

Original Research Article

Risk-Informed Regional Development Planning for Tourism Giga-Projects in Saudi Arabia: Integrating Infrastructure Safety, Resilience and Sustainable Destination Growth Under Vision 2030

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Abstract: The massive tourism initiatives of Saudi Arabia are having a significant impact on the way the country develops geographically, but at the same time their large scale mean that infrastructure, environmental, operational and governance risks are concentrated in destinations whose long-term value relies on reliable services and good ecological conditions. This study presents a regional development approach based on risk considerations which links tourism planning with the resilience of critical infrastructure, the vulnerability of destinations and the governance of megaprojects. In order to achieve this, a structured critical integrative review was carried out using 30 peer-reviewed studies published between 2020 and 2025, those being chosen because of their direct relevance to Saudi or Gulf planning, tourism resilience, infrastructure systems, sustainability or the delivery of megaprojects. The findings indicate that risk should be seen as a development condition which varies from one location to another rather than as a factor that is only considered at the project level. Destinations situated along the coast, in the desert with heritage sites, in the mountains, in metropolitan areas and those focused on pilgrimage face different combinations of risks relating to heat, flooding, water supply, the environment, mobility, supply chains and demand, while common dependencies on power, water, transport, digital networks and emergency services lead to the possibility of cascading disruptions. The review also points out a gap in governance between optimisation at the project level and the overall performance of the regional system. In order to bridge this gap, the paper puts forward a six-stage planning framework that incorporates hazard and vulnerability assessment, mapping of infrastructure interdependencies, scenario stress testing, portfolio sequencing, resilience safeguards and adaptive monitoring. This framework transforms resilience from a concept associated with recovery into a development criterion that determines where, when and how tourism capacity is added. This method offers a practical means of coordinating destination growth, infrastructure safety, environmental limits and the creation of regional value in accordance with Vision 2030.

Keywords: Tourism Development; Regional Development; Risk-Based Planning; Destination Resilience; Critical Infrastructure; Megaprojects; Infrastructure Interdependencies.

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1. INTRODUCTION

Tourism has now become a key means by which Saudi Arabia is aiming to achieve economic diversification, promote the development of places, and stimulate new regional growth. The new range of destinations is unusual not only due to the large amount of capital involved, but also since many of the developments integrate hospitality, transport, utilities, conservation, entertainment, cultural assets and new settlement functions in one programme. As shown by comparative studies of AlUla and The Red Sea, destination design is being used to link up tourism growth with protected landscapes, lower-impact mobility and long-term sustainability goals (Filippi and Mazzetto, 2024). On a wider spatial scale, research carried out in Saudi Arabia and the Gulf area also indicates that for development to be successful it is necessary to have coordination between national objectives, sector programmes and the capacity for implementation at the municipal or regional level (Arif and Aldosary, 2023; Zaidan and Abulibdeh, 2021). Because of these factors, tourism giga-projects can be seen as regional systems rather than as separate construction projects.

The importance of the regional-system approach lies in the fact that quick investment can lead to both development benefits and the emergence of new concentrations of risk. Tourism destinations need a reliable supply of electricity, water, transport facilities, telecommunications, waste management systems, health services and emergency response measures. If one network fails it can disrupt the others and reduce the quality of the visitor experience even though each individual component may still be technically sound. That is why research into critical infrastructure views resilience as involving resistance, absorption, adaptation and recovery across interconnected systems, not just as the strength of a single facility (Mottahedi *et al.*, 2021; Liu *et al.*, 2022). In Saudi Arabia the situation is made more difficult by high temperatures, aridity, limited water supplies, hazards from coastal erosion and flash flooding, rapid urbanisation and the necessity of protecting environmentally sensitive or culturally important areas. Research into urban resilience in Saudi Arabia holds that climate vulnerability and urban policy should be examined together rather than treated as separate issues (Almulhim and Cobbinah, 2024, 2025). Coastal studies in the Gulf region likewise point to rising temperatures, flooding and sea-level rise as major threats which call for responses in the areas of infrastructure, environment and governance (Almheiri *et al.*, 2024).

Tourism scholarship introduces another level of consideration. The fact that a destination is resilient does not mean that business operations will

continue without interruption. Destinations can be viewed as socio-ecological systems, and their vulnerability is due to factors such as physical exposure, environmental sensitivity, institutional capacity, economic structure and social conditions (Alvarez *et al.*, 2022). Further research conducted after the pandemic shows that organisational networks and dynamic capabilities affect the ability of Saudi tourism actors to adapt and keep going with their operations following a disruption (Ragmoun Wided, 2022). Research into religious tourism also shows how important visitor experience, service quality and sustainability are for encouraging repeat visits and for enhancing destination value (Alhothali *et al.*, 2023). From these findings it follows that infrastructure safety and tourism competitiveness are linked via service continuity, perceived reliability and the quality of the regional environment.

The issue is that the pertinent evidence is still scattered. Tourism studies generally concentrate on destination attractiveness, sustainability or recovery; infrastructure studies stress system performance in the face of hazards; urban-planning research looks at spatial coordination; and research into megaprojects focuses on organisational design, governance and value creation. A planning framework for Saudi tourism giga-projects has to bring together these various areas of knowledge since risk spreads across their boundaries. For example, a transport disruption turns into an operational problem for hotels, an accessibility problem for visitors, a revenue problem for local businesses and a reputational problem for the destination. Similarly, water scarcity is at the same time an environmental constraint, an infrastructure capacity problem, an exposure to higher operating costs and a social legitimacy issue.

This review therefore seeks to establish a risk-informed regional development framework for tourism giga-projects in Saudi Arabia, one that incorporates infrastructure safety, resilience and sustainable destination growth. The analysis is guided by five objectives: to identify the main risk pathways which link regional hazards with tourism outcomes; to look at the critical infrastructure interdependencies and the requirements for service continuity; to assess the way in which ecological and resource constraints influence safe tourism capacity; to evaluate the governance and delivery-capacity risks involved in a range of megaprojects; and to turn the findings into a staged planning framework that includes decision points and monitoring indicators. The review is intentionally focused on planning. Instead of questioning whether giga-projects are inherently sustainable or resilient, it looks at what regional planning should do in order to prevent growth targets from giving rise to avoidable

vulnerability and to make sure that investments in resilience enhance the long-term value of the destination.

2. REVIEW DESIGN AND METHODOLOGY

A structured critical integrative review is employed in this study. This type of design is suitable whenever a research problem involves a number of different areas of literature and the aim is to develop an explanatory framework rather than to estimate a single pooled effect. As review literature has emphasised, a high-quality literature review should make clear its scope, the logic of the search, the criteria used for selection and the process of analytical synthesis, going beyond a simple descriptive summary to identify relationships and gaps (Paul and Criado, 2020). In accordance with this, the current review incorporates transparent source selection together with thematic interpretation and cross-domain comparison.

The time frame for the evidence was from January 2020 to December 2025. The searches were based on combinations of the following terms: Saudi Arabia, Vision 2030, tourism destination, mega-project, megaproject, regional planning, critical infrastructure, infrastructure safety, resilience, vulnerability, climate risk, water, sustainability and governance. Scopus and Web of Science were regarded as the main discovery databases and were supplemented by carrying out targeted citation tracing in cases where a highly relevant article linked together otherwise distinct research areas. Only peer-reviewed journal articles written in English and having a traceable DOI were included. In order to keep the focus on the topic, a study had to make a direct contribution to at least one of four evidence clusters: Saudi or Gulf regional planning and tourism; destination risk or resilience; critical-infrastructure resilience; or megaproject governance and value delivery. A preference was placed on research that used conceptual frameworks, provided empirical evidence, involved a systematic synthesis or had clear planning implications.

Any studies that had been published outside the specified time frame, did not have a DOI, concentrated solely on visitor marketing without any implications for planning, or looked at construction performance without also considering a regional, resilience or governance aspect were excluded. The final set of studies included thirty. The time limit was

applied in a consistent manner in order to ensure comparability within the corpus and to prevent publications from affecting the synthesis, and the evidence base focused on Saudi Arabia in order to ground the interpretation in the country's planning, infrastructure and tourism situation.

The analysis was carried out using a thematic evidence matrix. The articles were coded in response to five questions: what hazards or chronic stressors are identified; which assets, networks or actors are at risk; how disruption can spread throughout the systems; which capabilities have the effect of reducing vulnerability or speeding up adaptation; and which outcomes are important for sustainable destination performance. In a second coding phase, the difference was made between project-level controls and regional-system controls. The comparison resulted in five synthesis areas: the spatial variation of risk; infrastructure safety and interdependency; environmental and resource capacity; governance and delivery capability; and destination resilience and regional value. Contradictory findings were kept rather than being averaged out, since transferability depends on the type of destination, its hazard profile and the scale of the institutions. In the final stage, the consistent findings were turned into a planning cycle which can be used before investment approval, during portfolio sequencing and at all stages of destination operations.

The assessment concentrated on the analytical value rather than giving each study a single numerical rating regardless of the different study designs. For each source, attention was paid to the clarity of the research question, the agreement between the methods and the conclusions, the transparency of the evidence, the way uncertainty was addressed, and the relevance to planning decisions. Findings that were backed by explicit methods, comparative evidence, or well-defined conceptual models were given more interpretative weight. When it came to claims that were specific to Saudi Arabia, evidence from within the country was given priority, while international studies on resilience and megaprojects were used to explain mechanisms that could plausibly be transferred to other settings. By taking this approach, the method avoided treating a case study, a review article and an econometric analysis as being of equal value while at the same time allowing the complementary insights from each to contribute to the synthesis.

Table 1: Analytical domains used in the critical synthesis

Domain	Core review question	Planning signals	Evidence anchors
Spatial differentiation	Where do hazards, sensitive assets and tourism growth intersect?	Exposure zones; peak occupancy; access redundancy; phasing constraints	Arif and Aldosary (2023); Almulhim and Cobbinah (2024)
Infrastructure safety	Which essential functions depend on shared networks and interfaces?	Minimum service levels; redundancy; recovery time; repair capacity	Mottahedi et al. (2021); Liu et al. (2022)
Resource and ecology	What safe operating envelope can water, energy and ecosystems support?	Reserve days; intensity metrics; ecological thresholds; restoration capacity	Suhail et al. (2024); Kamboj et al. (2024)
Governance and delivery	Who owns shared risk across projects and agencies?	Decision gates; interface ownership; supplier concentration; portfolio sequencing	Brunet (2021); Berge et al. (2025)
Destination and social value	Can firms, workers and communities adapt while maintaining visitor trust?	Business continuity; workforce readiness; local supply; visitor disruption	Ragmoun Wided (2022); Posch et al. (2024)

3. Conceptualising Risk-Informed Regional Development

Regional development based on a risk-informed approach starts with a different unit of analysis. Instead of asking, as conventional project risk management does, whether a specific asset or programme can achieve its scope, cost and schedule objectives, regional tourism planning should ask whether a network of projects is able to provide safe and reliable destination functions when facing changing environmental, operational and demand conditions. This change is significant for giga-projects since their value comes about through interaction. Although airports, roads, ports, hotels, cultural venues, ecosystems, power systems and digital services may be managed separately, visitors perceive them as part of a single destination system. Denicol et al. (2021) refer to megaprojects as evolving organisational systems which have many actors and layers; Gil (2022) makes a similar point by saying that the value of megaprojects must be understood in terms of purpose, value creation and value distribution. Resilience, therefore, is a characteristic of the connected system and its governance and not something that is specified for a single asset.

A good way of thinking about risk is in terms of hazard, exposure, vulnerability, capability, and outcome. The hazards involve sudden shocks such as flash floods, heat emergencies, cyber incidents, interruptions to transport or failures in supply, as well as long-term stresses such as water scarcity, ecological degradation, congestion and increasing maintenance demands. Exposure refers to the people, assets, services and environmental resources that are at risk. Vulnerability indicates how sensitive something is and by how much disruption can spread. Capability encompasses redundancy, preparedness,

adaptive governance, alternative supply, emergency response, financial flexibility and institutional learning. The outcomes are life safety, service continuity, recovery time, ecosystem condition, visitor confidence, business continuity and the distribution of regional benefits. Alvarez et al. (2022) indicate that destination vulnerability is multi-dimensional, and critical-infrastructure reviews show that resilience assessment has to include robustness, recoverability, adaptability and interdependency (Guo *et al.*, 2021; Capacci *et al.*, 2022).

Because of the spatial aspect, this kind of reasoning cannot turn into a general checklist. Although national standards are necessary, exposure varies from one location to another. Tourism in coastal areas can be affected by thresholds of the marine ecosystem, the effects of rising sea levels, extreme heat and disruptions to access; destinations in deserts and those with heritage sites have to deal with problems relating to water, heat, conservation and the difficulties of remote logistics; mountain areas bring with them risks involving terrain, slope, wildfire, flash floods and problems concerning access routes; metropolitan areas combine the issues of heat, congestion, crowding and dependence on networks; and regions geared towards pilgrimage have to cope with sharp increases in demand for mobility, health services, accommodation and public services. As shown by Saudi research into urban quality of life, there is a need for indicators that are specific to the context rather than for universal measures which are disconnected from local conditions (Al-Qawasmi *et al.*, 2021). Regional planning must therefore set different standards according to the risk profile while at the same time keeping a common national assurance framework.

Resilience also has to be understood in terms of time. It involves the ability to anticipate, withstand, absorb, recover, adapt and, if needed, transform. A resource that quickly returns to an unsafe or resource-heavy mode of operation is not necessarily resilient when considering development aspects. Nowadays, research into destination resilience sees it as dynamic and dependent on the actors involved, focusing on learning, agency and the difference between merely coping with specific hazards and developing a wider adaptive capacity (Posch *et al.*,

2024; Wang *et al.*, 2022). In the case of Saudi giga-projects, this implies that resilience should affect decisions regarding site selection, the sizing of capacity, the structure of the network, procurement procedures, the phasing of projects and the rules governing operations before any hazard occurs. Although recovery planning is still necessary, its greatest value is obtained when it identifies design flaws early on so that the development pathway can be altered.



Figure 1: Risk-to-value pathway linking regional hazards, infrastructure dependencies and destination outcomes

4. Critical Evidence Synthesis

4.1 Regional differentiation and exposure

A key finding from the synthesis is that tourism risk varies from region to region even when different projects are aiming to achieve the same national policy goals. In the case of Saudi Arabia, the development model involves a number of tourism initiatives that are geographically separate, and the risk associated with them cannot therefore be expressed by a single sustainability rating. Filippi and Mazzetto (2024) demonstrate that both AIUla and The Red Sea achieve sustainability in different ways depending on the context of destination development, even though they share the same national objectives. Broad research across the Gulf has reached the same conclusion, namely that spatial strategy has to take into account both the national direction and the local environmental, infrastructural and institutional circumstances (Arif and Aldosary, 2023; Zaidan and Abulibdeh, 2021). The result for planning is that demand forecasts should not be used

to set capacity without also considering hazard exposure and the regional carrying capacity.

The evidence relating to climate change and urbanisation makes this need more urgent. Almulhim and Cobbinah (2024) claim that Saudi Arabia's resilience strategy has to address the way in which climate vulnerability interacts with urban expansion, and their study of Dammam demonstrates how changes in land use, together with heat and infrastructure pressures, can end up reinforcing one another (Almulhim and Cobbinah, 2025). For coastal areas, Almheiri *et al.* (2024) find that increasing temperatures, flooding and sea-level rise are among the hazards most frequently cited in the Gulf coastal cities. The importance for tourism giga-projects does not lie merely in the fact that such hazards exist, but in the possibility that a development could increase exposure by extending valuable assets, the settlements of its workforce and its supply routes into vulnerable areas. Regional planning should thus

examine different possible spatial arrangements and phasing options before committing to costly dependencies.

4.2 Infrastructure safety and interdependency

The second point is about the interdependence of infrastructure. Tourism destinations depend on uninterrupted chains of services: energy is needed for cooling, for the production of water and for digital operations; transport facilitates the movement of staff, the supply of food and materials, emergency access and the circulation of visitors; telecommunications enables reservations, payments, security and operating control. Research into critical infrastructure continually cautions that networked systems can fail through cascading or common-cause mechanisms which are not visible when the individual components are examined separately. Mottahedi et al. (2021) define resilient infrastructure in terms of anticipation, protection, absorption, adaptation and recovery, while Liu et al. (2022) stress that for a system to be resilient it is necessary to use assessment methods appropriate to interconnected networks. Guo et al. (2021) also point out the great variation in resilience frameworks, indicating that the selection of metrics should be based on the specific decision problem rather than on a general index.

When it comes to tourism planning, the most important factor is functional continuity. A hotel area can still be structurally safe but become impossible to use if road access, drinking water, cooling facilities, or digital payment systems fail. Since transport infrastructure is so important, it is because the routes for access link the regional economy to the destination and influence the methods available for evacuation or emergency response. Capacci et al. (2022) show the benefits of considering life-cycle risk and resilience for transport networks that are subject to deterioration and hazards. Osei-Kyei et al. (2021) also point out the wide range of threats impacting critical infrastructure, which underlines the need to examine compound and cascading scenarios instead of just single hazards. In practice, planning should start by identifying the essential functions and then determine the smallest group of infrastructure needed to maintain them. This is the opposite of the normal approach, which is to begin with an inventory of assets and only afterwards look at the service dependencies.

Safety assurance must also be applied throughout the asset's entire life cycle. While design redundancy can lower the likelihood of immediate failure, resilience might be lost if the maintenance procedures, the availability of spare parts, the skills of the workforce, or the operating budgets are

inadequate. Evidence from Saudi Arabia regarding its expansion of renewable energy shows that even when capital is available, ambitious infrastructure targets can be limited by local manufacturing capabilities, skills, and supply-chain capacity (Alghamdi *et al.*, 2025). This lesson can be directly applied: regional tourism portfolios need capability audits to check whether the systems involved in construction, commissioning, maintenance and emergency repair can keep up with the size of the asset base. If reliability cannot be maintained during the peak seasons or following simultaneous disruptions, then a safe opening date is not enough.

4.3 Environmental and resource capacity

The fact is that ecological and resource limitations constitute both infrastructure risks and sustainability issues. Water provides the most evident example. Since Saudi Arabia has a dry climate, any increase in destination growth will lead to a greater reliance on desalination, conveyance, storage, reuse and energy-intensive treatment. Suhail et al. (2024) have recorded the Kingdom's long-existing difficulty in meeting water demand and the shifting balance of demand among different sectors. Therefore, water planning for tourism should take into account scenarios involving drought and interruptions in water supply, seasonal peaks in demand, the use of non-potable water, the capacity for reuse and emergency storage. The aim is not simply to reduce consumption per visitor; it is to be able to keep essential health and operational functions running without going beyond the regional resource or ecological limits.

An associated network is created. In order to achieve decarbonisation Saudi Arabia needs to rapidly deploy renewable energy and make major changes to its energy system, while its energy policy reviews emphasise the importance of coordination across sectors, technology, human capital and the conservation of resources (Kamboj *et al.*, 2024; Islam and Ali, 2024). Tourism planning must therefore regard energy efficiency, cooling demand, storage, microgrids and the integration of renewable energy as options which contribute to resilience—this is especially true in the case of destinations that are remote or vulnerable to climate change. Li et al. (2024) discover that even though renewable energy helps to reduce emissions tourism expansion can increase environmental pressure, showing that growth and decarbonisation cannot be taken as automatically going hand in hand. When making capacity decisions there must be clear carbon, water and ecosystem budgets.

This point is particularly relevant for destinations whose appeal is based on nature and heritage, since the environmental quality is an

integral part of the tourism offering. Overdevelopment may diminish the asset which generates demand. The idea of carrying capacity should therefore be seen as a risk limit rather than as a fixed visitor number. It must take into account ecological sensitivity, the margins of infrastructure services, evacuation capacity, the ability to assimilate waste, exposure to heat, and the level of tolerance within the community. As Almulhim et al. (2022) have shown, urbanisation and environmental sustainability in the Gulf are closely linked, while Hübscher (2021) warns that tourism megaprojects can interact with processes of urban change and displacement. Risk-informed planning thus does not merely ask how many visitors a place can accommodate, but also under what operating conditions the level of demand remains safe, resource-feasible and socially acceptable.

4.4 Governance and delivery capability

The fourth point is that the quality of governance decides whether information about risk leads to a change in decisions. Since megaprojects involve a large number of organisations, have multiple layers of authority and see their delivery arrangements change over time, Brunet (2021) finds that governance frameworks need to strike a balance between efficiency, accountability and legitimacy rather than focusing on optimising a single objective. Denicol et al. (2021) reach a similar conclusion, showing that the organisational structure develops at both the project and system levels. In the case of a tourism region, this implies that no single project company is able to fully manage the risks arising from shared roads, utilities, ecosystems, labour markets or emergency services and so risk ownership at a regional level must be clearly defined.

It is especially important to have a good system of portfolio governance whenever several giga-projects are competing for suppliers, specialist labour, transport capacity, finance or regulatory oversight. According to Berge et al. (2025), proactive management of uncertainty, flexible governance and coordinated leadership are essential to the success of megaproject portfolios. A regional approach also calls for sequencing discipline in that projects should not be given the go-ahead simply because each of them is individually financeable or technically feasible. The whole portfolio should be subjected to stress testing in order to assess the simultaneous demand it will place on critical resources and its correlated vulnerability to the same type of disruption. Gil's (2022) value approach is useful in this context since resilience spending can be justified on the grounds of avoiding service loss, protecting reputation, generating regional spillovers and preserving environmental assets, not just on the basis of financial returns at the project level.

Decision gates are also required in a risk-informed approach. Approval at the early concept stage should call for a statement on regional vulnerability; master planning should show the interdependency of the infrastructure and the means of emergency access; the detailed design phase should set out the minimum service levels and recovery objectives; the procurement stage should deal with supplier concentration and repairability; commissioning should involve testing of integrated scenarios; and during operation a shared risk register should be kept together with measurable trigger thresholds. By following this sequence of governance, the risk is reduced that safety, sustainability and resilience will be set out in separate reports without the same investment decisions being influenced.

4.5 Destination resilience and regional value

The fifth point is that destination resilience requires both social and economic adaptation as well as robust physical systems. As shown by tourism research following major disruptions, networks, learning, and organisational capabilities have an impact on recovery and on continuity (Ragmoun Wided, 2022). The literature on destination resilience also stresses the role of actor agency and the ability to adapt beyond the predefined list of hazards (Posch et al., 2024; Wang et al., 2022). This is important for giga-project regions since workforce housing, local suppliers, small businesses, destination-management organisations and public agencies make up the operating system; if they are unable to absorb shocks then the mere availability of infrastructure will not bring the visitor economy back.

Resilience indicators should therefore take account of regional value creation. Research into urban quality of life in Saudi Arabia shows the significance of using multi-dimensional indicators which reflect local circumstances (Al-Qawasmi et al., 2021). In the case of tourism areas, appropriate measures are local supplier involvement, the retention of the workforce, equity in access to emergency services, the affordability of essential services, the length of time it takes for businesses to reopen, and the way in which tourism benefits are distributed among neighbouring communities. Religious tourism provides an important viewpoint since visitor numbers can be highly concentrated and service expectations go beyond those of ordinary commercial hospitality. Alhothali et al. (2023) link sustainable religious travel with repeat visits and a positive experience, thus supporting the idea that social organisation, service reliability and destination trust are elements of long-term competitiveness.

The evidence together points to a transition from 'bounce back' to 'safe adaptive growth'. Growth can be considered resilient so long as the addition of

capacity does not cause the system's overall vulnerability to increase more rapidly than the region is able to manage it. In order to assess this, leading indicators must be used since lagging indicators such as the number of incidents or the number of visitors each year show problems only after the fact. Suitable leading indicators are spare infrastructure capacity, network redundancy, the number of reserve days of water, the amount of maintenance backlog, the degree of dependence on critical suppliers, the performance in emergency exercises, how close the ecosystem is to its threshold, and the level of workforce readiness. Resilience thus becomes a guideline for how fast development should proceed rather than a designation given after a project is finished.

5. Proposed Risk-Informed Regional Planning Framework

The synthesis presents a six-stage risk-informed approach to regional planning. The first stage involves setting out the regional context and identifying hazards. Planning authorities and destination developers establish the spatial system, identify the important environmental assets, define the communities, outline the seasonal patterns of demand and specify the plausible acute and chronic hazards. The result is not a general hazard list but a series of risk narratives that explain how development affects exposure over time. In the second stage the existing capabilities are assessed by linking the key functions to the power, water, transport, digital, waste, health and emergency networks which support them, and minimum acceptable service levels together with recovery objectives are set for both peak and disrupted conditions.

In stage three, scenario stress testing is carried out. The scenarios must combine different hazards with operational stresses, for example by linking extreme heat with a power shortage, flash flooding with a road closure, a high number of occupants with a failure of the water-treatment system, or a cyber incident occurring during a major event. The aim is to identify common dependencies, single points of failure and response bottlenecks before it becomes impossible to reverse the investment. This multi-hazard and functional approach is supported by the literature on infrastructure resilience since resilience is determined by how well systems are able to absorb and recover from disruption, not just by their design resistance (Guo *et al.*, 2021; Osei-Kyei *et al.*, 2021).

The fourth stage involves portfolio sequencing. The various development phases are assessed in relation to the regional capacity limits for infrastructure, water, ecology, construction logistics,

the workforce, and emergency response. Even if individual projects have passed their feasibility tests, they may still have to be resequenced if, when taken together, their demand undermines the resilience margins. At the fifth stage, the preferred sequence is turned into resilience safeguards: these include redundancy where the consequences of failure make it worthwhile, modular expansion in cases of high uncertainty, distributed backup systems, a design that allows for maintenance, alternative means of access, diversification of suppliers, environmental buffers, and pre-agreed rules for emergency operation. The safeguards should be evaluated on the basis of their whole-life value and not merely on capital cost.

The sixth stage is that of adaptive monitoring. The regional resilience dashboard should include both leading and lagging indicators and set thresholds which lead to action. Examples of such indicators are reserve margins, the length of outages, recovery time, the maintenance backlog, water-use intensity, ecosystem-condition indicators, evacuation performance, visitor disruption, supplier concentration and local-business continuity. The dashboard should be examined by a cross-project regional body which has the authority to alter the phasing, operating capacity or mitigation priorities. Thus the cycle is completed between monitoring and investment decisions.

The way in which the framework handles evidence when preparing plans has changed. While demand forecasts are still important, they are now limited by the safe capacity at the regional level rather than being treated as a fixed target. Environmental assessment is now linked to infrastructure reliability rather than proceeding within a separate compliance process. Emergency planning influences master planning rather than being prepared after the design has been carried out. Portfolio governance includes the shared risks that exist between the various project organisations. This is in line with the evidence that resilient urban development requires a coordinated spatial strategy (Arif and Aldosary, 2023), that tourism giga-projects need place-sensitive sustainability design (Filippi and Mazzetto, 2024), and that megaproject governance must align the different levels and objectives of organisations (Brunet, 2021; Berge *et al.*, 2025).

Another consequence of this is that assurance should be based on interfaces rather than on administrative boundaries, since the most serious failures are likely to take place when responsibility passes from one infrastructure operator to another, from a project company, to a municipality, to an emergency agency and to a destination manager.

Assurance at the interface therefore needs to clarify who is responsible for each important dependency, who receives the early warning information, who has the authority to curtail a service, and how recovery priorities are decided when there is a regional disruption. By carrying out repeated scenario exercises under realistic seasonal conditions, these arrangements can be tested and any weaknesses in

the governance structure that ordinary compliance audits might overlook can be revealed. Thus, preparedness becomes a continuous learning process and provides the basis for revising master plans, operating limits, procurement strategies and capital priorities before vulnerabilities become widely entrenched.

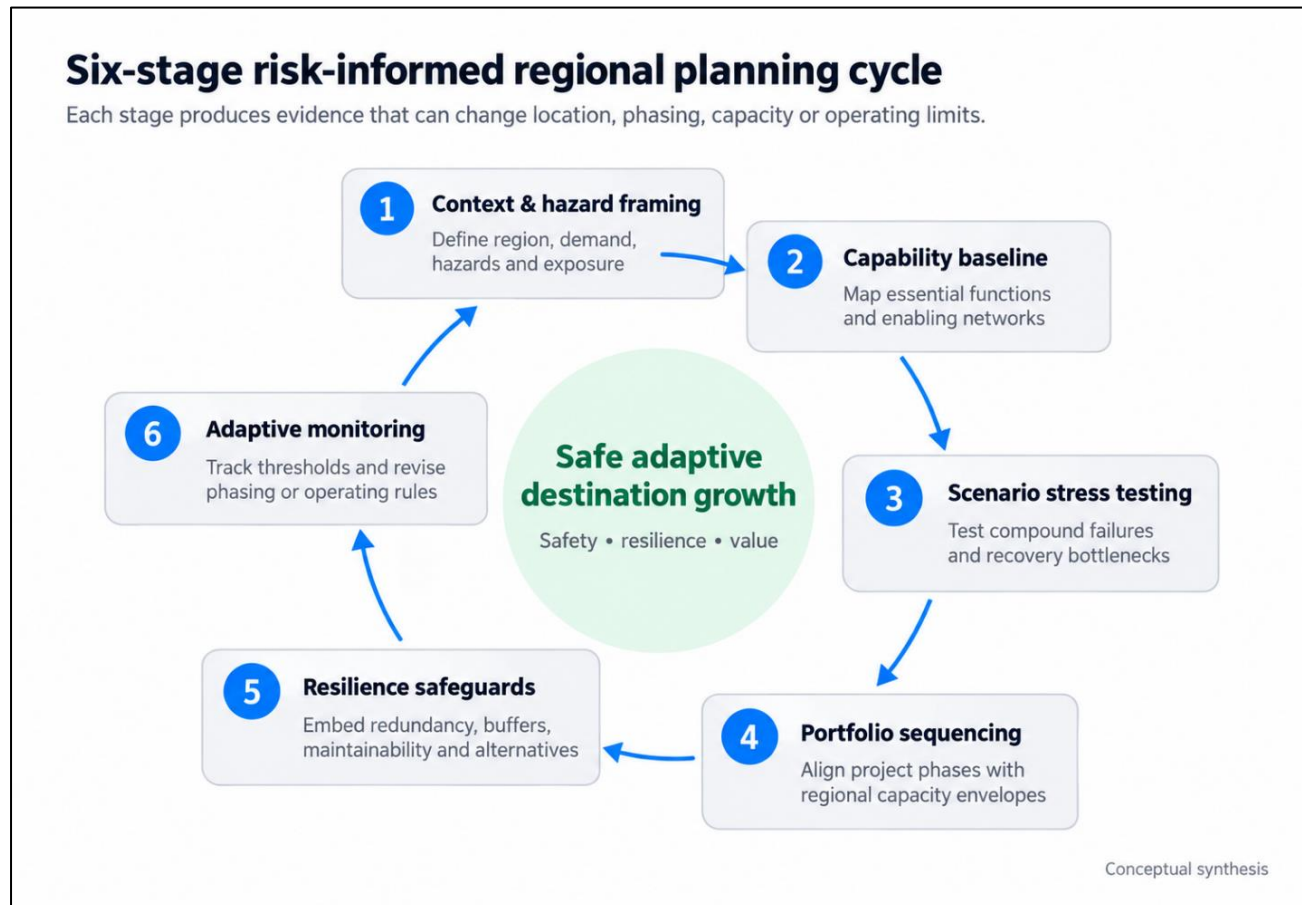


Figure 2: Six-stage planning cycle for controlling destination growth against regional risk and capacity

Table 2: Destination archetypes and risk-informed planning priorities for Saudi tourism regions

Destination archetype	Dominant risk interactions	Priority planning responses
Coastal eco-destination	Heat, sea-level effects, flooding, marine sensitivity, utility and access dependence	Coastal setbacks; nature-based buffers; distributed backup power; emergency access; marine-condition thresholds
Desert and heritage destination	Heat, water scarcity, remote logistics, conservation limits, seasonal access	Water reserve targets; shaded mobility; modular utilities; conservation buffers; alternative supply routes
Mountain nature destination	Terrain, flash flood, slope or wildfire exposure, constrained roads, emergency access	Route redundancy; hazard zoning; early warning; staged occupancy; evacuation and refuge planning
Metropolitan events and business destination	Heat, congestion, crowding, network dependency, cyber and mobility disruption	Peak-load stress tests; multimodal redundancy; cooling resilience; digital continuity; crowd and emergency management
Pilgrimage and heritage corridor	Extreme demand peaks, health and mobility pressure, accommodation and public-service dependency	Surge-capacity envelopes; pedestrian and transit continuity; health-system readiness; distributed services; demand-triggered operating rules

6. Discussion: Implications for Vision 2030 Delivery

The main point of this review is to show how various bodies of literature, which are normally dealt with on their own, are related. Tourism resilience makes it clear why destinations are vulnerable as socio-ecological systems; infrastructure studies explain how disruption spreads through networks; spatial planning highlights the significance of place and of coordination at multiple levels; and research into megaprojects demonstrates that it is the governance arrangements which decide whether concerns at a systemic level are addressed. Combining these different areas of study turns risk from something that stands in the way of delivery into information which should influence the geography, sequence and operating scale of development.

In order to achieve the objectives of Vision 2030, it is necessary that the regional growth targets be combined with resilience margins. If occupancy, the level of infrastructure use, water demand or environmental pressure increases more rapidly than redundancy, maintenance capacity and institutional coordination, then a destination may be able to expand at the same time as its underlying capacity becomes more fragile. The framework suggested provides a means of making this kind of trade-off visible. It is particularly applicable in cases where several projects make use of the same airports, roads, utility corridors, workforce pools or sensitive ecosystems. Since risks are shared, assurance should also be shared.

The review also points out some gaps in the evidence. There is at present a lack of long-term evidence regarding the performance of giga-project regions when facing a series of disruptions, the way in which infrastructure interdependencies affect visitor outcomes, and the impact of resilience investments on local economic spillovers. Future research should aim to create region-specific stress-test datasets, develop operational resilience indicators, and carry out comparative studies among coastal, heritage, mountain, metropolitan and pilgrimage destinations. It should also examine the governance mechanisms that would allow risk data to be shared among project companies and public agencies without reducing accountability. These gaps are significant since the next phase of tourism development will increasingly rely on operating performance, not just on the completion of projects.

7. CONCLUSION

The huge projects carried out by Saudi Arabia offer the chance to build resilience into regional development before it becomes difficult to

alter the infrastructure and land-use patterns. As the evidence examined shows, this involves more than just having strong assets or emergency plans; risk arises from spatial exposure, the interdependence of infrastructure, resource limitations, the interfaces between organisations, and the adaptive capacity of the actors in the destination area. It is for this reason that a risk-informed approach links hazard assessment with capacity planning, portfolio sequencing and operational monitoring.

The six-stage framework suggested offers a practical way of applying this principle to planning decisions. It starts by developing risk narratives which are specific to each location, identifies the functions and networks that support the destination, examines the impact of combined disruptions, orders investments in relation to regional capacity, incorporates resilience safeguards and makes use of adaptive indicators to manage future growth. The main idea is straightforward: tourism capacity should only be increased when the region is able to do so safely, reliably and within environmental limits. If this approach is applied consistently, it will help to enhance the continuity of services, safeguard the quality of the destination and contribute to making the creation of regional value more durable under the Vision 2030 plan.

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