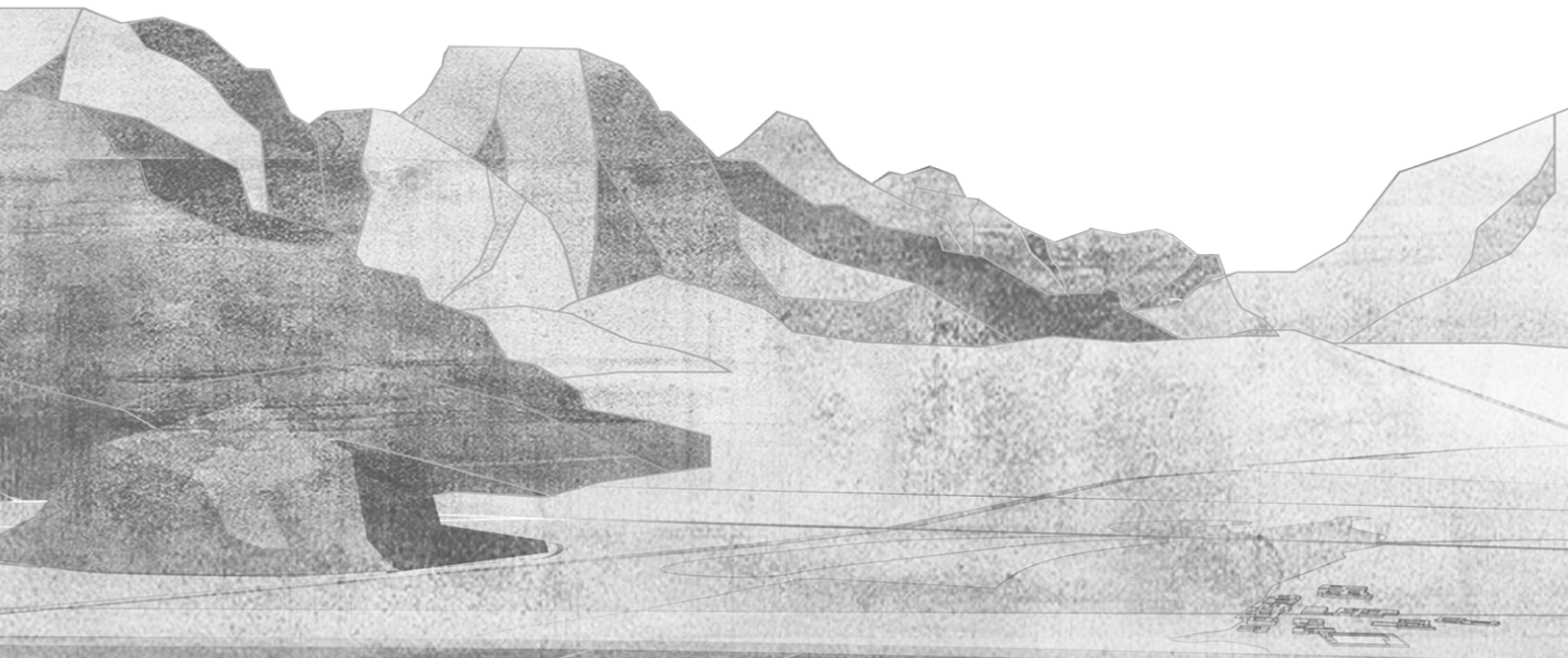
“Those Who Leave and Those Who Stay":

Re-imagining a Sustainable Future for Jinchang, a Resource-Based City in China

Planning Complex Cities Graduation Studio

Yuanjie Wang



Colophon

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This report made responsible and transparent use of Artificial Intelligence(AI) tools, notably ChatGPT, to support specific aspect of the research and writing process. ChatGPT was employed to assist with language refinement, summarization of complex texts, and initial brainstorming of structure and context ideas, or ethical reflections; rather AI outputs were carefully reviewed, verified, and contextualized with the broader research conducted by the author. The limitations and potential biases inherent in AI-generated content were acknowledged, and extra measures were taken to cross-check accuracy reliable academic and professional sources.

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Abstract

Jinchang City, as a typical resource-based city in China, has long relied on the extraction and smelting of non-ferrous metals such as nickel and cobalt, resulting in a single-industry economic structure, environmental degradation, and social fragmentation. Against the backdrop of global resource price fluctuations, climate change, and regional economic transformation, the traditional resource-dependent development path faces severe challenges. This study aims to explore a transformation pathway based on ecological restoration and sustainable development, breaking the dependency on single-resource economies and achieving economic diversification, ecological recovery, and socially inclusive development.

The research adopts Scenario Planning methodology to construct three typical future development paths: "Desert Oasis," "Industrial Revival," and "Managed Shrinkage." These three scenarios represent ecological priority, market orientation, and governance-focused transformation strategies, respectively. They are tailored to regional characteristics and social preferences, exploring feasible development pathways under future deep uncertainties.

Through the analysis of river restoration, land rehabilitation, and community revitalization strategies, the study proposes adaptive development solutions for Jinchang, including de-channelization of rivers, mixed-species planting, solar-agriculture integration, and industrial heritage reuse. Furthermore, the project emphasizes social equity during urban regeneration, promoting community participation and social inclusion to prevent social segregation and inequality during the transition process.

The findings present a more resilient and sustainable transformation model for resource-based cities, providing practical insights for policy-making and ecological restoration in similar regions.

keywords:
Resource-Based City, Sustainability Transition, Just Transition, Scenario Planning, Adaptive Planning, Design with Nature

Context

Acknowledge

I'm grateful for the courage it took—and the support from my parents—that support me to return to school and reflect on my journey as a planner. This thesis is part of my effort to make sense of the questions that have been building up throughout my work and study.

I would like to sincerely thank my graduation mentors, Marcin and Nikos. Marcin, wise and gentle, supported me with calm encouragement. Nikos, insightful and sharp, always offered ideas that inspired me to think deeper. I'm also thankful to other teachers throughout my master's journey. Their feedback and teaching continued to enlighten me at unexpected moments during my thesis process.

Lastly, thank you to my friends—both nearby and far away in China—who reminded me of life beyond the thesis, and gave me the support I needed to keep going.

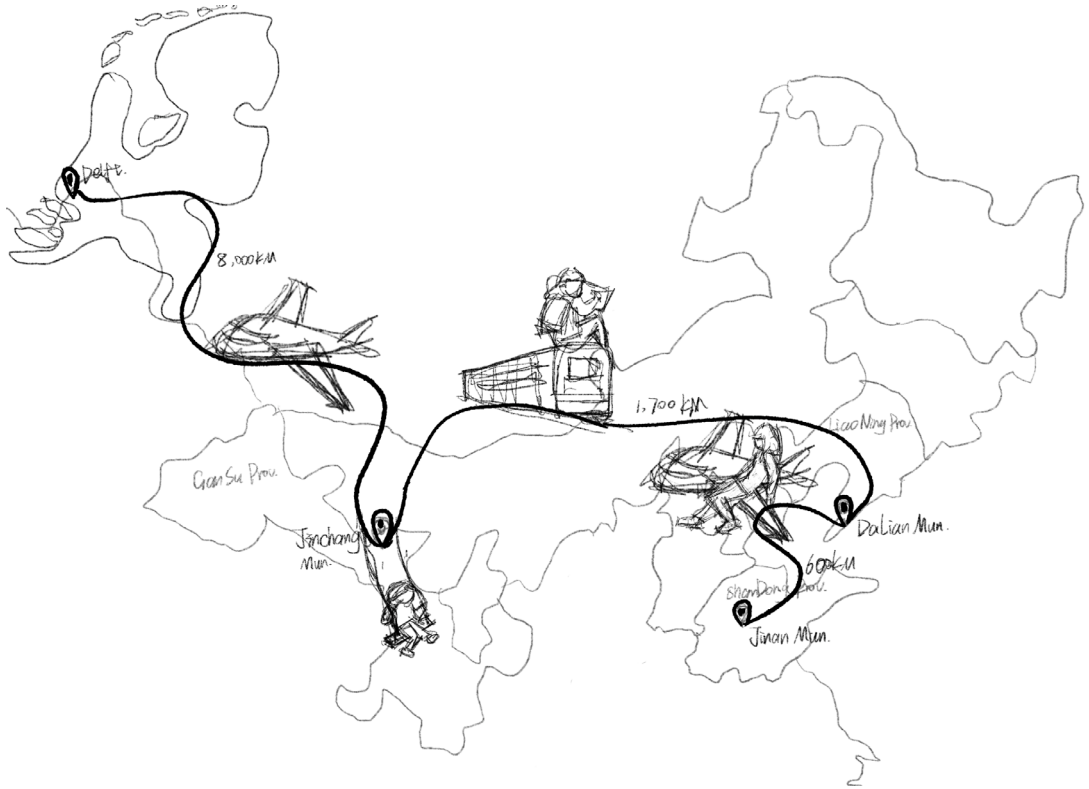


Figure. Personal Journey (Source: Drawn by the author)

Personal Motivation and Research Inspiration

My undergraduate studies took place in the old industrial base of Northeast China, where I actively participated in discussions and design projects focused on the future development and transformation of post-industrial cities and industrial parks. It was during this time that I developed a deep interest in the challenges faced by declining industrial cities. However, I observed that many studies often attempted to replicate successful experiences—such as converting old industrial zones into artist districts or creative hubs. These transformations typically began organically in grassroots settings, where low rents in decaying communities allowed new industries to emerge. Yet, when cities attempted to imitate these outcomes from the top down, especially in small and medium-sized cities lacking economic momentum, population support, and cultural consumption, the transitions often struggled to succeed. This prompted me to think critically: in urban transformation, the crucial questions are not merely "what was done," but "why it was done," and "whether it fits the local context."

At the same time, my hometown—Jinchang City—was gradually losing its economic advantages due to global resource price fluctuations and domestic industrial restructuring. As a declining industrial and resource-dependent city, Jinchang has been searching desperately for new development pathways, yet it lacks sufficient support and clear strategic direction. This sense of "exploration in confusion" made me realize that this is a crucial moment to reimagine and plan for a more resilient and sustainable urban future.

Another driving force behind my research is my firsthand experience with the major transformation of China's urban planning system. Amidst the reform of Territorial Spatial Planning, the central government successfully integrated various departments, unified base maps, and restructured institutions. However, at the local level, a disconnect remains between new policies and on-the-ground practices. Having participated in the early stages of this reform, I became acutely aware of the time required for policy adaptation and the challenges posed by the coexistence of new and old planning outcomes. This experience inspired me to pursue a study that could offer a comprehensive planning method capable of addressing uncertainties and integrating environmental and developmental issues. I hope that my research can provide practical insights for resource-based and marginalized cities like Jinchang, while also contributing theoretical and methodological support to the evolving planning system in China.

Growing up, I was always told that receiving a good education was my way out of this "hopeless city," leading me to live in different cities far from family and friends, feeling rootless and disconnected. This is a common experience for many in declining industrial cities, sometimes even resulting in generational trauma—the despair of those who leave and the harsh conditions for those who stay. With Jinchang as my case study, I aim to break the cycle of decline by preparing adaptive strategies for the recurring challenges faced by shrinking cities, paving the way for a more resilient future.

1 Introduction

1.1 Jinchang City: Geographical Location and Natural Environment
1.2 China Context: Declining Resource-Exhausted Cities
1.3 Challenges in the Transformation of Resource-Based Cities
1.4 Problem statement
1.5 Research Aim
1.6 Research Question

1.1 Jinchang City: Geographical Location and Natural Environment

Jinchang City is located in the central part of Gansu Province in northwestern China, a region rarely highlighted on the national map due to its remote position at the northwestern frontier.

The natural environment of Jinchang is characterized by typical northwestern features: arid climate, frequent sandstorms, interwoven plateaus, and deserts. The city is shielded by the Qilian Mountains, which block moist air currents from the southeast, and faces the Badain Jaran Desert and the Tengger Desert. Historically, the Jinchuan River, a tributary of the Shiyang River, flowed through the city. However, these watercourses have gradually disappeared from both sight and memory, with sandstorms and intermittent water shortages serving as stark reminders of the region's inherent aridity.

The city and its surrounding deserts are connected by stretches of the Gobi Desert. Although large areas have been reclaimed for agriculture and covered with photovoltaic panels, the tension between urban development and the harsh natural environment remains unresolved.

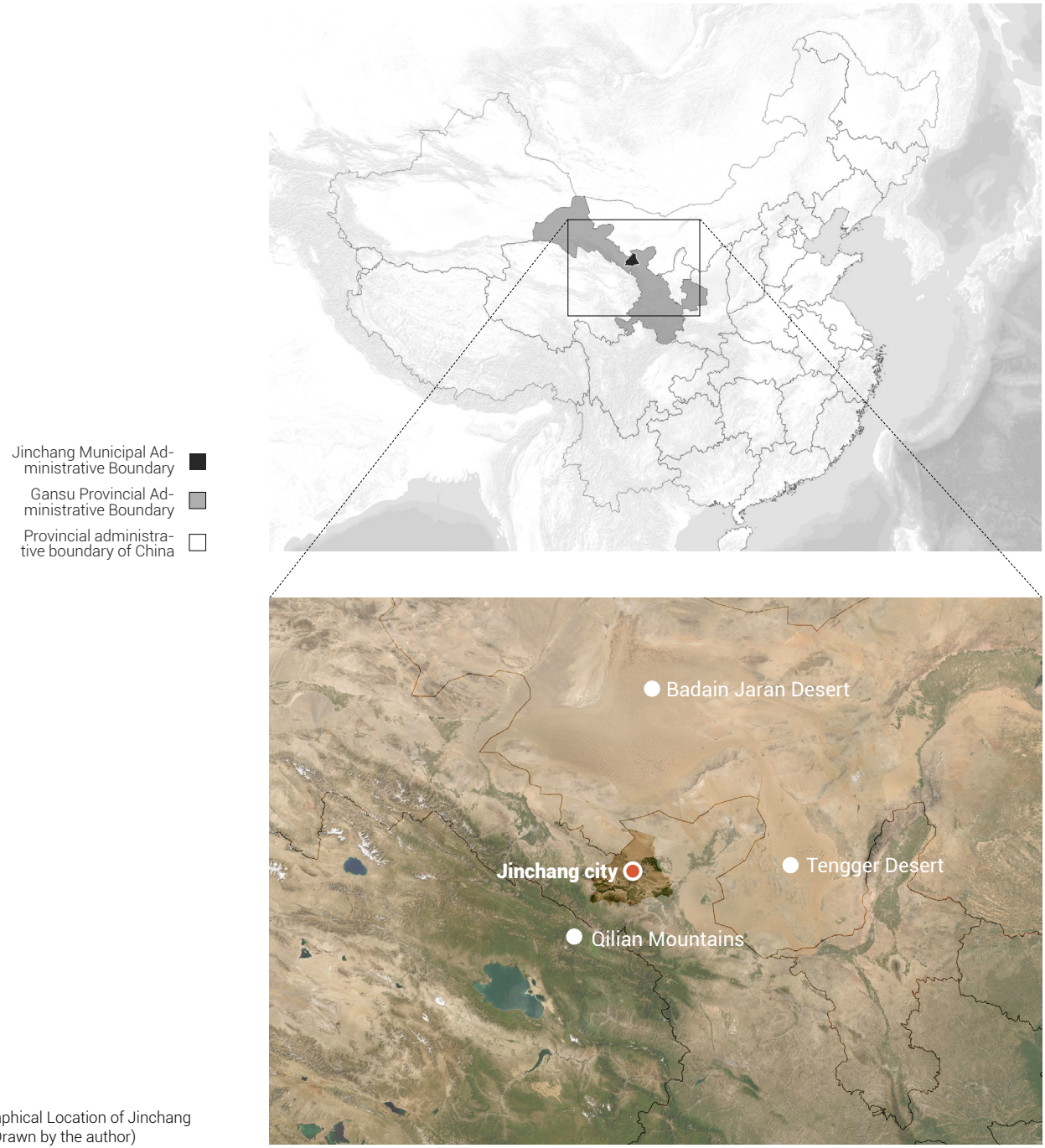


Figure. Geographical Location of Jinchang City (Source: Drawn by the author)

1.2 China Context: Declining Resource-Exhausted Cities

After a period of rapid development, many resource-based cities in China have faced decline. The State Council of the People's Republic of China issued policy documents defining resource-exhausted cities as "cities where mineral resource development has entered its late or final stages, with cumulative extraction reaching more than 70% of the exploitable reserves" (State Council of the People's Republic of China, 2013).

The State Council also released a list of resource-exhausted cities. Jinchang City was included in the second batch of resource-exhausted cities in 2009 and the third batch in 2011. This designation reflects its heavy dependence on mineral resources, particularly nickel, and the challenges it now faces as those resources become increasingly depleted.

Sustainable Development Planning for Resource-Based Cities

Following this, the Chinese government released the National Sustainable Development Plan for Resource-Based Cities, categorizing resource-based cities into four types: growing, mature, declining, and regenerating (State Council of the People's Republic of China, 2013). Due to its intensive mineral resource exploitation, annual depletion of reserves, lagging development of alternative industries, a single industrial structure, and heavy reliance on resources, Jinchang City was classified as a "declining resource-based city."

Although the plan did not provide specific guidance for Jinchang, it offered policy directives for resource-exhausted cities, emphasizing the importance of economic restructuring and upgrading. The plan advocates for economic diversification, the development of alternative industries, and improvements in public services and living conditions. Furthermore, it calls for sustainable resource management and environmental governance to restore ecological balance, alongside fiscal support and transition assistance for emerging sectors.

The policy document also stressed the need for the Jinchang Municipal Government to formulate localized implementation plans that align with its unique regional characteristics and socio-economic conditions. These localized strategies are expected to drive economic recovery, improve community resilience, and create sustainable development pathways for the city's future.

Following this, the government introduced the National Sustainable Development Plan for Resource-Based Cities, classifying these cities into four categories: growth, maturity, decline, and regeneration. Due to its intensive resource extraction, dwindling reserves, emerging but underdeveloped alternative industries, and a highly resource-dependent economic structure, Jinchang City was designated as a declining resource-based city.

Although the plan did not provide specific guidance for Jinchang, it outlined policy directions for resource-exhausted cities, including: Economic Transformation and Diversification, Livelihood ImprovementsEcological Protection and Environmental Management, Financial Support and Industrial Transition. The policy documents also recommended that Jinchang's government formulate localized implementation plans to achieve these objectives.

Implementation of Jinchang's Transition Policies

Jinchang City has identified new energy, new materials, and other emerging industries as alternative sectors to support its economic transition. However, these industries heavily rely on national financial support and still face significant technological bottlenecks. The city has proposed strategies for industrial resource recycling and the development of a "zero-waste" city, which, while in its early stages, has shown some initial success. Nevertheless, substantial ecological debts remain unresolved. To drive industrial innovation, a partnership between the leading enterprise, Jinchuan Group, and the municipal government was proposed (Jinchang Municipal Government, 2024). However, there are underlying concerns regarding economic inequality and limited access to these new opportunities for marginalized communities.

The city also set a goal for urban-rural integration (State Council of the People's Republic of China, 2019), aiming for agricultural modernization and equal access to public services. However, a comparison with the newly released draft of the National Territorial Spatial Plan reveals that rural areas remain marginalized, highlighting a gap between planning intentions and spatial realities.

Additionally, modern service industries, such as logistics, cultural tourism, and related services, have been introduced to diversify the economy. Yet, these projects often lack local relevance and fail to attract sustained interest, resulting in short-lived developments that quickly fade away.

The underlying causes of these unsuccessful transitions prompt the author to explore the challenges faced by resource-based cities during global economic shifts. This inquiry connects with academic discussions on globalization and post-industrial transformation, aiming to understand the systemic barriers that inhibit sustainable development and equitable growth in cities like Jinchang.

1.3 Challenges in the Transformation of Resource-Based Cities

The development of resource-based cities has garnered significant attention in international academic circles. Globally, economies rich in natural resources such as oil, natural gas, and minerals often face long-term dependence on resource extraction, resulting in industrial stagnation, single-sector economic structures, and social inequality. This phenomenon ultimately hampers overall development, with resource endowment becoming a "curse" rather than a blessing (Sachs & Warner, 1997; Auty, 2001).

Research indicates that the intensity of research and development in resource-based cities is only 57% of that in non-resource-based cities (He et al., 2017), significantly constraining urban innovation and transformation. The single-resource economic structure also makes these cities highly susceptible to market fluctuations, with GDP volatility increasing by 2.3 times due to resource price instability (Takatsuka et al., 2015).

Moreover, approximately 1,300 resource-based cities worldwide contribute to 28% of global greenhouse gas emissions. The carbon intensity of GDP in these cities is 3.2 times higher than that of service-oriented cities (Wu et al., 2023; Zhao et al., 2023), reflecting the environmental costs of unsustainable resource extraction and industrial practices. These challenges highlight the pressing need for economic diversification, sustainable development strategies, and technological innovation to break free from the "resource curse."

Development History of Jinchang City: Resource Dependence and Depletion Concerns

Resource-based cities are often characterized by a highly concentrated industrial structure. Their development is heavily influenced by fluctuations in international resource markets, with resource industries dominating labor and capital allocation. This reliance suppresses the growth of alternative industries, making it challenging for innovation-driven sectors to emerge.

Jinchang City epitomizes this model: it was established with a resource-centric mission—its growth linked to the mining sector and the establishment of the city around industrial needs. As the largest nickel and cobalt production base in China, Jinchang is famously known as the "Nickel Capital" of the nation. For decades, the non-ferrous metal industry has been its economic backbone, leading to a highly singular industrial structure.

Historically, Jinchang's economic trajectory has been cyclical—rising, contracting, and then regrowing in waves. Although recent years have shown signs of economic growth, the city's resources are not inexhaustible. After prolonged extraction and production, Jinchang now faces the looming threat of resource depletion, forcing it to seek raw materials beyond its borders.

Environmental Degradation and Desertification Threats

Land Degradation

The development of resource-based cities is fundamentally built on the consumption of environmental resources. Mining activities lead to severe land degradation, with the cost of reclamation estimated to be 3 to 5 times the original land value (Zhang et al., 2021). Among China's 69 declining resource-based cities, historical mining activities have left behind 12,000 square kilometers of damaged land, with a reclamation cost exceeding 300 billion yuan (He et al., 2022). In Jinchang City, the remnants of mining activities and the accumulation of tailings not only degrade the landscape but also pose significant environmental and safety hazards.

Over-extraction of Water Resources and the Threat of Desertification

Resource-based cities in China have faced severe groundwater over-extraction, with a national average over-extraction rate of 67% (Zhao et al., 2022). Jinchang City, located in the Shiyang River Basin, is part of the most heavily exploited inland water system in the Hexi Corridor, leading to severe ecological degradation and desertification. In the middle reaches of the Shiyang River, agricultural irrigation consumes 85% of the total water supply, resulting in a 63% shrinkage of the Minqin Oasis since the 1950s. The groundwater table has been dropping at an average rate of 0.5 to 1.2 meters per year (Shi et al., 2024).

The Shiyang River Basin serves as a natural barrier between the Tengger Desert and the Badain Jaran Desert, but the advancing desertification and drought have weakened its protective function. At the border between these two deserts, the annual rate of desert expansion has reached 3 to 5 meters (Qing et al., 2022).

Sandstorms and Climate Refugees

Desertification has also led to an increase in sandstorm events. In Minqin County, located just 1.5 hours from Jinchang, the average number of sandstorm days per year rose from 14 days in the 1960s to 27 days in the 2020s (Li et al., 2021). This growing environmental threat not only endangers the ecological security of the Hexi Corridor but has also resulted in climate migration, with some residents relocating from Minqin County to Jinchang City to escape worsening living conditions.

Historical Trajectory and Economic Dependency

From a historical perspective, human settlement in this area dates back over 3,000 years, whereas its history as an industrial city spans just over four decades. The initial development of nickel mining began in 1958, and the city was officially established in 1981.

Like many other resource-based cities, Jinchang's economy has been heavily dependent on mineral extraction. The Jinchuan Group, the city's dominant enterprise, plays a central role in the local economy. However, its profitability is highly sensitive to international nickel prices, which are subject to significant volatility.

Accompanying this economic instability, population outmigration has intensified. This trend began around 2010, following the first major downturn in nickel prices, which triggered a prolonged period of economic contraction.

Economic and population change curve of Jinchang city

Jinchang GDP

Jinchang's permanent population

Development cycles of Jinchang city (five-year plans)

Key milestones in the development of Jinchuan Group Co.

Land expansion in Jinchuan district

Built-up Land

Newly Developed Built-up Land

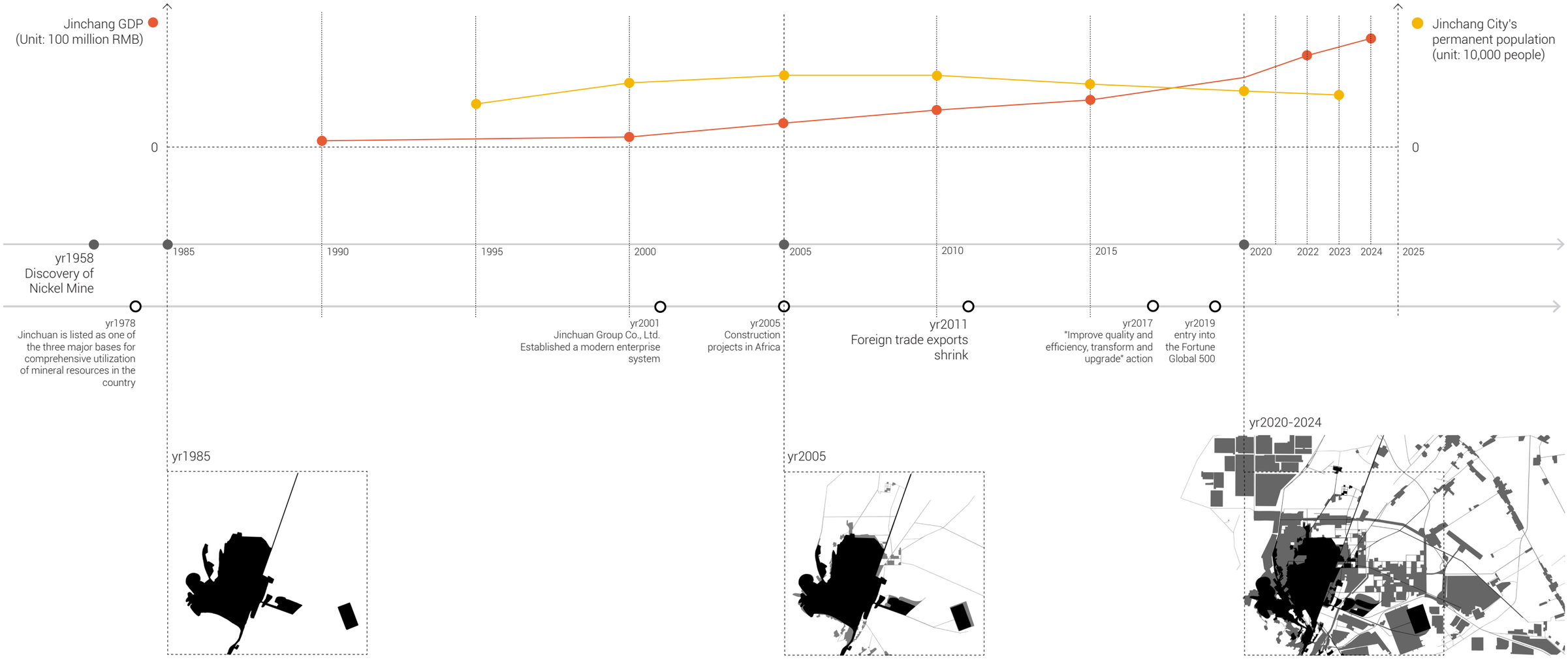


Figure. Historical development of Jinchang City and Jinchuan Group Company (Source: Drawn by the author)

Climate Adaptation and Solar Energy Dilemma

The "Dual Carbon" Dilemma of Resource-Based Cities

Resource-based cities like Jinchang face dual pressures of development and emission reduction. Although China committed to peak carbon emissions by 2030 and achieve carbon neutrality by 2060 (Xi, 2020), Jinchang's carbon emissions continue to grow at 3.5% annually, far above the national average of 1.8% (Nature Cities, 2024). About 65% of its GDP depends on nickel and copper extraction, with Jinchuan Group producing 200,000 tons of nickel and 1.1 million tons of copper yearly, contributing 4% of global nickel supply. However, Jinchang's carbon intensity is 3.2 times the national average (Zhang et al., 2023). Efforts to cut emissions rely on technological innovation, but Jinchang's R&D investment is only 1.2%—significantly below the national average of 2.4%—and low-carbon technology patents account for less than 5% (Frontiers in Environmental Science, 2023). The technological gap, combined with harsh environmental conditions and geographic isolation, further limits its capacity for green industrial transformation.

Opportunities and Challenges in the Solar Industry

China's Nationally Determined Contribution (NDC) targets include achieving over 1.2 billion kW of installed wind and solar capacity. Although this target has been exceeded, structural inefficiencies persist, particularly in the northwest region where the solar energy abandonment rate remains at 8%, compared to the national average of 3%. In 2023, Jinchang alone recorded 1.2 billion kWh of wasted solar energy (State Grid Jinchang, 2024), mainly due to outdated lithium battery storage and insufficient energy network infrastructure.

Jinchang's solar projects heavily rely on state subsidies, with profitability concerns emerging as these subsidies phase out. In 2024, 14.7 billion RMB in wind and solar subsidies were granted, but project yields fell below 6% after subsidy cuts (Solarbe Global, 2024). Most solar farms are located in the Gobi Desert around the Tengger and Badain Jaran Deserts, positioning Jinchang as a significant solar energy hub in Northwest China. As of 2024, its solar installations reached 5.56 million kW, comprising 75.6% of the province's total capacity, with plans for a 10-million kW solar base (China Daily, 2024). However, outdated grid infrastructure and limited storage capacity have led to high production with low consumption, making the sector heavily reliant on government support.

The Challenge of Balancing Carbon Neutrality and Urban Development

Under the dual constraints of carbon neutrality targets and urban development planning, Jinchang faces the challenge of maintaining economic growth while significantly reducing carbon emissions. Given its dependence on resource extraction and the structural rigidity of its industrial base, achieving both economic expansion and sustainable emission reductions in the short term remains a formidable challenge. The reliance on state funding for renewable energy projects, combined with technological bottlenecks in energy storage and transmission, further complicates the path to green transformation.

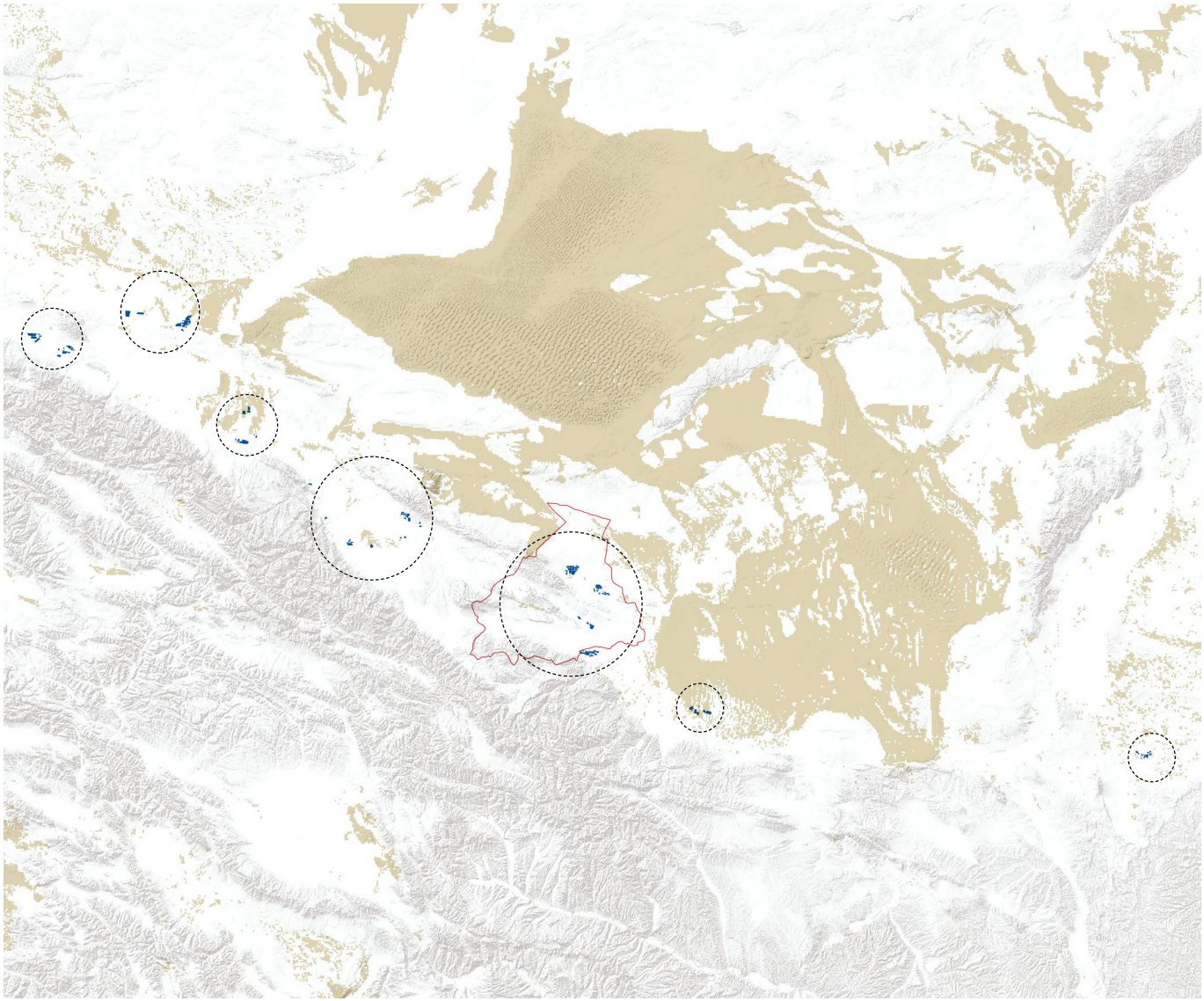


Figure. Regional photovoltaic farms (Source: Drawn by the author)

Collapse of Social Resilience

Resource-based cities like Jinchang often suffer from single-industry economic structures, leading to rigid employment patterns dominated by "miner-enterprise-mining area" cycles (Sachs & Warner, 1997; He et al., 2022). In Jinchang, 65% of industrial jobs are in nickel and copper sectors, while new energy employment accounts for less than 8% (Jinchang Statistical Yearbook, 2023). Efforts to transition, such as Jinchuan Group's hydrogen metallurgy project, require over 40% skilled workers, yet local skill conversion remains low at 12% (State-owned Assets Supervision and Administration Commission, 2024), highlighting a major skills mismatch.

Historically, mine closures in the early 2000s led to 12,000 layoffs with re-employment rates below 30% (Ministry of Human Resources and Social Security, 2010), and the current industrial shift may similarly displace many miners unable to adapt to new technology-driven roles.

Population Dynamics and Social Segregation

According to the Seventh National Population Census in 2020, Jinchang's population was 438,026, a modest decline of 0.58% per year compared to 2010. However, there has been a clear replacement effect: technological talent is leaving while rural populations move in for low-skilled service jobs. From 2010 to 2020, the proportion of college-educated residents dropped from 9.7% to 7.3%, while 62% of new residents were rural migrants primarily engaged in low-skilled work (Gansu Provincial Bureau of Statistics, 2023).

Center-Periphery Urban Structure and Social Segregation

Jinchang's urban form shows a center-periphery divide. The central area, like Longshou Mining Community, enjoys high public service investment, while peripheral regions like Ningyuan Fort Town Migration Community suffer from poor infrastructure, low sewage treatment, and higher crime rates (Jinchang Urban Planning Report, 2022; Chen & Chen, 2021). This reflects broader issues in Chinese resource-based cities, where peripheral communities receive less than 30% of the infrastructure investment compared to central districts (State Council of the People's Republic of China, 2013).

The spatial divide is further deepened by the coexistence of state-owned enterprise housing and migrant settlements, with 82% of Jinchuan Group's residential zones holding local household registration, compared to only 35% in migrant communities. This segregation exacerbates social fragmentation and limits social mobility (Urban Inequality and Segregation in Europe and China, 2021).

Intergenerational Migration Risks

Concerns over resource depletion and limited job prospects have driven second-generation migration out of Jinchang. In cities like Datong, 65% of miners' children express willingness to leave, compared to 25% of their parents (Cai & Xu, 2022). This trend reflects the lack of diverse employment opportunities, increasing the risk of "skill hollowing" as younger, more educated workers seek opportunities elsewhere.

Figures: Differences in living environment (Source: Photo by the author)

city center — city edge

Good living environment — poor living environment

Old residential areas built by Jinchuan Group:
Originally constructed for middle- to high-income company employees. Now inhabited by a mix of original residents and new migrants. Located in the city center, these areas are relatively old but have good living conditions and well-developed facilities.

city center — city edge

Good living environment — poor living environment

Newly developed residential zones by real estate developers:
Located on the urban fringe, far from the city center. These areas lack adequate facilities and are mainly inhabited by new migrants and original residents purchasing a second home.

city center — city edge

Good living environment — poor living environment

Residential areas built by the poorly performing mining company (Bayeh Group):
Mostly occupied by rural migrants and low-income residents. These areas are old, with poor environmental quality, and are planned for demolition in current urban planning schemes.

city center — city edge

Good living environment — poor living environment

Privately developed housing in relatively central areas:
Located near commercial centers, mostly occupied by long-term residents.

Governance Dilemmas

Fiscal Dependence and State-Owned Enterprise Dominance

Jinchang City faces significant challenges related to fiscal dependency, state-owned enterprise (SOE) dominance in municipal construction, and barriers to resource flow. The development of resource-based cities often involves complex power dynamics between local governments and dominant enterprises. In Jinchang, the state-owned Jinchuan Group controls 83% of the city's infrastructure (Chen et al., 2023). Although the municipal government has been gradually taking over public service facilities, Jinchuan Group still wields significant influence over urban development and transformation, including industrial upgrades, infrastructure construction, and environmental modifications.

Furthermore, the local government holds less decision-making power than the SOE. As a provincial-level state-owned enterprise, Jinchuan Group's influence extends beyond local governance, especially in projects like the national-level industrial park, where the approval of land use, tax incentives, and project planning remains under the company's jurisdiction (Jinchang Urban Planning Report, 2023). This power imbalance limits the local government's ability to independently direct urban and industrial transformation.

Limited Public Participation

Under the dominance of state-owned enterprises, the connection between the government and local communities has weakened, reducing public trust and potentially leading to a loss of social cohesion. Decision-making processes regarding major infrastructure projects and public resource allocation largely exclude citizen input, contributing to growing social dissatisfaction and a lack of community engagement. The lack of participatory governance diminishes transparency and reduces residents' sense of ownership over urban development.

Short-Sighted Development Values

Driven by economic interests, dominant enterprises tend to prioritize economic gains over environmental protection. This approach often results in the expansion of industrial land at the expense of public and ecological spaces, degrading urban living conditions. In Jinchang, industrial land expanded by 23% from 2015 to 2020, primarily due to nickel mining and smelting activities. Meanwhile, the city's per capita green space dropped from 9.5 m^2 to 7.8 m^2, far below the national average of 11.4 m^2 (Jinchang Urban Planning Report, 2023). This unsustainable land-use strategy not only affects urban livability but also threatens long-term ecological resilience.

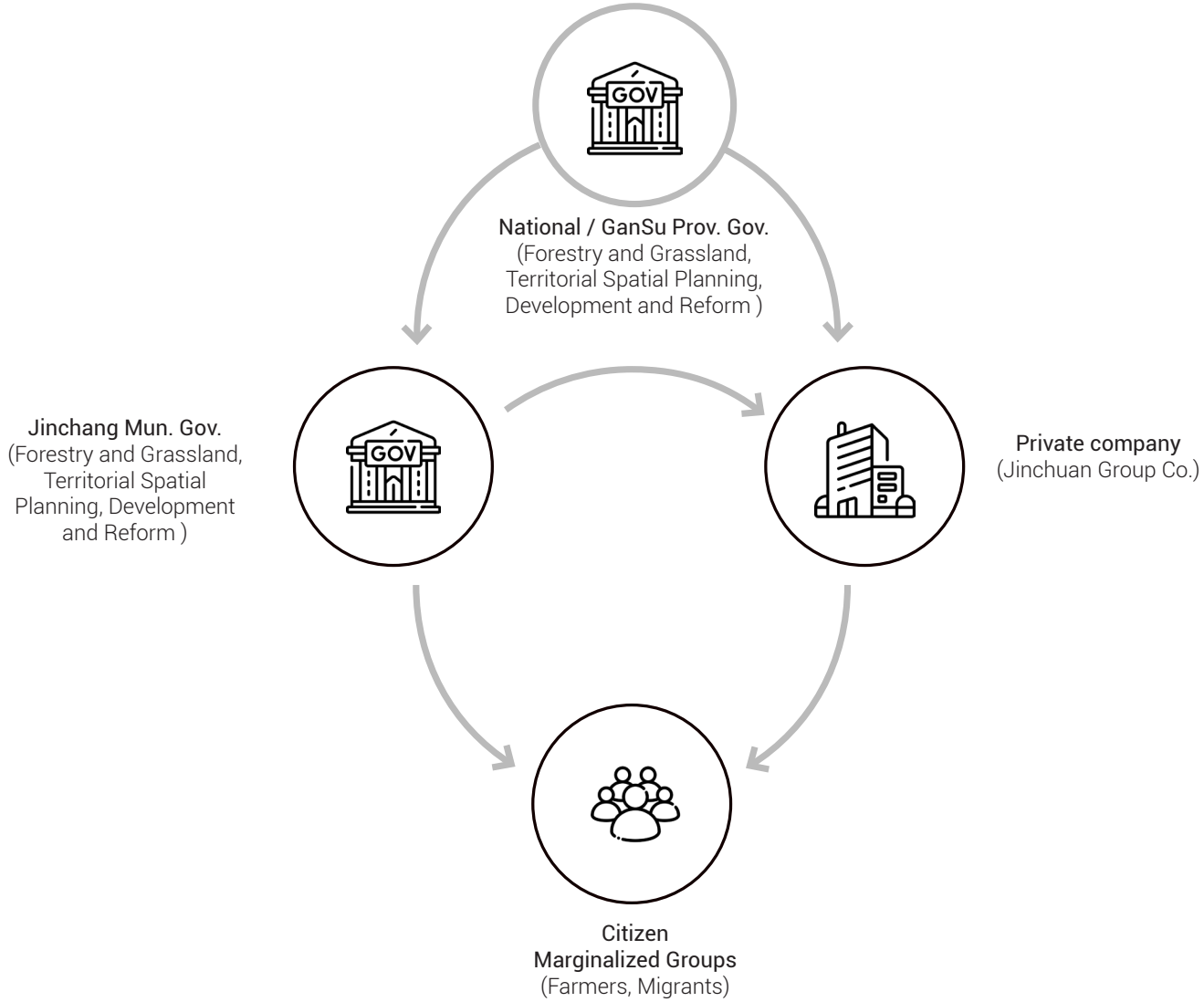


Figure. Governance dilemmas diagram (Source: Drawn by the author)

Debates on Transformation Pathways for Resource-Based Cities

Although Jinchang was originally established as a mining service community, after more than 40 years of development, it has evolved into a complex urban system with a diverse social structure. For the city's long-term sustainability and the continued well-being of its inhabitants, it is imperative to address the existing development challenges and pursue more sustainable transformation pathways.

International Debates on Transformation Pathways

Industrial Substitution Pathway:

This pathway is primarily applied to cities where resource extraction has entered a decline phase. It is often government-led and advocates for a complete shift away from resource dependency toward entirely new leading industries.

Case Study: Kitakyushu, Japan
—After the decline of its coal industry, the city transformed into a model of a circular economy. However, such a transition heavily relies on technological innovation, which is constrained in Jinchang due to its limited talent attraction and technological capacity.

Industrial Chain Extension Pathway:

This approach is suited for cities in the mature stage of resource exploitation. It is predominantly market-driven and focuses on extending the value chain of existing resource industries, moving towards higher value-added segments.

Case Study: Ruhr Area, Germany
—Following the closure of coal mines, the region extended its industrial chain in the steel sector, promoting downstream processing and high-value production.

Hybrid Transformation Pathway:

This pathway targets cities transitioning from maturity to decline. It is led by public-private partnerships that integrate emerging industries with local resource-based extensions, creating a diversified economic structure.

Case Study: Ruhr Area, Germany
—Implemented ecological restoration of abandoned industrial sites, transforming them into landscape parks and cultural heritage sites. Simultaneously, some steel production was upgraded to high-grade specialty steels, alongside the development of hydrogen energy and circular economy models.

Turin, Italy
—Repurposed the former FIAT Lingotto factory into a multifunctional commercial complex and upgraded urban transportation infrastructure.

Smart Shrinkage Pathway:

This model is designed for cities in the decline phase, emphasizing community participation and the deliberate reduction of urban scale. It prioritizes urban space optimization and the enhancement of public service facilities.

Case Study: Leipzig, Germany—The city's urban planning responded to population decline by closing surplus infrastructure, repurposing vacant housing into community centers, and restoring Renaissance-era historic districts to attract creative industries.

Current Transformation Approach in Jinchang

Jinchang currently adopts a **Hybrid Transformation Pathway**. However, compared to the aforementioned successful examples, Jinchang's industrial chain extensions and emerging industries face significant challenges, particularly in overcoming technological barriers and attracting talent.

Attempts to repurpose industrial heritage sites into service and tourism sectors have been observed in China with promising results. Notable examples include:

Yangpu Riverside, Shanghai—Revitalization of century-old industrial docks (e.g., Yangshupu Power Plant, textile mills) into public spaces, art venues, and technology innovation hubs.

Wanshan Mercury Mine, Guizhou—Transformation of an abandoned mercury mine into the Cinnabar Town cultural tourism complex.

Despite these initiatives, Jinchang still faces critical challenges in cultural revitalization, ecological restoration, and pollution management. The replicability of these transformation pathways depends on overcoming these barriers.

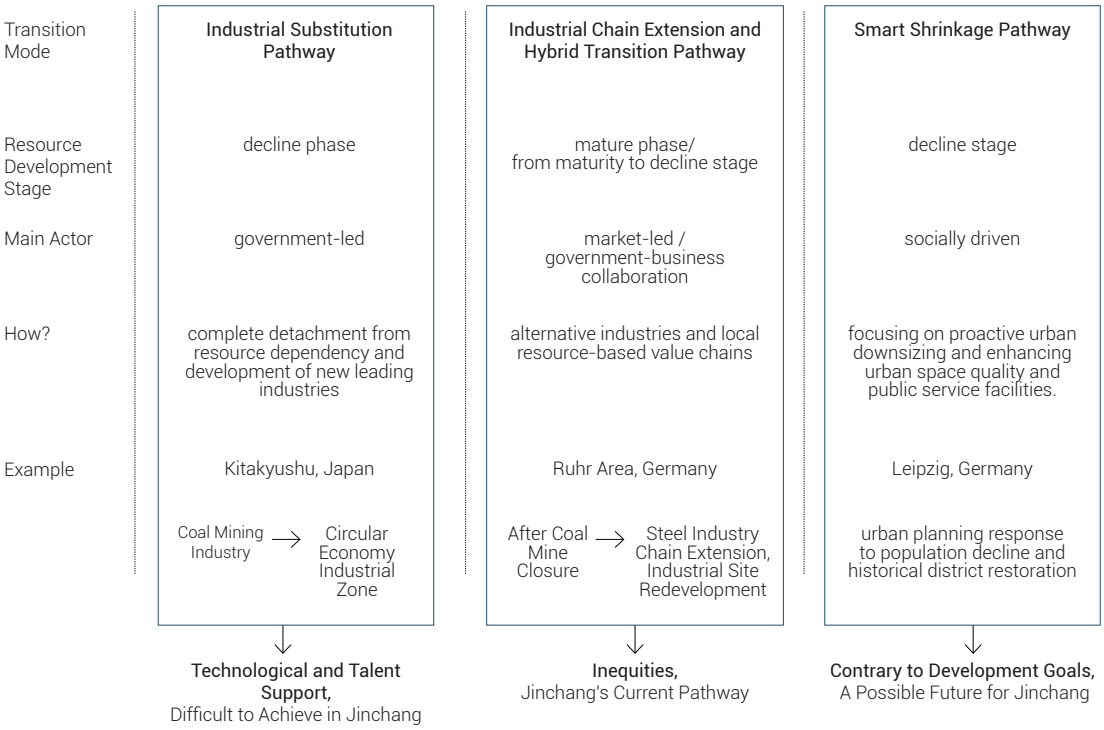


Figure. Transformation pathways diagram (Source: Drawn by the author)

1.4 Problem statement

Jinchang City, as a typical resource-based city in China, has long relied on the extraction and smelting of non-ferrous metals such as nickel and cobalt, forming a single-industry economic structure. However, with global resource price fluctuations and domestic industrial restructuring, Jinchang now faces severe challenges of resource depletion, environmental degradation, and economic transition. Over-exploitation has led to ecological fragility, groundwater over-extraction, and accelerated desertification, further deteriorating the natural environment. Simultaneously, the city's concentrated resource-based industry hinders economic diversification, deepening its dependence on a single economic pillar.

On the social level, the decline of traditional industries has reduced employment opportunities, triggering a significant outflow of younger populations, weakening social inclusivity and diminishing community vitality.

Against this backdrop, Jinchang's transformation is confronted with intertwined economic, environmental, and social pressures, compounded by complex uncertainties such as climate change, global market volatility, and regional urbanization dynamics. In light of the ongoing national spatial planning reform, breaking resource dependency and achieving a coordinated pathway for industrial diversification, ecological restoration, and socially inclusive development has become a critical challenge that urgently needs to be addressed.

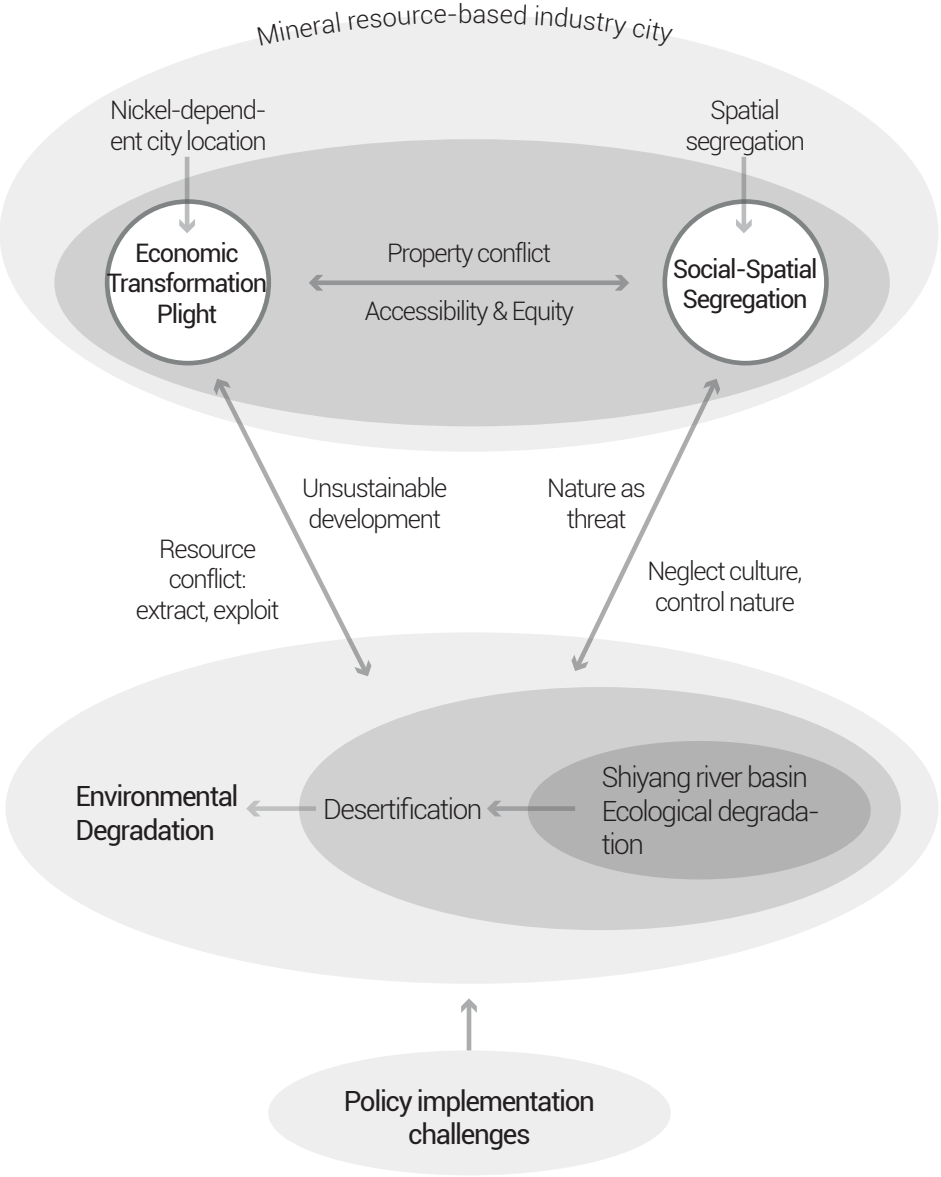


Figure. Problem statement diagram (Source: Drawn by the author)

1.5 Research Aim

This research aims to explore how Jinchang City, as a typical resource-based city, can achieve sustainable and resilient urban transformation in the face of resource depletion, environmental degradation, and economic transition challenges. The study focuses on identifying key barriers in environmental, economic, and social dimensions, and seeks to develop strategies for industrial diversification, ecological restoration, and social inclusion. The goal is to break the dependency on single-resource industries and build adaptive capacities to respond to climate change, market fluctuations, and regional urbanization dynamics.

1.6 Research Question

Main research question (MRQ)

How can Jinchang City achieve a sustainable and equitable transformation within environmental and policy constraints while preserving its landscape and safeguarding residents' well-being?

Sub research questions (RSQs)

RSQ1: What environmental constraints limit the city's transformation, and which landscapes are essential to protect for both the city and its residents, considering the historical, cultural, and ecological relationships?

RSQ2: What challenges does Jinchang's current economic structure face in transitioning from a resource-dependent economy, and what potential exists for developing alternative economic sectors—both traditional and emerging?

RSQ3: How do economic transformation and environmental degradation affect residents' livelihoods and lifestyles, and contribute to the emergence of social discontent that leads to out-migration?

RSQ4: What transformation pathways and spatial strategies can enable Jinchang to achieve a more sustainable and equitable future?

RSQ5: How can evolve to support a locally adapted and inclusive transition, addressing existing institutional and governance constraints?

2 Methodology

2.1 Theoretical framework
2.2 Conceptual framework
2.3 Methodology framework

2.1 Theoretical framework

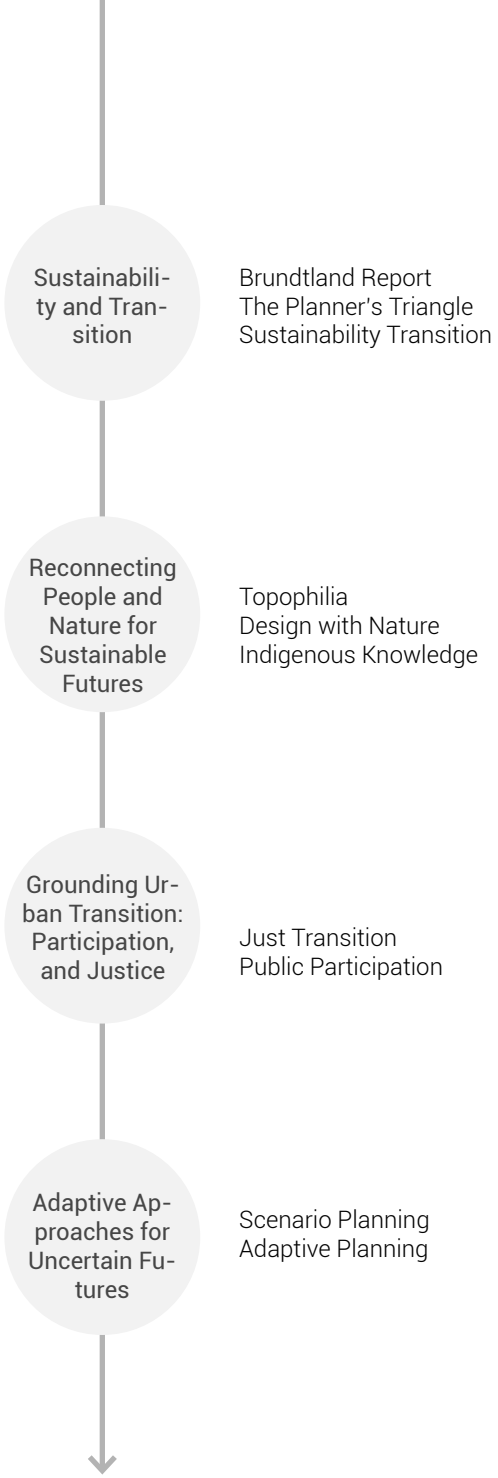
This research is grounded in four interconnected theoretical perspectives that provide the foundation for understanding sustainable urban transformation in resource-based cities.

Sustainability and Transition explores how socio-technical systems shift from unsustainable to sustainable models, highlighting the need for long-term, multi-dimensional changes in technology, economy, and society.

Reconnecting People and Nature for Sustainable Futures emphasizes the emotional and cultural bonds between communities and their natural environments, advocating for ecological restoration that also rebuilds social cohesion and local identity.

Grounding Urban Transition: Participation and Justice addresses the importance of inclusive governance and public participation in achieving equitable urban development, ensuring that marginalized communities are part of decision-making processes.

Finally, Adaptive Approaches for Uncertain Futures introduces flexible planning methods that embrace uncertainty, focusing on resilience and iterative learning to navigate complex socio-environmental challenges. Together, these theoretical perspectives form a comprehensive framework to guide the sustainable and adaptive transformation of resource-based cities.



Sustainability and Transition

Brundtland Report

The "environment" is where we all live, and "development" is what we all do in attempting to improve our lot within that abode. The two are inseparable. (1987: Brundtland Report).

According to the World Commission on Environment and Development (1987), sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

The report emphasizes that sustainable development is not solely about environmental protection; it also involves the balance of social equity, economic growth, and environmental preservation. Achieving this balance requires regional cooperation and integrated planning, rather than isolated, localized efforts. It highlights the interconnectedness of ecological health, economic stability, and social well-being, stressing that one cannot be achieved at the expense of the others.

This research aims to realize a sustainable future based on the principles outlined in the Brundtland Report, emphasizing that economic, environmental, and social dimensions must be addressed simultaneously to support long-term resilience and adaptability. In the context of Jinchang City, achieving sustainability requires addressing ecological degradation, economic restructuring, and social inclusion, grounded in collaborative regional planning and adaptive strategies.

The Planner's Triangle

The Planner's Triangle forms the foundational understanding of dynamic sustainability in this research. First introduced by Scott Campbell in his influential article "Green Cities, Growing Cities, Just Cities: Urban Planning and the Contradictions of Sustainable Development" published in the Journal of the American Planning Association (1996), the model deconstructs the inherent contradictions within sustainable development by illustrating the conflicts and synergies among three core objectives: Economic Growth (Growth), Environmental Protection (Green), and Social Equity (Just).

The central idea of the Planner's Triangle is that these three goals are not easily compatible and often come into direct conflict during urban planning processes. According to Campbell, sustainability is not a fixed endpoint but rather a continuous process of negotiation, adaptation, and innovation. He argues that "sustainability is not a final destination, but a path of compromise and innovation that planners must navigate through conflicts." This perspective moves away from the illusion of "perfect balance," embracing contradictions as a catalyst for adaptive strategies.

Dynamic Understanding of Sustainability

In this research, the Planner's Triangle is not only used as a tool to diagnose urban imbalances but also serves as a theoretical lens to understand dynamic urban sustainability. According to Campbell's interpretation, sustainability is inherently fluid—a continuous pursuit rather than a static achievement. This study aims to realize this dynamic sustainability in Jinchang City, a resource-based city historically prioritizing economic growth at the expense of environmental health and social inclusion.

Conceptually, the ideal of sustainable development is represented at the center of the triangle, where the three fundamental priorities—Green Cities (Environment), Growing Cities (Economy), and Just Cities (Society)—intersect. This nexus symbolizes the conflict zones among resource allocation, property rights, and development goals.

The UN-Habitat (2016) report further reinforces this understanding by proposing sustainability as a process that requires dynamic adaptation and learning, mirroring Campbell's conflict-driven model of sustainability.

Integrating Global Practices: The SDGs and Dynamic Sustainability

Building on the Planner's Triangle, this research aligns with the United Nations Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities), which emphasizes the need to balance economic, environmental, and social objectives. This global framework mirrors the Planner's Triangle at a broader scale, reinforcing the idea that sustainability is not a static target but a constantly evolving process that requires continual negotiation and adjustment.

For Jinchang City, the path to sustainable transformation involves navigating the conflicts between economic development, environmental conservation, and social equity. This study explores various transformative pathways that emphasize different value orientations and stakeholder interests, aiming to achieve sustainable development that is adaptive, resilient, and inclusive.

By drawing from Campbell's theory and integrating it with global sustainable development goals, this research proposes that sustainability is achieved through dynamic adaptation—an ongoing process that reconciles growth, environmental integrity, and social justice through collaborative governance and innovative policy mechanisms.

Sustainability Transition

The concept of sustainability transition was introduced by Frank Geels in the early 2000s to explain how socio-technical systems such as energy, transportation, and urban infrastructure shift from unsustainable to sustainable models. Key concepts include Regime, Niche, and Socio-Technical Landscape, which represent different levels of technological and institutional stability. In this framework, technological transitions are primarily driven by enterprises and public-private partnerships. For Jinchang City, sustainability transition is supported through infrastructure improvements, environmental restoration, and spatial reconfigurations, with a strong focus on addressing desertification.

Sustainability transitions represent long-term, multi-dimensional transformations across technology, economy, society, and politics (Biely & Chakori, 2025). There are two primary pathways for transition: one emphasizes Socio-Technical Transitions (Geels, 2002), which focus on market mechanisms and policy incentives for technological innovation, while the other promotes Socio-Ecological Transitions (Swyngedouw, 2010), prioritizing ecosystem restoration and redefining human-environment relationships. Jinchang's current development trajectory leans towards socio-technical transition, but this research integrates scenario planning to explore alternative pathways.

Reconnecting People and Nature for Sustainable Futures

Topophilia

The concept of Topophilia was introduced by Yi-Fu Tuan in his 1974 work Topophilia: A Study of Environmental Perception, Attitudes and Values. It is defined as the "affective bond between people and place," emphasizing emotional connections to specific locations shaped by memories, cultural identity, and sensory experiences (Tuan, 1974).

Place Attachment and Disconnection in Jinchang

Jinchang's industrial development led to environmental degradation, disrupting key cultural landscapes like mountains, rivers, and grasslands. State-led urbanization and industrial expansion weakened community attachment, especially among migrant communities. Generational outflows further deepened emotional disconnection.

Reconnecting People and Landscapes

This research proposes to restore the connection between people and landscapes by revitalizing natural and cultural landmarks. Ecological restoration and enhanced public access to green spaces aim to rebuild community identity and strengthen local cohesion. Reestablishing topophilia is seen as a way to heal community fragmentation and foster a shared sense of belonging.

Design with Nature

The concept of Design with Nature was introduced by Ian McHarg in his 1969 work Design with Nature. McHarg emphasized that ecological processes should be the foundation of urban planning, advocating for development that aligns with natural systems rather than disrupting them. He proposed regenerative design to create urban spaces as ecological and cultural communities, enhancing environmental resilience.

This research emphasizes ecological restoration and integrates it with Topophilia, aiming for designs that connect emotional, cultural, and ecological values. This is achieved through the revitalization of cultural landscapes and the incorporation of Indigenous Knowledge.

Indigenous Knowledge

Indigenous Knowledge (IK) refers to the body of knowledge developed by Indigenous and local communities through generations of interaction with their natural environment. It includes ecological management, cultural practices, social norms, and spiritual beliefs (UNESCO, 2001; Johnson, 1992). IK is characterized by its holistic approach, adaptability, locality, and intergenerational transmission.

This research leverages Indigenous Knowledge as a foundation for understanding local adaptations to natural environments, using it as a reference for nature-based urban transformation and sustainable land-use design.

Grounding Urban Transition: Participation, and Justice

Just Transition

The concept of Just Transition originated from the labor movement, first proposed by American labor leader Tony Mazzocchi in the 1980s through the idea of a "Superfund for Workers," advocating for compensation and retraining for workers displaced by environmental policies. The Paris Agreement (2015) further integrated Just Transition into the global climate governance framework, emphasizing the need to ensure "decent work and social inclusion" during emission reductions.

In practice, Just Transition has expanded to address challenges in resource-declining cities, providing support for unemployed workers and ensuring that new industries do not displace existing ecological or indigenous lands. In Jinchang, the decline of nickel mining and issues in enterprise management have led to layoffs and uneven profit distribution, where the benefits of new industries are concentrated among a small group, leaving marginalized communities with limited opportunities. This project aims to achieve a just transition through public participation and inclusive urban planning.

Public Participation

Public participation is crucial for sustainable development. SDG 11 calls for building "structures for direct civic participation" in urban governance. This project adopts public participation methods as outlined by UN-Habitat, integrating community voices into decision-making during the transition process to enhance transparency, equity, and local resilience.

Adaptive Approaches for Uncertain Futures

Scenario Planning & Adaptive Planning

Traditional scenario planning often relies on fixed assumptions of best-case, worst-case, and most-likely scenarios to select robust solutions. However, in the face of climate change and global market shifts, this deterministic approach is increasingly insufficient. This project adopts the concept of Adaptive Planning, as proposed by Davoudi (2013), which shifts the focus from "controlling outcomes" to "enhancing system resilience."

Adaptive planning emphasizes dynamic learning and iterative adjustments, accepting multiple possible futures instead of relying on a single trajectory. It also integrates the perspectives of diverse stakeholders, aligning with the worldviews of Hierarchist, Egalitarian, and Individualist groups to design flexible policy tools. The project draws inspiration from the Dutch Adaptive Delta Management model, which emphasizes proactive governance in the face of uncertainty.

Compared to traditional planning, adaptive planning supports diverse evolutionary pathways, embracing the complexity of social and ecological systems while fostering multi-party collaboration.

2.2 Conceptual framework

The Emergent Gears of Sustainability Transition Framework

The Emergent Gears of Sustainability Transition Framework positions the sustainability transition goals of resource-based cities at its core, driven by three key dimensions: economic, social, and environmental.

The framework emphasizes the importance of achieving social inclusion and equity, economic diversification and resilience, as well as environmental sustainability and ecological restoration. These goals are pursued through operational mechanisms that drive progress in each dimension, including social inclusion, cultural heritage preservation, inclusive economic transition, adaptive reuse of industrial heritage, cultural landscape restoration, and ecological watershed rehabilitation.

The framework also highlights the synergistic interactions among these mechanisms, enabling social, economic, and environmental transformations to reinforce one another. To navigate uncertainties, it adopts a scenario planning approach that explores three potential pathways: ecological priority, market-oriented growth, and socially inclusive development.

This integrated model seeks to guide Jinchang City towards a sustainable and resilient future.

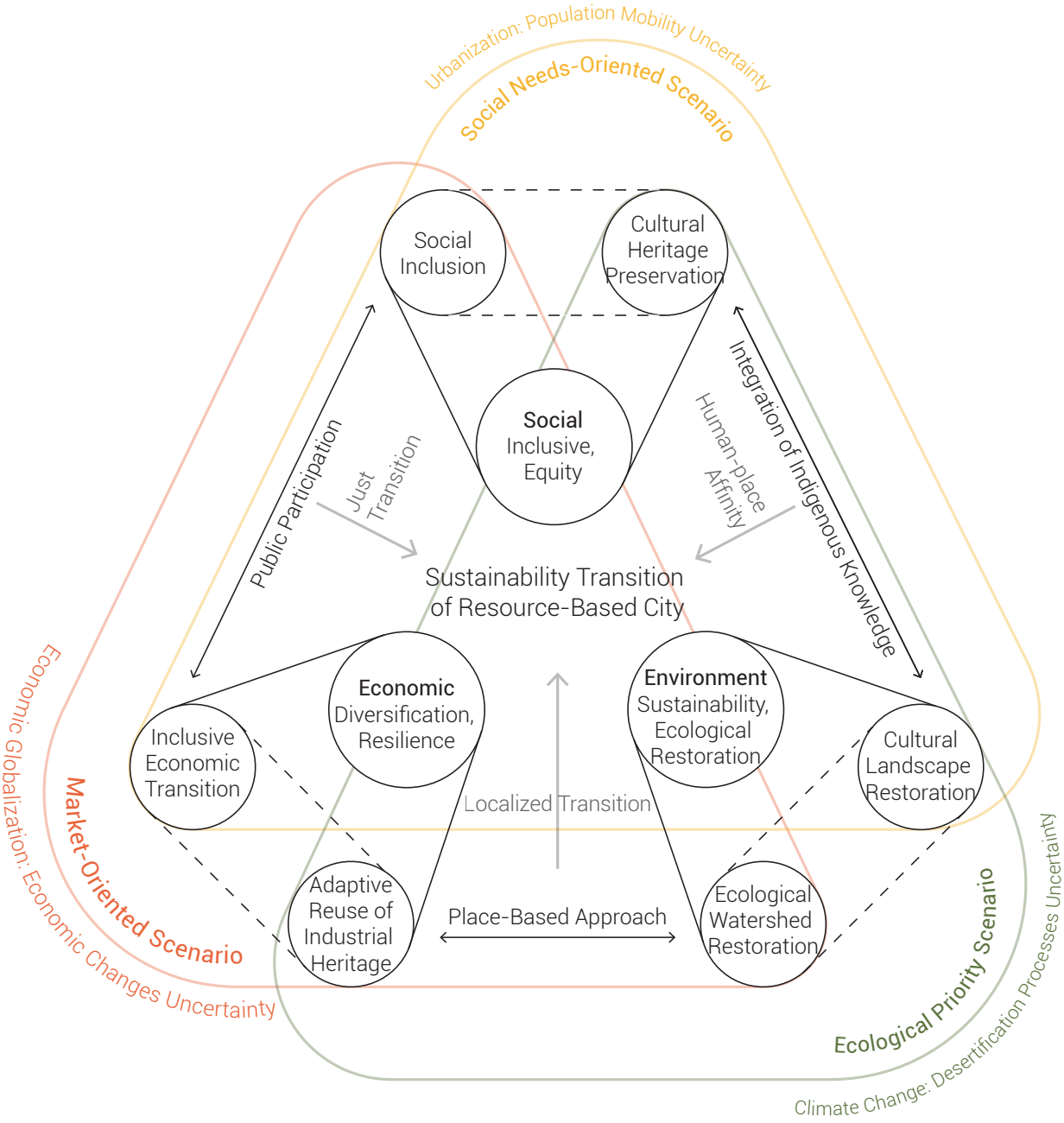


Figure: The Emergent Gears of Sustainability Transition Framework (Source: Drawn by the author)

Goal Identification Methodology

The goal-setting methodology integrates the United Nations Sustainable Development Goals (SDGs), academic research on resource-based cities, national policies for the development of resource-depleted cities in China, and Jinchang's local practices. This comprehensive approach provides a systematic basis for defining economic, social, and environmental goals.

For the social dimension, the focus is on inclusion and equity, aiming to integrate fairness into sustainable urban development while avoiding "elite-driven sustainability" (Short, 2021). This aligns with SDG 10 (Reduced Inequalities) and SDG 11 (Sustainable Cities and Communities), addressing the challenges of state-owned enterprises dominating urban transformation and infrastructure construction, as well as the limited participation of migrants and low-income local residents in decision-making processes.

The economic dimension emphasizes diversification and resilience, aiming to enhance the city's capacity to withstand resource price fluctuations and climate-related disasters (Coulson et al., 2020; He et al., 2022). This aligns with SDG 8 (Decent Work and Economic Growth) and SDG 9 (Industry, Innovation, and Infrastructure), seeking to overcome Jinchang's heavy reliance on resource-based industries and the underdevelopment of emerging sectors.

For the environmental dimension, the goal is to achieve sustainability and ecological restoration, enhancing total factor productivity through green transformation in resource-based cities (Song et al., 2022). This is consistent with China's vision of "Green Mountains and Clear Waters are as Valuable as Gold and Silver" (State Council of the People's Republic of China, 2015) and aligns with SDG 15 (Life on Land). These goals address Jinchang's ecological debt caused by industrial activities, along with threats of watershed degradation and desertification.

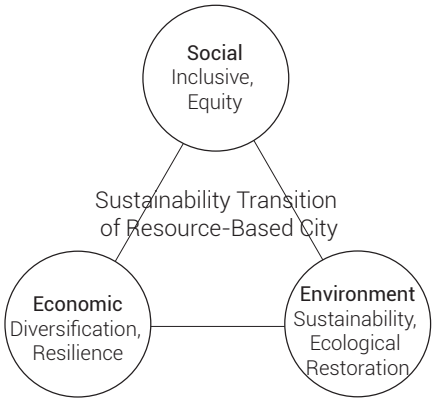


Figure: Goals for sustainability transition of resource-based city, Jinchang (Source: Drawn by the author)

Strategic Approach

Social Inclusion

Social inclusion is at the core of sustainable urban transformation, integrating fairness, justice, and green objectives to prevent "elite-driven sustainability" (Short, 2021; Mirzoev et al., 2021). In Jinchang, urbanization has led to significant migration inflows, while economic decline and harsh environmental conditions have triggered the outflow of local residents. These demographic shifts have reshaped the city's social structure, with development policies often marginalizing migrants and intensifying social segregation. Implementing social inclusion strategies, such as co-created public spaces and participatory governance, can help bridge the gap between new and long-term residents, fostering social cohesion and urban resilience.

Cultural Heritage Preservation

Jinchang's focus on industrial development has historically overshadowed its rich cultural heritage, weakening local cultural identity and emotional connections to place. To rebuild this connection, it is crucial to identify and preserve local historical

and cultural heritage, recognizing both ancient traditions and ongoing local practices. Protecting iconic landscapes and integrating indigenous knowledge with institutional practices can help restore the emotional bonds between people and their environment. Culturally inclusive heritage governance also plays a key role in enhancing community belonging and social integration, ensuring that all residents participate in the identification and preservation of cultural assets.

Cultural Landscape Restoration

Jinchang's historical and cultural roots are deeply intertwined with its unique landscape of deserts, mountains, and oases. These cultural landscapes not only serve ecological functions but also hold historical memories and local identity (Knights, 2014). Therefore, ecological restoration must include the recognition and rehabilitation of cultural landscapes, serving as a means to reconnect social-ecological systems and revive historical cultural significance.

Ecological Watershed Restoration

The industrial activities in Jinchang are closely linked to broader-scale ecological degradation. Human activities within the watershed have led to the degradation of natural grasslands and the conversion of these areas into industrial lands, while excessive water usage has accelerated desertification. Given Jinchang's location between arid desert regions, watershed-scale ecological restoration—such as the rehabilitation of rivers and wetlands—is vital for improving urban environmental quality and enhancing ecological resilience.

Inclusive Economic Transition

Economic transformation in Jinchang must prioritize both inclusivity and diversification, ensuring that all stakeholders participate in the transition process and benefit from economic growth (Inclusive Growth for Cities, n.d.). Mechanisms such as stakeholder engagement and workforce participation are necessary to guarantee social equity during economic restructuring, promoting broader social inclusion and reducing inequality.

Adaptive Reuse of Industrial Heritage

The adaptive reuse of industrial heritage is a powerful strategy to achieve economic, social, and environmental sustainability. It can activate underutilized spaces, foster economic diversification, and promote cultural revival (World Economic Forum, 2025). Ideally, the reuse of industrial sites not only contributes to community revitalization and multi-value creation but also integrates with ecological restoration efforts. Given that much of Jinchang's industrial land is situated along former riverbeds, aligning industrial site reuse with watershed ecological restoration can enhance environmental quality and promote equitable public service access.

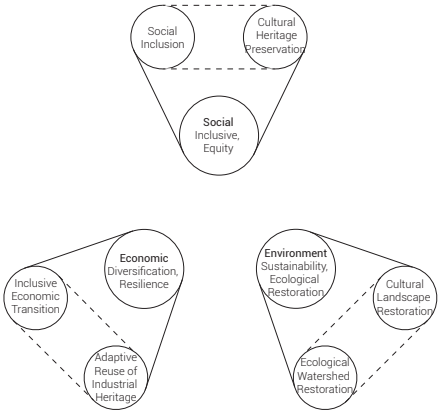


Figure: Strategic approach for sustainability transition of resource-based city, Jinchang (Source: Drawn by the author)

Gear Synergy

The framework emphasizes the synergy between cultural landscape restoration, industrial heritage reuse, and ecological rehabilitation. Through cultural landscape restoration, emotional attachment to place is reestablished, strengthening community identity and connection. Integrating adaptive reuse of industrial heritage with watershed ecological restoration not only enhances environmental quality but also preserves cultural values. This coordinated strategy promotes mutual benefits between ecological restoration and improved living conditions.

Additionally, the approach includes the local adaptation of industrial transformation, focusing on upgrading industries based on existing resources and economic foundations while ensuring local communities benefit from this development. The interactive dynamics of the economic, ecological, and social strategic gears enhance the city's resilience against risks and increase its capacity to navigate future uncertainties.

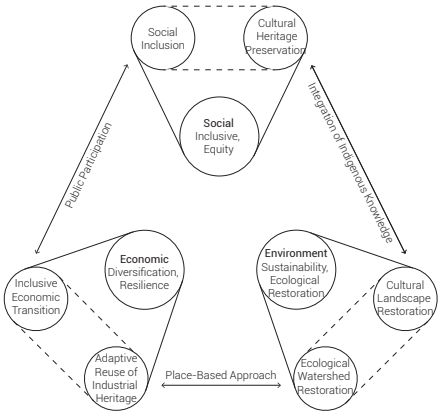


Figure: Gear synergy of resource-based city, Jinchang (Source: Drawn by the author)

Addressing Uncertainty

The path to sustainable development is inherently dynamic and filled with uncertainties, making it impractical to rely solely on linear policy pathways. In the face of climate change, variations in regional precipitation, accelerating desertification, shifts in global economic and political landscapes, technological advancements, and population mobility driven by urbanization, cities must adopt adaptive scenario planning (Abou Jaoude et al., 2022) and Dynamic Adaptive Policy Pathways (DAPP) (Haasnoot et al., 2013). These methodologies allow cities to navigate deep uncertainties through flexible, resilient strategies.

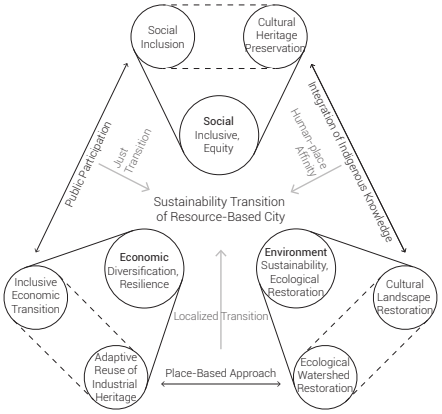


Figure: Synergistic effects between strategies, Jinchang (Source: Drawn by the author)

Three Scenario Types and Three Dynamic Sustainable Futures

This study draws on Dutch scenario planning practices to explore sustainable futures for Jinchang:

The Ecological priority scenario focus on responding to economic uncertainty and supporting community building and social equity.

The Market-oriented scenario explore responses to ecological uncertainties under climate change, highlighting market-driven solutions and technological adaptation.

The Social needs-oriented scenario focus on managing population mobility caused by urbanization, giving priority to orderly governance and social stability.

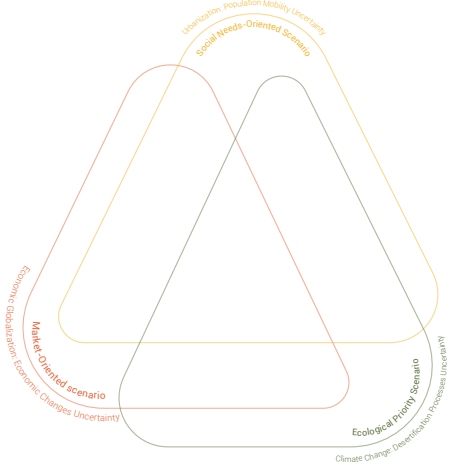
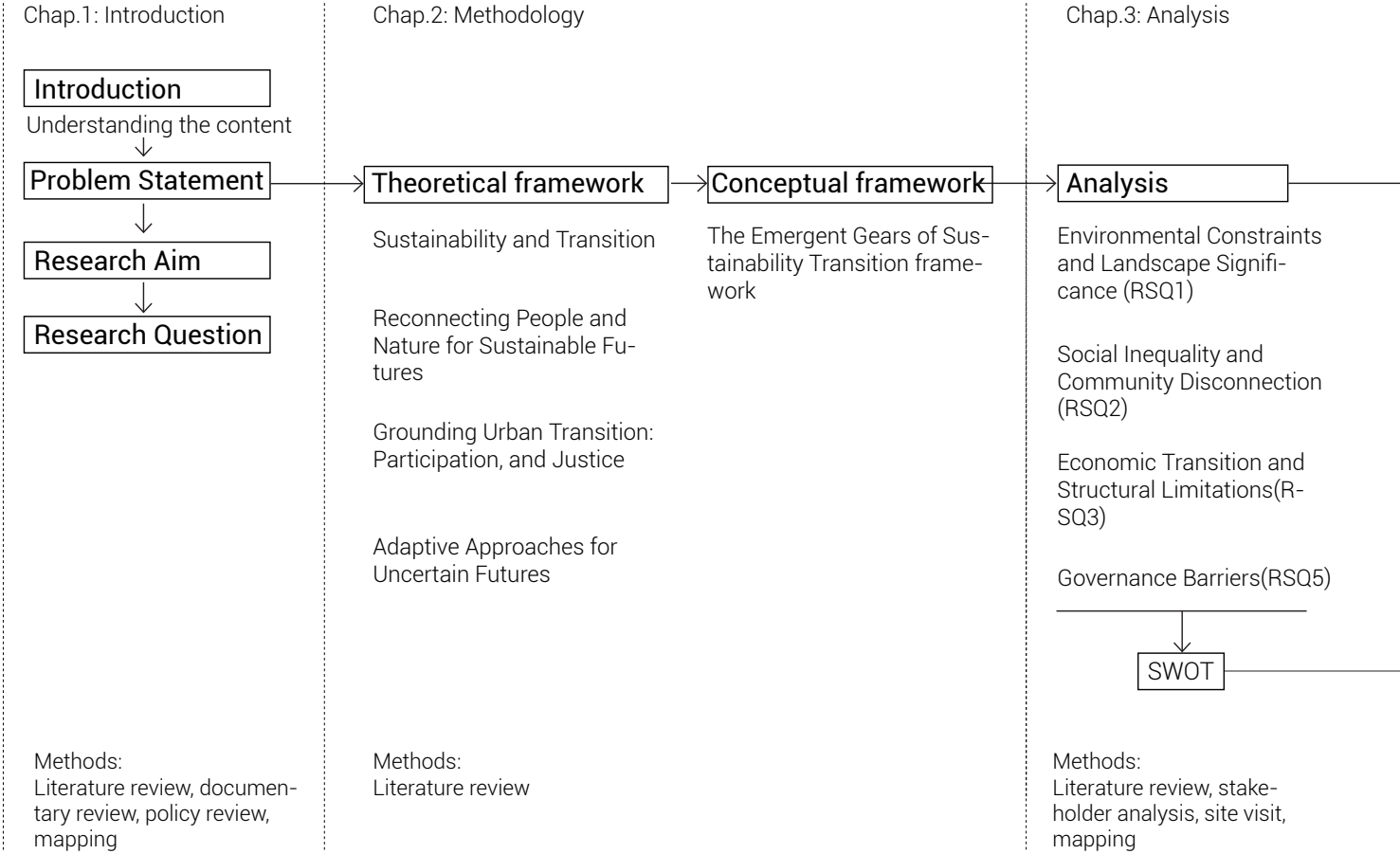


Figure: Three scenarios for resource-based city, Jinchang (Source: Drawn by the author)

2.3 Methodology framework

This research adopts a constructivist perspective, positing that urban development issues and future scenarios are not objective or neutral but are instead socially constructed through the interactions of different stakeholders, shaped by cognition and power dynamics. In exploring sustainable urban transition pathways, this study draws on Campbell's understanding of sustainable development: it is not a static endpoint but a dynamic process of resolving conflicts and progressing amidst tensions.

The challenges faced by Jinchang City are the result of intertwined social, economic, and environmental factors, positioning the city as a dynamic and complex system. Its future is not defined by a single optimal path but emerges from multiple possible trajectories driven by diverse value orientations. Based on this understanding, the research adopts systems



thinking to define the boundaries of the problem and incorporates horizontal (environment, economy, society), vertical (multi-level governance), and temporal (history–present–future) dimensions to understand the challenges and opportunities within the urban system.

In terms of methodology, the study integrates qualitative and quantitative approaches through field surveys, semi-structured interviews, and observations to collect primary data. It employs stakeholder analysis and narrative mapping to understand the perceptions, expectations, and underlying value logics of different groups regarding their "ideal future." Based on this analysis, the study further develops Scenario Planning to construct diverse future development pathways.

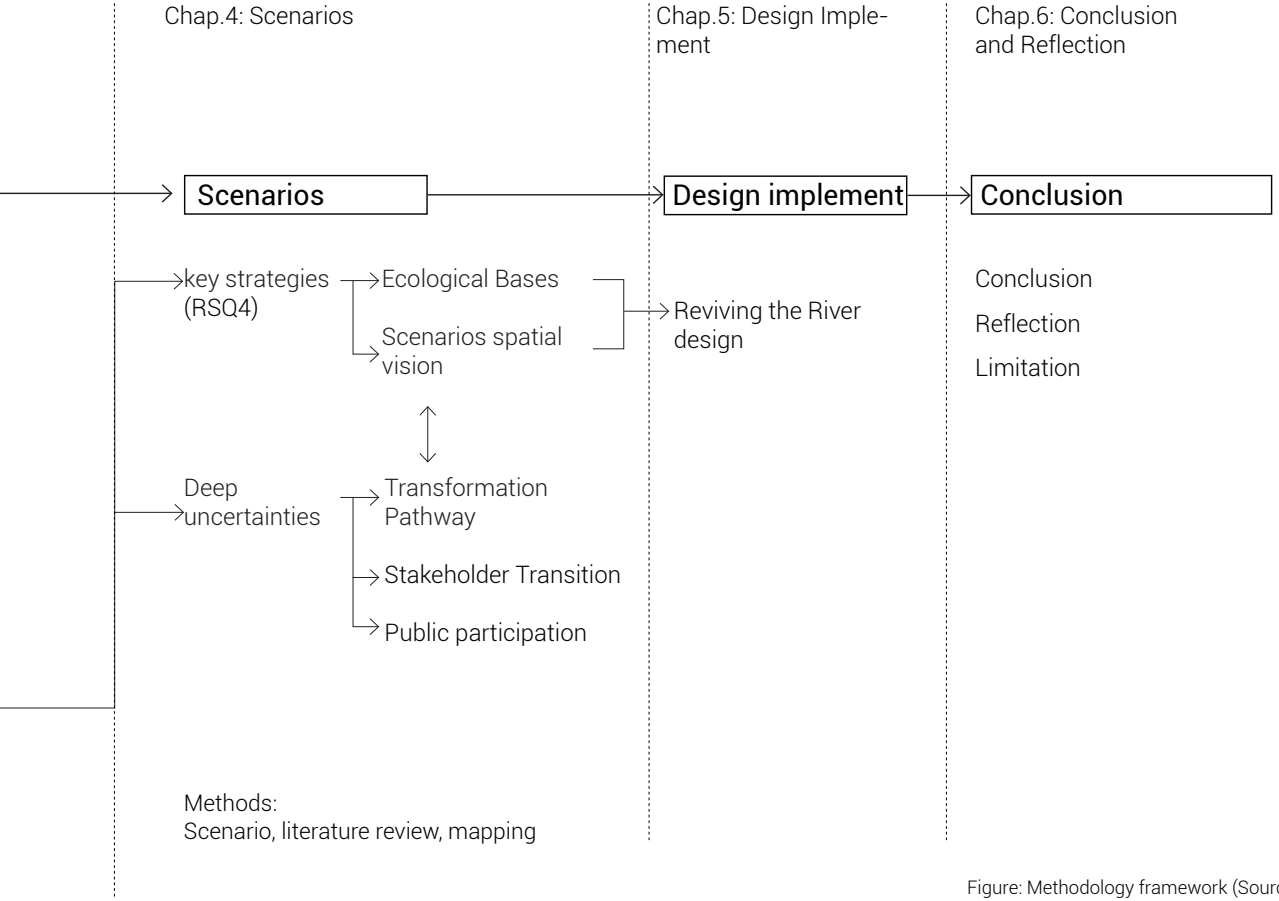


Figure: Methodology framework (Source: Drawn by the author)

3 Analysis

3.1 Analytical Framework

A cross-scalar analysis forms the analytical framework and design foundation of this project. By examining the regional, watershed, urban, and neighborhood scales, and integrating traditional and current modes of production and daily life, the project explores the possibilities of re-planning.

XL scale - Desertification restoration

This level responds to the issue of desertification driven by degradation in the Shiyang River Basin.

At the regional scale, the planning scope is expanded based on geomorphological and natural resource characteristics.

Environmental protection measures are considered not only from an ecological perspective but also in terms of their economic and social implications. This provides a new, integrated perspective that combines watershed conservation and desertification control, forming the foundation for exploring different transformation scenarios.

L scale - River protection

This scale is defined by the Shiyang River Basin, including the watershed of its tributary, the Jinchuan River. Jinchang City is located in the middle reaches of the Jinchuan River.

It serves as the foundation for exploring different scenario visions, with a primary focus on Jinchang City and its relationships with surrounding cities and the broader region.

M scale - Spatial and social segregation

This scale is defined by the built-up area of Jinchuan District and the administrative boundary of Jinchang City. The built-up area of Jinchuan District serves as the implementation boundary for spatial design, while the administrative boundary of Jinchang City functions as the analytical boundary, as most data are collected at the municipal level.

The focus is on socio-spatial segregation and, in relation to the city's spatial form, the exploration of adaptive strategy implementation.

S scale - Spatial quality

At the community scale, both urban and rural production and living areas are included.

The focus is on improving and transforming spatial quality, and this scale also serves as a platform for exploring the integration of traditional ways of life with modern ecological restoration techniques.

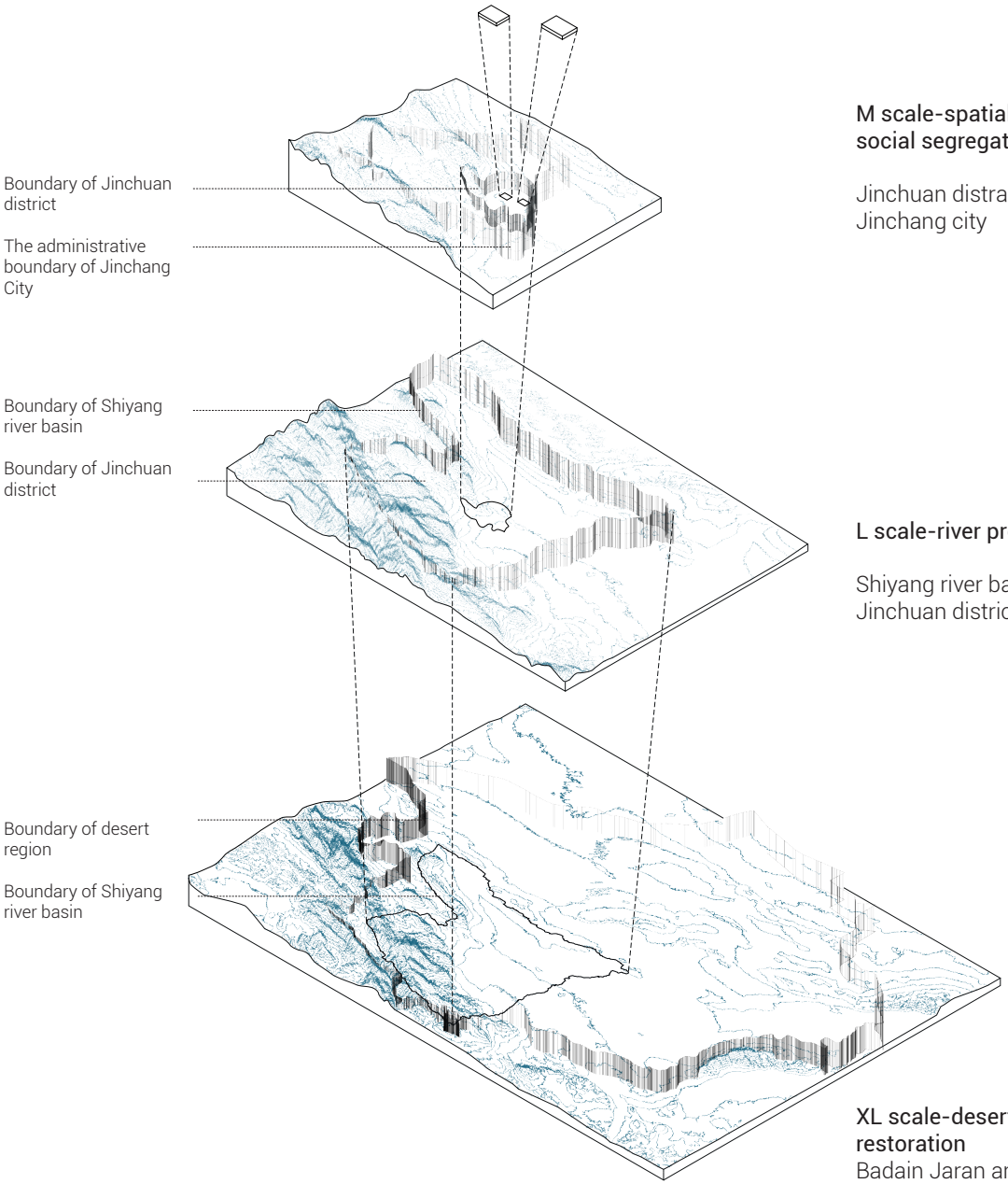


Figure: Analytical framework (Source: Drawn by the author)

3.2 Environmental Constraints and Landscape Significance

This section identifies the key ecological and environmental constraints affecting Jinchang's urban development and emphasizes the landscape value and environmental foundations that should be prioritized during future transformation. Nature is no longer merely seen as a backdrop but as an organic component of a sustainable future.

Mechanisms of Ecological Degradation

Jinchang is located in the arid region of Northwest China, facing typical environmental vulnerabilities and resource pressures. The city is nestled between the Qilian Mountains and the Badain Jaran Desert. Its unique geographical conditions mean that urban development must contend with natural constraints such as land desertification, water scarcity, wind erosion, and extreme climate events. The Shiyang River Basin ecosystem, where Jinchang is situated, has long suffered from human modification and development pressures. The Jinchuan River, which once supported urban growth, is now nearly dried up. Natural water systems have been disrupted, groundwater levels have dropped, and grasslands have widely degraded.

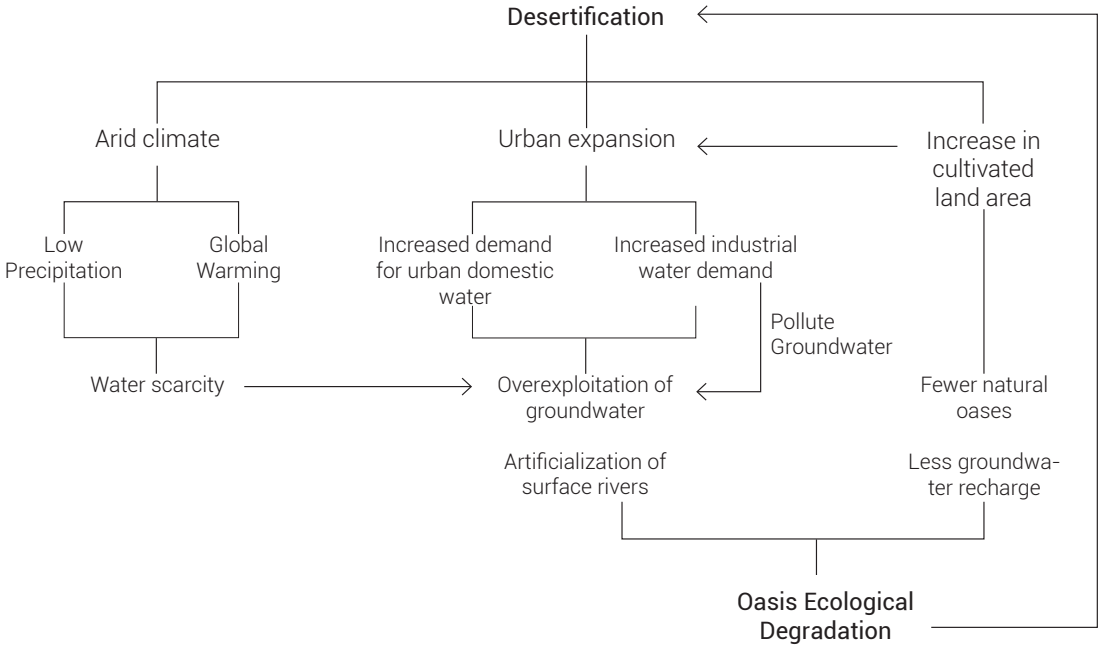


Figure: Mechanisms of ecological degradation (Source: Drawn by the author)

Natural water cycle of the watershed

The water cycle of the Shiyang River Basin is primarily influenced by its arid climate and fragile ecological conditions.

The basin's water sources mainly originate from precipitation and snowmelt in the Qilian Mountains, which flow into the river system, providing essential water resources for agriculture, industry, and urban life. Due to the arid climate, abundant sunshine, high surface water evaporation rates, and limited rainfall, water resource availability is a critical concern.

Water usage is primarily concentrated in the middle and lower reaches of the river, where farmland expansion hinders natural water infiltration, reducing groundwater recharge. Additionally, the artificial modification of the river system to supply water for irrigation and urban needs further disrupts the natural hydrological balance.

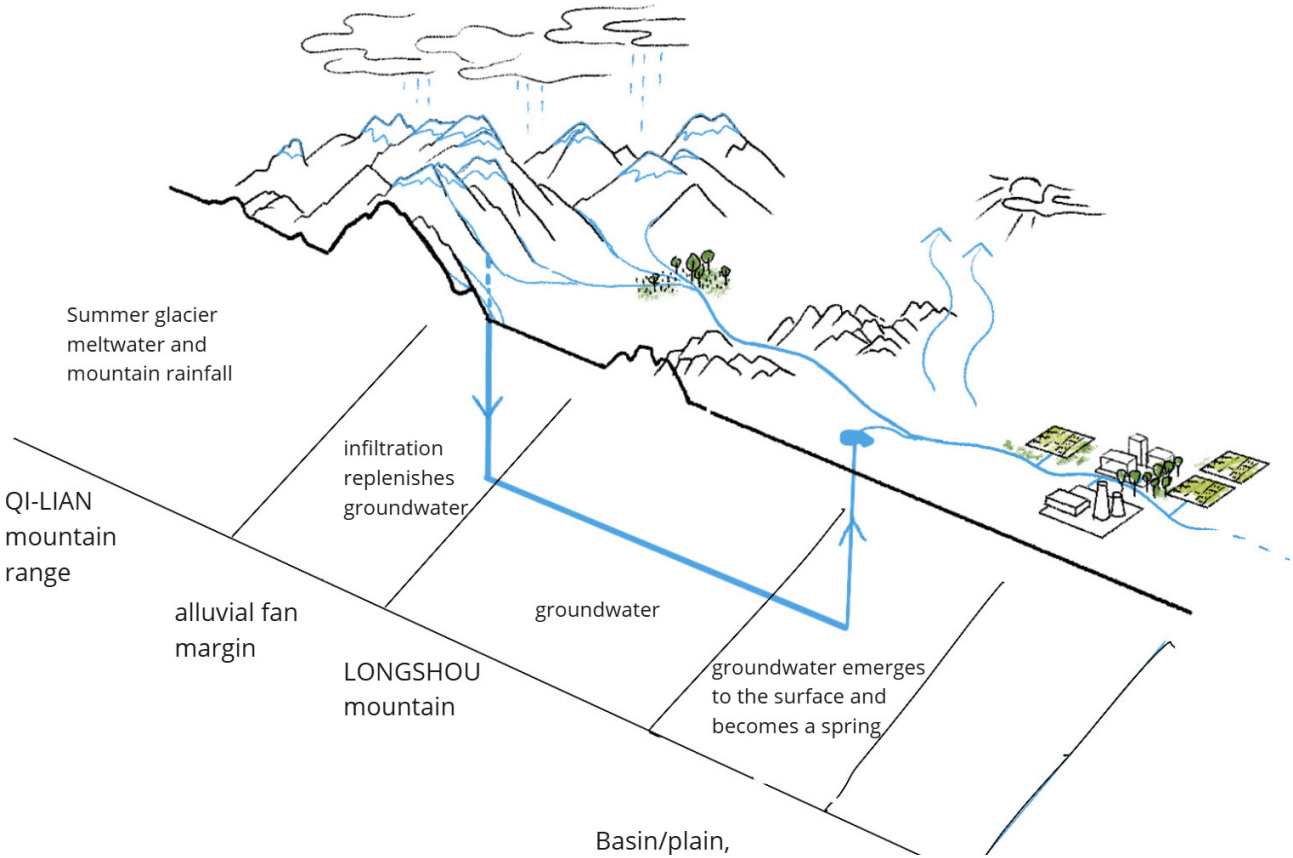


Figure: Natural water cycle of the Shiyang river basin (Source: Drawn by the author)

Disconnection Between the City and Nature

The relationship between the city and its natural environment has long been in a state of "disconnection." During its initial development, Jinchang viewed nature merely as an inexhaustible resource base. Urban spatial expansion primarily revolved around industrial production functions, neglecting the carrying capacity of natural systems. To cope with extreme sandstorm weather, the city planned protective forest belts to encircle the urban area, further intensifying its isolation from the environment. This development model, guided by the notion of "conquering nature," along with a planning mindset that views nature as a threat, has caused the city to become spatially disconnected from the surrounding desert, mountains, and rivers.

As shown in the figure on the right, the city is spatially enclosed by distinct landscape and industrial elements on all sides. To the north, shelterbelt forests serve as a natural buffer. On the west side, industrial zones form a barrier separating the urban area from the nearby mountains. To the east, the presence of industrial waste dumps and expansive solar panel fields further reinforces this separation.

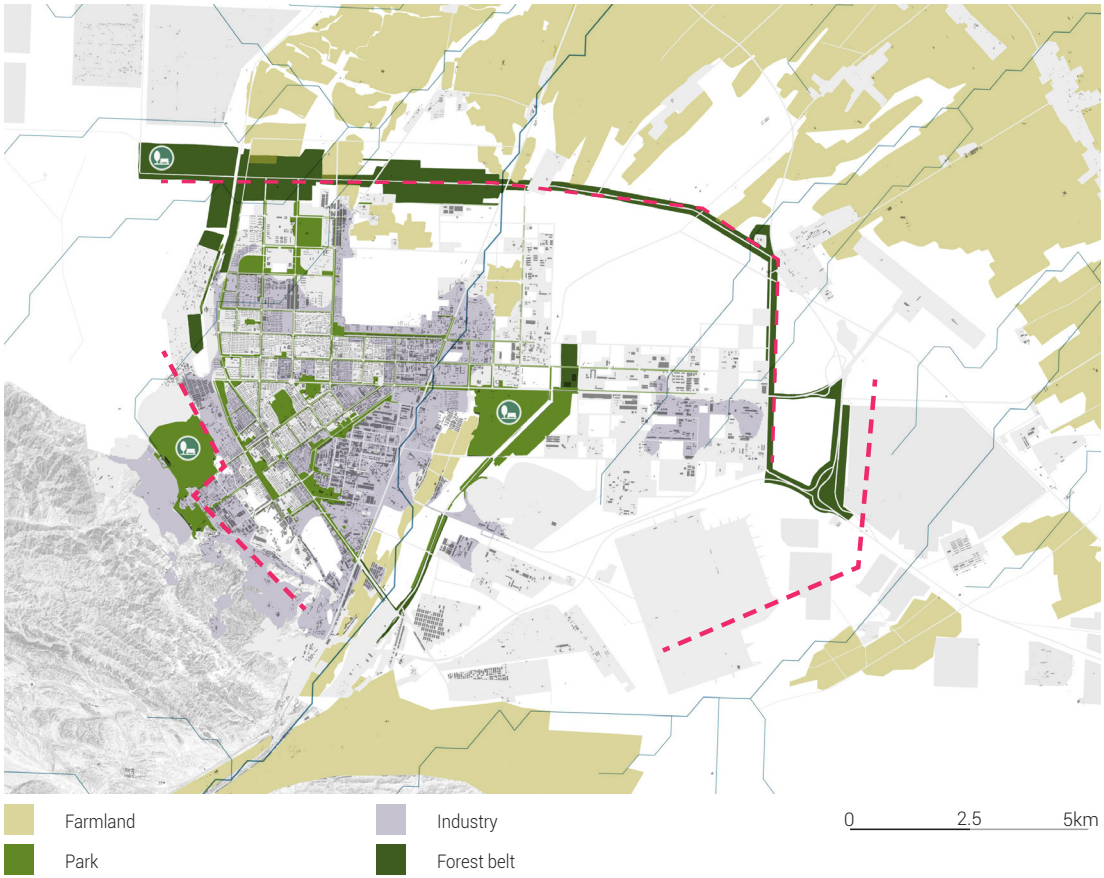


Figure: disconnection between city and nature (Source: Drawn by the author)

Potential for Natural Landscape Restoration

Nevertheless, Jinchang's natural landscapes and ecological heritage still hold potential for transformation. On the one hand, the Qilian Mountain's snowmelt water system is terrain-dependent, and the Shiyang River Basin's natural grassland degradation is traceable, suggesting a foundation for ecological restoration. On the other hand, the local community and broader Chinese culture still maintain a sense of identity and expectation for the concept of a "desert oasis," providing a cultural basis for ecological "reconnection."

Landscape, Memory, and Human–Land Connection

Looking beyond the recent industrial history, the relationship between people and their surrounding environment has played a central role in shaping this region. The landscape itself has profoundly influenced local history, forming what can be understood as a cultural landscape—deeply embedded in emotional connections between people and place. These connections are most vividly preserved in the traditional rural lifestyles that now receive little attention in mainstream urban planning.

Learning from history, we can identify several key periods that continue to carry meaning for the city and its broader region. The early settlements, dating back 3,000 to 4,000 years, indicate the formative role of natural desert-oasis landscapes in shaping initial human habitation. During the frontier defense era, the region was marked by watchtower relics and the poetic legacy of riding through desert expanses. The traditional rural ways of life—evolving over centuries—remain a living testament to this long-standing human–land relationship. These historical layers offer valuable opportunities to restore emotional and cultural connections between people and the landscape.

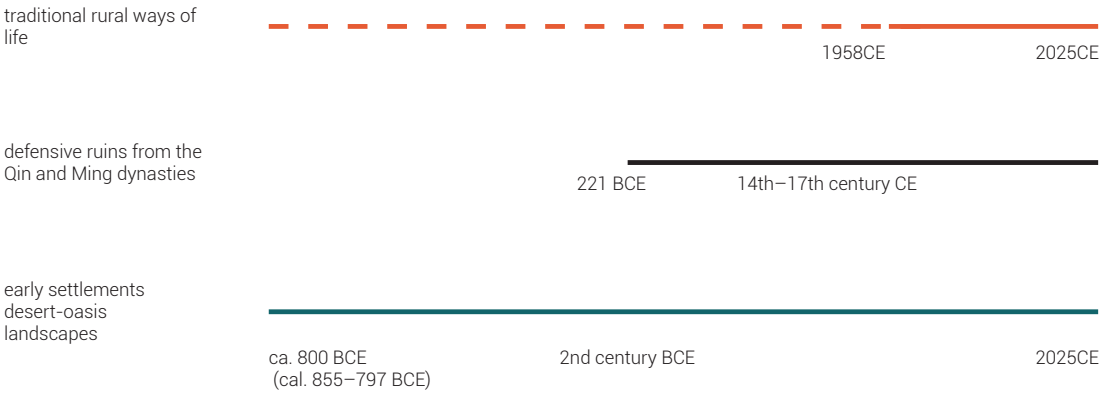


Figure: Diagram of key historical periods (Source: Drawn by the author)

Integration into Silk Road Tourism

Although Jinchang lies along the historic Silk Road and shares in the rich legacy of the Hexi Corridor, its key heritage sites are mainly located in Yongchang County. Most tourists follow north–south routes to visit Yongchang, while the Jinchuan District remains less accessible—requiring an additional one-hour drive northwest. Preservation and development efforts in Jinchang are still limited, and its historical sites currently lack the appeal to attract significant tourism.

As shown in the diagram on the right, the natural topography forms a corridor between the Mongolian Plateau and the Tibetan Plateau, creating a passage connecting the inland Central Plains with the West—known as the ancient Silk Road. Jinchang City (marked by the red triangle in the diagram) is located within this Silk Road region.

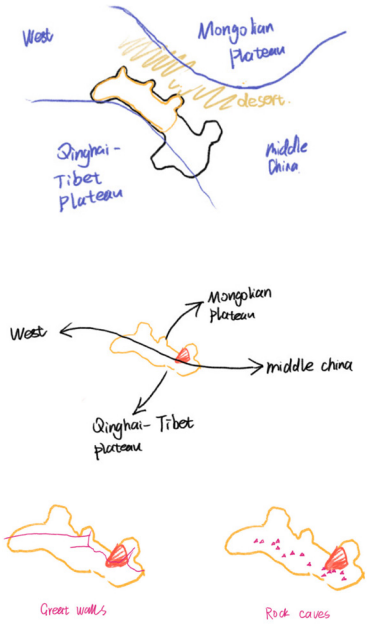


Figure: Formation logic of ancient silk road and heritage sites (Source: Drawn by the author)

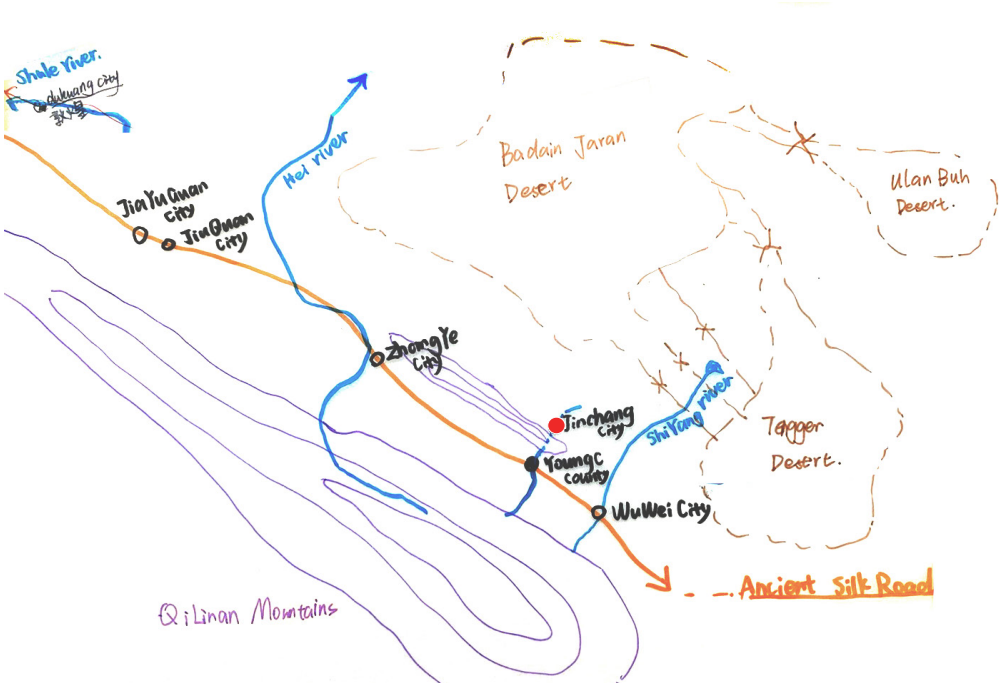


Figure: Diagram of Jinchang city's relationship to the silk road (Source: Drawn by the author)

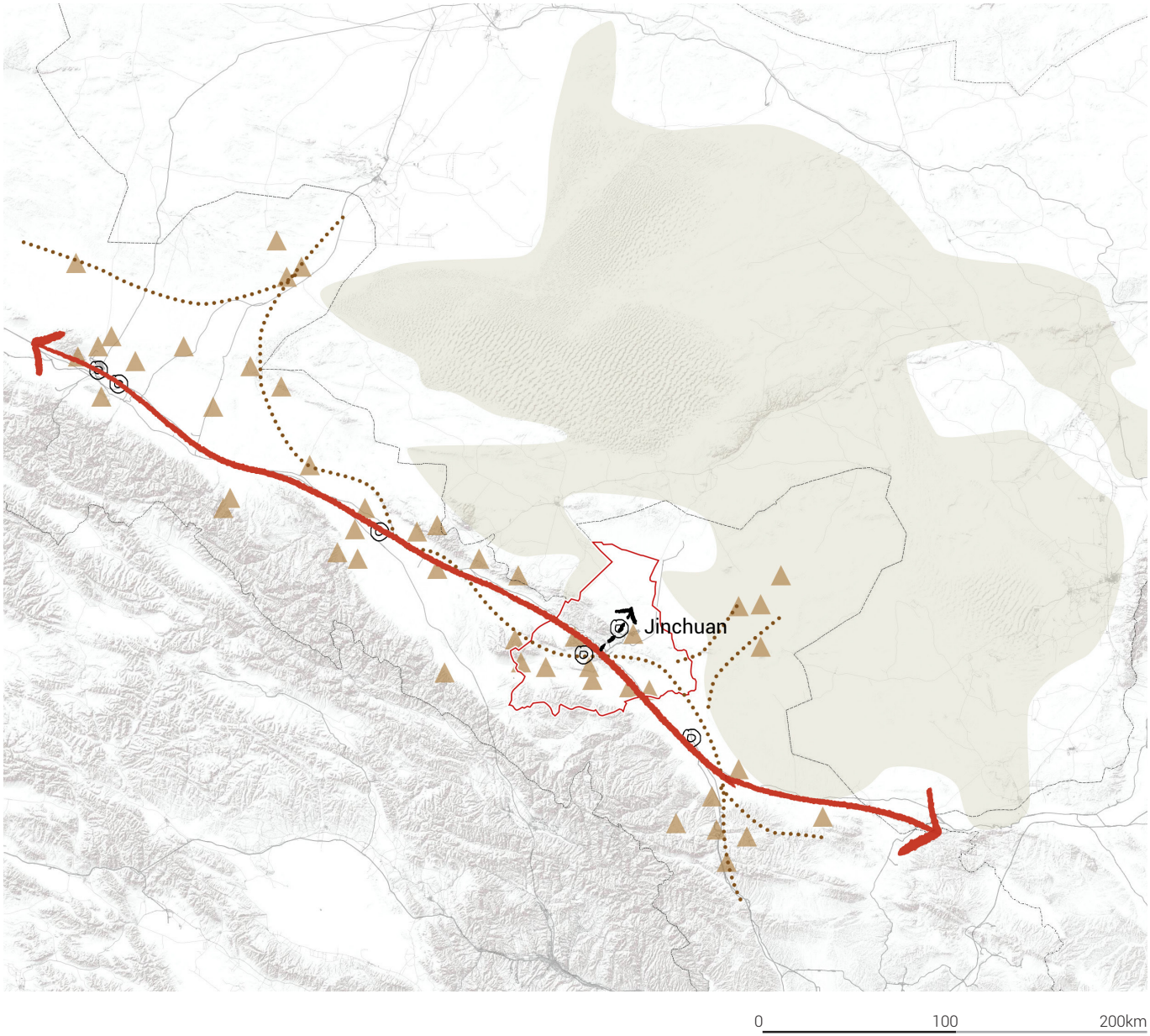


Figure: Heritage sites on the ancient silk road (Source: Drawn by the author)

Indigenous Agricultural Practices and Lifestyles

Taking Jiagou Village in northern Jinchang as an example, a comparison is made using Google satellite imagery from 2000 and 2024. The selection is based on both the clarity of image data and the preservation of traditional production and living landscape patterns.

Figure: Location of Jiagou village (Source: Drawn by the author)

Spatial relationship between villages, rivers, and farmlan

In 2000, a transition from natural river-based irrigation to artificial channels had begun. The imagery still reveals how the seasonal river shaped the landscape and influenced the layout of farmland accordingly. At the same time, the traditional village settlement pattern was beginning to shift toward a more standardized, planned layout.

By 2024, the natural river course and its overbank flow areas had become nearly unrecognizable, having been replaced by farmland, irrigation channels, or village roads. Traditional dwellings were largely replaced by newly constructed buildings arranged in a uniformly planned layout.

Farmland

Seasonal flow spread area

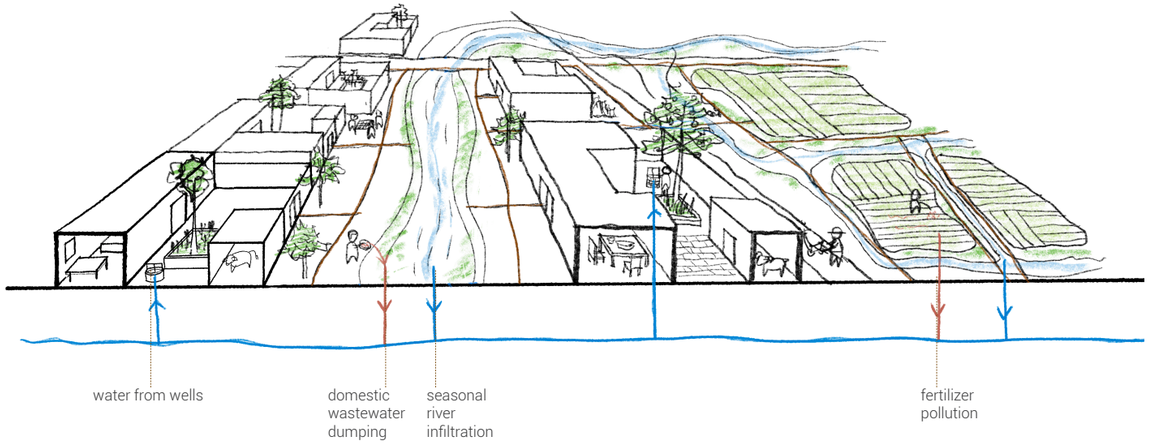
Village roads

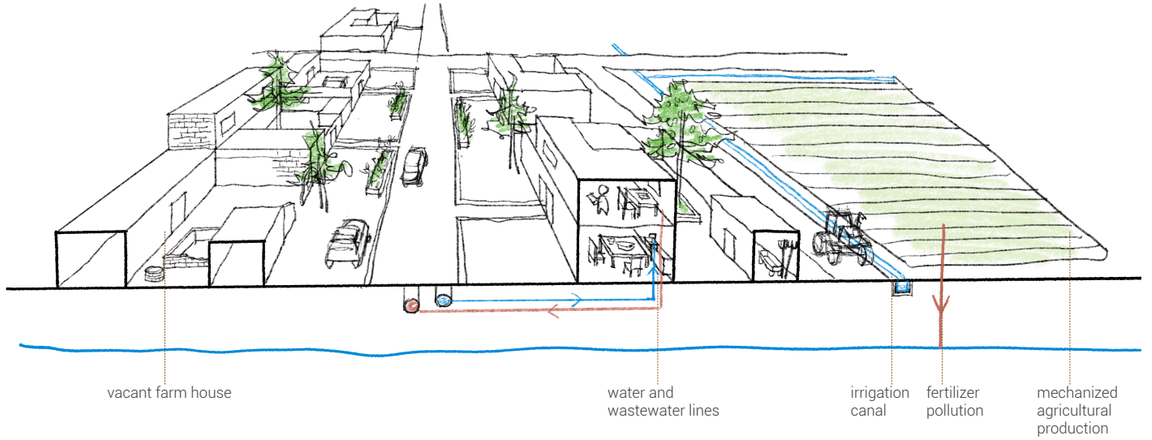
0 200m

year 2000

year 2024

0_40m





Advantages of traditional villages:

Seasonal rivers **naturally infiltrate** the ground, helping to replenish groundwater. **Traditional dwellings** built with plant ash walls offer **good thermal performance**—warm in winter and cool in summer. The traditional way of life also **preserves historical and cultural continuity.**

Disadvantages:

Residents often **discharge domestic wastewater directly into the river**, leading to **water pollution**. **Outdated practices** such as dry toilets and reliance on hand-dug wells create **inconvenience in daily life**.

Advantages of current villages:

Higher agricultural productivity and **improved living conditions** and convenience.

Disadvantages:

Lack of groundwater recharge and **excessive water use**. Uniform village layouts and standardized housing design have led to a **loss of local character**. Modern building materials no longer provide the climate adaptability of traditional dwellings. In addition, the use of **chemical fertilizers** has contributed to **groundwater pollution**.

3.3 Economic Transition and Structural Limitations

Jinchang's economic transition challenges are not only rooted in external resource constraints and locational disadvantages but also deeply reflect structural barriers such as institutional path dependency, governance inertia, and outdated planning mindsets. If these issues are not systematically addressed, they will directly limit the expansion of sustainable pathways in the future.

The Dilemma of a Nickel-Dependent Economic Structure

Jinchang's economic structure is heavily dependent on mineral resource development, particularly mining and metallurgy centered on nickel. Known as China's "Nickel Capital," the city has long focused its urban and industrial planning around the state-owned leading enterprise—Jinchuan Group. This company once accounted for over 80% of the nation's nickel production. However, this single-resource-dependent development model has made the city's economy highly vulnerable to fluctuations in the global nickel market and technological advancements in the industry. In recent years, Jinchuan Group's market share and technological advantage have gradually weakened, impacted by international competition, the global shift towards green energy, and changes in domestic industrial policies, leading to a continuous decline in the city's overall economic vitality.

The Fragility of Emerging Industries and the Risk of Path Dependency

Amid the decline in economic vitality, the local government proposed driving industrial transformation through investment attraction, aiming to cultivate new growth points represented by emerging industries such as new energy (e.g., photovoltaics, energy storage), modern agriculture, and cultural tourism. However, field surveys and desk research reveal that the spatial location, resource matching, and policy support for these new industries often suffer from poor implementation and a lack of localization, resulting in limited development effectiveness.

Geographical Barriers

Jinchang's geographical location also poses obstacles to its transformation. The city is far from major national economic corridors, with inadequate transportation infrastructure and high logistics costs, diminishing its comparative advantage in emerging industry layouts. Furthermore, the weakness in basic service facilities and human resource support limits the city's ability to attract high-value-added industries.

a.Tailings dam

c.Waste slag piling

Figure:
Mining waste dump
(Source: google map, Environmental assessment report of mineral production, Jinchuan Group Co.)

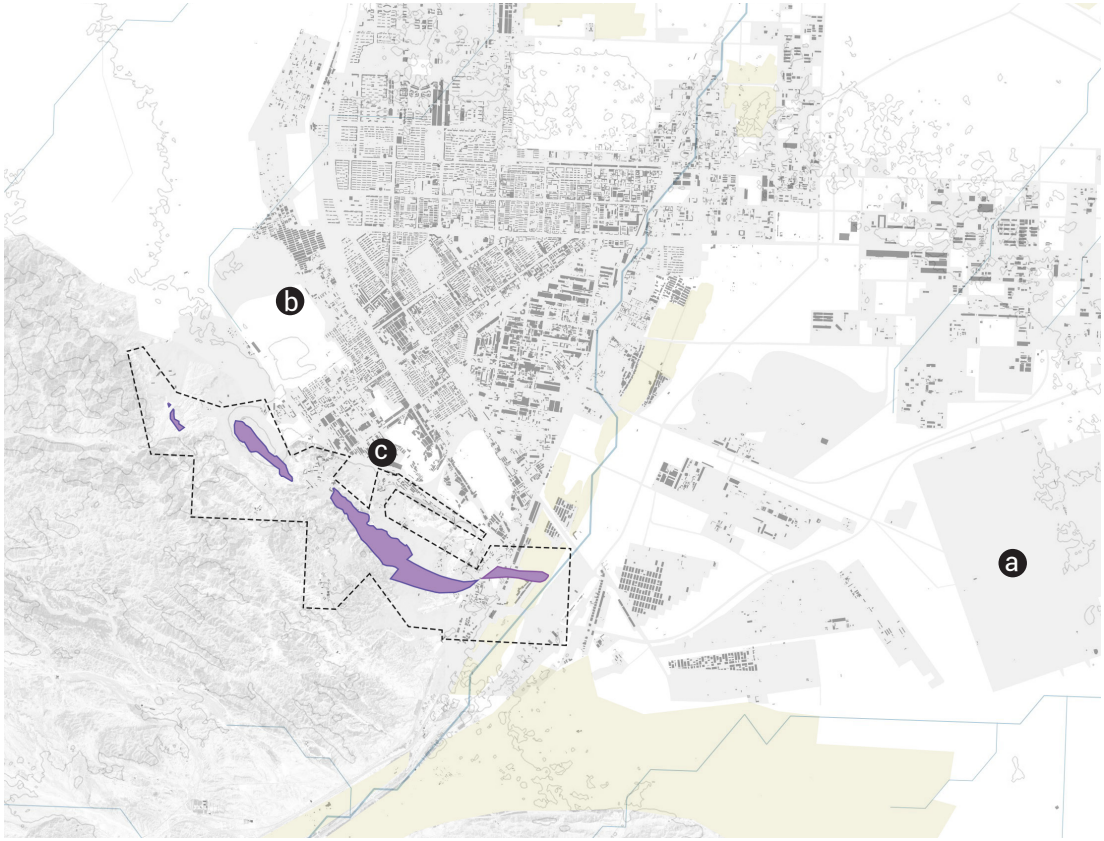


Figure: location of mineral resources (Source: Drawn by the author)

Evaluation of Local Government's Economic Transition Strategies

The city's internal economy is highly dependent on the benefits brought by a single enterprise, resulting in evident fractures between the "economic dominant class" and marginalized groups. The urban spatial structure is solidified under the traditional industrial layout, making it difficult for new industries and new forms of employment to grow freely within the existing land and institutional framework. Some flexible and adaptive economic spaces, such as markets and street bazaars, have been removed or relocated to peripheral areas due to urban development policies, limiting the city's capacity to embrace diverse and grassroots economic forms.

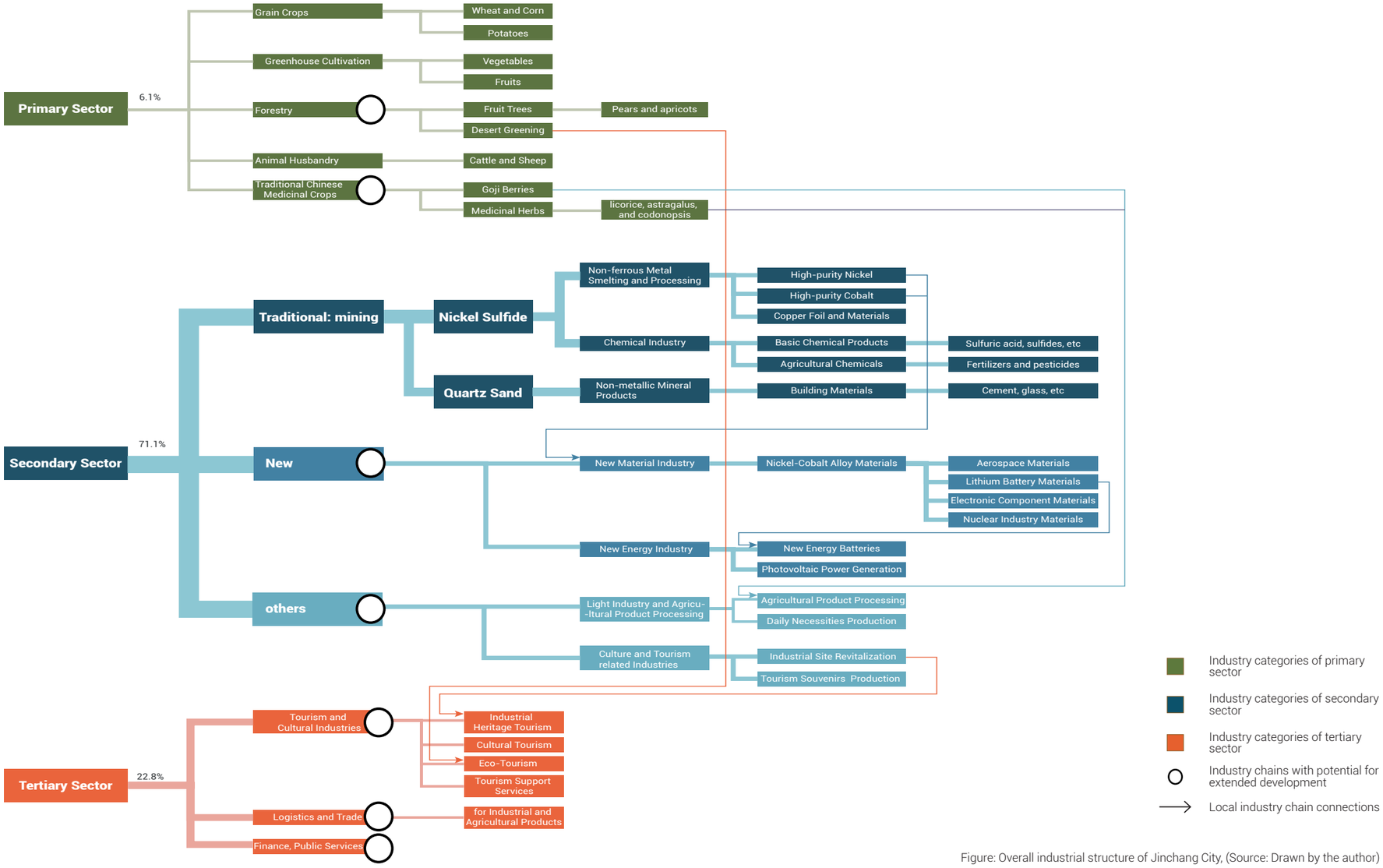


Figure: Overall industrial structure of Jinchang City, (Source: Drawn by the author)

3.4 Social Inequality and Community Disconnection

The challenges faced by Jinchang's social system are not limited to population decline or labor loss, but more deeply rooted in the erosion of social trust and sense of belonging. This state of a "city without a sense of connection" may further weaken the foundation of public life and community support networks, becoming a hidden obstacle on the path to transformation.

Social Stratification

Urban development has not only brought changes to spatial forms and economic structures but has also profoundly affected the social structure and lifestyles of residents. In Jinchang, the economic structure's singularity and the industrial-oriented development model, while contributing to economic prosperity, have also created significant social stratification and inequality. Research findings indicate a clear income gap between high-income groups dependent on state-owned enterprises and those engaged in service industries, agriculture, and other informal employment. The distribution of transformation dividends is highly uneven.

Population Outflow and Distrust in the Future

With the decline of traditional industries and the intensifying trend of population outflow, the notion of "leaving home through higher education" has almost become a mainstream mindset among the city's youth. Long-term residents often instill in their children the idea of "study hard and leave Jinchang." This value orientation reflects a lack of confidence in the city's future and exposes the social reality that Jinchang has failed to provide a stable, fair, and predictable living environment. During interviews, residents frequently mentioned the impact of climate conditions on their quality of life. Frequent sandstorms, dry air, extreme heat, and water scarcity are particularly prominent in daily life, intensifying negative perceptions of the city's livability and further driving the choice to "leave here."

Population Vitality Brought by Urbanization

Despite the continued outflow of long-term residents, Jinchang has also attracted agricultural populations from surrounding rural areas during the process of regional urbanization. These new residents usually come to the city seeking better employment opportunities and more comprehensive public services. Most of them engage in labor-intensive jobs such as construction, sanitation, and logistics, or maintain their livelihoods through running shops or street vending.

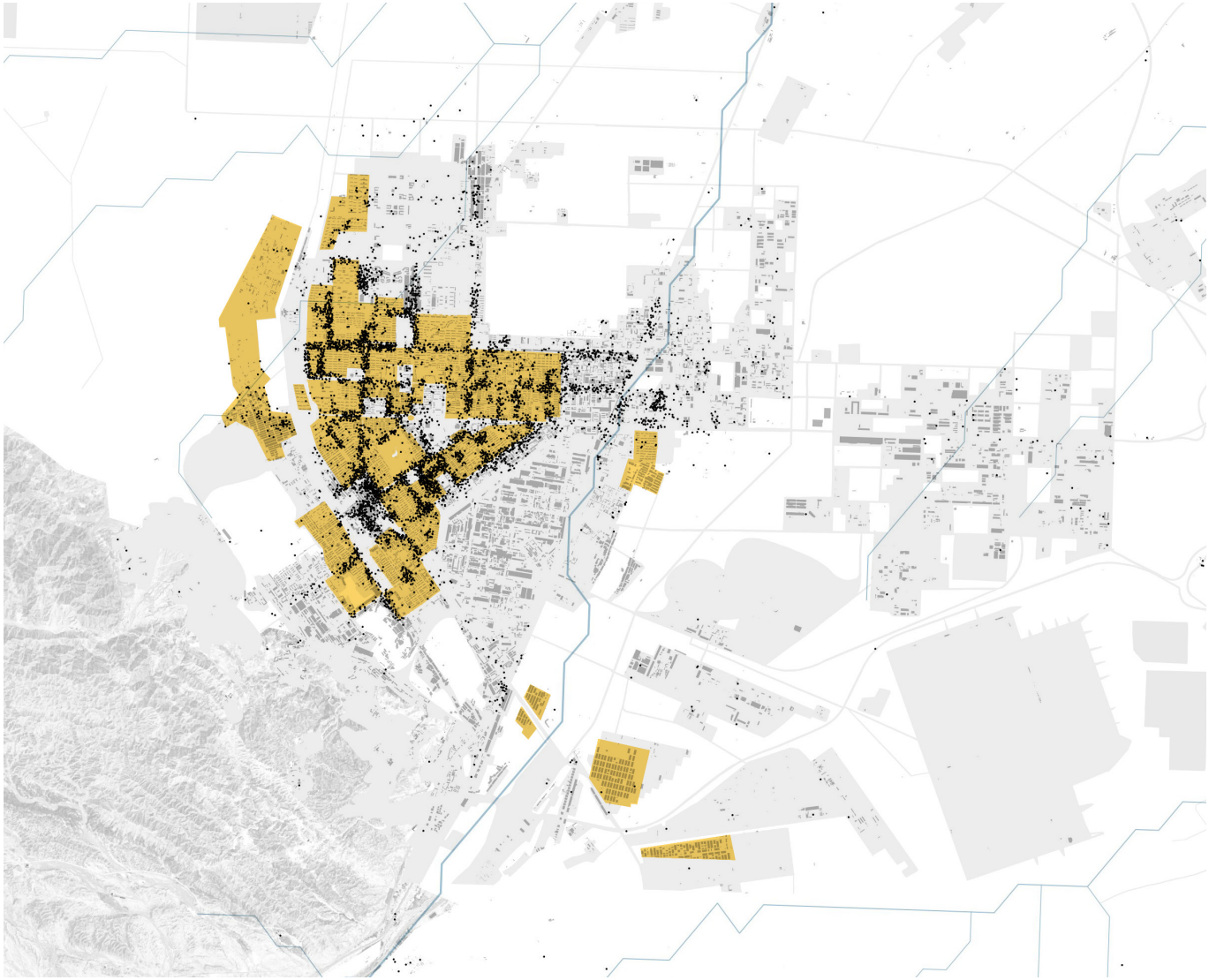


Figure: Distribution of public service facilities, (Source: Drawn by the author)

Social Exclusion and Functional Segregation in Spatial Use

These groups are often the "overlooked" in urban development and planning, lacking formal recognition and spatial security. Under urban renewal and city beautification policies, markets and street spaces that once concentrated flexible employment groups have been dismantled or relocated to the city's periphery. This not only weakens their economic livelihood opportunities but also limits their process of social integration. These new residents usually live in peripheral areas of the city where rent is low, but environmental quality is poor and infrastructure is inadequate, further exacerbating class stratification and social exclusion in urban spaces, both in terms of function and symbolism.

Residents' Perceptions of the City's Future

The lack of social participation mechanisms is also a key reason for urban fragmentation. Most urban planning and development decisions are still made in a top-down manner, leaving residents—especially marginalized groups—without channels to voice their opinions or opportunities to participate in the city's spatial future. This places them in a position of being "planned for" rather than actively participating in urban transformation, making it difficult for them to share in the benefits of future development.

3.5 Institutional and Governance Barriers

The numerous challenges faced by Jinchang are not only rooted in ecological, economic, and social systems but also stem from the failures and disconnections of planning mechanisms, governance structures, and policy implementation. Against the backdrop of China's territorial spatial planning reform, although institutional alignment has been achieved through "multi-plan integration" and unified base mapping, planning practices still adhere to outdated concepts and operational paths.

Disconnection Between Planning and Environmental Realities

At the regional level, the national ecological security pattern planning aimed at combating desertification and the ecological protection planning of the Shiyang River Basin are led by different levels of government. These plans are formulated independently, with varying standards and often misaligned with the actual natural resource boundaries. This "administrative boundary-oriented" planning system overlooks the integrity of ecosystems, making effective regional collaborative governance difficult to achieve.

On the urban level, although territorial spatial planning has been compiled, its content still reflects the traditional logic of "economic growth as the core and nature as a controllable resource." It continues the previous land allocation model centered around leading industries, failing to account for the ecological constraints and long-term sustainability of natural systems.

Opportunities for Planning System Reformn

Nevertheless, institutional reform presents new opportunities for Jinchang's sustainable transition. On the one hand, during the "gap period" before the full implementation of the new round of territorial spatial planning, there is potential to reorganize regional-scale challenges, integrate multiple plans, and establish multi-level ecological management strategies. On the other hand, to address uncertainties and transition challenges, Jinchang can draw on adaptive planning approaches to build a more open, inclusive, and uncertainty-friendly planning system. This would facilitate a shift from linear, growth-oriented policies to dynamic, scenario-based strategic planning. Such a planning method, grounded in learning and feedback mechanisms, can inject resilience into the current system and provide institutional support for medium- and long-term spatial transformation.

Overall, Jinchang's governance problems are not merely about a lack of capacity but are symptoms of a misalignment between institutional logic and environmental realities. At this critical stage of sustainable transition, how effectively Jinchang can leverage the policy window of planning system reform to shift from a resource-based development model to an eco-socially coupled governance mechanism will directly influence its potential and direction for future development.

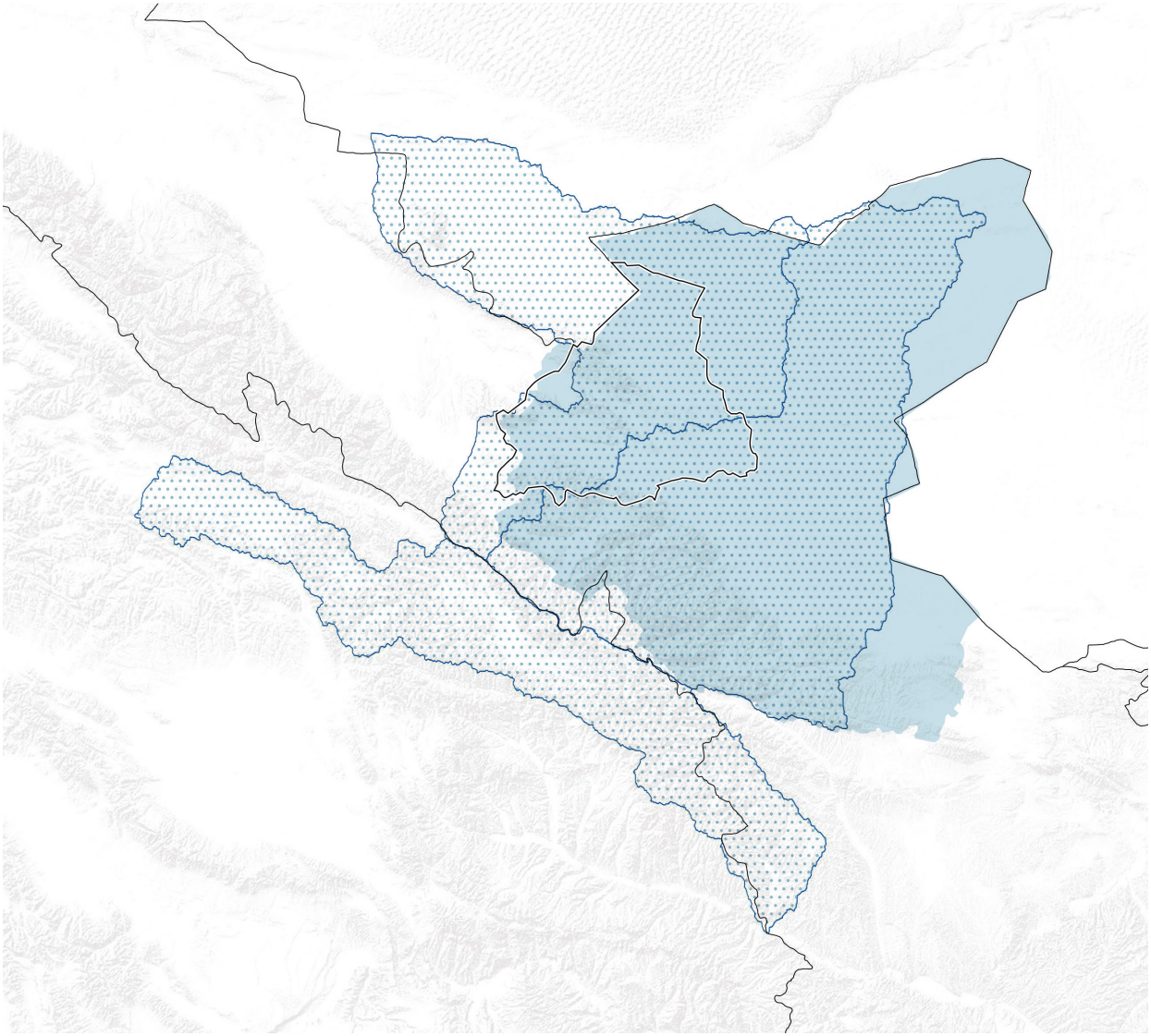


Figure: Shiyang River Basin Protection Planning and basin boundary overlap(Source: Drawn by the author)

Stakeholder analysis

Key Stakeholders:

Local Government and Planning Departments: Focused on economic growth, urban expansion, and policy implementation, but often lack consideration for long-term environmental and social inclusivity.

State-Owned Enterprises (e.g., Jinchuan Group): Major economic drivers controlling infrastructure development and industrial growth, prioritizing resource extraction and industrial output.

Local Residents (including rural populations and urban citizens): Facing pressures from environmental degradation, job reduction, and social segregation, particularly in rural areas isolated by ecological protection zones.

Migrant Workers: Serve as a labor force supplement but remain marginalized, with limited access to urban services and development opportunities.

Environmental and Conservation Organizations: Advocate for sustainable development and ecological restoration, aiming to reduce over-exploitation and pollution.

Investors and Developers: Interested in emerging economic opportunities such as industrial heritage reuse, cultural landscape restoration, and eco-tourism projects.

PUBLIC

1. European Union
2. National / Gansu Provincial / Jinchang Municipal Government
3. National / Gansu Provincial / Jinchang Municipal Forestry and Grassland Administration
4. County and Township Governments in Surrounding Region
5. National /Gansu Provincial / Jinchang Municipal Territorial Spatial Planning Department
6. National / Jinchang Municipal Development and Reform Commission
7. Jinchang Economic and Technological Development Zone Administrative Committee
8. Regional Industrial Park Management Organizations
9. Public Service Agencies (Education, Transportation, Water Supply)

PUBLIC/PRIVATE

1. Jinchuan group Co.

PRIVATE

1. New Energy and High-Tech Enterprises
2. Agricultural SMEs (Small and Medium-sized Enterprises)
3. Service Industry SMEs
4. External Investment Enterprises
5. Banks, Investment, and Financing Platforms
6. Public Tree-Planting Platforms (e.g., Ant Financial)
7. Eco-Tech Enterprises

CIVIC

1. Community Residents Committee
2. Village Collective
3. Urban Residents
4. Farmers
5. Migrants from Surrounding Townships
6. Industry Associations and Chambers of Commerce
7. Volunteers and Social Welfare Organizations
8. Universities and Research Institutes (e.g., Lanzhou University, Gansu Academy of Agricultural Sciences)
9. Vocational Schools (Local Vocational Schools in Jinchang)
10. Media and Cultural Centers

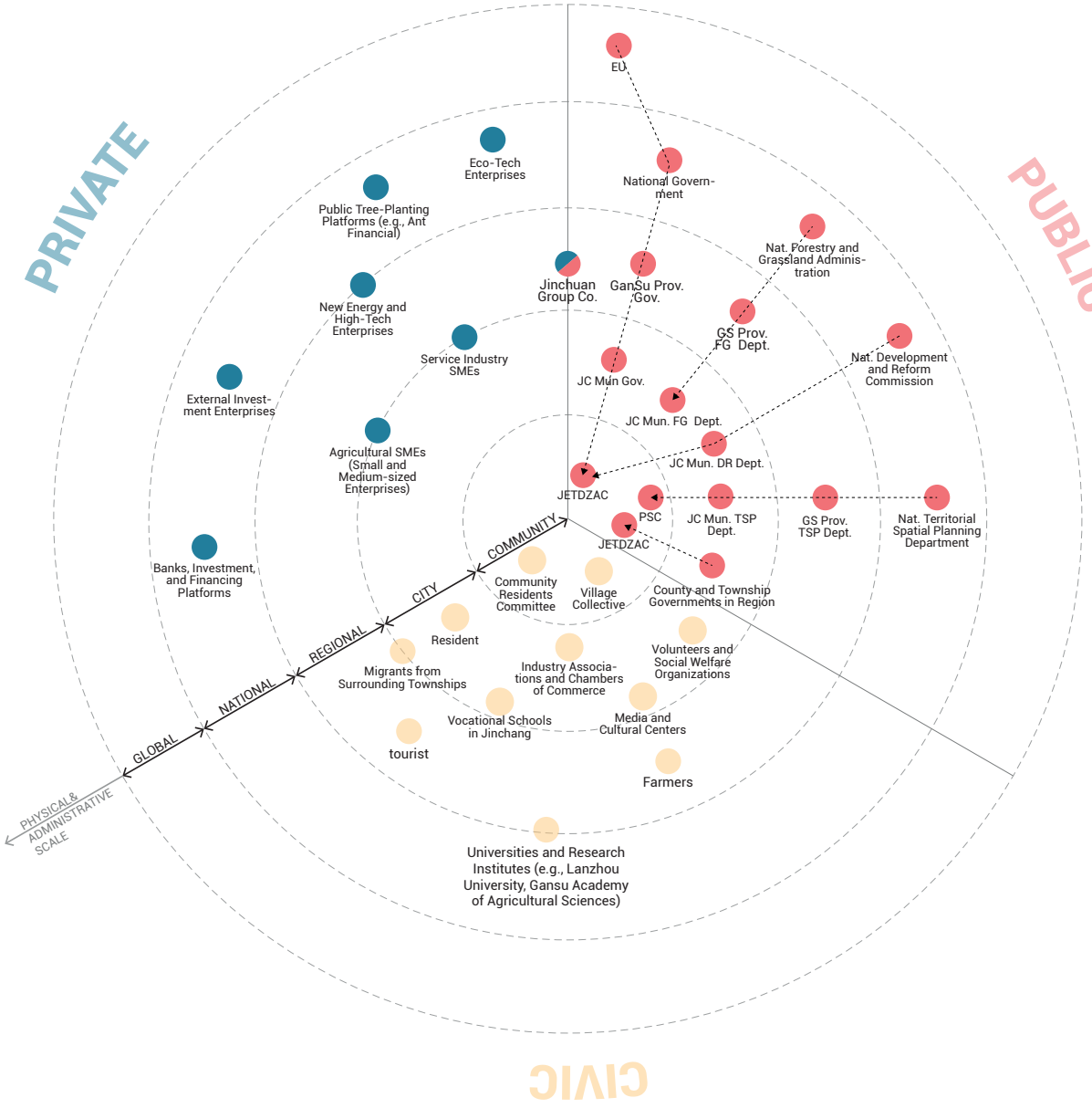


Figure: Stakeholder analysis, (Source: Drawn by the author)

Stakeholder Power-interest analysis

Among the stakeholders mentioned above, there is an intention to shift certain power dynamics.

Vulnerable groups such as migrants and farmers should be given more opportunities to participate in the urban transition.

Although Jinchuan Group holds a dominant position that is difficult to challenge, policy measures can encourage its contribution to local sustainability initiatives.

External investors and knowledge institutions are expected to be attracted to support investment.

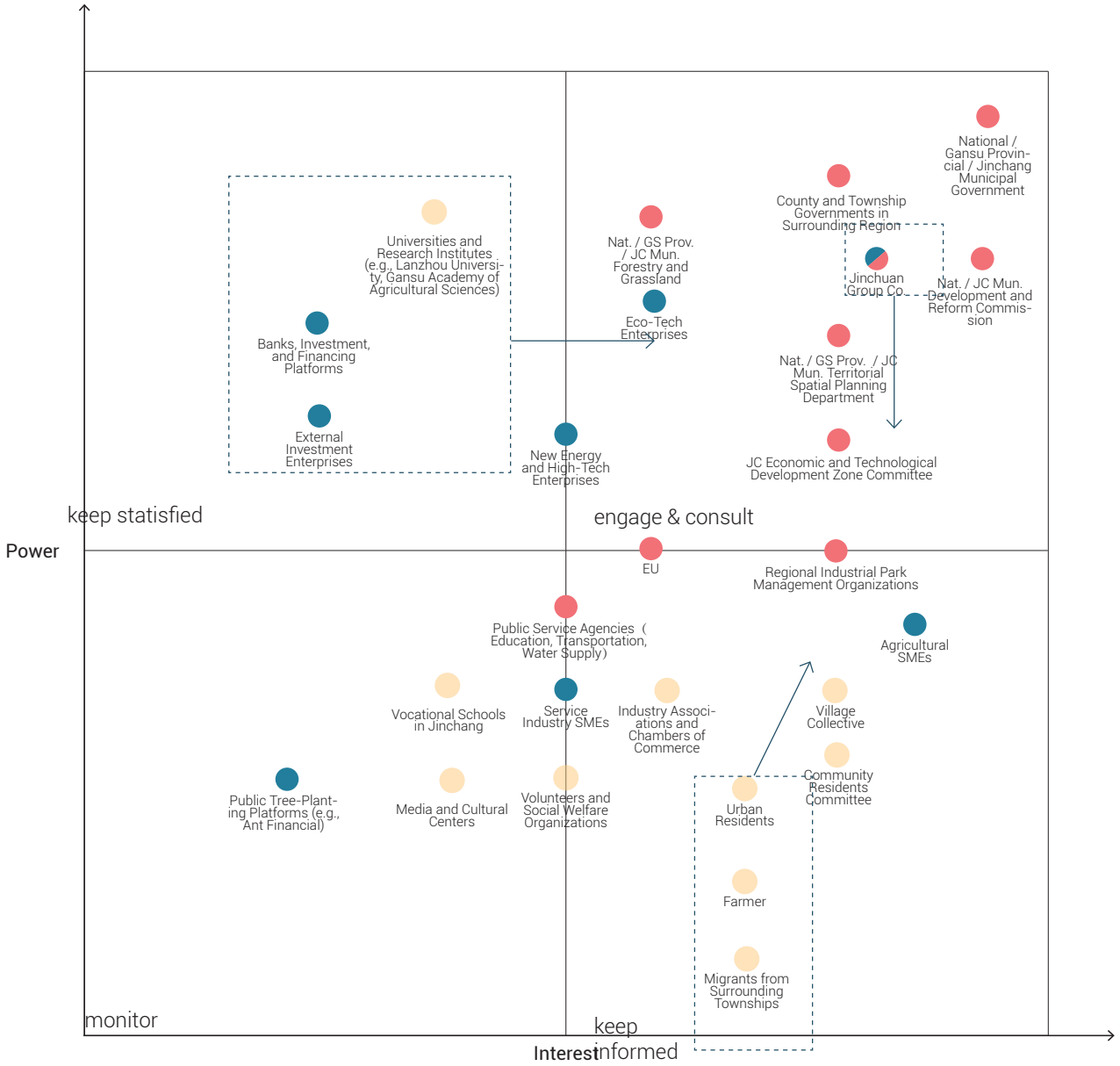


Figure: Stakeholder Power-interest diagram, (Source: Drawn by the author)

Conflicts and Tensions

Economic Interests vs. Ecological Protection: State-owned enterprises prioritize high production, whereas ecological restoration requires reduced extraction intensity.

Economic Growth vs. Social Inclusion: Government policies focus heavily on economic development and infrastructure, often neglecting the participation and protection of marginalized groups.

Spatial Competition between Local Residents and Migrant Workers: Urban renewal and land redevelopment increasingly intensify conflicts over space and resources.

Figure: Stakeholder section cut location map (Source: Drawn by the author)

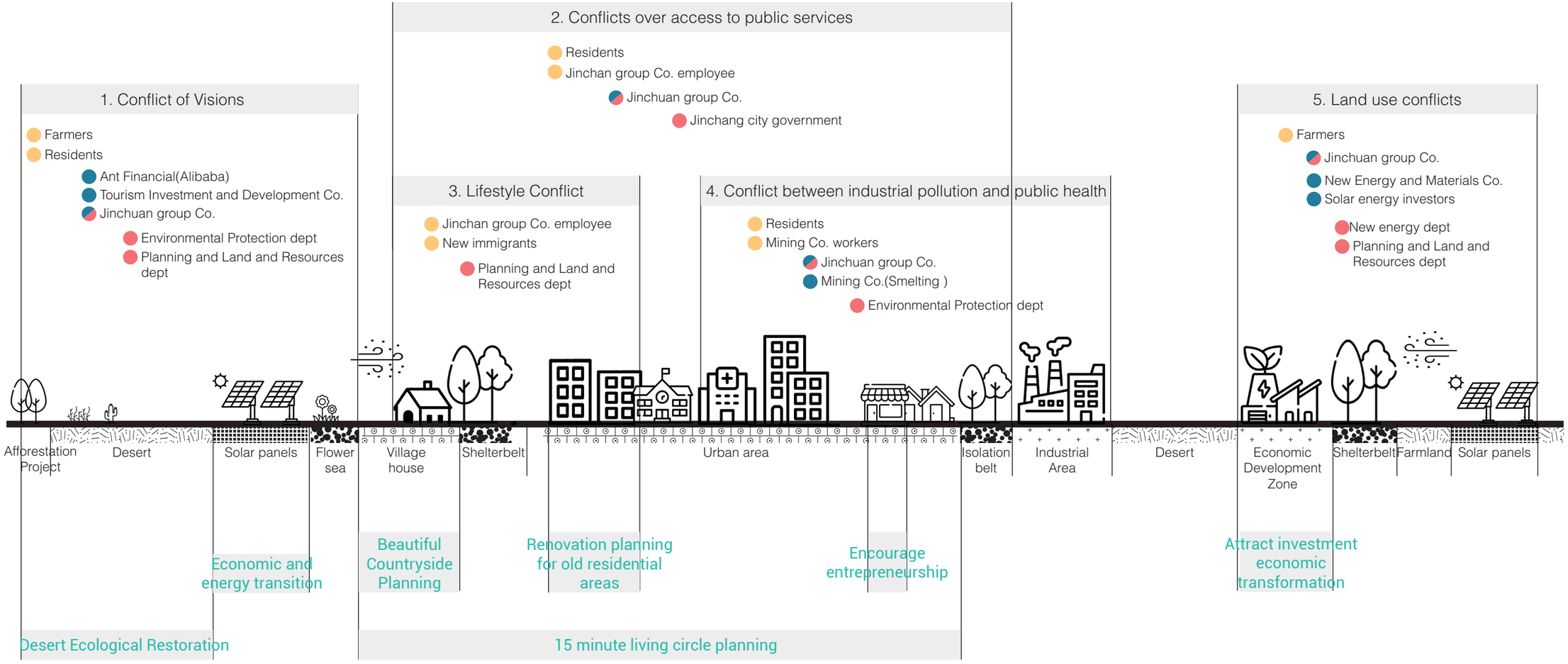


Figure: policy opportunities and key actors (Source: Drawn by the author)

3.6 Conclusion: SWOT Analysis for Transformation

Based on a systematic analysis of the ecological, economic, social, and institutional transformation challenges faced by Jinchang, and drawing from field research and scenario analysis, this study summarizes the Strengths, Weaknesses, Opportunities, and Threats (SWOT) Jinchang encounters in its future urban development.

Strengths

Resources and Geography:

Rich nickel resources and a strong metallurgical industrial foundation provide a certain degree of regional influence.

Unique natural landscapes, including deserts, mountains, and rivers, present potential for ecological restoration and cultural regeneration.

Institutional and Policy Background:

The advancement of national spatial governance reform offers a platform for local institutional innovation and experimentation.

Opportunities

Institutional Windows and Methodological Introduction:

The territorial spatial planning system is still in its formative stage, providing opportunities to develop adaptive planning methods.

International and domestic experiences in sustainable transformation of resource-based cities are gradually maturing, offering replicable pathways.

Ecological Restoration and Regional Collaboration:

National ecological security frameworks and watershed governance policies support regional-scale integration and ecological transformation.

Population and Local Development:

Regional urbanization brings a rural population influx, stimulating service economy growth and community vitality.

Weaknesses

Economic Structure and Development Model:

A single-industry economic structure heavily reliant on traditional mineral industries, with a lack of diversified industrial support.

Emerging industries are unstable, highly dependent on policy incentives, and lack local technological support.

Ecological and Spatial Systems:

The arid climate, frequent sandstorms, and fragile ecosystems reduce urban livability.

Spatial planning remains outdated, centered on natural exploitation and industrial service, with spatial usage that excludes marginalized groups.

Social and Transport Infrastructure:

Vulnerable groups lack channels for participation and expression, exacerbating social spatial segregation.

Disadvantageous transportation location and weak external connectivity constrain urban development.

Threats

Ecosystem Risks:

Issues such as desertification, land degradation, and river shrinkage continue to threaten urban sustainability.

Economic and Market Uncertainty:

Global and domestic markets show volatile demand for resource-based products, with traditional mineral resources projected to deplete within 20 years.

Emerging industry paths are highly dependent on external markets, making them vulnerable to policy adjustments.

Institutional and Governance Challenges:

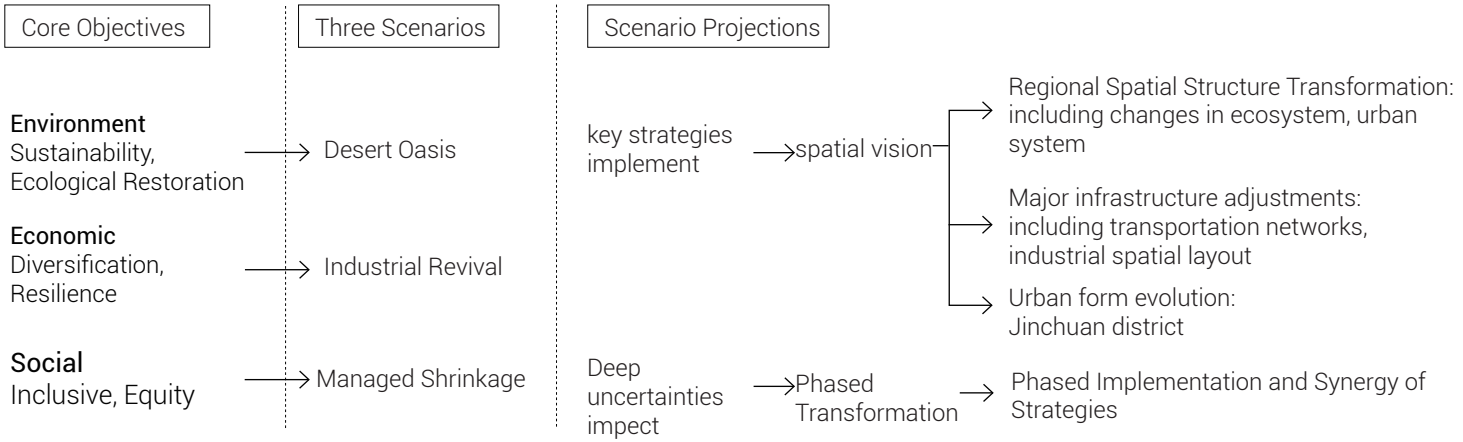
Although planning system reforms are advancing, old thinking and path dependency persist in practice, hindering quick adaptation to new challenges.

This research adopts Scenario Planning as the core method for strategic development. The purpose is not to predict what the future will be, but to reveal what futures are possible and to create space for strategic responses under different conditions. Scenario planning emphasizes trends, uncertainties, and social values as the foundation to explore multiple development pathways for the city under varying logics. This approach allows for the identification of both adaptive capacity and robustness of strategies across different scenarios.

4 Scenarios

4.1 The logic of scenarios

This research adopts scenario planning as the core method to address uncertainty and planning complexity. The logical pathway consists of three key stages: first, identifying deep uncertainties to project potential future development paths for the city; second, defining each scenario's core objectives, key strategies, spatial vision, and governance models; and finally, identifying robust strategies that are effective across multiple scenarios, as well as adaptive actions that require adjustments in response to specific changes.



Scale of scenario planning

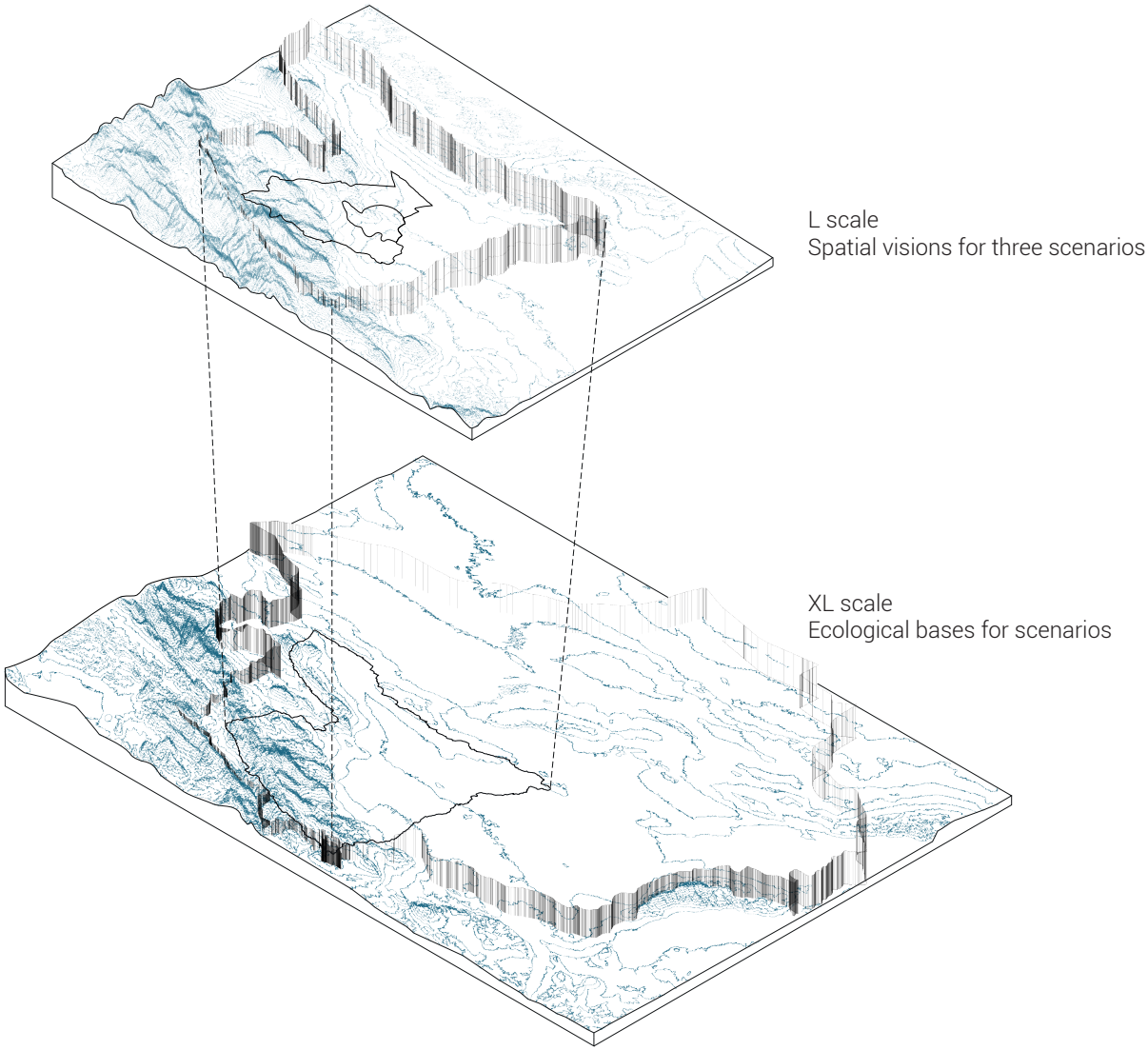


Figure: Scale map of scenario planning (Source: Drawn by the author)

Deep uncertainties and impects

Deep Uncertainty refers to situations where decision-makers cannot clearly determine the probability distribution of future scenarios or understand the interactions among key driving factors. Its main characteristics are multiple possible futures, unpredictability, and dynamic complexity (Lempert et al., 2003; Walker et al., 2013).

The sources of uncertainty in this context arise from historical economic fluctuations driven by changes in mineral prices, the progression of desertification influenced by climate change, and shifts in rainfall patterns. Additionally, urbanization processes contribute to uncertainty, with differing levels of urban development affecting rural-to-urban migration. Extreme climate conditions also lead to climate-induced displacement, further complicating population dynamics in the region.

Economic Fluctuations Driven by Mineral Price Volatility

Resource-based cities like Jinchang are highly vulnerable to fluctuations in global mineral prices. The volatility of nickel prices, influenced by factors such as Indonesian export policies and shifting demand for electric vehicles, has caused the annual GDP volatility rate of Jinchang to be 2.3 times higher than that of non-resource-based cities (Wang et al., 2024).

Jinchang's share of China's nickel production, once at 80%, has fallen to less than half due to competition from Indonesian exports and domestic technological advancements in Zhejiang. The instability of nickel prices not only affects Jinchang's economy but also reduces local consumer spending power, weakening its ability to attract social migrants engaged in small businesses. These migrants, described as "nomads" of commerce, move between cities in search of better business environments rather than settling permanently. Despite their transient nature, they are crucial to Jinchang's social vitality.

To counter these vulnerabilities, economic diversification is essential to break free from the constraints of a single-industry dependency and build resilience against global market shocks.

Impact of Climate Change: Desertification and Rainfall Variability

In the Shiyang River Basin, excessive groundwater extraction and the shrinking of oasis areas have accelerated desertification. Research indicates a critical tipping point: if the annual expansion rate of the Tengger-Badain Jaran Desert exceeds 5 meters, the oasis barrier may collapse before 2035 (State Council of China, 2022).

Worsening droughts in the Hexi Corridor's rural areas are expected to displace up to 5 million climate migrants by 2050, with 30% potentially moving to resource-based cities like Jinchang (UK Government Office for Science, 2011). However, these migrants often settle in the peripheries of cities, occupying old communities or rural areas with poor public service accessibility and high crime rates. These neglected spaces are often relegated to urban margins, serving as "dumping grounds" for undesirable urban functions.

To accommodate climate-induced migration, there is a critical need to address social service equalization and improve living conditions in marginalized urban areas.

Urbanization Trends and Impact Analysis

According to statistical data, as of 2023, China's urbanization rate reached 66.16% (National Bureau of Statistics of China, 2024), and it is projected to continue increasing between 2035 and 2050. Jinchang City exhibits an even higher urbanization rate, reaching 80.54% by the end of 2023, significantly surpassing the provincial average in Gansu.

As urbanization enters its mature phase, Jinchang is likely to experience a series of spatial structural changes. Generally, when urbanization reaches saturation, population growth tends to slow down or even decline, often accompanied by population aging. However, due to its relative economic strength in the Hexi Corridor, Jinchang may attract populations from surrounding areas with lower urbanization rates, resulting in a population replacement effect—local residents moving out while newcomers move in.

This population flow will lead to spatial changes, including the decline of old neighborhoods, the emergence of new settlements in peri-urban areas, and potential social segregation and cultural conflicts between long-term residents and new migrants. Future urban planning should address the impacts of this population replacement on urban services, neighborhood integration, and the capacity of urban-rural fringe areas. Moreover, if Jinchang's economy slows down, its attractiveness to migrants will weaken, potentially causing population shrinkage and spatial decline. Conversely, if economic growth remains stable, the city will need to upgrade its urban structure to accommodate both expansion and structural transformation.

4.2 Ecological Base for the Three Scenarios: -Regional Ecological Restoration and Desertification Control Plan

Boundary Definition

The existing environmental protection plans currently include the Shiyang River Basin Protection Plan and the regional Forestry Planning. The former's boundaries are based on administrative divisions, making it ineffective for managing cross-administrative river basin protection. The latter only defines a north-south boundary with specific plantation area targets.

To address this, the author proposes overlaying the watershed boundaries with county-level administrative boundaries, encompassing all administrative regions that overlap with the watershed. This newly defined regional protection boundary also includes the desert areas, making it suitable for comprehensive regional ecological protection planning.

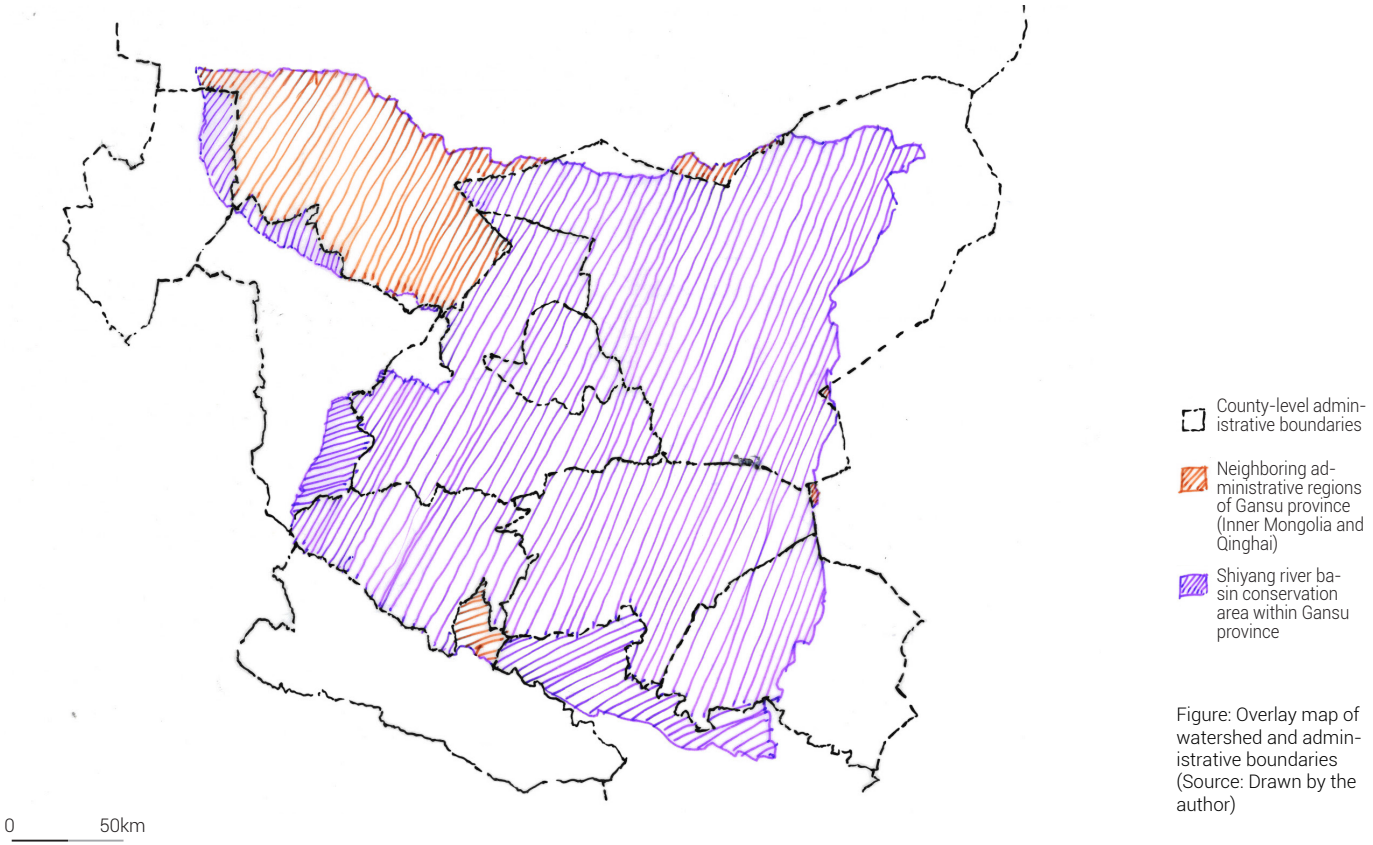


Figure: Overlay map of watershed and administrative boundaries (Source: Drawn by the author)

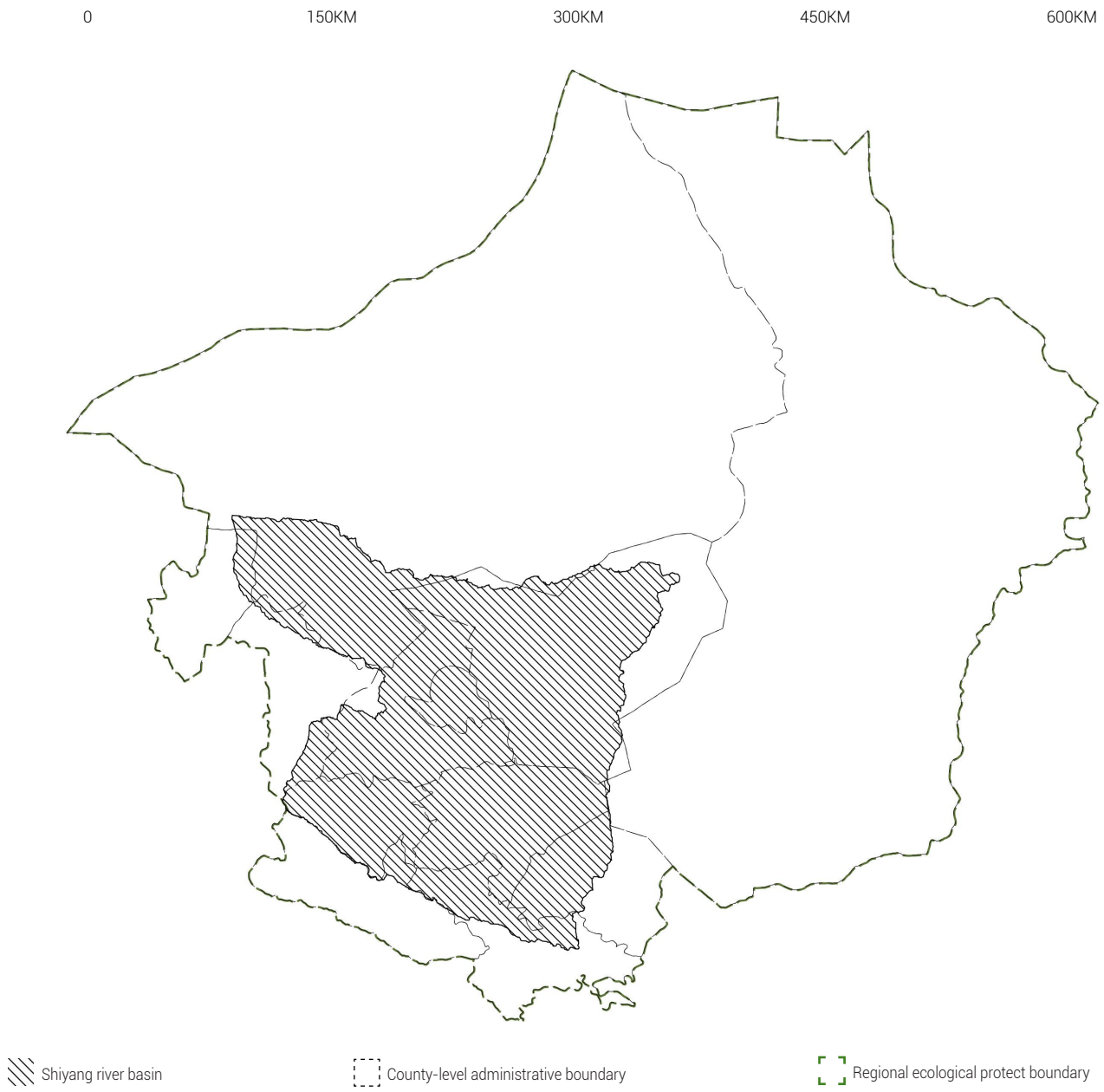


Figure: Regional land-use map (Source: Drawn by the author)

Current landuse

Given the urgency of regional ecological issues, this research prioritizes Ecological Watershed Restoration strategies before constructing scenario pathways. The restoration approach draws inspiration from local knowledge, the United Nations Convention to Combat Desertification (UNCCD), and case studies from the World Atlas of Desertification (WAD).

The primary objective is to address desertification, soil degradation, and water scarcity through targeted interventions, setting a resilient ecological foundation for the three scenarios—Desert Oasis, Industrial Revival, and Managed Shrinkage. These ecological baseline maps serve as the spatial framework for sustainable planning, emphasizing watershed protection, reforestation, wetland restoration, and the reconnection of fragmented natural habitats.

This ecological groundwork ensures that each scenario begins with a robust environmental strategy, aligning with global best practices and local adaptive capacity.

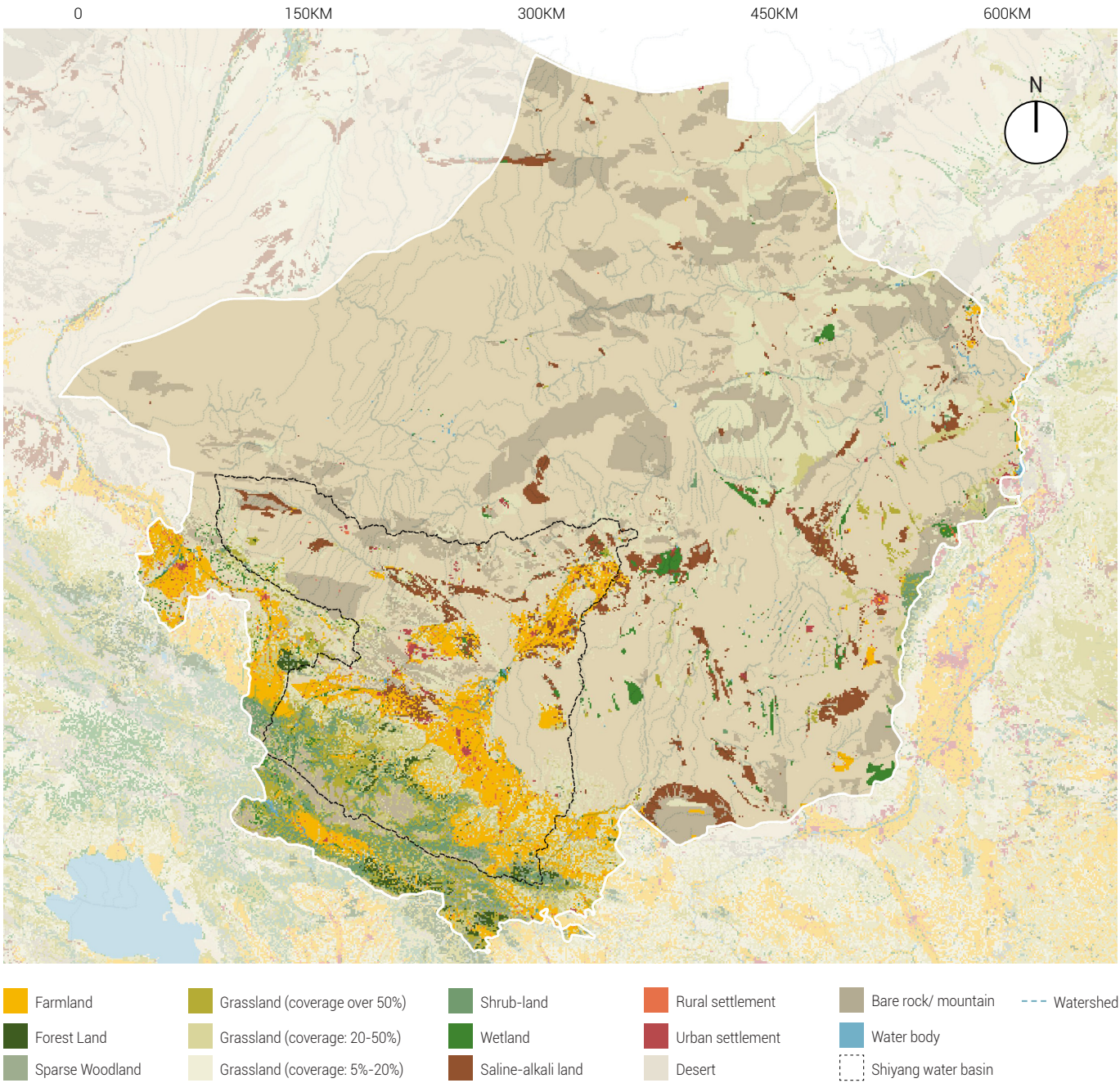
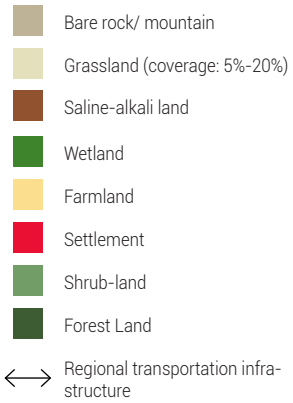


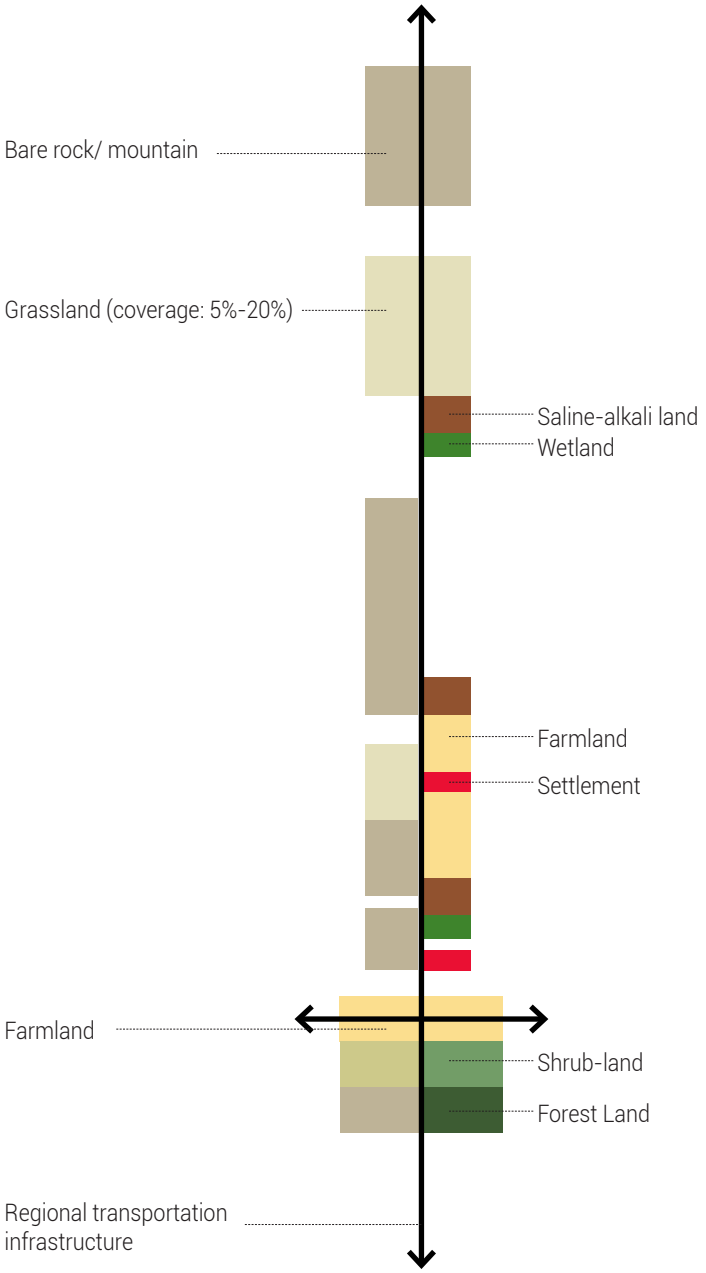
Figure: Regional land-use map (Source: Drawn by the author)

Intervention landuse

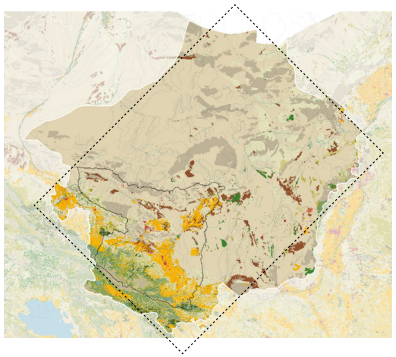
Drawing from the regional ecological degradation analysis and recommendations from the United Nations Convention to Combat Desertification (UNCCD), this research outlines restoration strategies across four key land-use categories: Forests and Shelterbelts, Grasslands and Shrublands, Farmlands, Mountains, and Water Bodies.

Limatation:
The data available at the regional level is limited in detail and type, making it difficult to determine which sections of the river are artificial channels and which forested areas are artificial plantations.





Current landuse abstract



Rotate the regional landscape image 45 degrees westward based on the map frame, in order to provide a more intuitive visual interpretation of the landscape thumbnail.

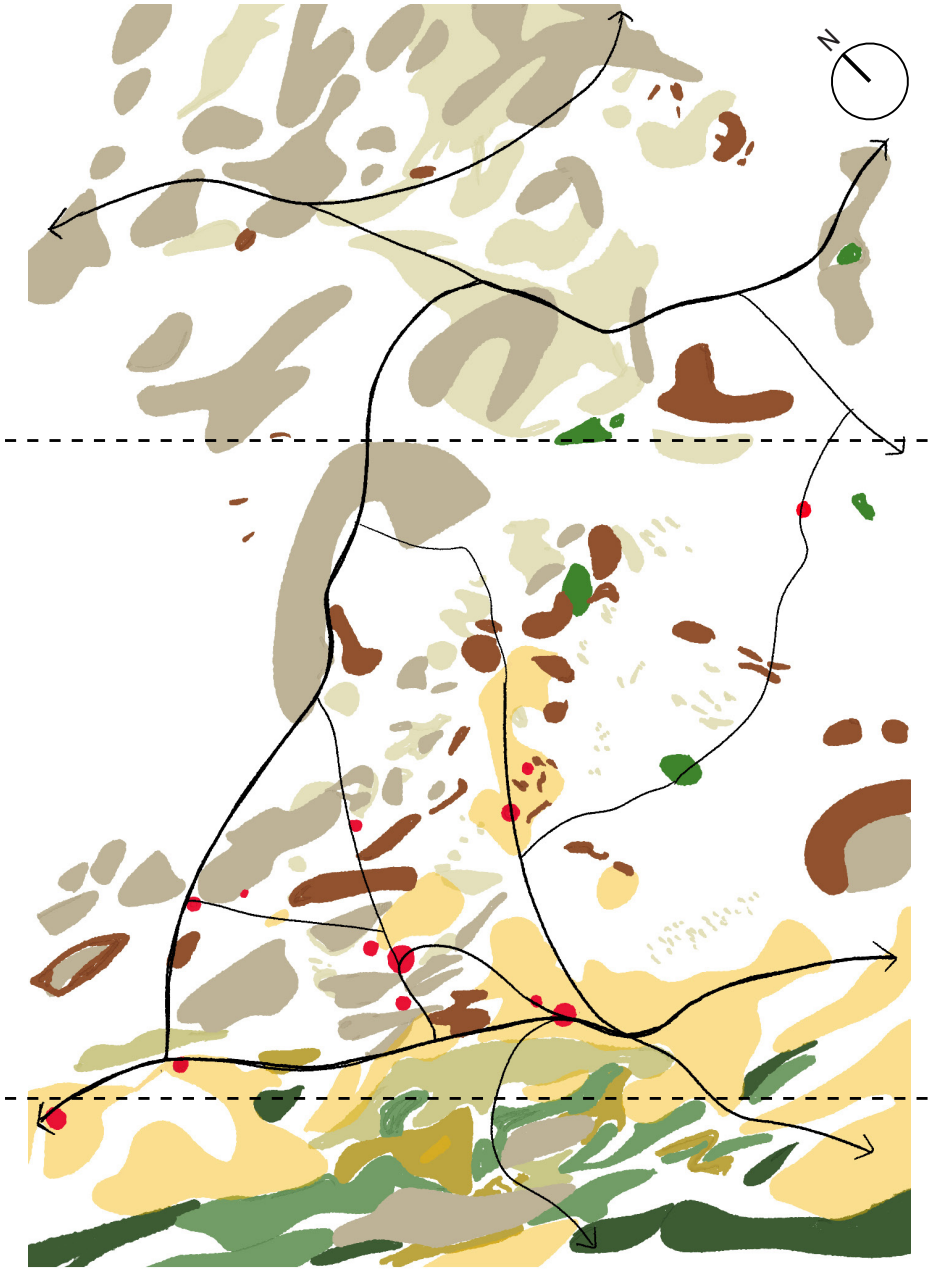


Figure: Current land-use abstract map (Source: Drawn by the author)

Desertification expansion and desert movement

Desertification in the Shiyang River Basin

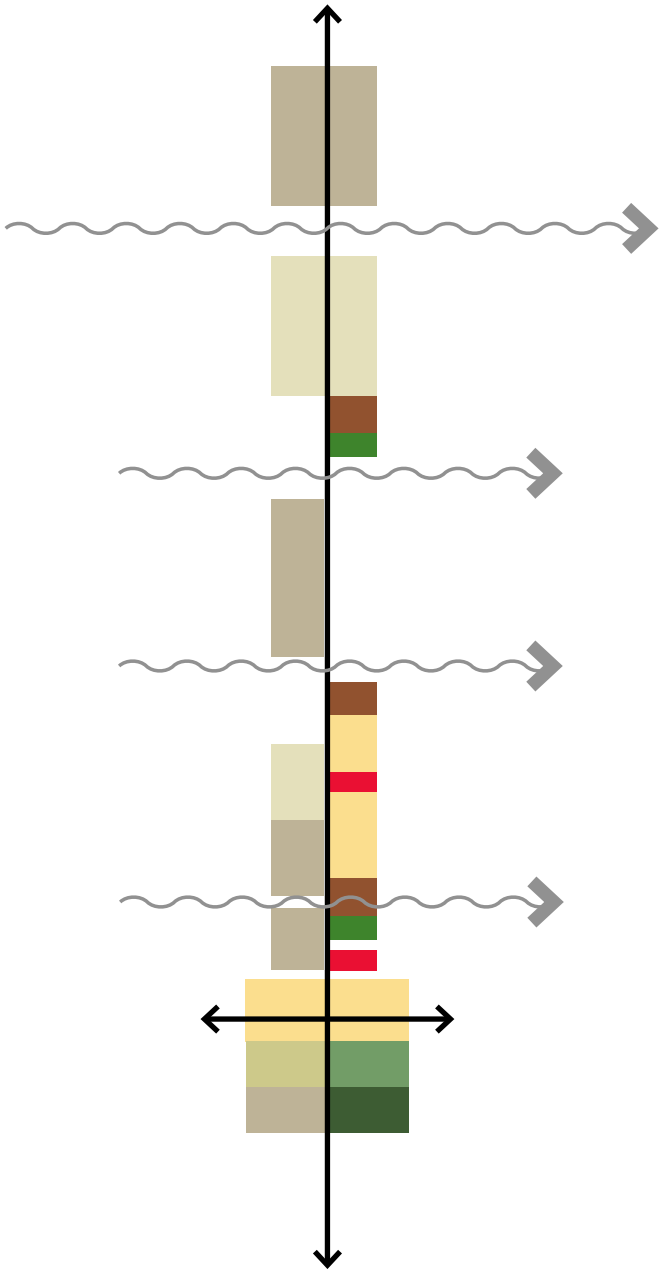
The grasslands, shrubs, and other natural landscapes within the Shiyang River Basin—originally serving as a natural barrier between the Badain Jaran and Tengger Deserts—have undergone desertification, turning the area into a corridor for shifting sands.

Prevailing Winds

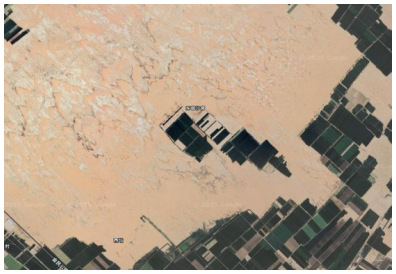
The region is dominated by northwesterly and northerly winds, especially during winter and spring, when the northwesterlies intensify and bring strong wind speeds. These winds are key drivers of sandstorms and dune migration.

Desert Expansion

Under the influence of prevailing winds, drifting sands from the Badain Jaran Desert advance through mountain gaps and degraded landscapes, leading to the formation of new desertified areas in the eastern part of the Shiyang River Basin. This expansion poses a risk of desert coalescence, threatening not only local production and living spaces but also potentially affecting broader areas toward the southeast.



- Bare rock/ mountain
- Grassland (coverage: 5%-20%)
- Saline-alkali land
- Wetland
- Farmland
- Settlement
- Shrub-land
- Forest Land
- Regional transportation infra-structure
- Prevailing wind and desert movement direction



Shifting sands from the mountain gaps and degraded deserts move toward east, covering infrastructure, villages, and farmlands.

Figure: Diagram of desert migration mechanism (Source: Drawn by the author)

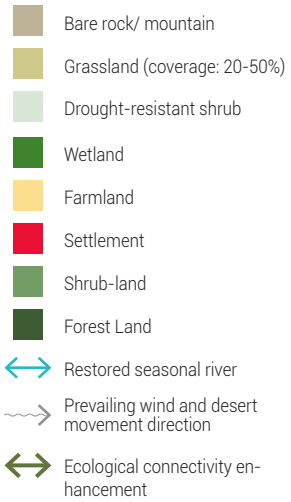
Vision to stop desrt expansion

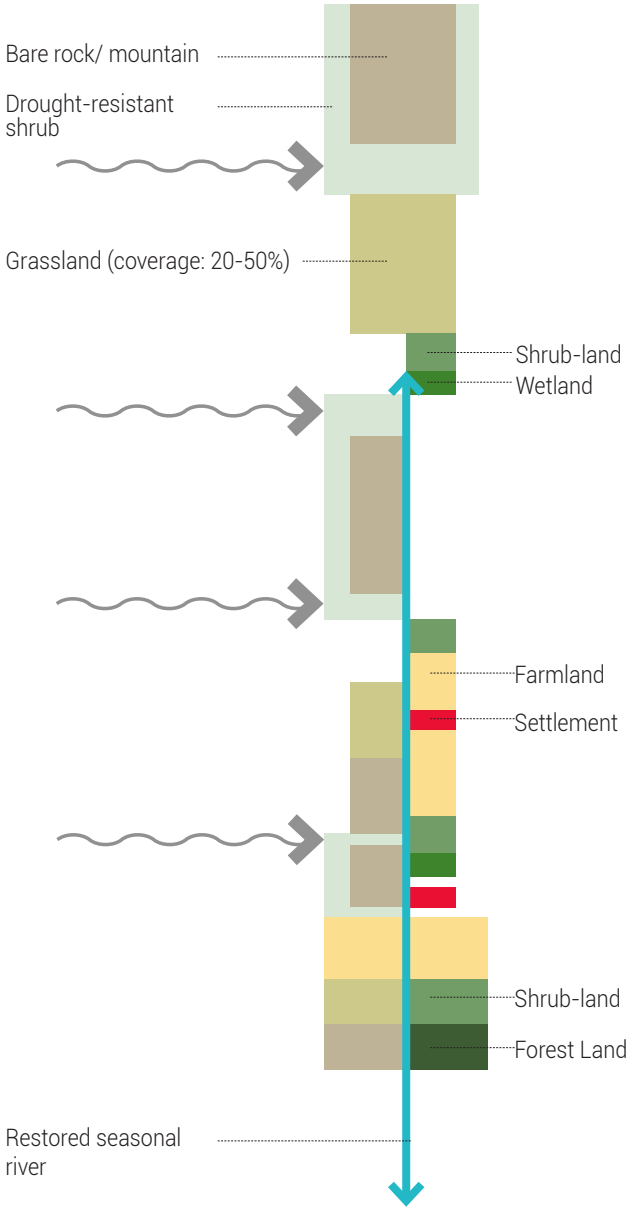
The envisioned goal is to mitigate, and potentially halt, the advancement of desertification by restoring and reconnecting ecological patches within the Shiyang River Basin, thereby reestablishing the natural ecological barrier between the Tengger and Badain Jaran Deserts.

The proposed strategy comprises two components:

(1) the restoration of degraded ecological patches, including salinized lands, forests and shelterbelts, farmland and grasslands.

(2) the reinforcement of longitudinal ecological connectivity through the rehabilitation of selected river segments and adjacent riparian grasslands.





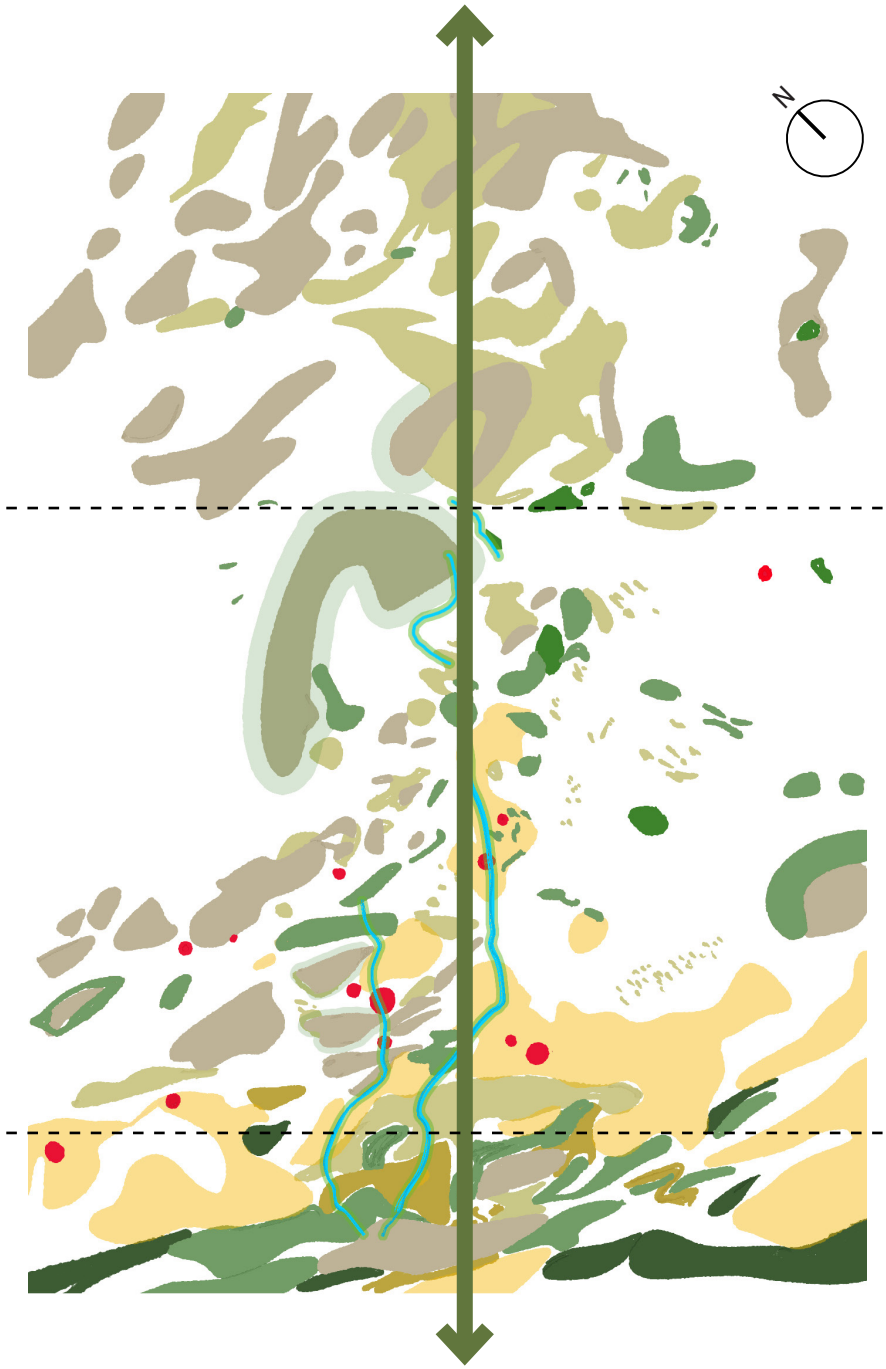


Figure: Concept vision diagram (Source: Drawn by the author)

Ecological Watershed Restoration Strategies: restore pitches

Forests and Shelterbelts

The region's forest coverage has increased, mainly due to windbreak and sand fixation projects that replaced natural forests with artificial plantations. However, these artificial forests have low biodiversity. Therefore, a mixed-species reforestation approach will be adopted to restore forest diversity.

Method: Agroforestry and Mixed Plantation

Agroforestry: involves integrating trees, shrubs, and crops into multifunctional landscapes. This method not only improves soil health and enhances water retention but also promotes sustainable land use and increases carbon sequestration. In Jinchang, shelterbelts currently require significant irrigation and have limited ecological functions. Meanwhile, local farmers are interested in cultivating cash crops like apples and goji berries, which are well-suited to the region's arid climate and are renowned for their quality within China. Integrating shelterbelts with agricultural production would not only expand their ecological functions but also enable local farmers to serve as volunteer caretakers for the forested areas, promoting community involvement in ecological preservation.

Mixed plantation : involves replacing single-species artificial forests with diverse tree species. This approach aims to restore natural forest structures, enhance habitat diversity, and improve ecological stability. By mimicking natural ecosystems, mixed plantations are more resilient to pests, diseases, and climate variability. Currently, Jinchang's shelterbelts are primarily constructed with hard surfaces and artificial channels, providing limited ecological benefits. This project proposes the application of diversified planting techniques to restore ecological functions and increase environmental resilience.

Grasslands and Shrublands
Method: Local Practices for Saline-Alkali Land Restoration

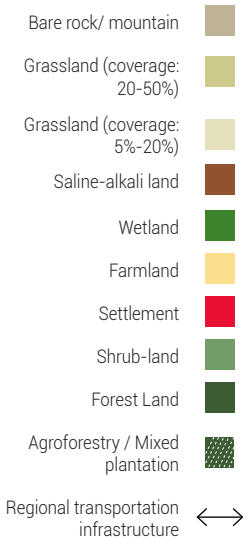
For degraded grasslands or farmlands, another potential restoration method is to preserve grassland patches as ecological islands and seed banks. However, this approach requires the construction of windbreak barriers and shelterbelts (Critchley et al., 2021). In arid desert regions, planting drought-resistant shrubs may be a better option, although it faces challenges in providing effective wind and sandstorm protection.

Farmlands, Saline-Alkali Land and shrub-lands

Agricultural Activities Lead to Land Productivity Decline, Resulting in Farmland Degradation into Saline-Alkali Land.

Method: Local Practices for Saline-Alkali Land Restoration

Planting shrubs such as Tamarix (Salt Cedar) and Sophora alopecuroides (Kudouzi) has been proven effective in reducing soil salinity and pH levels in saline-alkali lands, while also improving soil fertility and microbial diversity (Wang et al., 2021; Li et al., 2025).



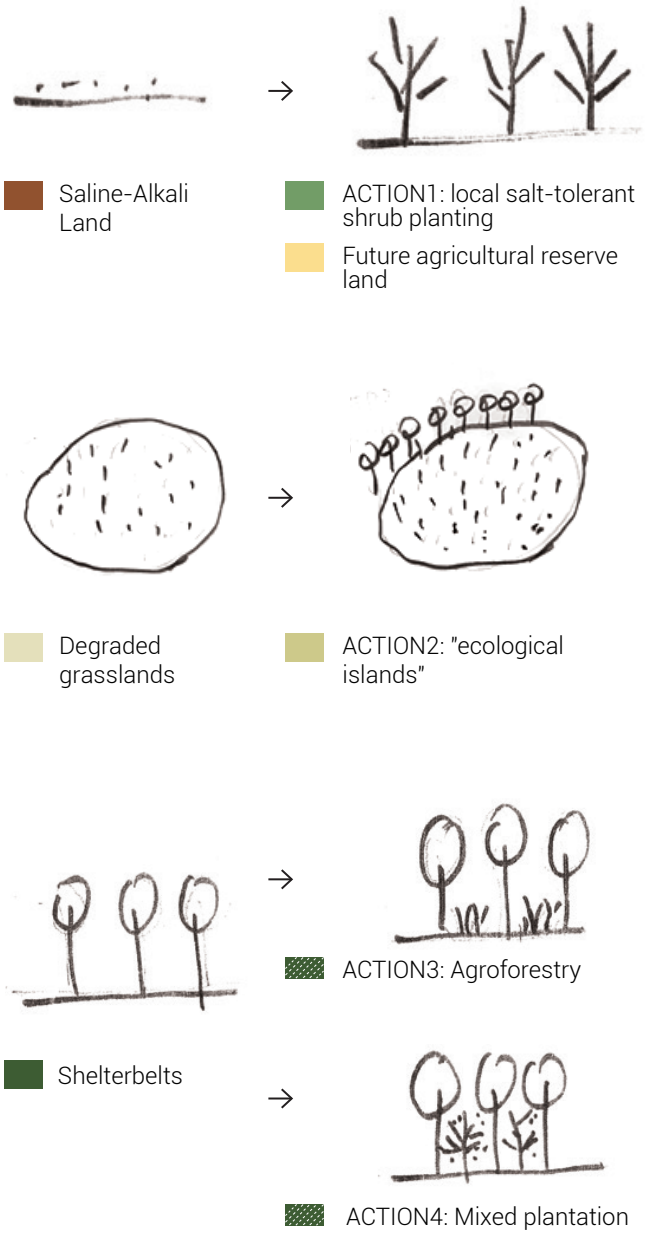


Figure: Methods Diagrams (Source: Drawn by the author)

Ecological Watershed Restoration Strategies: block and connect

Mountains

The movement of drifting sand in the region is primarily directed from west to east, with the Shiyang River Basin acting as a natural boundary. In addition to water bodies and grasslands serving as barriers, the natural mountain terrain also alters the trajectory of sand movement.

Utilizing Mountain Ranges as Barriers Against Desert Expansion

To combat desert expansion, this strategy proposes leveraging mountain ranges as natural barriers. Under the influence of prevailing winds, sand particles are blown over the mountains and accumulate on the leeward side, increasing the volume of drifting sand in the eastern desert areas. This accumulated sand can then be carried further east by wind, potentially impacting cities along the Yellow River.

To address this, the project suggests planting cold-resistant shrubs on the leeward slopes or employing local grid planting methods to stabilize the drifting sand and prevent further expansion.

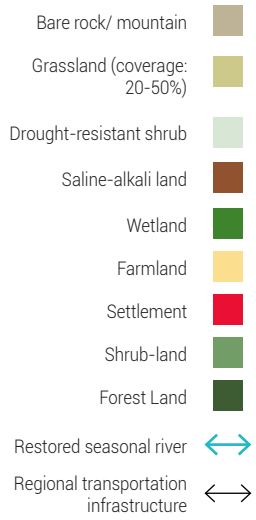
Water bodies
Method: River Channel Restoration and De-Channelization

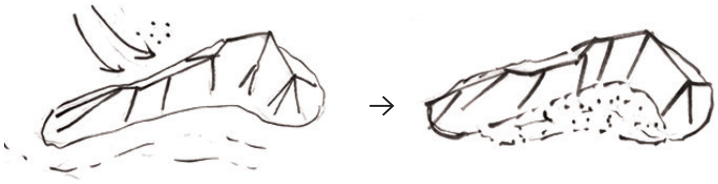
The region has historically utilized artificial channelization of river systems for water resource management. However, this has led to issues such as insufficient groundwater recharge and river pollution.

To address these challenges, the project proposes partial de-channelization of certain river sections, particularly seasonal rivers. During the rainy season, these restored segments can act as natural infiltration zones, allowing water to percolate into the ground and enabling the river to "rewild" through natural precipitation.

Channelized rivers with hardened banks have disconnected the river from its floodplain, limiting groundwater recharge. De-channelization would allow seasonal rivers to naturally overflow during rainy periods, enhancing water infiltration and supporting groundwater replenishment.

This approach also aims to improve water quality and ecological health. Through natural filtration, floodplain vegetation and soil can absorb heavy metals and degrade organic pollutants, effectively reducing the pollution load and restoring ecological balance.

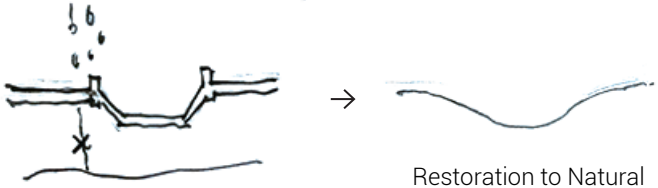




Shifting sand crossing over mountains or rocks

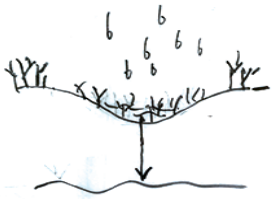
Sand Dune Accumulation on the Leeward Side

ACTION5: Drought-Resistant Shrub Planting for Sand Stabilization



Current Artificial Irrigation Channels: Infiltration Blocked

Restoration to Natural Riverbanks in Suitable Areas



ACTION6: Restored Seasonal River Channels: Groundwater Recharge and Vegetation Restoration

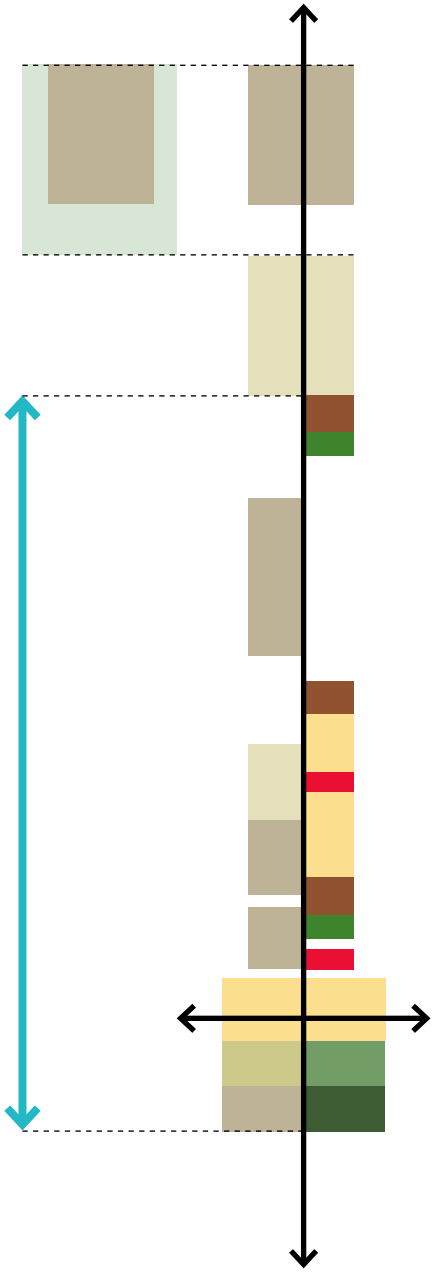


Figure: Methods Diagrams (Source: Drawn by the author)

Desertification Restoration Action Plan in Northwest China

Finally, an action plan map is developed to guide desertification control and ecological restoration efforts. This regional planning/action framework aims to coordinate and provide strategic direction for the current multi-actor initiatives addressing desertification. It represents an integration and refinement of the previous provincial-level Shiyang River Basin Conservation Plan and the national-level Three-North Shelter Forest Program.

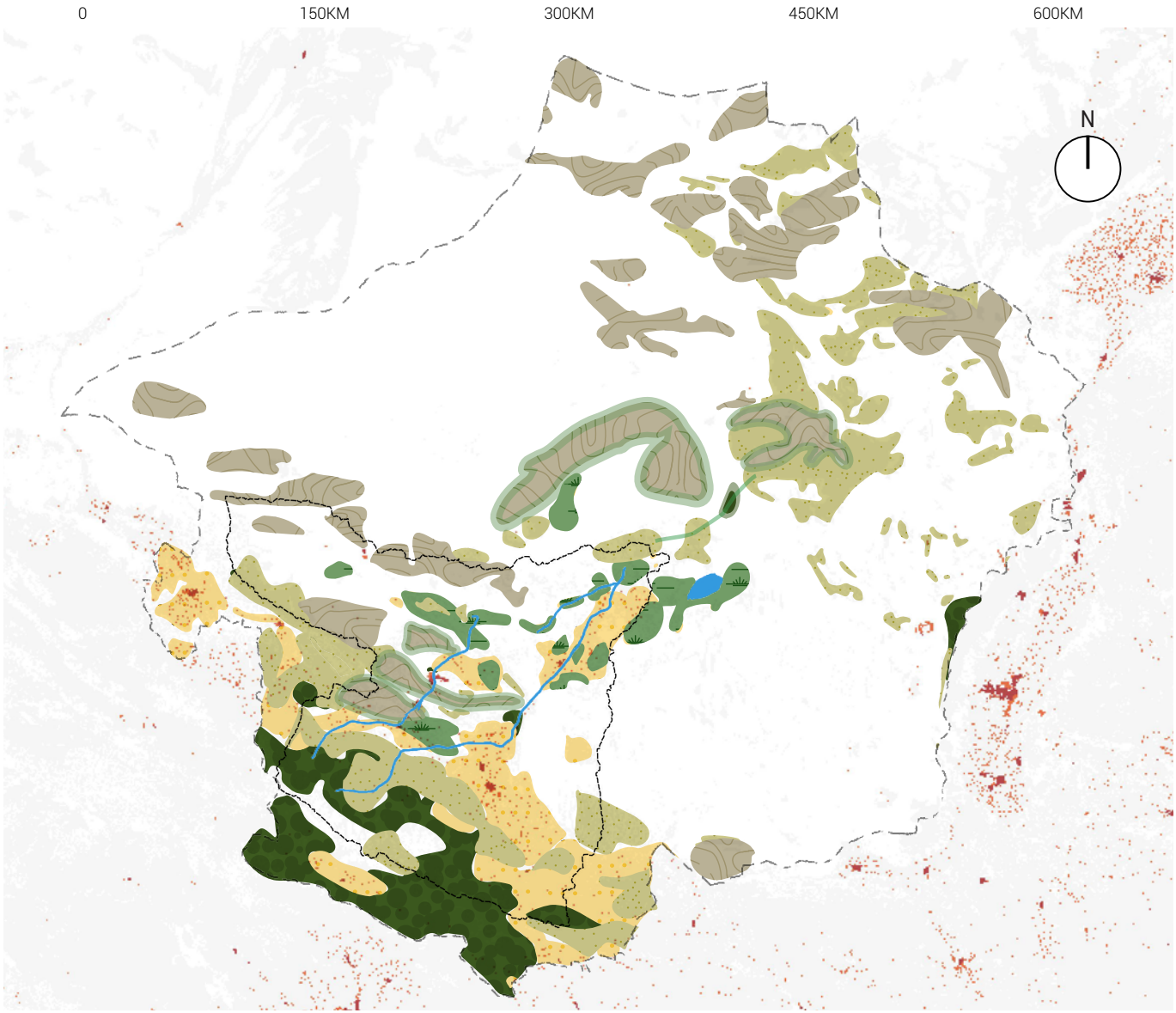


Figure: Action plan map for desertification restoration in Northwest China (Source: Drawn by the author)

Implement phases of desertification restoration action plan

Phase One: Targeted restoration and pilot implementation in degraded zones

Implementation unit a: Emergency **restoration of severely degraded areas**, focusing on saline-alkali land restoration around agricultural zones, wetlands, and lakes designated for ecological protection.

Actors: **Government and enterprises provide funding**, and **routine tree-planting activities(employees of Jinchuan group Co. and the municipal government)** are carried out in designated areas, with **farmers** cooperating in management and maintenance.

Implementation unit b: **Mixed forestry in urban peripheral shelterbelts.**

Actors: **Farmers** cooperate with the **Forestry Bureau** for implementation, where the Forestry Bureau is responsible for facility upgrades, and farmers engage in planting and maintenance.

Implementation unit c: De-channelization pilot projects for **seasonal rivers in urban agricultural area**

Actors: **Government** funds the reconstruction, and surrounding **farmers** participate in maintenance.

Phase Two: Optimization and functional enhancement of existing shelterbelts

Implementation unit a: Ecological Optimization of **Artificial Shelterbelts**.**Locate past desert and arid land plantation areas** and apply mixed planting.

Actors: **Government and enterprises** provide funding, **Arbor Day planting activities**, and **farmers** cooperate in management

Tipping Point:

When the vegetation coverage in the pilot areas reaches the target and groundwater levels show signs of recovery, it indicatesthe feasibility of the restoration approach and the effectiveness of community participation in maintenance, allowing for the next phase of restoration to begin.

and maintenance. Initial planters and the **Public Tree-Planting Platforms** are responsible for optimization.

Implementation unit b: Desertification control with **mountain barriers.** Plant shrub barriers on the windward slopes of mountains near settlements and use straw checkerboards to stabilize sand on the leeward slopes.

Actors: Funded by **corporate profits** and supported by **landscape tourism revenue**.

Tipping Point:

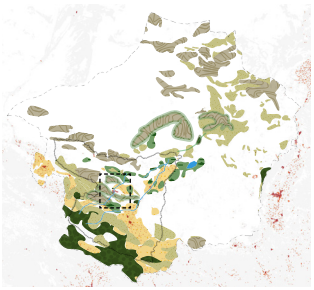
If the strategy proves effective, resulting in reduced sandstorm occurrences or successful new industries, the generated revenue can be reinvested into ecological construction.

Phase Three: Regional coordination and strategic integration for long-term resilience

Further joint implementation:Regional collaboration for **water resource allocation**. **Seasonal river restoration** within the region, serving as a buffer between farmlands and ecological protection zones. Potential development of **regional ecotourism**.

Actors: Inter-provincial and municipal government cooperation, regulated by higher-level government authorities(national government).

Current landscape conditions



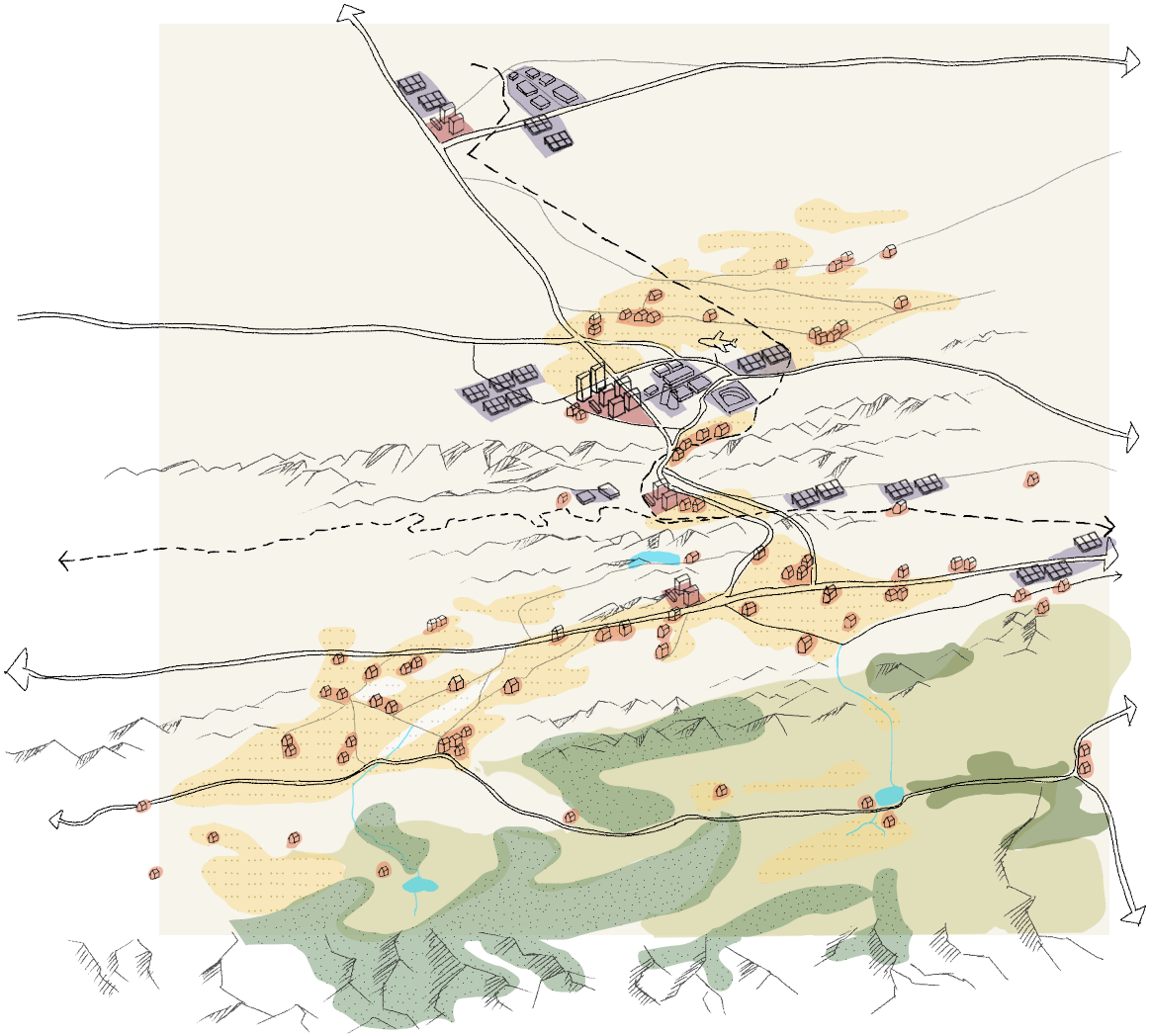


Figure: The current Landscape (Source: Drawn by the author)

Figure: Current desert landscape collage (Source: Drawn by the author)

Landscape transformation after ecological restoration

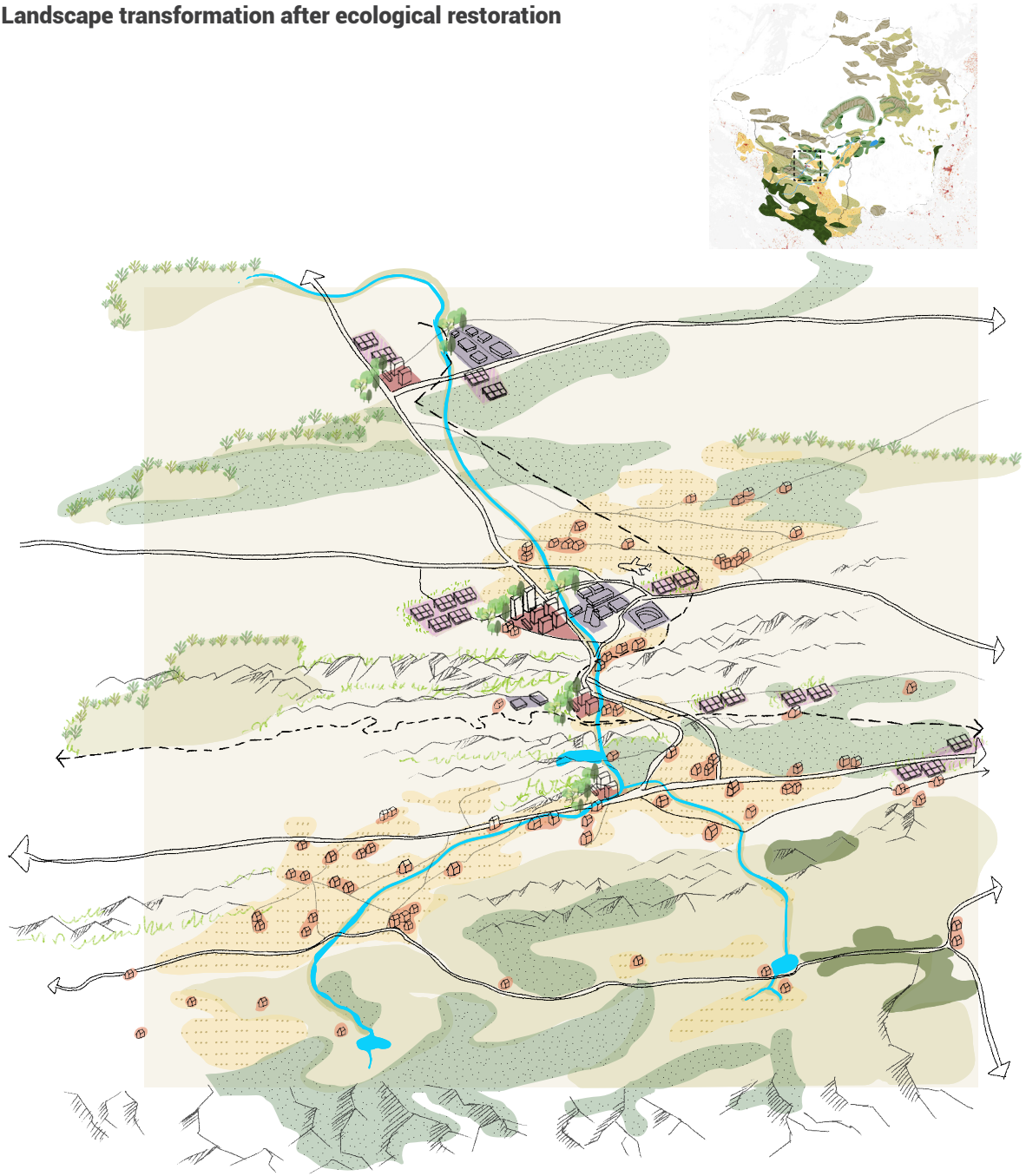


Figure: The landscape transformation after ecological restoration (Source: Drawn by the author)

Figure: Landscape transformation collage (Source: Drawn by the author)

4.3 The Three Scenarios: Visioning Alternative Futures Grounded in Regional Ecological Restoration

Drawing from identified trends, uncertainties, and social value orientations, this research constructs three representative scenarios

Desert Oasis -- Ecological Priority

This scenario emphasizes ecological restoration and nature-first principles, focusing on rebuilding human-nature relationships, even if it requires sacrificing short-term economic growth. Key supporters include environmental organizations, academia, and ecologically-oriented local governments. The primary objective is to restore degraded landscapes, combat desertification, and prioritize sustainable land use.

Industrial Revival -- Market-Oriented

This scenario aims for economic revival and industrial upgrading, driven by technology and efficiency, with a strong focus on market mechanisms. Supporters primarily include business communities, industry alliances, and technology innovation platforms. The core strategy emphasizes competitive industries, technological breakthroughs, and market-driven economic growth.

Managed Shrinkage -- Social Needs-Oriented & Governance Priority

This scenario accepts the urban shrinkage trend, prioritizing quality of life, governance capacity, and balanced development of basic services. It focuses on enhancing social resilience and regional cooperation. Supporters include local governments, community organizations, and social service agencies. The approach emphasizes controlled urban contraction, infrastructure optimization, and social stability.

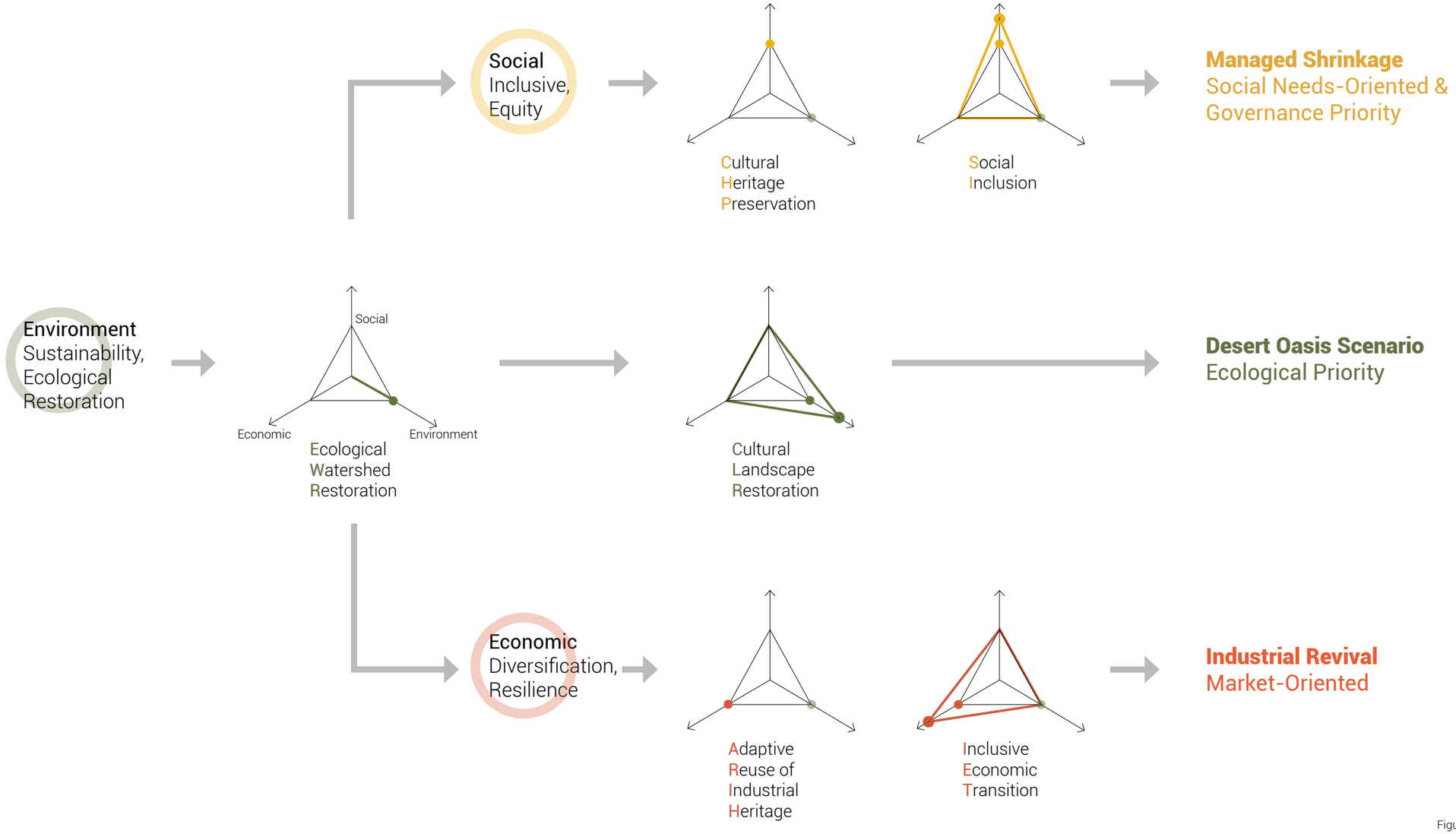


Figure: Scenario diagrams (Source: Drawn by the author)

Location: Focus on Densely Populated River Basins

Most of the area within the desertification restoration planning scope is uninhabited. To better discuss the transformation of Jinchang City and its connection with surrounding regional development, the planning scope is narrowed to the Shiyang River Basin, focusing on urban and regional transformation under different scenarios.

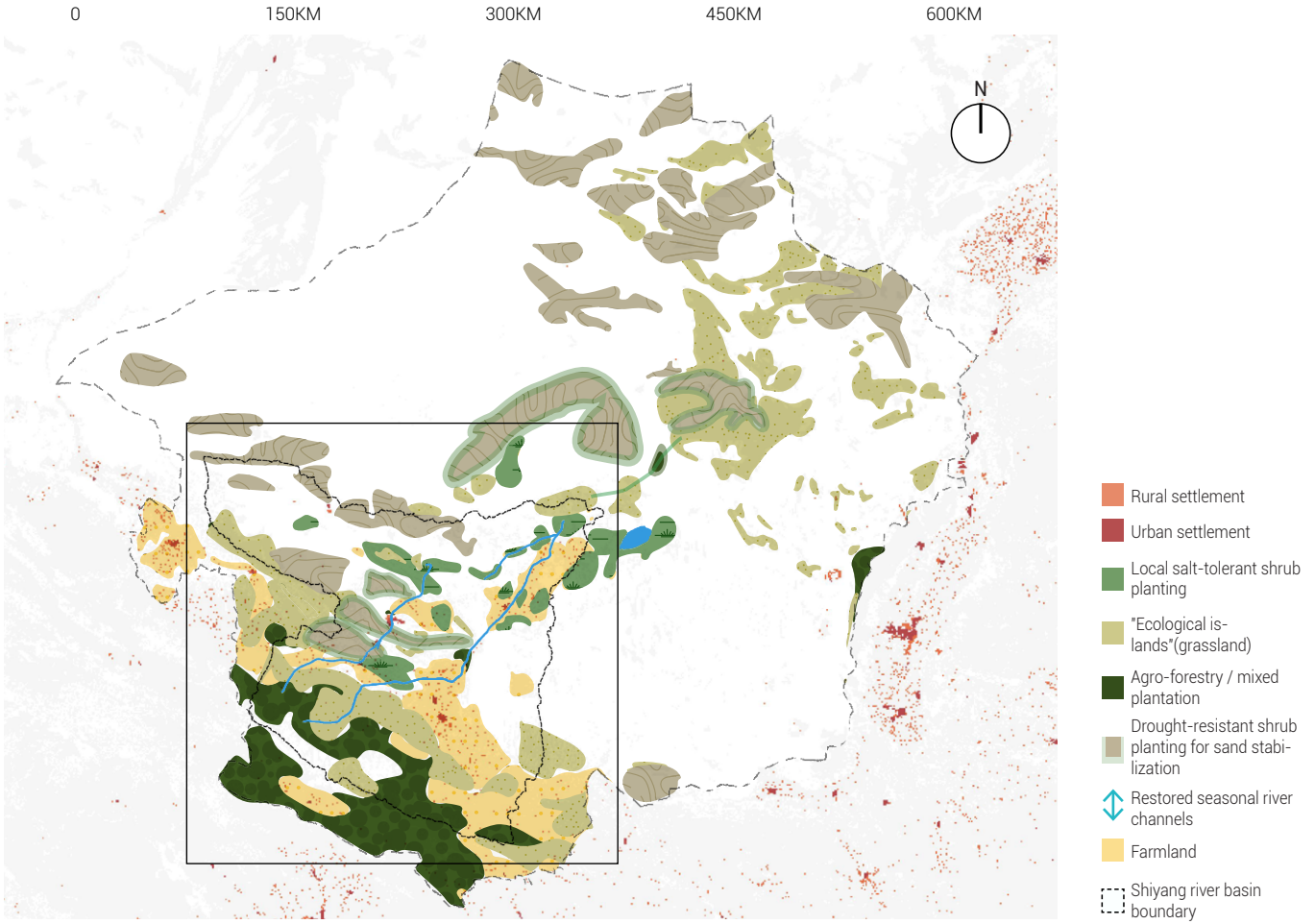
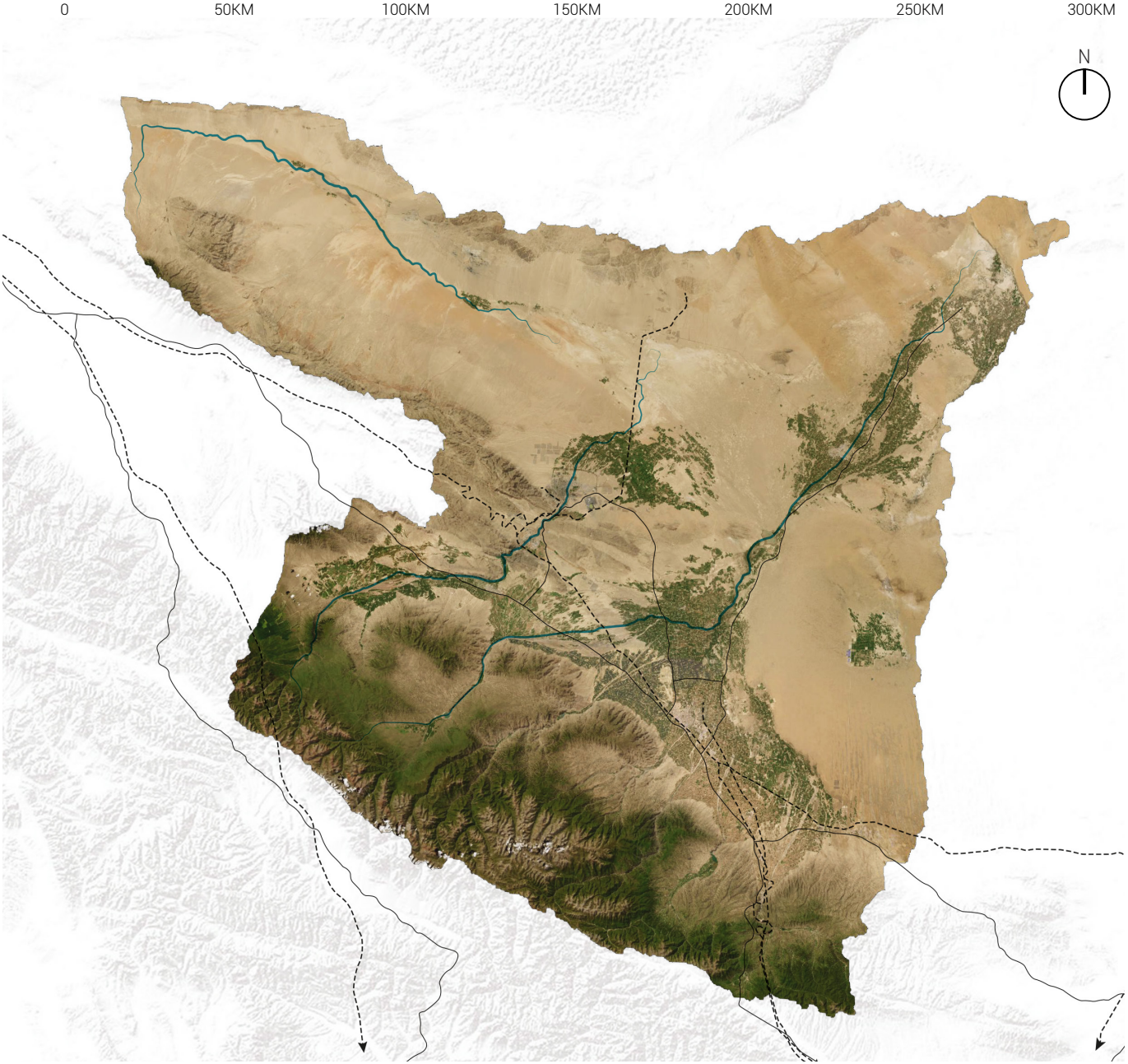
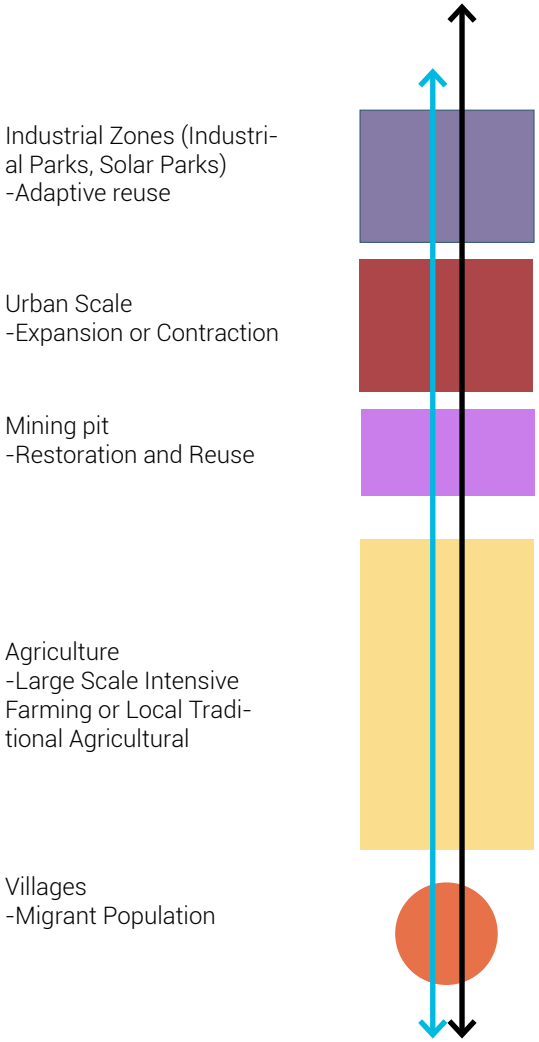


Figure: location of the three scenarios (Source: Drawn by the author)


0
50KM
100KM
150KM
200KM
250KM
300KM
N

Current landuse: Implementation Space for Measures

Interventions in this region primarily focus on industrial and living spaces. Key areas include the reuse of industrial parks, solar energy zones, and mine pits, along with the restructuring of agricultural layouts. Additional strategies address transportation connectivity, water systems, population mobility, and the overall scale of urban development.



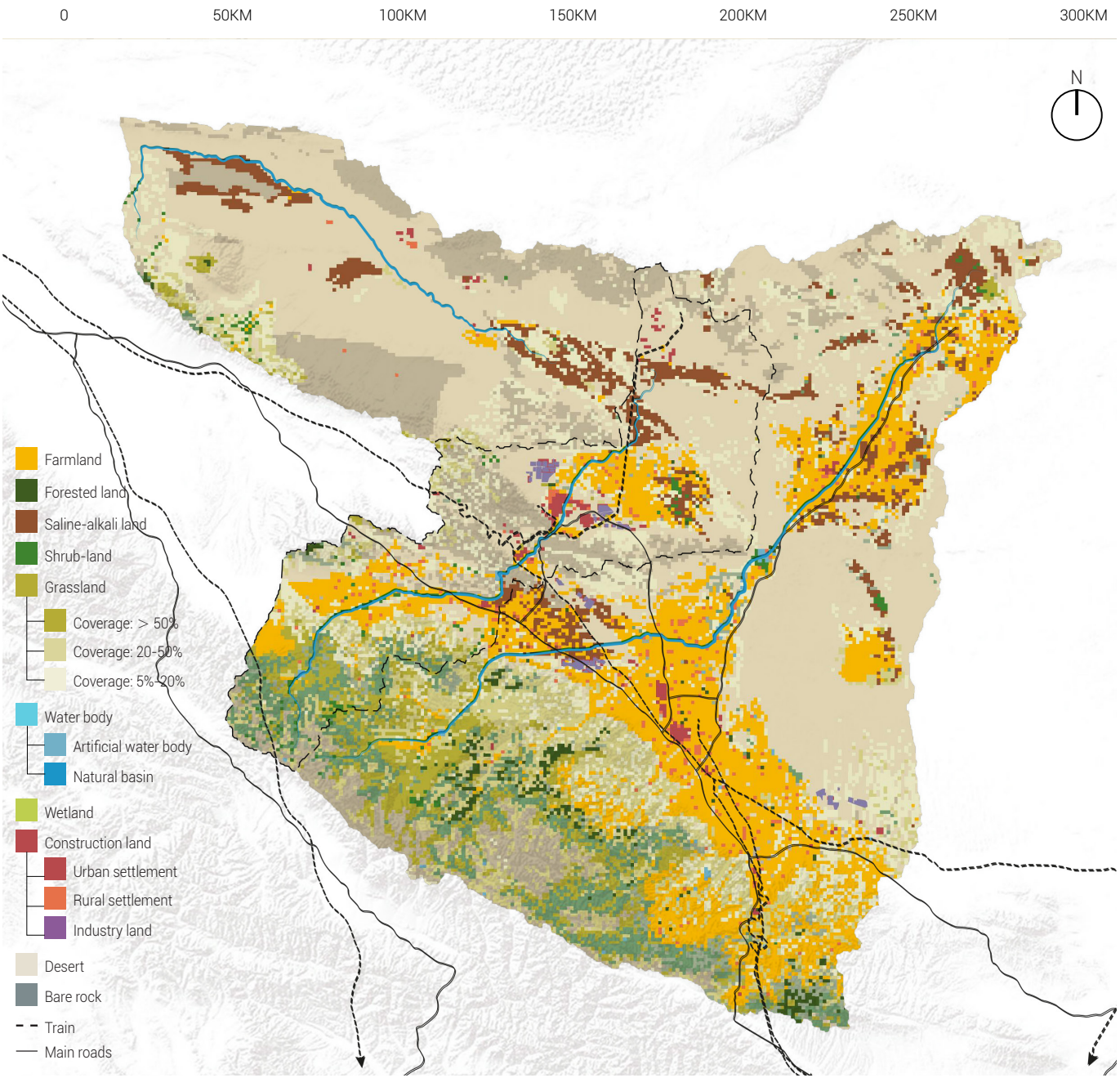
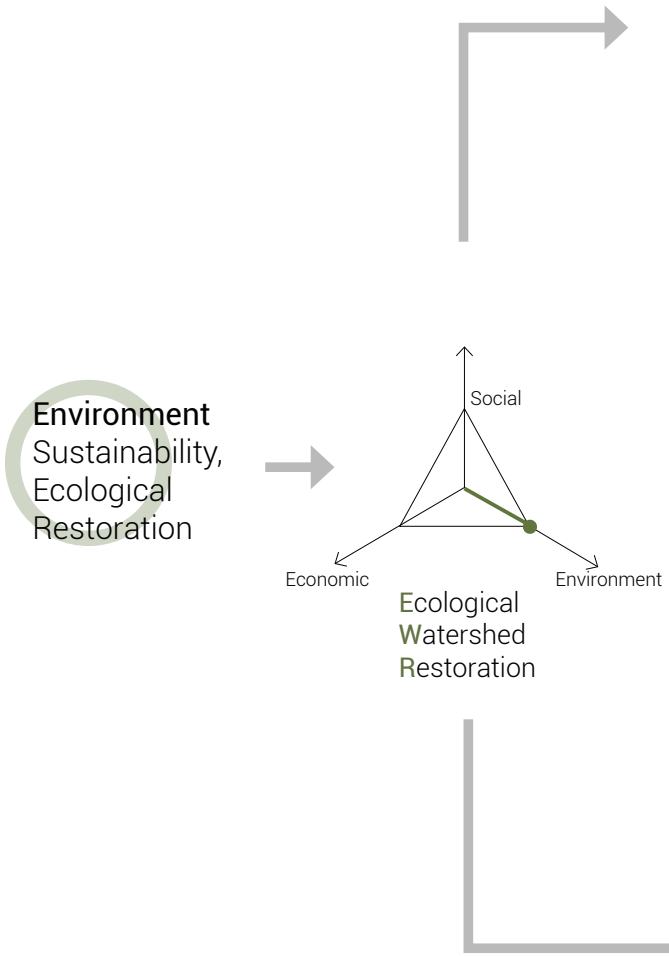


Figure: Scenario base-map (Source: Drawn by the author)

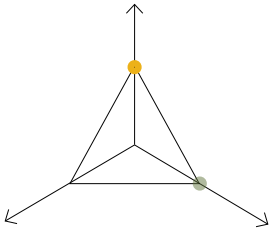
4.4 Scenarios Managed Shrinkage: A Shrinking but Sustainable City

Introduction

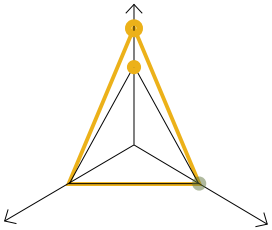
Mainly focused on acceptance of industrial decline and urban scale reduction,
regional development of agriculture, utilization of industrial spaces for agricultural production and service facilities,
preservation of historical sites, and integration into the Silk Road tourism.



Social
Inclusive,
Equity

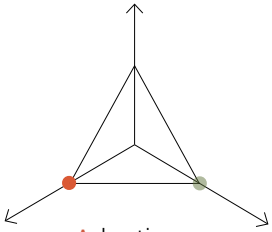


Cultural
Heritage
Preservation



Social
Inclusion

Managed Shrinkage
Social Needs-Oriented &
Governance Priority



Adaptive
Reuse of
Industrial
Heritage

Characteristics of the scenario

Urban Restructuring:

Manage urban development by setting urban growth boundaries to limit expansion. Proactively downsize unused industrial and residential areas, repurposing land for community parks, green buffers, and urban agriculture.

Water Management:

Optimize water distribution through reservoirs and channels, improve the utilization rate of reclaimed water, and replenish groundwater reserves.

Public Services and Social Inclusion:

Prioritize historical site preservation and invest in public services (education, healthcare) in marginalized communities to enhance social resilience and inclusivity.

Regional Coordination for Urbanization Control:

Strengthen government-led regional cooperation to manage population flows, ensuring fair resource allocation and social equity through policy regulation.

note: Scenario illustrations will be included in the presentation.

Factors Affecting Sustainable Transition:

Without economic recovery as support, the city may face further decline.

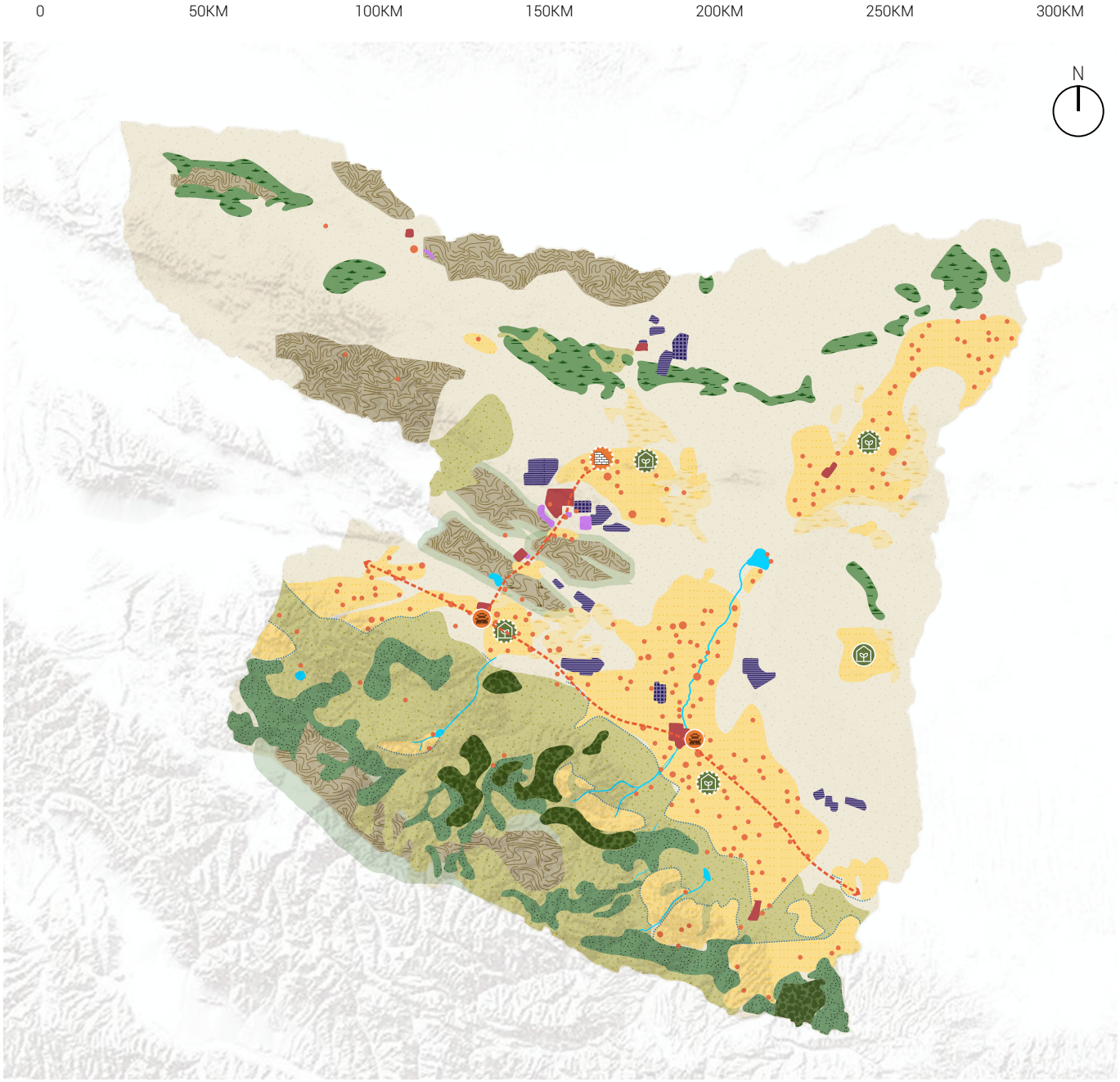


Figure: Managed Shrinkage Scenario vision map (Source: Drawn by the author)

The Pathway of Strategies and Actions of Managed Shrinkage scenario

This transformation pathway focuses on leveraging existing assets under a shrinkage policy to support sustainable regional development. Historical areas linked to the ancient Silk Road are preserved and integrated into cultural tourism, requiring supportive infrastructure such as guesthouses and visitor facilities. Vacant rural residences are repurposed to accommodate tourism, creating new economic opportunities.

As industrial activity declines, former industrial sites become heritage spaces that can be converted into public service facilities—such as libraries and community centers—to enhance living conditions, especially in peripheral urban areas. In parallel, regional agricultural development is advanced by repurposing industrial parks into small and medium-sized agro-enterprises and transforming mining pits into vertical farming zones.

Together, these strategies aim to promote a transition toward modernized, locally integrated agriculture while supporting cultural tourism and improving spatial equity.

Note: Text enclosed in double quotation marks ("") refers to potential future milestones or intended planning outcomes

Social Inclusion strategy
Urban boundary control

Adaptive Reuse of Industrial Heritage
Historical heritage protection

Cultural Heritage Preservation
Provide Tourism Facilities

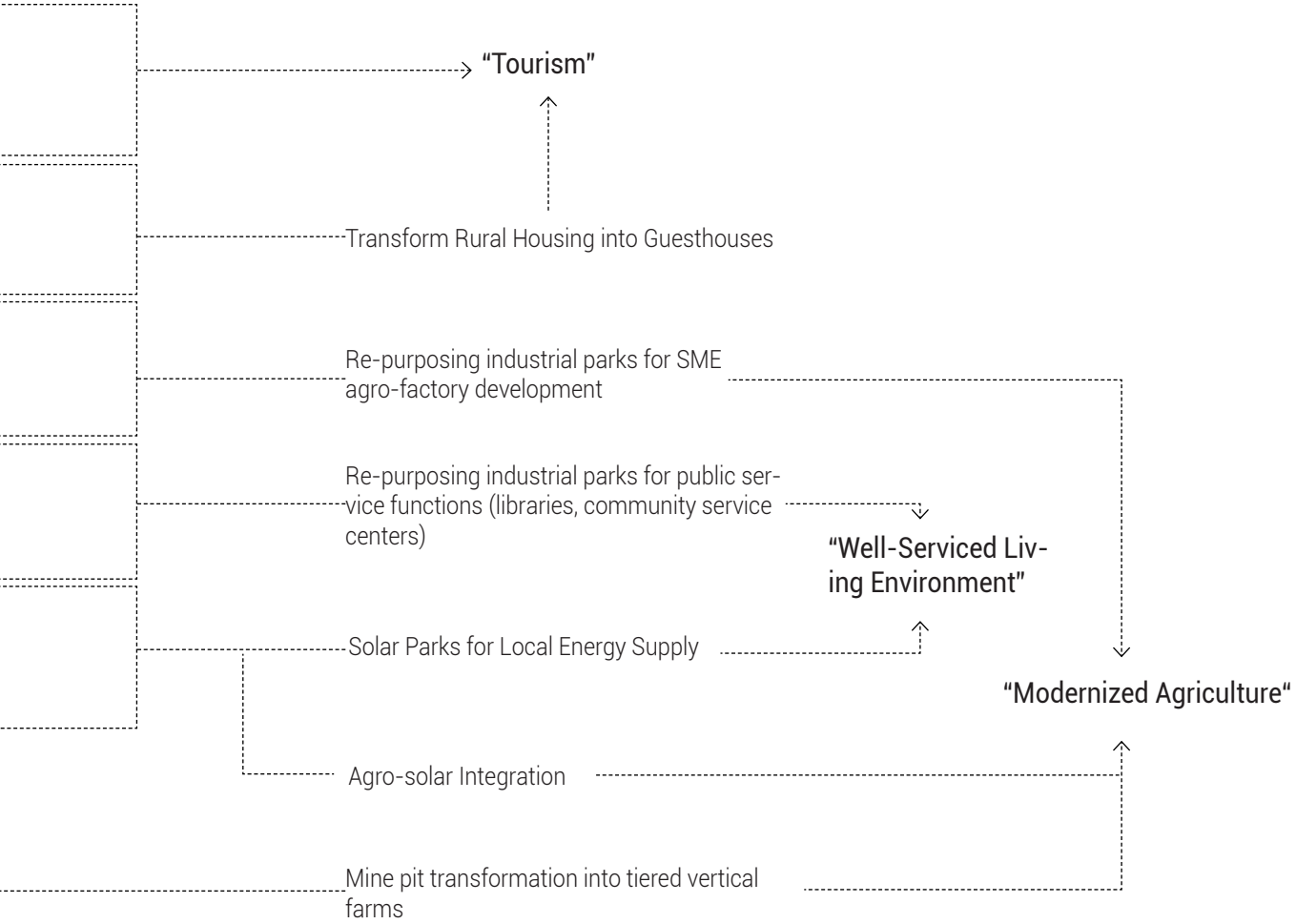
Social Inclusion strategy
Provide Employment Opportunities

Adaptive Reuse of Industrial Heritage
Re-purposing industrial parks

Social Inclusion strategy
Residential Quality Improvement

Adaptive Reuse of Industrial Heritage
agro-solar Integration

Adaptive Reuse of Industrial Heritage
Mine pit Restoration and Reuse


"Tourism"
Transform Rural Housing into Guesthouses
Re-purposing industrial parks for SME agro-factory development
Re-purposing industrial parks for public service functions (libraries, community service centers)
"Well-Serviced Living Environment"
Solar Parks for Local Energy Supply
"Modernized Agriculture"
Agro-solar Integration
Mine pit transformation into tiered vertical farms

Strategy Implementation Phase

Milestones

Territorial spatial planning boundaries updated

Mineral resources depleted

Phase

Phase one: base conditioon identification and early action preparation
Characteristics: mineral resources are not yet depleted; mining industries are still operating.

Phase two: pilot implementation and preparation for alternative industries
Characteristics: Resource depletion and industrial decline.

Strategies and Actions

Social Inclusion strategy

action: urban boundary control

In urban areas within the region, under an economic decline scenario, development focuses on opportunities within existing built-up areas rather than spatial expansion, emphasizing the renewal of vacant and underutilized land.

Cultural Heritage Preservation

action: Historical Heritage Preservation

Protect historical and industrial heritage sites. This includes the preservation and development of historical sites within and around the city, such as the Qin and Ming Dynasty sections of the Great Wall and the Sanjiaocheng ruins.

action: Provide Tourism Facilities

Under the requirements of a stock-based development scenario, vacant rural houses resulting from the urbanization process are to be transformed into guesthouses and visitor service facilities.

Adaptive Reuse of Industrial Heritage

action: Agro-solar Integration

Many solar parks in the region struggle to remain profitable after losing policy support. This scenario explores local reuse by combining solar panels with agriculture, using the heat effect for cultivation and supplying energy for local use.

Adaptive Reuse of Industrial Heritage

action: Mine pit pollution remediation

action: Repurpose industrial parks for SME agro-factory development

action: Repurpose industrial parks into public service facilities

action: Development of local solar power supply lines

Social Inclusion strategy

action: Residential Quality Improvement

With industrial decline, many parks on the urban fringe become heritage sites. These are repurposed into community centers, libraries, and other public facilities to improve services in nearby rural and informal areas.

Cultural Heritage Preservation

action: Local cultural tourism route planning

Public Participation

Public participation in co-developing the urban vision

Public participation in the co-design of urban renewal

Industrial pollution remediated

Becomes a tourism hotspot on Internet

Phase three: Traditional industries gradually phase out, and industrial heritage sites are repurposed
Characteristics: Formation of alternative industries.

Adaptive Reuse of Industrial Heritage

action: Mine pit Restoration and Reuse

Based on preserving mine pit heritage, pollution is remediated and vertical farming is explored to expand agricultural space, combining industrial landscape with farming to support both tourism and production.

action: Agri-solar corridor established, and local solar power supply systems improved

Cultural Heritage Preservation

+

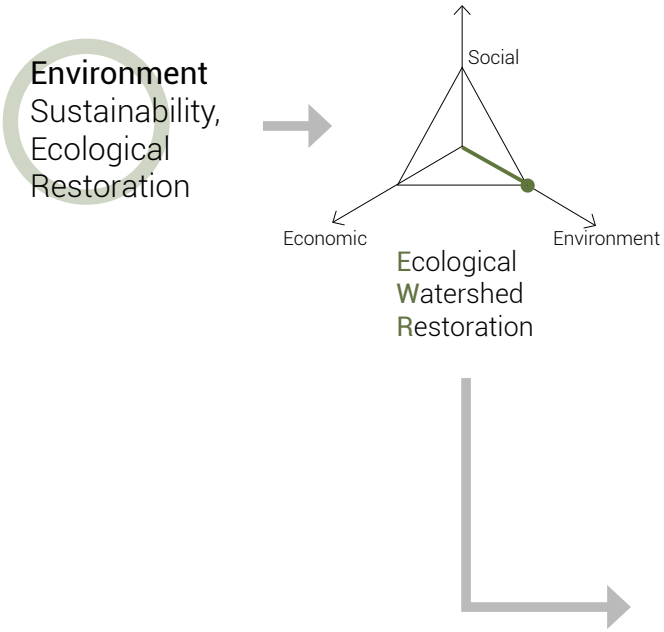
Adaptive Reuse of Industrial Heritage

Through industrial heritage tourism, cultural heritage tourism, and the integration of industrial landscapes with agriculture, a unique local tourism identity is formed along the Silk Road route.

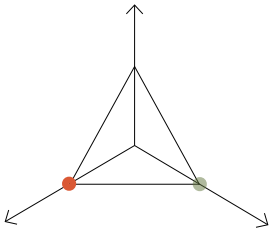
4.5 Scenarios Industrial Revival: A Tech-driven Future

Introduction

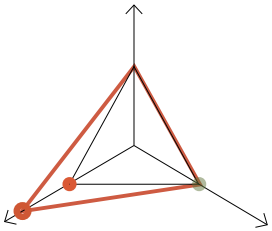
Aiming at economic revival and industrial upgrading, promote industrial development through technological innovation and market mechanisms to enhance urban economic vitality.



Economic
Diversification,
Resilience



Adaptive
Reuse of
Industrial
Heritage



Inclusive
Economic
Transition

Industrial Revival
Market-Oriented

Characteristics of the scenario

Infrastructure Expansion:

Upgrade transportation networks to strengthen connections with national and provincial highways, enhancing regional economic connectivity. Increase train frequencies and renovate industrial parks with modular layouts, improved facilities, and enhanced environmental standards.

Industrial Upgrading:

Focus on technological breakthroughs to achieve a circular economy, where industrial processes benefit urban living, such as waste heat for heating, solar power for energy supply, and water recycling for environmental projects. Reserve land for future solar energy parks in areas with minimal ecological impact and good transport access, promoting industrial chain extension. Industrial investments are primarily driven by Jinchuan Group, focusing on new energy and manufacturing, while opening up industrial parks to encourage the entry of small and medium-sized enterprises.

Social Participation:

Encourage economic diversification and support the presence of regulated small businesses in urban centers to stimulate local commerce.

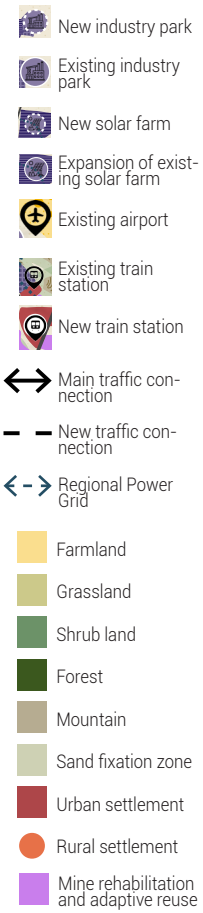
Environment:

Focus on industrial environmental restoration, including the conversion of abandoned mines into parks and the treatment of slag disposal sites. Enhance water recycling, optimize water-saving technologies, and employ carbon capture technologies and efficient waste management to reduce industrial impacts.

Factors Affecting Sustainable Transition:

Industrial expansion may increase environmental pressure, and technological upgrades in industries may face significant challenges. Economic benefits could be concentrated among a few dominant entities, potentially exacerbating social inequality.

note: Scenario illustrations will be included in the presentation.



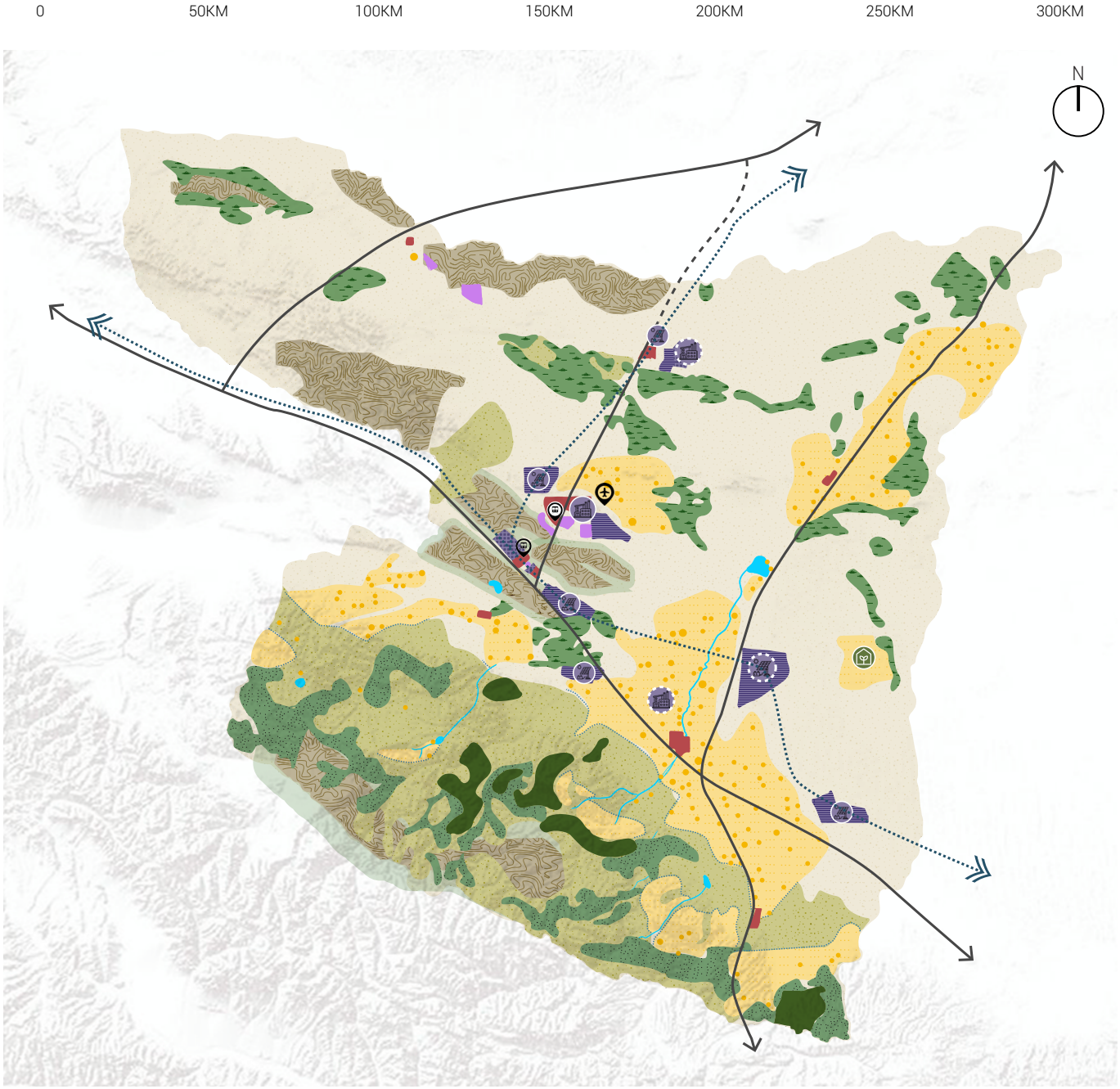


Figure: Industrial Revival Scenario vision map (Source: Drawn by the author)

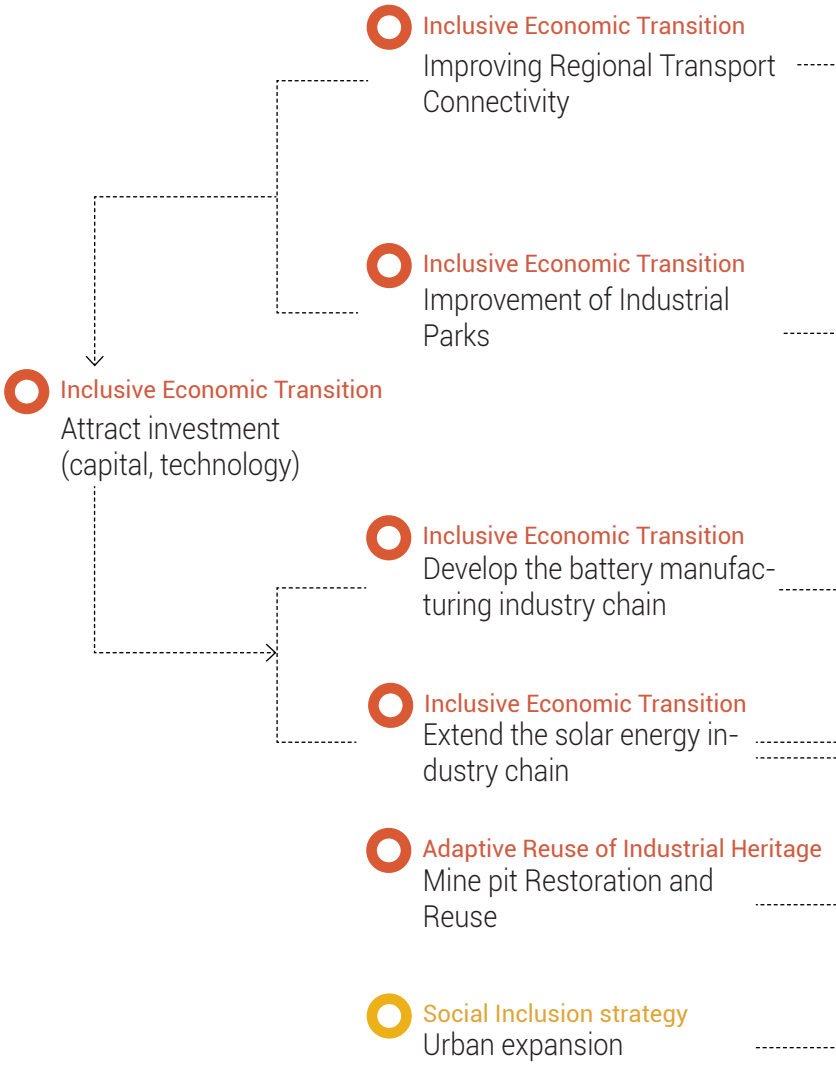
The Pathway of Strategies and Actions of Industrial Revival

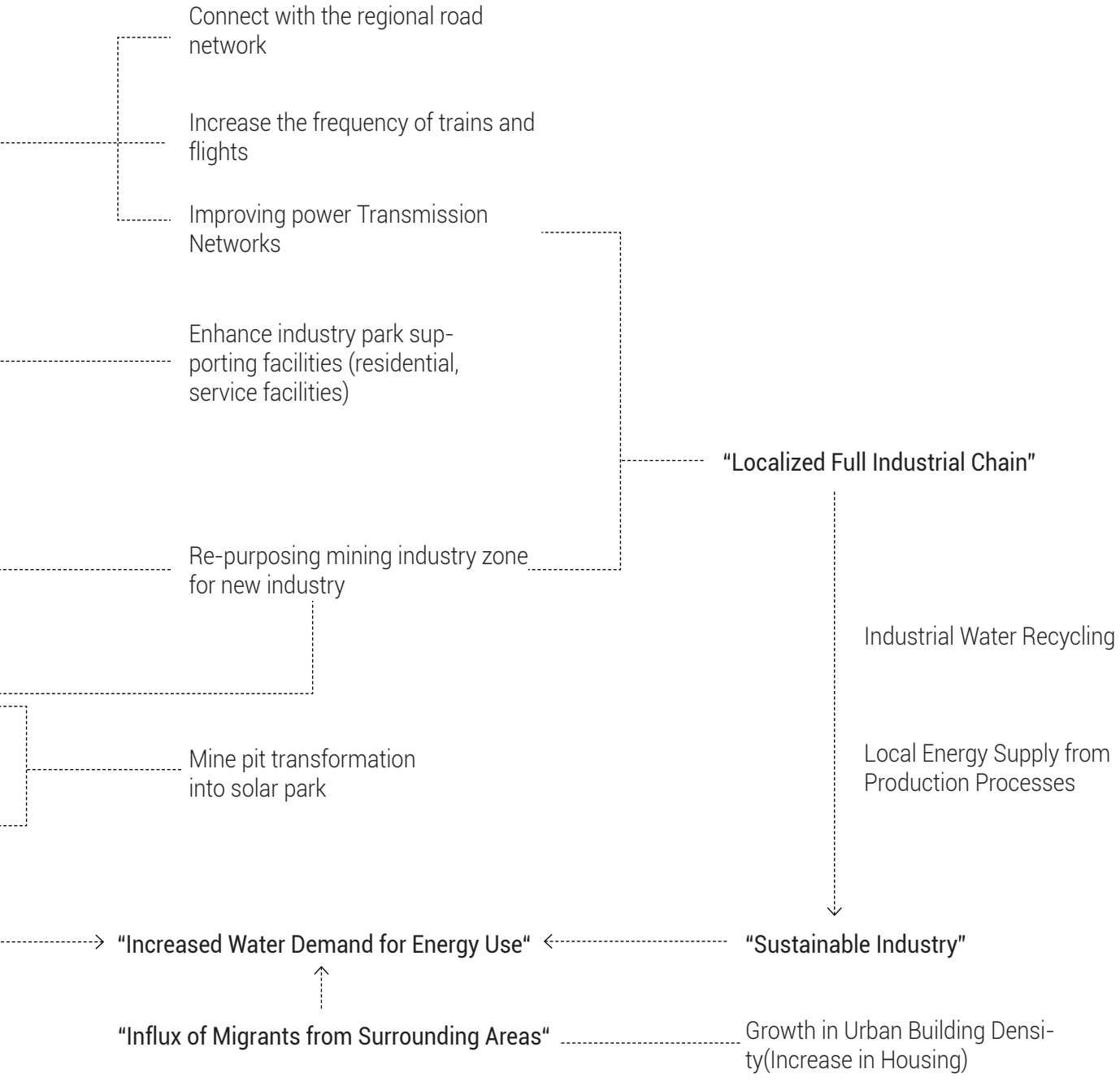
This scenario envisions industrial revitalization driven by the attraction of external technologies and investments. By improving transportation connectivity and upgrading industrial park infrastructure, the region aims to integrate with the broader regional transport network and enhance its capacity to support new industrial development.

With these advancements, the region could attract high-tech industries such as battery and solar panel manufacturing, forming two new industrial chains. Abandoned mining sites would be repurposed for emerging industries, while existing solar energy parks would expand. Nickel mines, in particular, could be transformed into solar energy production zones.

Together, these developments would establish a localized industrial chain encompassing solar panel manufacturing, energy production, battery manufacturing, and energy storage and transmission. As industrial growth accelerates, the city is expected to expand, attracting population from surrounding areas. This would require urban boundary expansion and increased residential density to accommodate housing demand.

Note: Text enclosed in double quotation marks ("") refers to potential future milestones or intended planning outcomes

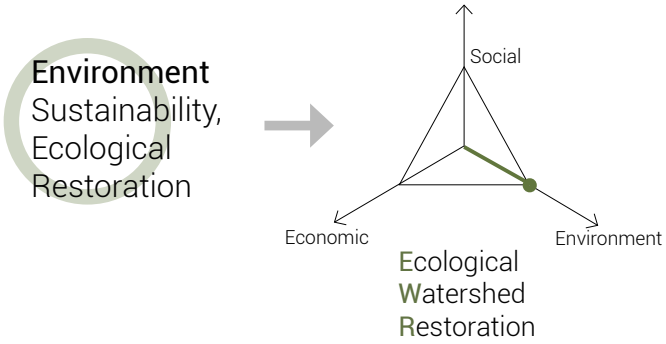


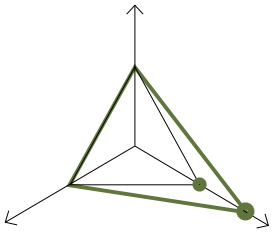

Connect with the regional road network
Increase the frequency of trains and flights
Improving power Transmission Networks
Enhance industry park supporting facilities (residential, service facilities)
"Localized Full Industrial Chain"
Re-purposing mining industry zone for new industry
Industrial Water Recycling
Mine pit transformation into solar park
Local Energy Supply from Production Processes
"Increased Water Demand for Energy Use"
"Sustainable Industry"
"Influx of Migrants from Surrounding Areas"
Growth in Urban Building Density(Increase in Housing)

4.6 Scenarios Desert Oasis: An Ecological Vision

Introduction

Based on an ecological restoration and nature-first pathway, it emphasizes the reconstruction of human-environment relationships, even at the cost of short-term economic growth to achieve long-term ecological recovery.





Cultural
Landscape
Restoration

Desert Oasis Scenario
Ecological Priority

Characteristics of the scenario

Based on an ecological restoration and nature-first pathway, this approach emphasizes the reconstruction of human-nature relationships, even at the cost of short-term economic growth, to achieve long-term ecological recovery.

Ecological Restoration:

Large-scale vegetation restoration, mixed-species planting, and salt-tolerant shrub planting to combat desertification. Seasonal river de-channelization or environmental landscape improvement based on shoreline functions to enhance groundwater recharge. Cultural landscape restoration to strengthen social identity.

Water Resources:

Sustainable water use through groundwater replenishment, natural infiltration zones, and the restoration of natural grasslands.

Economy:

Development of desert oasis landscape ecotourism, sustainable agriculture (e.g., apples, goji berries), and green industries as primary economic drivers.

Community Participation:

Local communities participate in river restoration projects, encouraging agricultural populations to engage in ecological protection, agroforestry, and ecological volunteer services, enhancing community cohesion.

Factors Affecting Sustainable Transition:

The cost of ecological restoration is high, and prioritizing the environment over economic growth may result in slower economic development and delayed results. Traditional mining industries may resist policies that prioritize ecological restoration.

note: Scenario illustrations will be included in the presentation.

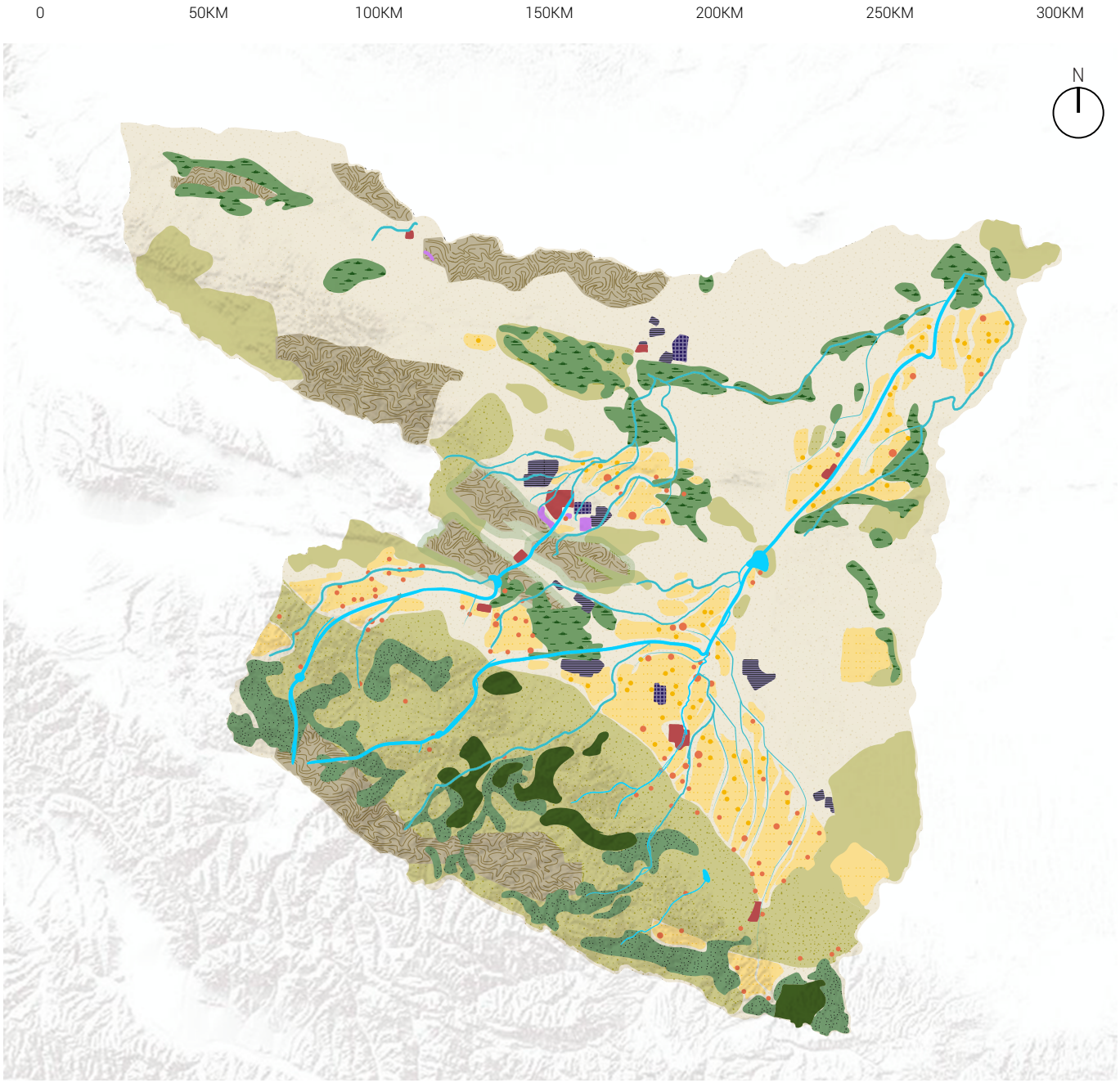


Figure: Desert Oasis Scenario vision map (Source: Drawn by the author)

The Pathway of Strategies and Actions of Desert Oasis

This vision focuses on restoring the city's lost connections with its surrounding natural landscapes—mountains, rivers, and deserts—while integrating these efforts into a cohesive green-blue infrastructure network. The mining areas at the foot of the mountains are transformed into industrial heritage tourism zones, complemented by the introduction of mountain climbing activities and enhanced walkable city pathways with mountain views.

River reconnection efforts are divided into three categories. In rural areas, traditional farmland patterns and river restoration are implemented to form seasonal river buffers and small-patch agriculture. This process aligns with gradual urbanization, rural depopulation, and the increasing vacancy of village houses and farmland. In urban areas, waterfront accessibility is improved along artificial shorelines in parks, while river channels are restored in industrial zones to enhance environmental quality. In shelterbelt zones, naturalized riverbanks are combined with agroforestry systems to support biodiversity.

At the urban edge, former factory sites are repurposed into desert viewing points, creating opportunities for residents and visitors to engage with the desert landscape. These elements are interconnected through the city's green-blue infrastructure pathways, which also serve as a boundary for urban expansion control. The overarching vision is to restore a desert oasis landscape that can serve as both an ecological buffer and a regional tourist attraction.

Note: Text enclosed in double quotation marks ("") refers to potential future milestones or intended planning outcomes

Adaptive Reuse of Industrial Heritage
Mining Industrial Heritage Site Redevelopment

Cultural Landscape Restoration
Restore the connection with the **mountains**

"With urbanization and village aging, villages and farmlands become vacant"

Rural Areas:
Seasonal River Restoration

Cultural Landscape Restoration
Restore the connection with the **river**

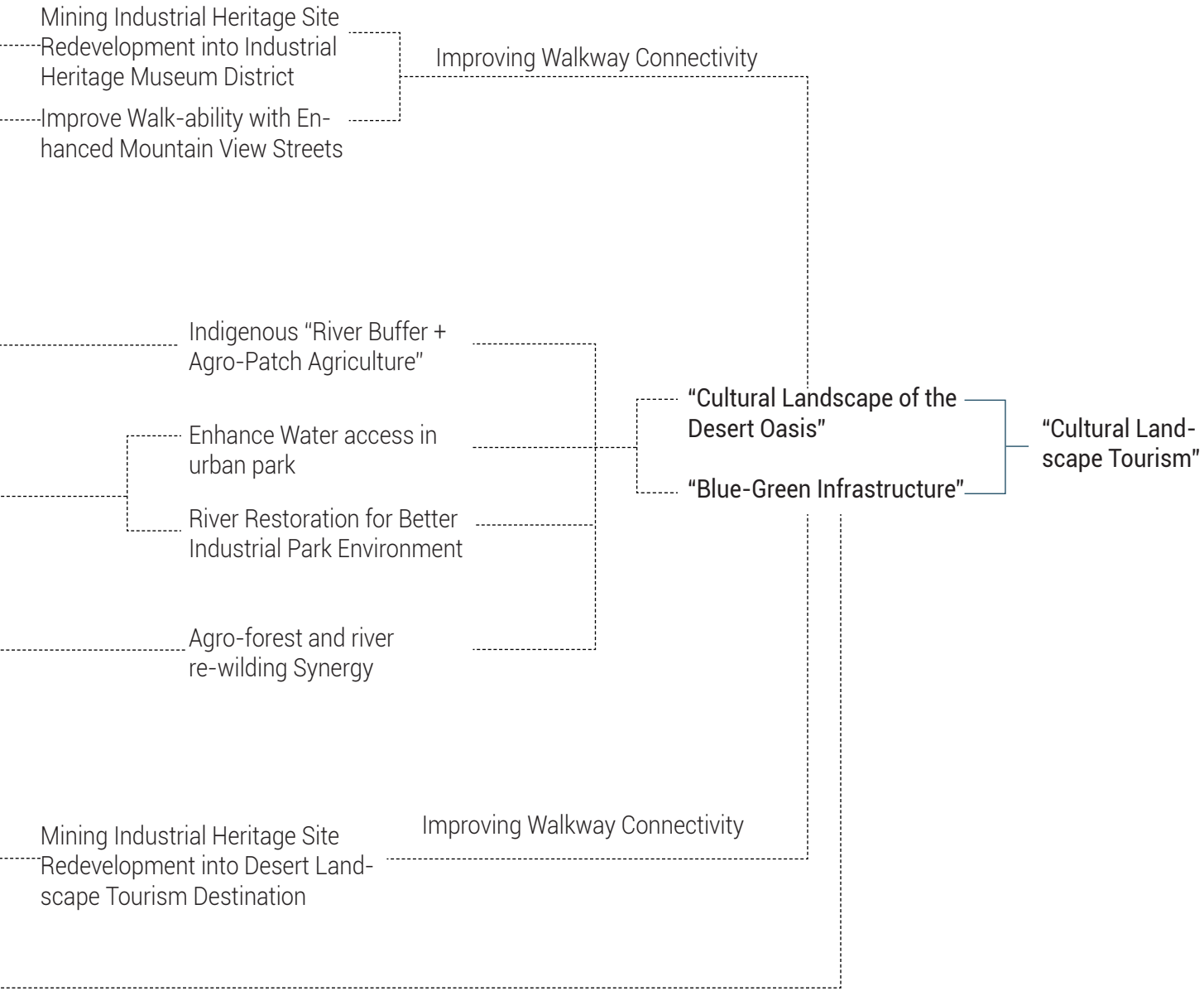
Urban Areas:
Transform Artificial Shorelines to Enhance Water Interaction

Shelter-belts:
Re-wilding Artificial Channels

Cultural Landscape Restoration
Restore the connection with the **desert**

Adaptive Reuse of Industrial Heritage
Mining Industrial Heritage Site Redevelopment

Social Inclusion strategy
Urban Boundary Control


Mining Industrial Heritage Site Redevelopment into Industrial Heritage Museum District
Improve Walk-ability with Enhanced Mountain View Streets
Improving Walkway Connectivity
Indigenous "River Buffer + Agro-Patch Agriculture"
Enhance Water access in urban park
River Restoration for Better Industrial Park Environment
Agro-forest and river re-wilding Synergy
"Cultural Landscape of the Desert Oasis"
"Blue-Green Infrastructure"
"Cultural Landscape Tourism"
Mining Industrial Heritage Site Redevelopment into Desert Landscape Tourism Destination
Improving Walkway Connectivity

The design primarily implements the Desert Oasis strategy, while also integrating elements from the other two scenarios.

5 Design Implement

5.1 Location and current condition

Location

Design the implementation of planning strategies within the urban space, focusing on the main urban area of Jinchuan District and its surrounding agricultural and industrial lands.

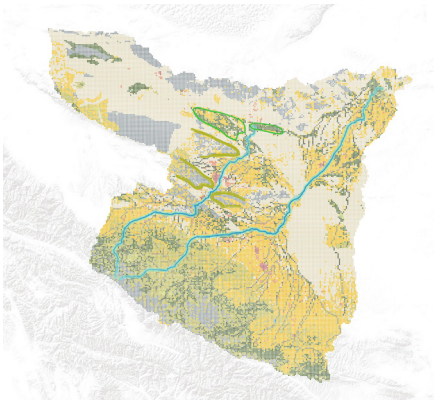


Figure: x (Source: Drawn by the author)

Current condition

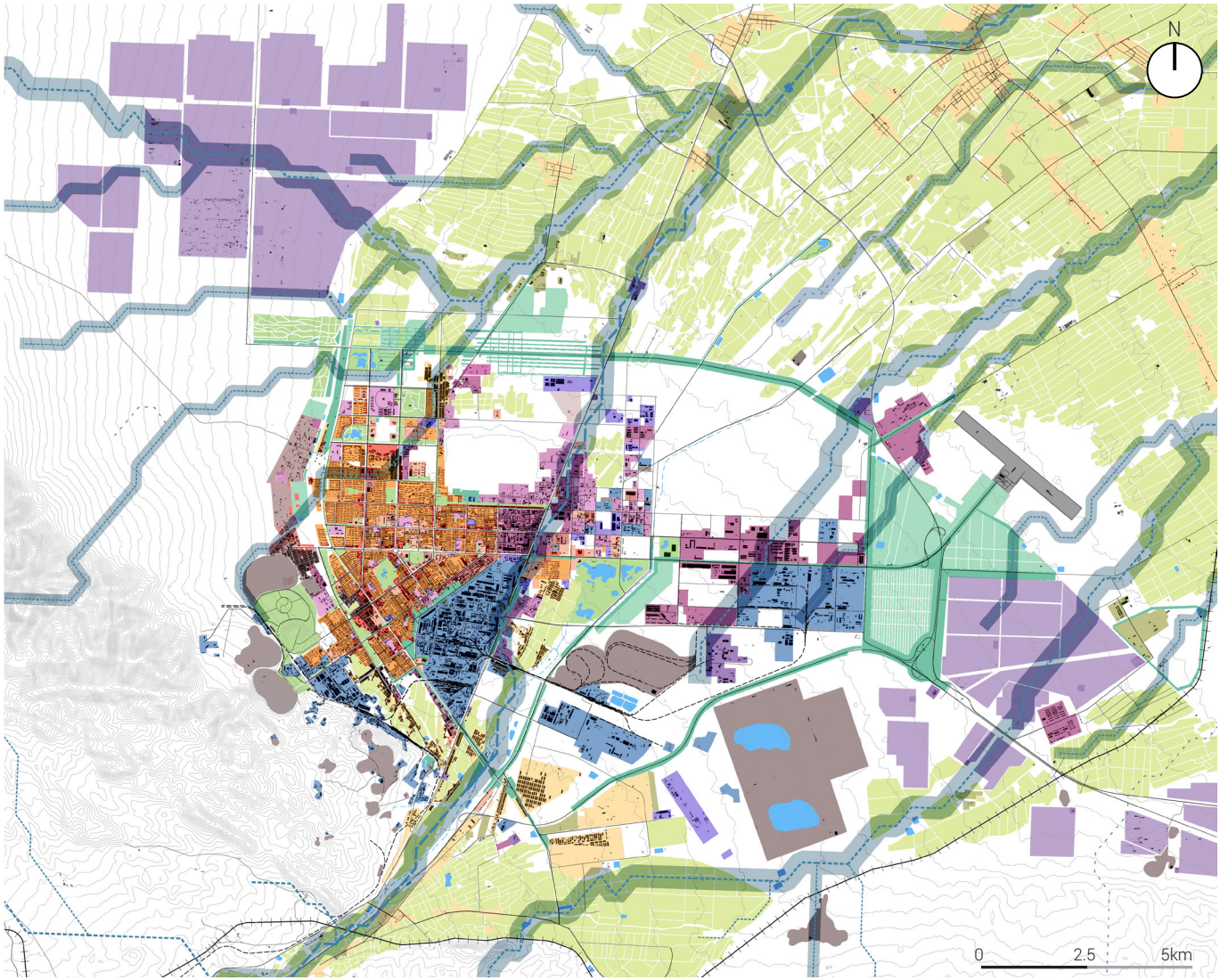


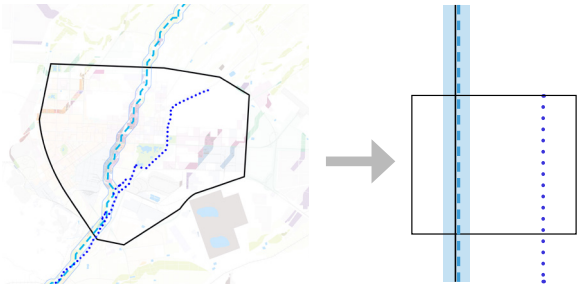
Figure: Design implement location-Jinchuan district (Source: Drawn by the author)

5.2 River–Land Use Interactions Abstract

Current Condition

Analyze the land use types within the current river buffer zones to provide a foundation for strategic development.

Using the largest tributary, the Jinchuan River, as an example, the urban spatial pattern is abstracted to examine the overlaps between the seasonal river course and various land use functions.



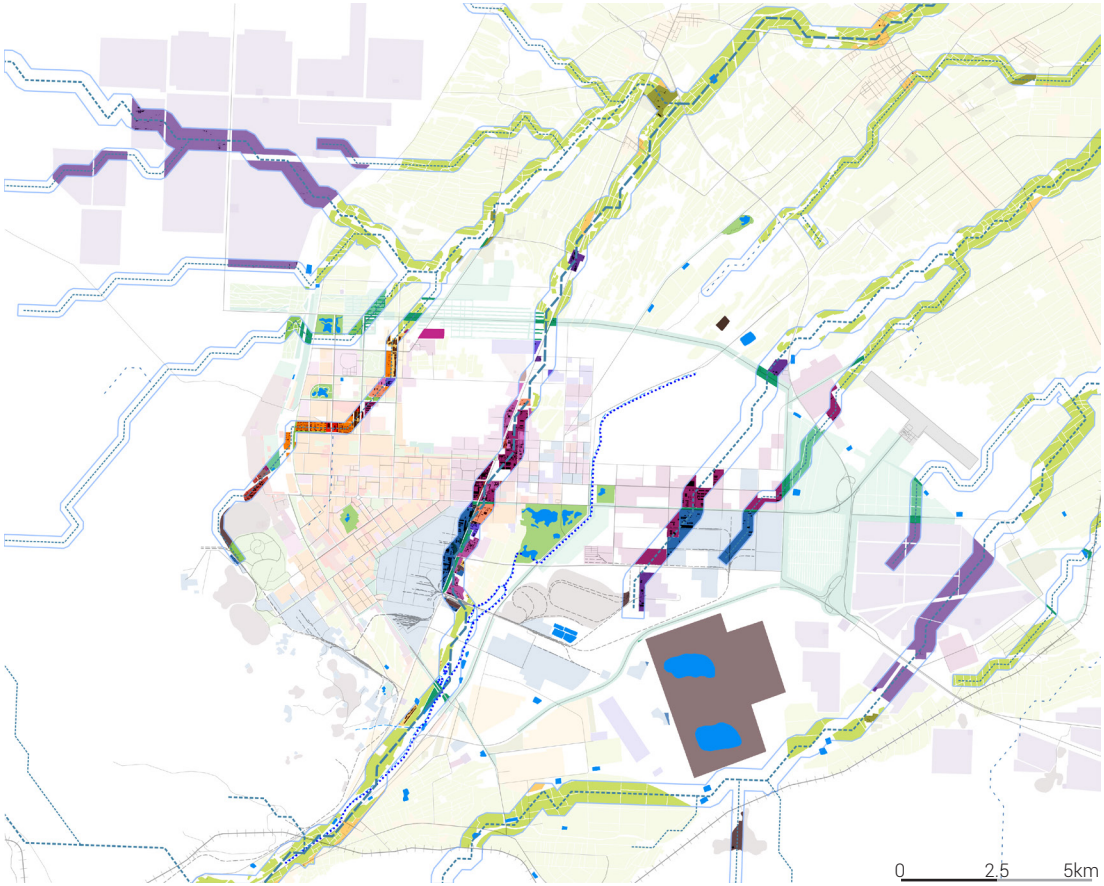


Figure: Map of overlaps between river-way and land-use functions (Source: Drawn by the author)

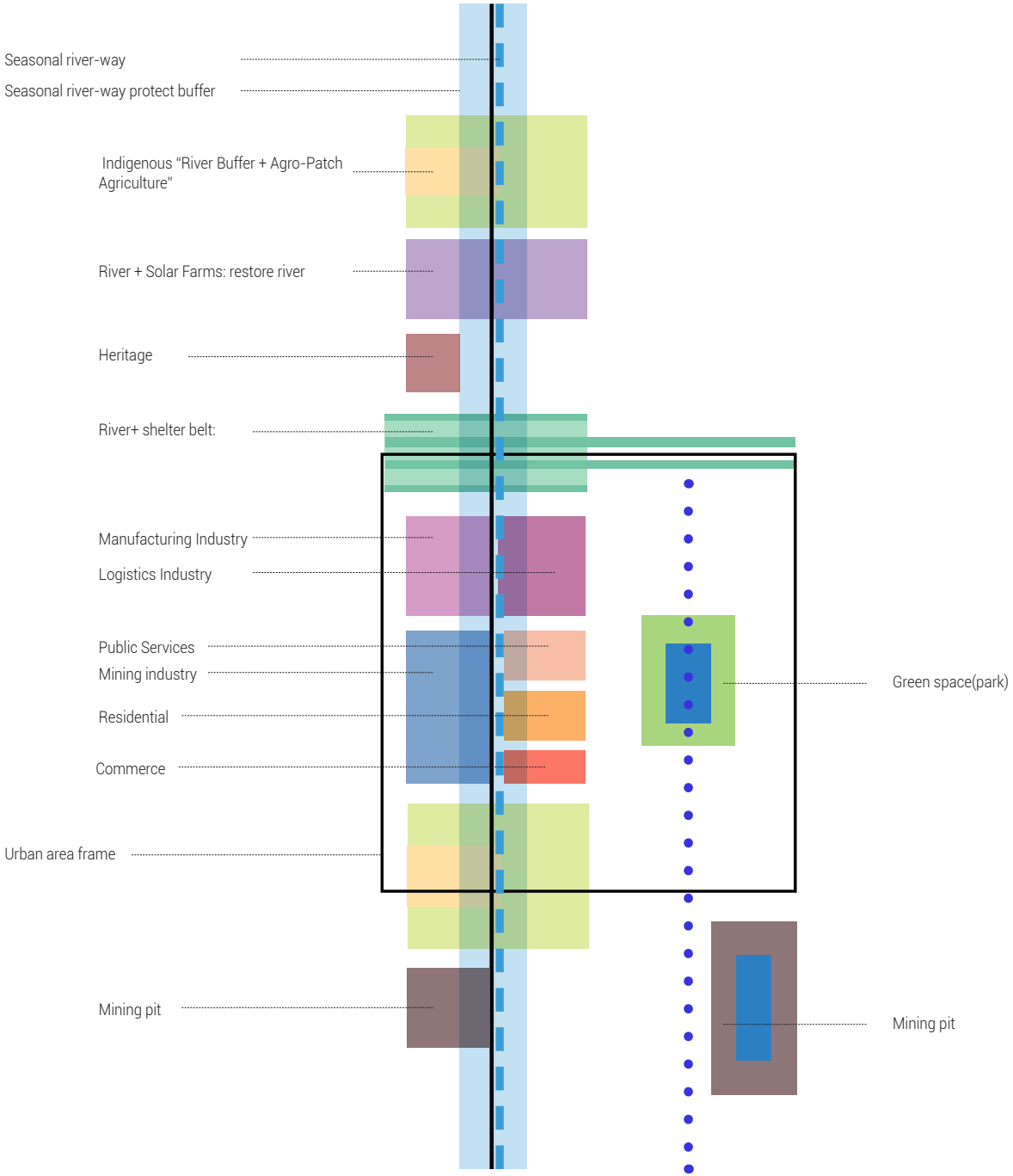
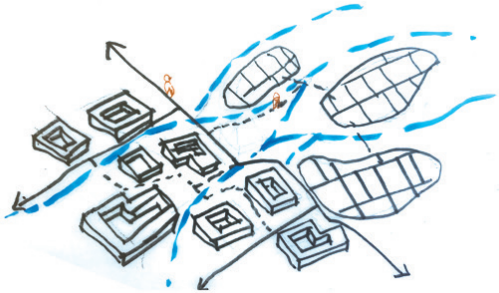


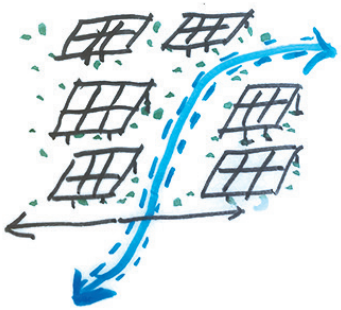
Figure: diagram of overlaps between river-way and land-use functions (Source: Drawn by the author)

5.3 Design Principles

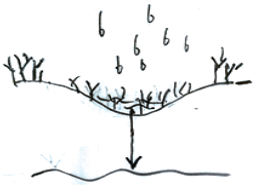
Rural area transform to Indigenous “River Buffer + Agro-Patch Agriculture”



Solar Farms, space for river, ecological solar park



Shelter belt: Agro-forestry and river restoration



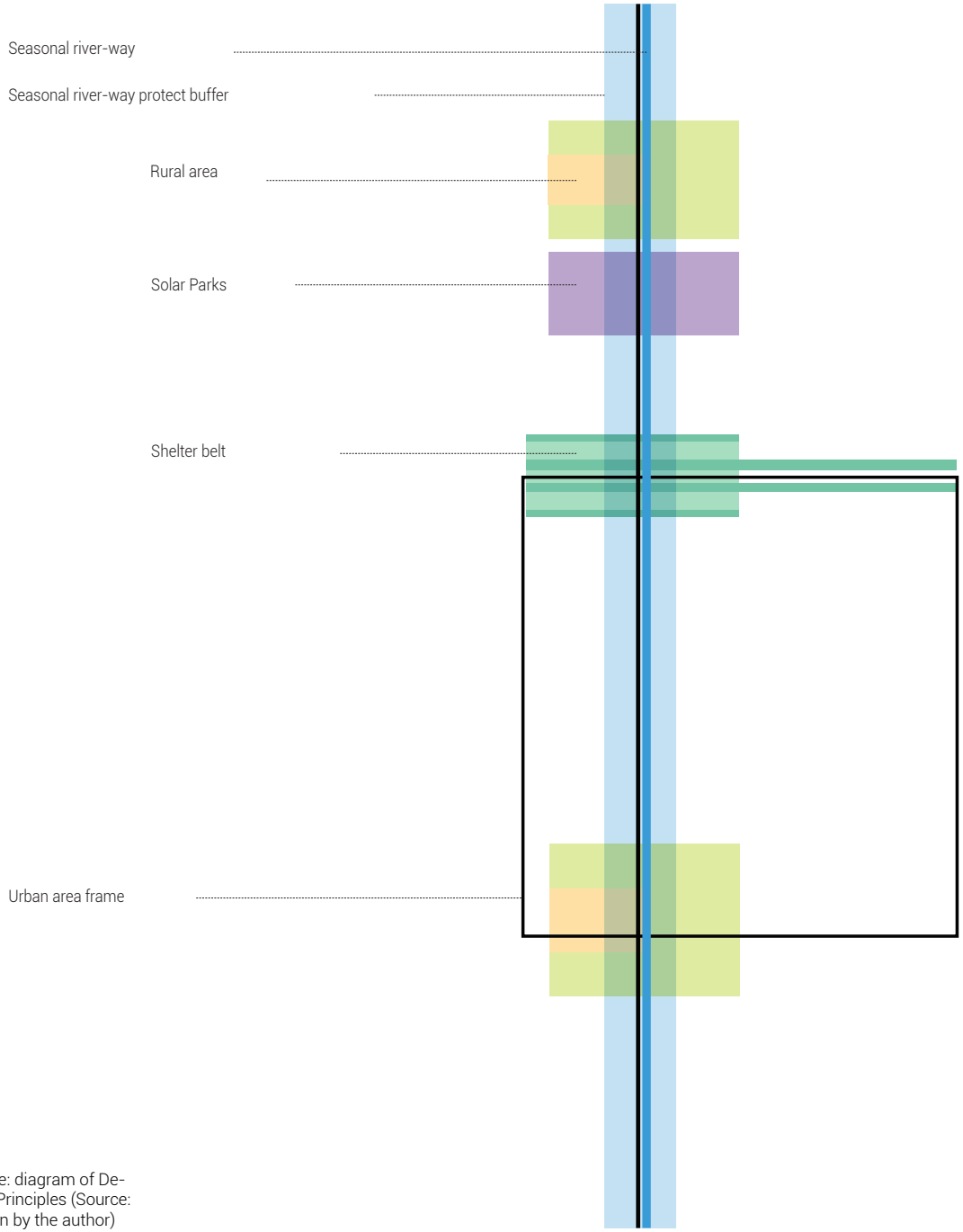


Figure: diagram of Design Principles (Source: Drawn by the author)

Industries:

· Withdrawal of polluting industries from river buffer

· Controlled low-density development

· Industry heritage re-purposed for public services

· Enhance supporting facilities of Industrial Parks (residential, service facilities)

Mining pit:

· Preservation of original landscape and pollution remediation

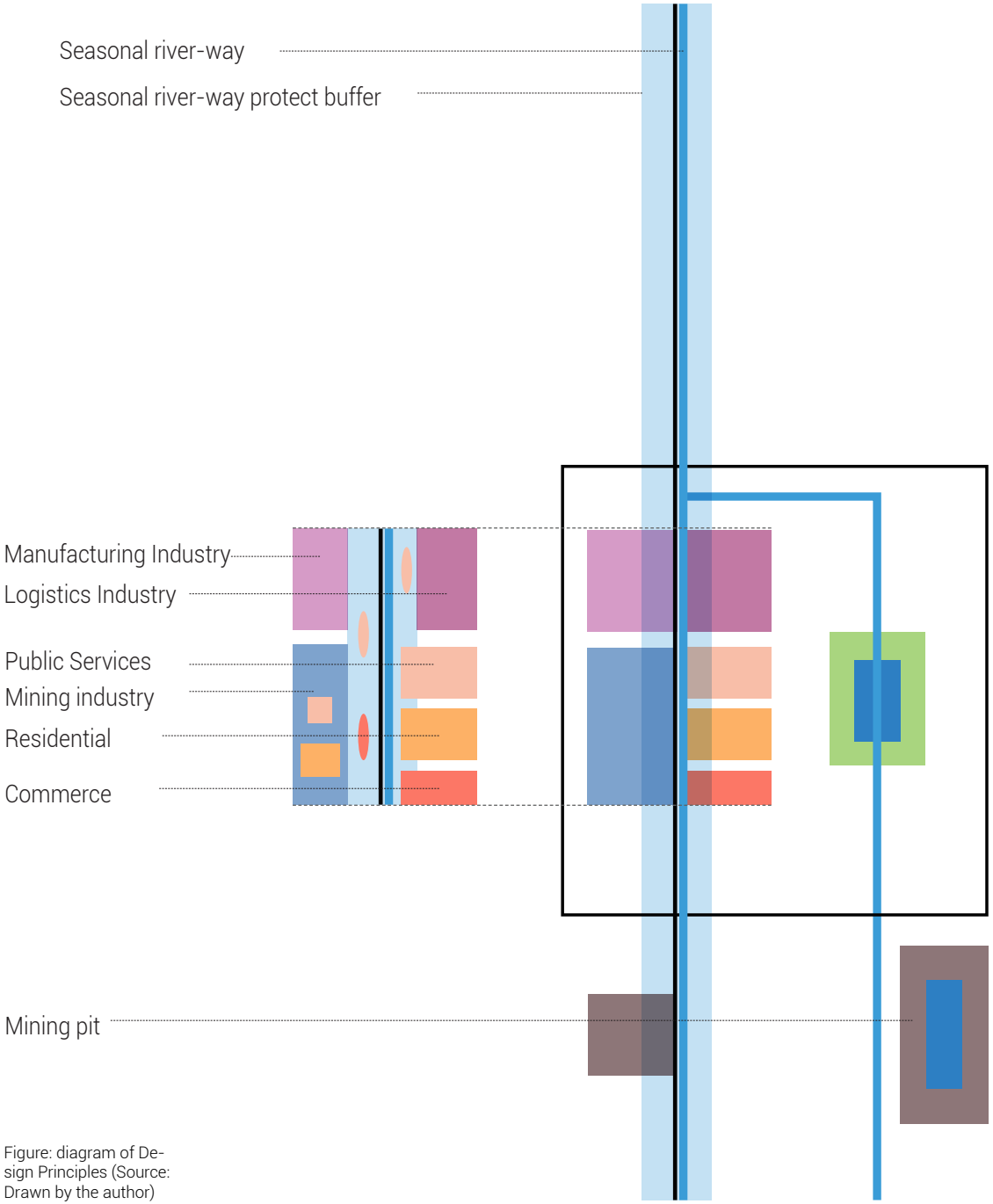


Figure: diagram of Design Principles (Source: Drawn by the author)

5.4 Design approach: Reviving the River

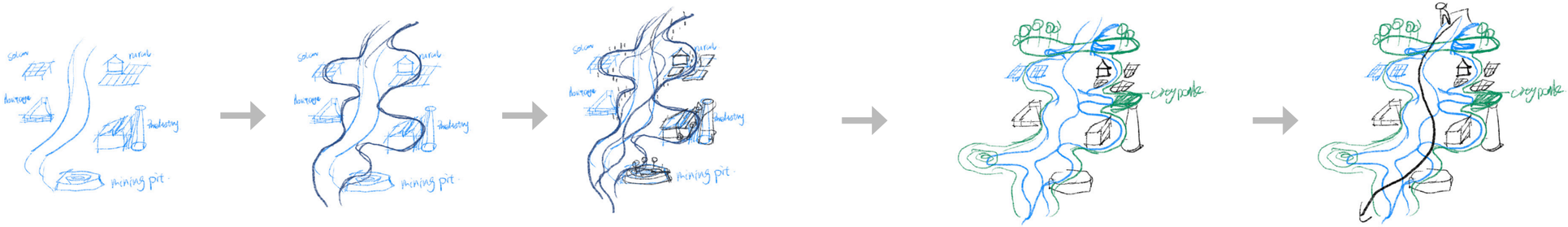
This design adopts river restoration as the core vision, integrating different strategies mentioned in the strategy chapter to generate new quality. Through the restoration of river ecology and the optimization of riverbank functional layouts, it aims to reconnect urban spaces with natural landscapes. The strategy emphasizes leveraging local knowledge and sustainable development principles to create an eco-friendly, community-driven river landscape.

STEP1:River System Integration and Spatial Optimization

Integrated seasonal riverbeds and designed a restored river system. The road network was optimized to reserve space for the river, supporting ecological flows and future adaptability.

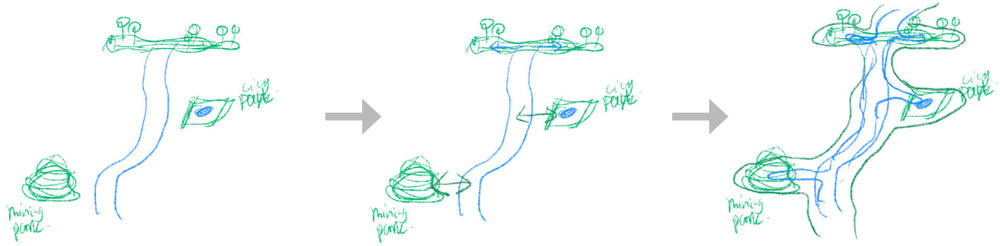
STEP2: Spatial Enhancement of River-Adjacent Functional Areas

Enhanced the spatial quality of functional areas overlapping with the river system, including industrial zones, public spaces, and both urban and rural landscapes.



STEP3: Green Infrastructure Integration

Integrated scattered green spaces to establish a cohesive green infrastructure network.



5.5 River System Integration and Spatial Optimization

Current Condition

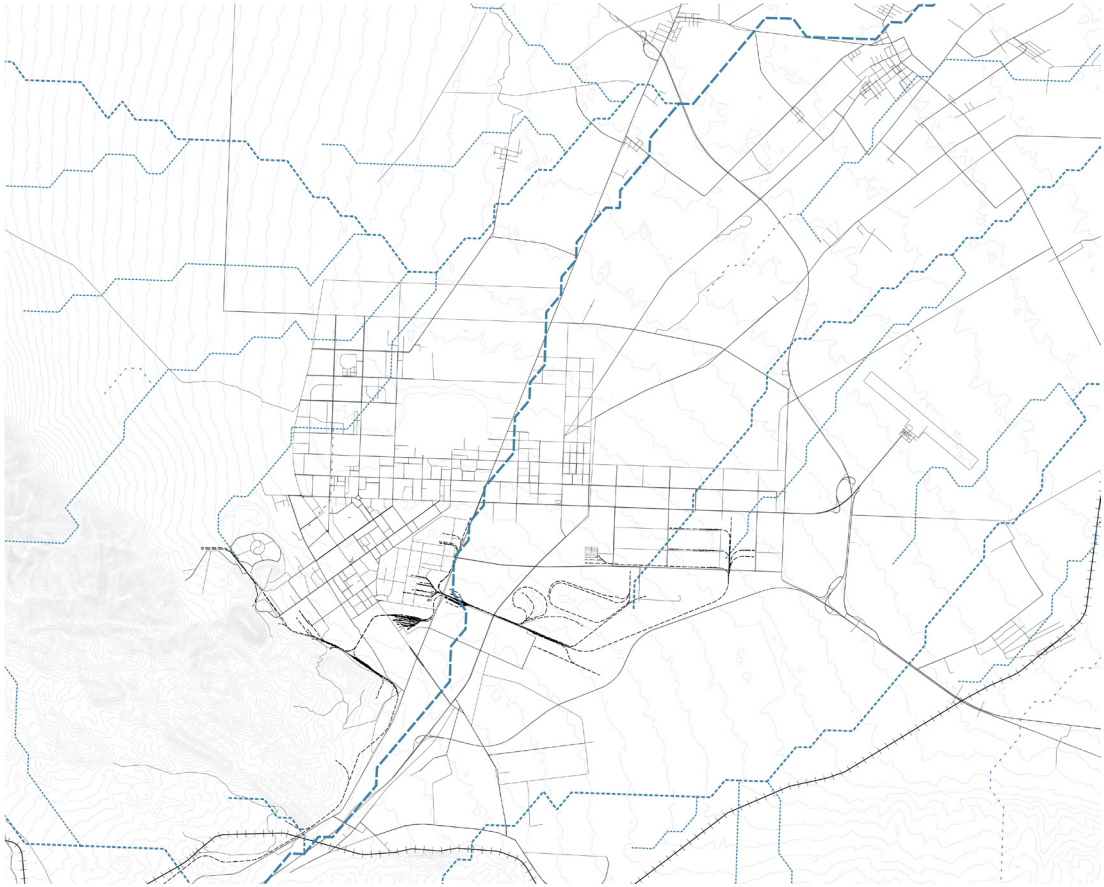


Figure: Current transport condition (Source: Drawn by the author)

Hydrological and Transportation Networks

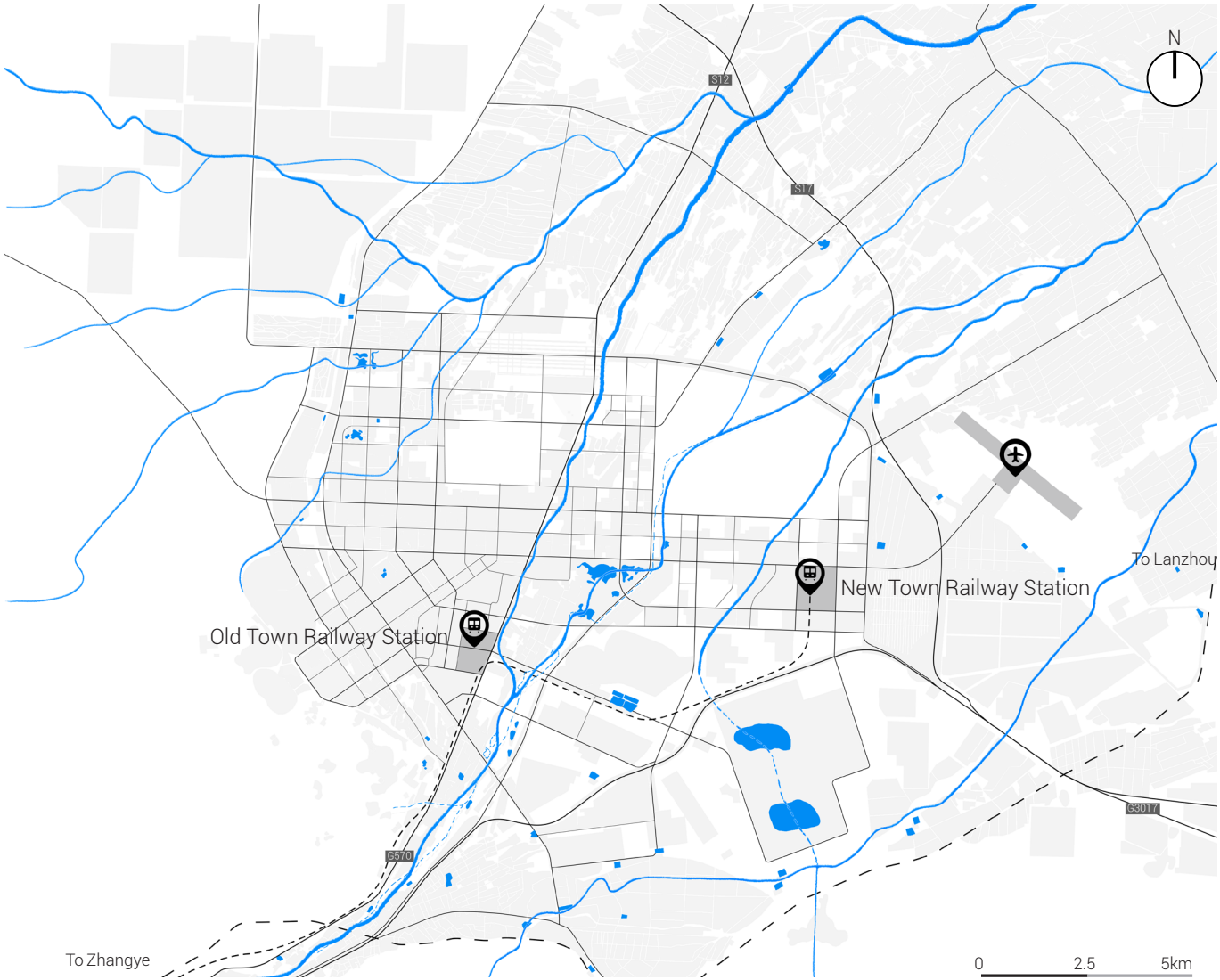


Figure: Hydrological and Transportation Networks map (Source: Drawn by the author)

River System Integration and Spatial Optimization

Measure: Jinchuan River Corridor Realignment and Riparian Space Release

Problem: The original course of the Jinchuan River, the largest tributary within the city, has been occupied by Provincial Road S17, resulting in limited space for the river channel and its adjacent functional zones—particularly in the southern part of the city.

Proposed Measure: Due to the significant infrastructure changes required for restoring the original riverbed, the river course is proposed to be shifted eastward, creating a new corridor between National Road G570 and Provincial Road S17 to accommodate both the river and associated riparian functions.

A partial eastward realignment of S17 is also proposed. By utilizing the alignment of an existing village road and placing it parallel to the realigned provincial road, additional space can be made available along the river for ecological and public uses.

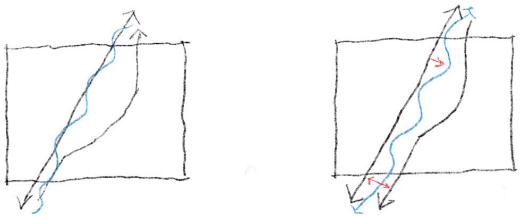


Figure: river occupied by road and riparian space release diagram
(Source: Drawn by the author)

Measure: Heritage Pit Integration and Road Network Completion

Problem: In the northern part of the city, numerous dead-end roads exist around the former mining pit. Residential, commercial, and industrial functions are currently located at the ends of these disconnected roads, resulting in poor traffic connectivity. Additionally, there is an emerging trend of urban development encroaching upon the mining site.

Proposed Measure: Preserve the physical form of the mining pit as part of future development, and extend surrounding dead-end roads to connect with the broader urban road network through a ring or radial pattern around the heritage site.

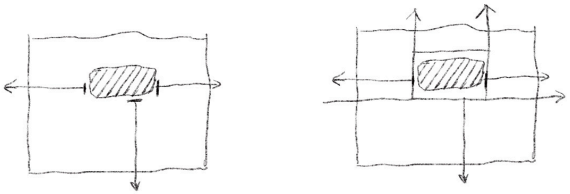


Figure: dead-end roads and road network completion diagram
(Source: Drawn by the author)

Measure: Freight-to-Passenger Rail Conversion and In-City Station Redevelopment

Problem: The city's main passenger railway station is located in Hexibao, a satellite town approximately 20 kilometers away from the urban center of Jinchang, requiring around 30 minutes by car. This distance causes inconvenience for urban residents, especially as the number of intercity bus connections has declined in recent years. At the same time, the city has existing railway lines primarily used for mineral freight transport. With the anticipated decline of the mining industry, these freight lines may lose their original function.

Proposed Measure: Repurpose the existing freight railway lines within the city into passenger rail services, improving regional connectivity. Additionally, convert part of the industrial heritage site into a new urban passenger station, enhancing accessibility and revitalizing underused land.

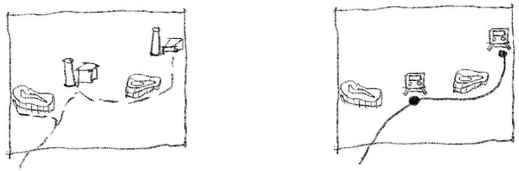


Figure: freight line heritage and passenger line planning diagram (Source: Drawn by the author)

Measure: Industrial Zone Opening and Transport Hub Integration

Problem: In the southern part of the city, the industrial area occupied by the Jinchuan Group covers a large area and remains a closed zone. This creates barriers to urban traffic flow, disrupting both north-south and east-west connections. Moreover, if mineral-based industries decline in the future, the reuse of this industrial land will become necessary.

Proposed Measure: Open up the internal road network of the industrial zone and connect it with the city's main roads. In conjunction with the design of a new passenger railway line, transform part of the industrial land into a new passenger station area to enhance overall transportation accessibility.

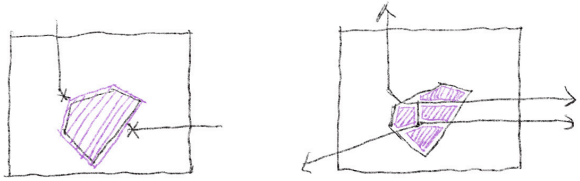


Figure: closed industrial area and open to the city diagram (Source: Drawn by the author)

Before

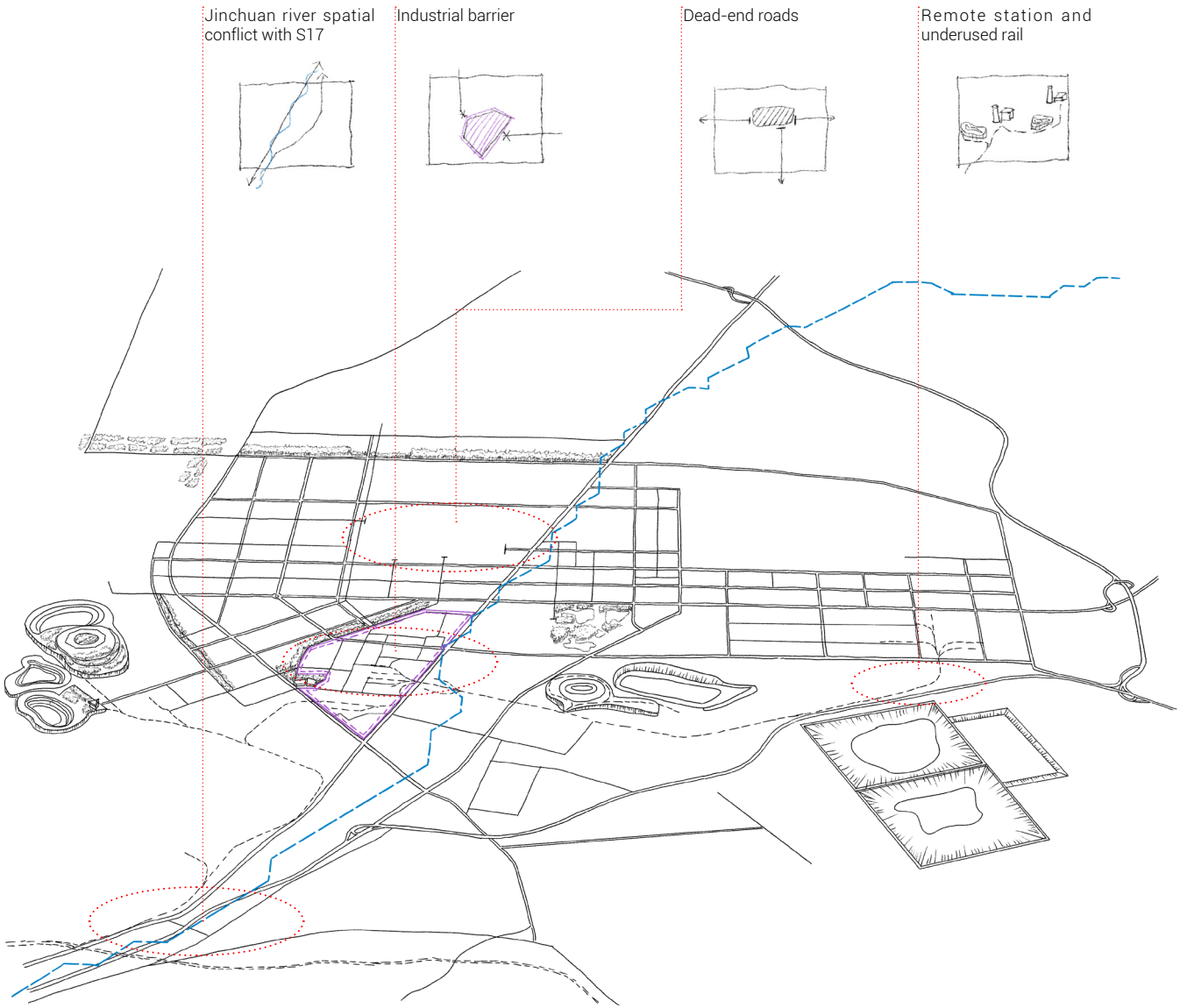


Figure: Sketch of the current status of Jinchuan District's transportation system and seasonal rivers (Source: Drawn by the author)

After

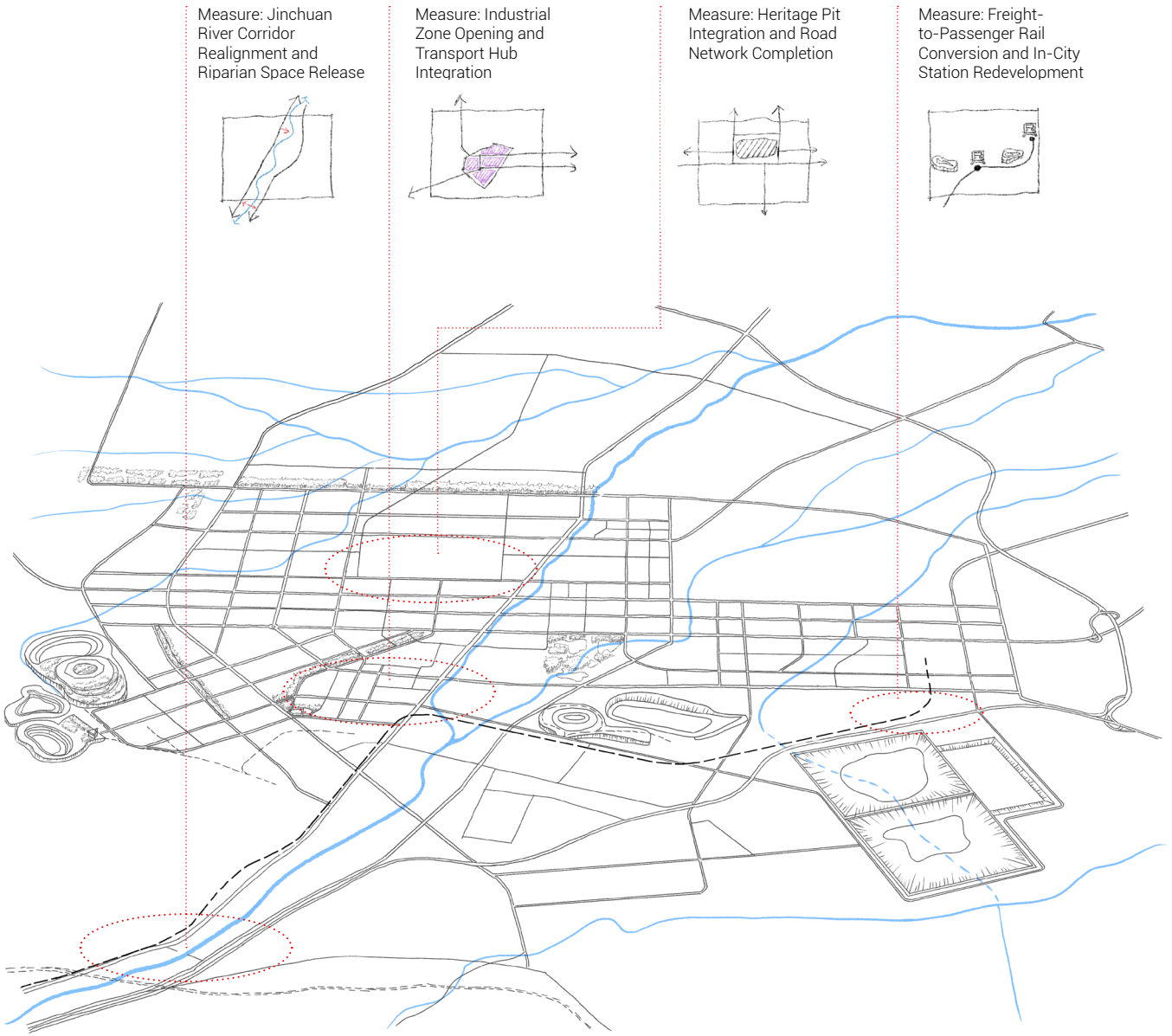
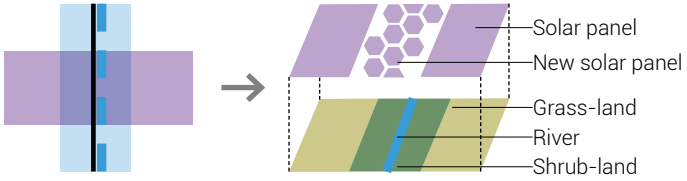


Figure: Jinchuan District transportation system optimization and river design sketch
(Source: Drawn by the author)

5.6 Spatial Enhancement of River-Adjacent Functional Areas

River + Solar Farms: Ecological Solar Park Design

Design devices with combined water collection and shading functions, utilizing the heat effect of the solar park to support riverbank vegetation restoration.



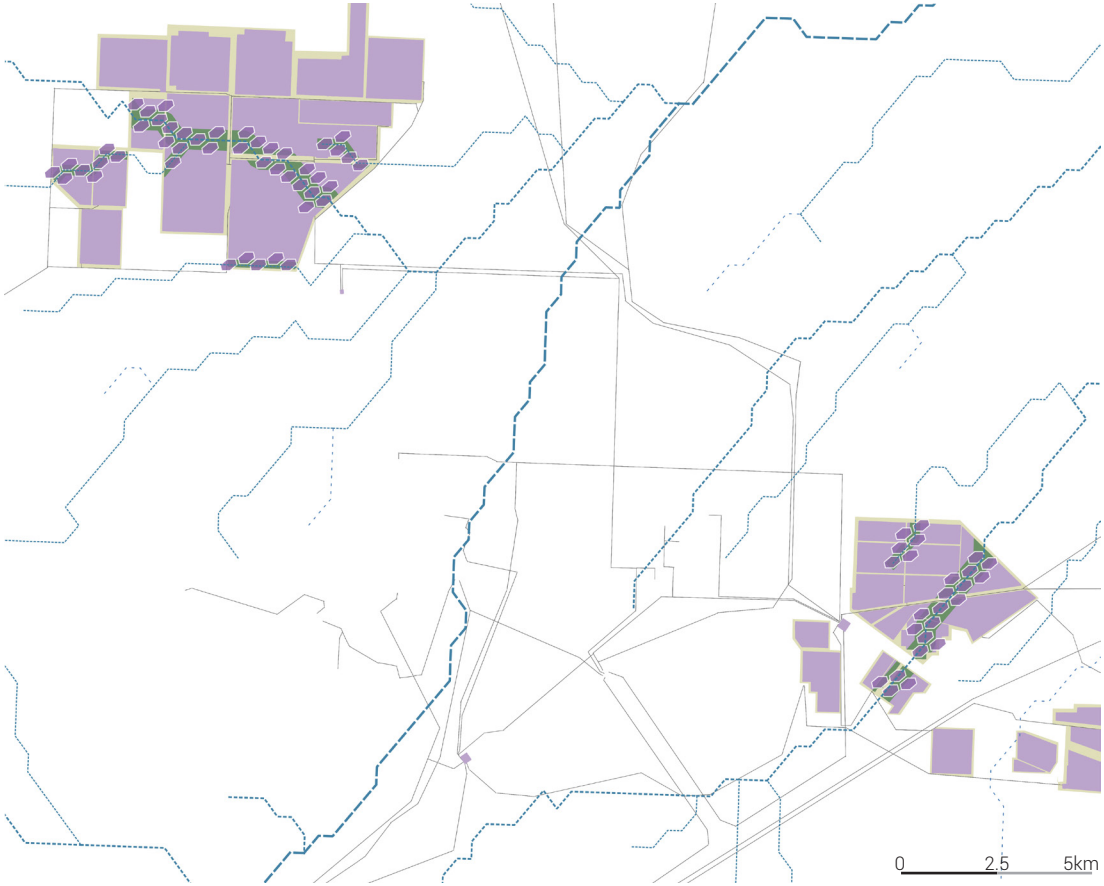


Figure: Ecological Solar Park Design (Source: Drawn by the author)

Integrated System Design

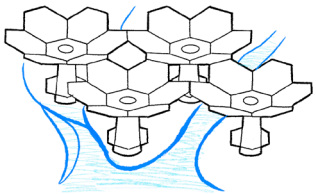
Device Function Description:

Gradually replace solar panels in the river buffer zone with devices that provide both water collection and shading functions.

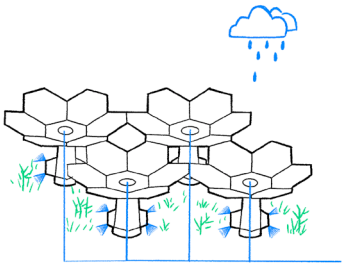
Note: The illustrated form of the device—modular and umbrella-shaped—is only a conceptual representation. The design is not limited to this shape; the essential functions include water collection, irrigation, and shading, and the final form can be flexible.

Umbrella-shaped devices with water collection and irrigation functions

The base support occupies minimal ground space, allowing seasonal river flows to meander around it.



Assist in the restoration of buffer vegetation along the river channel.



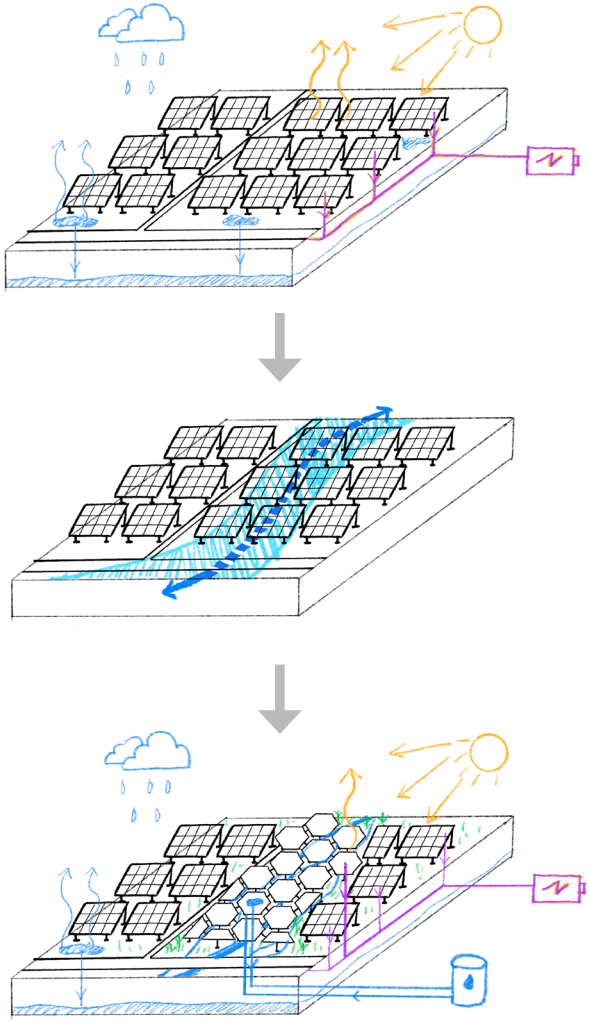
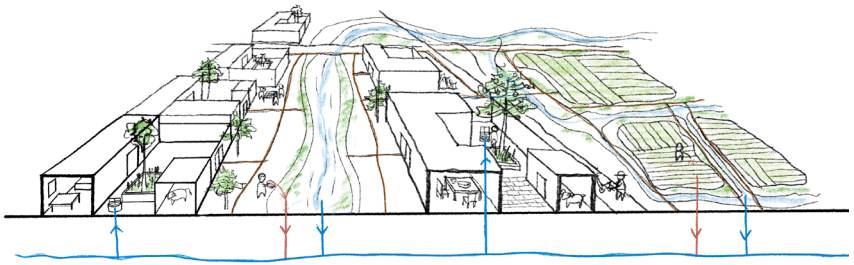
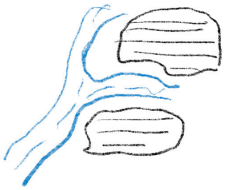


Figure: Ecological solar park diagram (Source: Drawn by the author)

Indigenous "River Buffer + Agro-Patch Agriculture"

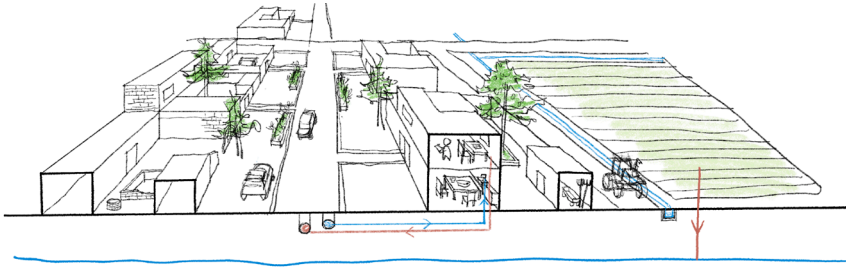
Extract the spatial relationships between rivers, dwellings, and farmland from traditional rural production and living patterns.

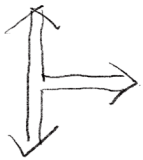




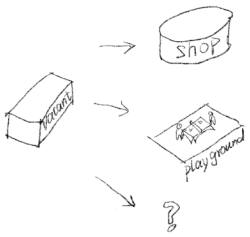
River and patchwork farmland restoration

Current village conditions: retain basic infrastructure and repurpose vacant houses as public facilities, with specific functions determined through participation by the village collective.





Retention of basic infrastructure



Reuse of vacant houses

Figure: Indigenous "River Buffer + Agro-Patch Agriculture" measure diagram (Source: Drawn by the author)

Figure: Location of Jiagou village (Source: Drawn by the author)

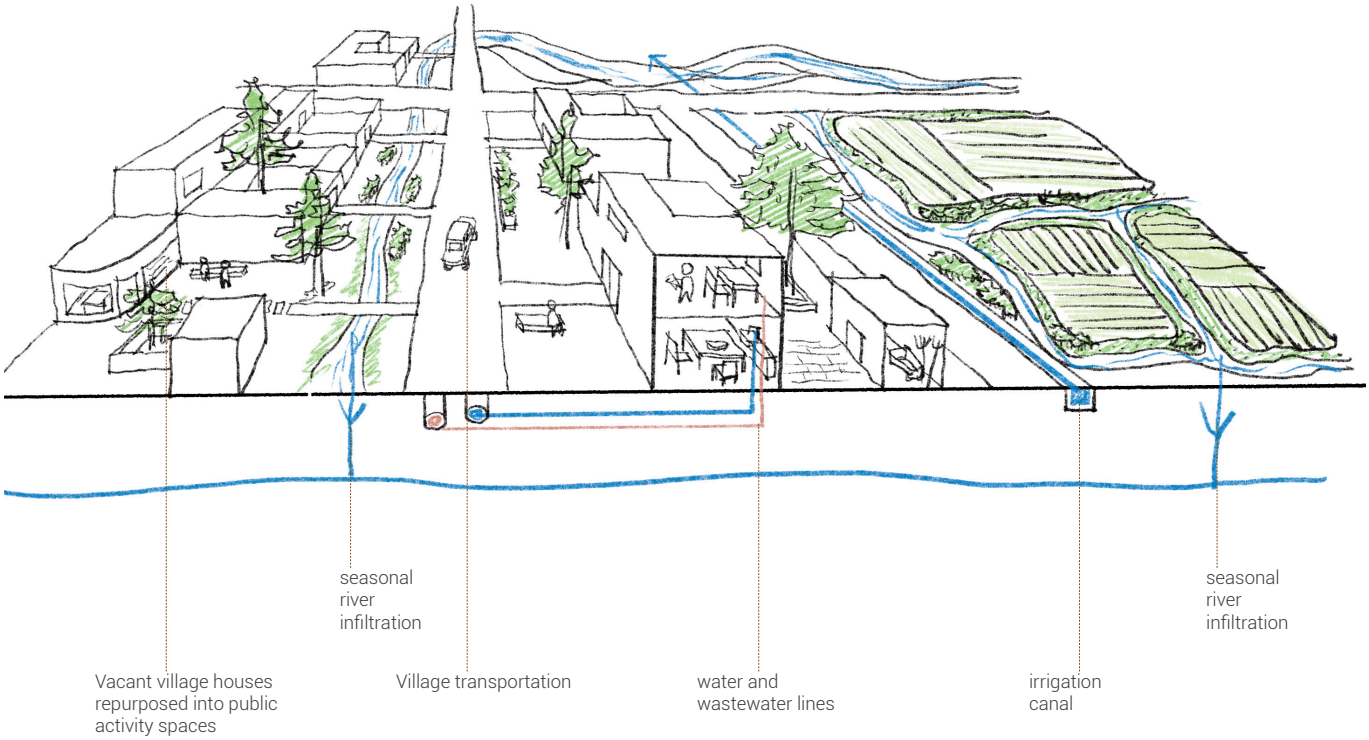


Figure: Indigenous "River Buffer + Agro-Patch Agriculture" design section (Source: Drawn by the author)

5.7 Green Infrastructure Integration

The river buffer is restored with grasslands and shrubs, becoming part of the green space system and enhancing connectivity within the urban green infrastructure.

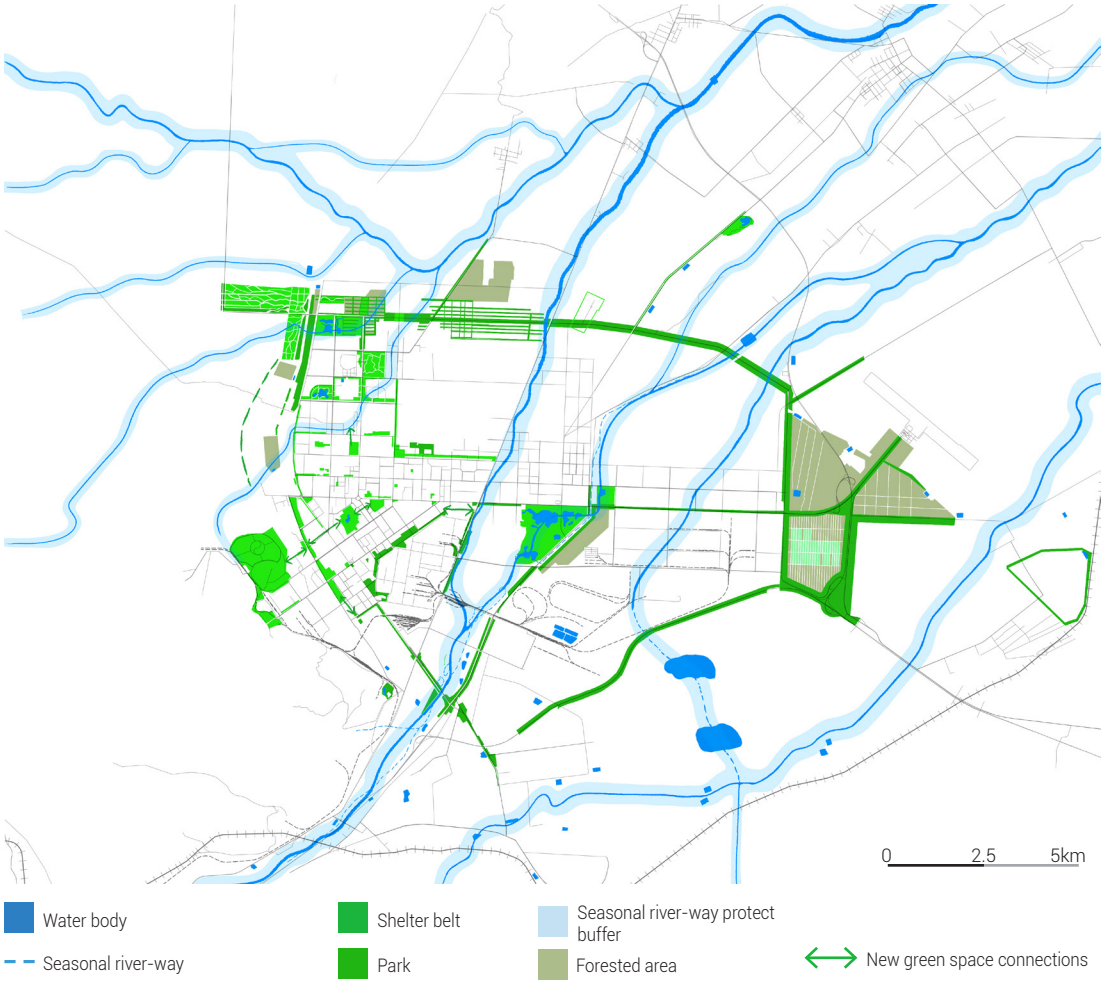


Figure: Green space connectivity enhancement diagram(Source: Drawn by the author)

Shelter-belt Revitalization:
The current condition consists of hardened pathways, artificial irrigation channels, and single-type vegetation. The proposed transformation includes de-channelization of rivers and mixed planting, which could be led by farmers for crop cultivation or by the government for ecological diversity restoration.

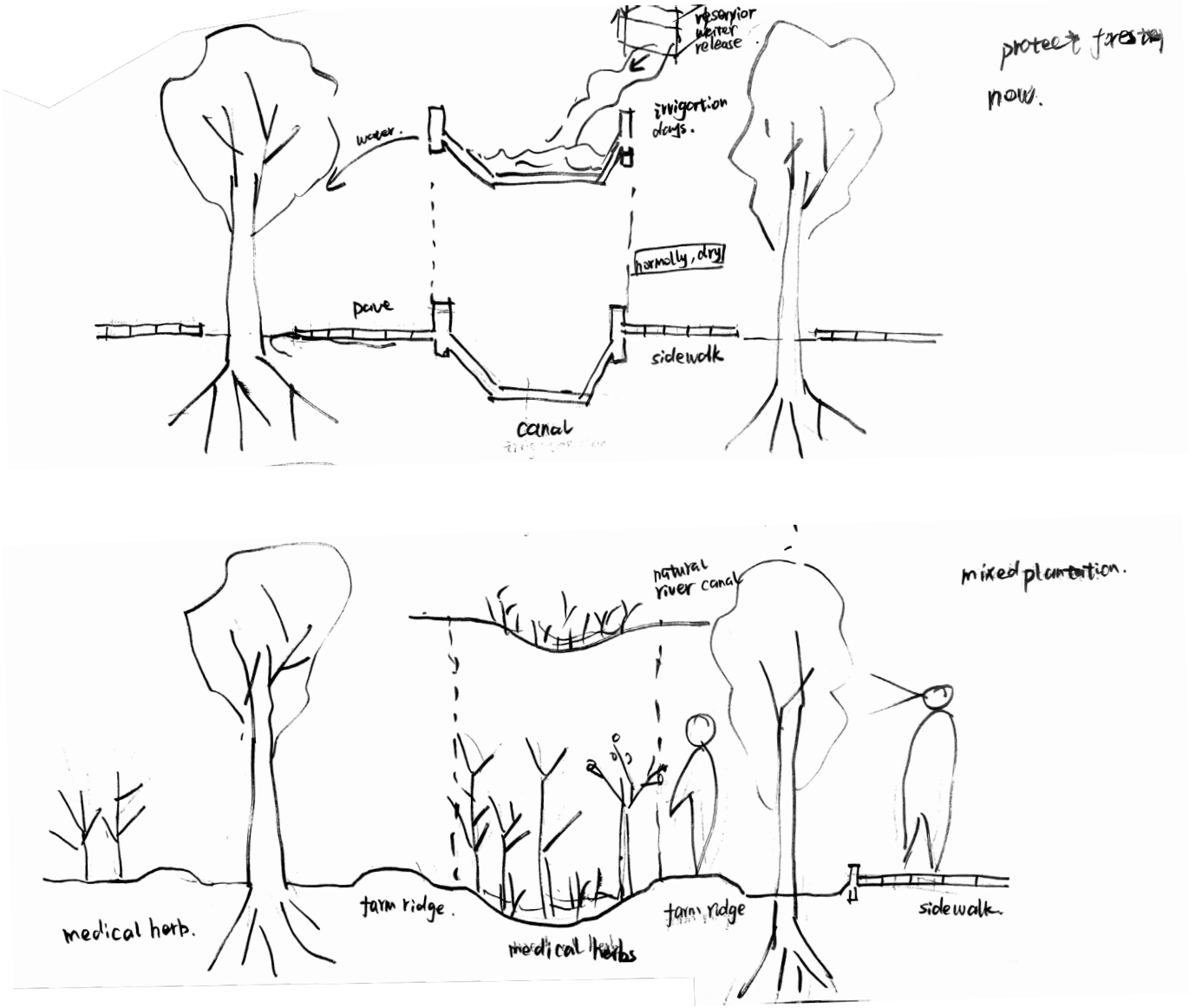
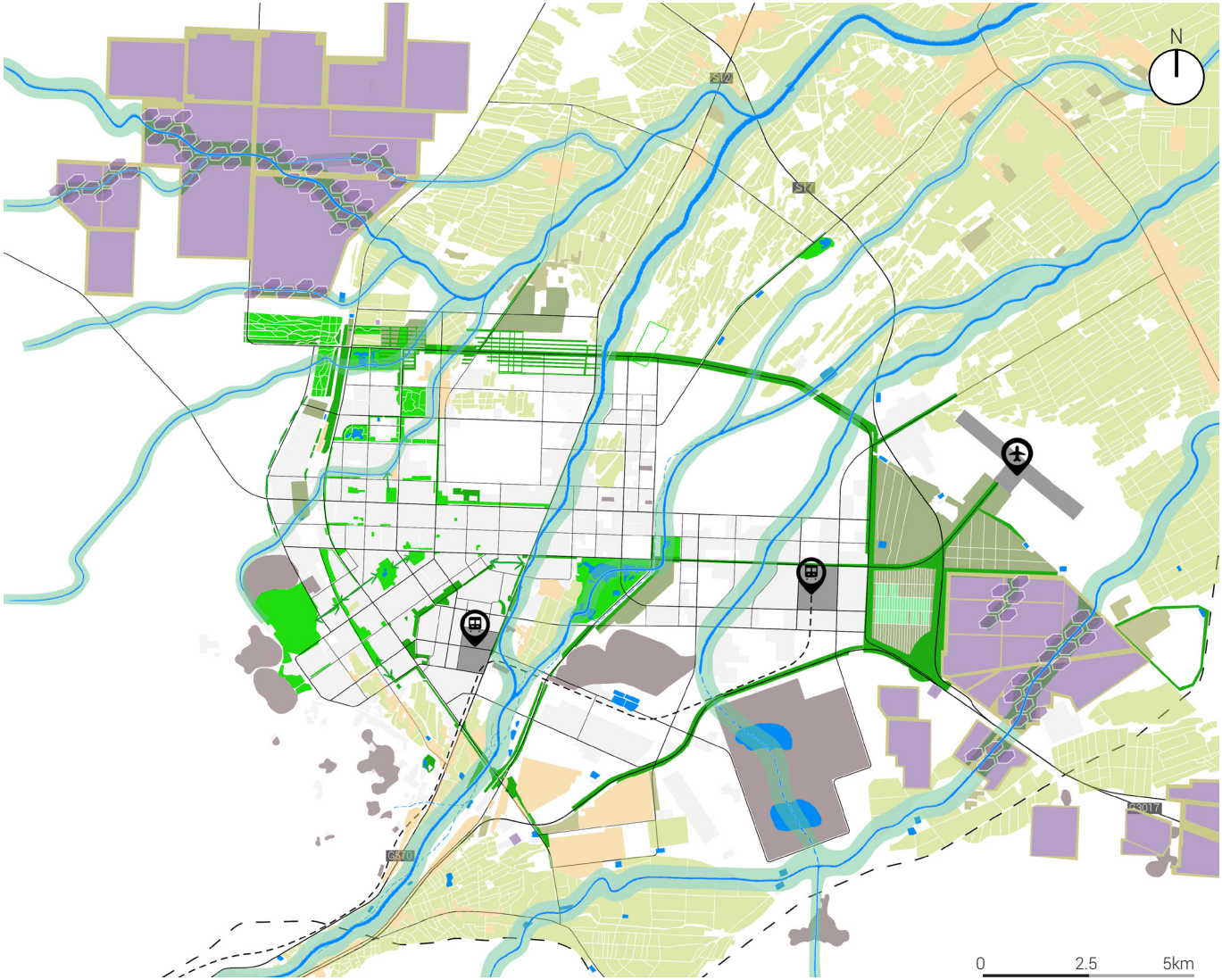


Figure: detailed section of shelter belt (Source: Drawn by the author)

5.8 Integrated Spatial System



Restored river system

Shelter belt and park

Seasonal river-way protect buffer

Transportation hub land use (train station, airport)

Newly planned passenger railway line

Major urban transportation

Newly planned train station

Forested area

Solar park

Mining pit tourist spot

6 Conclusion and reflection

6.1 Conclusion
6.2 Scientific and Social Relevance
6.3 Ethical considerations
6.4 Reflection

6.1 Conclusion

QI: What environmental constraints limit the city's transformation, and which landscapes are essential to protect for both the city and its residents, considering the historical, cultural, and ecological relationships?

Environmental Constraints

From an ecological perspective, the overextraction of water resources in the Shiyang basin has led to the loss of natural vegetation, further resulting in land degradation and desertification, which in turn has accelerated desert expansion. From the perspective of threats to residents' daily lives, the arid environment manifests as severe water scarcity, most notably impacting agricultural production. Desertification also intensifies sandstorms in the region, adversely affecting everyday life.

Essential Landscapes

From the perspective of rebuilding the emotional connection between people and place—rooted in both history and culture—the key landscapes are those formed by desert oasis, comprising rivers and grasslands, which shaped the local identity during the agrarian civilization era. These landscapes attracted nomadic tribes to settle and form cities. The poetic legacy and public perceptions of the region are deeply tied to the desert environment and the Qilian Mountains. Therefore, the core landscape elements that construct the emotional connection between citizens and their environment are: the Qilian Mountains, deserts, rivers, and grasslands.

However, many of these features have been significantly altered or lost. In Jinchuan District, rivers and grasslands have largely disappeared due to canalization, conversion to farmland, and urban expansion. Longshou Mountain is now occupied by mining operations, reducing its visual presence and physical accessibility from the city, weakening the human-landscape bond.

From an ecological restoration perspective, the Shiyang River Basin serves as a natural buffer between the Tengger and Badain Jaran Deserts. Its ecological degradation has led to desert expansion and intensified sandstorm activity. Restoring the seasonal river channels and grasslands within the basin can help reestablish its function as an ecological barrier, mitigate desertification, and reduce sandstorm threats. The Qilian Mountains, as a seasonal water source, also play a critical role in supporting the health of these river systems; their ecological preservation is essential for effective watershed restoration.

Attitude towards deserts

Deserts are often seen as ecological threats in both planning and social narratives, leading to a dominant attitude of "greening" through vegetation cover and ecological conversion. However, the Badain Jaran Desert—listed under the UN's protected desert ecosystems—possesses unique ecological value. Transforming it entirely into vegetated land risks erasing its desert ecosystem integrity, echoing the outdated notion of "conquering nature" at the expense of planetary ecological diversity. This project advocates for the protection of desert ecosystems and refrains from excessive intervention. The goal of restoring the Shiyang River Basin is not to alter the desert itself, but to reestablish the natural buffer that prevents anthropogenic desertification, respecting the desert's natural dynamics and ecological functions.

In sum, the restoration of the river–grassland–mountain–desert landscape system in the Shiyang River Basin serves a dual purpose: to recover ecological functions and to rebuild the emotional and cultural ties between people and place—two

objectives that are deeply interdependent.

Q2: What challenges does Jinchang's current economic structure face in transitioning from a resource-dependent economy, and what potential exists for developing alternative economic sectors—both traditional and emerging?

current economic structure

Jinchang's current economic structure is **highly dependent on the mining and smelting of non-ferrous metals**, particularly the production of nickel and cobalt, resulting in a **single-resource-based industrial system**. This economic model faces multiple challenges, such as fluctuations in global resource prices, declining market demand, and resource depletion, which limit the city's economic resilience and its capacity for sustainable development. Furthermore, the dominance of traditional industries has inhibited investment in emerging sectors and services, further exacerbating the difficulties of economic transformation.

potential for alternative economic sectors

Nevertheless, Jinchang still holds potential for developing alternative economic sectors. Firstly, leveraging its **rich industrial heritage**, the adaptive reuse of industrial sites could promote the growth of cultural tourism and creative industries. Secondly, the surrounding area is rich in solar energy resources, providing favorable conditions for large-scale development of renewable energy industries, which could become a new driver of economic growth. In addition, **ecological restoration and cultural landscape protection can stimulate regional ecotourism and the green economy**, contributing to a more diversified and sustainable local economy. Therefore, a strategic approach centered on industrial diversification and sustainable development is key to breaking Jinchang's dependence on resource extraction and achieving economic transformation.

limitation of current development path

While current urban development plans have already addressed these alternative sectors to some extent, this project argues that **the proposed development models largely continue to adopt a city-centric approach, often at the expense of ecological integrity, surrounding landscapes, and the living environment of peripheral communities.** However, through the exploration of the "Desert Oasis" scenario in this project, it is demonstrated that **alternative economic sectors and the extension of industrial chains—as proposed in current plans—can still be developed under the condition of preserving ecological functions and essential landscapes.** In fact, ecological protection can enhance the environmental quality of emerging industrial zones, while the restoration of key landscapes can reinforce the historical and cultural identity of the desert oasis environment, making the city's character more distinctive and potentially boosting tourism development.

Q3: How do economic transformation and environmental degradation affect residents' livelihoods and lifestyles, and contribute to the emergence of social discontent that leads to out-migration?

The combined impact of economic transformation and environmental degradation has significantly affected residents' livelihoods and lifestyles, leading to growing social dissatisfaction and triggering population outflow.

long-term residents

For **long-term residents**, Jinchang's historical reliance on resource-based industries means that economic transition may result in a **reduction of traditional jobs**, especially in the mining and smelting sectors. A large number of workers face the risk of unemployment or forced career shifts. At the same time, the development of emerging industries has been slow, with **limited job**

opportunities and high uncertainty regarding the success of future transformation. The continuing environmental degradation in the region further exacerbates the situation—water shortages and land degradation threaten agricultural production and residents' access to daily water needs. **Drought and desertification have negatively impacted the living environment, further reducing life satisfaction**.

new migrants

For **new migrants** arriving during the process of urbanization, many are engaged in small-scale economic activities such as agricultural product sales or running small shops. However, urban planning policies have pushed farmers' markets, street vendors, and low-rent commercial spaces to the city's outskirts or near industrial areas. As a result, many migrants are **concentrated in informal settlements at the city's periphery, creating barriers to social integration**. That said, these migrants tend to have a more tolerant attitude toward the local environment—many come from severely desertified regions such as Minqin and see the relatively green environment of Jinchuan District as an improvement in living conditions.

Under the dual pressures of economic and environmental issues, public confidence in the city's future has weakened. Social divisions and discontent are growing. Original residents feel constrained by limited opportunities and upward mobility, while migrants are marginalized and struggle to integrate into the urban system, resulting in social isolation and spatial inequality. Ultimately, more and more young people and working-age individuals choose to leave the city in search of better employment and life prospects.

Q4: What transformation pathways and spatial strategies can enable Jinchang to achieve a more sustainable and equitable future?

Based on the explorations in the scenario planning section, overall, promoting alternative industries and extending traditional industrial chains represent a feasible multidimensional transformation pathway for Jinchang. However, under environmental constraints, ecological protection measures must be advanced simultaneously. In fact, ecological restoration can become a new source of economic opportunity, helping Jinchang shift toward a more sustainable model of development.

In the city's past development trajectory, economic transformation was largely driven by dominant enterprises. In contrast, this project explores strategies such as improving the investment environment, treating ecological conservation as an economic asset, and repurposing industrial heritage sites as spaces for small and medium-sized enterprise (SME) development. These approaches aim to distribute economic opportunities more broadly among stakeholders and avoid the over-concentration of benefits during transformation.

Moreover, the urban design concepts proposed in this project seek to recognize the value of traditional agricultural practices and provide opportunities for environmental improvements in agricultural zones and informal settlements. This helps address spatial inequality in living conditions caused by previous urban planning policies.

From the perspective of the three scenarios, Jinchang's possible transformation paths are as follows:

Managed Shrinkage Scenario

This scenario accepts the decline—or even disappearance—of traditional industries and envisions a locally focused shrinkage model

where agriculture and tourism become alternative economic pillars. However, considering the reality that Jinchang's historical and cultural resources are peripheral in the regional context, the city may lack the attractiveness needed for large-scale tourism. Additionally, the low profitability of agriculture makes it difficult to sustain urban public services (which were previously maintained by Jinchuan Group and the municipal government, such as hospital equipment upgrades). If the economy cannot support public services, large-scale outmigration may occur, leading to an outcome resembling a "ghost city." Furthermore, large-scale agricultural production may require mechanized and intensive farming, which risks degrading land productivity—ironically, one of the primary causes of regional ecological degradation and desertification. Thus, the sustainability and feasibility of this narrative remain questionable.

Industrial Revival Scenario

This scenario focuses on extending the existing industrial chain, which, combined with the development of other sectors, most closely resembles the vision laid out in Jinchang's current development plans. However, given the city's industrial structure, any future industrial expansion will likely continue to be led by Jinchuan Group, a powerful enterprise, making it difficult to resolve issues of unequal access to development opportunities in the short term. This scenario also proposes attracting investment, knowledge institutions, and skilled labor to foster upstream industries like battery and solar panel manufacturing. But this development model, which relies on the clustering of technical migrants, may repeat the past approach—when people were drawn to this remote area due to policy and resource-driven migration. Moreover, from an ecological standpoint, the region is already experiencing overuse of water resources, indicating that current population levels exceed ecological capacity. Industrial expansion could increase economic output and urban growth, but it also imposes greater pressure on the region's fragile ecosystem—potentially contradicting the vision of a sustainable future the author seeks.

Desert Oasis Scenario

This scenario emphasizes ecological preservation and the restoration of natural landscapes, particularly desert ecosystems. From the perspectives of natural resource management, ecological restoration, and rebuilding human–land relationships, it aligns most closely with the author's vision. However, what this scenario does not explicitly reveal is the enormous scope and investment required for ecological and landscape restoration, as well as the potential sacrifice of industrial or economic growth. The proposed phasing out of polluting industries and development restrictions may be nearly unacceptable to dominant enterprises and the local government under current values. Nonetheless, the author argues that short-term sacrifices in industrial development—or redirecting industrial revenues toward ecological restoration rather than further industrial expansion—may slow economic growth in the short run but enable the city to endure longer. This would avoid the cycle of depleting resources rapidly and then abandoning the city in search of new ones (an extreme possibility). Given the national emphasis on high-quality development, the author believes this scenario offers a chance to temporarily slow resource depletion and pursue parallel ecological restoration. In the long term, improved environmental quality and the creation of a distinctive urban identity may attract investment and tourism, achieving the economic goals envisioned in current planning frameworks.

Q5: How can planning institutions evolve to support a locally adapted and inclusive transition, addressing existing institutional and governance constraints?

Although the top-down planning system imposes certain limitations on urban planning, local planning departments still retain considerable flexibility in the implementation of specific content. They are also well-positioned to incorporate local knowledge and public participation into urban and rural planning processes.

urban planning practice

In practice, various participatory approaches have been explored, including multi-scenario discussions facilitated through village collectives and community centers, which serve as organizing bodies and venues for public engagement. Field activities such as "walk with residents" are also adopted to better understand urban and rural life from the residents' perspective, thereby reducing the dominance of planners' subjectivity in shaping outcomes.

urban planning results

The resulting plans integrate historical and rural local knowledge into spatial strategies and aim to grant equal recognition to different social groups. Taking the "Desert Oasis" vision as an example, the planning approach replaces standardized rural development models with traditional agricultural practices and village housing typologies that are grounded in rural communities, respecting the organic spatial patterns of the countryside. River restoration projects are framed as opportunities for community involvement, where local groups participate in selecting and shaping the functions of surrounding riverfront spaces.

MRQ: How can Jinchang City achieve a sustainable and equitable transformation within environmental and policy constraints while preserving its landscape and safeguarding residents' well-being?

Sustainable and equitable urban transformation can be positioned as a central objective. To move toward this goal, Jinchang may explore a multi-dimensional transformation pathway that weaves together economic diversification, ecological restoration, cultural heritage preservation, and inclusive governance.

Prioritizing effective ecological restoration and landscape preservation plays a key role in addressing long-term environmental degradation. Potential measures include restoring the Shiyang River Basin, developing green infrastructure to mitigate desertification, and revitalizing cultural landscapes that reflect local environmental stewardship. These actions contribute to strengthening ecological resilience while also safeguarding regional historical and cultural identities.

Cultural heritage preservation can be more deeply embedded in urban planning—not only through the restoration of industrial heritage but also by recognizing the territorial histories that trace back to ancient settlements. This perspective helps reinforce local identity and community cohesion. Identifying and protecting historical sites, restoring traditional village forms, and promoting heritage-based tourism may support both economic diversification and social inclusion.

A diversified and inclusive economic transition also holds promise for reducing reliance on resource extraction. Relevant approaches could involve expanding renewable energy sectors, facilitating the adaptive reuse of industrial heritage for tourism and creative industries, and encouraging local entrepreneurship. Urban planning projects, while not the primary drivers of economic change, can play a supportive role by improving spatial infrastructure—for instance,

through industrial park retrofitting and the reuse of heritage spaces to enable spatial adaptation.

In parallel, adaptive urban governance can help respond to policy constraints and future uncertainties, including those related to climate and economic shifts. The introduction of tools such as **Scenario Planning and Adaptive Policy Pathways may offer a flexible framework for responsive policy-making, allowing development strategies to evolve in step with emerging local needs.**

Through the integrated advancement of economy, ecology, culture, and governance, Jinchang has the opportunity to move beyond resource dependence, restore its ecological landscapes, safeguard cultural heritage, and foster a more inclusive and resilient urban environment—one where both human and non-human life can not only survive but thrive.

6.2 Scientific and Social Relevance

Scientific Relevance

Expanding the Spatial Scope and Regional Typology of Transition Studies

Existing research on resource-based city transitions in China tends to focus on mature resource cities located in the more economically dynamic southeast and central regions, where data accessibility is higher. This study shifts the perspective to a more extreme context—Jinchang, a city situated in the arid northwestern periphery, characterized by ecological fragility and declining resource value. It provides a transition case under constrained conditions, broadening the spatial scope of resource-based city studies and responding to the question of whether generalized transition paths exist across different geographical settings.

Putting Transition Theories into Practice

From Socio-Technical to Socio-Ecological Mainstream sustainability transition theories often emphasize technological innovation, market mechanisms, and institutional adjustments. This study, by employing scenario planning and ecological restoration combined with the reconnection of people and nature, places ecosystems at the core of urban transformation. It offers a practical extension of the socio-ecological transition framework and engages with the question of how ecosystem services can serve as a foundation for future urban development.

Integrating Cultural Landscapes and Local Knowledge to Inform Transition Pathways

Drawing on concepts such as Topophilia, cultural landscape, and indigenous knowledge, the project highlights that transformation is not only about economic restructuring but also about reconnecting people with land, memory, and identity. This culturally and ecologically integrated approach, still relatively rare in the context of resource-based cities, offers an example of how cultural dimensions can support sustainable urban transition.

Proposing an Ecology-Based Logic for Alternative Economies

China's dominant strategy for resource-based city transitions often emphasizes identifying substitute industries and developing manufacturing sectors. This study proposes an alternative pathway—leveraging ecological restoration to catalyze green industries and service economies. Examples include desert tourism and cultural revitalization, agroforestry and ecological volunteering, and the transformation of industrial relics and heritage sites into public and tourism infrastructure. This approach helps address inequalities arising from technology dependence and capital concentration, and contributes to the broader discussion on how localized and inclusive alternative economies can be cultivated in peripheral regions.

Social Relevance

The enterprise-led development model in resource-based cities often results in inequality for vulnerable groups. In Jinchang City, these issues are further complicated by the presence of urbanization migrants and climate refugees, who face disparities in living conditions and access to opportunities. These social inequalities are not only a reflection of industrial dominance but also of the marginalization of certain communities within urban and regional planning.

This project, through field surveys, literature review, and analysis of the marginalization of agricultural settlements and their employment spaces, exposes these underlying social problems. In the design of the scenarios, solutions learned from case studies are applied to address these challenges. These include promoting public participation in urban transformation, recognizing the value of agricultural practices, protecting cultural heritage, and creating public spaces that foster social inclusion and community resilience. These measures aim to bridge the gap between marginalized groups and the broader urban development goals, ensuring a more equitable and sustainable transition for Jinchang City.

The Social Dilemmas of Resource-Depleted Cities: Between Those Who Leave and Those Who Stay

The Social Dilemma of Resource-Depleted Cities

This study explores the profound social challenges faced by resource-exhausted cities—places that once thrived on state-led resource extraction and in-migration, but later experienced economic collapse, industrial layoffs, and waves of outward migration. These abrupt transitions have not only disrupted the lives of one generation, but have also caused intergenerational trauma, affecting the psychological, social, and economic well-being of their descendants. Literature, photography, and music have documented such urban transformations and the deep sense of loss and disorientation they leave behind.

Personal Experience and Emotional Attachment

Drawing from personal experience, the author has lived through the socioeconomic shifts brought on by industrial transformation. As a second-generation technical migrant within a resource-based city, the author has witnessed how environmental harshness—shaped by desert proximity and industrial pollution—interacts with social uncertainty. Despite these challenges, a strong emotional connection to the land remains, suggesting that attachment to place can coexist with discontent and doubt about the future. This duality is common among long-term residents, for whom leaving may not be an easy or desirable choice.

Exploring Possibilities for Continuity

If resource exhaustion no longer guarantees urban survival, then new foundations for urban continuity may be found through economic diversification, cultural reinterpretation, and ecological repair. By identifying opportunities beyond traditional industrial frameworks, it becomes possible to rebuild place-based meaning and allow residents to maintain a sense of rootedness. Under such conditions, some residents may find reasons to stay, not only out of necessity, but also through renewed possibilities for belonging and livelihood.

Addressing the Experience of Departure

Out-migration may remain a reality in the post-industrial era, especially where local opportunities are limited. For those who leave, a more livable and culturally connected urban environment could foster symbolic forms of return—emotional, cultural, or temporary. This may help reduce the

sense of dislocation often felt by those who depart with no clear destination or future. In this context, improving the quality of urban life may contribute to strengthening collective memory and identity, even for those no longer physically present.

Ecological Loss and the Possibility of Regeneration

In parallel with social displacement, landscape degradation and ecological loss have occurred as a result of past development. Rivers, grasslands, and native species once integral to regional ecosystems have been altered or replaced by urban expansion and agricultural conversion. Through targeted restoration of key landscapes and habitats, it is possible to reintroduce ecological functions and biodiversity that had previously receded. This may allow both human and non-human forms of life to reestablish relationships with the land, and revive lost patterns of coexistence.

To help readers understand the social trauma resulting from the failed transformation of resource-based or post-industrial cities mentioned by the author, several literary works are referenced here. For those interested, these works may serve as an entry point for further exploration.

Introduction to Winter Swimming by Ban Yu

Winter Swimming is a short story collection by Chinese writer Ban Yu, set primarily in the old industrial cities of Northeast China. The stories portray urban landscapes marked by resource depletion and industrial decline, and follow the lives of ordinary people struggling to survive amid these transformations. Written in a restrained and composed narrative style, the collection depicts the emotional aftermath of mass layoffs, factory closures, family breakdowns, and personal disorientation. The characters often find themselves trapped in stagnant, hopeless circumstances, seeking emotional refuge during the long, cold winters. Through these narratives, the work reveals the complexities of intergenerational trauma, identity crises, and the erosion of collective memory.

Introduction to Kill the Man from Shijiazhuang – Omnipotent Youth Society

Kill the Man from Shijiazhuang is a song by the Beijing-based independent rock band Omnipotent Youth Society. The song opens with the line: "Getting off work at six in the evening, changing out of the pharmaceutical factory uniform." It tells the story of an ordinary worker leading a monotonous, repetitive life in a resource-based or industrial city—his wife cooks porridge while he drinks beer, and this continues for thirty years, "until the building collapses."

Through its stark and disenchanted imagery, the song portrays the emotional numbness, mass layoffs, and fractured intergenerational identities caused by economic decline and industrial decay. It powerfully captures the sense of powerlessness and emotional desolation experienced by residents of cities shaped by the rise and fall of heavy industry.

Planning recommendation

One of the core outcomes of this project is the Desertification Restoration Action Plan in Northwest China, envisioned as a complementary and alternative strategy to the current desertification control policies and the Three-North Shelterbelt Forest Program (TNSFP) in the northwestern region of China.

Limitations in the Existing TNSFP Implementation

The TNSFP, initiated by the Chinese government in 1978, marked a major ecological construction effort during the early phase of the Reform and Opening-Up era. The plan aimed to establish a continuous green protective barrier across 13 provinces in Northwest, North, and Northeast China, in order to curb desertification, soil erosion, and sandstorms while safeguarding agricultural productivity and ecological security. Spanning more than 70 years, the project has been implemented in eight phases.

However, this research identifies significant shortcomings in the current implementation of the TNSFP. While the plan emphasizes the expansion of vegetation cover, it lacks concrete performance requirements and clear implementation guidelines, particularly regarding the specific sites and ecological rationale for afforestation. For instance, in the urban planning of Jinchang City, broad shelterbelt forests were planted along the eastern outskirts, following infrastructure corridors, while western rural settlements were excluded from such protection.

This raises the question: can such an implementation model—with limited spatial precision and ecological differentiation—truly fulfill its intended objectives? Moreover, the widespread afforestation effort appears to imply a transformation of desert ecosystems into non-desert vegetated landscapes. This research questions the sustainability of such an approach, given that deserts themselves are complex and

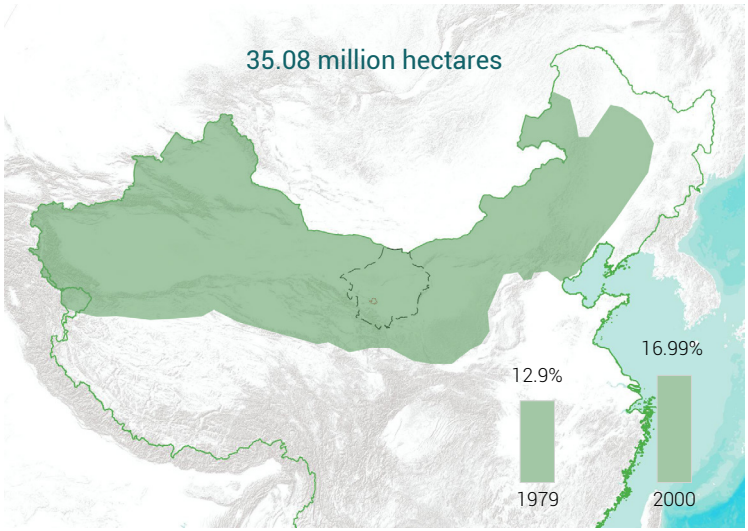


figure: National forestry planning(source: drawn by author)

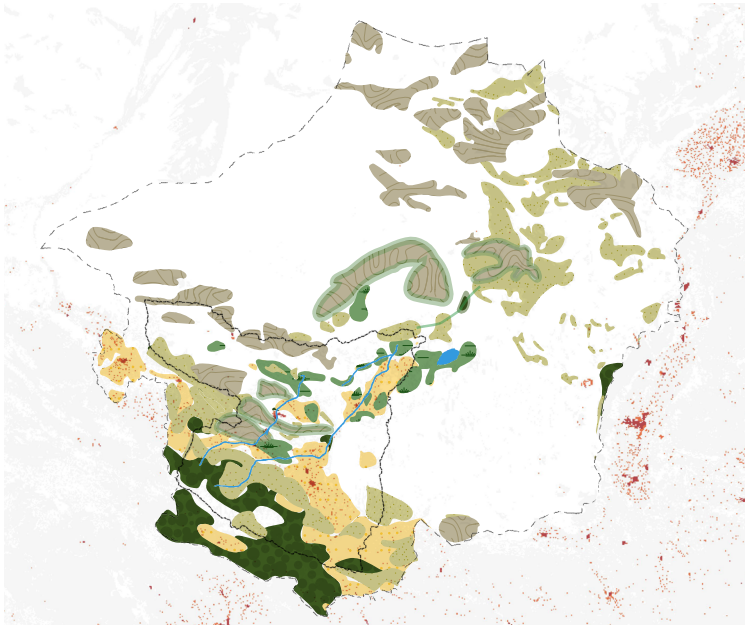


Figure: Alternative regional environmental restoration plans/measures (Source: Drawn by the author)

ecologically valuable ecosystems. Is afforestation an appropriate solution to desertification, or does it risk undermining the intrinsic value of desert landscapes?

Project Approach and Focus Area

In contrast, this project's Desertification Restoration Action Plan in Northwest China takes a more ecologically sensitive and spatially specific approach. Situated at the interface between Jinchang City and the Tengger Desert, the study area encompasses marginal desert zones (referred to here as gobi areas, not to be confused with the Gobi Desert itself). These zones are characterized by arid conditions and sparse vegetation, but not by active sand dunes.

The proposed interventions are limited to the Shiyang River Basin, which lies between the Tengger and Badain Jaran Deserts, and focus on:

Protecting the natural integrity of desert ecosystems

Restoring areas degraded by human-induced desertification

Prioritizing intervention in zones of ecological urgency (e.g., saline-alkali lands and sand-prone foothills)

Offering clear and actionable implementation guidance, rather than relying on broad afforestation targets.

Coordinating Multi-Stakeholder Planting Activities

In and around the project area, afforestation has become a multi-actor endeavor. Government agencies implement the TNSFP under the supervision of forestry bureaus, overseeing procurement and planting. Private enterprises, responding to national campaigns, have launched public tree-planting platforms (e.g., Ant Financial), integrating tree planting with commercial models. Large state-owned enterprises such as the Jinchuan Group organize annual tree-planting events on Arbor Day, while local communities, especially in severely affected agricultural areas such as Minqin, engage in spontaneous planting to defend their homes and fields against encroaching deserts.

Despite the scale and diversity of these activities, most remain fragmented and uncoordinated. This project aims to serve as an operational guide to inform and regulate multi-actor planting efforts, ensuring that planting actions align with ecological priorities, appropriate techniques, and strategic locations.

Limitations of the Proposed Action Plan

Compared to the TNSFP, the scope of this action plan is relatively limited, focusing only on the central section of Northwest China, particularly the project site and adjacent zones. It does not address the broader goal of forming a national ecological shield against the expansion of arid zones such as the Gobi Desert. While the TNSFP aims to reduce the overall influence of desertification on China's ecological security, this plan specifically targets the prevention of ecological degradation within the Shiyang River Basin and the containment of landscape connectivity between the Tengger and Badain Jaran Deserts.

Thus, while this project does not claim to replace the TNSFP at a national scale, it offers a site-specific, ecologically nuanced, and operationally implementable alternative within the context of Northwest China.

6.3 Ethical Considerations

Ethical Considerations of the Project Topic

Intergenerational Equity

This project envisions the long-term development of Jinchang City, particularly focusing on ecological restoration and urban renewal over the next 100 years. It emphasizes the need for intergenerational equity, ensuring that today's resource development and urban planning do not compromise the survival and development opportunities of future generations. Special attention is given to groundwater replenishment, land restoration, and climate adaptation to avoid long-term environmental debt.

Social Equity and Inclusion

As a resource-based city, Jinchang has long relied on mineral extraction and smelting, resulting in a single-industry economy and exacerbating social inequality, particularly for urban migrants, climate refugees, and marginalized agricultural communities. In the design and scenario planning process, the project prioritizes the livelihoods of these vulnerable groups, equitable distribution of public services, and their right to participate in urban development. The project proposes to enhance public participation, promote the value of agricultural communities, and strengthen cultural heritage protection and public space creation to ensure social cohesion and prevent further social fragmentation during the transition process.

Ethical Considerations of the Project Outcomes

Environmental Justice and Ecological Restoration

The project design emphasizes ecological restoration and nature conservation, particularly under the Desert Oasis scenario, which proposes large-scale ecological restoration, de-channelization, and oasis recovery strategies. These ecological restoration processes must avoid potential community displacement and land occupation resulting from large-scale ecological transformation. The design should ensure that local residents' quality of life improves after ecological restoration, rather than being forced to relocate or lose land use rights. I believe further stakeholder interviews are necessary, including community consultations, as well as input from forestry and planning departments to assess feasibility and collect diverse perspectives.

Ethical Considerations of Cross-Regional Ecological Cooperation

The project's scenario planning within the Shiyang River Basin involves regional-scale ecological restoration, cross-administrative river governance, and industrial spatial coordination. This requires careful consideration of inter-regional interest alignment, ensuring cooperation and fair treatment of stakeholders, and avoiding the transfer of environmental and economic burdens to downstream communities or neighboring regions.

6.4 Reflection

Reflection on graduation project topic, master track(Urbanism), and professional journey

Throughout my academic and professional experiences, I have repeatedly revisited the development pathways of Jinchang—a typical resource-based city—each time with a different perspective and evolving thoughts.

My first exploration dates back to my undergraduate studies in urban and rural planning. During my senior year, I participated in a competition focusing on the development of rural areas in my hometown, Jinchang. I chose to concentrate on villages located on the urban fringe, beyond the protective shelterbelts—communities that are often overlooked in the urban landscape. Yet, the fruits and grains we find in markets are the results of their labor. However, urban planning policies were gradually transforming these villages into uniform new residential areas, with some villages already undergoing this homogenized renewal. I have always opposed this form of standardization, believing that the original village patterns are organic, representing generations of adaptation to the local environment and reflecting wisdom in coexisting with nature. The homogenized transformation erases these unique characteristics. At that time, I proposed to preserve the original village structure while updating the buildings, maintaining the traditional spatial fabric. I also introduced the idea of rural tourism, inspired by the local "agritainment" model, where urban residents visit rural areas to experience farm life and enjoy rural hospitality. However, looking back now, I realize that I underestimated the actual demand for this form of recreational economy and overlooked the high costs associated with such redevelopment. More importantly, I failed to consider the fate of the original agricultural population and their livelihoods. This top-down approach likely benefits those with existing economic means while neglecting the real needs of local farmers.

My second exploration began after I moved to Jinan for work, participating in urban planning projects during the reform of China's Territorial Spatial Planning. During this period, I deeply experienced the ambiguity of policy guidelines, the variability of implementation paths, and the uncertainties caused by the disconnect between policy and practice. This confusion prompted me to pursue further studies. Before returning to academia, I spent some time back in Jinchang, rethinking its development path. This time, I observed that the shelterbelts had become more fortified, isolating the villages entirely from ecological protection zones. Large investments in ecological conservation projects made a few years ago were left largely unused due to safety concerns and a lack of appeal. This led me to consider: could landscape design be a new starting point for revitalizing urban vitality? Could blue-green networks, pedestrian corridors, and open peripheries reconnect the city's landscapes? However, the solutions I proposed at the time were still overly idealistic and filled with my personal projections: I envisioned glass corridors extending into the desert, multifunctional structures that combined water collection and shading, aiming to transform the barren landscape into a "technological desert oasis."

My third exploration is this graduation project. In this study, I tried to distance myself from the site, adopting a more macroscopic perspective to investigate Jinchang's urban transformation. I began to realize that urban decline is not an isolated phenomenon but is closely linked to global resource market fluctuations, regional economic restructuring, and the implementation of policies. However, in this process, I also became aware of my own skepticism toward local practices, which led me to favor international best practices and authoritative guidance. Additionally, my experience working at a design institute in China had instilled

a sense of distrust in policy implementation. I believed that although the principles behind policy reforms were rational, their practical application was often chaotic and inefficient. This bias made me adopt a critical attitude toward local policy practices during the early stages of my project, even avoiding interviews with local experts, fearing their perspectives would not offer additional value.

However, as the project progressed, I gradually realized that policy mechanisms themselves are not the problem; the challenges lie in delayed execution and slow adaptation. Comparing the Dutch Dynamic Adaptive Policy Pathways (DAPP) with domestic practices, I discovered that the effectiveness of policies requires time for adaptation—it is not an instant process. This led me to reflect: as a planner, have I been too focused on the limitations of the system, neglecting the possibility of finding better pathways within existing conditions?

Moreover, this project prompted me to reconsider the role of the urban planner. My professional experience exposed me to the uncertainties and debates of territorial spatial planning reform: Should planners be economists, land-use analysts, or designers balancing diverse interests and solving real-world problems? Throughout the project, I deeply felt the limitations of being a planner—there were always more influential stakeholders dictating what the "right solutions" should be, and often, these decisions reflected the biases of the decision-makers. However, the inherent complexity of urban systems makes it nearly impossible to predict the outcomes of policy interventions. This uncertainty led me to question the value of my profession—should I instead become an urban analyst, presenting only data and facts without taking a stance? But during a discussion in the Q3 project, my supervisor Alex's remark enlightened me: "Data analysis itself carries biases." This statement awakened me—I realized that neutrality does not equate to a lack of stance, and perhaps true neutrality does not exist. My experiences and environment have inevitably shaped my views on Jinchang's future. For instance, regarding village development, I have always believed that villages should remain as they are, instead of being uniformly converted into new residential communities. However, during field research, I encountered rural residents who expressed their desire to move into modern buildings with flushing toilets, something I had not fully considered. At the same time, I recognize that traditional village preservation plays a crucial role in maintaining cultural heritage and strengthening local emotional ties, which is essential for sustainable development. Perhaps more effort is needed to help them understand the significance of preserving traditional living environments, or at least explore ways to combine quality of life improvements with heritage conservation. This reflection led me to realize that the key is not to be "neutral," but to better understand the tension and coordination between different perspectives.

Therefore, in this graduation project, I decided to leverage the "privilege" of academic research to position myself as a planner with a critical perspective, not just an analyst of data, but also an explorer of future urban visions. I aim to analyze Jinchang's development pathways through a dynamic, sustainable, and open perspective, drawing on my understanding of international practices and reflecting on local policies to identify the gaps between academic research and practical implementation. I believe that these gaps and tensions are where the true potential for planning innovation and practical optimization lies, and this is my response to the future of my hometown as a planner.

Limitation on Research Progress

Due to the remote location of the project site, the field investigation was conducted based on the understanding of the project during its mid-phase. However, as the project progressed to the later stages, some strategies learned from case studies—such as shoreline restoration, co-cultivation with solar panels, and others—could not be further investigated or verified through interviews, making it difficult to assess their feasibility. Additionally, data limitations made it challenging to obtain current information about the river channels, hindering the implementation of the design.

When envisioning the scenarios, many factors needed to be considered. However, due to time constraints and my own knowledge limitations, it was difficult to fully account for the impacts of economic activities and environmental restoration measures. This limitation is also reflected in the environmental planning for desertification at the regional scale. Ideally, the planning process would comprehensively consider the social and economic impacts of large-scale regional environmental restoration projects, as well as their practical implementation. However, given the 600 km-wide scale of the region, the amount of information is vast, and this project mainly focuses on the development of Jinchang City. Therefore, the feasibility of planning at this broader regional scale requires further verification, as the study did not extensively explore the macro-structural understanding of the entire region.

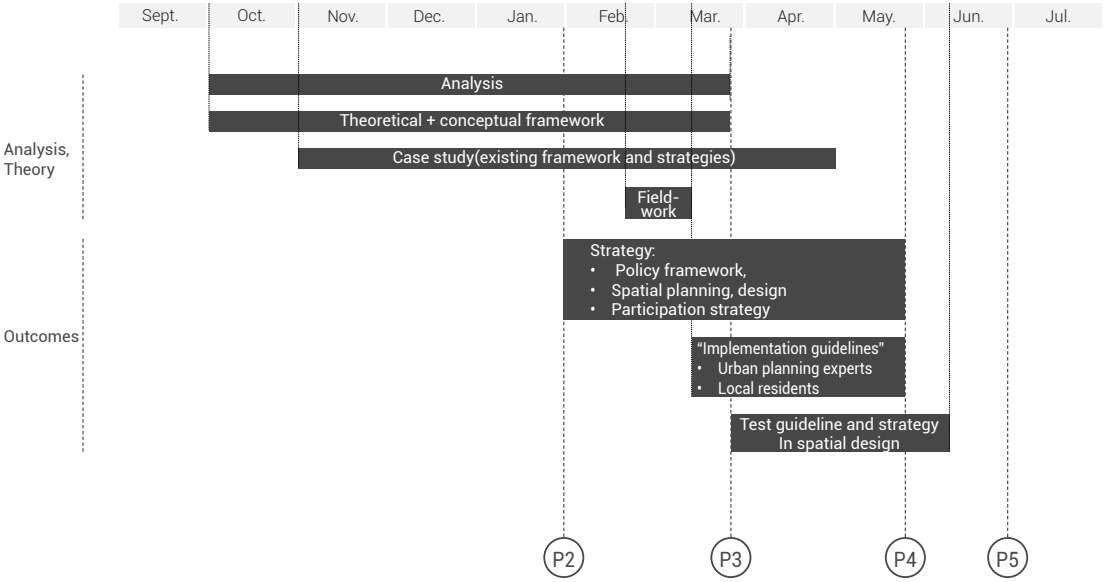


Figure: Project time-line design(mid-term) (Source: Drawn by the author)

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