

PARCEL FRAGMENTATION AND LAND CONSOLIDATION

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Abstract: Parcel Fragmentation is the division of parcel into smaller pieces having individual ownership. The main parameters used for measurement of Parcel Fragmentation have been considered the spatial location of parcel, shape & size of parcel and number of parcel. The main causes of Parcel Fragmentation are; inheritance, population growth, land market, historical/ cultural perspective, personal prestige & status, economic & physical process, quality of soil and physical condition of parcels. The main impacts seen due to the Parcel Fragmentation are as reduction of agricultural production, increases of agricultural production cost, increases land disputes, increases transport cost, wasted time for the workers travelling, supervision, securing & management, reduce parcel area due to walls & fences and cannot use modern equipment in agricultural activities.

Land Consolidation is the reverse act of Parcel Fragmentation. It is the process of formation of single or individual parcel by merging several parcels having enough size & suitable shape and helps to reduce those impacts which are seen in the fragmented parcels so it is profitable to move in the direction of Land Consolidation.

1 PARCEL FRAGMENTATION

Fragmentation, in literal meaning, indicates a small or incomplete part or piece broken off to which it originally belongs. Parcel fragmentation is the scattering or division of parcel in which a single farm consists of numerous spatially separated parcels (Demetriou, The Development of an Integrated Planning and Decision Support System for Land Consolidation, 2014). According to the Harvey, Kaim and Gajda (2014) the main area of parcel fragmentation were located along the transportation corridors it means along the road and railway. In the same way, according to the King & Burton (2014) land fragmentation is the sub-division or scattering of the existing parcel into individual ownership and parcellization is the spatial division of the parcel. They further wrote that fragmentation & land consolidation are the spatial process. The sub-division or fragmentation of land seems like the act of dividing land or houses into smaller pieces. The main purpose of sub-division of land has been found for commercial or industrial development. The main parameters used for measurement of parcel fragmentation have been considered the shape characteristics of parcel, the spatial location of parcel, shape & size of parcel, number of parcel and size of parcel in practice. World census of Agriculture (2006) estimated that more than 80 percent of World's farm land is fragmented. Land fragmentation had been documented in all parts of the world. However closely associated with Europe, some examples are Mexico, Taiwan, Peru, Malaysia, Kenya, Uganda, the United States and Japan (Sendqvist & Andersson, 2006). According to Jha, Nagarajan, &

Prasanna (2005) parcel fragmentation could raise land holdings. They also described that in India, the Jamindari System located in many river valleys that enhanced the land fragmentation. According to the Chapagain (2004) the root of parcel fragmentation is traditional Hindu law where parental property as well as land is divided into their sons.

So far Nepalese practice is concerned, CBS (1994) has mentioned that the parcel fragmentation information in the ecological regions of Nepal has been illustrated as in table 1

Table 1: Parcel Fragmentation based on Ecological Region

Regions	Average parcels per farm	Number of parcels per hectare
Nepal	3.96	4.2
Mountains	4.63	6.8
Hills	3.92	5.1
Terai	3.85	3.1

Source: CBS, 1994

Dijk & Van (2003) have described four types of land fragmentations including fragmentation of land ownership, land use, internal fragmentation and separation of ownership and use. Land ownership fragmentation refers to the number of land owners and their use of a given piece of land. Similarly, land use fragmentation refers to the number of users and also tenants of the parcel. In the within or internal fragmentation parcel size, shape and distance are the

main issues. When there is discrepancy between ownership & use, then there occur separation of ownership & use. In Nepal, fourth type of land ownership & use type of fragmentation is appeared.

You (2010) claimed that there are mainly two kinds of land fragmentations: one is land ownership fragmentation and the next is land use fragmentation. He further described that in the land ownership fragmentation, there are number of separated land parcels which are registered in the cadastral system. But in the land use fragmentation, there are distinct numbers of separated land parcels which are being used in the fragmented land use situation.

2 CAUSES OF PARCEL FRAGMENTATION

Land fragmentation may vary country to country and from region to region (Demetriou, The Development of an Integrated Planning and Decision Support System for Land Consolidation, 2014). There are main four factors which play the role of catalyst in parcel fragmentation. These four factors are inheritance, population growth, land markets and historical/ cultural perspectives. He further added that inheritance is the primary cause of land fragmentation, in which land fragmentation happen by the equal sub-division of parcel among all heirs or sons. Due to this region, land fragmentation has become a continuous process and hence parcels getting smaller and smaller. Population growth is directly related to the inheritance. People wish to acquire a parcel not only for agricultural activities but for investment, enhancing personal prestige & status and also for future of family.

According to the King & Burton (2014) the main causes of land fragmentation are social, cultural, economic and physical process. Land use for dowries, new buildings, charities or religious organizations.

Lusho & Papa had written when landowners land was divided among all their heirs, it was divided on the basis of quality of soil (fertility, irrigation, capacity, cropland), distance between house and parcels and physical conditions (hilly, flat and mountainous land) due to these causes each land parcel was fragmented. Institutional, political, historical and social factors also played vital role in the parcel fragmentation (King & Burton, 2014). The large amount of parcel fragmentation was caused by the residential development (Neal, Doye, & Brorson, 2012). Bullard (2007) also agreed that the major causes of land fragmentation are population growth, laws of inheritance and poverty.

3 IMPACTS OF PARCEL FRAGMENTATION

King & Burton (2014) described that land fragmentation may have social and psychological impacts. They also further noted that land fragmentation reduce inequalities among farmers and

reduce land disputes in the case of shared or multiple ownership. The social tension is caused by disputes over access and ownership (King & Burton, 2014). According to the Lusho & Papa (1998), the negative impacts of parcel fragmentation which are classified as; restricts agricultural modernization, in some parcels there is problem to the improvement of land and increased risk of abandonment and created economic and production problem because of work, time & parcel distance increased which could be measured by using the digital elevation model (DEM) of that regions. In small parcel mechanization was inefficient, the previous irrigation system was inefficient because of the initial parcels were fragmented into numerous parcels. Neal, Doye, and Brorson (2012) wrote in their research paper that while parcel size decreased, the price per acre was increased. As other researcher Sendqvist & Andersson (2006) also wrote that land fragmentation constrained crop production and modernization on agriculture. They also described that land fragmentation is a significant barrier to gaining from agricultural productivity. They further claimed fragmented parcels / plots increased transport costs, wasted time for the workers travelling, supervision, securing and management of scattered parcels took more time and costly, wasted land area and also required more land area for fencing or wall construction & path or roads. It also increased risk of disputes among neighbours. Similarly in the more fragmented parcels more profitable like fruit crops could not grow because of lesser plot area. According to the Bullard (2007) the negative impact of parcel fragmentation was as increased in boundaries, overgrown land, increased in pests, disused farm buildings, decreased in cultivated land and abandoned machinery. In the fragmented parcels the production cost is high and modern mechanization technology is almost impossible, time is wasted in moving workers, animals & carrying seed and manure from one parcel to another, expensive on making fences, threshing floor & water supplying. Similarly due to the parcel fragmentation social tension also increased. In fragmented parcels more manpower and other resources are required than necessary.

4 LAND CONSOLIDATION

The food and Agriculture organization (FAO) has defined the land consolidation as the formation of single or individual farms which have enough size, structure and suitable for productive use. Land consolidation means landowner gives up their scattered parcels in order to get an equivalent area or value of land in fewer or more continuous parcels (Sendqvist & Andersson, 2006). According to the You (2010) the main tasks in land consolidation are elimination of land fragmentation, land reclamation & soil improvement, improvement of the pattern of settlement and improvement of the farm size pattern. The main objectives of land consolidation were grouping of neighbour parcels that reduce the negative effects of

fragmentation, reduction of total agricultural production costs and enhance more effective agricultural plans and projects (Lusho & Papa, 1998). According to the Lusho & Papa some land consolidation methods are; exchanging parcels of land, planting the whole ex-cooperation field with the same crop, farming in the groups, creating the land market. He further described the benefits of land consolidation that could help to create viable farms, improvement of the landownership structure, enlargement fragmented holdings, construction of infrastructure, avoidance of land abandonment, reduction of production cost, improvement of irrigation system and mechanization. Ahmadi, Feali & Soltani (2013) pointed out that land consolidation is the planned readjustment of pattern of ownership & parcels, which integrates and decreases the number of parcels and it also helps to make the proper suitable structure of farm and provides the required infrastructures including drainage network, irrigation system and road for agricultural development. Ayranci (2007) described that the farm land is scattered into very small parcels in many Countries which is unfavourable for agricultural production so land consolidation is one activity or one kind of instruments or tools which can consolidate or integrate such scattered parcels. He further wrote that land consolidation is weapon that re-organizes the fragmented parcels and makes suitable structure for agricultural use, improving of parcellation, water control, accessibility and improvement of land protection or recreation of land is generally includes in the land consolidation project. The main three activities that should do in land consolidation are administration, allocation and mapping. He again claimed that in land consolidation the parcellation design is very complex because it is difficult to settle the new formed parcel according to previous.

Akkaya, Aslan, Gundugdu, Yaslioglu, Kirmikil & Arici (2007) described main principles of modern land consolidation which are; the objective should to improve rural livelihood rather than the agricultural production only, the output should be oriented in the sustainable economic & political development as well as sustainable management of natural resources, the process should democratic & participatory and approach should be comprehensive, cross-section and integration of rural & broader regional area development, while forming the land consolidation strategy it should recognize that rural society is diverse, not all fragmentation is a problem, protects and enhances the environment, need for diverse local solution and accommodate national and sub-national priorities and strategy should address institutional, financial, legal, international cooperation & capacity building issues. Vitikainen (2004) described two types of land consolidation procedures one of them is 'cadastral surveyor model' and the next is 'committee model'. In the cadastral surveyor model a cadastral surveyor is appointed in the post of in charge to implement the project but in the committee model the

committee is appointed by the ministry. The main objective of the land consolidation is varies as countries wise but it may effects by the culture, historical trends, traditions and legislation of that countries.

Figure 1: Changes by Land Consolidation



New apartment formed by China government after land consolidation in picture a & b



Barren land converted into cultivated land after land consolidation in China in picture c & d

5 PROCEDURE OF LAND CONSOLIDATION

The process of land consolidation is the method of reversing the action of fragmentation which is not new. Some of the earliest attempts at consolidation, as a method of land reform, took place in Scandinavia, particularly in Finland (FAO 2003), Sweden, and Denmark, in the 18th and 19th centuries. The three main land reforms in Sweden took place between 1750 and 1920, resulting in severe fragmentation being replaced by land consolidation (Osterberg and Pettersson, 1992). However, with the subsequent population increase subdivision leading to fragmentation has occurred thereafter (Lindskog and Millgard, 1983). In Finland the first law was passed in 1757 (King and Burton, 1982), and nearly all of the land has been consolidated at least once (Leppikangas, 1994). In Denmark the first Consolidation Act was introduced in 1781 (Binns, 1950). Legal aspects of land consolidation may be complicated by different procedures. In The Netherlands four types of land consolidation exist (Sonnenberg, 1999); in Germany five, and in France seven (although only three are commonly used - Brussaard and Grossman, 1992). In many African societies, land remains the paramount resource base (Deng, 1988) and whether communal or individual ownership forms of tenure are implemented, it is important that the peasants are encouraged to remain and work on the land (Kiamba, 2001; Törhönen and Goodwin, 2001). The major activity of land consolidation has been to bring fragmented parcels of land together to produce economic units. Additionally, during the process of land consolidation, particularly when it occurs over a large area, it is usual to undertake

major land development, which would otherwise have been uneconomic when only a few parcels were consolidated. The process of consolidation is long-term, and benefits from a continuous dialogue between government officials and the farming community.

Different countries have developed different types of Land Consolidation procedures. Similarly FAO (2003) has set out one of the more recent comprehensive procedures for land consolidation which is listed below:

5.1 Initiation of the land consolidation project

- (a) Request for initiation of a project.
- (b) Analysis of the situation and identification of what is needed and wanted.
- (c) Preparation of an initial concept plan that states the aims of the proposed project and approximate estimates of costs and sources of financing.
- (d) Approval of the request by participants and the state.
- (e) Formation of a local management team with representation from the community.

5.2 Design of the project

- (a) Selection of consultants to design the project.
- (b) Precise definition of the area and scope of the project.
- (c) Preparation of cost-estimate and schedule for project.
- (d) Evaluation of projected costs and benefits.
- (e) Preparation of cost-sharing formula.

5.3 Inventory of existing situation

- (a) Identification or adjudication of boundaries and the legal status of parcels, including lease rights, mortgages, easements or servitudes.
- (b) Delimitation of important environmental areas.
- (c) Determination of the value of the parcels.
- (d) Handling of objections related to boundaries, ownership and valuation.

5.4 Elaboration of the detailed land consolidation plan

- (a) Preparation of the draft consolidation plan showing the new parcel layout, location of new roads and other public facilities, and identifying those roads and facilities which will be removed.
- (b) Presentation of several plan alternatives with cost-benefit and environmental impact assessments.
- (c) Review of the options for consolidation by participants.
- (d) Preparation of the final detailed consolidation plan to accommodate comments of participants.
- (e) Handling of objections.
- (f) Approval of the detailed consolidation plan.

5.5 Implementation of the detailed consolidation plan

- (a) Selection of contractors for construction works, etc.
- (b) Construction of public works (agricultural improvements, levelling, drainage, new roads with bridges and culverts, etc.)
- (c) Survey of new boundaries on the ground.

5.6 Concluding phase:

- (a) Working out compensation and apportionment of costs.
- (b) Final updating of the cadastral map.
- (c) Issuing and registration of new titles.

6 ADVANTAGES OF LAND CONSOLIDATION

The main advantages of Land Consolidation are described below;

- Improving the agricultural sector by enabling farms to become more efficient and competitive, and better integrated in agricultural chains.
- Encouraging alternative ways of agricultural production such as the implementation of agro-environmental measures and good agricultural practices.
- Strengthening the rural economy by promoting broad-based growth, including supporting non-farm activities and providing access to credit, markets and infrastructure support.
- Improving social conditions by promoting employment opportunities and providing increased access to social services, water and sanitation.
- Providing greater protection of natural resources and for their sustainable management.
- Ensuring greater participation in the development process by those usually left out of it.
- Improvement of agricultural land division.
- Improvement of property division in village centres.
- Re-allotment of leasehold areas.
- Enlargement of the farm size.
- Land use planning in village centres.
- Acquisition of land for the municipality/state in village centres.
- Readjustment of building land (homestead areas) in village centres.
- Improvement of road network in the land consolidation area.
- Improvement of drainage network in the land consolidation area.

- Implementation of environment and nature conservation projects, etc.
- Promotion of regional development projects.

7 CONCLUSION/ RECOMMENDATION

The objective of this paper is to describe the meaning of parcel fragmentation, the major causes of parcel fragmentation, the impacts seen in the fragmented parcels and introduction, procedure & of land consolidation. The main impacts which are seen in the fragmented parcels can be solved by the land consolidation techniques so the government has to make the proper land policy to reduce the parcel fragmentation and encourages applying the land consolidation process which may help in the social, cultural and economic development of the society.

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