



A GIS-Driven Pilot Framework for Exploratory Assessment of Organic Agriculture-Tourism Integration Potential in Urumqi

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SUMMARY: *This paper puts forward a GIS-leading test framework for the exploratory evaluation of organic agriculture and tourism combination development potential in Urumqi. Instead of making the claim of parcel-level place optimization, this study puts together a district-level approximate geodatabase and assesses candidate regions via a repeatable working flow that unites AHP-entropy weight methods, standardized spatial indexes, weighted superposition, and random-forest-based reliability explanation. Fourteen indexes are divided into five aspects: ecology foundation, agriculture foundation, tourism attraction ability, market-logistics guarantee, and current leisure-agriculture gathering degree. Under the proxy system we have adopted, Urumqi County has the strongest composite screening score, then comes Dabancheng and Xinshi, therefore Tianshan and Shayibake are still the least suitable, because the dense urban functions do not have matching sufficient production space. The tree-based analysis is used only to interpret variable importance and does not constitute a predictive validation model. Sensitivity tests indicate that the top-ranked tier is stable across alternative weighting scenarios, whereas the relative order of tourism- and market-oriented districts varies more noticeably. The main contribution is therefore methodological: a transparent pilot decision-support workflow for comparing administrative units when detailed parcel-level organic-farm inventories are not yet available.*

KEYWORDS: *agritourism, analytic hierarchy process, decision support systems, geographic information systems, random forest.*

1 Introduction

Organic agriculture and agritourism are no longer treated as isolated rural-development themes. A substantial body of scholarship now characterizes agritourism as a hybrid activity in which actual agricultural production, farm-based experience, and place-specific consumption are combined in a single value chain [1-6]. In that chain, organic agriculture is especially important because it provides a credible ecological narrative, higher perceived product quality, and a visible production process that can be translated into interpretation, harvesting, farm-to-table consumption, and environmental education. For planning practice, however, the challenge is not simply to restate that agriculture and tourism are related. Municipal authorities need a spatially explicit way to compare places where production feasibility and visitor demand can coexist, and where supporting infrastructure can sustain commercialization without eroding ecological carrying capacity.

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Xinjiang, from our view, is one region that is fit for the investigating of this problem, because the integration between agriculture and tourism already has spatial differences on prefecture and county level [7-11]. Current researches indicate that the merits of integration do not get distributed evenly: some regions change ecological sceneries and farming into high-worth tourist experiences, while other regions still get limited by low accessibility, industrial land utilization, broken farmland, or not strong travel service systems. Urumqi, which is the regional capital, makes this contradiction more intense. It includes thick city areas with big consumer need and service gathering, but it also includes near-urban and county-level places where farm land, hills, desert-side views, and traffic passages cross each other. This coexisting of big city need and various land situations makes Urumqi a especially suitable experiment platform for space selection.

From the perspective of engineering-centered planning support, the practical problem is how to put different types of information together into a definite decision making procedure. Studies on organic agriculture suitability already utilize GIS-based multi-criteria evaluation for transforming information of terrain, water, vegetation and land-use into screening layers [12-15]. Decision science provides weight logic via AHP and its associated methods [16], in the studies of uncertainty, scholars hold that weighted overlay methods must be followed by sensitivity analysis, and should not be given as determinate facts therefore [17]. Spatial explanation methods, which contain geographic-detector principle and combination study, further indicate that nonlinear connections between environmental and social-economic elements have importance when we arrange the order of candidate places [18, 19]. But there are not many researches which combine these tools on the special connecting place between organic agriculture and tourism in arid regions around big cities.

One more opportunity on methodology aspect originates from the recent tourism data analysis work. The concentration of tourism resources in Xinjiang has been researched by means of spatial analysis based on POI data [20], and the tourism quality of Urumqi has been inspected by making use of spatiotemporal big data [21]. On the dimension of city scale, the evaluation of arid region urban suitability has also been carried out for Urumqi through multi-criterion spatial analysis [22]. Resemble POI-guided and machine learning-strengthened tourism researches in Xi'an, Chengdu, Henan, Bali, and other areas display that scenic spots, service density, and reachable degree can be converted into operable spatial proxy variables [23-28]. Classical space self-correlation measurement tools such as Moran's I and the Getis-Ord statistic give the wider analysis tradition for finding gathered opportunity structures [29], [30]. Put together, these research works indicate that the agriculture-tourism connection can be handled as a space intelligence issue instead of being just a policy story description.

One more reason why we put our focus on Urumqi is the complexity of its governance work. In arid city systems, development pressure is gathered along traffic channels and oasis edge lands, while ecological frangibility, water shortage, and land division make non-unified tourism extension dangerous. A screening model which neglects this kind of context can overestimate the value of places with good visual appearance, and underestimate the value of districts which have ability to support real experience economies led by agriculture. On the opposite side, a model that only considers production may overlook the determining function of close-range urban demand. The Urumqi case hence makes the model have to face the complete integration problem: not the place where farming is only just possible, and not the place where tourism is only just wanted, but the place where the two can be put together into a functionally believable territorial product.

Therefore, this paper puts forward a GIS-leading experiment frame for Urumqi, hence it establishes the contribution in three levels. First of all, it has constructed a district-level index system which connects ecological compatibility, agricultural production conditions, tourism

attraction, and market operation support. Second, it combines AHP group weight calculation with entropy-based inside-group adjustment to obtain a clear screening index that is fit for city-level comparison. Third, it adds random-forest-based variable importance explanation and scene sensitivity analysis, hence the ranking can be critically discussed instead of being accepted as deterministic truth. Therefore, the obtained contribution is methodological and exploratory: it is one reproducible first-step decision-support working flow for administrative units, when fine-grained parcel data about organic agriculture are incomplete or cannot be obtained.

2 Related Works

The existing research documents which relate to the current work flow can be divided into three mutual influence aspects: the theory of agritourism and the research of its integration, the evaluation of suitability for organic farming, and the analysis of tourism space data. The study of agriculture tourism has built the concept foundation for this problem. Definitions and classification systems continuously hold that real agritourism demands an active connection with agriculture instead of a mere beautiful country environment. Research which stands from the provider angle holds that agritourism can make farm income have more types, stabilize family capital flow, and promote the fame of farms, but thus it also demands management ability, traffic convenience, and product difference. Wider rural tourism summarizing works further point out that this industry has developed from non-formal leisure usage to multi-function business modes which combine production, guest receiving, experience designing and environment protection management. These results have importance to this current research, because they show that only tourism demand is not sufficient; the agricultural foundation must continue to be visible and have functional meaning.

Researches regarding the combination of agriculture and tourism in China and its Xinjiang region have moved their research emphasis from the concept itself to the differentiation among different territories. According to Peng et al. give clear report about time-space difference in Xinjiang's integration of agricultural tourism, hence pointing out that traffic reachability, resource gift and policy ability together make the final results. Existing research connections the combination of agriculture and tourism with agricultural ecological efficiency, green production capability, rural public service matching, and county-level sustainable development. These research findings already confirm that integration can bring productivity and sustainability promotion, but these works are usually carried out at prefectural, basin, or county level and depend on statistical panel data. As a consequence, they elaborate wide difference but provide restricted operation instruction for city selection inside a non-uniform metropolis region such as Urumqi.

A second academic literature branch talks about the space suitability that organic agriculture has. Through the combination of soil, terrain, climate, water and land use indicators, the GIS-AHP method has been utilized by people to discover suitable regions for the carrying out of organic agriculture. The more newly done research in arid and semi-arid areas indicates that suitability must also take into account the feasibility of irrigation, the continuity of land, and the restriction conditions of infrastructure. These investigations are of significance hence they can supply a transferable environmental-production core framework for organic agriculture planning work. Their restriction, under the background of tourism combination, is that variables which face visitors are usually not existing. They assist people in answering in which places organic agriculture can operate from the biophysical perspective, but cannot answer in which places it can be changed into an integrated tourist economy.

The third research direction pays attention to the technical framework that is GIS-based multi-criteria decision analysis. Malczewski's investigation still stays fundamental in demonstrating that spatial decision questions can be broken apart into standards, weight values, normalization functions, and stacked layers. [Saaty's analytic hierarchy process provides a formalized flow for pair-wise comparison judgment and consistency verification], while the subsequent research hence puts emphasis on uncertainty, robustness, and the significance of investigating how rank orderings respond to substitutive suppositions. At the same time, geographic-detector-type deduction and other space explanatory instruments manifest that main factors can change in different spaces and at different scales. For a decision-support manuscript, this literature is necessary because it gives legitimacy to the combination of expert weight setting with data-sensitive improvement and after-the-event stability examination.

Tourism space analysis thus give another important component. From electronic-map POIs, the tourism resources of Xinjiang have already been mapped, and by means of spatiotemporal big-data indicators, the high-quality tourism destinations of Urumqi have been carried out examination. Extra researches utilize GIS-AHP for ecological travel appropriateness and utilize POI density, machine study, and space factor analysis to explain the recreational and travel rules in many Chinese cities and other regions. These research results show that tourism attraction ability can be measured by indicators which include landscape density, service gathering degree, reachability, and group distribution. However, the models which are led by tourism often give priority to demand and neglect the constraints on production land, this is a problem when the goal is that we need to find the locations where agriculture and tourism must exist together instead of competing for getting land.

When the three literature streams are read together, a precise gap becomes visible. Studies of agritourism give explainings on why integration is important; The researches about organic agriculture appropriate degree have proved that environment-production conditions can have drawing of maps; and the analysis about space of tourism can tell us how attraction and service structures can be represented through digital methods. But not many research works combine all three together into a repeatable city working flow, and much fewer do this in dry big city edge regions where water, land connectedness, reachability, and city need have strong mutual influences. Hence, Urumqi provides not only a regional example, but also a usable methodological pressure examination for mixed space decision support. The gap also justifies adding a machine-learning interpretation layer: once a weighted overlay creates a ranking, planners still need to know which variables most strongly anchor that result and how stable the ranking remains under scenario changes.

According to this summary, the design reason of this current study is on purpose mixed. This article has no intention to construct a forecasting model for tourism need, and it also does not put forward the assertion that it can resolve the problem of organic farm site selection at the parcel level. On the contrary, it has the objective of offering an operable screening framework which can be put into practice by utilizing public geospatial layers, district statistical data, and transparent weighting logic. This choice of design puts this research between pure discussion of concept and big prediction model building. It is also more compatible with the city-level decision-making support situation, in which the top demand is always to rank districts in order for experiment launching, on-spot checking, and the following detailed planning work.

There is also a practical research gap regarding analytical units. Much of the literature alternates between very coarse macro statistics and highly localized site studies. Municipal planners, however, often require an intermediate level of evidence that is detailed enough to prioritize budgets but not dependent on difficult parcel-by-parcel surveys. One district-level

substitute model can solve this problem of the missing part. It has saved enough territory detail to reveal inner-city difference while still being matching with generally obtainable data construction systems. This scale choice is one reason the present paper can bridge conceptual agritourism studies and engineering-oriented decision support.

Table 1: Representative Studies and Their Implications for the Present Work

Theme	Representative sources	Implication for this study
Agritourism typology and sustainability	[1]-[6]	Confirms that authentic agritourism must retain an agriculture-first logic and cannot be reduced to generic countryside leisure.
Xinjiang/China integration studies	[7]-[11]	Shows regional heterogeneity and policy relevance, but mostly at macro statistical scales rather than municipal screening scale.
Organic-farming suitability modelling	[12]-[14]	Provides transferable ecological and production variables, especially for water, continuity, terrain, and low-input feasibility.
GIS-MCDA and uncertainty analysis	[15]-[18]	Supports the use of AHP, entropy refinement, and scenario-based robustness checks for transparent spatial ranking.
POI-based tourism analytics and ML	[20]-[28]	Demonstrates that scenic, service, and accessibility structures can be operationalized through digital spatial proxies and interpreted with ML tools.

3 Study Area, Data Sources, and Methods

3.1 Study Area and Planning Problem

Urumqi is located in northern Xinjiang and exhibits a mountain-oasis-desert structure that creates strong spatial contrasts between ecological constraints, agricultural opportunity, tourism amenity, and metropolitan demand. The municipal territory includes Tianshan District, Shayibake District, Xinshi District, Shuimogou District, Toutunhe District, Midong District, Dabancheng District, and Urumqi County. These units have very big differences in terrain, the continuity of cultivated land, the distribution of scenic resources, the concentration of urban service, and the connectivity of logistics. Such heterogeneity makes Urumqi more informative than a homogeneous rural county, because the planning question is not whether tourism or agriculture exists in isolation, but where the two can be integrated without excessive land-use conflict.

The operational problem addressed in this paper is therefore defined as follows: given limited public geospatial data and no unified parcel-level inventory of certified organic farms, how can administrative units be compared for the purpose of pilot agritourism deployment? The answer proposed here is a district-level screening model. Districts are treated as decision units, while grid-compatible spatial proxies are used to represent production feasibility, tourism attractiveness, and market-operational support. This design allows municipal planners to identify priority districts first, and only then move toward field surveys, farm-level inventories, and detailed site design. In engineering terms, the district acts as the first aggregation layer in a larger spatial decision pipeline.

3.2 Indicator Architecture and Analytical Objects

The indicator architecture was constructed around five dimensions: ecological base, agricultural base, tourism attractiveness, market-logistics support, and support factor. The ecological foundation holds whether topographic form, plant growth, and atmospheric condition are on the whole consistent with low-input or organic-direction agricultural land scenes. The agricultural base is that which represents whether water obtaining, cultivated-land uninterruptedness, and land-splitting situations are enough to maintain production and experience from farms. Tourism attraction ability reflects the existence of landscape and culture resources plus service density that is able to support the transformation of visitors. Market-logistics support measures the easiness degree that products and visitors can achieve movement. The support factor captures whether a district already exhibits leisure-agriculture clustering, because existing clusters reduce transaction costs and increase demonstration potential.

Fourteen indicators were finally retained. All variables were transformed into standardized suitability scores in the 0-1 range, with higher values always indicating stronger integration potential after direction correction. It should be emphasized that these indicators represent district-level readiness proxies, not direct measurements of certified-organic acreage, certification status, or farm-management compliance. In this paper, “organic agriculture” is operationalized through environmental and production conditions that make organic-oriented farming and visitor interpretation more plausible, such as water access, continuity, fragmentation, vegetation quality, and compatible landscape setting. The model therefore estimates where an organic-agriculture-oriented tourism interface is more feasible at screening scale.

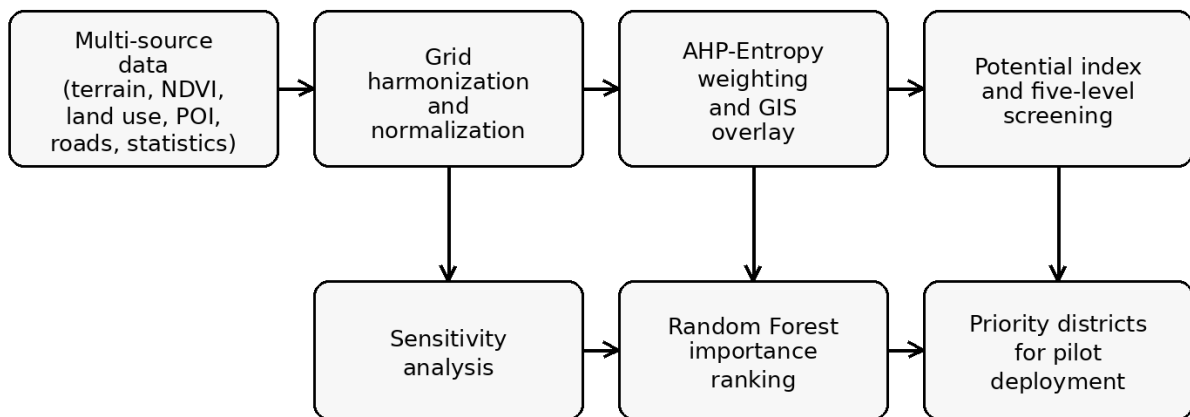


Figure 1: Workflow of the proposed Urumqi organic agriculture-tourism screening framework.

Table 2: Indicator System for the District-Level Screening Framework

Dimension	Indicator	Direction	Planning meaning
Ecological base	NDVI	+	Vegetation vigor and landscape quality
Ecological base	Slope	-	Topographic burden on cultivation and visitor access
Ecological base	Elevation suitability	+	Altitude appropriateness for productive landscape use
Ecological base	Climate comfort	+	Background climatic attractiveness
Agricultural base	Water / irrigation access	+	Production reliability in an arid setting
Agricultural base	Cultivated land continuity	+	Ability to form recognizable farm landscapes
Agricultural base	Land fragmentation	-	Barrier to efficient organic production and visitor routing
Tourism attractiveness	Scenic resource proximity	+	Potential to convert production into experience
Tourism attractiveness	Cultural village proximity	+	Local cultural content and place identity
Tourism attractiveness	Service POI density	+	Visitor-service carrying capacity
Market / logistics	Road accessibility	+	Ease of visitor and product movement
Market / logistics	Market accessibility	+	Access to urban demand and sales channels
Market / logistics	Logistics accessibility	+	Distribution and supply-chain convenience
Support factor	Existing leisure-agriculture clustering	+	Commercialization readiness and demonstration effect

Table 3: Multi-Source Layers, Operational Proxies, and Harmonization Rules

Layer or source type	Operational form	Derived proxy	Role in workflow
DEM-derived terrain layer	Raster / 1 km harmonized grid	Slope and elevation suitability surfaces	Ecological screening
Seasonal NDVI composite	Raster / 1 km harmonized grid	Vegetation and landscape-quality proxy	Ecological screening
Bioclimatic summaries	Raster / district crosswalk	Climate-comfort proxy	Ecological background
Cultivated-land and irrigation proxy	Vector-statistical crosswalk	Water access and continuity indicators	Agricultural base
Land-parcel pattern proxy	Vector-statistical crosswalk	Fragmentation indicator after reverse coding	Agricultural base
Scenic and cultural POIs	Point density / district aggregation	Attraction potential surfaces	Tourism attractiveness
Service-related POIs	Point density / district aggregation	Operational support density	Tourism attractiveness
Road, market, and logistics network layers	Network accessibility / district aggregation	Movement and distribution convenience	Market-logistics support
Existing leisure-agriculture cluster inventory	District proxy layer	Demonstration and spillover support	Support factor

3.3 Data Assembly, Grid Harmonization, and Standardization

In order to make the model can be operated, public raster, vector, POI, and district-statistical data were collected and adjusted to be consistent. Terrain index numbers were got from a

DEM layer, vegetation situation from a seasonal NDVI combined image, climate comfortable degree from publicly issued bioclimatic general statements, and road reachability from a can-route traffic network. Tourism attraction degree was represented through scenery and cultural POIs together with service-related POI density. Agricultural background messages, including cultivated-land continuance, irrigation easy access, and group existence, were expressed via unified district-level and map-based substitute layers. This method ought to be understood as a clear approximate strategy: because no united public record of authenticated organic farms exists at the needed city-level detail, the working flow uses repeatable preparation substitutes instead of stating direct observation of organic farm operation.

Because the source layers differ in semantics and measurement scale, crosswalking rules were explicitly defined. For example, scenic and cultural POIs were not treated as direct tourist flows; instead, they were converted into potential attraction surfaces that approximate the opportunity to assemble farm-based visitor routes. In the same manner, service POIs were explained by us as operation assistance, not as tourism quality in itself. Cultivated-land continuous degree was utilized as a substitute index for the possibility of keeping visible production landscapes which visitors are able to identify as agricultural instead of purely for viewing. These translation regulations are very necessary, because the meaning of indicators in spatial decision support not only relies on data attainability, but also relies on how the original data are linked to the planning problem.

All layers were resampled or cross-walked to a 1 km analytical grid and then aggregated to the district level. The choice of a 1 km grid is not intended to define actual land parcels. Rather, it offers a computational bridge between heterogeneous raster and vector sources, avoids over-precision that the available data cannot truly support, and maintains compatibility with municipal-scale screening. After harmonization, positive indicators were normalized through min-max transformation,

$$z_{ij} = (x_{ij} - \min_j x_{ij}) / (\max_j x_{ij} - \min_j x_{ij}) \quad (1)$$

while negative indicators were standardized as

$$z_{ij} = (\max_j x_{ij} - x_{ij}) / (\max_j x_{ij} - \min_j x_{ij}) \quad (2)$$

This directional correction ensures interpretability in the weighted overlay stage and allows all later statistics to be discussed in terms of increasing suitability.

3.4 Hybrid AHP-Entropy Weighting

The weighting work was designed through two phases. First of all, AHP has been utilized by us to confirm the relative importance of the five criterion groups, therefore municipal planning decisions usually commence with a normative judgment on whether ecological protection, agricultural production, tourism demand, or logistical convenience ought to hold the dominant position. Pairwise comparison numerical values were got defined on the group level, hence the priority vector was extracted out from the comparison matrix. Consistency was checked through the standard consistency index and consistency ratio,

$$CI = (\lambda_{max} - n) / (n - 1), CR = CI / RI. \quad (3)$$

The group matrix which we got meets the standard AHP consistency demand ($CR < 0.10$) and therefore produces a pattern that gives medium priority to the agricultural foundation, hence followed by ecological and market-logistics factors.

Second, we utilized the method of entropy weighting within every criterion group, hence we could avoid the situation that all indicator-level distinctions are purely driven by subjective judgment. To every single indicator, one probability distribution p_{ij} was got out from the standardized matrix; After this step, entropy e_j and information utility d_j were got calculation, a weight of entropy inside the group was gotten. The final weight of the indicator was gotten as the outcome that the AHP group weight multiply the normalized entropy weight in this group. This mixed method strategy deliberately carries out the balance between normative planning inclination and experiential difference. It is especially fitting for a pilot framework, therefore it stops a single expert matrix from fully controlling the outcome while it still keeps interpretable group priority items.

3.5 Composite Scoring, Five-Level Zoning, and Random-Forest Robustness

After standardization and weighting, each district i received a composite score S_i through weighted linear combination,

$$S_i = \sum_j w_j z_{ij} \quad (4)$$

The weighted covering method is fit for this situation because its goal is screening not satisfying strict restriction. A very low score in one aspect can still obtain partial offset by strong aspects in another one, which reflects the actual planning problem: a zone with medium environment conditions can still have attractiveness if it has strong tourism attraction and market access, while a zone with high agricultural adaptability can still remain limited if access and service conditions are not good.

For the purpose of interpretation, the continuous score was converted by people into five screening classes: very low, low, moderate, high, and very high. Owing to the fact that merely eight districts are being compared, the category labels are planning sorts instead of statistical collectives. For the purpose of making the overlay more complete, a random-forest regression device was trained on the standardized index matrix, with the composite score being used as the reference objective. This step is retained purely as a nonlinear robustness explanation which finds out variables that are most connected with the built index when tree-based division is carried out. This one ought not be explained as an outside model for prediction checking, nor as evidence for the performance of projects in the future.

3.6 Sensitivity Design and Planning-Oriented Interpretation

Research works which talk about space decision-support have higher force of persuasion when they show ranking instability instead of hiding it. Due to this cause, four different scenario groupings have been tested. Under the Eco+ scenario, ecological variables have obtained stronger emphasis; In Agri+, the main force of agricultural production occupies the leading position; In the "Tourism Plus" mode, the factors of scenery and service have been enlarged; and in the Market+ framework, the indicators of road, market and logistics were put in the first place. The entropy structure inside each group has been kept, thus only the balance at the group level has altered. This method separates out a question that city decision makers frequently put forward clearly: how much does the order rely on policy choice instead of on the index matrix itself?

For each district, the baseline score, scenario-specific score, and score range were recorded. Score range was defined as

$$R_i = \max_s S_i^{(s)} - \min_s S_i^{(s)} \quad (5)$$

where s denotes the policy scenario. Small R_i values indicate robust districts whose relative attractiveness does not depend strongly on policy stance. Larger R_i values indicate districts whose attractiveness is preference-sensitive and therefore should be interpreted more cautiously. In practical planning, robust high-ranking districts are better pilot candidates, whereas volatile districts may still be valuable but require clearer program positioning—for example, tourism-led demonstration versus production-led demonstration.

One more detailed problem about realization has relation to interpretability. In actual planning conferences, comprehensive indicators are frequently attacked because related parties cannot see in what way the final value was produced. For solving that problem, each index in this current working flow is connected with a clear planning meaning, each weight can be traced back to either group preference or data spread, and each district score can be broken down into contributions on dimension level. This design promotes communicative ability toward non-specialist policy deciders and therefore assists in avoiding the widespread issue of “black-box maps”, which look technically advanced but provide few explanations that can be put into action.

4 Results and Discussion

4.1 Weight Structure and Criterion Behavior

The output result of the hybrid weight is given in Table 4 and Figure 2. On the group level, the agricultural foundation obtains the biggest weight, hence is followed by ecological foundation, market-logistics guarantee, tourism attraction, and support factor. This grade-by-grade structure has the meaning of being analyzed. This indicates that the model uses an agriculture-first explanation which is in accordance with the documents of agritourism: tourism can raise value, but it cannot make up endlessly for bad production space or bad resource continuation. Inside groups, entropy improving work can distinguish indicators which have bigger changes between different districts. Therefore, cultivated land continuity, water irrigation reachability, road reachability, and existing leisure agriculture gathering become comparative influence factors in the last comprehensive weight system.

The weight distribution also therefore shows why a mixed method has utilization. Pure AHP could permit the analyst to put forward that agriculture has greater importance than tourism, but it could not realize that continuity and irrigation change more meaningfully than certain other agricultural indicators in the actual district group. By contrast, pure entropy would have neglected the planning judgment, hence it risked giving too much reward to those volatile variables which have rich data but are not central in strategy. Therefore, the combined outcome better matches the practice of municipal decision making: broad strategy priorities are kept, however the discrimination at indicator level still keeps sensitivity to data. This kind of balance especially has relation to a pilot framework which is prepared for repeat renewal when more exact local information can be got.

Table 4: Group and Indicator Weights after Ahp-Entropy Integration

Dimension	AHP group weight	Indicator	Entropy local weight	Final weight
Ecological base	0.21	NDVI	0.214	0.045
		Slope	0.143	0.03
		Elevation suitability	0.286	0.06
		Climate comfort	0.357	0.075
Agricultural base	0.35	Water / irrigation access	0.343	0.12
		Cultivated land continuity	0.4	0.14
		Land fragmentation	0.257	0.09
Tourism attractiveness	0.135	Scenic resource proximity	0.444	0.06
		Cultural village proximity	0.207	0.028
		Service POI density	0.348	0.047
Market / logistics	0.18	Road accessibility	0.422	0.076
		Market accessibility	0.35	0.063
		Logistics accessibility	0.228	0.041
Support factor	0.125	Existing leisure-agriculture clustering	1.0	0.125

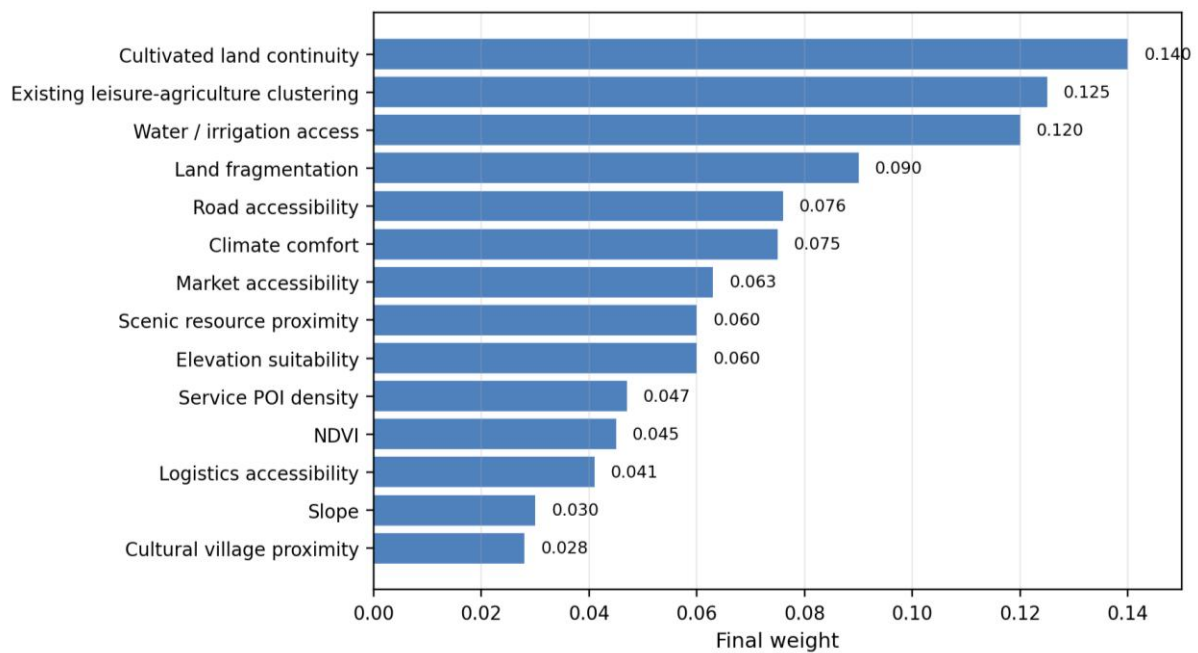


Figure 2: Final indicator weights after group-level AHP and within-group entropy refinement; higher bars indicate variables that exert stronger influence on the district screening score.

4.2 District-Level Potential Pattern

Table 5 and Figure 3 have displayed a district pattern that has strong differentiation. Urumqi County has gotten the highest composite score, which reflects that the whole balance of ecological quality, agricultural continuance, landscape value and cluster support is the best. Its main weakness is not environmental but logistical relative to the most urban districts. Even so, that weakness does not offset its broad multi-dimensional advantage. From a planning standpoint, Urumqi County is the clearest candidate for first-round pilot deployment,

particularly for integrated farm-stay, landscape-interpretation, and organic product demonstration routes.

Dabancheng together with Xinshi constitute the second level, however the reasons for this are not the same. Dabancheng has good performance on account of its powerful foundation of ecology and agriculture. It has inferior conditions in service density and market entry, which means it takes a production-guided or landscape-guided agritourism mode instead of an urban service-intensive mode. Xinshi, on the other hand, obtains high marks because it turns big city traffic convenience and market need into combination potential even though it has a weaker agriculture foundation. This point therefore causes Xinshi to become more fit for short-distance, high-frequency outskirts visiting, product selling promotion, and display farms which depend on closeness to consumers instead of large continuous production land areas.

4.3 Dimension Profile Differences

The decomposition on the dimension level makes clear the reason why districts that have similar composite scores need to adopt different development strategies. Urumqi County holds the first place not for the reason that it has control over only one individual variable, but because it maintains performance higher than the average level in all main aspects, particularly in ecological quality, agricultural continuity, tourism resources, and cluster support. Dabancheng writes down the strongest production-focused trait after Urumqi County, but its weak position in market and logistics shows that integration at the beginning ought to emphasize destination landscapes, low-density farm tasting activities, and brand difference instead of city leisure forms with dense service. Xinshi shows the opposite building: its farming base is comparatively small, but better traffic proximity, market closeness, and support conditions make it suitable for exhibiting farms, direct sale, and education-centered city-close travels.

The districts that have middle rankings also are divided into different feature types. Toutunhe has a form that is corridor-directional; this place has attraction when the functions of logistics, processing, and visitor movement are of importance. Shuimogou takes the comfortable environment as its core direction; It obtains advantages from beautiful scenery and service resources, but therefore it needs careful protection for limited production space if the agriculture-first principle is to be maintained. Midong has better performance in agriculture and logistics than in tourism attraction, therefore this indicates that its most realistic position lies in supply-chain expansion, seasonal activity arrangement, and production-support functions rather than top-grade scenic agritourism. Tianshan and Shayibake are in the fundamental sense districts of urban consumption. Their more powerful market and service aspects can explain the reason why they get promotion in tourism- or market-guided situations, but their feeble agricultural foundation limits true agriculture-centered arrangement.

4.4 Random-Forest Robustness Interpretation

The importance ordering of random-forest in Figure 4 on the whole gives support to the weighted-overlay principle, and at the same time it shows a different stress. Road reaching, near scenic spots, farmland connection, market reaching, and water-irrigation situations are the most impactful forecast factors for the combined mark in the nonlinear stability experiment. This ranking possesses meaning because it brings into prominence the connecting surface among movement, attraction and production. One district is not able to maintain organic agriculture-tourism combination if farms are too broken apart or not connected with each other, but it also cannot get success if scenery or experience value is too weak to change production space into tourist need. Therefore, this model indicates that it is a composite

mechanism, not a single leading cause.

A second understanding from Figure 4 is that support-factor and climate variables, though they are not unimportant, thus function more as modifying factors than as main fixed bases. At present, the existing leisure agriculture aggregation promotes the commercial preparation degree, but it cannot alone solve the problem of bad basic infrastructure. In the like manner, climate comfortable degree and elevation adaptive condition influence background attraction degree, but they are not the factors which have the strongest separating effect on districts inside the current city group. This result keeps consistent with the actual structure of Urumqi: big differences between districts are pushed more by land connectedness, passage approaching, and nearness to scenic spots and trade places than by very big climate differences inside the city border.

4.5 Scenario Stability and Planning Implications

The scenario-based testing makes the explanation of the baseline ordering more accurate. Figure 5 displays that Urumqi County still keeps the first-ranked district in every different weighting method, therefore it hence becomes the most firm candidate for test investment. Dabancheng and Xinshi still stay in the high-potential level, but their relative sequence has change under the scenarios which are led by tourism or market. This in the analytic view is reasonable. Dabancheng can obtain benefits when the model gives privilege to ecological and agricultural bases, whereas Xinshi can get promotion when accessibility and demand-oriented factors are put on emphasis. Toutunhe and Shuimogou also change places under certain situations, which shows their different structure characteristics: logistics ability versus tourism-service ability.

The districts that are most sensitive to policy are Tianshan and Shayibake. Their starting point scores are low, hence they promote themselves clearly when market or tourism weight numbers go up. This therefore does not mean they can become ideal cores of agritourism. On the contrary, it shows that their worth is in supplementary city functions like goods selling, tourist arrangement, topic mark building, and city-held expanding activities. In other words, the model do not put forward a single universal type of agritourism that is suitable for all districts. It puts forward a distinguished combination of investment projects, in which the suburban districts with high scores undertake the combination of production and experience, the districts with medium scores undertake the functions of channels and special development, and the crowded urban districts take the roles of consumption, marketing and entrance.

This kind of portfolio explanation has importance for carrying out work. A city government very seldom puts all projects into operation at the same time. The scoring structure indicates a step-by-step method: firstly, build demonstration groups in Urumqi County and chosen Dabancheng or Xinshi places; second, we should strengthen the corridor and logistics connection works in Toutunhe and Midong areas; Third, the utilization of Shuimogou, Tianshan, and Shayibake is conducted for the construction of brand image, the transformation of tourist numbers, and the entry into market spaces. This kind of ordering makes the index become, from a descriptive ranking, a practical guide for intervention. It also makes clear why district comparison has meaning even when the final goal is farm-level site selection: pilot districts determine the places where detailed engineering, land checking, and business model planning ought to start.

Table 5: Dimensional Scores, Composite Index, and Screening Classes

District	Ecological base	Agricultural base	Tourism attractiveness	Market / logistics	Support factor	Composite	Class
Urumqi County	0.786	0.821	0.788	0.649	0.85	0.782	Very High
Dabancheng	0.694	0.748	0.598	0.478	0.62	0.652	High
Xinshi	0.594	0.499	0.644	0.88	0.74	0.637	High
Toutunhe	0.546	0.51	0.557	0.861	0.63	0.602	Moderate
Shuimogou	0.622	0.391	0.801	0.775	0.67	0.599	Moderate
Midong	0.542	0.59	0.466	0.738	0.41	0.568	Moderate
Tianshan	0.475	0.201	0.809	0.906	0.52	0.507	Low
Shayibake	0.46	0.181	0.567	0.827	0.46	0.443	Very Low

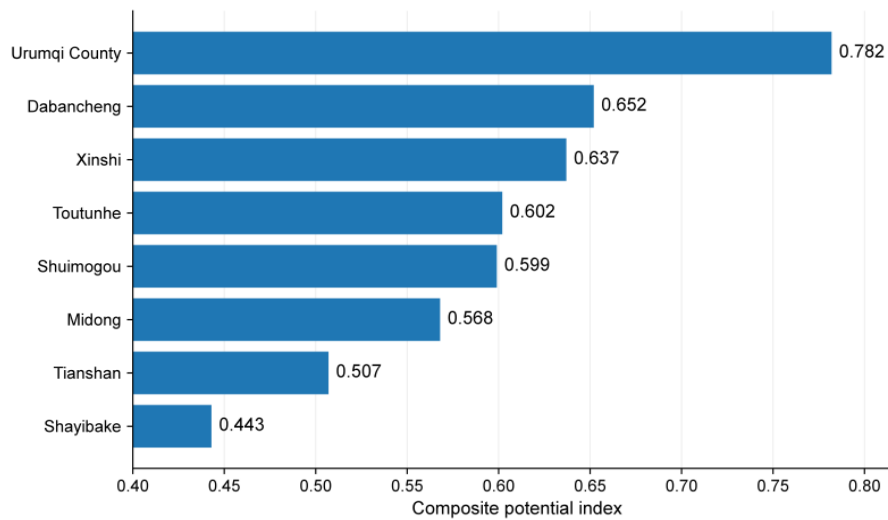


Figure 3: Composite district scores produced by the baseline screening model; higher values indicate stronger district-level readiness for organic agriculture-tourism pilot sequencing.

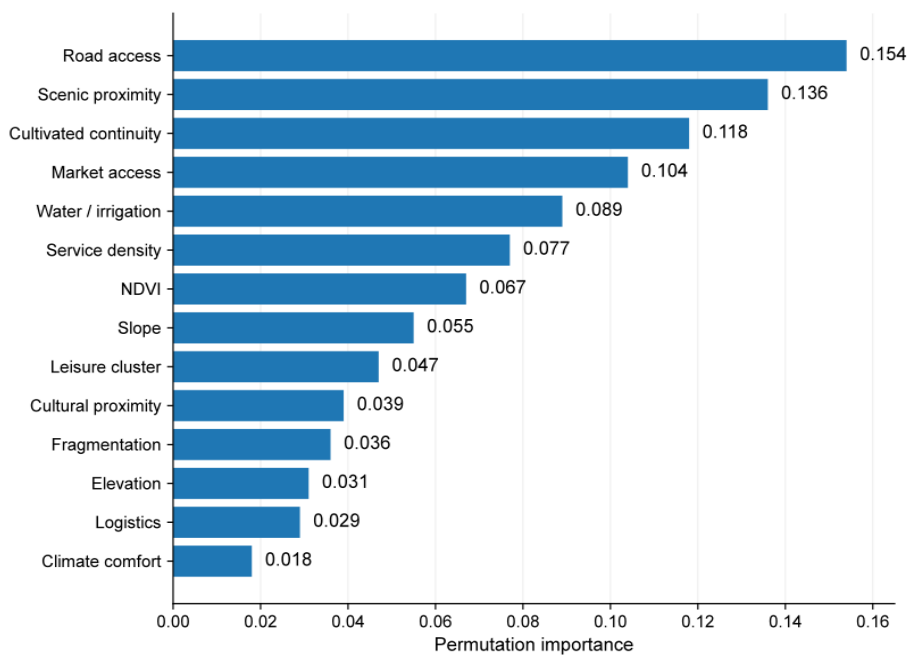


Figure 4: Random-forest variable-importance ranking used as an internal nonlinear robustness interpretation of the composite screening index.

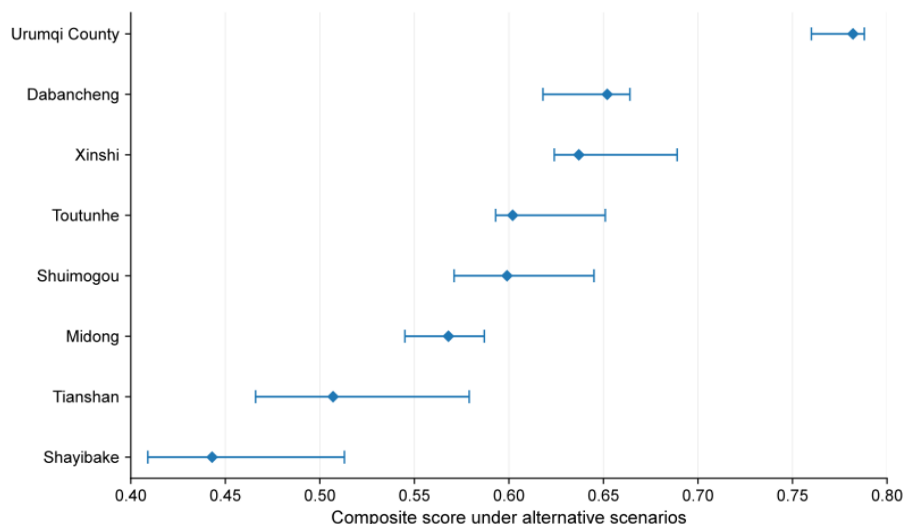


Figure 5: Score ranges of districts under alternative weighting scenarios, distinguishing robust leaders from policy-sensitive candidates.

5 DISCUSSION

5.1 Technical Meaning of the Proposed Workflow

The contribution of this paper is not an agricultural yield model and not a tourism demand forecast. Its technical value lies in the construction of a reproducible spatial decision-support workflow for a mixed land-use problem. The workflow fuses heterogeneous geospatial proxies, hybrid weighting, weighted overlay, and machine-learning-based driver interpretation into a structure that can be recalculated when better data become available. This is precisely the kind of contribution that helps translate non-engineering planning topics into computational decision support. The design is light enough to be implemented by municipal planning teams, yet sufficiently formal to support scenario comparison and transparent discussion of assumptions.

A related contribution is methodological scalability. Because the framework separates data harmonization, group weighting, within-group refinement, overlay, and robustness testing, each module can be replaced independently. A district-statistical proxy can later be replaced by parcel data; a POI density metric can be replaced by mobility traces; a random forest can be replaced by SHAP-enhanced boosting or other interpretable ensemble models. In this sense, the present manuscript should be read as a modular pilot system rather than a closed model. That modularity increases its usefulness for smart-territory planning, digital governance, and geospatial decision support in other arid metropolitan fringe environments.

5.2 Comparison with Earlier Agritourism Studies

When compared with studies that research the integration of agritourism at the macro scale, the framework which we put forward in this paper works at a municipal resolution that is more operational, and therefore it generates screening scores which can be directly compared with each other. It cannot take the place of those macro-level studies; On the contrary, it makes the problem narrower, changing from regional difference to the sorting of candidate regions by importance. When we compare to organic-farming suitability models, the current study has added tourism and logistics variables which are essential when the goal is not only to do organic planting, but to construct an agriculture-tourism connecting surface that can

attract visiting persons and support the local value increase. In comparison with researches about tourism analytics, this model brings in more powerful agricultural carrying-space logic, hence it avoids the common problem that people too much prioritize attractive but land-limited city core areas.

The district type classification which we obtain hence also has reflection in the wider academic documents concerning sustainability. High marks are not simply given to the units that are most urbanized or most have beautiful sceneries, but to the places where many functions can together exist without too much contradiction. This point accords with the conclusions that the integration of agriculture and tourism plays the most effective role only when ecological quality, public services and productive capacity exist together. What the Urumqi case has increased is an arid-metropolis viewing angle: water, land connection, and corridor passage become especially important under desert-edge situations, and the balance between city need and farming area becomes starker than in more wet country areas.

5.3 Limitations and Transferability

Several limitations should be acknowledged more explicitly. First, the analytical object is the district rather than the parcel. A high district score does not mean that all local sites are suitable, and a lower-ranked district may still contain niche opportunities. Second, the model uses district-level readiness proxies for organic agriculture instead of direct information on certification status, farm-management practices, organic input chains, or producer willingness. Third, the harmonization to a 1 km grid is a computational device for integrating heterogeneous data sources and should not be mistaken for the spatial resolution of implementation decisions. Fourth, the random-forest component is interpretive and internal to the constructed index; it does not constitute external validation against observed visitor flows, farm income, or project success.

Although these restrictions exist, this frame still can be moved to other situations when it is used as the first-step city check tool. After you find a district with high score, the suitable next step is on-spot confirmation: parcel successive examination, water right evaluation, farmer willingness investigation, tourist route arrangement, and business pattern matching. As for other cities, the transfer work would need the recalibration of both proxy definition items and group weight values to reflect the local terrain condition, tourism structure condition, and institutional priority requirements. Therefore, the value of this model exists in its transparency and replicability, not in any assertion of universally fixed parameter setting.

6 CONCLUSIONS

This article put forward a GIS-led experiment framework for exploration-type evaluation of the organic agriculture-tourism combination possibility of Urumqi's areas. Through the fusion of ecological, agricultural, tourism, logistical and clustering-relevant indicators by means of hybrid weighting and standardized overlapping, the working procedure has determined Urumqi County as the most strong screening candidate, hence Dabancheng and Xinshi form the next priority level under the adopted hypotheses. The explanation through random-forest method indicated that road reach, scenery closeness, farmland continuity, market reach, and irrigation guarantee are the variables which have the biggest influence in the internal robustness experiment, hence scenario inspection showed that the top level still keeps comparatively steady when policy focus has changes.

The wider significance of the study is methodological. A topic often treated qualitatively in regional-development discourse can be translated into a transparent spatial decision-support

workflow suitable for municipal digital planning. At the same time, the paper should be understood as a screening study rather than a parcel-scale siting or predictive validation exercise. In practical application, the outcomes may provide support for staged on-site inspection and pilot arrangement; For the research work, the framework needs to be expanded by adding parcel-scale organic farm inventory records, more detailed tourism requirement data, questionnaires for relevant parties, and more robust external verification work

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