

# A Theoretical Framework for Climate Change Adaptation Participatory Planning in Vulnerable Coastal Zones

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**Abstract.** Coastal zones are vulnerable climatic ecosystems. This is due to anthropogenic factors such as population growing and increase in settlement density, as well as geographical and natural pressures, including coastal danger, sea level rise, and biodiversity loss. Managing these problems and their interdependencies requires a bottom-up approach which can involve coastal communities in the climate change adaptation processes and encourage citizen participation towards a more sustainable resource management. This paper seeks to propose a set of guidelines on climate change adaptation through participatory planning for the assessment of the vulnerability of highly problematic areas such as coastal ones. To achieve this goal, a holistic approach based on systematic and transversal assessment of participatory best practices was applied and a theoretical framework was developed specifically for coastal areas. The proposed guidelines will facilitate (ii) a broader understanding of climate change concerns by the public and coastal tourism, (ii) the incorporation of stakeholders' requirements into local climate change policies, and (iii) local empowerment of coastal communities in accordance with sustainability principles.

**Keywords:** Sustainable Development · Participatory Planning · Climate Change · Coastal Zones · Bottom-Up Urban Planning · Urban Strategies

## 1 Introduction

Coastal ecosystems are among the most vulnerable to the effects of climate change because of human and natural pressures. Millions of people depend on these ecosystems for sustenance, recreation, and coastal tourism, even though climate change is affecting their stability [1]. The loss of these ecosystems can have severe repercussions for coastal communities, including loss of livelihoods and intensified vulnerability to natural disasters. Indeed, the effects of climate change, such as sea level rise, coastal hazards, and biodiversity loss, present significant obstacles for coastal communities. Addressing

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these challenges requires employing a bottom-up strategy which includes citizen participation and participatory planning [2] and promotes a broader public understanding of issues related to climate change. Indeed, participatory planning is an effective response to the urban complexities presented by top-down forms of urban planning [3, 4]. Adaptation to climate change presents the most compelling specific instance for participatory practices to resolve "structural vulnerabilities in relation to service provision, economic inequalities and access to policy making" [5, p.2]. This relates to the effectiveness of integrating a spatial approach into participatory practices. Indeed, a spatial approach to participatory practices requires mapping exercises, which make conflicts and compatibilities of human use spatially clear and, thus, presumably controllable [6]. This type of cartography encompasses ecosystems, their characteristics, and the human activities that impact these ecosystems [7]. Participatory urban planning is a bottom-up approach in which citizens actively participate in decision-making processes. Citizens can take responsibility for the procedures in which they are involved and can contribute, with their knowledge and experience, to the development of sustainable policies. Integration of stakeholder requirements into local policies is crucial for effective climate change adaptation and mitigation [8]. This process allows stakeholders to contribute with their knowledge and experience to the development of policies that are customised to fulfil their requirements and interests. Moreover, this system ensures that policies are developed in dialogue with the communities they will affect, allowing them to take part in the process, feeling more engaged in the results and successfully implementing them. In climate-vulnerable coastal ecosystems, the inclusion of stakeholder requirements is crucial because it enables the development of policies adapted to the specific needs of coastal communities. According to Kearney et al. (2007), most of the coastal community criticism comes from the sea-land relationship. In addition to the problems of the mainland (environmental changes and competing land uses) and those of the sea (jurisdictional challenges), coastal communities must also deal with erosion, inundations, pollution from agricultural runoff, and access challenges [9]. Furthermore, coastal communities have a deep understanding of their local environments, and their inclusion is important for assessing the vulnerability of these areas and developing policies perfectly suited to their requirements. Vulnerability assessment is the first step towards effective adaptation to climate change [10, 11]. It is essential to identify the factors that contribute to vulnerability, including both natural and anthropogenic pressures. The assessment should consider all aspects of vulnerability, including social, economic, and environmental factors, and also "biophysical orientations (i.e., bridging contextual/bottom-up and climate-driven/top-down approaches)" [12, p.134]. In the context of vulnerable coastal ecosystems, the assessment should consider the impacts of climate change on coastal infrastructure, settlement trends and biodiversity loss. Involving coastal communities improves the probability that developed policies will be effectively implemented and accepted. Considering these premises, this paper explores the role of participatory urban planning as a model that enables local communities to address the impacts of climate change on climate-vulnerable ecosystems in coastal zones. The main goal is to propose guidelines on the participatory practices of coastal communities, with particular attention to the coastal areas. This study aims to answer the questions: (i) what concerns do coastal communities have regarding climate change? (ii) what type of mechanisms are

in place between the requirements of the local population and those of decision-makers in the context of environmental problem-solving decisions?

To achieve this, the paper starts by focusing on vulnerable coastal zones in relation to adaptation to climate change (Sect. 2). Subsequently, Sect. 3 proposes a theoretical framework with various participatory planning methods and tools to identify guidelines for participatory planning for climate change adaptation in vulnerable coastal zones. Finally, the results and future directions are discussed (Sect. 4).

## 2 Climate Change and Participatory Practices: Why Coastal Zones?

Coastal zones are the world's most diversified and productive ecosystems where land and sea merge and interact. These ecosystems are extraordinarily complex due to the intersection of a wide range of geomorphological, socioeconomic, and ecological conditions with human activities associated with urbanisation, port activity, industrialisation, and tourism. Indeed, these areas provide a variety of vital services for both humans and animals. Nevertheless, many coastal regions are vulnerable to the effects of climate change, such as sea level rise, storm surges, and erosion. In addition, coastal areas are home to millions of people and support a variety of ecosystems, making them extremely vulnerable to climate change. These concerns have significant repercussions for the environment and for the communities that depend on these areas for their livelihoods. In these areas, climate change represents one of the most critical environmental challenges the planet currently faces [13, 14].

According to Laignel et al. (2023), the future sustainability of coastal zones is entirely dependent on being capable of using systematic monitoring with an emphasis on: (1) anthropogenic factors affecting "coastal zones at different spatiotemporal scales (sea level rise, winds and waves, offshore and coastal currents, tides, storm surges, river runoff in estuaries and deltas, sediment supply and transport, vertical land motions and land use); (2) morphological response (e.g., shoreline migration, topographical changes)" [15, p.1].

Coastal zones can be protected from the effects of climate change through a variety of practical measures. This can be accomplished by adopting policies and regulations aimed at reducing carbon emissions and encouraging the use of renewable energy sources. Adaptations can also be made to coastal infrastructure and management practices to mitigate the effects of climate change. Developing coastal defences, restoring natural habitats, and instituting coastal zone management plans can assist in erosion control and runoff management. Lastly, the development of adaptive strategies is essential for mitigating the effects of climate change that are already happening. To achieve climate goals, these strategies may involve relocating infrastructure at risk from rising sea levels and providing early warning systems, but it is necessary to develop climate-resilient communities that are aware of it and actively participate in climate actions. For instance, applying a more inclusive, people-centred disaster approach is fundamental to empower local communities affected by natural disasters [16]. Resilience can start from awareness and local governments should support and empower communities for a more effective disaster response.

In the context of climate change, participatory practices include individuals, communities, and/or groups in the identification, planning, and implementation of initiatives that can mitigate the effects of climate change. Participatory practices are based on the concept that everyone has an individual perspective and can contribute to a global strategy for addressing the challenges presented by climate change. Participatory practices can stimulate more inclusive and effective responses to climate change through the integration of diverse perspectives. Community-led initiatives are an example of participatory practices that can be employed in climate change mitigation. For instance, community initiatives can assist in identifying climate-vulnerable areas, such as coastal zones and surrounded by water regions. Participatory spatial mapping has been applied to several fields such as socioeconomics, education, health, mobility, service allocation, prevention of crime and monitoring. The underpinning idea is that local people can design their own maps that might be more accurate than the ones produced by professionals [17]. Community-based mapping has been used to produce indigenous maps for claims on ancestral lands [18] and to ensure access to and the ownership of information [19]. In the 2000s, innovative participatory techniques emerged as increasingly popular to assist communities in assessing the causes and effects of climate change, integrating scientific and local knowledge of the issue, and developing adaptation strategies [20]. The literature of those years suggested the need for effective methods to engage or activate communities and to support community roles, as well as systemic approaches to understanding climate change and adaptation needs [21]. Ross et al. (2015) state that local communities may be at the forefront of climate change's negative effects because inhabitants and organisations are integrally connected to and familiar with the region's unique social, historical, and political contexts. This has both social justice and practical implications [20]. The concept of local knowledge for preventing climate change was reaffirmed in 2007 by the IPCC's Fourth Assessment Report on Climate Change, which states that scientific and political consensus helps community's understanding of complicated problems such as climate change. "In the case of climate change, participatory processes encourage local practitioners from climate-sensitive endeavours to become engaged so that past experiences can be included in the study of (and the planning for) future climate change and development pressures" [13, p.1]. Subsequently, policymakers have increasingly planned for future local and regional climate-related impacts. The importance of involving stakeholders in such decision-making processes is debated, but more evidence is required to persuade institutions to involve stakeholders to make sensible decisions [22]. Although community engagement in climate change adaptation initiatives has been encouraged for some time, their implementation in decision-making processes is still lacking [23–25]. Currently, the Report Committee on Political Affairs and Democracy of the EU (2021) asserts "tackling climate change is a momentous challenge which requires not only clear political engagement from the authorities but also the active involvement of citizens. Combining a top-down and a bottom-up approach would enhance citizens' trust in public decision-making as well its legitimacy, transparency, inclusiveness, and responsiveness. It would also result in greater support for public action." [13, p.1]. Based on these premises, the authors note that the literature has not yet explored the most effective participatory approaches in the context of coastal

zone climate management, where participatory practice can take many forms, such as community-based planning, stakeholder involvement, and management agreements.

This paper, seeks to demonstrate the potential advantages of such bottom-up approaches, through the development of an inventory of participatory practices which will serve as a basis for designing a specific climate change adaptation strategy in vulnerable Coastal Zones.

## 3 Methodological Approach for Vulnerable Coastal Zones

In recent years, the vulnerability of coastal zones has become even more evident because climate change impacts pose significant threats to populations and environments. Understanding, evaluating, and mitigating these risks requires a bespoke methodological strategy that takes into consideration the dynamicity and complexity of coastal zones. This section aims at providing a comprehensive outline of participatory practices and how these methodologies can (i) help in decision-making, (ii) involve the population and (iii) improve the resilience of these areas and reduce risks.

### 3.1 Comparison Between Participatory Planning Best Practices

Based on the aforementioned considerations and motivations, participatory practices can be divided into the following categories: a) general models analysing participatory planning involving a wide range of citizens and organisations; b) models analysing decision-making and engagement processes that involve citizens in making specific decisions and include online surveys, public meetings, and focus groups; c) models analysing online participatory planning that allow citizens to participate without being physically present; and d) models analysing the various methods of participatory planning in behavioural processes. Below they are described in detail.

a) *Analytical models of participatory planning in general*. Participatory planning consists in involving community members in in decisions making processes that impact their environment and future. It is based on active collaboration and gives community members a direct role in planning and implementing policies affecting their well-being. The primary goal of participatory planning is to create more sustainable, conscientious, and responsible communities. In this regard, the White's model "typology of participation" [26] distinguishes four types of participation and asserts that the actors of each typology ('at the top'; more powerful actors; 'at the grass roots'; and less powerful actors) have different perceptions and interests.

The typologies of participation are: (i) nominal, used by more powerful actors to give legitimacy to development objectives; (ii) structural, used by the community to a specific end; (ii) representative, involves giving community members a voice in decision making and project implementation, and (iv) transformative, resulted in the empowerment of those involved [25, 27].

The CLEAR Participation model developed by Lawndes and Pratchett (2006) correlates barriers to empowerment with policy responses and requirements. This model identified five factors behind citizen participation responses: "Can do—have the resources

and knowledge to participate; Like to—have a sense of attachment that reinforces participation; Enabled to—are provided with the opportunity for participation; Asked to—are mobilized through public agencies and civic channels; Responded to—see evidence that their views have been considered" [28, p.22].

The Behaviour Grid model by BJ Fogg (2010) [29] describes 15 ways in which a community or an individual's behaviour can be influenced through psychological strategies and persuasive techniques.

In conclusion, these models are useful tools for comprehending participatory planning and assisting administrators and community members in the development of more effective and inclusive participatory decision-making processes. Adopting such models can facilitate the development of more sustainable and equitable communities, but it is important that they be applied in a manner that considers the actual needs of the community in consideration.

b) *Analytical models of decision-making and participation processes.* Individually or collectively, the decision-making process consists of a series of actions and decisions that lead to a decision. Numerous factors, including emotions, opinions, available information, social pressure, and long-term objectives, can influence this process. On the other hand, Involvement is the process of motivating people to actively participate in a decision-making process or of fostering a sense of belonging and responsibility towards a common objective. Involvement can be an effective strategy for improving the effectiveness and efficacy of decisions, as well as for fostering feelings of trust and collaboration among group members. "Levels, spaces, and Forms of Power" by John Gaventa (2006), "Varieties of Participation" by Archon Fung (2006), "Spectrum of public participation IAP2" (2007), and Engagement in the policy cycle by Diane Warburton (2007) are among the most significant recent models. The first one "Levels, spaces, and Forms of Power" examines levels, spaces, and shapes through a "power cube" that investigates how their intersection defines various dimensions of power. The "forms" dimension refers to the visible, hidden, and invisible manifestations of power, "spaces" refers to the potential spaces for action and participation, and "levels" refers to the process of decision-making at the local, national, and global levels [30, 23]. The Spectrum of public participation IAP2 [31] depicts various levels of participation and was created to aid in the selection of the level of participation that defines the public's role in any kind of public participation process [32]. Engagement in the policy cycle [33] evaluates public participation by emphasising that there are times when public expectations should not be expressed (for instance, when a decision has already been made or when a delaying stratagem is employed because it is too difficult to decide immediately). However, participation is a prerequisite when social and political change is still possible [31]. Finally, Varieties of Participation by Archon Fung emphasises the various ways the public can participate in government policy and decision-making [34]. This model consists of (1) the methods of participatory selection; (2) the modes of communication and decision-making provided to the public, and (3) the degrees of power and authority granted to public participants. These three factors are examined using a three-dimensional model known as the democracy cube, which identifies various participatory mechanisms suitable for addressing government problems [33].

c) *Analytical models of online Participatory Planning*. Online participatory planning refers to the process of involving a diverse group of stakeholders, including citizens, community organizations, and government officials, in the planning of a project's development using digital platforms. In the early 2000s, online tools, such as surveys and interactive maps, were used to collect feedback and monitor community preferences [27, 35–37]. Since then, digital technologies associated with participatory planning have evolved, along with the development of new tools, approaches, and techniques. The city dashboards and connected applications provide public administrators with real-time data provided by citizens regarding the various requirements, challenges, and opportunities of the urban context under analysis. Smart Specialisation Platforms (SSPs) are digital platforms that facilitate collaboration and knowledge exchange between companies, research institutions, and government agencies within specific sectors or regions) [38–41, 41]. More in particular:

(i) Among their many functions, city dashboards enable citizens to access an extensive range of data quickly and easily about the city via the web or mobile applications. These data can be related to a variety of topics, including mobility, air quality, energy consumption, differentiated waste collection, local economic trend, etc. [42, 43] Citizens can therefore become co-producers of information using city dashboards, thereby enhancing the transparency of the public administration, and fostering a heightened awareness for the management and development of the city [40].

(ii) SSPs present an opportunity to strengthen local governance in the planning and implementation of urban policies. SSPs are collaborative big data platforms that bring together public authorities, businesses, universities, and other local actors to define a smart specialisation strategy for urban or regional development.

Among the most authoritative examples of city dashboards and SSPs are: (i) The Amsterdam Smart City programme (ASC), a public-private initiative that acts as an information connector, facilitating cooperation and the exchange of ideas and opportunities between partner; (ii) Helsinki Smart Region (HSR), a regional smart specialisation strategy aimed at enhancing regional innovation potential and developing international collaborations by employing the region's economic, environmental, and social resources effectively; (iii) Copenhagen Smart City (CSC) uses smart data to create a sustainable city and a more favourable business climate. The city's strategy includes three goals: achieving carbon neutrality, creating a greener and more sustainable city, and fostering economic growth; and (iv) Snap4City - Florence Smart City (FSC) is based on two key factors: collaboration with public authorities, businesses, universities, and other local actors and a holistic approach.

d) *Analytical models of different methods of participation in behavioural processes.* Below some of these models.

i. Shared Space Café - a facilitated dialogue process that encourages conversations among participants, designed to increase mutual understanding and collaboration [44].

ii. World Café - a structured process for small and large group conversations, designed to foster open dialogue, creativity and innovation [45].

(iii) Open Space Technology – a self-organizing approach to facilitating interactive and participatory meetings and events, allowing participants to designate their

own issues and discussion priorities [45]. In an Open Space environment, participants meet and organise themselves based on the issues that arise during discussions. The objective is to collect ideas and recommendations in a collaborative and innovative setting. A practical approach to Open Space Technology are the Living labs. These are intended to encourage end-user participation in the development of innovative solutions. In this scenario, the main goal is to generate productive and feasible solutions, using user experience and knowledge to improve effectiveness and efficiency.

(iv) Appreciative Inquiry - a method of inquiry that emphasises on identifying, understanding, and celebrating an organization's strengths and successes to promote effective and positive change [45].

(v) Public Participation Geographic Information Systems (PPGIS)- an approach for involving citizens, stakeholders, and decision makers in the development and use of geospatial technologies to facilitate decision-making process [7]. With the evolution of ICTs, PPGIS have been combined with extensions to more established programs, innovative tools, apps and combined to big data platforms. All of this is aimed at offering a variety of interactive functions that enable users to access real-time geospatial data and participate in the process of defining environmental and territorial policies. Moreover, it allows users to share information, interact with other users, create customised maps. These modalities and approaches promote greater transparency and accountability in environmental and land-use policies and improve durability and democracy in urban planning.

(vi) Participatory Rural Assessment (PRA)/Participatory Learning and Action (PLA) - approaches and methodologies used to support planning, decision-making, and community action, particularly in rural and resource-poor regions [46, 47];

(vii) Local knowledge mapping (LKM) supports community-based development and sustainable resource management by producing, capturing, and disseminating local knowledge, especially among marginalised or disadvantaged groups [48].

(viii) Metaverse and Performance Modelling - In recent years, the use of technology in behavioural processes is increasing popularity [49–55]. This trend has been driven by the demand for more efficient and successful approaches to comprehending human behaviour and enhancing decision-making. A key component of these patterns is the capacity to identify emotions accurately. This resulted in the creation of specific tools od apps, which use facial expressions to identify emotions.

The development of learning-based performance models is another area of emphasis in behavioural processes. This means utilising data to predict performance outcomes and identify improvement opportunities. This approach allows more targeted interventions and can result in improved decision-making outcomes. In the field of behavioural processes, digital twin technology is another emerging field. These are virtual replicas used to simulate and predict behaviour in a variety of scenarios. This technology facilitates a deeper comprehension of complex systems and can guide decision-making in real-world situations.

### 3.2 Results

By applying high- or low-technological approaches and tools, the bottom-up models described in the previous section can be used to actively engage citizens. Nonetheless, it must be kept in mind that each model has its limitations, and that the selection of the most appropriate model depends on the specific requirements of the case study, particularly if the context is in a coastal area with unique characteristics. Table 1 provides an overview of the proposed approaches and highlights their key principles. Active involvement typically implies the participation of all stakeholders, including citizens, NGOs, and local government officials. This approach is particularly relevant in coastal areas, where the impacts of climate change are increasing the vulnerability of communities. The process of raising awareness is long and complex, and awareness activities are crucial because they serve to identify potential risks and vulnerabilities during the long-term planning stage. Climate change refers to long-term changes in the environment, particularly those associated with rising temperatures, rising sea levels, acidification of the ocean, and the occurrence of extreme weather events. Due to their location and susceptibility to natural disasters and sea level rise, these changes have significant implications for coastal zone planning and management. It is expected that coastal cities will face great challenges in managing the significant growth in exposure as a consequence of both human and environmental influences, including climate change [56]. In addition, the global rise in sea level significantly impacts Africa's coastal cities due to the socio-economic vulnerability of urban poor. In this context, spatial approaches in their various forms that integrate ICTs and participatory practices have shown to be significantly effective for developing a shared understanding of the territory and bringing inclusive and democratic participatory processes into practice. For instance, the spatial approach can be utilised to create a virtual map of the territory on which citizens can investigate and experiment with various development options. The generated maps can be incorporated into databases, SSPs, or dashboards, and are always usable, consultable, and integrable in real-time. Indeed, these cutting-edge tools (i) identify common challenges and opportunities and co-produce solutions; (ii) allow cities to collect, analyse, and visualise data on various aspects of urban life, such as transport, energy consumption, air quality and public services; (iii) support city leaders in monitoring and optimising city performance, enhancing citizen engagement, and facilitating evidence-based decision making. Using these platforms within a participatory planning process has numerous advantages. Firstly, the data processed are readily accessible and comprehensible, forming an effective tool for citizen empowerment. Secondly, the adoption of these cutting-edge techniques increases data collection and analysis efficiency. Lastly, city displays can be used to identify problems and monitor the adopted solutions, thereby increasing the transparency of the decision-making process and citizen participation in urban planning also via a spatial approach.

It should be noted that for the spatial approach (but in general for all participatory approaches considered) to function optimally, the most technologically advanced tool is not always the most effective if it is not completely understood in the context analysed. All these assessments conducted seek to determine the most effective methods of involvement and participation for each phase of the decision-making process. Therefore, the use of the best participatory practice combined with i) the active participation of all

**Table 1.** Key principles of participatory planning models

| *Models and approaches* | *KeyPrinciples* |
|---|---|
| *Analytical models of participatory planning in general* | |
| *Typology of participation* | 1) Nominal participation; 2) Instrumental participation; 3) Representative participation<br>4) Transformative participation |
| *CLEAR Participation* | Each user can design his/her method to satisfy local demands. Nevertheless, during the implementation of the instrument, users should be aware on these points:<br>1) Existing data sources<br>2) Internal or counselling activities<br>3) Quantitative or qualitative information<br>4) Range of stakeholders involved<br>5) Analysis level<br>6) Sequences: organizations might not be interested in collecting all the information at the same time. Organizations might want, as a first step, to do an initial internal diagnosis using a small team of elected politicians or public administrators before extending the process to other stakeholders or focusing on specific geographical communities or communities of interest |
| *Behaviour Grid* | 1) Clear expectations: the behaviour grid gives guidelines and clear expectations to the behaviour in a particular contest<br>2) Coherence: the behaviour grid promotes coherence in the behavioural management, ensuring that all the individuals are treated with equality and coherence<br>3) Positive enhancement: the behaviour grid encourages a positive behaviour rewarding individuals to achieve the desired results<br>4) Based on consequences: the behaviour grid includes also the consequences of negative behaviour; it gives a clear understanding of repercussions if predetermined expectations are missed<br>5) Efficient communication: the behaviour grid facilitates an efficient communication between the individuals, it ensures that everyone is aware of expectations and consequences<br>6) Flexibility: the behaviour grid can be adapted to be used with specific situations and specific individuals. It becomes, indeed, a useful instrument for various contexts<br>7) Proactive approach: the behaviour grid promotes a proactive approach in the behavioural management, it focuses on prevention of negative behaviour before it will happen<br>8) Responsibility: the behaviour grid encourages responsibility, it ensures that individuals are considered responsible of their actions, both positive and negative ones<br>9) Objective oriented: the behaviour grid is objective oriented; it gives a clear framework to the people about what to work on to achieve specific results<br>10) Continuous improvement: the behaviour grid promotes continuous improvement to give to people feedback about their behaviour and encouraging them to support positive changes |

(*continued*)

**Table 1.** (*continued*)

| *Models and approaches* | *KeyPrinciples* |
|---|---|
| *Analytical models of decision-making and participation processes* | |
| *Levels, spaces and forms of power* | 1) Power is not equally distributed in society: power is detained by specific individuals or groups that are able to exercise control on other people<br>2) Power can be obvious or hidden: obvious power is clear and can be easily detected, whereas hidden power, as it says, it is hidden and therefore more difficult to detect<br>3) Power can be used through various shapes, some of them include economic, political, legal social, cultural, and even psychological means<br>4) Power can be contested and negotiated: people can challenge power and try to negotiate it for a more equal distribution of power<br>5) Power relationships are not fixed: they can change during the time when circumstances between people change and if social, economic, and political conditions change<br>6) Power is relational: it exists in dynamic interactions between individuals or groups of people, more than being an intrinsic characteristic of an individual or a group of people<br>7) Power can be legitimate or illegitimate: it depends on the rules, the values and the laws of a society, power can be considered legitimate or illegitimate<br>8) Power can be strengthening or weakening: whereas power can allow individuals or groups to achieve their goals, it can also limit their ability to do it<br>9) Power affects people in different ways: depending on some factors, as sex, race, class and other identity indicators, power can have different effects and it can be perceived in different ways by individuals or groups<br>10) Resistance to power can be a form of power: when people challenge or resist power, they are expressing their form of power and raising their voice |
| *Varieties of Participation* | 1) public participation in governmental policy-making and decision-making;<br>2) national level application;<br>3) functioning of local (e.g., municipal or educational) governments and institutions;<br>4) there is no canonical form of direct participation in modern democratic governance;<br>5) public participation advances multiple purposes and values in contemporary governance;<br>3) mechanisms of direct participation are not a strict alternative to political representation but instead complement them |

(*continued*)

**Table 1.** (*continued*)

| *Models and approaches* | *KeyPrinciples* |
|---|---|
| *Spectrum of public participation IAP2* | 1) Inform: to give to the public balanced and objective information to help it in understanding the problem, the alternatives, the opportunities and/or the solutions<br>2) Consult: to obtain public feedback on analysis, alternatives and/or decisions<br>3) Involve: working directly with the public during the decisional process to guarantee that concerns and aspirations of the public are constantly understood, taken care of and combined in the final decision<br>4) Collaborate: to collaborate with the public in every aspect of the decisional process, including the development of alternatives and the identification of the favourite solution<br>5) Empower: giving to the public the responsibility and the authority to take joint decisions with the policy makers |
| *Engagement in the policy cycle* | 1) Inclusion: the policy cycle should involve all the interested parties that can be influenced or that can have an interest in the policy. Their perspectives should be taken into consideration<br>2) Transparency: the policy cycle should be conducted open to checks and it should include a clear communication about process, results, and recommendations<br>3) Reactivity: the policy cycle should respond to environmental changes, and it should include the feedback of stakeholders in order to improve the policy results<br>4) Based on proofs: the policy cycle should be informed by reliable proofs and analysis to guarantee that the political measure is based on reality, therefore, it would have better chances of succeed<br>5) Continuous improvement: the cycle of policy should allow a continuous supervision and valuation to evaluate the efficacy of the policy and to identify the opportunities to perfect it or improve it<br>6)Responsibility: the policy cycle should plan clear mechanism of responsibility in order to ensure that all the involved actors would be considered responsible of their actions and decisions<br>7) Participation: the policy cycle should give priority to active participation of all the interested parties in policy process to guarantee that their voices will be heard, and their needs satisfied<br>8) Coherence: the policy cycle should guarantee that policies are coherent and aligned with the framework, the goals and priorities at regional and national level |

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**Table 1.** (*continued*)

| *Models and approaches* | *KeyPrinciples* |
|---|---|
| *Analytical models of online Participatory Planning* | |
| *City Dashboards* | 1) It improves citizens participation: the connection between participative practices and city dashboard can increase citizens participation in the city management. The instruments of information visualization give to citizens an opportunity to better understand the city issues and to have a clear idea of the general trend<br>2) It increases transparency: the connection between participative practices and city dashboards can improve transparency in the city management. Open data and information access can give citizens the possibility to evaluate city choices and to give more significative feedback<br>3) Real time monitoring: city dashboards can give real time monitoring of the condition of the city, such as quality of the air, of the services, traffic gridlock, levels of acoustic pollution and more others. This can help citizens to actively participate and to take informed decision about the city services<br>4) It enhances collaboration between citizens and authorities: the connection between participative practices and city dashboards helps governmental authorities to understand better the needs of the city and of its citizens. This can encourage a better collaboration between authorities and citizens who can work together to solve city issues and improve the quality of life<br>5) Support to decisions based on data: the connection between participative practices and city dashboards allows governments to take decisions based on data and on evaluation of city needs. This can improve the efficiency of public policy and to achieve a better operative efficiency<br>6) It enhances efficiency in city management: the connection between participative practices and city dashboards can improve efficiency in city management. This can allow governmental authorities to answer in a faster and more efficiently to the demands of the city and of its citizens |
| *Smart Specialisation Platforms (SSPs)* | 1) More inclusion and representativeness of the parties involved: involving citizens and stakeholders in defining clever specialization strategies can guarantee more inclusion and representativeness of local interests in public policy<br>2) More legitimation and sustainability of the strategy: activating participative practices can increase the legitimacy of the clever specialization strategy on behalf of the local population, it makes it more sustainable and long lasting<br>3) More capacity of innovation and adaptation: involving a wide range of stakeholders can lead to a major capacity of innovation and adaptation of volatile demands of the market |

(*continued*)

**Table 1.** (*continued*)

| *Models and approaches* | *KeyPrinciples* |
|---|---|
| *Analytical models of different methods of participation in behavioural processes* | |
| *Shared Space Café* | 1) In the space, everyone has the same opportunities and duties, regardless of his/her ethnic group, culture, language, education, gender, or social condition<br>2) Individuals are respected for their opinions, beliefs and personalities without being undergone to any form of discrimination<br>3) Communication is encouraged and resources and ideas are shared openly in the space<br>4) Every person is responsible of his/her security and of the one of the others. Before taking any action, a notice is communicated<br>5) The environment is planned to support diversity, in this environment people from different extractions can collaborate freely<br>6) Participants in the shared space can see above their differences and they can work together towards shared visions and goals, this creates a sense of community<br>7) Creativity and innovation are encouraged and people have the power to grow and develop throughout tutoring, sharing knowledges and developing competences |
| *Open Space Technology (OST)* | 1) Whoever comes is the right people: there is no need to invite specific individuals, on the contrary, it is trusted that whoever is present it is the right group of people to address the issue<br>2) Whatever happens is the only thing that could have: the group should not lose time in lingering on what could have been or what should have been, instead, it should focus on what is happening in the very moment<br>3) Whenever it starts is the right time: instead of trying to strictly manage the opening times or the session times, it should be allowed to the session to start when the group is ready and enthusiastic<br>4) When it is over, it is over: it is better to leave the session to finish when it is naturally done instead of imposing arbitrary limits of time<br>5) The law of two feet: every individual is encouraged to assume the responsibility of his/her learning process and of his/her participation and to undertake all the necessary actions to maximize his/her learning and contribution. This includes the possibility to leave or attend to the sessions as desired<br>6) The importance of offering: encouraging participants to offer suggestions or ideas, but also to be open to suggestions and ideas of other people<br>7) The research of the passion: allowing people to deepen topics for which they have a specific passion instead of trying to cover all the topics in a superficial way<br>8) The power of participation: encouraging participation of as many people as possible, this includes people that traditionally could not talk in formal contexts |

(*continued*)

**Table 1.** (*continued*)

| *Models and approaches* | *KeyPrinciples* |
|---|---|
| *World Café* | 1) Create hospitable space in which participants can feel themselves welcomed and at ease in sharing their ideas<br>2) Encourage everyone's participation and dedication, independently from his/her role or position<br>3) Focus on conversations instead of on presentations or conferences<br>4) Plan questions that inspire creative thinking and open dialogue<br>5) Facilitate discussions in small groups that allow focused and more intimate conversations<br>6) Encourage participants to contribute with their prospectives and experiences to the conversation<br>7) Encourage participants to actively listen and to build on other people's ideas<br>8) Use of visual instruments to increase communication and comprehension<br>9) Co-create significate and comprehension throughout thoughts and synthesis<br>10) Encourage participants to act at the base of intuitions and ideas generated through the World Cafè process |
| *Appreciative Inquiry* | 1) Based on investigation: the Appreciative Inquiry (AI) is based on a participated and collaborative process of investigation. The process is focused on the exploration of the best of people, of their organization and other areas of interests<br>2) Based on strength points: the process is projected to identify strength points of individuals and of organization and to use them to obtain better results<br>3) Appreciation: the process is gratefully driven and encourages people to evaluate and recognise other's strength points<br>4) Collaborative: Appreciative Inquiry is a collaborative process that encourages all the interested parties to participate and co-create solutions<br>5) Indefinitely timing: it is an indeterminate approach, this means that it doesn't exist a pre-determined result. On the contrary, the goal is to explore and discover new possibilities<br>6) Engagement: Appreciative Inquiry encourages active participation and engagement from all the interested parties, this creates a sense of involvement and belonging<br>7) Development: Appreciative Inquiry is an approach to development, focused on building what works well to create a better future both for individuals and organizations<br>8) Action oriented: Appreciative Inquiry underlines actions towards the achievement of positive results, combining strategic planification and implementation<br>9)Sustainable: the approach is built to be sustainable, with a focus on long-term benefits more than only towards to short-term gains |

(*continued*)

**Table 1.** (*continued*)

| *Models and approaches* | *KeyPrinciples* |
|---|---|
| *Participatory rural appraisal (PRA)* | 1) Participation: PRA is a participative methodology that involves all the members of the community, included farmers, women, youngsters, and disadvantaged people<br>2) Approach based on local knowledge: PRA recognises that people who live and work in rural areas have a deep knowledge of their natural resources, of the wild fauna, of the plants and the earth condition<br>3) Collaboration and partnership: PRA encourages collaboration between members of the community, not governmental organization (NGOs), government and other partners<br>4) Use of visual and interactive methods: PRA uses visual and interactive methods, as maps, diagrams, approach walk, and other participative techniques to promote collective discussion and comprehension<br>5) Respecting and valuing community members' rights: PRA must respect and enhance community members' rights, including the ones of women, youngsters, disadvantaged people, and elderly<br>6) Sharing knowledge and information: PRA is based on sharing knowledges and information between community members, partners, and other interested parties<br>7) Action oriented approach: PRA is focused on an action-oriented approach, promoting the use of pragmatic and sustainable solutions to solve local issues<br>8) Respect for the environment and the culture: PRA takes in account cultural and environmental aspects of the community. It promotes conservation and sustainable use of natural resources |
| *Public Participation Geographic Information Systems* | 1) Online mapping platforms that allow individuals and communities to actively participate to collect, analyse and share spatial data<br>2) It integrates GIS and participative methods to consent to locals, planners and decision makers to collaborate and take informed decisions about the use of soil, environmental issues and infrastructure development<br>3) PPGIS technologies allow people to collect and share data about natural characteristics and the artificial ones, as the position of important reference points or cultural sites, areas that need reactivation or environmental protection and critical points for the traffic congestion or public security issues<br>4) The PPGIS instruments offer different modes for users to interact and visualize data, as the creation of maps, the generation of reports or the creation of scenarios that show the potential impact of different decisions<br>5) PPGIS applications have been used in various contexts as urban planification, environmental management, disaster response and community development<br>6) PPGIS allows citizens to be involved in decisional processes about issues that would interfere with their everyday life; in this way it would contribute to create a more participative and democratic society |

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**Table 1.** (*continued*)

| *Models and approaches* | *KeyPrinciples* |
|---|---|
| *Participatory Leaning and Action (PLA)* | 1) Collaborative and inclusive: PLA underlines the importance of involving all the interested parts in learning and decisional process, including the ones that are traditionally emarginated or excluded<br>2) Contextualized: PLA recognises that learning and action must be eradicated in specific cultural, social, economic, and political contexts of the community and the organization<br>3) Experiential: PLA encourages active and practical learning through practical experiences that promote considerations and critical thinking<br>4) Empowering: PLA aims to increase capacities of individuals and communities to act for themselves and to influence decisional processes<br>5) Continuous: PLA recognises that learning and action are ongoing and they should be continuously evaluated, reviewed and improved<br>6) Reflective: PLA underlines the importance of thoughts and self-consciousness in the process of learning and action, including recognition and challenging dynamics of power and prejudices<br>7) Action oriented: PLA gives priority to development and implementation of the action and concrete strategies to face issues and objectives of the community and the organization<br>8) Adaptive: PLA recognises that learning and action must be flexible and sensitive to changing circumstances and new information |
| *Local knowledge mapping (LKM)* | 1) Collaboration: LKM is a collaborative process which plans involvement of different interested parts to identify sources and gaps of knowledge<br>2) Participation: LKM promotes participation involving local communities in the mapping process and allowing them to have easy access to information<br>3) Local property: LKM is focused on building local property of knowledge, ensuring that it is relevant and useful for local communities<br>4) Contextualization: LKM requires contextualization of knowledge taking into account of the social, cultural and environmental contexts that shape it<br>5) Diversity: LKM recognises diversity of knowledge and perspectives sources. It recognises that knowledge is not limited to experts and academics<br>6) Interdisciplinary approach: LKM reunites different disciplines such as anthropology, geography, and ecology, in order to create a holistic understanding of local knowledge<br>7) Ethical considerations: LKM follows ethical guidelines to collect, analyse and disseminate local knowledges. It guarantees the respect of confidentiality and informed consent<br>8) Sustainability: LKM aims to create sustainable and long-lasting knowledge nets that can be adapted and improved through time |

(*continued*)

**Table 1.** (*continued*)

| *Models and approaches* | *KeyPrinciples* |
|---|---|
| *Metaverse and Performance Modelling* | 1) Expanding participative experience: it allows to create a virtual simulation in which participants can interact in a more dynamic and involving way than traditional participative practices<br>2) Communication improvement: models and visual representation can help participants to better understand the information and to communicate more effectively during participative practices<br>3) Building future scenarios: to create virtual models can allow participants to visualize and experiment possible future scenarios in more concrete way; it would give a support to decisional processes<br>4) More collaboration during practices means to involve competences and knowledge of professionals coming from different education fields. This kind of multidisciplinary collaboration can lead to major consciousness and understanding of complex issues that are faced<br>5) Cost reduction: use of virtual modes can reduce costs such as time, money and resources needed for traditional participative practices, it will increase decisional process efficiency and improve citizen participation |

citizens as effectively as possible, ii) the consideration of the particular spatial context and the best innovative techniques and technologies for that specific spatial and cultural reality, represent key decisions for achieving a conscious development. Figure 1 shows these relationships also considering climate change in highly vulnerable areas such as coastal zones.

## 4 Discussions and Conclusions

Local communities and other stakeholders (e.g., governments, academic institutions, community-based organisations, etc.) should be actively involved in coastal zone climate management decision-making processes to ensure that their concerns and specific requirements are represented in planning and implementation phases. The above mentioned bottom-up approaches recognise the complex interrelationships between the environment, economy, and society and aim (i) to create a collaborative and inclusive approach to coastal zone management, (ii) to assist planners (and other professionals) and policy makers understand the social, economic, and ecological context of coastal areas, (iii) to help identify potential trade-offs and conflicts that must be addressed in the management of these areas, and (iv) to develop a standard methodology for high-resolution coastal zone assessments.

Participatory practices can also contribute to the development of social capital and community resilience in the face of climate change's effects. Collaborative decision-making can facilitate cooperation and problem-solving by fostering trust and mutual understanding among stakeholders. This enables the development of self-organisation and social networks that can be mobilised to respond to the effects of climate change, such as adapting to changes in managing sea level rise, storm surges and erosion.

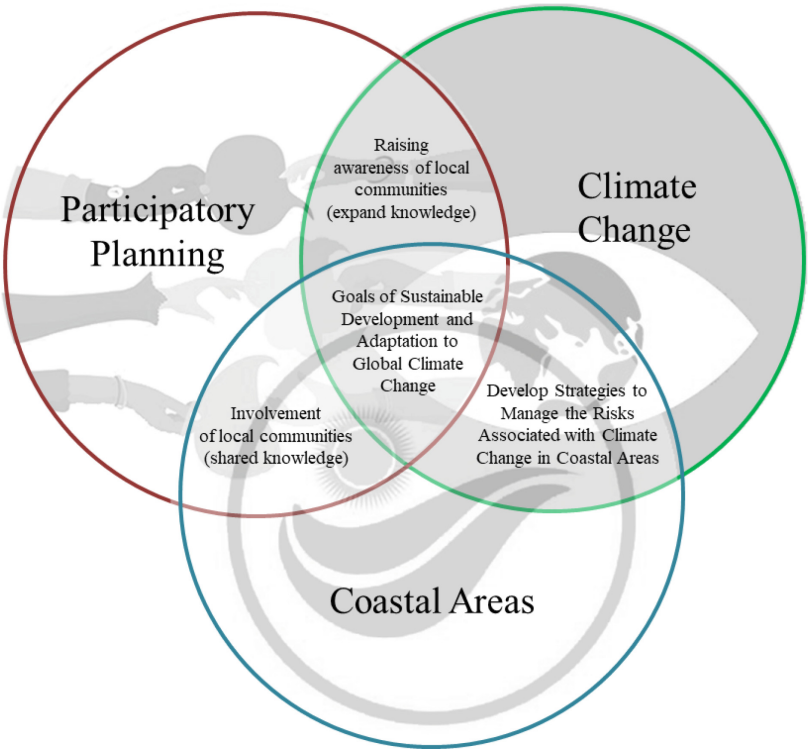


**Fig. 1.** Relationships between Climate Change, Coastal Zones, and Participatory Planning

In African cities, such bottom-up practices allow to involve previously marginalized communities by integrating their local knowledge and perceptions, which is essential for improving quality of life and reducing risk in unplanned and spontaneous settlements. Participatory practices in the context of coastal zones and climate change can also contribute to more equitable outcomes for all stakeholders. Planners, policymakers, community-based organisations and research institutions can ensure that the requirements and concerns of marginalised groups are taken into consideration by involving a diverse range of voices and perspectives in the decision-making process. The success of technology-based participatory practices is closely tied to the selection of the most appropriate technology for the context under investigation, as well as an involvement that does not manipulate the citizens involved. Participatory practices stimulate collaboration and inclusiveness in decision-making processes and have proven to be a valuable aid in coastal zone management. All these bottom-up approaches acknowledge that all individuals with diverse perspectives and experiences (including the marginalised population) can provide valuable insights and contribute to co-produce practical solutions to complex problems. This study emphasises the significance of openness, responsibility, and equity in decision-making processes. Participatory planning approaches are crucial tools for coastal communities to address the effects of climate change on climate-vulnerable ecosystems in coastal zones. Integrating stakeholder needs and expectations

into local climate change policies and involving coastal communities are key to the success of these approaches. Coastal communities can take charge of their future and devise strategies to adapt to the effects of climate change while safeguarding vital ecosystems through participatory planning. By doing so, they can reach community resilience and contributing to sustainable development.

Future studies will look at the application of the proposed theoretical framework to various case studies in vulnerable coastal areas in different continents and with unique morphologic characteristics.

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## References and Notes

1. United Nations Framework Convention on Climate Change (2022). https://www.sciencedirect.com/topics/earth-and-planetary-sciences/united-nations-framework-convention-on-climate-change. Accessed 17 Apr 2023
2. Participatory Urban Planning for Climate Change Adaptation. https://unfccc.int/files/bodies/awg/application/pdf/05_vanessa_castan-broto.pdf. Accessed 17 Apr 2023
3. Garau, C.: Citizen participation in public planning: a literature review. Int. J. Sci. **1**(12), 21–44 (2012)
4. Garau, C.: Processi di piano e partecipazione. Gangemi Editore Spa (2013)
5. Castán Broto, V., Boyd, E., Ensor, J.: Participatory urban planning for climate change adaptation in coastal cities: lessons from a pilot experience in Maputo, Mozambique, current opinion. Environ. Sustain. **13**, 11–18 (2015). https://doi.org/10.1016/j.cosust.2014.12.005
6. Loggia, C., Govender, V.: A Hybrid methodology to map informal settlements in Durban, South Africa. In: Proceedings of the Institution of Civil Engineers - Engineering Sustainability, vol. 173, no. 5, pp. 257-268 (2020).https://doi.org/10.1680/jensu.19.00005

7. Moore, S.A., Brown, G., Kobryn, H., Strickland-Munro, J.: Identifying conflict potential in a coastal and marine environment using participatory mapping. J. Environ. Manage. **197**, 706–718 (2017). https://doi.org/10.1016/j.jenvman.2016.12.026
8. Different Models and Concepts of (Youth) Participation (2011). https://www.academia.edu/2548314/Different_Models_and_Concepts_of_Youth_Participation. Accessed 17 Apr 2023
9. Kearney, J., Berkes, F., Charles, A., Pinkerton, E., Wiber, M.: The role of participatory governance and community-based management in integrated coastal and Ocean management in Canada. Plan. Theory Pract. **79–104** (2006). https://doi.org/10.1080/10.1080/08920750600970511
10. AR5 Climate Change 2014: Impacts, Adaptation, and Vulnerability. https://www.ipcc.ch/report/ar5/wg2/. Accessed 17 Apr 2023
11. Forum on Cities and Subnationals (henceforth the Forum) at the UNFCCC Warsaw COP in November 2013. https://unfccc.int/event/forum-on-experiences-and-best-practices-of-cities-and-subnational-authorities-in-relation-to. Accessed 17 Apr 2023
12. Climate Change 2022: Impacts, Adaptation and Vulnerability (2022). https://report.ipcc.ch/ar6/wg2/IPCC_AR6_WGII_FullReport.pdf. Accessed 17 Apr 2023
13. Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability (2022). https://archive.ipcc.ch/publications_and_data/ar4/wg2/en/ch20s20-8-2.html. Accessed 17 Apr 2023
14. More participatory democracy to tackle climate change (2021). https://assembly.coe.int/LifeRay/POL/Pdf/TextesProvisoires/2021/20210622-ClimateDemocracy-EN.pdf. Accessed 17 Apr 2023
15. Laignel, B., Vignudelli, S., Almar, R., et al.: Observation of the coastal areas, Estuaries and Deltas from space. Surv. Geophys. (2023). https://doi.org/10.1007/s10712-022-09757-6
16. Williams, D.S., et al.: Vulnerability of informal settlements in the context of rapid urbanization and climate change. Environ. Urban. **31**(1), 157–176 (2019)
17. Chambers, R.: Participatory mapping and geographic information systems: whose map? who is empowered and who disempowered? who gains and who loses? Electron. J. Inf. Syst. Dev. Countries **25**(1), 1–11 (2006). https://doi.org/10.1002/j.1681-4835.2006.tb00163.x
18. Massey, D., Jess, P.M.: A Place in the World? Places. Oxford University Press, Oxford, UK, Cultures and Globalization (1995)
19. Elwood, S.: Negotiating knowledge production: the everyday inclusions, exclusions, and contradictions of participatory GIS research. Prof. Geogr. **58**(2), 197–208 (2006). https://doi.org/10.1111/j.1467-9272.2006.00526.x
20. 60 participatory learning and action Community-based adaptation to climate change. https://www.iied.org/sites/default/files/pdfs/migrate/14573IIED.pdf. Accessed 17 Apr 2023
21. Ross, H., et al.: A participatory systems approach to understanding climate adaptation needs. Clim. Change **129**(1–2), 27–42 (2015). https://doi.org/10.1007/s10584-014-1318-6
22. Contestabile, M.: Participatory planning. Nat. **3**, 861 (2013). https://doi.org/10.1038/nclimate2021
23. Samaddar, S., et al.: Successful community participation in climate change adaptation programs: on whose terms? Environ. Manage. **67**(4), 747–762 (2021). https://doi.org/10.1007/s00267-020-01421-2
24. Salazar, V.: From practices to praxis: ASEAN's transnational climate governance networks as communities of practice. J. Curr. Southeast Asian Aff. (2023). https://doi.org/10.1177/18681034231167443
25. Swanson, K.: Centering equity and justice in participatory climate action planning: guidance for urban governance actors. Plan. Theory Pract. (2023). https://doi.org/10.1080/14649357.2023.2189288

26. White, S.C.: Depoliticising development: the uses and abuses of participation (La dépolitisation du développement: usages et abus de la participation / Despolitisando o desenvolvimento: participação: usos e abusos/Despolitizando el desarrollo: los usos y abusos de la participación). Dev. Pract. **6**(1), 6–15 (1996). http://www.jstor.org/stable/4029350
27. People working together around the world to generate ideas and action for social change. https://www.participatorymethods.org/method/levels-participation. Accessed 17 Apr 2023
28. Participation Models A chase through the maze Citizens, Youth, Online. https://www.nonformality.org/wp-content/uploads/2012/11/Participation_Models_20121118.pdf. Accessed 17 Apr 2023
29. Behavior Wizard (2022). https://behaviordesign.stanford.edu/resources/behavior-wizard. Accessed 17 Apr 2023
30. Gaventa, J.: Finding the Spaces for Change: A Power Analysis. https://www.powercube.net/wp-content/uploads/2009/12/finding_spaces_for_change.pdf. Accessed 17 Apr 2023
31. Core Values, Ethics, Spectrum – The 3 Pillars of Public Participation. https://www.iap2.org/page/pillars. Accessed 17 Apr 2023
32. A potpourri of participation models. https://www.nonformality.org/2011/07/participation-potpourri/. Accessed 17 Apr 2023
33. Making a Difference: A guide to Evaluating public participation in central government. http://www.sp.gov.tr/upload/Sayfa/47/files/Making_a_Differece_-_A_guide_to_evaluating_public_participation_in_centralgovernment.pdf. Accessed 17 Apr 2023
34. Varieties of Participation. https://organizingengagement.org/models/varieties-of-participation/. Accessed 17 Apr 2023
35. Participation Online – The Four C's. https://participationpool.eu/resource/participation-online-the-four-cs/. Accessed 17 April 2023
36. Garau, C., Annunziata, A.: Smart city governance and children's agency: an assessment of the green infrastructure impact on children's activities in Cagliari (Italy) with the tool opportunities for children in urban spaces (OCUS). Sustainability **11**(18), 4848 (2019)
37. Fogg, B.J., Eckles, D.: The behavior chain for online participation: how successful web services structure persuasion. In: de Kort, Y., IJsselsteijn, W., Midden, C., Eggen, B., Fogg, B.J. (eds.) PERSUASIVE 2007. LNCS, vol. 4744, pp. 199–209. Springer, Heidelberg (2007). https://doi.org/10.1007/978-3-540-77006-0_25
38. Chiordi, S., Desogus, G., Garau, C., Nesi, P., Zamperlin, P.: A preliminary survey on smart specialization platforms: evaluation of European best practices. In: Gervasi, O., et al. (eds.) Computational Science and Its Applications – ICCSA 2022 Workshops. ICCSA 2022. Lecture Notes in Computer Science, vol. 13382. Springer, Cham (2022). https://doi.org/10.1007/978-3-031-10592-0_7
39. Garau, C., Nesi, P., Paoli, I., Paolucci, M., Zamperlin, P.: A big data platform for smart and sustainable cities: environmental monitoring case studies in Europe. In: Gervasi, O., et al. (eds.) ICCSA 2020. LNCS, vol. 12255, pp. 393–406. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-58820-5_30
40. Azzari, M., Garau, C., Nesi, P., Paolucci, M., Zamperlin, P.: Smart city governance strategies to better move towards a smart urbanism. In: Gervasi, O., et al. (eds.) ICCSA 2018. LNCS, vol. 10962, pp. 639–653. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-95168-3_43
41. Mannaro, K., Baralla, G., Garau, C.: A goal-oriented framework for analyzing and modeling city dashboards in smart cities. In: Bisello, A., Vettorato, D., Laconte, P., Costa, S. (eds.) SSPCR 2017. GET, pp. 179–195. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-75774-2_13
42. Mannaro, K., et al.: Towards a smart region: the case study of a teledermatology platform in Sardinian region (Italy). In: 2017 IEEE 13th International Conference on Wireless and Mobile Computing, Networking and Communications (WiMob), pp. 370–377. IEEE (2017)

43. Rashid, A., et al.: RES-Q an ongoing project on municipal solid waste management program for the protection of the Saniq River basin in Southern Lebanon. In: Gervasi, O., et al. (eds.) ICCSA 2021. LNCS, vol. 12956, pp. 536–550. Springer, Cham (2021). https://doi.org/10.1007/978-3-030-87010-2_40
44. Shared Space Café. https://organizingengagement.org/models/shared-space-cafe/. Accessed 17 Apr 2023
45. Metodologie Participative. https://www.format.bo.it/metodologie-partecipative/ Accessed April 17, 2023
46. Introducing Participatory Approaches, Methods and Tools. https://www.fao.org/3/ad424e/ad424e03.htm. Accessed 17 Apr 2023
47. Mayoux, L. Participatory Methods. https://watsanmissionassistant.org/wpcontent/uploads/2018/08/participatory-methods-_linda-mayoux.pdf. Accessed 17 Apr 2023
48. Hemmerling, S.A., et al.: Elevating local knowledge through participatory modeling: active community engagement in restoration planning in coastal Louisiana. J. Geogr. Syst. **22**(2), 241–266 (2019). https://doi.org/10.1007/s10109-019-00313-2
49. Mariotti, M., Gervasi, O., Vella, F., Cuzzocrea, A., Costantini, A.: Strategies and systems towards grids and clouds integration: a DBMS-based solution. Futur. Gener. Comput. Syst. **88**, 718–729 (2018). https://doi.org/10.1016/j.future.2017.02.047
50. Biondi, G., Franzoni, V., Gervasi, O., Perri, D.: An approach for improving automatic mouth emotion recognition. In: Misra, S., et al. (eds.) ICCSA 2019. LNCS, vol. 11619, pp. 649–664. Springer, Cham (2019). https://doi.org/10.1007/978-3-030-24289-3_48
51. Vella, F., Neri, I., Gervasi, O., Tasso, S.: A Simulation framework for scheduling performance evaluation on CPU-GPU heterogeneous system. In: Murgante, B., et al. (eds.) ICCSA 2012. LNCS, vol. 7336, pp. 457–469. Springer, Heidelberg (2012). https://doi.org/10.1007/978-3-642-31128-4_34
52. Riganelli, M., Franzoni, V., Gervasi, O., Tasso, S.: EmEx, a tool for automated emotive face recognition using convolutional neural networks. In: Gervasi, O., et al. (eds.) ICCSA 2017. LNCS, vol. 10406, pp. 692–704. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-62398-6_49
53. Perri, D., Sylos Labini, P., Gervasi, O., Tasso, S., Vella, F.: Towards a learning-based performance modeling for accelerating deep neural networks. In: Misra, S., et al. (eds.) ICCSA 2019. LNCS, vol. 11619, pp. 665–676. Springer, Cham (2019). https://doi.org/10.1007/978-3-030-24289-3_49
54. Laganà, A., Gervasi, O., Tasso, S., Perri, D., Franciosa, F.: The ECTN virtual education community prosumer model for promoting and assessing chemical knowledge. In: Gervasi, O., et al. (eds.) ICCSA 2018. LNCS, vol. 10964, pp. 533–548. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-95174-4_42
55. Simonetti, M., Perri, D., Amato, N., Gervasi, O.: Teaching math with the help of virtual reality. In: Gervasi, O., et al. (eds.) ICCSA 2020. LNCS, vol. 12255, pp. 799–809. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-58820-5_57
56. Nicholls, R.J., et al.: Ranking port cities with high exposure and vulnerability to climate extremes: exposure estimates (2008). https://doi.org/10.1787/011766488208