

Review

Transitioning from Social Innovation to Public Policy: Can Bangladesh Integrate Urban Rooftop Farming Policies into Governance by Examining Global Practices?

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Abstract

The concept of green cities promotes efficient utilisation of resources, with urban rooftop farms (URFs) being a key initiative involving a series of actions and decisions between stakeholders and the state. The new public governance discourse (NPGD) emphasises this interplay between the state, the market, and civil society to strengthen collaboration and network-driven social innovation and requires a comprehensive understanding of human/stakeholder behaviour. In this study, we explore the connection between organisational rational choice in URF policy development and social innovation. Through a review of the existing literature on URF policies and a case study of Dhaka, Bangladesh, we investigate the development of a comprehensive policy via participation and collaboration, considering the popularity of URFs and the absence of governing mechanisms in Dhaka. The results suggest that, despite the rising popularity of URFs in Dhaka, existing policies and strategies lack clarity. The review findings suggest that a participatory and co-productive approach is optimal for URF policy formulation. This would require active engagement from community members, local governments, and non-governmental organisations and gaining an enhanced understanding of stakeholder dynamics by testing stakeholder salience and co-production theories for successful URF governance.

Keywords: URF; governance; social innovation; stakeholder salience; ladder of co-production



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1. Introduction

The concept of the green city aims to bolster urban resilience and diminish reliance on external resources by fostering efficiency [1]. Over the past few decades, green infrastructure such as roofs, parks, and rooftop farms has proliferated in cities globally [2]. Research demonstrates that urban rooftop farms (URFs) provide advantages in terms of food security, water management, and biodiversity [3]. Implementing initiatives for URFs necessitates support from policies and governance, as well as strategies customised to local climatic and economic conditions, as emphasised by scholars [4]. This holistic approach is vital for integrating ecological knowledge into urban planning policies.

Public policy entails a variety of governmental interventions aimed at catalysing societal and economic transformations [5]. As stated by Hill and Varone [6], policy encompasses a complex web of decisions and actions rather than a solitary decision. Moreover, this decision-making network can be intricate, contributing to the generation of further actions. Policy is typically shaped through a series of choices that collectively define its

character, as opposed to a single, isolated decision [7]. The emergence of the postmodern state has given rise to the concept of ‘governance’, which underscores the dynamic and multifaceted nature of the policy process [8]. This necessitates a consideration of the full range of stakeholders involved, beyond just the central decision-making authorities, and scrutinising the power dynamics at play [6].

The new public governance discourse (NPGD) underscores the intricate interplay between the state, the market, and civil society, with the aim of fostering collaboration and network-driven social innovation [9]. This approach is grounded in institutional and network theory, as well as the concepts of a pluralist state and co-production. Rather than completely relinquishing the state’s responsibility for social innovation, this perspective seeks to transform the state by encouraging collaborative decision-making through inter-organisational networks [10]. The design of public policy entails establishing incentives and limitations that shape the decisions and actions of both the intended recipients of the policy and the individuals responsible for its implementation. To determine appropriate incentives and limits, a comprehensive understanding of human behaviour and reactions to various stimuli is necessary. The typical approach to policy formation is based on rational choice theory, which presumes that actors have predetermined preferences that guide their decision-making [11].

Bangladesh’s capital city Dhaka, a megacity with a population of 23.21 million, is one of the world’s most densely populated urban centres, grappling with a deteriorating urban environment and substandard living conditions [12]. Fuelled by social media influence and the visible success of URF practices among neighbours and relatives, the adoption of urban rooftop farming is rapidly increasing among urban residents. This trend is motivated by the desire for fresh produce, the creation of private recreational areas, improved environmental quality, the restoration of urban greenery, and the psychological and health advantages associated with such activities [13]. Dhaka has significant potential for URFs, with an estimated 4500 hectares of rooftop space capable of accommodating 4.5 million URFs. One study indicates that Dhaka already boasts over 30,000 URFs, covering approximately 7% of multi-storey building surfaces. Recent research and media reports have highlighted the benefits of URFs for urban residents, including the finding that URFs significantly impact roof and floor temperatures in Dhaka [14]. However, URF practices are not yet integrated into existing policy frameworks, and the necessary support systems to promote their expansion are lacking. Between 1989 and 2020, the city experienced a 56% reduction in healthy green spaces, undermining the conditions needed for a healthy urban environment [15]. Future policy development should prioritise the management and restoration of Dhaka’s green spaces to foster a healthier urban environment.

In this study, the relationship between organisations’ rational decision-making in developing urban agriculture (UA) policies, specifically for URFs, and the role of social innovations is examined. From a theoretical perspective, this study aims to establish connections between the concepts of rational choice theory, governance, social innovation, stakeholder salience, and the ladder of co-production. To achieve this aim and understand the relevant perspectives and approaches, it is crucial to review the existing literature on URF policy formulation processes. The objective is to uncover the different URF policies, their development processes, and the reasoning behind the choice of policy instruments used to support and promote URF initiatives. Furthermore, this study focuses on Dhaka, a city lacking a distinct URF policy despite its widespread adoption by residents. The aim is to determine the most appropriate policy formation process for Dhaka, including analysing global best practices and considering the integration of URFs into broader urban planning and environmental sustainability frameworks.

The sections that follow systematically explore the theoretical underpinnings of policy formulation, the dynamics of social innovation within urban contexts, and specific international case studies on the integration of URF policy into urban governance. Subsequently, a detailed analysis of Bangladesh's current policy landscape is conducted to identify potential pathways and challenges for integrating URF policies within its existing governance structures. Finally, drawing upon these insights, recommendations for the strategic integration of URFs into Bangladesh's urban governance are provided.

2. Theoretical Background

2.1. Realising the Relation Between Rational Choice Theory and URF Governance

Various methodologies exist for analysing the policy processes informed by economic theory, but fundamentally, they are variations of what is known as rational choice theory or public choice theory [6]; it is argued that these are crucial to understanding the assumptions underlying decisions in competitive market scenarios, as they are often employed in political processes. In the case of URF governance, there are two distinct sets of stakeholders who would like to develop a policy that serves their own best interests (individuals who practice urban farming and institutions that govern and develop cities for its residents). A fundamental aspect of this type of theory lies in how its assumptions stem from the idea that individuals behave according to their own best interests.

According to Delshammar and Brincker [16], the stakeholders involved in URF governance include a diverse range of entities, each with their own interests. The rational choice approach to policy formulation recognises these competing stakeholder interests and can inform the development of policy guidelines. Moreover, Smit and Ratta [17] stated that stakeholders play key roles such as regulating, facilitating, providing, and partnering, with governments often engaging in the most extensive tasks. Additionally, policy-making processes involve collaborative decision-making among various participants, highlighting the importance of inclusive approaches [18]. Thus, understanding the interrelationships between concepts such as social innovation, stakeholder theory, and co-production is crucial for shaping the URF policy formulation process.

The rational choice approach to policy formulation emphasises the importance of considering the diverse interests and roles of stakeholders in developing policies that support URFs. This approach recognises that stakeholders, including government bodies, non-governmental organisations, private firms, and the public, each have their own agendas and preferences that influence the policy-making process. By understanding these competing interests, policymakers can develop more comprehensive and effective guidelines to promote URF initiatives. Furthermore, the rational choice perspective emphasises the importance of incentives and limitations in shaping stakeholder behaviour and decision-making [19].

2.2. Social Innovation and New Public Governance

Public policy fundamentally pertains to change, encompassing the transformation of burdens, life opportunities, and power. The concept of public policy lacks significance without the goal of instigating change, so it is essential to establish an intrinsic connection between public policy and social innovation [10]. However, social innovations can transform social connections concerning governance, thereby fulfilling the requirements and enhancing the involvement of marginalised groups in society by augmenting civic capacity to access essential resources. Authors such as [20] defined social innovation as the methods designed to address unmet human needs through collective actions and strengthened social relationships, potentially leading to socio-political reforms and characterising governance as 'innovative methods of administration', encompassing participatory and

collective decision-making alongside traditional governmental structures. Moreover, it is undeniable that both innovations and governance make impactful contributions towards fulfilling sustainable city goals. García and Eizaguirre [21] also found that collective actors can establish new arenas for public discourse and influence everyday behaviours to enhance community life and citizenship.

Among the four discourses of social innovation in the context of governance suggested by Hulgård and Ferreira [10], new public governance emphasises a multifaceted connection among the state, the market, and civil society, intended to strengthen partnerships and network-oriented social innovation across sectoral boundaries. Similarly, van der Heijden [22] characterised new urban governance as a shift toward networks and collaborations of stakeholders addressing urban problems rather than relying on the government itself as the sole authority. Hence, in the case of UA/URF governance, it can be said theoretically that public institutions have a duty to provide suitable platforms for developing a sustainable policy by involving stakeholders and encouraging co-production.

Public policy is fundamentally about instigating change and transforming burdens, opportunities, and power. Social innovation and new public governance are intricately linked, with the former addressing unmet needs through collective action and the latter emphasising multifaceted connections among the state, the market, and the civil society to promote sustainable partnerships and network-driven innovation. Both are crucial for achieving sustainable city goals, involving diverse stakeholders in collaborative decision-making and the co-production of policies for initiatives like the implementation of URFs.

2.3. Stakeholder Salience and the Ladder of Co-Production

When considering a public policy from the perspective of a new public governance, Dahiya and Das [23] stated that participation in the urban policy-making process determines its overall success. Although the level of involvement has always been a matter of debate, the authors in [24] found that participation had a positive impact on policy success. Hence, it becomes significant to understand the role and attitude of stakeholders in urban governance as well as the co-production process of policy formulation in an urban setting.

According to Raha and Hajdini [25], a multi-stakeholder management setting is required to develop an inclusive policy. The stakeholder salience model [26] illustrates the dynamics of stakeholders' power, legitimacy, and urgency. Similarly, the central concept in contemporary NPGD is the notion of co-production, which is closely associated with the concept of collaboration among state and non-state actors in the production or enhancement of public service delivery. Moreover, according to Bandola-Gill and Arthur [27], co-production has become a fundamental term in comprehending the linkages between knowledge and policy.

From the perspective of public policy formulation for URF, the underlying concepts of co-production cannot be overlooked, as the practice developed from the knowledge of stakeholders, who are traditionally not responsible for policy formulation. However, challenges relating to power need to be taken into consideration whenever there is a preference for increased co-production [28]. Hence, both stakeholder salience and the ladder of co-production are central to the concepts of new public governance and social innovation that impact governance.

3. Materials and Methods

To investigate the existing policy and the process of its development, a literature review was conducted on the studies that dealt with URF policies in effect since 2001. This was performed to uncover the approaches used by institutions to adopt policies into governance frameworks. As a result, advanced searches were carried out in Scopus and

Web of Science to gather relevant academic publications. Limiting the search to studies published since 2010 ensured that the analysis focused on the most current developments in URF policy. The search terms targeted key topics, including URF policy, stakeholders involved, and urban rooftop agriculture policy, which are crucial for understanding the policy formulation process. The systematic identification of 82 publications within this timeframe provided a comprehensive dataset for further analysis.

After a thorough selection process, the final database included 24 studies that were directly relevant to the research aims (Figure 1). To focus on high-impact, policy-relevant scholarly work, each publication was assessed for its contribution to policy formulation methodologies, stakeholder involvement, and the socio-economic impacts of the URF initiative. Publications lacking substantial content in these areas were excluded. Due to the limited research on URF policies in Bangladesh, this review includes papers on the development of both UA and URF policies. This broader view helps uncover essential factors for the case study of Bangladesh's policy landscape, where URF policies are weak. Shared themes, stakeholder engagement methodologies, and policy tools in the worldwide urban agricultural policy-making literature were identified that could enhance URF governance in Bangladesh.

The search was limited to the keywords “urban agriculture”, “urban agriculture policy”, “city farming”, and “rooftop agriculture”, which resulted in a total of 82 articles. Exclusion criteria such as year of publications ranging from 2010 to 2024 were applied, along with the removal of duplicated articles and unretrievable documents, resulting in 50 studies that were assessed for eligibility. Out of these 50 studies, 26 did not cover URF policy-related matters. A thorough review was conducted on 24 studies, focusing on the stakeholders involved, the participation process, policy formulation, and co-production of policies in UA, with a specific emphasis on URFs. Finally, as a case study, the national policies and strategies for promoting URFs in Bangladesh were reviewed to assess the gaps and loopholes that hinder the process of governing URFs. Dhaka, the capital of Bangladesh, was chosen as the focus for this case study, as the authors of [29,30] suggest that URFs are thriving in the city despite a lack of specific policy frameworks to support and govern them. This makes Dhaka an interesting case for exploring the current policy landscape and identifying potential areas for improvement in the governance of URF initiatives.

Qualitative approaches were employed to analyse the selected cases concerning UA/URF policy formulation. Thematic analysis involved familiarisation with the data; generating initial codes; searching for, reviewing, defining, and naming themes; and producing the report. Furthermore, content analysis was employed to systematically categorise and interpret the textual data from academic papers to identify recurring patterns, concepts, and relationships relevant to URF policy development and implementation [32]. Cases were then summarised based on their content, and respective themes were extracted; these are presented in both tabular and written format within the Analysis Section. These reviewed cases were categorised into five thematic areas and are subsequently discussed in detail.

However, it is important to acknowledge that relying solely on international research might not fully capture the unique socio-political and economic context of Bangladesh, potentially limiting the direct applicability of some proposed policy frameworks. To mitigate this, a focused case study on Dhaka is integrated to ground the theoretical insights in local realities, thereby bridging the gap between global best practices and specific national needs. Given the scarcity of URF policy cases in Bangladesh, this study first provides an overview of related policies within the country, followed by a discussion of the gaps and challenges in developing a URF policy for Bangladesh. Additionally, the findings on suggested approaches for URF policy development from the literature are discussed, and key components for formulating a URF policy, including the involved stakeholders, are

elaborated upon in Section 8. This integrated approach allows for a nuanced understanding of how global policy frameworks can be adapted and implemented effectively within the distinctive operational landscape of Bangladesh. This dual perspective offers a robust analytical framework, ensuring that the proposed policy interventions are both theoretically sound and practically relevant to the Bangladeshi context. The subsequent sections of this paper delve into a comprehensive analysis of the existing policy vacuum surrounding URFs in Bangladesh, identifying critical shortcomings and proposing actionable strategies for effective policy integration. This involves dissecting the current regulatory environment, pinpointing legislative gaps, and examining the institutional capacities required for successful URF policy implementation. Furthermore, the critical roles of collaboration and community engagement are identified as prerequisites for developing a cohesive and sustainable URF policy framework in Bangladesh.

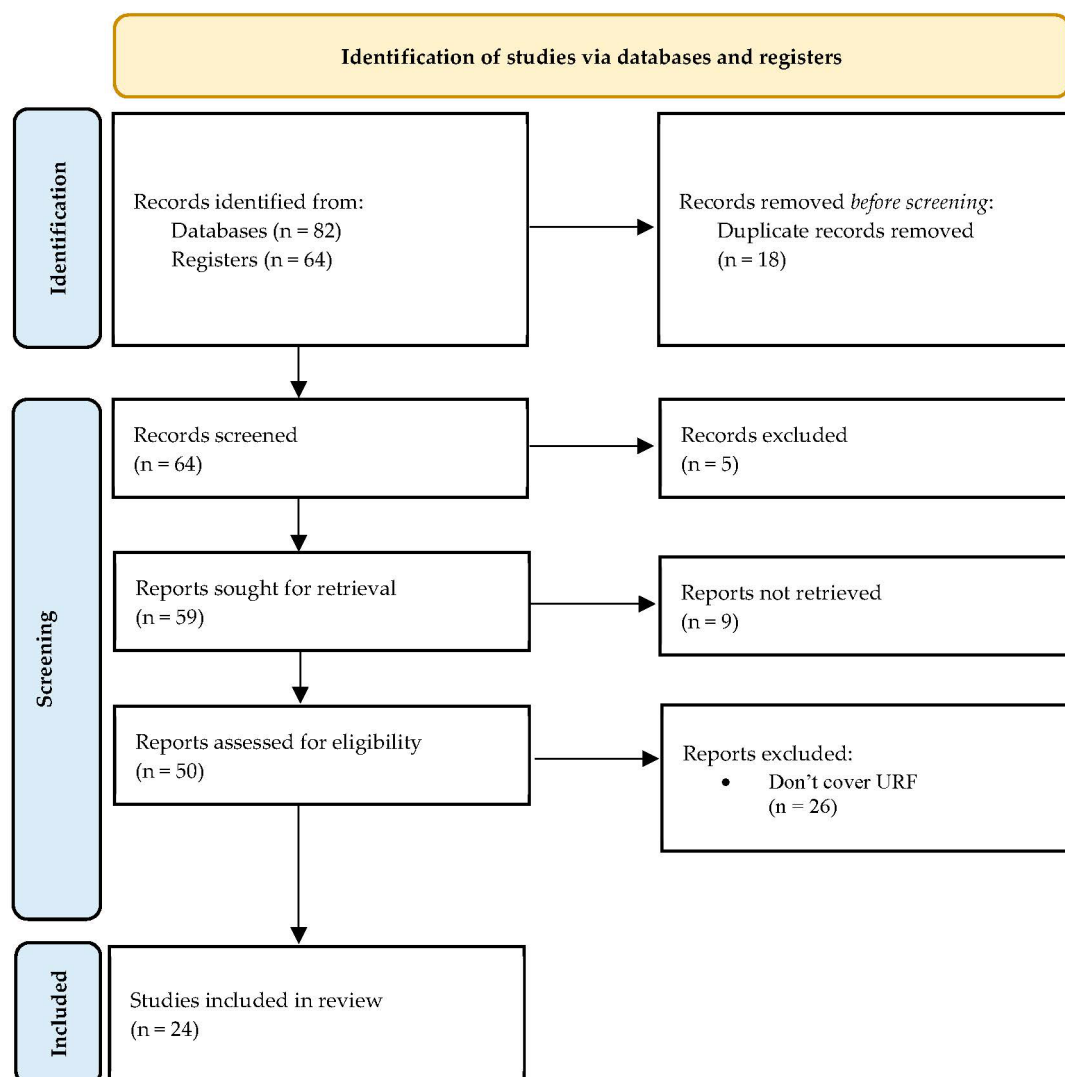


Figure 1. Process of systematic selection of studies [31] on URF policy-making.

4. Analysis of URF Policy Formulation Process

The results of this extensive literature review are summarised in the following table (Table 1). This table provides a concise, yet informative gist of the key contents and recommendations found within each of the 24 articles, with the aim of facilitating deeper discussion and analysis on this important topic.

Table 1. Overview of the studies examined regarding URF policy formulation and their recommended approaches.

Sl. No.	Year	Author(s)	Summary of Content	Suggested Policy Formulation Approach(es)	Theme				
					Stakeholder Engagement and Collaboration	Co-Production	Evidence-Based or Data-Driven	Context-Specific Solutions	Integrated and Holistic Approach
01	2023	Aslan, Menteş [33]	Analyses UA as a solution for sustainable development. Stresses the necessity of stakeholder engagement in advancing UA and endorses co-production via collaborative initiatives among stakeholders.	collaborative, inclusive, and participatory	✓	✓			
02	2023	Bai, Wu [34]	Concentrates on harmonising economic, social, and environmental requirements in urban revitalisation plans. Emphasises the significance of collaboration among many stakeholders for sustainable urban revitalisation. Proposes collaborative governance to mitigate stakeholder concerns and improve policy results.	integrated, participatory, and collaborative	✓	✓			✓
03	2023	Kim [35]	Emphasises the government's involvement in facilitating UA via legislative measures. Acknowledges the importance of stakeholder participation in implementing the UA Act. Proposes co-production via collaboration between governmental and community stakeholders.	top-down legislative action with bottom-up participatory implementation	✓			✓	✓
04	2023	Long, Cao [36]	Evaluation of analytical components of urban agricultural green spaces. Stresses the necessity of stakeholder engagement in evaluating urban agricultural techniques and proponents of co-production engage stakeholders in evaluative processes.	participatory, evidence-based, and collaborative	✓	✓	✓		

Table 1. Cont.

Sl. No.	Year	Author(s)	Summary of Content	Suggested Policy Formulation Approach(es)	Theme				
					Stakeholder Engagement and Collaboration	Co-Production	Evidence-Based or Data-Driven	Context-Specific Solutions	Integrated and Holistic Approach
05	2023	Ma, Utaberta [37]	Analyses urban renewal techniques via the lens of stakeholder theory. Emphasises the significance of stakeholder participation in urban renewal decision-making and promotes co-production via cooperation among diverse stakeholders.	participatory, inclusive, and cooperative	✓	✓			
06	2022	Salim, Wibowo [38]	Examines variables influencing community involvement in UA. Highlights the significance of social, cultural, and economic elements in stakeholder participation. Promotes co-production by engaging community members in decision-making processes.	community-driven, participatory, and inclusive	✓	✓			
07	2022	Zou, Cheshme-hzangi [39]	Examines the function of UA in improving the sustainability of food systems. Acknowledges the importance of stakeholder involvement in advancing the University of Arizona. Facilitates co-production via collaborative initiatives among stakeholders.	collaborative, participatory, and co-productive	✓	✓			
08	2021	Grochulska-Salak, Nowysz [40]	Examines UA as a viable hybrid system for bolstering urban resilience. Promotes stakeholder engagement in mitigating production isolation and advancing ecological, social, and economic objectives. Facilitates co-production via collaborative endeavours among stakeholders to improve UA programmes.	integrated, participatory, and co-productive	✓	✓			✓

Table 1. Cont.

Sl. No.	Year	Author(s)	Summary of Content	Suggested Policy Formulation Approach(es)	Theme				
					Stakeholder Engagement and Collaboration	Co-Production	Evidence-Based or Data-Driven	Context-Specific Solutions	Integrated and Holistic Approach
09	2021	Lingzhi, Yang [41]	Examines the planning of agricultural landscapes inside urban environments. Stresses the necessity of stakeholder engagement in landscape design processes. Facilitates co-production via collaborative initiatives among stakeholders.	collaborative, participatory, and co-productive	✓	✓			
10	2021	Lucertini and Di Giustino [42]	Analyses urban and peri-urban areas as a mechanism for food security. Acknowledges the significance of stakeholder involvement in advancing UA. Facilitates co-production via collaborative initiatives among stakeholders.	collaborative, participatory, and co-productive	✓	✓			
11	2021	Schoen, Blythe [43]	Examines the impact of COVID-19 on community and allotment gardening. Emphasises the significance of community involvement and stakeholder networks in UA. Proposes collaborative governance to improve the efficacy of UA logistics.	collaborative, participatory, and adaptive	✓	✓		✓	
12	2021	Wang, Bai [44]	Examines the advantages of urbanisation on agricultural output. Emphasises the necessity of stakeholder engagement in urban agricultural efforts. Proponent of co-production via stakeholder collaboration.	collaborative, inclusive, and co-productive	✓	✓			

Table 1. Cont.

Sl. No.	Year	Author(s)	Summary of Content	Suggested Policy Formulation Approach(es)	Theme				
					Stakeholder Engagement and Collaboration	Co-Production	Evidence-Based or Data-Driven	Context-Specific Solutions	Integrated and Holistic Approach
13	2021	Whittinghill and Sarr [45]	Proponent of incorporating UA into land use planning and formulating evidence-based strategies. Stresses the necessity for collaborations with communities and stakeholders to enhance urban farming projects. Proposes collaboration between local authorities and community members to enhance policy effectiveness.	evidence-based, collaborative, and participatory	✓	✓	✓		
14	2020	Ayerakwa, Dzanku [46]	Analyses the geography of agricultural engagement and its influence on food security. Stresses the necessity of stakeholder involvement to comprehend the spatial dynamics of production in UA. Promotes co-production by incorporating stakeholders in dialogues concerning food security and agricultural methods.	spatially informed, participatory, and co-productive	✓	✓		✓	
15	2018	Martinez, Blanco [47]	Examines the water–energy–food nexus in UA and acknowledges the significance of stakeholder participation in advancing sustainable practices. Proponent of co-production via stakeholder collaboration.	integrated, participatory, and co-productive	✓	✓			✓
16	2018	Yu, Wang [48]	Examines the ecological security of farmed land in peri-urban areas. Stresses the necessity of stakeholder engagement in safeguarding natural resources and advancing sustainable agriculture. Proponent of cooperative strategies to tackle the difficulties presented by urbanisation.	ecologically focused, participatory, and cooperative	✓	✓		✓	

Table 1. Cont.

Sl. No.	Year	Author(s)	Summary of Content	Suggested Policy Formulation Approach(es)	Theme				
					Stakeholder Engagement and Collaboration	Co-Production	Evidence-Based or Data-Driven	Context-Specific Solutions	Integrated and Holistic Approach
17	2016	Specht, Weith [49]	Examines socially permissible urban agricultural enterprises. Emphasises the significance of stakeholder involvement in advancing UA. Facilitates co-production via collaborative governance frameworks.	participatory, socially inclusive, and co-productive	✓	✓			
18	2016	Sanyé-Mengual, Anguelovski [50]	Addresses the reconciliation of divergent stakeholder attitudes about urban rooftop agriculture. Identifies the main stakeholders whose attitudes impact urban agricultural policy. Proponent of co-production via stakeholder involvement in policy formulation.	conflict-sensitive, participatory, and co-productive		✓		✓	
19	2016	Specht, Siebert [51]	Examines the perception and acceptance of agricultural production inside urban structures. Identifies important stakeholders whose attitudes affect urban agricultural policy. Proposes co-production through stakeholder engagement in dialogues around urban agricultural methods.	participatory, inclusive, and co-productive	✓	✓			
20	2014	Filippini, Marracini [52]	Advocates for agronomic methodologies to evaluate food production potential in peri-urban regions. Stresses the need for local authorities to utilise agricultural data for informed policy evaluations. Proponent of stakeholder involvement in data gathering and policy formulation processes.	evidence-based, participatory, and data-driven	✓		✓		

Table 1. Cont.

Sl. No.	Year	Author(s)	Summary of Content	Suggested Policy Formulation Approach(es)	Theme				
					Stakeholder Engagement and Collaboration	Co-Production	Evidence-Based or Data-Driven	Context-Specific Solutions	Integrated and Holistic Approach
21	2013	Orsini, Kahane [53]	Evaluates UA in emerging nations. Highlights the significance of stakeholder involvement in advancing UA. Facilitates co-production via collaborative initiatives among stakeholders.	participatory, collaborative, and co-productive	✓	✓			
22	2013	Sanyé-Mengual, Cerón-Palma [54]	Examines the logistics of agricultural goods sourced from urban rooftop greenhouses. Identifies main parties engaged in the distribution and sale of urban agricultural goods. Proposes collaborative governance to improve the efficacy of UA logistics.	logistics-focused, participatory, and collaborative	✓	✓	✓		
23	2011	Mawois, Aubry [55]	Investigates the possibilities for farmers to expand production zones in UA. Emphasises the growing attention to UA by urban planners and stakeholders. Proposes cooperative strategies to include UA in planning methodologies.	expansion-oriented, participatory, and cooperative	✓	✓			✓
24	2010	Lovell [56]	Promotes participatory methods that engage diverse stakeholders in evaluating land suitability for agriculture. Facilitates co-production via geographical analysis and asset mapping with many stakeholders.	participatory, collaborative, and data-driven	✓	✓	✓		
				Count	23	22	5	5	5

✓—Theme covered by a study.

Each entry in Table 1 offers insights into the methodologies, challenges, and strategies for integrating URFs into urban planning and development. It is also visible that authors emphasise participatory, collaborative, and co-productive methods in policy formulation, highlighting the engagement of diverse stakeholders, including local communities, governments, planners, and environmental organisations. Moreover, some of the common themes and policy formulation approaches that prevail across the studies are summarised below.

4.1. Stakeholder Engagement and Collaboration

Most of the reviewed studies (Column 6, Table 1) consistently highlighted the vital importance of involving a diverse range of key stakeholders in the policy formulation process. This collaborative approach involves the active engagement and participation of local communities, government entities, agricultural specialists, urban planners, and private sector actors. By bringing together this wide array of stakeholders, the policy formulation process can effectively address the unique local requirements and needs of the community, while also leveraging the collective expertise, perspectives, and resources of the various participants. This inclusive, multi-stakeholder approach is crucial for enhancing the likelihood of successful policy implementation and adoption, as it ensures the policies are co-produced and tailored to the specific context and dynamics of the urban environment.

4.2. Co-Production

Similarly, 22 out of the 24 reviewed studies (Column 7, Table 1) strongly supported the concept of co-production, wherein stakeholders collaboratively engage in the development, implementation, and evaluation of policies and practices. This collaborative approach ensures that the resulting policies are guided by the practical knowledge, local experiences, and collective efforts of the diverse range of stakeholders involved. By incorporating the perspectives and contributions of local communities, government entities, agricultural specialists, urban planners, and private sector actors, the co-production process guarantees that the policies are tailored to the unique requirements and dynamics of the urban environment.

4.3. Evidence-Based or Data-Driven

The reviewed studies (Column 8, Table 1) consistently underscored the critical importance of data-driven decision-making approaches in the policy formulation process. By focusing on rigorous geographical analysis, advanced agronomic methodologies, and detailed asset mapping, these studies highlighted how urban planners and policymakers can effectively evaluate land suitability, assess the food production potential of urban areas, and design comprehensive urban agricultural systems. These evidence-based approaches ensure that the resulting policies are grounded in robust data and empirical findings, enabling them to be tailored and adapted to the unique contextual factors and dynamics of diverse urban environments. Integrating these data-driven analytical tools into the policy development cycle is essential for crafting contextually relevant and impactful URF policies that can be successfully implemented and sustained over time.

4.4. Context-Specific Solutions

Likewise, the reviewed studies (Column 9, Table 1) emphasised the critical importance of examining the distinct challenges and opportunities faced by emerging nations or in specific urban contexts. By promoting policies that are customised to the unique local socio-cultural, economic, and environmental conditions, a context-specific approach can be implemented to ensure the relevance and effectiveness of URF policies. This tailored, place-based perspective ensures that the policies developed can effectively address the nuanced needs and dynamics of the target urban areas, rather than applying a one-size-fits-

all approach. Accounting for the local context is crucial for crafting URF policies that can be successfully implemented and sustained over time.

4.5. Integrated and Holistic Approach

Some studies (Column 10, Table 1) also highlighted the need for a comprehensive and integrated approach that addresses the economic, social, and environmental aspects of UA. This entails aligning urban agricultural practices with overarching objectives, such as food security, sustainability, and resilience, while also advocating the incorporation of urban agriculture within broader urban revitalisation efforts and integrated land use planning. By adopting this holistic perspective, policymakers can ensure that URF initiatives contribute to achieving multiple complementary goals, including enhanced food production, improved environmental performance, and community empowerment.

While the findings elucidate the process of URF policy formulation, questions remain about the relationship between the themes, concepts, and theories presented in Section 2 of this study. Further analysis is needed to clarify how the key principles and approaches identified in the policy formulation process, such as multi-stakeholder collaboration, co-production, evidence-based decision-making, and context-specific solutions, are connected to and informed by the theoretical foundations outlined in the background. Exploring these linkages in greater depth would strengthen the overall conceptual framework and provide a more comprehensive understanding of the factors shaping effective URF policies.

5. Theories of URF Policy Formulation

The findings presented in the prior section provide the foundation for developing a framework that will help address all the recommended URF policy formulation processes. Figure 2 links the key concepts and processes that, according to the findings, are key to developing effective policy guidelines for URFs.

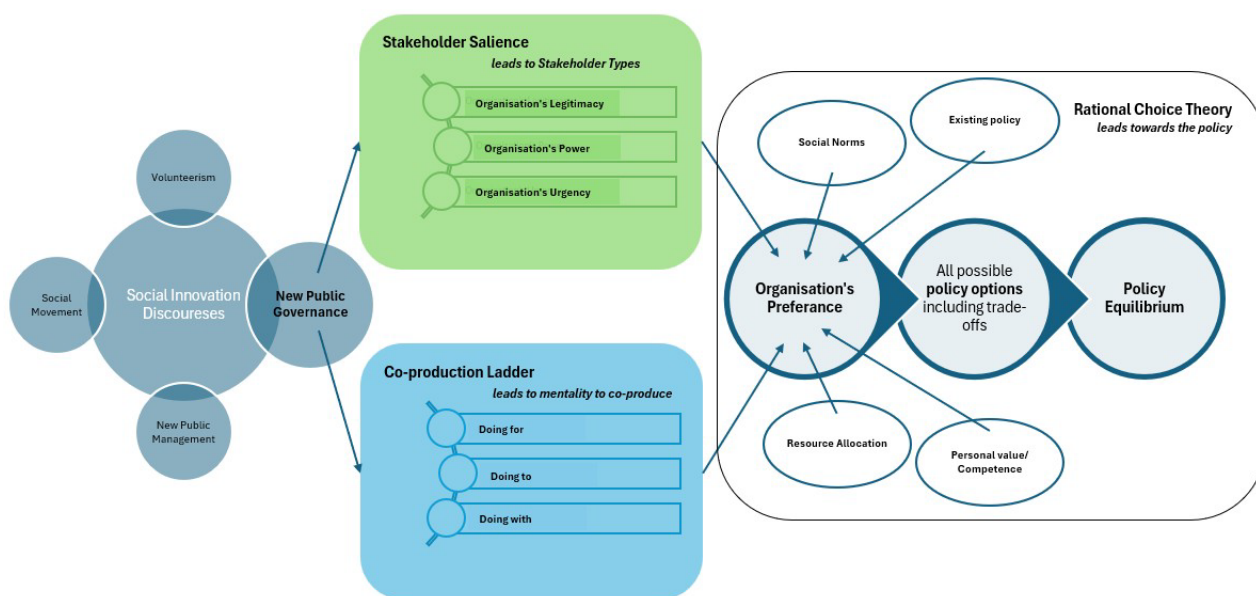


Figure 2. Developing connections between theories and processes of URF policy.

The framework encompasses all the possible themes identified in the analysis. Stakeholder involvement can be ensured by understanding the status of stakeholders' connection by measuring their salience. According to the authors of [4,57,58], a successful URF necessitates active participation from several stakeholders, including community members, local governments, and non-governmental organisations. Hence, it is not only important to

identify the stakeholders but also crucial to understand the quality of each possible stakeholder within the spectrum of URF governance. Hence, the concept of stakeholder salience, developed by Mitchell and Agle [26], provides the best possible outcome in terms of understanding stakeholder dynamics. Similarly, the concept of a co-production ladder also becomes significant; the authors in [50,59] suggested that co-productive endeavours among stakeholders improve the execution and sustainability of URF projects. Both concepts work in tandem when it comes to developing urban governance. However, connecting rational choice theory with these concepts can pose a challenge as the theory is based on how an individual or an organisation behaves according to their best interests. Wang and Pryor [60] showed that stakeholders make decisions based on the perceived advantages, expenses, and hazards related to URF.

In addition to these core concepts and themes of policy formulation, the authors in [57] found various other connections to themes such as food security and sustainability. Perhaps this reason alone should prompt governments to take collective action in developing a comprehensive legal framework that encompasses all aspects of URF. Moreover, according to Park [61], URFs promote social engagement and communal solidarity, thereby improving the overall quality of urban living. From a rational choice theory perspective, an organisation's preference for developing a policy usually depends on several factors. Among these factors, social norms play a vital role, alongside existing policies. URFs have already become a social norm by establishing themselves as sources of social, economic, and environmental benefits [59,61].

Similarly, Rawal and Thapa [62] noted that effective resource allocation is needed to ensure the sustainability of URF. Hence, from a practical point of view, the sustainability of URFs will directly benefit the city government, which aims to achieve sustainable city goals, as well as farmers who practice sustainable farming and require day-to-day support. However, there is usually a huge number of stakeholders who should be involved in URF policy formulation. The stakeholder salience model helps to measure the potential power of a stakeholder and how that power can be successfully transferred into co-producing policies. Co-production itself is the most integrated method of policy production, ensuring the involvement of all stakeholders in the process. Therefore, organisations prefer to develop URF policies based on social movements and the benefits, while also considering stakeholder salience and stakeholders' mentality in co-production; this is also known as 'new public governance'. These understandings raise the following questions that need to be explored when developing a URF policy:

- Who are the stakeholders in URFs?
- How powerful they are in terms of developing policy?
- What are the levels of inclusivity for each stakeholder in co-production?
- How involved do the stakeholders perceive themselves and others to be in the policy-making process?
- What role should and can each stakeholder play in the process?
- What are the policy instruments that can support sustainable URFs?

6. URF Policy Context in Dhaka

Dhaka is undergoing rapid urbanisation and population growth alongside significant challenges related to climate change, including flooding, increased temperatures, and extreme weather events. Environmental challenges are intensified by the impacts of climate change. The practice of maintaining URFs is considered a viable and innovative solution to certain pressing challenges [63]. However, a supportive and comprehensive policy environment is necessary for its successful implementation and widespread adoption [64]. With the growing popularity of URFs, it is essential for the city's policymakers and urban

planners to provide a thorough and well-designed legal framework to support and direct this expanding trend. However, it is also crucial to understand the existing regulations and policy strategies surrounding URFs in Dhaka.

6.1. National and Local Government Policies

Bangladesh's National Urban Agriculture Policy 2018, introduced by the Ministry of Agriculture, encourages the promotion of urban farming, including rooftop farming. The policy aims to reduce food insecurity, improve urban environments, and promote sustainable agricultural practices in cities [30,65]. Moreover, The Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC) have been active in promoting UA in various forms. These bodies have sometimes supported rooftop farming through small-scale initiatives, including pilot projects, as part of broader environmental sustainability goals [66]. Urban planning regulations in Dhaka, such as building codes, historically have not included provisions for rooftop farming [67].

6.2. Environmental and Climate Resilience Policies

Due to the various impacts of climate change, rooftop farming is considered amongst current climate resilience strategies, helping to reduce urban heat islands, absorb rainwater, and improve air quality. This aligns with policies related to climate change adaptation and disaster risk reduction [29]. Similarly, the government and local urban planners are increasingly recognising the role of green infrastructure, such as green roofs and rooftop farms, in improving environmental quality in Dhaka [68]. Rooftop farming is integrated into broader efforts to create green spaces in urban areas, contributing to better air quality and energy efficiency and reducing the urban heat island effect [67].

6.3. Economic and Social Development Policies

In Dhaka, where poverty and unemployment are significant issues, rooftop farming can offer an opportunity for marginalised communities to generate income and access fresh produce. The government and non-governmental organisations (NGOs) have occasionally supported small-scale urban farming initiatives as part of poverty alleviation programmes [69]. Moreover, URFs can contribute to food security by providing fresh vegetables, fruits, and herbs locally. Policies targeting food security, especially in urban areas, recognise the potential of urban farming to reduce reliance on long-distance food supply chains and enhance local food production [70].

The policy landscape in Bangladesh is gradually recognising the potential of URFs to address a range of urban challenges, including food security, environmental sustainability, and economic and social development. Table 2 illustrates the key policy areas for the sustainable development of URFs in Bangladesh based on case studies related to URFs and governance.

Table 2. Key areas for developing URF policy in Dhaka, Bangladesh.

Policy Areas	Key Considerations	Case Studies
Urban Planning and Building Regulations	- Integrating provisions for rooftop farming into building codes and urban development plans. - Providing incentives or allowances for the inclusion of rooftop farming in new construction and renovations.	[71,72]
Environmental and Climate Resilience Policies	- Recognising the role of rooftop farming in climate change adaptation and mitigation strategies. - Promoting rooftop farming to reduce urban heat island effects, improve air quality, and enhance urban biodiversity.	[16,73]

Table 2. *Cont.*

Policy Areas	Key Considerations	Case Studies
Food Security and Urban Agriculture Policies	• Incorporating rooftop farming into national and local policies aimed at improving food security, particularly in urban areas. • Providing technical support, resources, and financial incentives to encourage the adoption of rooftop farming.	[53,74]
Economic and Social Development Policies	• Leveraging rooftop farming as a strategy for income generation and livelihood opportunities, especially for marginalised communities. • Integrating rooftop farming initiatives into poverty alleviation and community development programmes.	[59,75]
Governance and Stakeholder Engagement	• Identifying key stakeholders in the rooftop farming ecosystem and facilitating their involvement in policy development. • Fostering collaborative policy-making processes that empower various stakeholders, including rooftop farmers, to co-produce effective policies.	[76,77]

7. Challenges in Policy Implementation in Dhaka

Despite the demand for a separate policy for URFs, the authors of [16,50,59] expressed concerns around issues such as lack of concrete financial incentives and subsidies to encourage rooftop farming on a larger scale. Many building owners and tenants lack the capital to invest in rooftop farming infrastructure, and the existing policies do not sufficiently address this gap [78]. Regulatory and zoning laws do not provide clear guidelines for building owners to convert rooftops into farming spaces. Zoning laws and building codes often focus on residential or commercial use without considering agricultural activities. A more flexible regulatory framework is needed to facilitate rooftop farming [67]. While rooftop farming has been promoted, there is still a knowledge gap regarding best practices, suitable technologies, and climate-smart techniques, and a lack of technical support from authorities has limited its widespread adoption [79]. The lack of collaboration and support among NGOs, international organisations, and local government is also a problem for the expansion of URFs. Many NGOs, such as the Bangladesh Rural Advancement Committee (BRAC), the Centre for Urban Equity (CUE), and the Urban Resource Centre (URC), have played a key role in promoting rooftop farming in Dhaka through training, research, and the implementation of small-scale projects. International development organisations, including the United Nations, have increasingly recognised rooftop farming as part of the sustainable urban development agenda. They have been involved in projects to integrate UA into the city's infrastructure, often providing funding and expertise [80]. However, these projects are not properly collaborated.

8. Discussion

The needs for a URF policy for Dhaka have been recognised by scholars [68,81]. This can be addressed through policy reforms, research, innovations, and integration in urban planning. Policymakers are beginning to understand the role of rooftop farming in improving food security, public health, and urban resilience. Future policies should focus on incentivizing rooftop farming through financial mechanisms (e.g., subsidies or grants), tax incentives, and access to land and water resources [67]. Another idea that has regularly been discussed by researchers is integrating URFs into Dhaka's broader urban planning and development agenda [82]. This includes creating specific guidelines for the construction of

buildings with rooftop farming potential, offering incentives for the adoption of green roofs, and promoting sustainable, low-cost farming techniques suitable for urban areas. Policies that promote research and the development of suitable technologies for urban farming are needed to make rooftop farming a viable option for a larger number of residents [83].

The theoretical perspective of this research and the case study of Dhaka provide a basic direction for developing a framework in which the approach to policy development is participatory, collaborative, and data-driven. Hence, to understand the working relationship among stakeholders, it is important to assess the nature and attitude of each stakeholder and to what extent they are willing to co-produce a policy where everyone has tangible and intangible benefits. However, to address the objective of the current study, the stakeholders mentioned in [84,85] are broadly categorised in Figure 3 along with sub-categories and their position in URF governance.

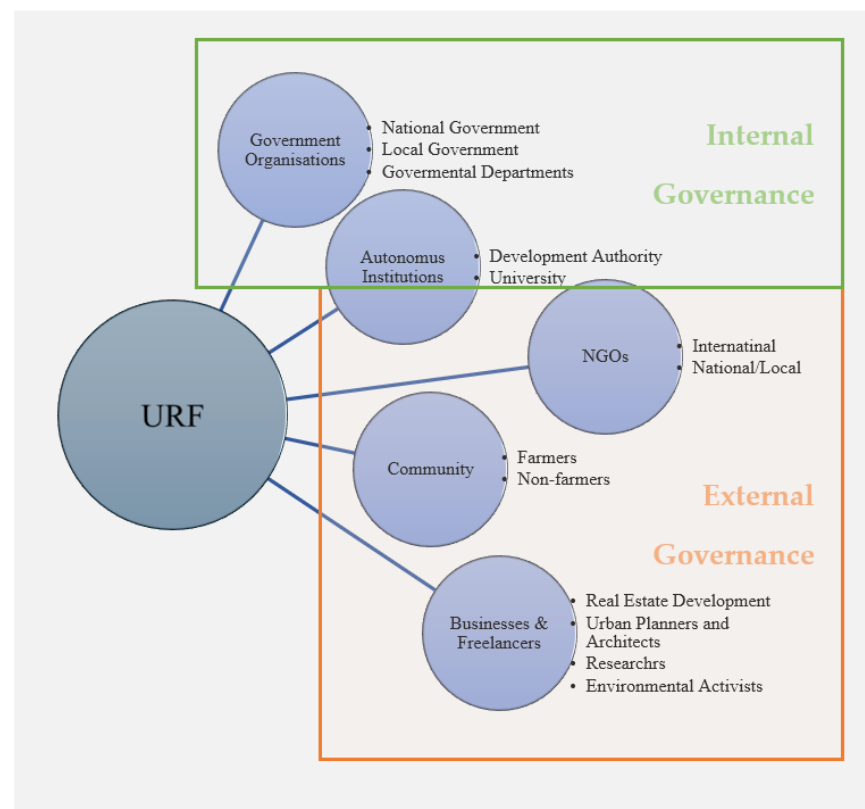


Figure 3. Where are actors distributed in URF governance? Adapted from [81].

Figure 3 illustrates that government organisations are integral to internal governance, with the legal authority to devise and execute policies. Conversely, communities, enterprises, and freelancers constitute external governance without the legal authority to design and administer policies while significantly contributing to the successful execution of those policies. Although various actors are affiliated with separate governing groups, there exists an intermediary category, such as autonomous and non-governmental organisations. These organisations are able to integrate the two distinct components of URF governance over time, adhering to policy norms that facilitate participation.

Based on the findings in Table 1, all previous studies suggest that a URF policy should be inclusive or participatory and collaborative. Hence, it is also important to develop a tool that incorporates all stakeholders' opinions and willingness to co-produce. In the context of policy-making, the participatory approach presented by Bai and Wu [34] and the top-down legislative support mentioned by Kim [35] can play a significant role in the

case of Dhaka city, as indicated by previous studies, organisational reports, and newspaper articles. However, they fail to provide a specific direction and theoretical perspective for developing a URF policy. Previous studies indicate that participation and co-production are the way forward for to URF policymaking. More specifically, stakeholder salience and co-production ladder models will help policymakers to understand the power structure among stakeholders and how this can be used to co-produce URF policies.

The results of this extensive literature review are summarised in Table 1, which provides a concise, yet informative gist of the key contents and recommendations found within each of the 24 articles, with the aim of facilitating deeper discussion and analysis on this important topic.

9. Conclusions and Limitations

The reviewed studies collectively underscore the critical importance of adopting a multi-stakeholder, collaborative approach to the development and implementation of URF policies. By engaging a diverse range of stakeholders, including local communities, government entities, urban planners, agricultural experts, and environmental organisations, the policy formulation process can leverage the collective knowledge, resources, and perspectives of these participants. This co-productive approach ensures that the resulting policies are tailored to the unique contexts and requirements of the urban environment while also enhancing the likelihood of successful implementation and sustained adoption.

This review suggests that policymakers should engage a diverse range of stakeholders in the policy formulation process, including local communities, government entities, urban planners, agricultural experts, and environmental organisations. Secondly, a co-productive approach should be adopted to ensure that the resulting policies are tailored to the unique contexts and requirements of the urban environment. Thirdly, evidence-based, data-driven decision-making should be emphasised, where rigorous analysis of factors such as land suitability, food production potential, and resource utilisation informs the policy development cycle. Fourthly, UA should align with broader food security, sustainability, and urban resilience goals to advance the successful integration of URFs into comprehensive urban planning and development frameworks. Fifthly, regulatory issues, lack of financial incentives, and the need for greater public awareness should be addressed to enable the widespread adoption of URFs in Dhaka. Finally, stakeholder salience theory and the co-production ladder model should be utilised to develop a policy-making guideline ensuring participation and collaboration among all stakeholders.

The key limitation of this article is that it does not provide a detailed analysis of the specific regulatory, financial, and public awareness barriers that need to be addressed to enable the widespread adoption of URFs in Dhaka. Additionally, this study could have further explored the practical application of the stakeholder salience and co-production ladder models, including how they can be used to develop a more comprehensive and actionable policy framework.

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