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Land fragmentation and small holdings major barriers for sustainable agricultural development in Iran: Situations and problems

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Abstract. More efficient production processes and better environmental management systems can significantly reduce pollution and waste, and save water and other resources. Land resources have an impact on effective agricultural activity, as well as economic, social and political stability. Sustainable land management is essential to meeting the global challenge of securing soil and water resources that can support an ever increasing population. There is a real need to analyse the economic benefits and long term sustainability of future development against the protection of high class land for current and future production requirements. Increasing population has posed insurmountable challenges to agriculture in the provision of future food security, particularly in the Middle East and North Africa (MENA) region where biophysical conditions are not well-suited for agriculture. Iran, as a major agricultural country in the MENA region, has long been in the quest for food self-sufficiency, however, the capability of its land and water resources to realize this goal is largely unknown. Whether there are enough land and water resources to realize the production growth needed in the future has been the subject of several global-scale assessments. In these regards land fragmentation, traditional peasantry and small holdings as major types of agricultural production system in Iran, have been known as main barriers for accessing to increasing productivity and receiving to food self sufficiency and security. For doing this study utilized qualitative approach with its tools for gathering information such as participatory observation, maps, discussions with experts, professors and beneficiaries, field research and visits, scientific articles, documents and pictures. Main locations of study were two provinces in Iran, namely Isfahan and South Khorasan provinces. In this article discussing various aspects that caused of land fragmentation, traditional peasantry and small holdings and their effects in confronting for utilizing modern technologies and increasing productivity and receiving to food self sufficiency and security in Iran. In the end present final and exigency acquired model on the ways of confronting to these traditional land use patterns for accessing to sustainable development (SD) goals and criteria in agricultural production system in Iran.

Keywords: Small holdings, land fragmentation, barriers, rural, sustainable development, Iran.

1 Introduction

Nowadays agricultural methods developments that are productively, economically, environmentally and socially sustainable are required immediately (Tohidyan Far and Rezaei-Moghaddam, 2018).

Agrarian structure and in particular the system of land tenure in many countries, prevent a rise in the standard of living of small farmers and agricultural laborers and impede economic developments. Small holdings or peasant land-holdings scattered strips (Khordeh Maleki in Persian), are too small to be cultivated with today's modern equipments (Mahmoudi, 1961).

More efficient production processes and better environmental management systems can significantly reduce pollution and waste, and save water and other resources. Land resources have an impact on effective agricultural activity, as well as economic, social and political stability (Cintina and Pukite, 2018).

The biggest problem in transition from traditional agriculture to modern and up-to-date agriculture is the lack of land consolidation of the fields. Small production units and scatter of the parts cause problems for fundamental equipment, watering yield increase, agriculture machinery usage, and mechanization which are barriers to the usage of advanced production methods. All these elements and lack of proper exploitation system, have negative effects on financial efficiency, sources, and production factors in agriculture (Rashidpour and Rasouliazar, 2019).

Currently, Iran's agriculture supplies about 90% of the domestic food demands but at the cost of consuming 92% of the available freshwater (Mesgaran et al., 2017).

In rough terms, the net value of agricultural import is equal to 14% of Iran's current oil export gross revenue. Located in a dry climatic zone, Iran is currently experiencing unprecedented water shortage problems which adversely, and in some cases irreversibly, affect the country's economy, ecosystem functions, and lives of many people. The mean annual precipitation is below 250 mm in about 70% of the country and only 3% of Iran, i.e. 4.7 million ha, receives above 500 mm/year precipitation (Mesgaran et al., 2017).

Agricultural land management commodities in Iran are individually owned by farmers (about 99 percent) and farms tend to be small units (Faramarzi, 2012).

Land Reform (1960s) processes in agricultural sector are the origin of land fragmentation in Iran (Kalantari and Abdollahzadeh, 2008).

Land Reform in Iran, caused land fragmentation, increased low-land farmers respectively (Keikha and Keikha, 2012).

Problem of fragmented land began from the 19th century in the world, and in the Iranian year 1341 (equal to 1961 A.D.). Scattering and small land area, is one of the structural elements of traditional agriculture. The distribution of parts, will be considered a deterrent. The fragmentation of agricultural lands has been seen more or less in all countries. With regard to problems of land distribution, agricultural planners and politicians recommended integration of land use to solve this problem (Keikha and Keikha, 2012).

Land fragmentation at the household level depends on external policy and market factors, agro-ecological conditions, and farm household characteristics. The resulting level of fragmentation, together with external factors, agro-ecological conditions and farm characteristics, affects agricultural production (Shuhao, 2005).

Countries with traditional agricultural structures face small and fragmented plots, cultivation is carried on to non-geometric small-scale plots which limit application of farm machinery, mechanization development, and putting to practice new cultivation methods. Therefore, application of modern technology, aimed at increasing yield and reducing production costs, has a direct relationship with land consolidation and optimum size of cultivation plots (Kalantari and Abdollahzadeh, 2008).

Although land fragmentation may have different meanings in different countries or regions, it covers two main aspects: (1) it refers to the spatial dispersion of farmers' plots over a wide area; and (2) it implies the subdivision of farm property into undersized units that are too small for rational (efficient) cultivation (Shuhao, 2005).

In a study by Kalantari and Abdollahzadeh (2008) they showed that household average annual income, per capita arable land, size of land rented by household, labour force of household, family size, number of crop planted by household and size of land rented out, contributing to land fragmentation in Fars province, south center of Iran (Kalantari and Abdollahzadeh, 2008).

Some studies showed that when there is a missing market for the commodities, farmers tend to diversify their cropping mixture to satisfy their consumption, which will be best suited by fragmented land. Indeed this is an extension of risk reduction examples. The different emphasizes in causes of fragmentation have a very strong practical implication. If fragmentation is a result of farmer's rational choice, we would assume that land consolidation would not be carried out unless conditions related to farmers' decision of cropping changed. If, however, land fragmentation is a result of supply side factors, land consolidation may have its benefits exceed its costs (Kalantari and Abdollahzadeh, 2008).

Nevertheless, one quarter of the rural population is landless in Iran, and one third of the remaining three quarters have small holdings, with poverty level income and frequent underemployment. Fewer farmers enjoy better conditions, with a more dynamic agriculture, capable of providing higher per capita income in Iran (CPF, 2012-2016).

Widening rural and urban disparities persist, with rapidly growing urban population, migration to urban areas and reduced employment opportunities in rural areas, affecting access to available food for both urban and rural population in Iran (CPF, 2012-2016).

Iran has a rich knowledge base, mass of expertise and a widespread network of research, training and educational institutions, although the full potential of this reservoir is not being harnessed because of archaic management practices (CPF, 2012-2016).

However, the small sizes of land holdings and the high degree of land fragmentation may be important obstacles to the adoption of new technologies by smallholders (Shuhao, 2005).

Under existing technologies, a considerable productivity improvement can be achieved by addressing the factors constraining technical efficiency. Land consolidation can be an important option in this respect (Shuhao, 2005).

Land consolidation, reducing the number of parts, increasing acreage, increasing land values, reduced water consumption, increased use of agricultural machinery, agricultural products and ultimately increase the income of farmers had a significant effect. So there is a direct relationship between the land consolidation and mechanization of the agricultural products (Keikha and Keikha, 2012).

Sustainable land management can promote the use of agriculture land by motivating owners to manage land, develop farms and benefit from the environment without endangering it (Cintina and Pukite, 2018).

The use of agricultural land is important for sustainable land management, whose mission is to maintain or improve production and provision of services, protect natural resources, ensure economic viability, prevent water quality deterioration and reduce soil degradation, reduce production risks (Allahyari et al., 2013) & (Cintina and Pukite, 2018).

Land consolidation should be considered in the framework of general policies of rural development and agriculture, because it is an essential tool for achieving sustainable development in rural areas (Keikha and Keikha, 2012).

2 The factors influencing land use

The factors influencing land use are indicated as follows:

1. Socio-economic factor,
2. Environmental factor,
3. Institutional factor (Cintina and Pukite, 2018).

The socio-economic factor is characterized by availability and use of land resources, introduction of innovative technologies, development of economic sectors and territories, environment and infrastructure, land capacity and productivity, living environment and population, credit facilities and investments, increase of competitiveness and use of renewable energy resources (Allahyari et al., 2013) & (Cintina and Pukite, 2018).

The use of agricultural land plays a major role in credit facilities, because the successful use of credit facilities can improve farms through the introduction of innovative technologies, as this can improve land management rapidly, save time, resources and produce more productive yields. Land capacity and productivity also play an important role in utilizing agricultural land, the more productive the land is, the more likely it is that it will be managed and yielded. Also, great importance is the territory, place where the land is located and its population or habitat area.

There is a regularity between the use of land and habitat area, for example, the larger the population, the more land is used in this territory, the less populated area, the more likely it is that the agricultural land will not be fully exploited in this area. Possibility of use of land is also influenced by the environmental factor (Cintina and Pukite, 2018).

Environmental factors are characterized by: biodiversity (genetic diversity, diversity of species and diversity of ecosystems), ecological integrity (ecosystem structure and processes), and natural capital (the soil in which we grow food, raw materials for construction and clothing, water for drinking and even the air we breathe). Environmental factor includes inadequate water supply, excessive drought or moisture, and the spread of plant diseases (Cintina and Pukite, 2018).

The use of land is also influenced by an institutional factor that is characterized as the interaction of regulatory norms and organizations. It is important to harmonize land use with statutory norms and regulations so that the way of land use does not conflict with the norms established by law.

These factors also have a significant impact on the use of agricultural land and its effectiveness (Cintina and Pukite, 2018).

In order to determine the factors influencing the use of agricultural land, it is necessary to look at the factors influencing other factors as well.

In a study "Effective Factors on Agricultural Land Use Change in Guilan Province, Iran" identified five factors influencing the use of agricultural land:

1. Economic factor,
2. Social factor,
3. Governance and political factor,
4. Technical and technological factor,
5. Individual factor (Allahyari et al., 2013).

The economic factors are high production costs, low prices for agricultural products, resulting in a decrease in profits from the use of agricultural land. Low income creates pressure on the owners and, as a result, decreases or the owners are forced to completely abandon the management of agricultural land. Intensive use of agricultural land reduces land productivity. In order to improve the productivity of agricultural land, it is necessary to invest in, for example, land fertilization, thereby increasing the cost of utilizing agricultural land, resulting in the loss of motivation to manage this land (Allahyari et al., 2013).

Social factor is characterized by changes in the population, for example, growth in urban areas and a decrease in rural areas. An important indicator is also the level of education of the population and opportunities for attending special courses to exit from traditional agriculture. Also, social factor indicators include the migration of people from the countryside to cities, the lack of employment opportunities in rural areas. The use of agricultural land is also affected by the fact that agricultural production is largely seasonal, which has a significant impact on the number of workers (Allahyari et al., 2013) & (Cintina and Pukite, 2018).

Governance and political factors are characterized by lack of support for producers, import of products, inheritance of land, lack of support for young farmers, an increase in land rent, timely reimbursement of damages, lack of support for producers, resulting in the purchase and sale of agricultural land. Foreign imports have an impact on production, because imported products can be cheaper than local produce. The use of agricultural land is also affected by the inheritance of the land, which is related to the wishes of the new owner to sell the land, but until the documents are arranged, the land is not used. In addition, the use of agricultural land is affected by the fact that, when inheriting land, it becomes a joint property between the heirs, as a result of which this land belongs to several owners as a joint property or it is divided into real parts, which leads to fragmentation of land. Such activities may result in non-economic production (Allahyari et al., 2013) & (Cintina and Pukite, 2018).

Technical and technological factors are characterized by traditional production methods, changes in land treatment technologies, poor knowledge of the use of pesticides and chemical fertilizers, as well as inappropriate plowing system causing losses and changes in soil physical and chemical properties (Allahyari et al., 2013) & (Cintina and Pukite, 2018).

The individual factor is characterized by physically heavy work related to the use of agricultural land, as labor productivity decreases as a result of aging, which may reduce the use of agricultural land, as well as the state of health affected land use and associated changes (Allahyari et al., 2013) & (Cintina and Pukite, 2018).

The main problems associated with the use of agricultural land are the increase in unused agricultural land and the continued degradation of land, but the major problem of land use is the existence of a fragmented property structure. These factors are affected by the economic, social, governance and political, technical and technological, environmental and individual factors. When problems and factors affecting the use of agricultural land are identified, it is necessary to look at the ways to ensure more efficient land use (Cintina and Pukite, 2018).

3 Shortcomings of land fragmentation and necessity for consolidation

Land-use efficiency differs according to land use needs, for example, whether the land is used by large agricultural enterprises: associations, cooperatives, research and education establishments or used by smaller or larger private households. Increasing land use efficiency is a topical issue in many countries; therefore, indicators of land efficiency measurement systems and ways of calculating economic land efficiency are being developed (Cintina and Pukite, 2018).

Low productivity of small-holder farmers, their limited access to land, combined with water shortage, excessive ground water withdrawal, inadequacy of irrigation systems and excessive post-harvest losses, aging farmers with low literacy, who have limited access to quality seeds of improved variety are main problems in agriculture system in Iran. For them, low productivity interacts with food security conditions (CPF, 2012-2016).

It is true that in traditional systems, fragmentation had some advantages, but under an agricultural renovation condition, fragmentation is a serious limiting factor. It causes high increase in costs, and makes the productivity improvement activities uneconomical. Therefore, consolidation of fragmented plots of lands for achieving optimum size and shape of farmland, directly affects productivity. The experiences of different countries confirm this claim. In view of these considerations, numerous land consolidation and land reform policies have been implemented to reduce fragmentation in European countries like the Netherlands and France, in African countries like Kenya, Tanzania and Rwanda, and elsewhere. Small landholdings were well-adapted to Iran's agriculture sector. With increasing population pressure and more efficient technology, they are coming under increasing strain. In the long run, they may be not adaptive at all. Therefore, for an economic crop production it is necessary to execute land consolidation programs that can provide appropriate living standards for farmers. According to some studies, the optimum farm size for economic crop production should be at least 12 ha. Because farmers with smallholdings are unable to take advantage of the new technology and were thus less productive. The low productivity of small farms constrains sustainable crop production at regional and national levels. Summarizing these arguments, land fragmentation is considered as one of the major obstacles to achieve sustainable rural livelihoods, in Iran. Accordingly, the extensive arrays of smallholdings need to be restructured and consolidated. Although land fragmentation is a recognized problem in Iran, little empirical research has been done on its driving factors and their relative importance. A better understanding of the causes of land fragmentation in Iran is needed, especially now that the country is confronted with the challenge of agricultural modernization resulting from its entry into the World Trade Organization (WTO) (Kalantari and Abdollahzadeh, 2008).

4 Advantages of land fragmentation for small farmers

Households with many fragmented plots may use the land rental market to decrease the dispersion of their land and increase production efficiency. In other word, land renting in and out depends positively on land fragmentation. At the village level, number of crop planted by household as sign for traditional and livelihood agriculture plays an important role on land fragmentation. In this case, land fragmentation may be a perfect logical and sound response to soil and crop variations or to spreading the risk of climatic and other hazards. Small field tends to lessen the damage of soil erosion and protect crops in a severe climatic condition. Since crops have distinctive growth requirements, a diversification in agricultural production caused by land fragmentation may reduce risk in total agricultural production. Per capita arable land availability is likely to be correlated with variation in land quality (soil types, water access, drainage conditions, road access, and so on). Income from off-farm employment increase land fragmentation by improving the land rental market by households (Kalantari and Abdollahzadeh, 2008).

5 Causes of farmland fragmentation (FF)

The causes of FF listed in the literature can be divided into two broad categories. The first regarded fragmentation as a result of exogenous or so-called supply side factors. Apart from the natural restriction, other factors include (1) partial inheritance system or population pressure; (2) significant imperfections in the land market; and (3) the breakdown of common property system under the pressure of population growth.

It is logical to argue that partial inheritance leads to land fragmentation when land with similar quality is equally divided by heirs. Other studies indicated that high transaction costs in labour markets and failures in commodity market were also responsible for the land fragmentation (Kalantari and Abdollahzadeh, 2008).

6 Advantages and disadvantages of small units and land fragmentation in China

Such subdivision into small units, may however be beneficial to farmers in certain circumstances (if markets for insurance, agricultural labor and so on are missing) and at certain points in time (depending on the technology level and institutional arrangements).

In addition to private gains, fragmentation may offer social benefits. Fragmentation induced by land distribution during land reform in many countries (Bulgaria, Vietnam and China, for example) realized a high degree of equity among smallholders and contributed to a high degree of national food self-sufficiency (Shuhao, 2005).

The costs associated with high levels of fragmentation are seen principally in terms of inefficient resource allocation (labor and capital) and the resulting cost increase in agricultural production (Shuhao, 2005).







Figs. 1 – 8. Land fragmentation, peasantry and small holdings as major type of agricultural production system in Iran, in 60 Km distance in west of Isfahan city and beside Zayandeh rood river in center of Iran. (By author. Spring and summer, 2019).

7 Consolidation of small, fragmented lands in China

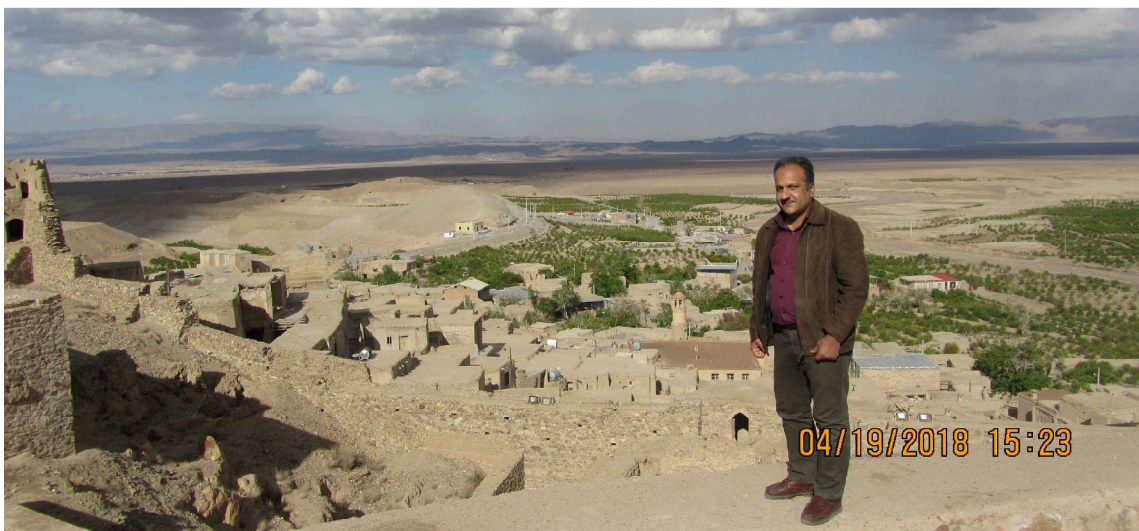
Small and highly scattered land plots will remain an important obstacle to cost reduction and productivity in rice production, and possibly even to soil quality improvement in the near future (Shuhao, 2005).

Consolidation of small, fragmented plots into a smaller number of larger plots located at smaller distances to the homestead in China have obtained following goals:

(1) reduces production costs, (2) causes a shift from labor-intensive methods towards the use of modern technologies, (3) reduces technical efficiency and increases input use efficiency, (4) contributes to soil quality improvement, and (5) increases the availability of the two major yield-limiting factors in rice production, namely the available phosphorus and potassium in the soil (Shuhao, 2005).

For reducing the high degree of land fragmentation this project implemented in China, namely to replace land distribution based on physical units by a system based on land values, to provide tradable land use rights to all farmers, and to promote the establishment of a local, small, nonstate-owned enterprise sector in rural areas with limited off-farm employment opportunities. A combination of these three policies is likely to lead to a significant reduction in land fragmentation, and thereby provide important incentives to farm households to strengthen the long-term production capacity, and make the agricultural sector more capable of meeting the challenges of increased foreign competition in China (Shuhao, 2005).

Land fragmentation also plays a role in farm management. Consolidation of small, fragmented plots into a smaller number of larger plots increases input-efficiency by inducing lower quantities of labor and herbicides use at given yield levels. Moreover, if these plots are located closer to the homestead, more manure will be used. Increased manure use contributes to soil quality improvement and increases the availability of the two major yield-limiting factors, namely the available phosphorus and potassium in the soil, and improves soil quality (Shuhao, 2005).







Figs. 9 – 13. Land fragmentation, peasantry and small holdings as major type of agricultural production system in Iran, in Barberry gardens in Robokht village (first picture – winter 2017) and Forg district (later pictures – Spring 2018), South Khorasan province, east of Iran. (By author. 2017 & 2018).

8 Materials and methods

Main challenging factor in land-use conflict studies is the multidisciplinary nature of this issue, and thus, different stockholders from various influential parties are involved. For doing this study utilized qualitative approach with its main tools for gathering information such as participatory observation, discussions, maps, scientific articles, documents and pictures. Main locations of study were rural areas in two provinces in Iran, namely Isfahan and South Khorasan provinces because of accessibility of them for author and also land fragmentation, peasantry and small holdings are more stronger and visible in them. Author utilized various documents such as Iranian and foreign scientific magazines and journals, TV and radio programs, Iranian Bureau of Statistics, discussions with experts, professors and beneficiaries and field research and visits by himself specially in above provinces. In below map, showed locations of this study as A and B. (Please see figures 1-17).



Fig. 14. Map locations of doing this study, A (South Khorasan province, east of Iran) and B (Isfahan province, and beside Zayandeh road river in center of Iran). (Iranian Bureau of Statistics, 2019).

9 Results

This study discussing various aspects, situations and problems of small holdings and land fragmentation as two major barriers for sustainable agricultural development in Iran. After utilizing a wide qualitative approach, and applying its tools for gathering information such as participatory observation, maps, discussions with experts, professors and beneficiaries, field research and visits, documents and pictures, etc. following results achieved. In this regard author classified them as below in Iran:

A) Socio-economic barriers and shortcomings:

- High production costs, low prices for agricultural products, resulting in a decrease in profits from the use of agricultural land. These create pressure on the owners and, as a result, decreases or the owners are forced to completely abandon the management of agricultural land in many rural areas.
- The migration of people from the countryside to cities, changes in the population, growth in urban areas and a decrease in rural areas.
- Low level of education of the farmers population and lack of their opportunities for attending special courses to exit from traditional agriculture.
- Agricultural production is largely seasonal, which has a significant impact on the number of workers in many rural areas.
- Lack of employment opportunities in many rural areas.

B) Legislative, Institutional, governance and political barriers and shortcomings:

- Lack of adequate support for producers, lack of support for young farmers, an increase in land rent, timely reimbursement of damages, lack of support for producers, that resulting in the purchase and sale of agricultural land.
- Foreign imports, because imported products can be cheaper to purchase than local producers.
- Inheritance of the land, which is related to the wishes of the new owner to sell the land, but until the documents are arranged, the land is not used, or leads to fragmentation of land. Such activities may result in non-economic production.
- Unavailability and weakness of farmers land cooperatives in many rural areas of Iran.
- Old and insufficient laws that caused prevalence of small holdings and land fragmentation.
- Missing markets for the farmers products and commodities and thus a solution extension for risk reduction by them in many rural areas of Iran.
- Uninsufficient pay attention and considering sustainable land management by many policy makers and governors in Iran.
- Uninsufficient credit facilities for motivating farmers in order to consolidating their lands.
- Conflict between consolidating lands with many norms established by law in Iran.

C) Individual barriers and shortcomings:

- Prevalence of sub – culture of peasantry in many rural areas of Iran. This caused a major barrier for farmers participation and coordinating with each other for improving their lives.
- Physically heavy work related to the use of agricultural land by farmers.
- Aging of farmers that causes labor productivity decreases, which may reduce the use of agricultural land, as well as the state of health affected land use and associated changes.
- Low rate in adoption of new technologies by smallholders because of their low education.
- Many population of farmers and their subsistence livelihood dependency on small farms.

D) Technical and technological barriers and shortcomings:

- Traditional production methods, changes in land treatment technologies, poor knowledge of the use of pesticides and chemical fertilizers, as well as inappropriate plowing system causing losses and changes in soil physical and chemical properties.
- Inadequate water supply, excessive drought or moisture that caused farmers preferrence small production units in many rural areas of Iran.





Figs. 15 – 17. Establishing a Hydro - electric wheel for producing new, safe, cheap and renewable energy resources by cooperating and working of some educated and innovative peasantry and small holdings farmers, in 60 Km distance in west of Isfahan city and beside Zayandeh rood river in center of Iran (By author. 2019).

10 Discussion and Conclusion

Before land reform in the 1960s that caused land fragmentation in all of the country, the Iranian agriculture sector, in addition to meeting the domestic food requirement, contributed to exports (Kalantari and Abdollahzadeh, 2008).

To promote the sustainable development of agriculture, forestry and fisheries as a contribution to the eradication of poverty in a more diversified, productive and competitive economy are main fundamental and basic goals in Iran (CPF, 2012-2016).

Agricultural growth depends greatly on productivity improvement. Production resources can be increased through infrastructural development, appropriate technology, new farming methods, and farm management improvement (Kalantari and Abdollahzadeh, 2008).

Even though land fragmentation is defined in different ways, three distinct interpretations can be identified: (1) it implies the subdivision of farm property into undersized units that are too small for rational cultivation; (2) it suggests that the plots are noncontiguous and are intermixed with plots operated by other farmers; and (3) the last type sees distance as an important aspect of land fragmentation (Shuhao, 2005).

Land use efficiency is based on agricultural production. Correct and effective land use could solve several problems in food production, improving the welfare and provision of social stability. The use of land and natural resources is an important issue in the development of the country. Efficient land use has an impact on different types of factors, which are mutually contradictory. The main directions for improving and increasing the efficiency of land use are the introduction of intensive farming systems as well as clear national policies and legal regulations related to agricultural production and the use of agricultural land. The main condition for efficient use of agricultural land is the increase of soil fertility. It is based on the improvement of agricultural systems in the holdings: the organization of land areas, the planning of rotational crops, the study of the structure of the sown area, the establishment of a soil treatment system, the maintenance and installation of drainage systems, fertilizer systems, pest, disease and weed control, seed production, environmental protection measures. In this regard, analyzing the problems that are associated with the use of agricultural land is seen as interactive interaction, as the fragmented property structure is one of the reasons influencing the use of agricultural land, which leads to an increase in unused areas of agricultural land, while unused areas of agricultural land are often overgrown with shrubs (Cintina and Pukite, 2018).

The economic efficiency of land use is characterized by the ratio between the amount of production and the cost per land unit area (Baumane et al., 2014).

The efficiency of land use is reflected in materials, and labor costs can be used to determine the efficiency of production and economic land use. The efficiency of land use is influenced by the set of economic measures undertaken to improve land quality and increase productivity.

The essence of land-use efficiency is economic activity, on the one hand, and different resources, and (or) costs – on the other hand (Cintina and Pukite, 2018).

Increasing population has posed insurmountable challenges to agriculture in the provision of future food security, particularly in the Middle East and North Africa (MENA) region where biophysical conditions are not well-suited for agriculture. Iran, as a major agricultural country in the MENA region, has long been in the quest for food self-sufficiency, however, the capability of its land and water resources to realize this goal is largely unknown. The overarching effects of climate change pose further threats to the sustainability of agricultural systems (Mesgaran et al., 2017).

Sustainable land management is essential to meeting the global challenge of securing soil and water resources that can support an ever increasing population. There is a real need to analyse the economic benefits and long term sustainability of future development against the protection of high class land for current and future production requirements (Curran-Cournane et al., 2014).

There is little room for cropland expansion to increase production but redistribution of cropland to more suitable areas may improve sustainability and reduce pressure on water resources, land, and ecosystem in Iran (Mesgaran et al., 2017).

For the efficient use of agricultural land, there are several conditions that need to be met or improved to achieve effective land use. Efficient use of agricultural land has both external and internal conditions that need to be met or improved to achieve effective land use. An essential element of the effectiveness of agricultural land is the organization of land parcels, which ensures proportionality between available land and available labor, financial resources, as well as proportionality with the use of agricultural land, areas of production and specialization of agricultural holdings. Due to lack of work in rural areas, people do not object to work at a lower wage, which leads to lower productivity and, in the end, to inefficient land use, as employees lack motivation to work. Land use efficiency also affects the scarcity of agricultural land, which makes it difficult to organize rotational rotation, which in time affects soil fertility. Mechanical soil cultivation is an essential element of the effectiveness of using agricultural land as it improves soil fertility. It accounts for 30 – 50% of all costs in crop production. Extreme conditions affecting land use efficiency are national legislation, land policy guidelines, credit facilities, land tax rates as well as relationships with agricultural production partners at local, regional and international level (Cintina and Pukite, 2018).

Land fragmentation in Iran is the result of several processes (social, cultural, economic, physical and operational processes) working either together or independently and is caused to a large extent by traditional and livelihood agriculture structure (Kalantari and Abdollahzadeh, 2008).

Enhanced capacity of smallholder producers to achieve higher productivity/production, higher competitiveness of agriculture, forestry and fisheries, and diversification of production are main solutions for promote the sustainable development of agriculture in Iran (CPF, 2012-2016). In the end it must be emphasized that for confronting to unfavorable effects of land fragmentation and accessing to optimal land consolidation, governors and policy makers must consider several criteria and processes including social, cultural, economic, physical and operational processes (Please see Model 1).

Removing main barriers that caused land fragmentation

A) Socio-economic barriers and shortcomings:

- High production costs, low prices for agricultural products, resulting in a decrease in profits from the use of agricultural land. These create pressure on the owners and, as a result, decreases or the owners are forced to completely abandon the management of agricultural land in many rural areas.
- The migration of people from the countryside to cities, changes in the population, growth in urban areas and a decrease in rural areas.
- Low level of education of the farmers population and lack of their opportunities for attending special courses to exit from traditional agriculture.
- Agricultural production is largely seasonal, which has a significant impact on the number of workers in rural areas.
- Lack of employment opportunities in many rural areas.

B) Legislative, Institutional, governance and political barriers and shortcomings:

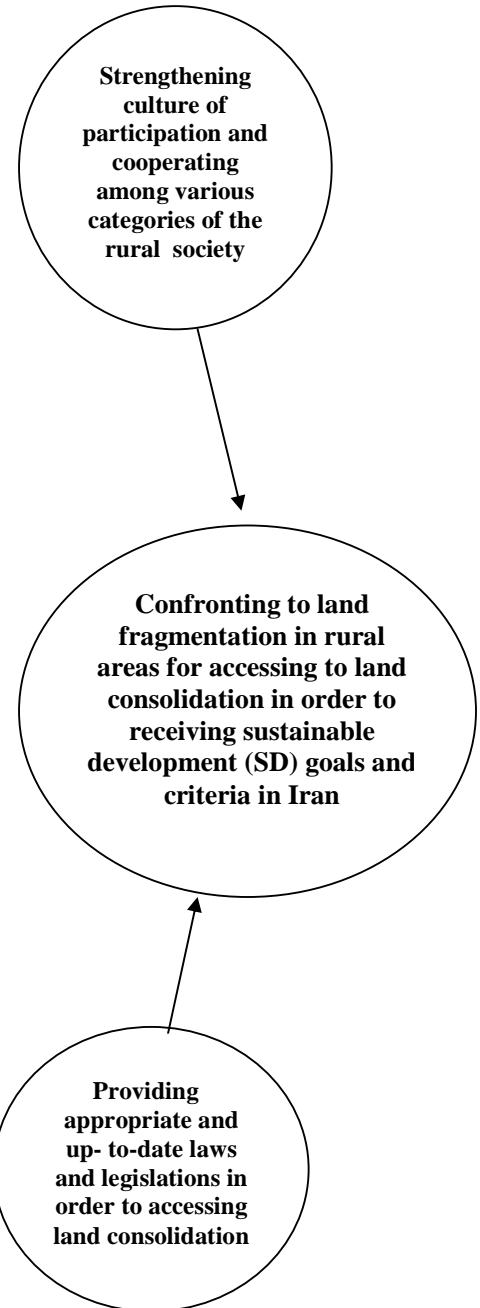
- Lack of adequate support for producers, lack of support for young farmers, an increase in land rent, timely reimbursement of damages, lack of support for producers, that resulting in the purchase and sale of agricultural land.
- Foreign imports, because imported products can be cheaper to purchase than local producers.
- Inheritance of the land, which is related to the wishes of the new owner to sell the land, but until the documents are arranged, the land is not used, or leads to fragmentation of land. Such activities may result in non-economic production.
- Unavailability and weakness of farmers land cooperatives in many rural areas of Iran.
- Old and insufficient laws that caused prevalence of small holdings and land fragmentation.
- Missing markets for the farmers products and commodities and thus a solution extension for risk reduction by them in many rural areas of Iran.
- Uninsufficient pay attention and considering sustainable land management by many policy makers and governors in Iran.
- Uninsufficient credit facilities for motivating farmers in order to consolidating their lands.
- Conflict between consolidating lands with many norms established by law in Iran.

C) Individual barriers and shortcomings:

- Prevalence of sub – culture of peasantry in many rural areas of Iran. This caused a major barrier for farmers participation and coordinating with each other for improving their lives.
- Physically heavy work related to the use of agricultural land by farmers.
- Aging of farmers that causes labor productivity decreases, which may reduce the use of agricultural land, as well as the state of health affected land use and associated changes.
- Low rate in adoption of new technologies by smallholders because of their low education.
- Many population of farmers and their subsistence livelihood dependency on small farms.

D) Technical and technological barriers and shortcomings:

- Traditional production methods, changes in land treatment technologies, poor knowledge of the use of pesticides and chemical fertilizers, as well as inappropriate plowing system causing losses and changes in soil physical and chemical properties.
- Inadequate water supply, excessive drought or moisture that caused farmers preference small production units in Iran.



Model 1. Final and exigency acquired model on the ways of confronting to land fragmentation in rural areas for for accessing to land consolidation in order to receiving sustainable development (SD) goals and criteria in Iran

Conflict of interest

The author declare that he has no conflict of interest.

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