

Review

## Models and Approaches for Integrating Protected Areas with Their Surroundings: A Review of the Literature

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**Abstract:** Several studies have identified threats that originate in areas surrounding protected areas (PAs). While there have been various efforts to integrate PAs with their surroundings, considerable challenges remain. Here we summarize these efforts to date, discuss their effectiveness, and provide recommendations for future research. Based on a broad literature review of theoretical and applied approaches, we have outlined 68 models for balancing conservation and sustainable development in PAs. We comprehensively analyzed 23 of these models for integrating PAs with their surroundings. They were divided into two categories: area-oriented and process-oriented approaches. This review reveals the absolute necessity of combining these two approaches for future conservation and sustainable development of PAs.

**Keywords:** protected areas (PAs); PA surroundings; models; area-oriented approach; process-oriented approach; conservation; sustainable development

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## 1. Introduction

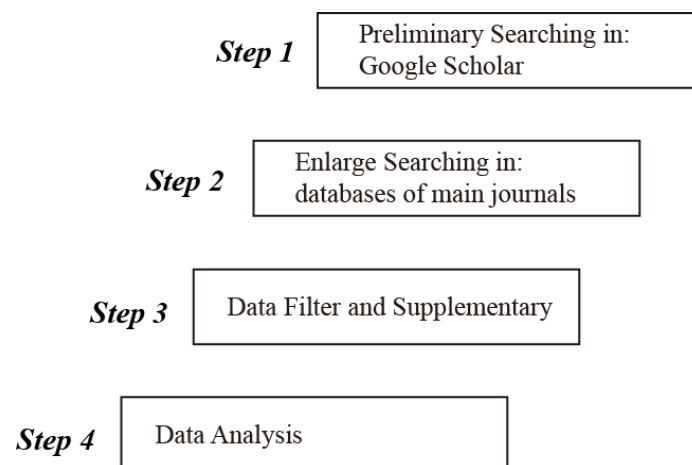
Protected areas (PAs) are widely recognized as one of the most important strategies for achieving conservation and sustainable development. However, they face great challenges. Many studies have indicated that most of the problems affecting PAs involve land use changes and activities that originate in surrounding areas [1–3], seriously undermining the harmonious balance between conservation and sustainable development in and around PAs [4]. Consequently, studies examining the relationships between PAs and their surroundings [5], and efforts to integrate them, have been widespread [6,7]. Some of these efforts that relate to a variety of concepts, perspectives, theories, methods, tools, approaches, models, and projects have proved effective to some extent, whereas others have been far from successful. Many of the efforts concentrated on the conservation of PAs: notably Biosphere reserve [8], identification of priority areas [9], Spatial indicators [10], UK National Ecosystem Assessment (NEA) [11], multi-criteria decision-making [12], *etc.*; while many other efforts were from the perspective of sustainable development, representative stakeholder approach [13], community-based management [14], Integrated Conservation and Development Projects (ICDPs) [15,16], adaptive governance [17], spatio-functional model [18], *etc.* Alternatively, while some models have proved useful in some cases, they have failed when applied to other cases [19].

There have been reviews on the effectiveness of some of the prevailing models and approaches such as buffer zones [8] and the participatory approach [20]. However, to the best of our knowledge, few studies have provided a concise but comprehensive review of the various efforts aimed at integrating PAs with their surroundings. It is important to examine historical changes in relationships between PAs and their surroundings; efforts that have been made in relation to PAs, and their effectiveness; the challenges that they continue to face; as well as future research priorities.

In this study, we have attempted to provide a clear and simple outline of efforts to integrate PAs with their surroundings. We observed that although conflicts were highly concentrated in the areas surrounding PAs, they, in fact, epitomized the contradictions entailed in various conservation and development strategies relating to PAs. Therefore, it would be inappropriate to separate the surroundings of PAs from an overall strategy for balancing conservation and sustainable development. Because of the complexity of concepts, methods, tools, and models relating to PAs, this article has focused on the wider context in attempting to analyze a broad range of these approaches. To achieve this goal, we conducted this process in three steps. First, we briefly summarized key events in the timeline of PA development from the 1850s to the present. Second, we summarized all of the concepts, perspectives, theories, methods, tools, approaches, models, and projects for supporting conservation and sustainable development of PAs and their surroundings entailed within a total of 68 models, which we displayed in a model tree structure. Last, we extracted 23 of these models aimed at (or related to) integrating PAs with their surroundings, and categorized them into two approaches: area-oriented and process-based approaches. Subsequently, we carried out an in-depth analysis of the features, effectiveness, and weaknesses of these two approaches. Based on our analysis, we discuss how their practices could be improved in the future.

## 2. Materials and Methods

In order to acquire data covering a broad scope of available literature, we conducted the review in four steps (Figure 1). Step 1 involved a preliminary search using Google Scholar. The following keyword phrases: “history of Protected Areas”, “review of Protected Areas”, “Protected Areas and boundary effects”, “Protected Areas and local communities”, and “Protected Areas and surroundings” were searched for to acquire an overview of the field. During this stage, we only selected papers, books, and other publications that were closely related to our topic. This search on PA-related efforts yielded diverse results such as concepts, perspectives, theories, methods, tools, approaches, models, and projects. During step 2, we analyzed the data acquired from the last step to trace more related publications referred to in the initial body of literature. The journals consulted included *Journal for Nature Conservation*, *Biological Conservation*, *Conservation Biology*, *Conservation and Society*, *Environmental Conservation*, *Philosophical Transactions of the Royal Society-Biological Sciences*, *Society & Natural Resources*, *Landscape and Urban Planning*, *Tourism Management*, *Land Use Policy* and *Journal of Sustainable Tourism*. We searched for the keywords “protected areas” and “national park” in the title-author-keywords information provided in the databases of each journal separately (Table 1).



**Figure 1.** Research Framework.

The resources covered all of the available website data. Step 3 involved filtering data obtained from step 2 as well as complementary data. We examined abstracts and extracted those focusing on conservation and sustainable development. Following a comprehensive reading of the relevant papers, we summarized efforts to resolve problems in areas surrounding PAs and to integrate PAs with their surroundings. These included concepts, perspectives, theories, methods, tools, approaches, models, and projects, which were then summarized as “models” using the End Note X7 software. The complementary literature was traced through the references found in the above papers and then managed using End Note X7. Data analysis was performed during step 4, and all of the models for integrating PAs with their surroundings were categorized within the relevant “approaches”.

**Table 1.** Results of the search for articles.

Name of Journal	Keywords	Number of Articles	Search Dates
<i>Journal for Nature Conservation</i>	Protected Area; National Park	140	1995 to present
<i>Biological Conservation</i>	Protected Area; National Park	99	1968 to present
<i>Conservation Biology</i>	Protected Area; National Park	97	1987 to present
<i>Conservation &amp; Society</i>	Protected Area; National Park	40	2003 to present
<i>Environmental Conservation</i>	Protected Area; National Park	50	1974 to present
<i>Philosophical Transactions of the Royal Society-Biological Sciences</i>	Protected Area; National Park	92	1934 to present
<i>Society and Natural Resources</i>	Protected Area; National Park	134	1988 to present
<i>Landscape and Urban Planning</i>	Protected Area; National Park	175	1974 to present
<i>Tourism Management</i>	Protected Area; National Park	99	1980 to present
<i>Journal of Sustainable Tourism</i>	Protected Area; National Park	89	1993 to present
<i>Land Use Policy</i>	Protected Area; National Park	81	1984 to present

The key words “protected areas” and “national park” in the title-abstract-keywords information provided were searched for in the databases of each journal separately. To avoid double counting, papers containing both keywords were counted only once.

### 3. Results

#### 3.1. PAs and Their Surroundings: Historical Changes in Their Relationship

As shown in Figure 2, commencing from the 1850s, there were changes in the conception of the relationship between PAs and their surroundings. With the establishment of Yellowstone National Park in the USA in 1876, an ideology of strict and isolated conservation that excluded local people and all forms of local participation in PAs took shape. This ideology gained popularity in several other countries, especially developing countries. In this model, people were generally excluded from PAs so as to leave nature undisturbed. This “people out” model effectively protects significant core landscapes within PAs, but overlooks ecological and socioeconomic flows within and outside of the boundaries of PAs [2]. This has an adverse effect on the inner areas. It also inevitably results in social conflicts and numerous other significant technical and ethical issues [20]. Evidently, there are several challenges associated with this high-cost methodology—both within and outside of the boundaries of PAs. It is necessary to strengthen the effectiveness of the management of PAs and their surroundings [21]. Since the hosting of the second World Parks Congress (WPC) in 1972 at Yellowstone and Grand Teton, USA, PAs have been conceived as part of a broader strategy for achieving sustainability. However, this conference mainly focused on the listed PAs, and failed to address their connections with the areas around them [22].

It was not until the third WPC in 1982, held in Bali, Indonesia, that the process of change was initiated. This conference marked a turning point in the relationship between PAs and their surroundings. The theme of the conference was the conceptual shift from PAs being areas “set aside” to their being “components of sustainable development”. This meant that PAs were no longer viewed as being isolated from their surroundings and that the people living around them were no longer to be ignored. Further progress was achieved during the fourth WPC in 1992, held in Caracas, Venezuela. Focusing thematically on “Parks for life”, the conference addressed PA categories and their management

effectiveness. It was stated that “partnership of stakeholders outside the boundaries must be solicited during the planning and subsequent management of a reserve” [23]. The fifth WPC in 2003, held in Durban, South Africa, was a highly significant landmark in the evolving relationship between PAs and their surroundings. A recommendation of this conference was that governments, NGOs, local communities, and civil society should adopt and promote design principles that emphasized the linkages between PAs and their surroundings, focusing especially on a shift toward “benefits beyond boundaries” [24]. Henceforth, people have been considered as environmental stewards, and, thus, as essential elements, of protected areas. The theme of the sixth WPC, held in Sydney, Australia, in 2014 was “Parks, People, Planet: Inspiring Solutions”. This was aimed at developing a much more comprehensive understanding of the relationship between PAs, their surroundings, and the wider world.



**Figure 2.** Timeline of Protected Areas (PAs) and their changing relationship with their surroundings.

### 3.2. Models for Integrating PAs and Their Surroundings

Based on our wider research on “efforts for PAs’ conservation and sustainable development”, we particularly focused on those efforts that were aimed at (or related to) integrating PAs with their surroundings.

#### 3.2.1. A Broad Review of Models for Conservation and Sustainable Development of PAs

The ideological changes evident at successive WPCs reflected changes in cognition based on studies of PAs from across the world. Commencing from the second WPC held in 1972, PAs have been viewed as a part of a broader strategy for achieving sustainability. Consequently, various efforts to better balance conservation and sustainable development of PAs proliferated with time. To acquire a complete information base, we reviewed the entire range of efforts in this area, including concepts, perceptions, theories, strategies, approaches, tools, methods, and models related to the conservation and development of PAs since the 1970s. To better clarify descriptions of these efforts in the context of this research, we simplified their descriptions by categorizing them all as “models”. Based on our literature review, we conclusively summarized 68 representative models that have been evident since the ideological transformation in the relationship between PAs and their surroundings that took place in the 1970s (Table 2).

To present these efforts in a way that is easy to understand, we displayed them within a model tree structure (Figure 3). The models were listed by the decades in which they first appeared (from the 1970s to the present) according to two dimensions: primarily conservation-oriented and primarily sustainable development-oriented. The results show that the most notable efforts aimed at conserving PAs conservation in the 1970s was the Biospheres reserve (BR) concept that emerged within the Man and Biosphere Program (MAB) [25]. In the 1980s, the concept of including buffers around PAs to protect them from disturbances originating in surrounding areas became widespread. The two primary goals in designing buffer zones around PAs have been, first, as an extension of national parks and, second, to integrate parks and people [8]. Simultaneously, research relating to environmental capacities has also advanced, leading to concepts such as Limits of Acceptable Change [26] and the Ultimate Environmental Threshold [27]. In the 1990s, there was a proliferation of models that emerged from efforts to promote effective conservation of PAs. Examples of these models include: multi-criteria evaluation [28], protected area management effectiveness assessments [29], *etc.* During this period, the buffer zone concept was developed to create broader systematic zoning methods, such as the impact zone [3]. In the 2000s, a key research focus was on the spatial patterns of PAs, for example, identification of priority areas [9] and species distribution modeling [30]. There was continued progress in the development of zoning methods, such as the zone of interaction [31], and multi-objective land allocation [32]. Moreover, quantization methods, such as the probability of connectivity index [33] and multi-tenure reserve networks [34] were developed. During the current decade, there has also been an emphasis on mapping suitable areas for better conservation, for example, through ecosystem service maps [2] and no-take boundary design [35].

**Table 2.** Strategies, approaches, tools, methods, and models for the conservation and sustainable development of PAs.

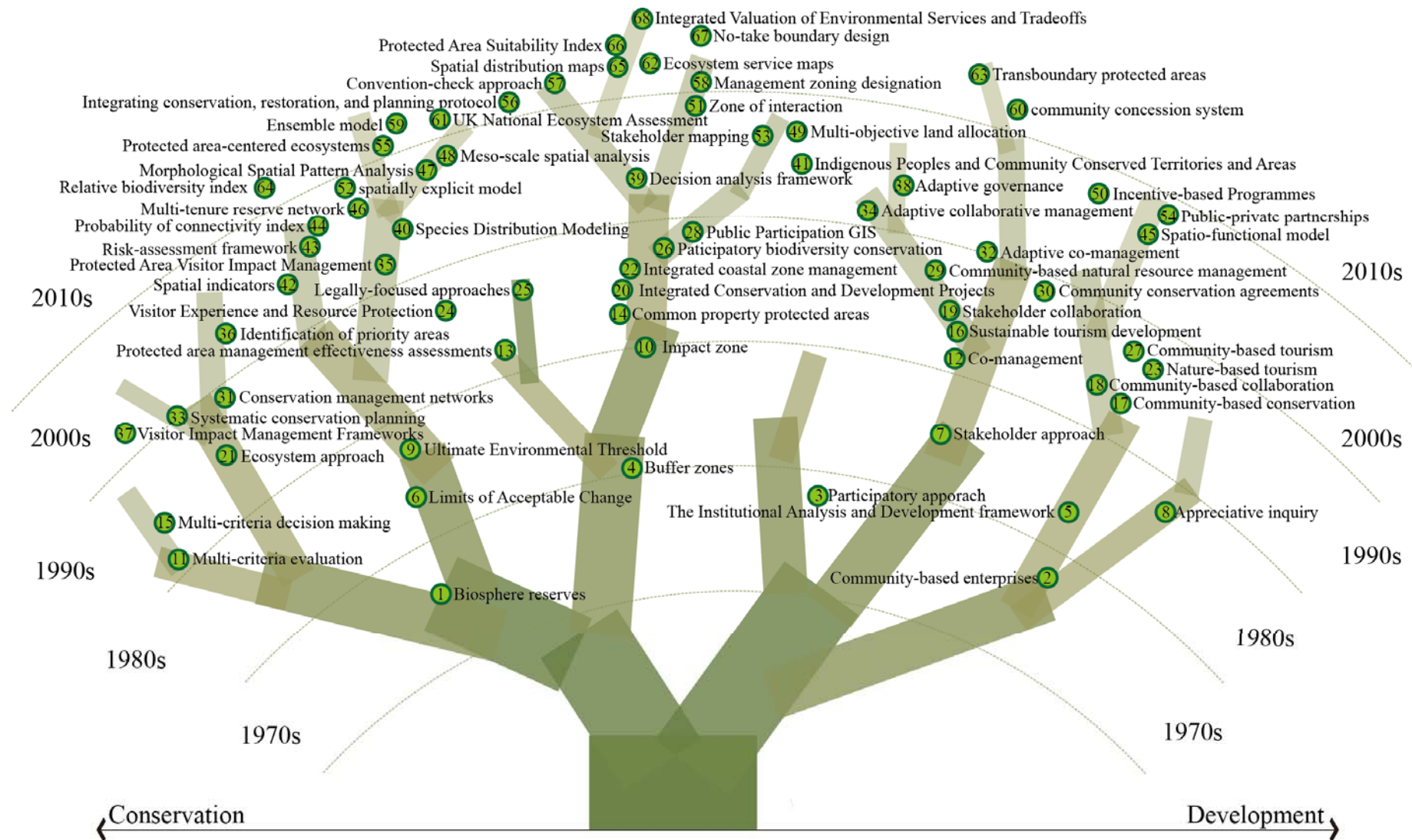
Decades	No.	Representative Models and Developed Date	Representative References
1970s	1	Biosphere reserves (dev. in 1976 by various)	[8,25]
	2	Community-based enterprises (dev. in 1970s by various)	[36]
	3	Participatory approach (dev. in 1970s by various)	[20]
1980s	4	Buffer zones (dev. in 1980 by various)	[8]
	5	Institutional Analysis and Development framework (dev. in 1982 by various)	[37]
	6	Limits of Acceptable Change (1984)	[26]
	7	Stakeholder approach (dev. in 1984 by various)	[13]
	8	Appreciative inquiry (dev. in 1987 by various)	[38]
	9	Ultimate Environmental Threshold (1988)	[27]
1990s	10	Impact zone (1990)	[3]
	11	Multi-criteria evaluation (1991)	[28]
	12	Co-management (1991)	[39]
	13	Protected area management effectiveness assessments (dev. in 1992 by various)	[29]
	14	Common property protected areas (1992)	[40]
	15	Multi-criteria decision-making (1992)	[12]
	16	Sustainable tourism development (1994)	[41,42]
	17	Community-based conservation (dev. in 1994 by various)	[43,44]
	18	Community-based collaboration (1995)	[14]
	19	Stakeholder collaboration (1995)	[45]
	20	Integrated Conservation and Development Projects (1995)	[15,16]
	21	Ecosystem approach (dev. in 1996 by various)	[46]
	22	Integrated coastal zone management (1996)	[47]
	23	Nature-based tourism (1996)	[48,49]
	24	Visitor Experience and Resource Protection (1997)	[50]
	25	Legally-focused approaches (1997)	[51]
	26	Participatory biodiversity conservation (1997)	[51]
	27	Community-based tourism (1997)	[52]
	28	Public Participation GIS (dev. in 1998 by various)	[53]
	29	Community-based natural resource management (1998)	[54]
	30	Community conservation agreements (1999)	[37]
	31	Conservation management networks (dev. in 1999 by various)	[55]
	32	Adaptive co-management (2000)	[56]

Table 2.Cont.

Decades	No.	Representative Models and Developed Date	Representative References
2000s	33	Systematic conservation planning (2000)	[57]
	34	Adaptive collaborative management (2001)	[58,59]
	35	Protected Area Visitor Impact Management (2002)	[60]
	36	Identification of priority areas (dev. in 2002 by various)	[9]
	37	Visitor Impact Management Frameworks (2002)	[61]
	38	Adaptive governance (dev. in 2002 by various)	[17]
	39	Decision analysis framework (2003)	[62]
	40	Species distribution modeling (2004)	[30]
	41	Indigenous Peoples and Community Conserved Territories and Areas (ICCAs) (dev. in 2004 by various)	[63]
	42	Spatial indicators (2005)	[10]
	43	Risk-assessment framework (2006)	[64]
	44	Probability of connectivity index (2007)	[33]
	45	Spatio-functional model (2007)	[18]
	46	Multi-tenure reserve networks (2008)	[34]
	47	Morphological Spatial Pattern Analysis (MSPA) (2008)	[65,66]
	48	Meso-scale spatial analysis (2008)	[67]
	49	Multi-objective land allocation (2008)	[32,68]
	50	Incentive-based Programs (2008)	[69]
	51	Zone of interaction (2009)	[31,70]
	52	Spatially explicit model (2009)	[71]
2010s	53	Stakeholder mapping (2009)	[72]
	54	Public-private partnerships (PPPs) (2009)	[73]
	55	Protected area-centered ecosystems (2011)	[74]
	56	Integrating conservation, restoration, and planning protocol (2011)	[75]
	57	Convention-check approach (2011)	[76]
	58	Management zoning designation (2011)	[7,77]
	59	Ensemble model (2012)	[78]
	60	Community concession system (2012)	[79]
	61	UK National Ecosystem Assessment (NEA) (2012)	[11]
	62	Ecosystem service maps (2013)	[2]
	63	Transboundary protected areas (2013)	[80,81]
	64	Relative biodiversity index (RBI) (2013)	[82]
	65	Spatial distribution maps (2013)	[83]
	66	Protected Area Suitability Index (PASI) (2013)	[84]
	67	No-take boundary design (2014)	[35]
	68	Integrated Valuation of Environmental Services and Tradeoffs (2015)	[85]

We found the models above in the selected journal papers, then searched for the models in the papers listed in the references, as well as in Google Scholar. Where there was more than one related publication, we cited the earliest and most representative one.





**Figure 3.** A model tree diagram depicting efforts aimed at the conservation and development of PAs.

The results show that the most obvious impact of research on PAs during the 1970s was a growing realization of the significance of the areas surrounding PAs in relation to their sustainable development. Efforts initiated during this period included the participatory approach [20] and community-based enterprises [36]. During the 1980s, stakeholders in the conservation and development of PAs focused especially on the Institutional Analysis and Development framework [37], and stakeholder theory [13]. During the 1990s, there was a remarkable shift in stakeholder relationships through developments such as common property protected areas [40] and integrated coastal zone management [47]. Community-based approaches [14,37,43,44,52,54] were particularly focused on sustainable development from different perspectives. In addition, some models were concerned with sustainable development principles and processes in PAs such as sustainable tourism development [41], nature-based tourism [48,49], Integrated Conservation and Development Projects [15], *etc.* In the early 2000s, adaptive and collaboration management were emphasized within research and practice. Examples included adaptive co-management [56], adaptive governance [17], *etc.* Frameworks for decision-making such as the Visitor Impact Management Frameworks [61] and the spatio-functional model [18] were another area of emphasis. In the 2010s, new development models emerged that increasingly emphasized the integration of the core areas of PAs with their surroundings. These models, which included management zoning designation [7,77], transboundary protected areas [80,81], and Integrating Conservation, Restoration Planning Protocol [75], reflected an emphasis on more comprehensive methods compared with previous models.

### 3.2.2. Models Aimed at (or Relating to) Integrating PAs with Their Surroundings

An examination of the 68 models, described above, indicates that efforts to conserve and develop PAs have focused on various dimensions. These include land use changes within PAs [86], assessing the effectiveness of PAs [87], hot spots of ecological significance within PAs [88], ultimate environmental thresholds of PAs [89], and Integrated Conservation and Development Projects [16]. Several studies have especially focused on conflicts between PAs and their surroundings [2,90]. This is because ecological flows and socioeconomic interactions mostly occur within as well as outside of their boundaries [5,91]. Scholars have recommended the incorporation of surrounding areas situated beyond the boundaries of PAs [92], or achieving a balance between conservation and sustainable development by integrating PAs with their surroundings. From the above 68 models, we extracted 23 models that were strongly aimed at (or related to) integrating PAs with their surroundings (Table 3).

The results of the analysis indicated that the key models for integrating PAs and their surroundings applied in the 1970s were the biosphere reserve [25] and the participatory approach [20]. Representative models during the 1980s, were buffer zones [93] and the stakeholder approach [94]. Thus, studies during these two decades reflected recognition of the changing relationship between PAs and their surroundings. Moreover, zoning methods to separate functions in PAs and their surroundings were widely adopted. Typical models applied in the 1990s include sustainable tourism development [42], and Integrated Conservation and Development Projects [15], *etc.* Studies during this period continued to focus on developing zoning methods in PAs and their surroundings, but at the same time, they began to explore ways of resolving conflicts linked to zoning designations in surrounding areas. The prevalent models during 2000s reflected efforts to explore more adaptive approaches. This was because early zoning methods had faced challenges as a result of overlooking the participation of local communities

in designated zones. There were considerably more in-depth studies conducted during the 2010s. For instance, in contrast with simple zoning designations during former decades, studies during this period reflected attempts to map the ecological, social, and economic interactions of PAs and their surroundings to support zoning and design making.

**Table 3.** Representative models aimed at (or related to) integrating PAs with their surroundings.

Dates	Representative Models and Developed Date	Representative References
1970s	Biosphere reserve (dev. in 1970s by various)	[8,25]
	Participatory approach (dev. in 1970s by various)	[20]
1980s	Buffer zones (dev. in 1980 by various)	[8]
	Stakeholder approach (dev. in 1984 by various)	[13]
1990s	Impact zone (1990)	[3]
	Co-management (1991)	[39]
	Integrated Conservation and Development Projects (1995)	[15,16]
	Sustainable tourism development (1994)	[41,42]
	Community-based management (1995)	[14]
2000s	Systematic conservation planning (2000)	[57]
	Adaptive collaborative management (2001)	[58,59]
	Risk-assessment framework (2006)	[64]
	Spatio-functional model (2007)	[18]
	Morphological Spatial Pattern Analysis (2008)	[65,66]
	Zone of interaction (2009)	[31,70]
	Spatially explicit model (2009)	[71]
2010s	Protected area-centered ecosystems (2011)	[74]
	Integrating conservation, restoration, and planning protocol (2011)	[75]
	Management zoning designation (2011)	[7,77]
	Ecosystem service maps (2013)	[2]
	Protected Area Suitability Index (2013)	[84]
	No-take boundary design (2014)	[35]
	Integrated Valuation of Environmental Services and Tradeoffs (In VEST) (2015)	[85]

The participatory approach is a broad and generalized term covering various participation-oriented methods, such as participatory biodiversity conservation. The stakeholder approach is a term that generalizes various stakeholder-based models, such as stakeholder collaboration. Community-based collaboration is an umbrella term covering various community-based models, such as community-based tourism, and community conservation agreements.

### 3.3. Approaches for Integrating PAs with Their Surroundings

Our comprehensive and in-depth investigation of the above models, based on their fundamental concepts and methods and extending beyond their supernatant features, revealed that most models could be categorized within two main approaches: area-oriented and process-oriented approaches. We further subdivided the area-oriented approach into zoning-and mapping-based approaches. The process-oriented approach was also subdivided into participation-based and systematic approaches.

### 3.3.1. The Area-Oriented Approach

Conceptually, the area-oriented approach highlights the use of “hard” scientific techniques and rational ways of integrating PAs with their surroundings. It aims to distinguish between conservation and development activities within specific areas through zoning, or to identify the most appropriate areas for supporting decision-making relating to PA planning and management through mapping. Direct methodologies can be regarded as zoning-based approaches, while indirect methodologies entail a mapping-based approach. The underlying logic of the area-oriented approach is the premise that different functional areas can be clearly defined and that the human activities should be managed within different zones, each with its own rules. Based on this reasoning, a great deal of efforts has been invested into developing the most appropriate zoning or mapping methods. Models representing the area-oriented approach, and their characteristics, are shown in Table 4.

**Table 4.** Models representing the area-oriented approach and their main features.

No.	Models	Main Features
Zoning-based Approach	1 Biosphere reserve (BR) [25]	A BR generally consists of three concentric rings: an inner ring, which is the core area; a second ring, which is a buffer zone; and a third ring, which is a transitional or experimental zone.
	2 Buffer zone (BZ) [1]	A BZ is a classic strategy for protecting PAs from negative impacts originating from activities carried out in surrounding areas. It gives an added layer of protection to a PA, while providing benefits for neighboring villages.
	3 Impact zone (IZ) [3]	An IZ is a type of zoning-based approach aimed at offsetting the pressure of continued loss of trees and forest land situated adjacent to a national park. It is determined according to the context on the ground, including, local availability of forests, the average distance traversed to collect firewood and fodder, and transportation for accessing the buffer zone.
	4 Zone of interaction (ZoI) [31,70]	A ZoI is a designated area around a PA that encompasses hydrological, ecological, and socioeconomic interactions between a PA and the surrounding landscape. It expands on the BZ concept. Rather than limiting land use and access over a broadly-defined buffer, the ZoI approach can more specifically target locations and processes of particular importance for maintaining the ecological integrity of protected areas.
	5 Management zoning designation (MZD) [7,77]	MZD is aimed at reducing conflict by partitioning the landscape into various land use units that are managed for different levels of human activity. Multi-criteria decision analysis has been used to identify five management zones based on three management objectives in Yunnan, China.
Mapping-based approach	6 Ecosystem service map [2]	An ESM is a powerful tool for integrating complex information relating to ecosystem services into decision-making. The ecosystem boundaries of PAs can be analyzed by mapping service provision hotspots (SPHs), degraded SPHs, and service benefiting areas (SBAs).
	7 Risk-assessment framework [64]	RAF is a framework developed to assess the risk posed by alien plants in watersheds adjacent to a protected area. The framework combines species- and landscape-level approaches and has five key components. It can help managers to identify areas for proactive intervention, monitoring, and resource allocation.

Table 4. Cont.

No.	Models	Main Features
8	Protected area-centered ecosystems (PACES) [74]	PACES emphasize zones as the logical focus of monitoring, research, and collaborative management needed to maintain the functions and conditions of protection around each PA. They entail four mechanisms used to objectively map the spatial extent of PAs: effective size, ecological flows, crucial habitat, and edge effects.
9	No-take boundary design (NTBD) [35]	NTBD is a decision-support tool for flexible vulnerability assessments of key species. It is used to identify the best boundary options for marine protected areas (MPAs).
10	Integrated Valuation of Environmental Services and Tradeoffs (InVEST) [85]	InVEST is a suite of software models used to map and value ecosystem services. It is aimed at enabling decision-makers to assess quantified tradeoffs associated with alternative management choices, and to identify areas where investment in natural capital could enhance human development and conservation.
11	Morphological Spatial Pattern Analysis (MSPA) [95]	MSPA is a complementary way of mapping green infrastructure to maintain connectivity at the regional scale and to improve the resilience of conservation networks.
12	Spatially explicit model [71]	The spatially explicit model is used to quantify how residential development has altered the structural context around cores of PAs. It paints a more complex picture of the difficulties that would be faced if the establishment of an official conservation system was ever attempted.
13	Protected Area Suitability Index (PASI) [84]	PASI is a logic spatial planning tool that combines human preferences and conservation criteria to assess the suitability of marine sites for being protected from fishing and other extractive use.

Our analysis shows that the area-oriented approach is strongly associated with cognitive and conceptual changes in the relationship between PAs and their surroundings. During the initial stage, the prevailing concept was in isolated protection by setting PAs aside from their surroundings. The area-oriented approach was first developed through zoning-based tools and methods. The standard approach was to design zones (usually buffer and experimental zones) around the core areas of PAs. Over a period of more than 40 years, commencing in the 1970s, the zoning-based approach has been evolving as a strategy for resolving conflicts in areas surrounding PAs, which was aimed at preventing disturbances caused by the surrounding communities. Early models of this approach are biosphere reserves and buffer zones. This basic concept focused on establishing a zone (or zones) around a PA to integrate it with the surrounding landscape. However, this simple approach led to conflicts between PA management priorities and the needs of the surrounding communities. Consequently, concepts for PA management that followed placed more emphasis on a combination of ecological, social, and economic elements, and on the coexistence of conservation and development. In the 1980s, the buffer zone model was widely used and subsequently developed further through the design of various improved models such as impact zones, zones of interaction, zone systems, and management zoning designation. The zoning approach has increasingly depended on accurate and scientific evaluation of PAs and their

surroundings. In fact, both of these models were derived from the same fundamental concept during the initial period.

Another aspect in the evolution of the area-oriented approach beyond direct designation of zones for management has involved broad measurements of ecosystem flows and social interactions within and outside of the boundaries of PAs [96]. This development is evident in mapping, which is an indirect approach aimed at applying spatial information within decision-making through the mapping of ecological and social interactions [35]. Most of the models under this category focus on how to map ecosystem services and PA hotspots [2]. The methods employed have become increasingly complicated, and spatial zones in landscapes surrounding PAs have steadily diversified, because development of the communities is also considered. The area-oriented approach attaches great importance to the coherence of PAs and their surroundings through the clear identification and demarcation of PAs and their surroundings into different functional zones that can effectively guide management and decision-making.

### 3.3.2. The Process-Oriented Approach

The process-oriented approach reflects the pursuit of “soft” social methods and adaptive processes for integrating PAs with their surroundings. It aims to improve the effectiveness of management of designated PAs, particularly in the areas surrounding PAs. Compared with the concern of the area-oriented approach to identify and designate the most suitable areas, the process-oriented approach is concerned with how to design and establish the most effective adaptive process for connecting different stakeholders. The process-oriented approach can be subdivided into two categories: participation-based and systematic approaches. The former emphasizes all kinds of collaborations among different stakeholders, especially those involving the participation of local communities. The latter emphasizes the establishment of a systematic and integrated process for managing PAs. Models that are representative of the process-oriented approach, and their main features, are shown in Table 5.

The process-oriented approach was initiated with the participation-based approach. It has experienced a long history entailing different levels of participation. This approach involves local people to some extent in areas such as the planning process, tourism development, or implementation. The participation-based approach, including associated methods and techniques, took root in the late 1970s and early 1980s in response to highly centralized, top-down approaches to research and planning. During the early period of its development, it was viewed as a tool for achieving the voluntary submission of people to protected area schemes [97]. Subsequently, in the 1990s, the concept of participation was significantly developed within various models that involved stakeholders in protected area management. Studies on the participation-based approach were widely revealed through a search using three key words: “participation”, “community”, and “stakeholder”. Although these studies have been from different perspectives, they have all entailed a participation-based approach. Some studies have focused on direct participatory processes such as participatory rural appraisal (PRA) [98] and participatory biodiversity conservation [49]. Other studies have mainly focused on the participation of communities within and outside of the boundaries of PAs, such as community-based management [14], community-based collaboration [49], and community participation [97]. Still others have focused on relationships among stakeholders, such as the stakeholders approach [94], stakeholders’ perceptions [16], and stakeholder collaboration [99]. In the 2000s, the participatory approach further evolved with the

development of new approaches such as participatory planning in the periphery of national parks [100] and integrating a participatory process within GIS-based decision analysis for PA zoning [77].

**Table 5.** Models representing the process-oriented approach and their main features.

No.	Models	Main Features
Participation-based approach	14 Participatory approach [97,101]	The participatory approach has been highly influential in PA management. It entails two key aspects: the relationship between the conservation agency and the “role-players”, and benefits that accrue to local people. It emphasizes the decision-making process in the management of PAs.
	15 Stakeholder approach [94,102,103]	The stakeholder approach was pioneered by Freeman in 1984. It was developed as a comprehensive tool for helping to maintain the balance between tourism activity and social and environmental concerns. It emphasizes the perspectives of various individuals and groups in relation to the conservation and development of PAs.
	16 Community-based management (CBM) [14]	Local communities are one of the main categories of stakeholders in PA management. CBM is particularly focused on fostering the collaboration of communities in PA management. Collaboration offers a dynamic, process-based mechanism for resolving planning issues and coordinating tourism development at the local level. There are several varieties of CBM such as community-based collaboration [14], community-based tourism [104], and community-based enterprises [36].
	17 Adaptive collaborative management (ACM) [58]	ACM is a planning strategy for fostering the participation of stakeholders in the management of natural resources. It places special emphasis on learning as a cyclical process that is strengthened when different stakeholders’ perspectives challenge dominant views and values.
	18 Co-management [105,106]	Co-management has occupied center stage in natural resource management thinking and practice since the 1990s [107]. It can be understood as an arrangement of joint decision-making between the state and local communities.
Systematic approach	19 Integrated Conservation and Development Projects (ICDPs)	ICDPs aim to link biodiversity conservation in PAs with social and economic development in the surrounding communities [108]. The model underlying ICDPs has always been to establish “core” protected areas in which uses are restricted, while promoting socioeconomic development and income generation activities that are compatible with park management objectives in the surrounding areas (buffer zones) [16]. However, according to many reviews, their success has been limited [109].
	20 Integrating Conservation, Restoration, and Planning Protocol (ICRPP) [75]	ICRPP is an operational protocol for integrating conservation and restoration with land-use planning in the context of islands. ICRPP integrates ecological and socioeconomic factors to identify the best spatial options for conserving and restoring biodiversity, both inside and outside of extant reserves.

Table 5. Cont.

No.	Models	Main Features
Systematic approach	21 Spatio-functional model (SFM) [18]	SFMs emphasize both regional and functional collaboration. This model extends Saarinen's tourism-centered approach to two further levels: collaboration within the tourism industry and collaboration between the tourism industry and other (local) industries.
	22 Systematic conservation planning [57]	SCP is a six-stage process that consists of measuring and mapping, identifying conservation goals, reviewing existing reserves, selecting additional reserves, implementing conservation actions, and management and monitoring.
	23 Sustainable tourism principles [6,41]	Principles for sustainable tourism relate to the environmental, social, cultural, political, and economic spheres.

The second type of process-oriented approach is the systematic approach. This can be regarded as an outcome of the evolution of the participation-based approach. It not only emphasizes the participation process in the management of PAs, but also focuses on how to establish a systematic and integrative process to better achieve the sustainable management of PAs and their surroundings. This approach has also focused on the rationality and adaptability of PA zones and the design of the PA management process. Thus, the systematic approach aims to better integrate conservation and sustainable development within PAs and their surroundings. Models that are representative of this approach include ICDPs [109,110] and (ICRPPs) [75]. Models that aim to establish a systematized process for planning and managing PAs include the spatio-functional model [18] and systematic conservation planning [57]. Another representative model entails sustainable tourism principles [6,41] and treats tourism as a vehicle for supporting the conservation of PAs [24].

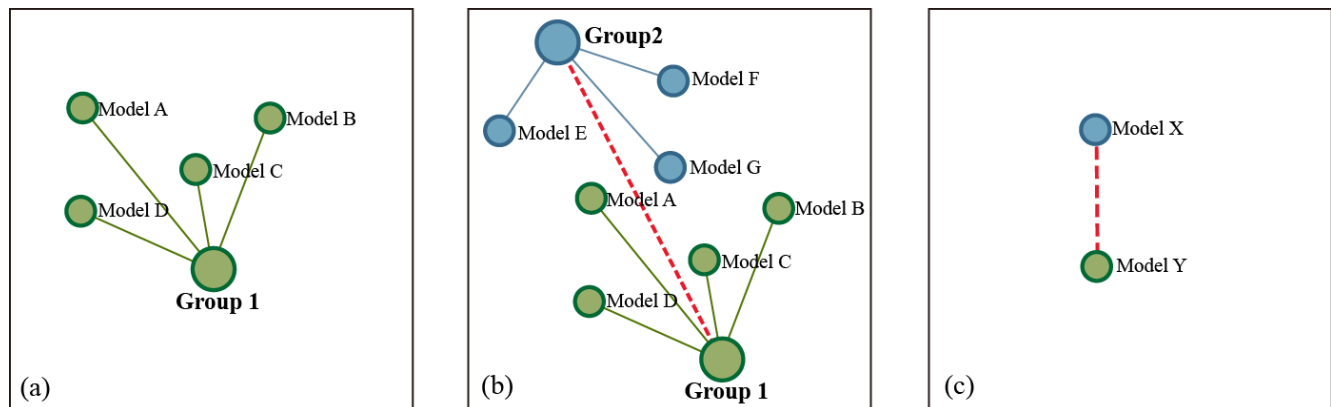
## 4. Discussion

### 4.1. Characteristics and Relationships between the Models: Complex Networks and Unequal Influence

The relationships among these models are very complex. It's really difficult to plainly differentiate their relationships. Generally, our analysis reveals the interconnections between many of the models within a network of relationships. Three kinds of relationships are evident among the models (Figure 4). The first are group relationships, where by the models share common fundamental concepts, principles, and theories, but differ in some aspects or operations in practice. For instance, the concept of community-based management has been developed within many models, such as community-based tourism, community conservation agreements, community-based collaboration, community-based conservation and community-based enterprises. These models focus on different aspects of community-based management. The second category is the intergroup relationship. This occurs when two groups of models that have different bases or emphases, demonstrate very close relationships with each other. For example, the concept of participation is entailed in models associated with the participatory approach, Public Participation GIS, and participatory biodiversity conservation. In this case, the participation group is conceptually very close to the community-based group. However, each group emphasizes different concerns, and has developed its own group models. The third category is the derivative relationship, which describes models that are derived from a previous model. The subsequent model can be seen as a



transformation and improvement of the earlier model. An example is Morphological Spatial Pattern Analysis, which is derived from Green Infrastructure Assessment.



**Figure 4.** The three types of relationships among the models: (a) group relationship; (b) intergroup relationship; and (c) derivative relationship.

Consequently, although the 68 representative models are summarized from large amount of literature, it is evident that there is unequal influence among them. With group relationships, some group models are much more influential and wide-spread than others in PAs' management, particularly in integrating PAs and their surroundings. The representative influential models in area-based approach include Biosphere reserve, buffer zone, Zone of interaction, Ecosystem service map, *etc.* Among the above influential models, the buffer zone model seems more principal in comparison to the others. The representative influential models in the process-based approach include community-based management, stakeholder approach, participatory approach, adaptive collaborative management, ICDPs, Co-management, *etc.* Relatively, some other models are obscure pilot projects or have little impact. The influential models constituted the main part of these two approaches.

#### 4.2. Characteristics and Relationships between the Two Approaches: Along Their Own Logic and Interdependent

The area-oriented approach is clear, distinctive, and site-specific, and its application is highly important in core areas of PAs, especially where there are key resources. Our analysis shows that the area-oriented approach is strongly associated with conceptual changes in the relationship between PAs and their surroundings. During the initial stage, the prevailing concept managed the PAs by setting them aside from their surroundings. In addition, many applications of this approach tended to be top-down and experientially based. This simplistic approach faced considerable challenges, because it overlooked the complex human activities that occur within and beyond the boundaries of PAs. Consequently, concepts for PA management that followed placed more emphasis on a combination of ecological, social, and economic elements, and on the coexistence of conservation and development. Many studies have attempted to enhance the scientificity of mapping and the adaptability of zone designation. These efforts have entailed not only more accurate analysis, measurement, and appraisal of environmental elements, but also greater consideration of the social elements. Consequent improvements have promoted adaptive and resilient management of PAs, while also adding complexity to management

practices. The methods employed have become increasingly complicated, and spatial zones in landscapes surrounding PAs have steadily diversified, because development of the communities is also considered.

On the other hand, the concept of process-oriented approach can be seen as having been stimulated by the challenges of area-oriented approach, particularly with the simple isolated zone designations in early period. Compared with the area-oriented approach, the process-oriented approach is more adaptable, acceptable, and resilient. By creating participation and dialogue opportunities within decision-making and management, this approach can facilitate understanding and cooperation of stakeholders, especially local communities, around PAs. The process-oriented approach has also been evolving through the expansion of different typologies of participation ranging from passive participation to self-mobilization. However, its effectiveness is highly contingent on education status as well as cultural, social, and political contexts. In other words, this approach has a much higher probability of failure in societies that lack a democratic administration tradition than in democratic societies. In some specific situations, conservation goals may also be compromised or weakened, particularly in areas that are densely populated.

Although the two approaches are evolving along their own pathways, they have been intertwined and interdependent with each other from the beginning, and combined more with each other in recent decades. There is a lot of evidence indicating the combination and overlapping of the two approaches. During the early period of their development, the relation between the two approaches when applied to the conservation and development of PAs was minimal. However, in the 1990s, the model of Integrated Conservation and Development Projects attempted to link local communities to the decision-making authorities within the areas surrounding PAs. In the 2000s, the identification of priority areas model entailed the convergence of ecological information (area-oriented) and expert-based decisions (process-oriented), as well as the advocacy of Integrating Community-based and Science-based approaches [111] and the developing of Stakeholder mapping [72]. In the early 2010s, the management zoning designation model explored multi-criteria decision analysis (a participatory process involving multiple stakeholders and technical experts) by inviting local communities to participate in the designation of national park zones in Yunnan, China [77]. This recent attempt to incorporate public participation at an early stage of the zoning designation process reflects the close synergy of the two approaches in recent practice.

#### *4.3. Cognition of the Two Approaches and Trends for the Future: Coordinating Two “Legs” for “Walking”*

The two approaches reflect different understandings related to conservation and sustainable development. The core concept underlying the area-oriented approach is the differentiation of various activities and their designation within appropriate areas. Its fundamental methodology is zoning/mapping PAs and their surroundings based on accurate scientific methods. This site-specific approach reflects the pursuit of scientific and rational ways to better integrate PAs with their surroundings. Correspondingly, the process-oriented approach is concerned with how to reduce conflicts among stakeholders in PAs and their surroundings. The key methodology for applying this approach is to establish an acceptable process to sustain dialogue, agreement, and even compromise in dealing with conflicts relating to the

conservation and development of PAs. The distinctive characteristics of the two approaches are shown in Table 6.

**Table 6.** Distinctive characteristics of the two approaches.

Category	Basic Concepts and Concerns	Disadvantages	Evaluation
<b>Area-oriented approach</b>	Attempts to guide, separate, conserve, and develop activities in appropriate areas with specific and rigid methods. PAs and their surroundings are spatially divided within different zones using accurate and scientific zoning or mapping methods.	Complicated, and creates challenges for management.	Applies scientific and distinctive management objectives or decision-making choices. It is essentially a rational approach.
<b>Process-oriented approach</b>	Attempts to reduce conflicts in PAs and their surroundings in a resilient and acceptable way. Emphasizes conservation and develops initiatives by establishing an acceptable and adaptive process.	Highly contingent on cultural and political contexts.	Applies an adaptive and collaborative process among different stakeholders. It is essentially an adaptive approach.

Here, we summarize community-based management as a group of “community-based” tools, methods, projects and approaches, which include Community-based Enterprises, Community-based Conservation, Community-based Collaboration, Community-based Tourism, Community-based Natural Resource Management, Community Conservation Agreements, Community Concession System, *etc.*

Both the area-oriented and process-oriented approaches have a significant role in integrating PAs with their surroundings. However, they both face challenges when they are utilized separately. It appears that a number of practices relating to area-oriented approaches are top-down [112], and several zone designations are overly simplistic or overly complicated. Even for those models referred to as “scientific” zoning/mapping, it is almost impossible to create harmonious zone designations when they overlook humans. In such cases, the area-oriented approach requires not only more “exact and scientific” evidence, but also more adaptive and “soft” organizational and process designs. In the same way, the process-based approach is highly contingent on cultural, political, and educational contexts, and most process-oriented approaches emphasize a bottom-up process. In addition, if there is lack of scientific zoning/mapping as a strong foundation, it brings about an endless debate or “discussion”, which may weaken the goal of conservation. It is evident that there are efforts to combine the two approaches together, but the methods must be improved in order to increase effectiveness. What should be noted for future studies is that global diversity demands that we develop more adaptive approaches, methods, and practices that use both the area-oriented and process-oriented approach together.

## 5. Conclusions

Firstly, although there are innumerable theories, concepts, methods, tools, perspectives, approaches, and projects for integrating PAs and their surroundings, this study attempts to arrange these efforts into 68 models from a comprehensive overview, and highlights key features of the 23 main representative models especially aimed at (or related to) integrating PAs with their surroundings, then refines them down into two fundamental approaches. Of course, distinguishing those representative models into

area-oriented and process-oriented approaches does not mean that they are discretely separate, conversely, this classification reveals that there are complex intertwined, interdependent and overlapping relationships among them. Furthermore, decades of research and practice have strongly shown that it is increasingly necessary to combine the two approaches for integrating PAs and their surroundings, and maintaining a balance between conservation and sustainable development in them. This combination should be effectively maintained throughout the entire process of designating, zoning, and managing PAs.

Secondly, there has been a lot of evidence indicating that both area-oriented and process-oriented approaches continue evolving along their own pathways, and have continuously developed more and more advanced models. However, the implementation of conservation and sustainable development models in PAs around the world has not been conducted in a synchronized manner. Hence, the quality of management associated with their implementation is extremely unbalanced within different countries. Unfortunately, we found that in many cases, PAs are still struggling, owing to their continued use of antiquated concepts. In some cases, the advanced concepts have been employed, but are still far from success. Perhaps, future work should be focused on harmoniously combining the two approaches, as well as on integrating them into the local culture and social background to promote new solutions to specific local issues.

Through the historical review of the 68 models and particularly the two approaches, it is evident that the efforts for integrating PAs and their surroundings are deeply embodied in fundamental methodologies that can be traced back from the sciences and humanities, as well as their combinations. Historically, there is a lot of effort on PAs' management all over the world, but this paper only covers the most representative journals. Based on results from more than 1000 papers in 11 representative and influential journals from conservation to sustainable development, we hope this review will aid future researchers and policy makers.

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## Author Contributions

Wenwu Du contributed substantively to the study design, acquisition, and analysis of data, and in drafting and revising the manuscript. Sofia M. Penabaz-Wiley provided extensive advice throughout the study. She also helped to edit the manuscript. Anthony Murithi helped to draft, edit, and revise the manuscript. Isami Kinoshita supervised and guided this work, provided advice during the study, and helped with the manuscript revision. All authors have read and approved the final manuscript.

## Conflicts of Interest

The authors declare no conflict of interest.

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