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URBAN AGRICULTURE, A METHOD TO UTILIZE MILITARY LANDS STUDY CASE: TEHRAN METROPOLIS

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ABSTRACT

Changing the use of military lands in order to improve the quality of civil environment has always been noteworthy to urban planners and managers in the world and also in Iran. The city of Tehran is of those kinds of cities in which military lands have assigned a significant area of the city. The current study is about to discover the state of distribution stability of green areas in Teheran by using dispersion coefficient model and then by indexes of percapita of green area, air pollution, poverty, municipality income of the regions and the area of military lands reach a synthetic index. Then by analyzing indexes in ARC GIS software it's possible to find out which regions are prior to implement agriculture projects. The result of the current study shows that regions 5, 1, 3, 6, 14 and 18 are prior for implementation of urban agriculture and in spite of the difference in the area of military lands, they have been chosen as resultant regions.

Keywords: *Military Lands, Urban Agriculture, Garrison, Dispersion Coefficient Model, Tehran*

INTRODUCTION

Nowadays, increasing population in cities is one of the most important issues for planners of cities, as according to estimations the world's population will reach 9 billion persons until 2050, which 6 billion persons would live in cities. Tendency to urbanism will have consequences such as environmental, economical and social variations; since urbanism is unavoidable, it is necessary to build cooperation between cities and environment; so that civil people would be able to get part of their needs on their own without any pressure and brunt on environment. There have been various solutions suggested to obviate such crisis in cities, among which agricultural and urban planners suggest kind of agriculture called "urban agriculture". Discussions over urban agriculture were introduced in 1980s and in 1990s it attracted more interests (Okpala, 2002).

Agriculture productions in cities and towns is not a new phenomenon in developing countries; studies of development planners in United States show that Since the mid-1990s, near 800 million of urban residents have produced agricultural productions, both for commerce and subsistence purposes (UNDP, 1996). On the other hand 1.5 square meters of green area, with the height of 40 cm can provide oxygen needed for one year. Maxvel (1999) defines urban agriculture as doing agriculture in cities and places with available empty spaces. urban agriculture supports sustainable development goals such as preserving environment, nutrition and health, decreasing poverty, knowing and using potentials of the society, participatory decision-making and economical development of the society; and also because it has a multisectoral nature and leads citizens towards knowledge and finding solutions, it is known as a dynamic network (Wekerle, 2004). Urban agriculture has environmental, social and economical privileges which are important in implementing urban agriculture. It can be said that urban agriculture is a subcategory of endogenous development. So the cities should be planned as a Bio-generating unit to reach a suitable level of Self-sufficiency (Soltani, 1992). The city of Tehran, as the capital of Iran, is faced to crisis of over population. Tehran has been vulnerable in three dimensions entirely related to urban agriculture in recent years. These three aspects are air pollution, poverty and nutrition safety. Today's, a different

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consequence of air pollution, especially its effects on health, has made supervision and control of pollution as an inevitable issue in all the societies.

One of the policies to achieve these objectives is to apply the capacity of the military lands and incompatible usage. One of the applications that are incompatible with urban spaces is military areas, which include garrisons. As the city grew larger, a number of garrisons entered the city territories. Currently military sites hold about 14% of lands in Tehran, while green areas and parks include only about 5% of the land (Razavi, 2002). In this regard, Article 123 of the law of sale and displacing the armed forces to outside of the boundaries of cities was approved and announced in 2009 and made it possible for the municipalities, the Ministry of Housing, urbanism and executive agencies to take steps in the same direction. Such projects are implemented in Jordan, Germany and Iran, but it should be noted that these projects focus mostly on applying military lands for services and sometimes residential development, while the aim of the present study is to investigate the use of garrisons as agricultural lands. This study is about to obtain the sustainable distribution of green spaces in urban areas of Tehran by using dispersion coefficient and considering the poverty indicators (social aspect), municipal income (economical aspect), Green space and pollution (environmental aspect) identify and offer important areas for implementing urban agriculture.

MATERIALS AND METHODS

This research is descriptive-analytic and also uses library sources and documents. Society and case of the study is 22 regions of Tehran. To analyze regions of Tehran 4 indexes is been considered: indexes of poverty (social aspect), municipality income (economical aspect) and percapita of green areas and air pollution (environmental aspect). To determine the situation of the above indexes, the method of dispersion coefficient is been used. This method in the first stage showed the state of the distribution of green spaces in Tehran. Then ARC GIS software would mix the above indexes according to being positive or negative and after analyzing the maps it would be clear that which region is prior to be studied. Using distribution coefficient model, it is possible to determine how much distribution of an index is been Unbalanced among regions. Providing the unbalanced distribution, the researcher continues to offer its recommendations for implementing urban agriculture to strengthen the improper distribution. In the current study, distribution of green areas is been surveyed and then by using the above indexes, the map of each index is been made and after getting synthetic index the final map can be processed. Here is the total structure of the formula (equation 1):

$$Dv = \frac{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2}}{\frac{\sum_{i=1}^n x_i}{n}}$$

x_i =the measure of variant in each region

\bar{x} = the measure of variant in other regions

N = the number of the regions

In this model the obtained measure is between 0 and 1. As this amount tend to 0 shows decrease in inequality and vice versa.

Research Domain

City of Tehran has an area of 730 square kilometers. Tehran is located between 51 degrees and 8 minutes to 51 degree and 37 minutes of east longitude, and 35 degrees 34 minutes to 35 degrees 50 minutes north latitude. Administrative divisions of this city consist of 22 regions, 123 districts and 374 neighborhoods. Tehran's current altitude is about 900 to 1800 meters; such noticeable difference in the altitude is because

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of the large extent of the city (Rad and Nasiri, 2009). Gradient of the ground in Tehran, from north to south in the mountains of Shemiranat is 10 to 15 percent, from Tajrish to the hills of Abbas Abad the average gradient is 3 to 5 percent, from Abbas Abad to the street of Enghelab the gradient is 2 percent and from the city center to the periphery areas is 1 percent (Mahmoudian, 2005). The westerly winds in Tehran are unable to discharge air pollutants. On the other hand, being adjacent to southern desert areas has caused a great amount of dust in the air. Most of the factories and industrial centers have been located in the direction of the westerly winds that carries all pollutant waste into Tehran. The first solution to have a healthy environment in Tehran is to know the natural conditions of its geographical environment. Among environmental factors, climatic conditions play a major role (Bahraini, 1997). Temperature inversion, especially in the height of 5 to 100 meters, makes the city even more potential for air pollution, plus increasing still air concerns planners to make living conditions healthier (Alijani, 2008). Therefore in order to improve the quality of the city, measures should be taken; and urban agriculture could be one of the options.

Theories Framework

Urban Agriculture

A Sustainable or habitable city is a city which is in harmony with its larger ecosystem and also with the natural environment. Sustainable urban agriculture refers to food production in an urban environment. This means that food would be produced on roofs, courtyards of homes, gardens and public open spaces. Cities and agriculture have had an old relationship. Sustainable urban agriculture is a system in which proper management of natural resources in the city can meet the food needs of citizens and also it helps to protect the quality of the urban environment and to conserve natural resources and prevent degradation. Urban agriculture takes place when a person can plant seeds in the smallest piece of land (Mougeot and Luc, 2006).

Urban agriculture makes the plants and animals to grow in urban lands and it helps people to survive in urban areas. Urban agriculture creates opportunities for sustainable development and management of cities; it makes significant changes in the environment of life, health and land management. It creates an opportunity for the urban poor people to reduce household expenses, brings food security and controls nutrition for further Health (Rana, 2006). Urban agriculture can be considered as a subcategory of the endogenous development; endogenous development, more than any other kind of development, relies on indigenous spiritual and financial resources. It is characterized by relying on national resources, trying to meet the basic needs of the society, using eco-technologies and supporting micro-scale technologies and users. In the endogenous development there is no place for parasitic cities which are only consumer. Endogenous development model requires endogenous city, the city which maintains a fair relationship with other cities and also with villages in its sphere of influence, and meanwhile relies on its own resources and the resources of its region as much as possible. Patakachy and Kaufman suggests that urban planners believe that agriculture is for rural areas and not urban areas, So they are not willing to deal with urban agriculture policy, moreover they do not have a complete understanding of the problems in the food system (Mendes *et al.*, 2008). Hereunder comes environmental, social and economical aspects of urban agriculture in details.

Environmental Aspect

Urban air pollution and its impact on the sustainability of cities is an issue that has been much discussed and several solutions have been presented to eliminate it. Refinement of air pollution, reducing the effect of the urban heat islands (UHI) through cooling the steam in the air, and reducing the use of facilities are the benefits of urban agriculture.

Urban agriculture affects air pollution in several ways. One is through raising the urban green space percapita which increases refinement of air. During photosynthesis plants take CO₂ available in the air and release O₂ into air. Absorption rate reaches its maximum while growing (Deelstra and Girardet, 1996). An example of this is the city of Frankfurt, Germany, Where urban green belts with a radius of 50 to 100 m could decrease temperature down to 3.5 ° C and increase relative humidity up to 5 percent (Isma'elpoor and Azizpoor, 2009). Urban agriculture has other benefits like the restoration of biodiversity.

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In this way it can have interactive effects on the especial productions through producing different products. In addition, urban agriculture helps to protect threatened or rare species of fruits, vegetables, flowers and shrubs (Mazereeuw, 2005).

Economical Aspect

Currently one of the policies of local governments for promoting urban agriculture sustainable development is to improve capacity of private organizations, to reform policies for supporting farmers and small and medium agricultural units, to adopt effective policies to support the production supportive units and also to support associations of urban agriculture. The prospect of this project is the urban self-sufficiency in production of crops and vegetables which are essential for families.

Another strategy to promote sustainable urban agriculture is cooperation between organizations and institutions. Factors such as globalization, privatization, changes in governance attitudes, increasing demands of civil society for participation, the inability of governments in connection with financial resources and institutional capacity, increase of the problems of underdevelopment and global recommendations all are suggesting NGOs as a mechanism to solve problems and respond urban challenges.

The cooperatives not only provide facilities and means of production, but also increase social stability, Self-sufficiency of people and consistent self-employment (Jajarm, 2002).

Urban agriculture has especial economic benefits for the society. Urban gardens can promote economic development and tourism, it can be a help for families by harvesting crops and vegetables, can create energy through a green roof and reduce costs of repair and modernization and by improving the ecology it has economical advantages too (Keshtkar Qalati *et al.*, 2010).

In a study over urban gardens, real estate brokers and members of the Chamber of Commerce confirmed that urban gardens have increased the value of residential and commercial properties (Schmelzkopf, 2002).

Green space is an advantage for each building or house. Private atmosphere of urban agriculture allows landlords to take their interests by increasing the amount of the rent (Sutic, 2003). A study shows that covering 6% of the buildings in Toronto, annually provides job opportunities, directly and indirectly, for about 1350 people. In addition, the market value of agricultural products in the city will be about \$4 to 5.5 million annually (Peck, 2003).

Job opportunities, especially in developing green roof, are:

- Industrialization and sale of materials designed for the creation and maintenance of green roofs
- Sale of green roof plants
- Design and implementation of green roofs
- Contracting and implementing landscape design (Group, 2002)

Markets of food products and the price paid for these products can affect the size and nature of the food. Local-Urban agriculture has the potential to create the ability to attract investors to the proper implementation (Urban Agriculture Strategy, 2002). Integration of agricultural production systems, such as animal husbandry, irrigation, vegetable and fruit trees can be used as a way to reduce input costs in cities (Hubert, 2008).

Based on accomplished researches, socio-economic impacts of urban agriculture in Africa can still be seen. In the absence of formal job opportunities in sectors such as industry and services, urban agriculture is still a necessity of life (Ellis and Sumberg, 1998). Increasing demand of cities for food gradually has made small-scale agriculture to move from subsistence farming towards a mix of commercial and subsistence agriculture (Cour, 2001). Lack of employment opportunities in industry and services has made urban agriculture to be count as a subsistence of millions of people in developing countries (World Bank, 2007).

In 1994 a study was conducted in Tanzania which showed that urban agriculture is the second largest employment in the country, which meant about 20 percent of workers. Annual gross output of more than 10,000 organizations in urban agriculture was totally \$27.4 million with value added of \$11.1 million per year (FAO, 2007).

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Important factors which affect the household's income of urban agriculture include the tendency of the market, extent of the land, number of workers in the home, choice of the crops and animals, the availability and cost of key inputs (especially the use of local resources such as organic waste and sewage), opportunities for irrigation in the dry season, technology and available investment, access to markets and prices, the ability to store and maintain products (Danso *et al.*, 2003).

As the cities grow and the number of urban farmers increase and agricultural productivity will be affected by decreasing cultivatable lands especially in crowded areas.

Moreover, the environmental issues such as the reduction of agricultural fallow and multiple cycles in one year will be affected too (Keys and McConnel, 2005).

Social Aspect

Food systems can play an important role in shaping a sense of community: the relationship between community members and agricultural products. Producing crops and food locally can increase local pride. Another important social impact of food systems is food consumption and access to adequate food supply for all members of the society (Urban Agriculture Strategy, 2002).

Moreover, agriculture is a dynamic, functional and healthy process that increases efficiency and skills of people. This property may also attract interested but not-specialist people and lead them to generative activities (Dick, 2006).

Review of social, economical and environmental concepts and objectives of replacing garrison with agriculture lands

Garrisons and Urban Agriculture

Changing the use of military garrisons in order to optimize the urban functions and improve the quality of urban environment has concerned urban managers and planners in recent years. Considering the previous adopted programs and documents, park of Velayat in Tehran can be an implemented instance of this project. Garrisons and military facilities had been located in the suburb of towns and cities in the past, but as the cities and towns expanded they gradually entered the urban territories. Studying international experiences suggests that displacing garrisons provides an opportunity to promote urban centers, to increase percapita and to define and produce projects affecting social, environmental and economical aspects. Recent actions of urban management in Tehran have had a significant role in improving living conditions, eliminating pollution, creating pleasant spaces for leisure and etc; but this research focuses on the capability of garrisons to be replaced by urban agriculture lands and green spaces.

In the process of displacing and modernization of military facilities, several conclusions can be realized in terms of the public interests. The most important of these conclusions include the possibility of solving urban problems and creating opportunities for local - urban economic development and positive effects on social spirit and urban environment.

The benefits of developing approaches of changing garrisons into urban agriculture lands include growth and dynamism of economy in local and regional levels, increased employment opportunities and business development for investors and private development companies. Identifying mechanisms of implementing and financing urban agriculture projects over garrisons can bring different economical benefits for the city, which eventually will lead to improvement in urban economy and employment opportunities. Studies show that in the present circumstances, Tehran is faced to a significant portion of the lands belonging to the military and security institutions, which a solution associated with a change in the use of garrisons seems to be necessary. Conducted studies suggest that these lands are often classified in two categories according to two different types of actions (Namjuyan, 2012). A. replacing garrison from territories of the town: military lands are located in the city territories, which according to the country's legal and institutional necessities, relocation of the garrisons to out of the city territories have been extracted. Similar examples can be seen in Iran, which according to the legal requirements of the Third and Fourth development program relocating garrisons to outside territories of the cities is been approved and also in Jordan, according to the king's order to withdraw the garrisons from the cities of Zarqa and Jordan. Although this creates an opportunity to develop the city in different aspects, it needs costs and requirements.

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B. Military Lands taken as a result of the closure of military bases: In some countries of the world, several military bases are being closed day by day. In this context, a significant fraction of free military lands can be used when necessary. Such examples can be seen in closure of American military bases in Philippines. The closure of these bases sometimes have caused concerns related to employment opportunities, However based on international experiences closed sites can be a great opportunity to build industrial parks, deal with medical needs, provide food and improve education in recent years.

RESULTS AND DISCUSSION

International experiences in changing the use of military lands in various studies related to this topic (such as iramko, Bagaean, 2006) suggest that changes in the use of military lands creates new opportunities for urban development needs in various fields of services and sometimes residential development. However, the innovative developments such as urban agriculture could be an option to change the use of garrisons' lands and create business opportunities.

Based on what already was said and considering the international experiences and the current situation in Iran, the benefits and positive outcomes of the project of relocating garrisons and replacing them by agricultural lands in general can be summarized as follows:

- The possibility of obtaining suitable lands of old garrisons' sites to meet the food and leisure needs
- Troubleshooting of military incompatibility with the surrounding residential areas and replacing it with agricultural areas to promote community spirit through public organizations to manage these areas
- Creating job opportunities in each region of Tehran through producing sustainable food and strengthening the local, regional and urban economy
- Increasing the percapita of green area and creating garden-care environment
- Increasing Green areas, effective in decreasing levels of air pollution and heat islands and making sound insulation
- Promoting sustainable urban perspectives

Examples of successful replacing of military lands in the world and in Iran (Velayat Park) have been in a way to mix residential and green space together, while the policy of the current study is to change military lands into agricultural areas and green spaces. Now, by Using the dispersion coefficient model, stability of the city will be calculated in terms of green space; and by measuring the shortage of green spaces and levels of military lands in regions of Tehran suggestions will be made to identify the priority of areas for implementing urban agriculture.

Using the formula of dispersion coefficient (refer to Equation 1) index of distribution of green space in Tehran was calculated. In this model, the prevalence rates are between 0 and 1. As this figure tends to zero, it represents the inequality, and vice versa (Equation 2).

$$DV = \frac{5/34}{29/18} \quad CV = 0/58$$

Table 1: Evaluation of index of distribution of urban green spaces in Tehran in 2006

Unbalanced	Semi-Balanced	Balanced
0/75 - 1	0/25 – 0/75	0/25
-	*	-

As the dispersion coefficient of urban green spaces in Tehran shows, the distribution of green places in Tehran has been in a balanced way.

The following table is based on authenticated information of indicators of air pollution and green spaces (the environmental aspect), poverty (social aspect), municipality income (economical aspect) and levels of areas of military lands in Tehran. Then, by comparing the following indexes and their combination (the GIS software) it is possible to identify the Priority of regions for land acquisition and adapt them to agricultural and landscaping areas.

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Table 2: Indexes of Tehran regions to identify priority of military lands to be replaced by urban agriculture

Regions	Municipality Income	Poverty	Air Pollution	Military Area	Green Spaces
1	1	0.3	1	0.12	0.16
2	0.06	0.22	1	0.0008	0.17
3	0.14	0.15	0.77	0.35	0.14
4	0.15	0.3	0.77	0.018	0.07
5	0.26	0.32	1	0.19	0.16
6	0.16	0.2	0.33	0.04	0.11
7	0.1	0.4	0.11	0.21	0.03
8	0.07	0.34	0.77	0.0008	0.04
9	0.06	0.45	0.77	0.1	0.05
10	0.12	0.38	0.77	0.02	0.01
11	0.05	0.4	0.33	0.05	0.04
12	0.1	0.6	0.33	0.05	0.04
13	0.05	0.35	0.33	0.24	0.07
14	0.1	0.43	0.33	0.17	0.05
15	0.1	0.61	0.77	0.12	0.12
16	0.06	0.58	0.33	0.0008	0.09
17	0.03	0.5	0.77	0.001	0.05
18	0.1	0.51	0.77	0.47	0.11
19	0.12	0.65	0.77	0.2	0.61
20	0.11	0.49	0.11	0.0001	0.15
21	0.04	0.42	0.1	1	0.19
22	0.35	0.38	1	0.09	0.33

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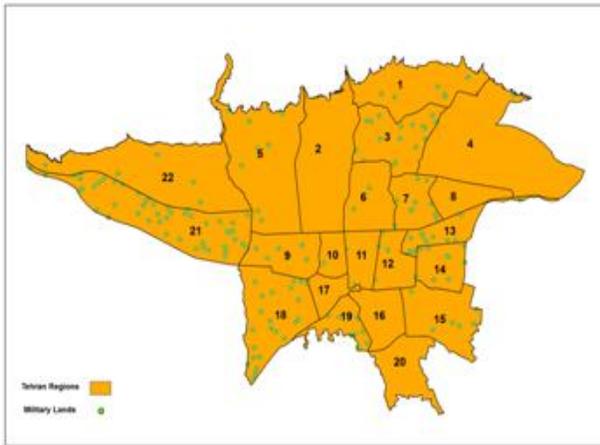


Figure 1: Distribution of military lands

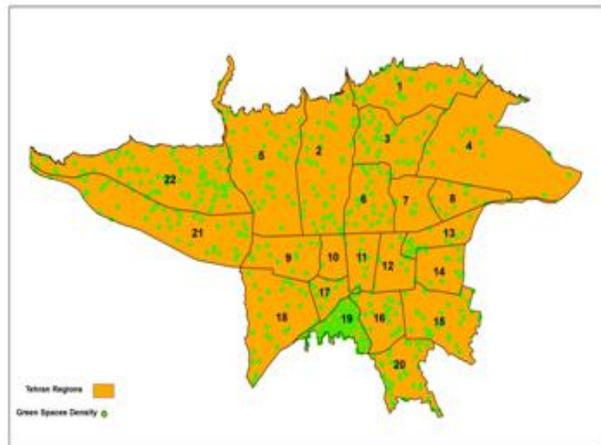


Figure 2: Distribution of green spaces

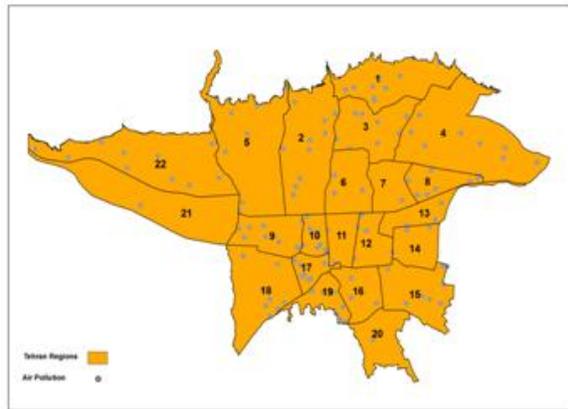


Figure 3: Distribution of air pollution

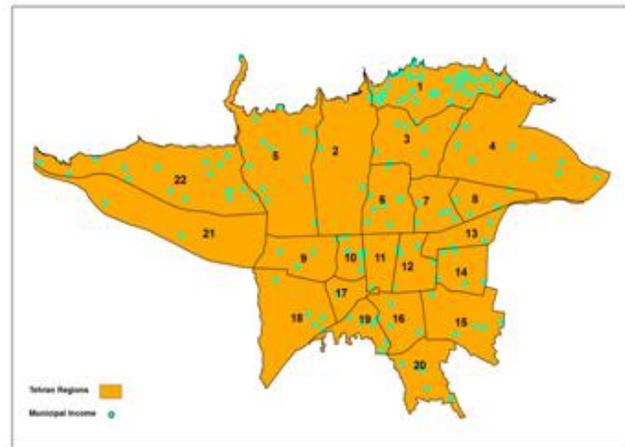


Figure 4: Distribution of municipal income

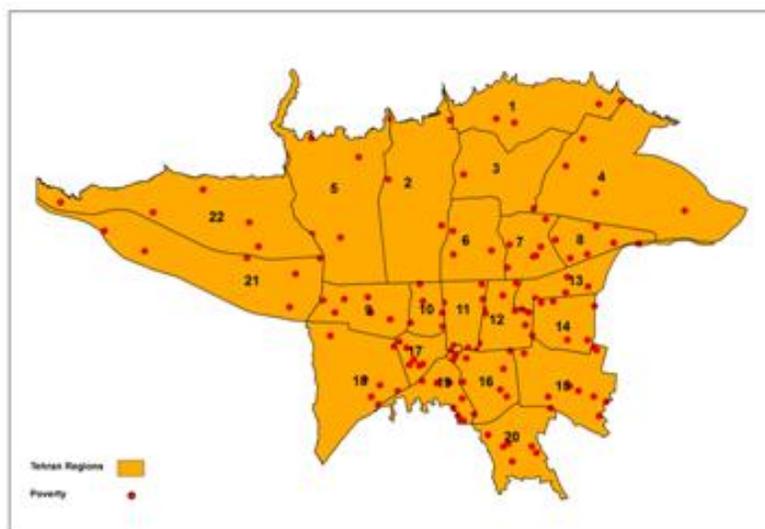


Figure 5: Distribution of poverty

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To accomplish analysis in GIS software all of the indicators should be counterbalanced. The used method for counterbalancing the indicators is division on the average digit. The indicators used in the study are positive and negative, so their effect is considered in the analysis. After reclassifying indexes, by considering the impact of each of the indicators by Arc Gis software, the synthetic index -which can be a representative for the combination of all indexes-, was produced. After producing the synthetic index the output of the map, which must have been capable to indicate the need of changing the military land to urban agriculture areas, was obtained. The following map shows military land distribution in regions alongside with designated areas for research purposes:

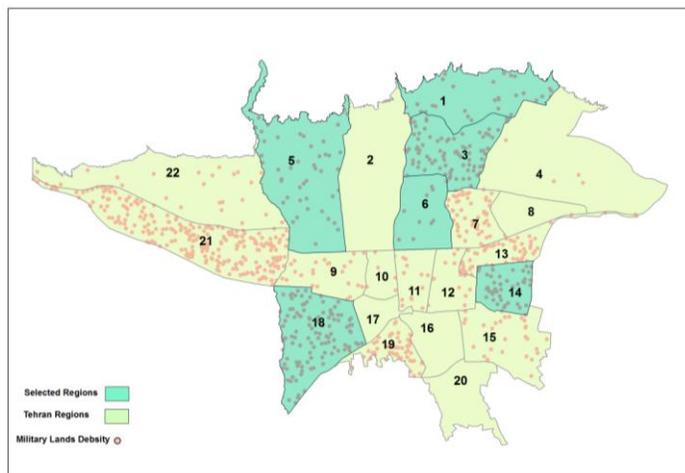


Figure 6: Designated areas for Analysis of indicators for identifying priority of areas to change military lands to agriculture areas

Figure 1 show that regions 1, 3, 5, 6, 18 and 14 have been selected as prior regions. It should be noticed that these regions are areas that have military lands, low green per capita, high air pollution, high poverty and high-income municipalities and combination of these indexes is the reason to choose them for changing military lands into urban and green agricultural areas.

The following table shows the regions that have been selected in order of priority:

Table 3: Selected prior regions in Teheran for urban agriculture, according to the indexes

municipality income	poverty	air pollution	military area	green spaces	regions	priority Rating
0.26	0.32	1	0.19	0.16	5	1
1	0.3	1	0.12	0.16	1	2
0.14	0.15	0.77	0.35	0.14	3	3
0.16	0.2	0.33	0.04	0.11	6	4
0.1	0.43	0.33	0.17	0.05	14	5
0.1	0.51	0.77	0.47	0.11	18	6

Table 3 shows that the region 5 has the third place for the military lands, but because of other indicators it has the first place for changing the land use, and other locations are in the lower ranks.

Conclusion

Public spaces are of the most important urban environments in which people can interact; however nowadays public green spaces not only makes people to connect with each other but also makes them to connect with nature too. Besides its own functions, Green space is the principle of sustainable development and it can be prepared in an urban environment in different ways. Green spaces in the form

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of urban agriculture are the new policy in the world, which can be planned in different aspects in metropolises. In addition to the ecological productivity, urban agriculture can be a factor for economic development, social stability and strengthening community spirit in society. One of the areas of the city that can be a good option for implementing the projects of urban agriculture is military lands. the law of the sale and replacing of the garrisons and other places of armed forces to outside of the cities in 1388 provided opportunities for municipalities, housing and urban development and related agencies to take possession of these lands and by benefiting them take a step in the direction of modern urban agriculture. In this study, the data were collected from areas of military lands and incorporated with measures such as green spaces, air pollution, poverty and municipality income important regions for this type of change were identified. In Iran garrison of Qal'e Morqi could be a model for other projects; but despite of the opportunities, there are barriers too. This project provides practical experience to displace garrisons and replace them by comprehensive centers. The present study differs with the implemented instance in Teheran in seeing land use change a necessity for increasing green space per capita, increasing food production, and environmental impact; this type of projects could affect various economical and environmental social aspects. Among the obstacles that currently exist in Teheran is that prerequisite of institutional, financial, and administrative management aspects are not yet provided. Due to the large area of garrisons in Teheran, respective organizations such as municipality and the Council of Teheran should interact with each other, and considering the high cost of acquisition, government and Parliament also should help them to taken a step towards justice in Teheran. This would be not only an important addition to the environmental factors, but also can involved residents of Teheran in the projects' management and affect the community spirit, besides it has economic benefits too.

Due to problems in Teheran, internal priority can also be considered for the selected regions of 1, 5, 14, 18, 6 and 3. Regarding Air pollution –which is one of the most important problems in Teheran- Regions 6 and 14 could take the first and second priority rank. Moreover, financial strength is also desirable in these regions, so it is possible to reduce air pollution through increasing green spaces, and as a result one of the commercial-ministerial areas in Teheran could develop in terms of environmental quality.

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