Research Paper: Land Use Planning to Determine the Optimal Spaces for Developing Sustainable Rural Employment in East Guilan

Mohammad Ali Rahimipour Sheikhani Nejad[1], Habib Mahmoodi Chenari[1*], Farzaneh Nasiri Jan Agha[2], Fatemeh Momeni Taromsari[2], Seyyedeh Fatemeh Emami[3], Zahra Jensi[4]

1. Assistant Professor, Department of Regional Studies, Environmental Research Institute, Academic Center for Education, Culture, and Research (ACECR), Rasht, Iran.
2. Research Expert, Department of Regional Studies, Environmental Research Institute, Academic Center for Education, Culture, and Research (ACECR), Rasht, Iran.
3. Postdoctoral Researcher, Department of Geography and Rural Planning, Faculty of Humanities, University of Guilan, Rasht, Iran.
4. Research Expert, Environmental Research Institute, Academic Center for Education, Culture, and Research (ACECR), Rasht, Iran.

Use your device to scan and read the article online

Citation: Rahimipour Sheikhani Nejad, M.A., Mahmoodi Chenari, H., Nasiri Jan Agha, F., Momeni Taromsari, F., Emami, S.F., & Jensi, Z. (2023). Land Use Planning to Determine the Optimal Spaces for Developing Sustainable Rural Employment in East Guilan. *Journal of Sustainable Rural Development, 7*(1), 31-44. https://doi.org/10.22034/jsrd.2023.177412

https://doi.org/10.22034/jsrd.2023.177412

Article info:
Received: 03 July 2022
Accepted: 18 Dec. 2022

Keywords:
Planning, Land use, Sustainable employment, Scenario, Land allocation

ABSTRACT

Purpose: The present study aims to plan land use - land allocation - to determine the optimal spaces to develop sustainable rural employment in East Guilan.

Methods: in this research, the effective and affected variables are first identified, and their general perspective is drawn by compiling optimal maps with the help of future research methods. In the next step, based on the effective and affected variables, the most important descriptors of the research problem are identified, and three possible states are developed for each of the variables obtained from MICMAC software in the Scenario Wizard environment.

Results: Then, each state was ranked using the expert opinion, and the scenario was compiled. Based on this, three possible final states are obtained, including the most desirable, middle, and most undesirable. Finally, the status of effective variables in three states of future scenarios was examined and identified.

Conclusion: The exploration of the three scenarios indicates that in the first scenario, homogenous employment compatible and incompatible with nature has attempted land allocation so that conflicts between different stakeholders are resolved, and natural resources are not harmed. By weighing and determining the competency, it is found that the second scenario, namely the environmentally friendly employment scenario, such as creating small conversion and complementary workshops, developing tourism and ecotourism jobs, and similar jobs, are more adaptable to the environment and have higher sustainability. In the third scenario, the employment situation and the extent of its damage to natural resources is worse than in the previous two scenarios. In this scenario, the threat of environmental degradation is higher, and with the expansion of jobs, the rate of erosion, damage to natural resources, and the change of use of farms will be evident.

*** Corresponding Author:**
Habib Mahmoodi Chenari, PhD
Address: *Department of Regional Studies, Environmental Research Institute, Academic Center for Education, Culture, and Research (ACECR), Guilan Province, Rasht, Iran.*
Tel: *+98 (911) 8404215*
E-mail: *habib.mahmoodi@ut.ac.ir*

1. Introduction

Land use change is one of the challenges of rural settlements that have been the focus of rural research in recent years. In this process, the rotation of the rural economy and the beginning of consumerism have become the source of emerging developments in rural settlements (Halfacree, 1999; Gallent et al., 2003: 73). Therefore, the developments of the global economy, land market, technological and social developments have been influential in the structural changes and functioning of the rural economy (Plummer et al., 2017: 1). In this regard, urban-rural interventions and the physical structure of rural areas and land reduction and land use change around cities (Inwood & Sharp, 2012: 107), and new concepts in the form of land access power and land scarcity in rural areas have been proposed (Muraoka et al., 2018: 611).

Land use and land cover changes have occurred since ancient times and are associated with natural phenomena and humans (Briassoulis, 2000). In this regard, land use change has always been one of the most important changes in the world (Meyer & Turner, 1994). Employment in rural areas, as the first cycle of communication with the natural environment, is highly dependent on land and the environment and is of great importance in conserving resources and principles of sustainable development. Having a single product in the agricultural sector and also the lack of diversity in economic activities of rural areas have weakened the income sources of these areas (Rouzbahani, Morad & Abassi, 2020), one of the consequences of which is the change of use of agricultural lands to residential and recreational areas for non-native people. The sale or release of rural lands without a plan and study will cause the collapse of the economic system of these areas and also change its social and physical framework.

Accordingly, it is necessary to improve rural areas' living and economic conditions by planning for rural areas and creating a mechanism for the sustainable development of rural employment (Archibong, 2004). Land cover change is an important indicator of local social, economic, and ecological changes (Kruger, 2005).

The type of land cover significantly affects economic growth and environmental quality, and planning in this regard will be very complex due to the dynamism and nonlinearity of the influential factors. Therefore, applying an appropriate method to handle this complexity is a major challenge for planners (Djaenudin, Oktaviani, Hartoyo, & Dwiprabowo, 2017).

Meanwhile, the rural areas of East Guilan in recent years have witnessed a change in land uses due to having the highest percentage of rural population and agricultural and tourism potentials, a significant percentage of which is contrary to sustainable development and the preservation of local economic, social, and physical principles.

With fertile lands and a favorable climate, this region is suitable for various economic activities, so planning to determine the potential of the geographical areas of the region seems necessary to develop sustainable employment. In this regard, the present study attempted to determine the indicators affecting sustainable rural employment in East Guilan, rural and natural areas prone to the development of agricultural, tourism, and workshop activities to determine the suitable areas for each category of activities according to the needs of jobs and the potential of the region.

2. Literature Review

Land use planning is a set of activities that organizes the human environment according to the wants and needs of society. Land use planning is like land management and practically provides the how of land use, activities' distribution, land conservation, and spatial organization based on the needs of the society (Ebrahimzadeh et al., 2009). Efforts to plan for land use have always been one of the topics of interest. In this regard, related domestic and foreign studies in this field are presented here.

Yan et al. (2021), in a study entitled Assessing the Impact of Rural Land Use Planning: A Case Study of Kyuwangfen Village in Beijing examined the situation of villages versus cities and believed that there are many problems in rural areas, which are: From destruction of cultivated areas, degradation of villages and environmental pollution. One of the main reasons for these problems is incorrect land use planning at the village level. It is believed that land use changes will lead to several potential risks in the future. Accordingly, in this study, maximizing the benefits has been considered instead of minimizing the risks in planning optimization. For this purpose, they used the term green development to continue the research and believed this model leads to balance. Efficiency, coordination, and stability.

Huang et al. (2020), in an article entitled Rural Rehabilitation in China: Using Land Use Optimization on

Earth, believe that with globalization and rapid urbanization, most of the world's villages are facing the challenge of transformation and revitalization. This article focuses on land use optimization and intends to reveal the trend of rural development in the theory of location from a micro perspective. A case study on the village of Yuanqivanesh in China showed that human-land relations can be coordinated in building a place that is the foundation of a harmonious neighborhood to implement land use policy. Location ultimately leads to the optimal allocation of rural resources. Finally, they suggested that incentive policies such as surrogate subsidies with rewards and rural planning should be adopted to help villagers revitalize the villages after production.

Anderson et al. (2018) conducted a study entitled "Land Allocation, a Factor for Forest Conservation in Peru." In this research, using the paired method, it is attempted to resolve the disagreements of lands and consider the most appropriate allocation. Lio et al. (2017) conducted a research entitled "Construction Land Use Allocation in China" using an analysis of existing panels between 1985 and 2014. They showed that land use changes have been more in the central part. However, in the eastern and western regions, more uncultivable lands can be used for construction, and these land use changes will be more optimal in the eastern part. Vebrug (2013) assessed the uncertainty of changes in the future spatial allocation of agricultural land in Europe, which is made possible by a general equilibrium model with a land allocation model. Two contrasting scenarios were used to eliminate some uncertainties in economic, demographic and political development. The results of this study showed that some specific areas are facing the trajectory of land change more than others. Also, generalizing uncertainties at the macro level to uncertainty in spatial patterns of land change helps better understand and visualize the consequences of land use change. Inan and Bomral (2011) examined geographic information system models for land management in Turkey. They aimed to provide a technical guide to rural land use rules and regulations. They used three items of soil and land resources, land use planning, and agricultural land use plan to analyze the obtained data. According to them, it is impossible to prepare a comprehensive and standard plan for rural land use due to a lack of information and poor management.

Ramezani and Jafari (2014) conducted a study entitled "land use change modeling using CA Markov Model and Landsat satellite imagery" in Esfarayen, North Khorasan Province, and showed the good performance of remote sensing data in combination with the Markov model in modeling land use and land cover change. Ebrahimnia et al. (2008) carried out a study entitled "Methods and Models of Land Use Allocation" and presented the methods and models used in the change and allocation of urban land use. They assessed three land allocation models, optimization models for sustainable land use models based on multiple objectives, and land use allocation models in multi-center areas, showing them to be appropriate.

As mentioned in previous research, many studies have been done on land use. These studies have included proper land use allocation, construction land use allocation, identifying non-cultivable land uses, reviewing GIS models for land management, and preparing an accurate rural land use guide. In this study, while using the mentioned studies and other research and the study of the region, an attempt was made to determine the optimal spaces for sustainable rural employment to formulate detailed land use planning. Also, in previous studies, determining land use indicators has been discussed more theoretically. However, in addition to recognizing and identifying the effective indicators in rural employment, the present study examined it in terms of space. Moreover, optimal spaces are presented for sustainable employment in a geographical area concerning the type of jobs.

In regional planning theories, especially the sustainable development system, ecological resources, one of the most important parts of the land, have always been of great importance (Badri & Pourtaheri, 2012). The theory of sustainable development emphasizing preserving existing resources for the future and, at the same time, economic, social, and cultural growth has been one of the most recent approaches used by planners in this field (Faraji Rad & Kazemian, 2012).

Since the 1990s, the optimal allocation of land resources has been highly regarded as an important step toward the sustainable development of areas (Lio, Zhao, and Lio, 2014). Land use allocation is a dynamic and complex process that connects natural and human systems and directly impacts all human activities. Land use allocation balances the economy, productivity, and ecological issues to achieve a sustainable strategy (Chang, 2013). Therefore, researchers worldwide have used land allocation as an effective tool to achieve various achievements (Meijl, Rheenen, Tabeau, & Eickout, 2006). Most studies in this field have focused on solving social, economic, or environmental problems (Haj Foroshnia, Sufianian, Mahini, & Fakhran, 2011). In other words, it can be said that optimal land use allocation is

one of the main aspects of research in land use planning and a key step for sustainable land use (Verburg, Tabean, Hatna, 2013).

Optimal land allocation refers to the appropriate classification, design, composition, and planning of land resources at multiple levels and different spatial scales to increase land use productivity and maintain the equilibrium relationships of the land ecosystem to lead to sustainable land use (Wang, Wang, & Zhang, 2015). Land allocation models or approaches have been used in agricultural production, economics, politics, landscaping, transportation, social welfare, etc. (Zhang, Zhang, Jin, Wei, 2014). Constraints are always considered when creating a land allocation model to address multiple application issues and objectives. Thus, environmental, economic, and social impacts are considered as a general and integrated issue at the macro level. At an intermediate level, various constraints, including vegetation, topography, road, soil, labor, production, and investment resources, can significantly affect land allocation (Chowdhury, Zhang, Messac, & Castillo, 2011). At the micro level, land use spatial-neighborhood relations are a key consideration in land allocation (Ligmann, Church, Jankowski, 2008). Many studies have used remote sensing techniques and GIS to extract, monitor and allocate land use (Gao, Kang, Jiang, & Yang, 2010). Inland allocation, the focus is often on creating models with multiple goals and parameters. However, socio-economic development and ecological sustainability are always the two main goals in the land use process. The most important land allocation models are applied land allocation models, including linear model, dynamic system model, multi-objective model, multi-factor system model, gray forecasting model, and GIS base model (Cao, Huang, Wang, & Lin, 2012). The Cellular Automata model includes optimization techniques, rule-based simulation models, and multi-actor models.

One of the most important land allocation planning models is the MOLA method, or multi-objective allocation, used when conflicting goals exist. Conflicts may occur in allocating land use based on different goals simultaneously (Taleshi & Rahimipour, 2018). The image below shows the pattern of land allocation in a multi-objective manner.

3. Methodology

The MICMAC model has been used to identify important factors in rural employment in the eastern regions of Guilan, emphasizing training houses. First, the most important variables and effective components (facilitators or moderators) in sustainable employment were calculated and weighted in a comprehensive process and according to experts by brainstorming method. Then, they were entered into MICMAC software as a matrix table. A multi-objective model has been used in the present study's land allocation section. Therefore, triple scenarios are considered triple goals. For each scenario, a competency zone is created. In this case, different states occur that the best planning for the appropriate zones of locating the three mentioned scenarios is determined with the help of the MOLA model.

The study area in the present study includes rural areas of East Guilan in 6 counties of Astane, Siahkal, Lahijan, Langrud, Amlash, and Rudsar. In this research, the whole rural area of East Guilan has been studied in three coastal plains, foothills, and mountainous highlands, and all environment-oriented rural activities have been considered.

4. Findings

As explained in the research method, it was first attempted to determine the relationship between the main indicators in locating the three employment activities in east Guilan by examining the components obtained in previous studies. Then, key components are extracted through the analysis of Micmac software data. The following diagram shows the components obtained from Micmac software.

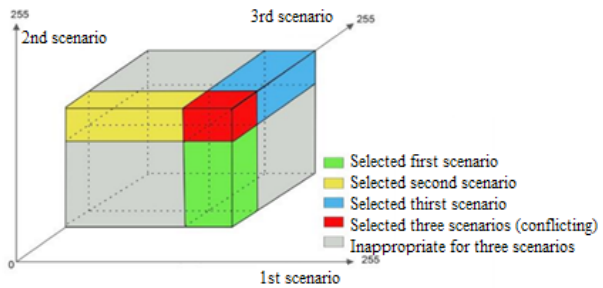

Figure 1. Multi-objective land allocation model for three contrasting scenarios (Noor Alipour, 2015)

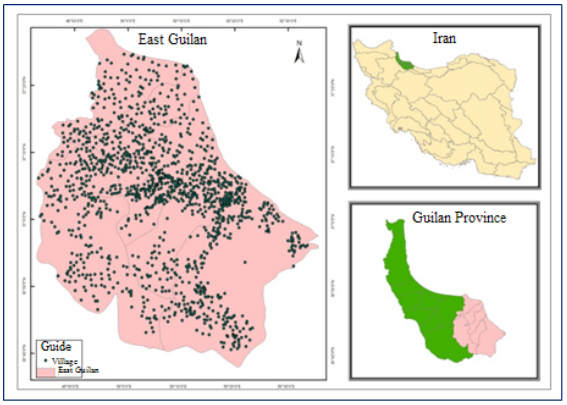

Figure 2. Map of the study area (Authors, 2021)

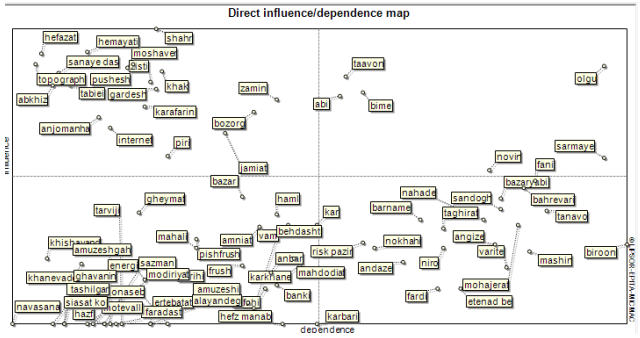

Figure 3. Identifying the importance of employment variables in East Guilan to protect the environment

The diagram above shows the status of variables affecting entrepreneurship and skills training in East Guilan. Based on the findings of the software, variables such as agricultural land, population density, soil erosion, watershed management, tourism, natural resources, topography, urban development, Internet, upstream plans, performance, and development of trans-regional markets are among the system inputs that cannot be changed from within the village environment. Also, variables such as the existence of centers to provide support services, counseling to strengthen entrepreneurship in the region, associations, developing an appropriate model of entrepreneurship in the region, promoting the benefits of entrepreneurial activities, and communication with entrepreneurs are variables that, despite being among the input part of the system can be changed and move the whole system.

Most variables are located in the southeastern quarter of the diagram obtained from the influential variables in East Guilan entrepreneurship. The placement of variables in this part will have different analyzes due to the placement above or below the diameter. Accordingly, variables such as guaranteed price, market access, transportation, and training are among the variables that, despite being influenced by first-quarter variables, are influential and can be used as secondary options in development strategy.

Other variables in this quadrant are considered discrete due to their location below the diameter. It means they have little effect on system dynamics and do not play a significant role in formulating future strategies. Variables such as banks, elimination of animal species, wholesale of products, general policies of the country, and similar items do not affect the entrepreneurial system of the region, and their movement path has been evaluated almost separately from the system.

In the third quarter, variables are more influenced by other dimensions. It means that changes in these variables can be expected by making the system dynamic. Individual characteristics such as greed, risk-taking, etc., are in this category. Also, variables such as migration, attracting foreign investors, using new inputs, productivity, and marketing are known to be among the influenced variables. It means that the variables mentioned in this section generally depend on the changes and movements of the first and fourth-quarter variables. In this regard, strengthening the input and bidirectional variables makes it possible to help improve the third-dimension variables and lead the system toward dynamics.

The fourth quarter of the diagram, located in the northeastern part, is divided by diameter and includes two parts of risk variables and target variables. In the present study, the risk sector variables include cooperatives,

insurance, and water resources, which have the most impact on and are mostly affected by the system after the target variables. The target section contains variables such as capital and innovation, technical knowledge, and cultivation patterns. These factors are the most important in system dynamics. It means that not only are they one of the future goals of the system, but they can be helped to improve and change the system by manipulating these variables. In this regard, the mentioned factors will play an important and key role in formulating regional strategies. As a result, factors of innovation, capital, technical knowledge, cultivation patterns, cooperatives, and insurance will be among the most important variables to formulate a business development strategy to preserve natural resources in the eastern part of Guilan.

Below is a diagram of the direct relationship between entrepreneurial variables to preserve the natural resources of East Guilan.

Scenario development

After reviewing the important drivers in the development of entrepreneurship in the eastern region of Guilan and the studies conducted in MICMAC software, appropriate strategies for sustainable employment in the region have been developed. In this regard, according to the results obtained from MICMAC software, fourteen influential factors in the eastern region of Guilan have been identified, and for each factor, three favorable, moderate, and unfavorable conditions have been considered. Thus, forty-two strategies were obtained after writing the strategies at the three levels mentioned. Then, with the help of scenario wizard software, strategies were reviewed. In this stage of the research, using the expert opinion, the limiting and reinforcing effects of the strategies on each other have been scored in 6 ranges. After this step, three favorable, moderate and unfavorable states have been obtained for the study area by entering the scores obtained in the software.

General ideal conditions:

- Rural job creation boom
- Preservation of natural resources
- Creating training houses
- Use of relative capacities

Competence of the first scenario

In the realization of the first scenario, jobs most dependent on the natural environment will have the opportunity to grow and develop. In this scenario, activities such as animal husbandry, agriculture, nature-oriented tourism, and generally jobs highly dependent on the environment are considered. With the policies of this scenario, attention to agriculture will increase, and investments will generally be drawn in this direction. Also, the cultivation pattern will change from the traditional form to an accurate and efficient method. The declining trend of the rural population will stop, and population stability will be achieved. In this regard, the pressure on natural resources will be reduced, and with the increase of income and productivity of existing lands, illegal activities, such as timber smuggling, unconventional land use change, and destruction of natural resources such as forests and pastures, as well as excessive pressure on existing resources will reduce and protect the natural environment. In this scenario, the existence of conversion workshops, rural cooperatives, areas with less erosion, distance from the forest, etc., are part of the development factors, and factors such as distance from urban areas, industrial plants, faults, rivers, protected areas, and ... are considered as limiting factors. Table 2 shows the weighting of the developing and limiting factors of the scenario, which are presented in the form of a map in Figure 5.

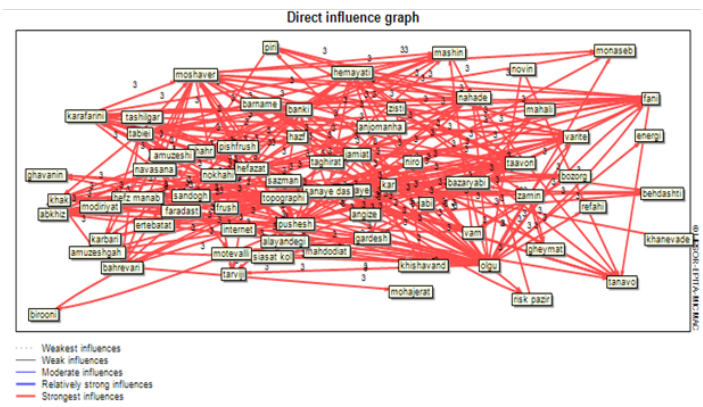

Figure 4. Direct relationships between employment variables in East Guilan to protect the environment

Table 1. Key factors and their status in possible scenarios

key factor	Scenario 1: Job creation compatible with the environment	Scenario 2: Environmentally friendly job creation	Scenario 3: Incompatible employment
Existence of agricultural lands	Optimal use and preservation of agricultural areas	Having a single product and traditional agriculture	Abandoning potential agricultural lands
population density	Attracting and stabilizing the rural population	Reducing the rural Indigenous population	Villages are being emptied of native inhabitants
Natural, agricultural and human resources	Rehabilitation of natural, agricultural, and human resources	Lack of integration in the protection of natural resources and ...	Improper exploitation of natural resources
Rural cooperatives	Production and development of rural cooperative activities	Continuation of the current trend of rural cooperatives	Loss of cooperative activities
Cultivation pattern	Preservation of cultivation patterns and native species	Continuation of the common pattern of cultivation without a plan	Loss of biological balance
Land erosion	Prevalence of basic agriculture and soil consolidation	Cross-sectional planning in soil protection	Land erosion due to unprincipled agriculture
Watershed management	Watershed management based on scientific methods	Relying on traditional watershed knowledge	Failure to apply appropriate watershed management practices
topography	Protection from natural disasters	Case manipulation in soil morphology	Elimination of natural roughness
water sources	Optimal use of water resources	Irrational use of water resources	Waste of water resources
Indigenous handicraft art	Prosperity of handicrafts with indigenous knowledge	Pay attention to handicrafts on a case by case basis	Loss of native skills and employment
Tourism	The prosperity of ecotourism and peaceful tourism with nature	Lack of integrated programs in the use of natural lands for tourism uses	Distribution of destructive tourism (villa construction, etc.)
Urban Development	Prevent the uncontrolled development of urban areas	Attachment of suburban villages to urban areas	The growing transformation of large villages into cities
Inter-organizational coordination	Coordination between government agencies to allocate space for the formation of training houses	Allocating space to form training houses in some villages on a case-by-case basis	Lack of agreement between government agencies to provide the space needed by entrepreneurial houses
Environmental compatibility of jobs	Prevalence of environmentally friendly jobs (such as growing seedlings, clean industries, processing products, etc.)	Establishment of some environmentally friendly jobs.	Prevalence of non-environmentally friendly jobs (such as polluting industries, intermediation, wood smuggling, etc.)
Management	Amend laws related to rural affairs	Stability of the current situation and continuation of the implementation of the adopted laws on rural economic affairs	Apply restrictive rules to develop sustainable employment
Superior design	Develop plans for employment	Considering the position of sustainable rural employment	The focus of projects on other rural issues
Facilitators	The focus of facilitators is to create sustainable employment	Existence of some facilitators on a case-by-case basis	Lack of necessary facilitators
Internet	Expansion of Internet networks	Expansion of internet network in the centers of some villages	Lack of attention to Internet infrastructure
Entrepreneurship model	Develop a suitable pattern for each area	Continuation of common patterns in entrepreneurship	Changing the common pattern and forming patterns contrary to the natural resources of the region
Market and access	Increase road quality and transportation	Improve access to local and regional markets	Lack of proper access to sales markets - and reduced motivation of producers
investment	Creating suitable grounds for attracting internal and external capital and creating a mechanism for the participation of local micro-capitals	Creating opportunities for investment by individuals and organizations on a case-by-case basis	Lack of suitable conditions for investment and exit of investors

Table 1. Key factors and their status in possible scenarios

key factor	Scenario 1: Job creation compatible with the environment	Scenario 2: Environmentally friendly job creation	Scenario 3: Incompatible employment
Guaranteed price	Develop a mechanism to consider a guaranteed price for all products in rural areas	Stability of the current trend concerning the price of rural products	Advance sales of products below the real price and reducing production incentives and production mobility
Technical knowledge	Development of production methods and tools suitable for agricultural products with low environmental impact	Expand technical knowledge and tools for some specific products on a case-by-case basis.	Production of rural products and activities, regardless of new production methods and tools
Innovation	Applying a new method to produce new products and new production tools	Production of agricultural products according to usual methods	Production of agricultural products regardless of market demand and innovative products

JSRD

Table 2. Weighting based on pairwise comparison of congruent scenario factors

	Factor	Factor weight	Limitations
1	Land resources	0.0534	Urban area
2	Dam	0.0700	Landslide risk range
3	Distance from main and secondary roads	0.0292	Adjacent to industrial factories
4	Existence of rural cooperatives	0.0389	Proximity to faults
5	Land irrigation area	0.0826	-
6	Distance from the forest	0.0729	Buffer of Rivers
7	Distance from the spring	0.0632	Quadruple environmental protected areas
8	Distance from the river	0.0583	Buffer of Roads
9	Distance from the city	0.0194	-
10	Ability to cultivate soil	0.0777	-
11	Agricultural poles	0.0972	-
12	Agricultural product conversion workshops	0.0875	-
13	Range	0.0680	-
14	Scope of activity of the Natural Resources Organization	0.0904	-
15	Water erosion range (to stabilize the soil)	0.0914	-
16	Compatibility	0.08	

Source: Authors, 2021

JSRD

Figure 5. Competence of the first scenario

JSRD

Competence of the second scenario

If the second scenario realizes, the jobs most compatible with the natural environment will be developed. In addition to preserving natural areas, jobs will be diversified in rural areas and bring economic prosperity. The difference between this scenario and the first scenario is using natural resources. In the first scenario, jobs with high dependence on the land, such as cultivating new varieties with high productivity, mechanized cultivation, etc., have been considered. However, the second scenario includes compatible jobs that complement current jobs, such as development and innovation in conversion and complementary industries, agricultural tourism, indigenous handicrafts, and waste products in this industry, as well as small-scale activities and workshops. In the second scenario, besides preserving more natural resources and rehabilitating the affected areas, there will be economic prosperity, and the villages will become dynamic economic networks. Expected jobs in this scenario will increase the ability to raise capital for rural areas and improve the infrastructure, including the Internet, in rural areas. For example, jobs such as innovative conversion industries, handicrafts that used to be popular in the region, marketing of existing products, and small workshop industries will be possible. In creating jobs compatible with the natural environment, different layers are weighed based on expert opinion, and each layer is prioritized based on its consequences.

Finally, restrictive layers such as urban areas, protected areas, and river areas have been removed from the study area. According to the plan approved by the Cabinet, building at a distance of 20 meters of these areas is impossible. It should be noted that the 300-meter range as the optimal access for these jobs had the highest priority based on expert opinion. Also, proximity to tourist spots with a radius of 500 meters, proximity to mines up to a radius of 2 km, and proximity to water sources up to a radius of 500 meters is considered.

Table 3. Weighting based on pairwise comparison of compatible scenario factors

	Factor	Factor weight	Limitations
1	Proximity to tourist landmarks	0.1205	Urban area
2	Distance from forest	0.0688	protected areas
3	Distance from main and secondary roads	0.1377	Buffers of Rivers
4	Distance from natural and cultural attractions	0.1291	Adjacent to industrial factories
5	Proximity to cities	0.1119	
6	Adjacent to the beach and the river	0.0861	
7	Distance from spring	0.0912	
8	Distance from river	0.0947	
9	Distance from basin	0.0826	
10	Proximity to mines	0.0775	
	Compatibility	0.76	

Source: Authors, 2021

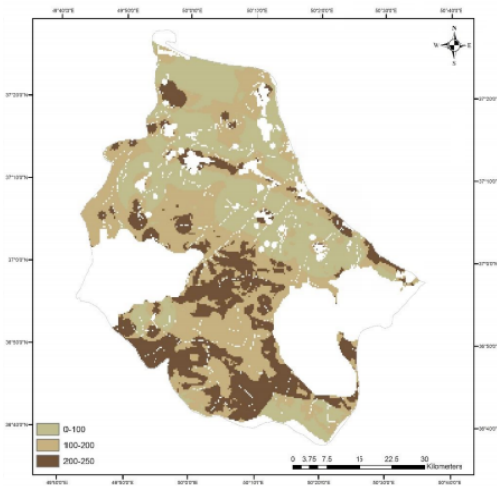

Figure 6. Competence of the second scenario

Third Senate Competence

In the third scenario, the situation of jobs and the extent of their damage to natural resources is worse than in the previous two scenarios. In this scenario, the threat of environmental degradation is higher, and with the expansion of jobs, the rate of erosion, damage to natural resources, and the change of use of farms will be evident. Villa construction, industrial jobs, and high-pollution factories will not allow environmentally friendly activities, and changes in cover will be affected by population density, and areas around water resources, beaches, and natural landscapes will be attacked by unconventional construction and industrial pollution.

Of course, the factors and limitations set in the third scenario are quite similar to the second scenario, and the difference in determining the competence of the third scenario is in changing the prioritization of the effects of the relevant layers. So, proximity to the city and proximity to industrial factories has been a priority. Natural land uses such as forests and pastures have also been considered for this group of stakeholders to achieve a proper zoning, considering that all individuals and interest groups have been seen in natural areas. Obviously, in the final map of this scenario, limiting factors such as protected areas, urban areas, and areas of activity of the Natural Resources Organization have been removed.

Table 4. Weighting based on pairwise comparison of incompatible scenario factors

	Factor	Factor weight	Limitations
1	Proximity to main and secondary roads	0.1201	Urban area
2	Proximity to natural and cultural attractions	0.0450	Scope of activity of the Natural Resources Organization
3	Proximity to tourist landmarks	0.0751	protected areas
4	Proximity to cities	0.1021	Crop areas
5	Adjacent to industrial factories	0.1426	
6	Agricultural poles	0.0796	
7	Range	0.0315	
8	Forest	0.0225	
9	water sources	0.0961	
10	Distance from the spring	0.0180	
11	Distance from the river	0.0556	
12	Distance from the basin	0.0736	
13	Proximity to mines	0.1381	
14	Compatibility	0.56	

Source: Authors, 2021

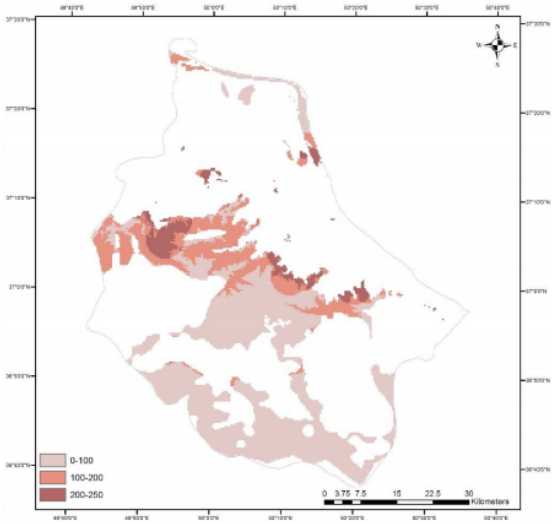

Figure 7. Competence of the third scenario

Figure 7 shows the competency map for establishing activities incompatible with nature. As mentioned, this scenario includes jobs that are generally industrial, highly polluting, causing changes in the use of fertile lands, hazardous to natural resources, and in the long run, will disrupt the original fabric of villages. Factors such as land use, saline and uncultivable lands, water erosion of lands, distance from fault lines and high-risk areas, proximity to cities and transportation networks, and not being located in unauthorized borders of the Natural Resources Organization have been considered to zone the establishment of these jobs. In this way, dark spots have gained more ability to create this category of jobs, and as the spots fade, these capabilities will also be much less.

Demand estimation and spatial calculation

In total, the criteria related to jobs that are congruent with nature, jobs that are compatible with nature, and jobs that are not compatible with nature received 50, 80, and 20 percent of the votes of different groups of rural stakeholders, respectively.

All cells in the competency map have values higher than zero and less than 255. But only the cells with the highest competency rank are used to assign each target. The purpose determines the scope of competency.

Table 4 shows the amount of land obtained for each activity category, the number of cells occupied in the software, and the weight obtained to show the importance of each category of jobs.

Allocation map

As noted in the Competency Maps section, each of the three scenarios is formulated to develop the sector and form different and sometimes identical spatial needs, each specifically zoned in the Competency Maps. The zones specified for each scenario will eventually overlap at some points, making it difficult to execute and plan. Therefore, the final resource allocation plan has been prepared and designed to resolve the conflicts and overlaps that applicants in all three scenarios will encounter. Land allocation prevents the occurrence of the most undesirable situation by resolving the conflict of conflicting goals and balancing different scenarios. Land allocation, on the one hand, helps increase the protection of natural and agricultural resource cover and, on the other hand, directs changes in natural resources to create jobs incompatible with nature and prevents sporadic cover changes that disrupt agricultural and natural coverings. In other words, the permissible limits for manipulating the natural cover are determined. Of course, this problem can be seen only in the northern region of Iran, where all the lands are good, and the uncultivable land is too little for residential and industrial uses. Therefore, zoning will be used to establish each job to meet all stakeholders' social and economic needs.

Table 5. Weight and spatial needs of targets in the multi-objective allocation of land

	Objective (scenario)	Weight	Space requirement (cell)	Space requirement (hectares)
1	Jobs that are congruent with nature	50	12517	127214
2	Jobs compatible with nature	80	15447	156942.94
3	Jobs incompatible with nature	20	308	3130.30

Source: Authors, 2021

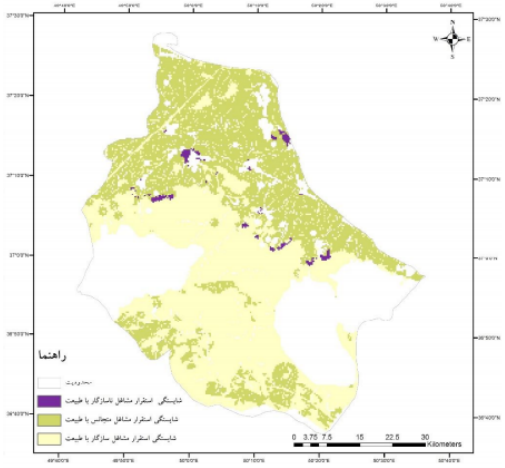

Figure 8. Allocation of land for the three purposes

All three scenarios have spots on the job zoning map. In this zoning, jobs that are incompatible with nature have the least spots, and jobs that are congruent with nature and those that are compatible with nature have also acquired approximately the same areas.

Green zones, which are generally found in the vicinity of the south of the sea and along the coastline, are best suited for agricultural activities, nature-oriented tourism, high-yield crops, and activities that are highly dependent on nature, such as turkey breeding, cold-water and hot-water fish farming, seedling and tree planting, animal husbandry, agriculture, and horticulture, as well as ecological handicrafts whose primary sources are provided by nature, etc.

Cream-colored areas, which are scattered mostly in the south of the region and in the foothills and mountains, are suitable for workshops, conversion, and complementary activities that reduce excessive land use in these areas and create a side income for people, such as lubrication, hazelnut packing, and processing workshops, citrus processing, etc.

The purple areas in the map (Figure 6), mostly scattered between the border between the foothills and the mountains, are suitable for developing incompatible activities. Some industrial workshops can be located in these areas.

5. Discussion

Today, discussions and concerns about land use change have received serious attention. In such a situation, land use has become an important issue of political analysis. Land use is an example of human impact on the environment. Land use has special economic characteristics in terms of its nature. For example, human activities such as production, consumption, investment, recreation, etc., require using geographical space. Economic activities are manifested in various forms, such as housing construction, providing facilities, infrastructure construction, agricultural lands, and green space in geographical space. Formed uses are raised as an issue when they have geographical differences in compatibility and desirability.

One of the necessary parts of economic planning is to pay attention to the environmental potential and the consequences that will enter the environment after economic activities start. Therefore, allocating land to systematize the location of jobs and examine their environmental effects will be an efficient approach to achieving sustainable development. In this regard, multiple stakeholders in the joint use of available natural areas and various ownership, monitoring, and control types of natural areas make it difficult. Land management uses cost-effective allocation methods for micro-planning, a common procedure for planning and implementing micro-economic plans. It also defines management tasks at hierarchical levels and thus directs land cover manipulation in a specific direction.

In this regard, taking into account the factors affecting rural employment, such as proximity to the city, access to transportation, population thresholds, major crops, proximity to industrial estates and factories, access to water, soil type, the rate of land erosion, proximity to faults, etc. the present study have considered competencies for the three possible employment scenarios. Thus, in the study area, any pattern that causes the loss or destruction of resources is more unstable. The land also has a certain capacity for various economic exploitation, both agricultural and industrial, and excessive pressure on it will cause damage. In this vein, if an approach has less destructive effects over time, it will be more sustainable. The point that should be considered in planning is the different needs of society and the interests of different economic groups. Therefore, it is impossible to achieve sustainable planning and provide radical guidelines for environmental protection by presenting a single approach. Therefore, considering these three possible job creation scenarios in East Guilan, including the job creation scenario congruent, compatible, and incompatible with nature, an effort has been made to allocate land so that conflicts between different stakeholders are resolved, and natural resources are not harmed. Finally, by weighing and determining the competency, it was found that the second scenario, namely the environmentally friendly employment scenario, such as creating small conversion and complementary workshops, developing tourism and ecotourism jobs, and similar jobs, are more adaptable to the environment and have higher sustainability. In total, rural areas of East Guilan are prone to develop and promote various production and processing activities, such as tea, legumes, vegetables, almonds, hazelnuts, herbs, walnuts, citrus, kiwi and wild plum, rice, wheat, barley, hot and cold water fish, wax and honey, silkworm, horticulture, carpet weaving and felt weaving, mat weaving, bamboo weaving, pottery, and indigenous handicrafts.

Acknowledgements

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of Interest

The authors declared no conflicts of interest.

References

Anderson, M.C, Asner, G.P, Liatayo, W., & Lambin, E.F. (2017). Overlapping land allocations reduce deforestation in Peru. 79: 174-178.

Archiburg, AE. Results of treatment in children with anorectal malformations in Calabar, Nigeria. Pediatric Surgery Unit, Department of Surgery, University of Calabar, Calabar, Nigeria. Pp 88-100.

Badri, A., & Poortaheri, M. (2012). Introduction to Sustainable Rural Development. Gorgan, Loghat Publication.

Briassoulis, H. (2000). Analysis of Land Use Change: Theoretical and Modeling Approaches. Wholbk, Regional Research Institute, West Virginia University, 17.

Cao, K, Huang, B, Wang, S.W, Lin, H. (2012). Sustainable land use optimization using Boundary-based Fast Genetic Algorithm. Computers. Environment and Urban Systems, 36 (3): 257–269.

Chang, H., Chiu, Sh. (2013). Discussion on sustainable land use allocation toward the sustainable city a practice on Linco New Town. The 3rd International Conference on Sustainable Future for Human Security SUSTAIN, Procedia of Environmental Sciences, 17: 408-417.

Chowdhury, S., Zhang, J., Messac, A., Castillo, L. (2011). Characterizing the influence of land configuration on optimal wind farm performance. Proceedings of ASEME: International Design Engineering Technical Conferences and Computers and Information in Engineering Conference: 1-12.

Djaenudin, D., Oktaviani, R., Hartoyo, Sri., Dwiprabowo, H. (2016). Modeling of land allocation behavior in Indonesia. Procedia of Environmental Sciences, 33: 86-78.

Ebrahim Nia, V., Rasooli, M., Zandieh, S. (2010). Land use allocation methods and models. Armanshahr Quarterly, 2: 9-21.

Ebrahimzadeh, E., Bazrafshan, J., Habibzadeh Lamso, K. (2010). Analysis and evaluation of rural land use (villages, small towns in Iran using GIS) Case study of Khoshroudyi Babol. 2(5): 111-138.

Faraji Rad, Kh., & Kazemian, Gh. (2012). Local and Regional Development from the Perspective of Institutional Approach. Tehran: Jihad Daneshgahi Publications.

Gallent, N., Juntti, M., Kidd, S., Shaw, D. (2013). Introduction to rural planning, Routledge, USA.

Gao, Q.Z., Kang, M.Y., Xu, H.M., Jiang, Y., Yang, J. (2010). Optimization of land use structure and spatial pattern for China's semi-arid loess hilly-gully region. Catena, 81: 196-202.

Hajehforooshnia, Sh., Soffianian, A., Mahiny, A., Salman, & Fakheran, S. (2011). Multi-objective land allocation (MOLA) for zoning Ghamishloo Wildlife Sanctuary in Iran. Journal for Nature Conservation, 19: 254– 262.

Halfacree, K. (1999). A new space or spatial effacement? In Walford,N., Everitt,J, alternative futures for the post-productivist countryside. & Napton, D. (eds) Reshaping the Countryside: Perceptions and Processes of Rural Change, CABI: Wallingford.

İnan, H. İ., & Yomralıoğlu, T. (2011). Geographical Information System Model for Rural LAND Management. TMMOB Harita ve Kadastro Mühendisleri Odası Türkiye Harita Bilimsel ve Teknik Kurultay, 18-22Nisan, Ankara, 13: 124-32.

Inwood, Sh. M., Sharp, Jeff S. (2012). Farm persistence and adaptation at the rural-urban interface: Succession and farm adjustment. Journal of Rural Studies, Vol. 28, PP.107-117.

Lingmann-Zielinska, A., Church, R.L, Jankowski, P. (2008). Spatial optimization as a generative technique for sustainable multi-objective land-use allocation. Int. J. George. Inf. Sci. 22(6): 601-622.

Liu, Y., Zhao, X., Liu, D. (2014). A paralleled decision support system for land-use allocation optimization based on an artificial immune system. Geomatics and Information Science of Wuhan University, 39(2): 166-171.

Meijl, H.V., Rheenen, T.V., Tabeau, A., Eickhout, B. (2006). The impact of different policy environments on agricultural land use in Europe. Agriculture Ecosystems Environment, 114(1): 21-38.

Meyer, W.B., & Turner, B.L. (1994). Change in land use and land cover: A global perspective. United Kingdom: Cambridge university press.

Muraoka, R., Jin, S., Jayne, T.S . (2018). Land access, land rental, and food security: Evidence from Kenya. Land Use Policy, Vol.70, PP. 611-622.

Plummer, P., Tonts, M., Argent, N. (2017). Sustainable rural economies, evolutionary dynamics, and regional policy. Applied Geography, In press.

Ramezani, N., & Jafari, R. (2014). Detection of Land Use and Land Coverage Change on the Horizon of 1404 Using CA Markov Chain Model (Case Study: Esfarayen). Quarterly Journal of Geographical Research, 29(4): 83-96.

Rouzbahani, A., Moradi, H., & Abbasi, N. Analyzing the Local-Spatial Consequences of the Development of the Tourism Economy with an Entrepreneurial Approach in Rural Areas (Case Study: Samen District in Malayer County). Ferdowsi University of Mashhad Press, 2: 105-130.

Vebrug, P.H, Tabeau, A., Hatna, E. (2013). Assessing spatial uncertainties of land allocation using a scenario approach and sensitivity analysis: a study for land use in Europe. J. Environ. Manage. 127: 132-144.

Wang, Sh., Wang, X., & Zhang, H. (2015). Simulation on the optimized allocation of land resources based on the DE-CA model. Ecological Modelling, 314: 135-144.

Yan, J., Zhang, D., Xia, F. (2021). Evaluation of village land use planning risks in green concepts: The case of Qiwangfen Village in Beijing, Land Use Policy, Land Use Policy Volume 104, May 2021, 105386.

Huang, Y., Hui, E., Zhou, J., Lang, W., Chen, T., Li, X. (2020). Rural Revitalization in China: Land-Use Optimization through the Practice of Place-making, Land Use Policy, Volume 97, September 2020, 104788.

Zhang, J., Fu, M., Zhang, Z., Tao, J., & Fu, W. (2014). A trade-off approach of optimal land allocation between socio-economic development and ecological stability. Ecological Modelling, 272: 175– 187.