamani and Arefi, 2013). Vertical misalignments between national ministries and autonomous municipal bodies, especially in major cities, further complicate implementation. Despite their influence over urban land-use planning, municipalities lack legal authority to manage or regulate contaminated sites. Meanwhile, the DoE, though formally responsible for environmental oversight, is institutionally disconnected from urban development processes. The PIB framework highlights the importance of structured institutional integration, yet in Iran, environmental and planning domains continue to operate independently, impeding the establishment of a unified brownfield policy agenda. Without formal communication channels, shared accountability frameworks or joint remediation protocols, brownfield governance in Iran remains reactive, fragmented and largely ineffective.

In Iran, the challenge of effectively implementing brownfield policy is significantly affected by a disconnect between environmental and spatial governance sectors, which is further exacerbated by organizational issues within LPAs and EPAs. This fragmentation is a major obstacle to successful brownfield regeneration efforts, as it creates barriers to cohesive policy execution and site management. One of the central issues is the insufficient cross-sectoral communication and integration at both national and local levels. This reflects weaknesses in both HPIB, where coordination between LPAs and EPAs remains limited, and VPIB, where national environmental objectives are not consistently embedded within municipal planning practice. This lack of coordination prevents the effective collaboration needed for comprehensive brownfield redevelopment. To illustrate the complexity of the situation, Figure 4 highlights the intricate network of key actors and their roles in cross-sectoral collaboration and decision-making for brownfield redevelopment in Iran. This includes major policy actors and sectors such as MRUD, the Ministry of Interior, the DoE and local municipalities. Each entity has specific responsibilities related to site characterization, legislative oversight, operational management and environmental regulation. Governmental landowners and developers are also expected to play an active role in decision-making, especially during land-use transfers within development plans. These collective responsibilities are crucial for ensuring a comprehensive and coordinated approach to brownfield redevelopment, addressing both environmental and urban planning needs as outlined by the PIB.

4.2.1 Land-use planning agencies. In Iran's urban management framework, two key ministerial bodies, MRUD and MoI, have the potential to be integrated within LPAs for brownfield site regeneration. The MRUD plays a central role in developing planning

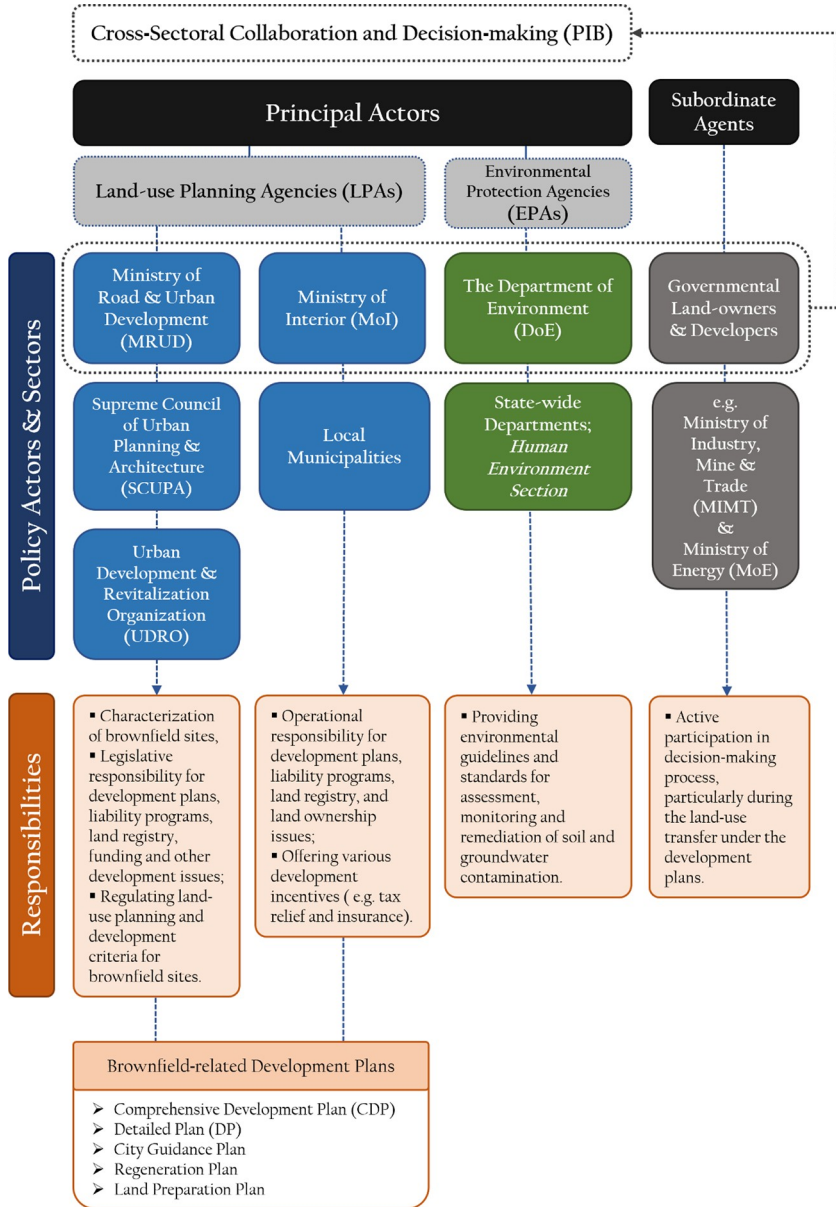


Figure 4. Key stakeholders and policy actors for brownfield regeneration in Iran

Source: Authors' own work

strategies and legal instruments, with the Supreme Council of Urban Planning and Architecture of Iran under its oversight, acting as the most influential legislative body for urban development. In addition, the Urban Development and Revitalization Organization of Iran (UDRO), under MRUD's control, is authorized to execute urban regeneration, focusing primarily on renewing deteriorated housing in city centers and informal suburban settlements. MRUD is thus positioned as a key player in brownfield site characterization, legislative frameworks, liability programs and regulating land-use planning. Local municipalities, although categorized under the MoI, operate with significant autonomy and are crucial legal actors in brownfield site regeneration across Iranian cities. They lead in city management, implementing major development plans and providing public services, but currently, their authority does not extend to brownfield regeneration. This institutional limitation illustrates a vertical integration gap (VPIB), where responsibilities for contaminated land are not clearly distributed across governance levels. Like UDRO, municipalities' urban regeneration efforts are limited to Deteriorated Urban Fabric (DUF). Drawing on international experience, the PIB framework suggests that municipalities could assume operational responsibility for brownfield sites, including implementing development plans, managing land registries and providing incentives such as tax relief or insurance support.

4.2.2 Environmental protection agencies. An essential aspect of brownfield regeneration in any country is the accountability of EPAs. The PIB framework highlights the pivotal role EPAs play in evaluating, negotiating, decision-making and regenerating brownfields or contaminated sites. In Iran, however, the issue of soil and groundwater contamination has yet to be fully integrated into the urban management and development system. From the perspective of the PIB framework, this reflects a horizontal integration gap (HPIB), where environmental oversight functions are not systematically embedded within land-use planning and redevelopment processes. This responsibility falls under the Iranian DoE, which has served as the national agency for environmental protection since its establishment in 1956. The DoE is organized into three primary divisions:

- (1) human environment,
- (2) natural environment and biodiversity; and
- (3) marine environment.

Within the Human Environment Division, soil and groundwater contamination are specifically addressed by the Soil and Water Section, the Pervasive Environmental Monitoring Section and the Environmental Assessment Section. These specialized sections are crucial to the DoE's efforts in managing and mitigating environmental issues, particularly those related to contaminated sites. They also have the authority to set guidelines and standards for assessing, monitoring and remediating soil and groundwater contamination, thereby contributing to environmental protection in the country.

4.3 PIB – dimension III; regeneration elements

The third dimension of the PIB involves a comparative analysis of brownfield regeneration policies and practices across different contexts and political regimes, including Iran. Using the PIB framework, and its key regeneration elements, this study explores how these elements can be leveraged to enhance decision-making and implementation processes in Iran.

4.3.1 Legal definition. As outlined in the PIB framework, brownfields are defined in various ways across different regions of the world. Over the past two decades, the definition

of brownfields has become a significant focus of both political and scientific discourse. This issue gained momentum in the early 2000s when several developed nations began to actively address the brownfield phenomenon. Alker *et al.* (2000) and Yount (2003) made seminal contributions to the discussion surrounding the definition of brownfields. They noted that achieving a consensus on such a definition is challenging, as it is likely that certain vested interests may not be fully satisfied. Yount (2003) further argued that a conceptual definition of brownfields should include unambiguous terms and provide policymakers and practitioners with the flexibility to address the dual nature of brownfields as both environmental and economic challenges. In line with Yount's characterization, a legal definition of brownfields should encompass three key aspects: environmental degradation, physical deterioration and economic instability. These aspects are shaped by the inherent characteristics of brownfields, including soil and groundwater contamination, as well as dereliction, vacancy and long-term abandonment of sites.

Terminologies for brownfield sites vary significantly across different national contexts, reflecting divergent policy priorities and historical legacies. In countries such as the USA, Japan, Italy and Spain, brownfields are primarily defined by the presence or suspicion of contamination, with emphasis placed on environmental risk, public health concerns and the need for remediation (Grimski and Ferber, 2001; Thornton *et al.*, 2007; Jacek *et al.*, 2022). This contamination-focused approach typically involves legal or regulatory frameworks that trigger site assessments and cleanup obligations. In contrast, countries like the UK, Germany and France adopt a broader definition that includes vacant, derelict or PDL, regardless of whether contamination is present (Rizzo *et al.*, 2015; Rey *et al.*, 2022). These definitions prioritize land-use efficiency, urban densification and the regeneration of underused sites within the existing urban fabric. The conceptual divergence between these approaches has important implications for policy design, institutional responsibility and data collection. It also shapes the perceived urgency and types of interventions that governments pursue, from environmental remediation to economic revitalization and spatial planning.

In Iran, there is currently no established definition for brownfields within the legislative framework. The term "brownfield" is not recognized in Iran's urban or environmental vocabulary. Iran's urban regeneration policies primarily focus on addressing deteriorated residential areas. This narrow focus has led to a lack of awareness and neglect of environmentally contaminated sites across various levels of governance and policymaking. Using the PIB framework, it becomes clear that brownfield definitions are typically established by either EPAs (e.g. USEPA in the USA) or LPAs (e.g. the Ministry of Housing, Communities and Local Government in the UK). In Iran, there is no legal definition for brownfields yet. MRUD, as the primary urban planning authority, has developed terms such as DUF and Underused and Deteriorated Urban Fabric (UDUF) for distressed urban areas. Under the 2015 urban regeneration agenda, the Iranian government expanded the scope of DUF to include irregular rural zones and incompatible urban areas, such as abandoned factories and barracks (MRUD, 2015). This expanded definition is somewhat similar to the broad definitions used in European countries. However, MRUD's new terms do not address environmental contamination or economic instability, which are commonly associated with brownfields. Despite this definitional expansion, Iran's urban regeneration policies continue to focus on deteriorated housing areas and informal settlements, leaving industrial and military brownfields largely unaddressed.

4.3.2 Supporting tools, programs and incentives. The PIB emphasizes that successful brownfield regeneration depends on a diverse array of policy instruments and programs aimed at reducing uncertainties for investors and private stakeholders, thereby boosting their involvement. Analysis of international case studies within the PIB framework categorizes

these support measures into two types: monetary incentives (e.g. tax relief, loans, grants and credits) and nonmonetary incentives (e.g. environmental insurance, liability programs, technical assistance). The experiences of the USA and the European Union offer valuable lessons when comparing brownfield regeneration strategies with those in Iran. Since the late 1970s, the USA has led efforts to address environmental issues related to contaminated sites through pioneering programs like the EPA's Brownfields Program, Superfund and Voluntary Cleanup Programs (Wernstedt *et al.*, 2013; Lyon *et al.*, 2018; Berman *et al.*, 2022). The EPA's Brownfields National Partnership Agenda (USEPA, 1997) significantly advanced multiagency collaboration and partnership-building across federal departments. This agenda, along with the Partnership for Sustainable Communities, fostered coordinated efforts among the Department of Transportation (DOT), the Department of Housing and Urban Development (HUD) and the EPA in addressing brownfield projects. These US programs offer a comprehensive suite of monetary and nonmonetary incentives, including cleanup subsidies, liability relief, technical assistance, environmental insurance and tax benefits. They also empower state governments with significant authority and responsibility in managing the remediation and redevelopment of contaminated sites.

Similarly, the EU has, over the past 15 years, developed effective planning policies for brownfield recycling and reuse. The EU and the European Environment Agency have created robust structural funding programs, such as the European Structural and Investment Funds, and established a liability framework through the Environmental Liability Directive (ELD) to support brownfield regeneration across member states (Berman *et al.*, 2022). In addition to EU-wide efforts, countries like the UK, Netherlands, France and Germany have developed national strategies focused on the protection, management and sustainable use of soil (Ginzky, 2021; Hou *et al.*, 2023; Nijkamp *et al.*, 2002). These nations have also implemented broader spatial-environmental integration policies, offering valuable tools for land-use management, particularly at the state and local levels. The diversity of monetary and nonmonetary instruments identified through the PIB framework is summarized in Figure 5.

In contrast to many other countries, Iran lacks dedicated legislation, institutional frameworks and financial programs specifically aimed at supporting brownfield regeneration. While the DoE introduced the Soil Quality Standards Guidelines (SQSG) in 2013 as the country's primary technical framework for soil contamination, its practical utility remains limited. The SQSG is largely preventive rather than forward-looking, offering general thresholds for pollutants across different land-use categories but lacking detailed implementation guidance. This ambiguity weakens its ability to support risk-based remediation or provide clear standards for redevelopment. Moreover, the guidelines focus predominantly on soil, offering little integration with groundwater contamination issues, an omission that limits their relevance for comprehensive site assessments. Compared to international practices, such as the EPA's liability relief and cleanup funding in the USA, or the EU's structured financial and regulatory instruments, the Iranian framework remains underdeveloped and fragmented. MRUD does oversee several planning instruments, including City Development Plans and Land Preparation Plans, which are implemented by local municipalities. However, these tools focus primarily on physical infrastructure and land preparation and offer minimal consideration of environmental remediation. The absence of integrated incentives, whether monetary, legal or technical, discourages private investment in contaminated land and undermines the feasibility of sustainable brownfield regeneration. Without an operational alignment between environmental and planning authorities, Iran's existing tools fall short of facilitating responsible and cost-effective redevelopment of brownfield sites.

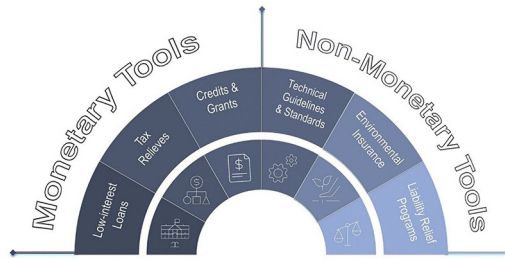


Figure 5. Monetary and nonmonetary tools for brownfields regeneration

Source: Authors' own work

4.3.3 Polluter-Pays principle and environmental liability issues. The Polluter-Pays Principle (PPP) is a cornerstone of environmental law in many developed countries, aimed at preventing and remedying environmental damage by assigning responsibility to those who cause pollution. The PIB model emphasizes that the effective implementation of PPP is crucial in the brownfield regeneration process. In both the USA and the European Union, legal liability for the costs associated with residual or new contamination is thoroughly addressed within environmental management policies and regulatory frameworks. The Love Canal incident in the late 1970s, for instance, spurred the US federal and state governments to introduce a wide range of legal initiatives, such as Superfund, RCRA, SARA and the Brownfields Law, that impose retrospective liability on developers or landowners responsible for site contamination (Fletcher, 2002). Similarly, to protect innocent landowners or new purchasers, the European Commission developed the ELD, which provides EU member states with comprehensive legal liability frameworks for the remediation and reuse of contaminated sites (Winter et al., 2008). Notably, before the ELD's enactment in 2006, various European nations had already established their own regulatory relief programs. For instance, the UK's Environmental Protection Act of 1990 sought to categorize polluters, allowing for the determination or transfer of liability for remediation under specific circumstances (Nathanail, 2011).

The PPP is not formally embedded in Iran's environmental policy. The current legal and regulatory framework of the DoE lacks the comprehensive legislative resources, tools and statutes necessary to address environmental liability adequately. This gap reflects a limited understanding of the environmental liability issue among the public and key stakeholders. Moreover, Iran's environmental system does not enforce accountability for the environmental damage caused by polluters. Landowners and developers in Iran typically lack awareness of soil contamination. In the absence of a regulatory framework and a viable enforcement mechanism, there is no legal obligation for stakeholders to negotiate cleanup responsibilities. Consequently, brownfields in Iran are often redeveloped without conducting risk assessments or implementing necessary remediation measures for soil and groundwater contamination.

4.3.4 Redevelopment approach in policy and practice. The PIB underscores the significance of site redevelopment approaches in shaping brownfield policy and practice. Two primary remediation strategies are used globally to address contaminated sites: the "total clean-up approach" and the "risk-based approach." The total clean-up approach, prevalent in countries such as the USA, Japan and China, entails comprehensive remediation of a site regardless of its intended future use. In contrast, the risk-based approach customizes remediation efforts based on the site's proposed end use, the probability of human exposure

and available resources. The total clean-up approach, though thorough, often necessitates the use of various expensive techniques to eliminate contamination entirely (Hollander *et al.*, 2010; Eckerd and Keeler, 2012). The risk assessment, evaluation and remediation processes involved in this approach can be prohibitively costly, leading to its limited adoption in most countries. On the other hand, the risk-based approach is more cost-effective, as it adjusts the scope of remediation to align with the level of risk appropriate for the prospective land use (Stezar *et al.*, 2013; Hou *et al.*, 2023). Due to its economic feasibility, particularly in urban areas where development costs are high, the risk-based approach has garnered increasing attention from policymakers and practitioners. For instance, the EC has mandated that EU member states establish a proportionate risk-based approach to soil contamination within a binding regulatory framework by 2020.

In the Iranian context, where land marketability and development costs are significant concerns, the risk-based approach could offer a more effective solution for brownfield activities by substantially reducing investigation and remediation expenses. The DoE, through its Soil Quality Standards and Guidelines (SQSG), recognizes the risk-based approach, identifying soil contamination thresholds across five distinct categories. Despite these legislative efforts, cost-effective redevelopment remains difficult in Iran due to the absence of clear guiding principles, limited infrastructure and insufficient technical expertise in soil and groundwater remediation. Examining the experiences of other countries and the current institutional framework in Iran reveals a gap in the capacity of the DoE and MRUD, or their certified agencies, to provide a coherent framework for stakeholders. This gap includes a lack of familiarity with various remediation techniques and their potential implications. At present, Iran's environmental protection and urban planning policy frameworks do not support the identification, remediation and reuse of contaminated sites. This shortfall is largely attributed to the lack of a cross-sectoral system that facilitates feasibility analysis for clean-up processes, assesses associated risks and identifies suitable remediation technologies for developers.

4.3.5 Contamination label and land registration. Addressing brownfield issues involves a bilateral responsibility between policymakers and the public, underscoring the importance of shared accountability in the processes of site identification, investigation, assessment and remediation. To streamline these processes, many governments are compelled to establish a land registry system and conduct a comprehensive national survey of contaminated sites (Wang *et al.*, 2023; De Sousa *et al.*, 2023). Such a system allows authorities to accurately quantify contaminated sites by providing detailed information on location, size, land value, former uses, periods of idleness, types of contamination and degrees of risk (De Sousa, 2021). By making these records public, prospective buyers and developers can be informed of the presence of soil contamination, whether real or perceived. However, several countries still lack quantitative standards or statistical databases for identifying contaminated sites. For example, in China, the government provides only a general overview of soil contamination through national bulletins, without offering comprehensive site-specific data (Mehdipour and Kellett, 2024).

From a public safety perspective, landowners bear the responsibility of registering their contaminated sites on national platforms. Nonetheless, this process is often fraught with challenges due to the environmental and socioeconomic complexities associated with brownfields. Contaminated sites frequently carry a stigma, and the negative image resulting from potential contamination can be a significant deterrent (Zhuang *et al.*, 2016; Greenberg, 2023). The PIB framework suggests that such cultural and social stigmas pose significant obstacles to accurately quantifying the extent of brownfield issues in many countries. This problem is particularly pronounced in countries like Japan, where strong social concerns and cultural discontent over contamination are prevalent (Mehdipour, 2020). Developers,

concerned about the economic impact and high remediation costs, may be reluctant to register their contaminated land, further exacerbating the stigma issue and complicating communication between landowners, developers and potential buyers. Conversely, in the USA, government funding programs and supportive tools have significantly mitigated these risks. Policy incentives, coupled with a transparent system, have not only reduced the stigma associated with brownfields but have also provided developers with substantial economic advantages over other locations.

In Iran, public awareness of soil contamination and its associated risks is notably limited. Cultural and policy attitudes do not emphasize land contamination as a significant issue, resulting in a general lack of recognition and concern. This limited awareness means that brownfields are not heavily stigmatized, potentially making it easier to establish a register of contaminated sites compared to contexts where such sites are more stigmatized. This limited familiarity with brownfield issues presents both a policy and market opportunity, creating space to establish site identification and management strategies without entrenched institutional resistance or societal bias. Nevertheless, this situation underscores the critical need for substantial efforts to enhance public education and awareness about soil contamination. Engaging the private sector and various levels of governance is essential to fostering a more informed and proactive approach to brownfield issues. Without a deeper understanding and acknowledgment of the risks associated with contaminated sites, policy initiatives may struggle to gain traction and achieve effective implementation. Addressing this gap in awareness is crucial for advancing both market solutions and regulatory measures, ultimately leading to more comprehensive and effective brownfield management strategies in Iran. The cumulative findings across the three PIB dimensions are synthesized comparatively in [Figure 6](#).

5. Discussion

The current state of land use planning and environmental protection in Iran presents significant challenges for the regeneration of brownfield sites. These governance challenges are unfolding alongside broader structural economic pressures, including sanctions-induced recession and the gradual decline of traditional industrial sectors, which have increased the number of underused and abandoned industrial sites in Iranian cities. The relatively low policy profile of brownfields in Iran has contributed to governance inaction and institutional fragmentation. Drawing on the analytical results generated through the three dimensions of the PIB framework, this study identifies and unpacks five key challenges that collectively hinder the development of a coherent and effective brownfield regeneration strategy. These findings are discussed below in relation to international experience and broader debates on policy integration and urban governance. In particular, the discussion interprets these challenges through the integration axes embedded within Dimension II of the PIB framework, namely, horizontal integration between planning and environmental sectors (HPIB) and vertical integration across national, regional and municipal governance levels (VPIB).

5.1 Institutional misalignment across policy domains

There is a pronounced misalignment between Iran's urban planning and environmental governance systems, manifesting both vertically (across government levels) and horizontally (across policy sectors). From the perspective of the PIB framework, these deficiencies reveal weaknesses along both integration axes. Vertical Policy Integration for Brownfields (VPIB) remains limited, as national environmental mandates are weakly translated into municipal practice. Horizontal Policy Integration for Brownfields (HPIB) is also insufficient, due to

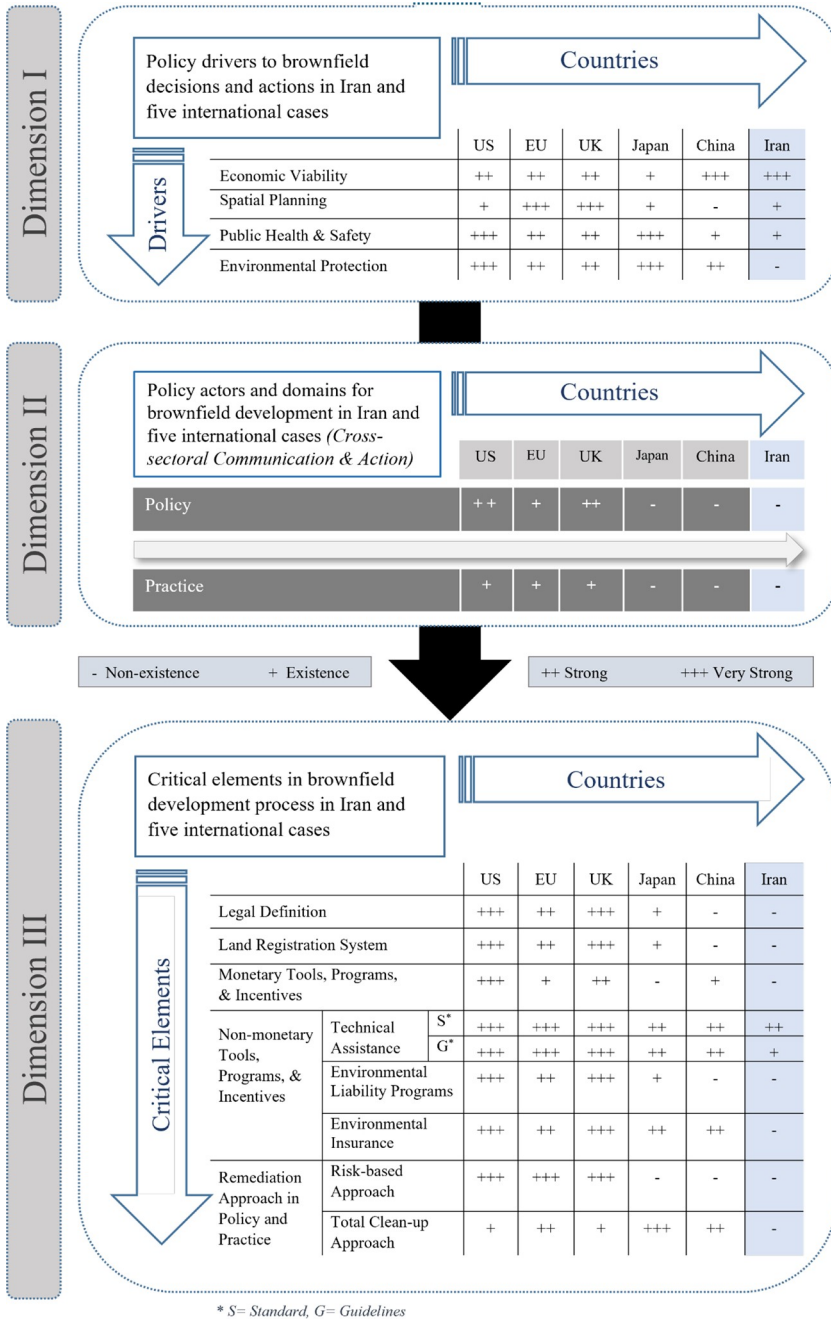


Figure 6. Comparative analysis of brownfield policy and practice in Iran through the lens of PIB

Source: Authors' own work

poor coordination between LPAs and EPAs. Municipalities, particularly in large cities, operate with considerable autonomy yet without corresponding environmental mandates, creating inconsistencies in land management and weakening oversight of brownfield redevelopment. This vertical fragmentation prevents national environmental priorities from being coherently operationalized at the local level.

Horizontally, the institutional disconnect between MRUD and DoE further undermines integration. Environmental oversight is not systematically embedded within urban development plans, and contaminated land considerations are rarely incorporated into spatial planning instruments or redevelopment approvals. This structural HPIB gap reinforces siloed decision-making and reactive governance, leaving brownfield sites overlooked or addressed in an ad hoc manner. Similar coordination challenges have been observed in other governance contexts where environmental regulation and spatial planning operate separately. International experience demonstrates that effective brownfield regeneration depends on formalized coordination mechanisms and clearly defined inter-agency responsibilities (Mehdipour *et al.*, 2024). In their absence, as in Iran, policy fragmentation persists and sustainable redevelopment remains constrained.

5.2 *Regulatory conflicts between municipalities and developers*

Conflicts of interest between municipal authorities and private developers constitute another major barrier to brownfield regeneration. Although municipalities are legally responsible for implementing urban development plans, including CDPs and DPs, they often face financial constraints, outdated planning instruments and limited enforcement capacity. These issues frequently give rise to disputes during land-use negotiations and development approval processes, particularly for sites designated for public services. Developers and landowners, motivated by higher returns from commercial or residential uses, are often reluctant to comply with regulatory provisions. Similar tensions between public planning goals and private development interests are widely documented in the brownfield literature, especially where liability rules and financial incentives are unclear or insufficient to offset remediation costs. While the Commission of Article No. 5 offers a mechanism for amending planning regulations and facilitating land transfers, it has not been sufficient to resolve the underlying tensions. As a result, many brownfield sites remain abandoned due to ongoing disagreements over ownership, land use and redevelopment responsibilities. This finding underscores the importance of regulatory clarity and incentive structures, which have been shown in other countries to reduce uncertainty and encourage developer participation in brownfield regeneration.

5.3 *Narrow focus of urban regeneration policy*

Iran's urban regeneration agenda remains heavily focused on structurally deteriorated housing and informal settlements, collectively referred to as DUF. While this focus responds to widespread sociospatial inequalities, it has inadvertently diverted attention away from brownfield sites, particularly those with environmental contamination. Even when regeneration policy has expanded to include broader categories such as UDUF, these efforts continue to emphasize physical and structural decline over environmental risk. This pattern contrasts with international approaches where brownfield regeneration is increasingly embedded within broader land recycling and sustainability agendas, rather than treated as a subset of housing renewal policy. Such prioritization of DUF over contaminated industrial land reflects a vertical integration gap (VPIB), where national regeneration agendas are not aligned with environmental risk management objectives. Simultaneously, the marginalization of contamination within regeneration policy reveals persistent horizontal

separation between housing policy and environmental governance domains (HPIB). According to MRUD's estimates, DUF zones cover roughly 30% of urban land in Iran, justifying their prioritization. However, this has led to the relative neglect of greyfields and brownfields, which carry both environmental liabilities and redevelopment potential. Moreover, limited public awareness of soil contamination, compared with air and water pollution, further reduces the priority given to brownfield remediation in both policy debates and planning practice.

5.4 Absence of a legislative framework for brownfields

One of the most fundamental obstacles to brownfield regeneration in Iran is the absence of a legal framework that formally defines, regulates or supports the management of contaminated land. There are no national guidelines or registries for identifying and tracking polluted sites, nor are there statutory requirements for environmental assessments prior to redevelopment. Cleanup efforts are sporadic and typically initiated only in response to public complaints or accidental contamination events. Brownfield sites that are inactive or unregistered fall outside existing regulatory mechanisms, creating a significant governance blind spot. In contrast, international experience demonstrates that formal legal definitions, liability regimes and site registries play a critical role in enabling systematic brownfield management and reducing redevelopment risks. Without liability protections, financial incentives or risk-sharing mechanisms, developers often proceed with redevelopment unaware of potential contamination and environmental authorities lack the legal mandate to intervene. This legislative vacuum severely limits Iran's capacity to manage environmental health risks and promote sustainable land reuse. The absence of a unified legal definition and liability regime also weakens both integration axes of the PIB model: horizontally, by failing to formally connect environmental regulation with land-use planning; and vertically, by preventing coherent policy transmission from national legislation to municipal implementation practices.

5.5 Limitations of the Soil Quality Standards and Guidelines

Although the SQSG, introduced in 2013, represents an important step toward standardized environmental monitoring, it remains technically limited and poorly suited for brownfield remediation. Originally designed for agricultural land, the SQSG has been used only occasionally to assess industrial or postindustrial sites. Several limitations impede its effectiveness:

- *Lack of clarity:* The SQSG lacks clear guidance on whether it applies to current or future land uses, a critical distinction for brownfield redevelopment. Its preventive focus prioritizes preserving existing soil conditions rather than enabling risk-based remediation aligned with future uses. As a result, its application has been limited, with recent use by the DoE mainly confined to agricultural, mining and petroleum contexts, rather than urban redevelopment.
- *Limited provision for references:* The SQSG appears to incorporate information from soil contamination standards in countries such as the USA, England, Canada and Australia, but lacks references to these sources. This absence of citation may have led to misinterpretations and inaccuracies in the standards, with potential mistranslations contributing to the document's vagueness.
- *Insufficient guidance on groundwater contamination:* The SQSG focuses primarily on soil quality and pollution, overlooking the integrated treatment of contaminated soil and groundwater. Since groundwater systems can be contaminated through water flow and

dispersion in aquifers, the absence of guidance on groundwater contamination represents a crucial gap that necessitates additional attention and technical support.

- *Absence of clear guidelines:* The SQSG offers environmental quality standards but lacks a forward-looking approach for remediation. Its general and superficial instructions for contamination assessment and cleanup highlight a significant gap. In contrast, countries such as Japan and China, despite not emphasizing risk-based approaches in their brownfield legislation, have developed detailed technical guidelines for effective remediation practices.

Similar limitations have been identified in other countries where soil standards were not originally designed for urban redevelopment contexts, highlighting the need for adaptive, risk-based frameworks aligned with future land use scenarios. These challenges illustrate a policy environment that is reactive, fragmented and dominated by short-term economic considerations. Without institutional coordination, legal clarity or operational guidance, brownfield sites in Iran are often neglected or mishandled. However, the relative lack of public awareness and regulatory entrenchment also presents an opportunity: Iran has the potential to shape a forward-looking brownfield policy from the ground up, learning from international models while adapting them to local governance structures and sociopolitical realities. Future reforms should focus on developing integrated frameworks that combine environmental safeguards with spatial planning objectives, supported by clearly defined roles, liability protections and stakeholder engagement mechanisms. This requires not only internal reform, but also opportunities for regional cooperation and policy experimentation, especially in contexts facing similar postindustrial urban challenges.

5.6 Implications and replicability of the findings

The findings of this study have important implications for both policy development and analytical practice in emerging governance contexts. From a policy perspective, the findings show that brownfield regeneration cannot be managed through isolated sectoral measures, but requires coordinated legal, institutional and operational frameworks that link environmental protection with planning and redevelopment decisions. The absence of such integration in Iran helps explain persistent implementation gaps and governance failures identified across the PIB dimensions. From an analytical perspective, applying the PIB framework shows that it can operate as a structured analytical lens for evaluating brownfield governance in settings marked by fragmented institutions and nascent regulatory systems. While the empirical focus of this study is Iran, the structural challenges identified, such as weak policy integration, unclear institutional mandates and limited regulatory capacity, are common to many postindustrial and rapidly urbanizing regions. As such, the PIB framework can be adapted and applied in other emerging or transitional policy settings to support comparative analysis, policy learning and evidence-based reform. Future research could also further examine the applicability of VPIB and HPIB across different national governance models, assessing how variations in vertical and horizontal integration influence the effectiveness of brownfield policy design and implementation.

6. Conclusion

This study applied the PIB framework to assess the readiness and capacity of Iran's institutional and regulatory landscape to address brownfield regeneration. By situating Iran's experience within broader international debates on policy integration and urban governance, the research examined how environmental, planning and institutional dimensions interact in shaping brownfield outcomes. The findings reveal several structural and procedural

challenges across all key dimensions of the PIB framework. Although MRUD, DoE and local municipalities play central roles in urban planning and environmental governance, their mandates remain fragmented and poorly coordinated. This lack of integration has contributed to a governance environment where brownfield sites, often environmentally degraded, socially neglected and economically underused, are not systematically identified, assessed or remediated. Current urban regeneration efforts continue to focus narrowly on deteriorated residential fabrics, with little to no institutional attention given to contaminated or abandoned industrial lands. The absence of a clear legal framework for brownfields, including a formal definition, liability provisions, incentive mechanisms and contamination registries, further deepens the problem and leaves significant risks unmanaged.

Despite increasing market interest in high-value urban land, particularly former industrial sites in central areas, Iran's approach continues to prioritize short-term economic gains over long-term environmental protection, public health and urban resilience. Sites with a high likelihood of contamination are frequently redeveloped without environmental assessments or cleanup obligations, a condition enabled by the limited scope and technical ambiguity of the existing SQSG. The absence of an enforceable environmental liability framework, coupled with limited public and stakeholder awareness of soil contamination, restricts both accountability and reform momentum. To move forward, Iran must adopt a more integrated and context-sensitive policy model, one that embeds the principles of PPP, strengthens coordination between LPAs and EPAs and aligns planning and environmental frameworks. From a planning and policy perspective, these findings underscore the need for integrated governance frameworks that formally align land-use planning, environmental regulation and redevelopment incentives. Drawing from international experiences and the structural insights provided by the PIB, Iran can begin to formulate a comprehensive policy framework that not only encourages economic reuse but also safeguards environmental health and public well-being.

Beyond the Iranian context, this study demonstrates the analytical value of PIB as a transferable and replicable methodological framework for diagnosing integration gaps in brownfield governance. By linking policy drivers, institutional arrangements and regeneration instruments, PIB provides a structured approach that can be adapted to other governance contexts facing institutional fragmentation and regulatory uncertainty. This study is subject to several limitations that should be acknowledged. First, the analysis is based primarily on qualitative data, including expert interviews and document analysis, which limits the generalizability of findings beyond the Iranian context. Second, although policy developments were current at the time of writing, institutional dynamics and regulatory frameworks continue to evolve and future reforms may modify the conditions identified in this study. Third, the absence of comprehensive national data on contaminated land constrained the ability to conduct spatially explicit or quantitative assessments of brownfield distribution and risk. These limitations highlight the need for continued empirical research and improved data availability.

Future research should aim to further operationalize the PIB framework in diverse regional and urban contexts across Iran, particularly in cities with a legacy of industrial decline or military use. Empirical studies involving spatial mapping of suspected brownfield sites, combined with environmental risk assessments, would provide critical baseline data for policymaking. In addition, quantitative studies examining the socioeconomic impacts of brownfield regeneration, such as effects on housing markets, health outcomes or land values, could complement this study's qualitative findings. There is also a need to explore the feasibility and design of public-private partnership models for brownfield remediation in the Iranian context, as well as public perception and community engagement strategies. Finally,

comparative research across Global South countries could yield valuable insights into how emerging economies are addressing institutional and legal voids in brownfield governance, offering a basis for transnational knowledge exchange and collaborative policy development.

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Table A1. List of interview participants and their details

Participant	Profession (expertise)	Position/affiliation	Years of experience
<i>Urban scholars and academics</i>			
Participant 01	Urban planner and designer, researcher and academic	Professor/Faculty of Architecture and Urban Planning, Shahid Beheshti University	20–25
Participant 02	Urban planner, researcher and academic	Associate Professor/Faculty of Architecture and Urban Planning, Shahid Beheshti University	10–15
Participant 03	Urban planner and geographer, researcher and academic	Associate Professor/Faculty of Management and Accounting, Shahid Beheshti University	10–15
Participant 04	Urban designer, researcher and academic	Assistant Professor/Faculty of Architecture and Urban Planning, Shahid Beheshti University	5–10
Participant 05	Urban planner, researcher and academic	Professor/School of Urban Planning, University of Tehran	20–25
Participant 06	Urban planner and designer, researcher and academic	Associate Professor/School of Urban Planning, University of Tehran	10–15
Participant 07	Urban planner and designer, researcher and academic	Assistant Professor/School of Urban Planning, University of Tehran	5–10
Participant 08	Urban planner and designer, researcher and academic	Associate Professor/Faculty of Art and Architecture/School of Urban Planning, Tarbiat Modares University	10–15
Participant 09	Urban planner and designer, researcher and academic	Associate Professor/Faculty of Art and Architecture/School of Urban Planning, Tarbiat Modares University	10–15
Participant 10	Urban planner, researcher and academic	Professor/Faculty of Art and Architecture, Shiraz University	20–25
Participant 11	Urban planner, researcher and academic	Professor/Faculty of Art and Architecture, Shiraz University	20–25
Participant 12	Urban designer, researcher and academic	Assistant Professor/Faculty of Art and Architecture, Shiraz University	5–10
Participant 13	Architect and urban designer, researcher and academic	Professor/Faculty of Architecture and Urban Planning, Shahid Beheshti University	20–25
Participant 14	Architect and urban designer, researcher and academic	Associate Professor/Faculty of Architecture and Urban Planning, Shahid Beheshti University	10–15

(continued)

Table A1. Continued

Participant	Profession (expertise)	Position/affiliation	Years of experience
Participant 15	Architect and urban designer, researcher and academic	Associate Professor/School of Urban Planning, University of Tehran	10–15
Participant 16	Architect and urban designer, researcher and academic	Associate Professor/School of Urban Planning, University of Tehran	10–15
<i>Government officials</i>			
Participant 17	Central Government Official	Deputy of the Department/ Coordinating and Planning Department, Urban Renovation Organization of Tehran Municipality	20–25
Participant 18	Central Government Official	Board of Directors/Urban Development and Revitalization Organization of Iran (UDRO)	20–25
Participant 19	Central Government Official	Manager in Charge/Urban Development and Revitalization Organization of Iran (UDRO)	10–15
Participant 20	State Government Official	Manager in Charge/UDRO's Department in Fars Province, MRUD	10–15
Participant 21	State Government Official	Head of the Department/ UDRO's Department in Fars Province, MRUD	10–15
Participant 22	State Government Official	Officer/UDRO's Department in Fars Province, MRUD	10–15
Participant 23	Municipal Government Official	Deputy of the Department/ Coordinating and Planning Department, Urban Renovation Organization of Tehran Municipality	15–20
Participant 24	Municipal Government Official	Deputy of the Department/Urban Development Department, Qaemshahr Municipality in Mazandaran Province	15–20
Participant 25	State Government Official	Head of the Department/ Department of Roads and Urban Development in Qaemshahr, Mazandaran Province, MRUD	15–20
Participant 26	State Government Official	Officer/UDRO's Headquarter in Mazandaran Province, MRUD	5–10
Participant 27	State Government Official	Head of the Department/ UDRO's Department in Mazandaran Province, MRUD	10–15
Participant 28	Municipal Government Official	Deputy of the Organization/ Organization of Urban Industries and Businesses Co., Shiraz Municipality	15–20

(continued)

Table A1. Continued

Participant	Profession (expertise)	Position/affiliation	Years of experience
Participant 29	Municipal Government Official	Head of the Department/ Department of Polluting Businesses, Organization of Urban Industries and Businesses Co., Shiraz Municipality	15–20
Participant 30	Municipal Government Official	Head of the Department/ Department of Polluting Businesses, Organization of Urban Industries and Businesses Co., Sari Municipality	15–20
Participant 31	Municipal Government Official	Deputy of the Department/Urban Development Department, Sari Municipality in Mazandaran Province	15–20
Participant 32	State Government Official	Technical and Environmental Officer/Department of Chemistry, Technical and Soil Mechanics Laboratory (TSML) in Mazandaran Province, MRUD	5–10
Participant 33	State Government Official	Technical and Environmental Officer/Division of Soil & Water, Department of Environment (DoE) in Fars Province	5–10
Participant 34	State Government Official	Technical and Environmental Officer/Division of Environmental Assessment and Monitoring, Department of Environment (DoE) in Fars Province	5–10
Participant 35	State Government Official	Technical and Environmental Officer/Division of Environmental Assessment and Monitoring, Department of Environment (DoE) in Fars Province	5–10
Participant 36	State Government Official	Urban Planning Officer/ Department of Roads and Urban Development in Qaemshahr, Mazandaran Province, MRUD	5–10
Participant 37	State Government Official	Architect and Urban Design Officer/Department of Roads and Urban Development in Qaemshahr, Mazandaran Province, MRUD	10–15
Participant 38	State Government Official	Technical and Environmental Officer/Department of Geotechnics, Technical and Soil Mechanics Laboratory (TSML) in Mazandaran Province, MRUD	5–10

(continued)

Table A1. Continued

Participant	Profession (expertise)	Position/affiliation	Years of experience
Participant 39	State Government Official	Technical and Environmental Officer/Department of Chemistry, Technical and Soil Mechanics Laboratory (TSML) in Mazandaran Province, MRUD	5–10
<i>Industry stakeholders</i>			
Participant 40	Principal project designer	Principal Project Designer/Tar-o Pood Museum Project (Development of the former site of the Shiraz Textiles Manufacturing in Shiraz, Fars Province)	10–15
Participant 41	Project manager and developer	Project Manager (Development of the former site of the Shiraz Textiles Manufacturing in Shiraz, Fars Province)	10–15
Participant 42	Project advisor	Project Advisor (Development of the Former Site of the Shiraz Textiles Manufacturing in Shiraz, Fars Province)	20–25
Participant 43	Project manager and developer	Project Manager (Development of the former site of the Nassaji Mazandaran Textiles Factory No. II in Qaemshahr, Mazandaran Province)	10–15
Participant 44	Project advisor	Project Advisor (Development of the former site of the Nassaji Mazandaran Textiles Factory No. II in Qaemshahr, Mazandaran Province)	20–25
Participant 45	Project manager and developer	Project Manager (Development of the former Khoshnoosh Carbonated Drinks and Plastic Packaging Factory in Sari, Mazandaran Province)	10–15
Participant 46	Land developer and builder	Office Manager/Headquarter office in Juybar, Mazandaran Province, Iran Construction Engineering Organization (IRCEO)	5–10
Participant 47	Land developer and builder	Office Manager/Headquarter office in Qaemshahr, Mazandaran Province, Iran Construction Engineering Organization (IRCEO)	5–10
Participant 48	Land developer and builder	Office Manager/Headquarter office in Sari, Mazandaran Province, Iran Construction Engineering Organization (IRCEO)	5–10

(continued)

Table A1. Continued

Participant	Profession (expertise)	Position/affiliation	Years of experience
Participant 49	Land developer and builder	Office Manager/Headquarter office in Sari, Mazandaran Province, Iran Construction Engineering Organization (IRCEO)	10–15
Participant 50	Land developer and builder	Office Manager/Headquarter office in Shiraz, Fars Province, Iran Construction Engineering Organization (IRCEO)	20–25
Participant 51	Land developer and builder	Office Manager/Headquarter office in Shiraz, Fars Province, Iran Construction Engineering Organization (IRCEO)	20–25
Participant 52	Land developer and builder	Office Manager/Headquarter office in Tehran, Iran Construction Engineering Organization (IRCEO)	10–15
Participant 53	Land developer and builder	Office Manager/Headquarter office in Tehran, Iran Construction Engineering Organization (IRCEO)	10–15
Participant 54	Land developer and builder	Office Manager/Headquarter office in Tehran, Iran Construction Engineering Organization (IRCEO)	10–15

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