

CLIMATE RESILIENCE

Strategies for Addressing Climate Change at Local and Global Levels

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Abstract

Climate resilience has become a central development challenge as warming intensifies extreme heat, flood, drought, wildfire, coastal hazards, ecosystem disruption, health burdens, and economic instability. This article develops an integrated framework for responding at local, national, regional, and global levels. It examines vulnerability, adaptive capacity, climate-resilient development, disaster-risk reduction, locally led adaptation, cities, infrastructure, food and water systems, ecosystems, health, finance, justice, migration, early warning, governance, and international cooperation. Particular attention is given to Indonesia as an archipelagic nation with diverse social-ecological risks. The central argument is that resilience should not mean returning to a vulnerable status quo. It should combine adaptation and mitigation with structural transformation, social justice, ecological stewardship, capable institutions, and sustained finance. The article concludes with a resilience matrix, strategic recommendations, glossary, and research-based agenda for building safer and more inclusive futures.

Keywords: climate resilience; climate adaptation; mitigation; disaster-risk reduction; locally led adaptation; climate justice; resilient infrastructure; ecosystem-based adaptation; Indonesia; global cooperation

Executive Synthesis

- Climate risk emerges from hazards interacting with exposure, vulnerability, and capacity.
- Resilience integrates anticipation, absorption, recovery, adaptation, and transformation.
- Local leadership requires decision authority and accessible finance, not consultation alone.
- Adaptation, mitigation, disaster-risk reduction, and development must be planned together.
- Justice determines whose risks are reduced, whose values count, and who receives resources and remedy.

Introduction: Living with a Changing Climate

Introduction: Living with a Changing Climate can be approached through the accelerating interaction of warming, extreme events, ecological degradation, urbanization, and inequality. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include the capacity to anticipate, absorb, recover, adapt, and transform. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve treating resilience as a return to a vulnerable status quo. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for climate-resilient development that advances well-being and justice. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

1. Understanding Climate Resilience

1. Understanding Climate Resilience can be approached through a systems concept linking hazards, exposure, vulnerability, capacity, and development choices. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure,

ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include persistence of essential functions together with learning and transformation. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve using resilience as a vague slogan or placing responsibility on vulnerable people. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for measurable capacities supported by institutions and resources. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

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2. Risk, Vulnerability, and Adaptive Capacity

2. Risk, Vulnerability, and Adaptive Capacity can be approached through climate risk produced by hazards interacting with exposed people, assets, ecosystems, and unequal vulnerability. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include risk reduction through social, ecological, physical, financial, and institutional capacity. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve assuming that the same hazard produces equal consequences. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for targeted action based on place, history, and distribution. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

3. Climate-Resilient Development Pathways

3. Climate-Resilient Development Pathways can be approached through the integration of adaptation and mitigation with sustainable development. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include actions that reduce emissions while lowering risk and inequality. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve maladaptation, lock-in, and trade-offs among near-term and long-term goals. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for development pathways compatible with human and planetary health. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough

to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

4. Connecting Adaptation and Mitigation

4. Connecting Adaptation and Mitigation can be approached through adaptation to unavoidable impacts and mitigation to limit future warming. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include synergies in cities, food, energy, ecosystems, and public health. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve adaptation that raises emissions or mitigation that deepens vulnerability. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for integrated decisions using lifecycle and distributional analysis. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting,

procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

5. Disaster Risk Reduction and the Sendai Framework

5. Disaster Risk Reduction and the Sendai Framework can be approached through a shift from reacting to disasters toward understanding and managing risk. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include risk knowledge, governance, investment, preparedness, and build-back-better practice. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve separate climate and disaster institutions that duplicate work. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for coherent prevention, response, recovery, and adaptation systems. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

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The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

6. Locally Led Adaptation

6. Locally Led Adaptation can be approached through local people holding knowledge, priorities, relationships, and responsibility for implementation. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems,

institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include devolved finance, decision authority, transparency, and learning. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve token consultation and externally imposed projects. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for community agency linked to technical and governmental support. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

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The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

7. Indigenous and Local Knowledge

7. Indigenous and Local Knowledge can be approached through place-based observation, cultural practice, ecological memory, and collective stewardship. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include knowledge pluralism and long-term relationships with landscapes and seascapes. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve extracting knowledge without consent or romanticizing all traditional practice. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for respectful co-production between communities and science. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

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The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

8. Climate-Resilient Cities

8. Climate-Resilient Cities can be approached through urban systems in which housing, transport, water, energy, health, ecosystems, and economies interact. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include compact and inclusive planning, redundancy, green infrastructure, and social protection. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve protecting high-value districts while displacing risk to informal settlements. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for resilience as a universal urban service. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure,

technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

9. Heat Resilience and Public Health

9. Heat Resilience and Public Health can be approached through rising temperatures, humidity, urban heat islands, occupational exposure, and unequal cooling access. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include early warning, shade, ventilation, cool surfaces, health systems, and worker protection. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve air-conditioning-only strategies that raise emissions and exclude the poor. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for heat action plans combining infrastructure, services, and rights. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

10. Flood, Storm, and Coastal Resilience

10. Flood, Storm, and Coastal Resilience can be approached through sea-level rise, extreme rainfall, storm surge, erosion, subsidence, and compound flooding. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include watershed planning, wetlands, drainage, resilient buildings, warning, and evacuation. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve hard defenses that transfer risk or encourage unsafe development. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for adaptive pathways combining protection, accommodation, and planned retreat. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

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The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

11. Water Security under Climate Change

11. Water Security under Climate Change can be approached through changing precipitation, drought, flood, glacier loss, groundwater stress, and water-quality decline. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include demand management, diversified supply, ecosystem protection, storage, reuse, and fair allocation. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve large infrastructure without basin governance or social legitimacy. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for integrated and conflict-sensitive water resilience. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

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The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

12. Food Systems and Climate-Resilient Agriculture

12. Food Systems and Climate-Resilient Agriculture can be approached through climate impacts across farms, fisheries, livestock, storage, transport, markets, and nutrition. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include diversification, soil health, agroforestry, resilient varieties, information, insurance, and local institutions. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve technology packages that increase debt, dependency, or ecological harm. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for productive, low-emission, nutrition-sensitive, and farmer-centered systems. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

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The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

13. Forests, Biodiversity, and Ecosystem-Based Adaptation

13. Forests, Biodiversity, and Ecosystem-Based Adaptation can be approached through healthy ecosystems that buffer floods, heat, erosion, drought, fire, and coastal hazards. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include conservation, restoration, connectivity, and community stewardship. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve carbon or tree-planting projects that displace people or ignore ecological integrity. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who

benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for nature-based solutions with biodiversity and social safeguards. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

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The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

14. Resilient Infrastructure and the Built Environment

14. Resilient Infrastructure and the Built Environment can be approached through long-lived assets exposed to future climate conditions different from historical records. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include risk-informed standards, flexible design, maintenance, redundancy, and lifecycle planning. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve rebuilding obsolete designs and protecting assets without protecting services. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for infrastructure that continues delivering essential functions. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

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The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

15. Energy-System Resilience

15. Energy-System Resilience can be approached through electricity, fuels, cooling, and communications exposed to heat, storms, drought, fire, and demand spikes. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include distributed resources, storage, grid modernization, efficiency, and diversified supply. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve fossil backup that creates emissions lock-in and affordability burdens. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for reliable low-carbon energy for essential services. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a

normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

16. Health-System and Social Resilience

16. Health-System and Social Resilience can be approached through direct injuries and heat stress together with infectious disease, malnutrition, displacement, anxiety, and disrupted care. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include climate-ready facilities, surveillance, primary care, social protection, and trusted communication. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve emergency-only responses that overlook chronic and mental-health effects. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for universal preventive capacity focused on vulnerable groups. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

17. Business, Supply Chains, and Climate Risk

17. Business, Supply Chains, and Climate Risk can be approached through physical risk affecting facilities, workers, suppliers, logistics, customers, finance, and markets. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past

development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include scenario analysis, supplier collaboration, resilient design, insurance, and continuity planning. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve disclosure without operational change or risk transfer to weak suppliers. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for enterprise adaptation that strengthens wider communities. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

18. Climate Finance and the Adaptation Gap

18. Climate Finance and the Adaptation Gap can be approached through the mismatch between escalating adaptation needs and available, accessible finance. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include grants, concessional finance, domestic budgets, insurance, bonds, and private investment. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve debt burdens, fragmented projects, and finance directed only to bankable assets. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for predictable funding for public goods and the most vulnerable. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

19. Insurance, Risk Pooling, and Social Protection

19. Insurance, Risk Pooling, and Social Protection can be approached through financial mechanisms that spread losses and support recovery. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include risk-based prevention incentives, public backstops, anticipatory cash, and inclusive protection. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve unaffordable premiums, withdrawal of coverage, and basis risk. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for layered financing that does not abandon high-risk communities. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to

adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

20. Climate Justice and Loss and Damage

20. Climate Justice and Loss and Damage can be approached through the unequal causes and consequences of climate change across countries, classes, genders, generations, and identities. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include recognition, participation, fair distribution, historical responsibility, and remedy. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve technocratic adaptation that preserves structural inequality. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for resilience grounded in rights and solidarity. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

21. Migration, Displacement, and Human Security

21. Migration, Displacement, and Human Security can be approached through mobility as adaptation, distress response, livelihood strategy, and consequence of uninhabitable risk. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include safe mobility, planned relocation, livelihood support, tenure, and regional cooperation. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve securitization and coercive relocation without voice or compensation. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for human-centered choices that protect dignity and social networks. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

22. Governance across Scales

22. Governance across Scales can be approached through households, communities, municipalities, provinces, states, regions, firms, and global institutions sharing interconnected risks. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include subsidiarity, coordination, transparency, accountability, and fiscal alignment. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve unfunded local mandates and fragmented sectoral plans. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for multi-level institutions able to learn and adjust. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

23. Information, Early Warning, and Climate Services

23. Information, Early Warning, and Climate Services can be approached through observations, forecasts, risk maps, communication, local interpretation, and last-mile action. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include people-centered warnings, open data, trusted messengers, and decision-ready information. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve technical systems that fail to reach or be understood by exposed groups. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for forecast-based action linked to resources and clear authority. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

24. Measuring Resilience and Avoiding Maladaptation

24. Measuring Resilience and Avoiding Maladaptation can be approached through tracking capacity, process, outcomes, distribution, residual risk, and unintended effects. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include baselines, mixed methods, participatory monitoring, and iterative evaluation. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve counting activities instead of reduced vulnerability or shifting harm elsewhere. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces

inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for evidence that supports learning rather than metric gaming. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

25. Indonesia: Archipelagic Climate Resilience

25. Indonesia: Archipelagic Climate Resilience can be approached through an archipelago facing sea-level rise, coastal hazards, heat, fire, drought, flood, food stress, and ecosystem loss. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include village capacity, mangroves, watershed governance, resilient cities, social protection, and national coordination. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve uneven capacity, subsidence, land-use conflict, and fragmented data. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for locally grounded resilience across islands and development corridors. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

26. Global Cooperation and Climate Diplomacy

26. Global Cooperation and Climate Diplomacy can be approached through collective action on mitigation, adaptation finance, technology, capacity, loss and damage, science, and migration. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include solidarity, predictable rules, transparent commitments, and shared learning. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve geopolitical rivalry, distrust, conditional finance, and implementation gaps. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for international cooperation that expands local solution space. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a

normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

Conclusion: Resilience as Transformation

Conclusion: Resilience as Transformation can be approached through the capacity to change development patterns before shocks make change unavoidable. Climate resilience is not a fixed property that a community either possesses or lacks. It is produced through infrastructure, ecosystems, institutions, wealth, knowledge, rights, relationships, and past development choices. The same climate event therefore creates radically different outcomes across locations and social groups.

The essential capacities include foresight, justice, ecological stewardship, capable institutions, and collective agency. These capacities must work together. A forecast has little value if people cannot act; a seawall may fail without maintenance; insurance cannot replace a destroyed ecosystem; and a strong hospital cannot protect health when water, power, transport, and communication collapse. Resilience requires systems thinking and attention to interdependencies.

The main dangers involve celebrating survival while accepting preventable loss. Adaptation can be maladaptive when it transfers risk, increases emissions, reinforces inequality, or creates irreversible dependence. Decision makers should ask who benefits, who pays, what happens under more severe warming, and whether an intervention keeps future options open. Distributional and intergenerational analysis is essential.

A strategic response aims for a safer, fairer, low-carbon, and adaptive future. It begins with inclusive risk assessment, credible climate information, clear ownership, local participation, and finance proportionate to need. Implementation should be flexible enough to adjust as hazards, exposure, technology, and social conditions change. Monitoring must include lived experience as well as quantitative indicators.

Local action and global action are mutually dependent. Communities experience impacts and hold detailed contextual knowledge, while national and international institutions control much of the finance, regulation, technology, and emissions trajectory. Effective resilience connects these scales without removing local agency. Higher levels should provide resources, standards, redistribution, and coordination; local institutions should shape priorities and implementation.

The broader development implication is that resilience cannot be added after roads, settlements, markets, and public services have been designed. Risk must enter land-use planning, budgeting, procurement, education, health, investment, and social protection. When resilience becomes a normal criterion of development, adaptation moves from isolated projects toward a sustained institutional capability.

Climate Resilience Action Matrix

Capacity	Illustrative measures	Intended result
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Anticipate	Risk assessment, scenarios, early warning	Earlier and better-informed action
Prevent	Land use, ecosystems, standards, emissions reduction	Avoided creation of new risk
Absorb	Robust infrastructure, reserves, social protection	Essential functions continue
Respond	Preparedness, evacuation, emergency services	Reduced mortality and disruption
Recover	Finance, repair, livelihood support, build back better	Faster and fairer restoration
Adapt	Flexible pathways, learning, livelihood change	Capacity under evolving conditions
Transform	Institutional, economic, and spatial change	Root causes of vulnerability addressed

Strategic Recommendations

1. Integrate climate scenarios into spatial planning, public investment, procurement, and asset management.
2. Fund locally led adaptation through devolved, predictable, and transparent mechanisms.
3. Link climate adaptation plans with disaster-risk reduction and social-protection systems.
4. Expand people-centered multi-hazard early warning and forecast-based financing.
5. Prioritize heat action, resilient health systems, safe housing, water security, and essential services.
6. Protect and restore mangroves, forests, peatlands, wetlands, reefs, and watersheds with community safeguards.
7. Use adaptive pathways for coastal zones facing sea-level rise and subsidence.
8. Strengthen climate-resilient agriculture, fisheries, storage, markets, and nutrition.
9. Require businesses and infrastructure operators to assess physical risk across value chains.
10. Develop blended finance without shifting unsustainable debt or risk to vulnerable communities.
11. Track distributional outcomes and identify maladaptation early.
12. Include women, youth, Indigenous Peoples, persons with disabilities, informal workers, and marginalized groups in decisions.
13. Build local government technical capacity and align mandates with fiscal resources.
14. Invest in open climate data, local research, and knowledge co-production.
15. Accelerate mitigation because adaptation limits become more severe with every increment of warming.

Extended Academic Synthesis

Climate resilience is fundamentally about development choices. Settlements placed in floodplains, degraded watersheds, unsafe housing, unequal health access, and precarious livelihoods turn climatic events into disasters. Adaptation projects can reduce immediate exposure, but lasting resilience requires attention to these structural conditions. This is why poverty reduction, public services, rights, and governance are part of climate policy.

Resilience also has temporal depth. Infrastructure decisions made today can lock in risk for decades. Ecosystem destruction may remove buffers that cannot be quickly restored. Children affected by malnutrition or interrupted education may carry consequences throughout life. Long-term planning must therefore value avoided loss, flexibility, and future options rather than discount them into invisibility.

The local–global relationship is asymmetric. Vulnerable communities often contribute little to global emissions but face large impacts, while access to adaptation finance and technology remains limited. Global solidarity is not charity; it reflects interdependence and responsibility. Migration, commodity markets, supply chains, health, biodiversity, and security transmit climate consequences across borders.

Locally led adaptation improves fit and legitimacy, but it should not become a way for higher levels to abandon responsibility. Communities cannot finance sea defenses, national forecasting systems, or global mitigation. Subsidiarity means decisions are taken at the lowest effective level while resources and redistribution flow from levels with greater capacity. Partnership requires both agency and support.

Nature-based solutions can provide multiple benefits, including cooling, flood attenuation, carbon storage, biodiversity, and livelihoods. Yet they are not universally sufficient. Severe hazards may require engineered protection, relocation, or service redesign. The best portfolios combine ecological and technological measures, protect rights, and avoid using uncertain carbon claims to justify continued emissions.

Resilience finance should recognize public goods and avoided losses. Many essential measures do not generate direct cash flows, especially for poor communities. Grants and public finance therefore remain indispensable. Private capital can contribute when risks, returns, and safeguards are credible, but it cannot replace public responsibility. Evaluation should consider affordability and debt sustainability.

Measurement poses a conceptual challenge because resilience is partly a capacity revealed under stress. Counting plans, workshops, or infrastructure does not prove reduced vulnerability. Indicators should examine service continuity, mortality, livelihood recovery, ecosystem condition, distribution, and learning. Participatory evaluation can reveal burdens and benefits hidden by aggregate statistics.

Indonesia illustrates the need for differentiated strategies. Coastal megacities, small islands, peat landscapes, mountain watersheds, agricultural regions, and fishing communities face different combinations of hazards and capacity. National standards and finance must enable, not flatten, local diversity. Village institutions, universities, customary communities, businesses, and provincial governments all have roles.

Mitigation remains the ultimate resilience strategy because adaptation has limits. Some ecosystems and settlements cannot adjust indefinitely to higher temperatures and sea levels. Continued high emissions shrink the solution space, raise costs, and make losses irreversible. Resilience planning must therefore avoid fossil lock-in and support a just energy transition.

A resilient society is not one that repeatedly endures preventable damage. It is one that learns before, during, and after shocks; distributes protection fairly; maintains ecological foundations; and changes unsafe patterns. Climate resilience is thus a democratic and moral project as well as a technical one. Its success depends on collective agency, trust, capable institutions, and sustained international cooperation.

Glossary

Adaptation: Adjustment in human or natural systems in response to actual or expected climate effects.

Adaptive capacity: Ability of systems and people to adjust, take advantage of opportunities, or respond to consequences.

Anticipatory action: Action taken before a forecast hazard occurs to reduce expected impacts.

Climate justice: Fair treatment and meaningful participation in relation to climate causes, impacts, action, and remedy.

Climate resilience: Capacity to anticipate, absorb, recover from, adapt to, and transform in response to climate-related risks.

Climate-resilient development: Integration of adaptation and mitigation to advance sustainable development for all.

Compound risk: Risk created by multiple hazards or drivers occurring together or sequentially.

Disaster risk reduction: Efforts to prevent new risk, reduce existing risk, and manage residual risk.

Ecosystem-based adaptation: Use of biodiversity and ecosystem services to help people adapt to climate change.

Exposure: Presence of people, assets, ecosystems, or activities in places that could be adversely affected.

Hazard: Potential occurrence of a physical event or trend that may cause harm.

Just transition: Fair transition to a low-carbon and climate-resilient economy.

Locally led adaptation: Adaptation in which local actors have meaningful decision power and access to resources.

Loss and damage: Adverse climate impacts that are not avoided through mitigation or adaptation.

Maladaptation: Action that unintentionally increases climate risk, inequality, emissions, or vulnerability.

Mitigation: Human intervention to reduce greenhouse-gas emissions or enhance removals.

Nature-based solution: Action protecting, managing, or restoring ecosystems while addressing societal challenges.

Residual risk: Risk remaining after risk-reduction measures have been implemented.

Resilience dividend: Benefits of resilience investment during both shocks and normal conditions.

Vulnerability: Propensity or predisposition to be adversely affected, including sensitivity and limited capacity to cope or adapt.

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