## Research Article
## Measuring Sustainability Levels of Rural Development (Case Study: Karaj County)

[1]F. Paseban and [2]B.H. Kaboudvand
[1]Planning Research Institute, Agriculture Economy and Rural Development, Ministry of Jihad
[2]Rural Development Department, Tehran, Iran

**Abstract:** The concept of sustainability has been considered as a framework for understanding the development process and environment resource management as well as delicate a balance between economy, environment and health sociality around the world in the recent decades. This research tries to determine the level of sustainability of Karaj rural development in order to identify and investigate the possibilities of Karaj County. For this purpose, 30 indicators of social, economic and environmental and structural-infrastructural are applied, using factor analysis and cluster analysis techniques for grading and evaluating the sustainability of the 82 villages were used in Karaj County. Thus, the 30 variables were reduced to 4 factors. According to the result of the principal component analysis with rotation, 65.32% of total variance among the 30 variables was explained by these 4 factors. Results indicate undesirable present condition in the studied region which Farokh Abad and Ghezel Hesar villages are sustainable, while Morad Abad and Ahmad Abad villages are unsustainable comparison with other settlements. Finally, the strategy policies are presented in different dimension in order to enhance and improve of the sustainability of Karaj County.

**Keywords:** Cluster analysis, factor analysis, karaj county, sustainable rural development

### INTRODUCTION

The concept of sustainability has produced as framework for understanding the development process and environment resource management as we as delicate balance between economy, environment and health sociality around the world in the recent decades. The change and the transitional process in the rural community of Iran in the last decades, indicates unsustainable and existence man social, economic and environmental challenge in sustainable development and sustainability attainment. So we are witnessing vast immigration people from rural area to cities and depopulation of many rural settlements with low population, change in social and economic structure, transition skills, young powers and resource to city area and so on. Carelessness towards of continuing change and diversity in cultural, economical and environmental conditions and lake of attention to social and cultural infrastructure like participation social coherence and local resource management, etc., has increased problems and challenges for rural development (Bosch, 2007). These lead to forming undesirable present condition. Every country develops policies and strategies targeted to their own economic and social structure to overcome regional disparities, in order to stimulate development in a balanced way, socio-economic development levels of provinces and districts are determined by the state planning organization to determined the allocation of public resources to priority areas and to stimulate private sector investments in these areas and to establish local development policies and strategies (Yilmaz et al., 2010). It is necessary to consider both urban and rural areas. Moreover, village development is directly related to urban development. However, the basic goal for rural development is to bring the work and life conditions of the rural society in balance with urban areas, taking into consideration local resources and the need to protect natural and cultural assets (Elands and Wiersum, 2001). In this context, the designation of provincial resources to achieve a well balanced provincial level of development is also an important subject; the allocation of resources for a balanced level of development has not yet been determined by using multi-dimensional approaches in Iran.

To achieve rural development a large variety of measures are needed aiming at improvement of the rural economy, the quality of life of the community, land-use, environmental protection and the attractiveness to reside in rural areas (Adamo, 2003). The perception of rural development has undergone considerable changes in the last 30 years and it has become a multi-dimensional issue. A number of studies show the importance of natural resources and environmental dimensions of rural development

Table 1: Groups, names and definitions variables in the research

| Group | No | Name and definition of variable |
|---|---|---|
| Natural structure | 1 | Slope |
| | 2 | Erosion level |
| | 3 | Land use |
| | 4 | Soil class |
| | 5 | Irrigated land ratio in total land |
| | 6 | Pasturage in total land |
| | 7 | Water resources |
| Demographic structure | 8 | Total population |
| | 9 | Population density |
| | 10 | Number of households |
| | 11 | Woman ration in total population |
| | 12 | Annual increment rapidity of population |
| | 13 | Active population |
| | 14 | Immigration during 5 years |
| | 15 | Dependency ratio |
| Socio-economic structure | 16 | Illiterate ratio in total population |
| | 17 | School-age population ratio in total population |
| | 18 | Rate of unemployment |
| | 19 | Cooperative existence |
| | 20 | Agricultural service |
| Economic | 21 | Animal number per capita |
| | 22 | Horticulture products per capita |
| | 23 | Crops products per capita |
| | 24 | Green house products per capita |
| | 25 | Mechanization index |
| Infrastructure | 26 | Type of irrigation |
| | 27 | Health service per 1000 people |
| | 28 | Number of school in total population |
| | 29 | Distance from city center |
| | 30 | Type of road (100 Km$^2$) |

(Martin, 2001). In order to encounter these problems, this research tries to determine the level of sustainability of Karaj rural development in order to identify and investigate the possibilities of Karaj County. The survey of theoretical of sustainable development, assessment and measurement sustainability and presenting a conceptual framework and methodology for sustainability assessment at the local level as well as presenting appropriate strategies for maintenance and improve sustainability procedure in rural community is the characteristic feature of this regional research reference to the related literature, theoretical foundation and integrated analytic condition case study at the different social, economical and environmental dimensions (Oakley and Garford, 1985; Tolunay, 2006; Yilmaz *et al.*, 2010).

## MATERIALS AND METHODS

Dates at the village have been collected from Agriculture Directorship of Karaj County, Governorship of Karaj County and State Forest Management of Karaj County, Directorship of Health, Directorship of Education, Directorship of Meteorology. In addition, the variables with numbers 1-4 in Table 1 have been obtained from using a Geographic Information System (GIS).

As we find in Table 1 variables can be grouped under 5 main subjects, namely:

- Natural structure
- Land-use structure
- Demographic structure
- Socio-economic structure
- Infrastructure

To evaluate all variable simultaneously and, thus, to determine the most important factors affecting improvement of the villages, a principal component analysis is used (Harman, 1967; Hair *et al.*, 1992; Yilmaz *et al.*, 2010). A data matrix of N×n (82×30) is used as input the principal component analysis. The Varimax criterion with Kaiser Normalization as the rotation method is used in the principal component analysis (Yilmaz *et al.*, 2010).

In applying these statistical techniques, version 15.0 of Statistical Package for Social Science (SPSS) and Microsoft Excel is used.

Finally, a table is presented with the most important factors affecting village development and strategies and policies for further development of each village group are suggested.

## RESULTS AND DISCUSSION

A principal component analysis is applied to divide the variables into distinct groups and thus, to determine the most important factors affecting development of the villages. The first 4 factors (or components), of which the eigen values are larger than 1 are extracted in a principal component analysis based on the 30 variables. Thus, the 30 variables were reduced to 4 factors. According to the results of the principal component analysis with rotation, 65.32% of total variance among the 30 variables was explained by these 4 factors. In the principal component analysis, the component matrix was rotated using an orthogonal rotation (Varimax method), in which the factors are independent of each other (Hair *et al.*, 1992), which are scientifically easier to explain (Table 2).

The rotated component matrix is given in Table 3 and the derived factors are named and interpreted based on the factor loadings in the rotated component matrix. In order to clearly see the variable groups, the dominating factors (with absolute factor loadings larger than 0.5) that determine the 4 factors are shown in bold in Table 3 (Harman, 1967; Bennet and Bowers, 1977; Mucuk, 1978; Daşdemir, 1996).

The first component is the most important factor which explains 21.25% over 15% of total variance. Development Index (DI) is defined as the sum of the standardized Z-values of the indicator variables of the factors multiplied with the factor loading consisting of the weights of the variables, which is the factor loading of the particular variable as obtained in the factor analysis as shown in Table 3 and in the last column in Table 4. Thus, DI consists of weighted combination of 4 factors ranging from geographical location to social infrastructure investments in Table 4. It is a comprehensive and multi-dimensional index measuring

Table 2: Total variance explained

| Factors | Initial eigen values | | | Rotation sum of squared loading | | |
|---|---|---|---|---|---|---|
| | Total | % of variance | Cumulative % | Total | % of variance | Cumulative % |
| 1 | 8.35 | 27.54 | 27.54 | 4.31 | 21.25 | 21.25 |
| 2 | 5.53 | 15.21 | 42.75 | 4.04 | 18.65 | 39.91 |
| 3 | 2.04 | 12.67 | 55.43 | 2.78 | 13.72 | 53.63 |
| 4 | 1.15 | 9.90 | 65.32 | 2.30 | 11.70 | 65.32 |

Table 3: Rotated component matrix

| Variables | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Illiterate ratio in total population | 0.882 | | | |
| Active population | 0.875 | | | |
| Rate of unemployment | 0.821 | | | |
| Total population | 0.785 | | | |
| Woman ration in total population | 0.734 | | | |
| Population density | 0.705 | | | |
| School-age population ratio in total population | 0.675 | | | |
| Immigration during 5 years | 0.656 | | | |
| Cooperative existence | 0.635 | | | |
| Annual increment rapidity of population | 0.611 | | | |
| Dependency ratio | 0.601 | | | |
| Number of households | 0.554 | | | |
| Agricultural service | 0.511 | | | |
| Soil class | | 0.844 | | |
| Erosion level | | 0.852 | | |
| Land use | | 0.818 | | |
| Irrigated land ratio in total land | | 0.656 | | |
| Slope | | 0.617 | | |
| Pasturage in total land | | 0.595 | | |
| Green house products per capita | | 0.554 | | |
| Water resources | | 0.514 | | |
| Animal number per capita | | | 0.878 | |
| Horticulture products per capita | | | 0.747 | |
| Mechanization index | | | 0.585 | |
| Crops products per capita | | | 0.630 | |
| Type of irrigation | | | 0.515 | |
| Type of road (100 Km$^2$) | | | | 0.749 |
| Distance from city center | | | | 0.724 |
| Number of school in total population | | | | -0.659 |
| Health service per 1000 people | | | | 0.551 |

Table 4: Factors affecting development in the village of Karaj county, their weights and variable's weight

| Factor no | Weight of factor (%) | Name of factor | Weight of variable |
|---|---|---|---|
| Factor 1 | 21.25 | Illiterate ratio | 0.882 |
| Factor 2 | 18.65 | Soil class | 0.844 |
| Factor 3 | 13.72 | Animal number per capita | 0.792 |
| Factor 4 | 11.70 | Type of road (100 Km$^2$) | 0.878 |
| Total | 65.32 | | |

Table 5: Village group according to development degreed after cluster analysis

| Levels of sustainability | Score | Name of villages |
|---|---|---|
| Sustainable | 2-4.70 | Farokh Abad, Ghezhel Hesar, Ali Abadgone, Jaro, Nashrood, Shahrestanak |
| Moderate sustainable | 1-1.80 | Sehat Abad, Kandar, Moradtape, Velatrood, Aderan, Sijan, Charan, Golestanak, Igan, Kalvan, Sira, Sarak, Hassasn Kadr |
| Weak sustainable | 0.05-0.90 | Varzan, Vale, Jey, Khor, Varngah Rood, Nesa, Asara, Malek Faliz, Gashnader, Morod, Kohne Deh, Nekojar, Azadbar, Asiabadrgah, Sarvdar, Varian, Jorab, Arangeh, Aviz, Kiasar, Garmab, Sepiddasht, Mokhtarabad, Porgan |
| Unsustainable | -4.20-0.01 | Sarziarat, Hameja, Kalha, Dardeh, Siahkolan, Leilestan, Nojan, Gachsar, Darvan, Khozangah, Koshakbala, Atashgah, Tekiye Sepahsalar, Mahmood Abad, Gosil, Amam Chashme, Ghale Roostaei, Polkhab, Koshk, Vine, Shelank, Jafar Abad, Meydanak, Naser Abad, Dokhanvari, Goldasht, Gheshlagh Gonk, Ghozloo, Ghesghlagh Dayler, Ahmad Abad, Morad Abad |

village development. The resulting ranking of villages according to DI values is presented in Table 4.

The classification results according to the cluster analysis are given in Table 5. There is no clear geographical pattern among villages in the center county, which has a mix of Sustainable, moderate Sustainable, weak Sustainable, unsustainable villages. Table 5 presents the main characteristics of the four village group by presenting the average values of the main variable of each factor. From these averages strategies and policies which can increase the development of a village in each village group can be determined.

**CONCLUSION**

Development, which is generally expressed in Gross Domestic Product (GDP) per capita terms, is limited; there is a need for a more comprehensive measure (UNDP, 2007). This study uses a method that can handle a great level of detail of quantitative information and distil out the main characterizing

factors and converting this into a more refined index. The resulting grouping of villages can be statistically confirmed to be precise and reliable. While establishing the DI, factors driving rural development in Karaj County can be derived as well. In this study, factors affecting rural development are determined using a multivariate statistical analysis. This approach or methodology is based on the multi-criteria assessment of village development rather than being based on only one criterion (national income per capita etc.). It simultaneously measures development in terms of multi-dimensions. For this reason, this methodology does not have the shortcomings of the single-criterion methods. Moreover, this methodology includes not only economic variables but also social, demographical, human-cultural, infrastructural and especially the use of environmental and natural resource variables. Hence, the environment and natural resources have an important role in rural development (Farrington and Lomax, 2001; Rizov, 2005; Narain *et al.*, 2008). Therefore, this methodology is well-suited for determining the development level of villages in Karaj County. Moreover, it is scientific, objective, consistent and uses multiple variables and it is also readily applicable and understandable, where the derived factors can be quantified in a deterministic manner. However, the names, definitions and weights of the variables can conceivably change over time and place in the country. Hence, the names, definitions and weights of the variables should be discussed and revised periodically according to the changing conditions.

Consequently, the results of this study can be a guide for similar rural development studies. It contributes to determining effective rural development strategies and policies towards an increasing social welfare. Also, the methodology developed in this study can be used to monitor village development and to assist in effective use of resources for sustainable forestry and development in Iran.

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