

# Status of Parcel Fragmentation in Nepal

Dr. Bharat Singh Air  
air3bharatsingh@gmail.com

## KEYWORDS

*Parcel, Parcel Fragmentation, Cadastral Map, Parcel Boundaries*

## ABSTRACT

*Prevailing laws of Nepal provide legal rights to the private land owners to register, transfer, mortgage their own land. Parcel fragmentation is the division of a parcel into two or more parcels. This research was carried out to analyse the current status of parcel fragmentation in Nepal. According to the findings of this research, parcel fragmentation in Nepal is haphazard mainly focussing on urban and peri urban areas consequently parcel being irregular in shape & smaller in size and ultimately incrementing huge number of land owners with in fixed area. In the context of Nepal, factors that drive parcel fragmentation are cultural, social, legal, economical, frequent disasters, geographic variations, unmanaged migrations, haphazard land use planning amongst others.*

*The uncontrolled and unmanaged parcel fragmentation in Nepal is the major challenge for land use planning and its implementation. Dense parcel fragmentation has created land related disputes. it is recommended that the government should reformulate and implement the proper land use policy as well as its supporting acts that encourage land consolidation in agricultural zone and reducing haphazard parcel fragmentation in urban and peri urban areas.*

## 1. INTRODUCTION

Parcel is a portion of land surrounded by its boundaries and surveyed by a specified tools and technique under the land related act of the country. Parcel has fixed location on land with its covered area and the additional attributes. Parcel is enclosed at least three parcel boundaries. A parcel cannot be a complete parcel, without enclosed by its boundaries and collecting other related attributes. Fragmentation, in literal meaning, indicates 'fragment' referring to 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 D. , 2013). In the same way, according to the King and Burton (2014), land fragmentation is the sub-division or scattering of the existing parcel into individual ownership and fragmentation is the spatial division of the parcel. According to Shrestha (2005), in the cadastral surveying, boundary is the main object visibly seen in somewhere. In the

cadastral map, rather than parcel boundaries, there are roads, water courses, buildings, temples and other additional features. The primary purpose of parcel boundary is to define or demarcate the parcel on the ground according to its shape, size and dimensions. Ojalampi (2006) described that due to the lack of permanent structure or demarcation on the ground according to the parcel dimensions, it is more chance to be a land dispute. So, boundary is a part of the discursive landscape of social power, governance and to control the land disputes. Likewise, according to Tuladhar (1996), parcel is constructed from three or more parcel boundaries lines and boundary line is formed by two boundary corners which location is known in local or national geodetic coordinate reference system. He further explained about fixed and general two types of boundaries. In the general boundary, a boundary line between adjoining two parcels is defined through physical boundary features, it may be natural such as rivers, roads, streams etc. or manmade such as; hedge or fences etc. Generally, farm fragmentation consists of three activities first one is ownership fragmentation, second one land use fragmentation and third one internal fragmentation.

According to Platonova and Jankava (2012), in the ownership fragmentation, the ownership of agricultural land is divided into more than two land owners and land use of farm land may varied according to interest of according to the land owners. Similarly, 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 separation of ownership that increases number of land owners in the given piece of land. Likewise, land use fragmentation refers to the use of land by users or by tenants of the parcel. Parcel size, shape and distance from the node played the main role in the fragmentation of a parcel.

When there is discrepancy between ownership and use in a parcel, then there occur separation of ownership and its use. In Nepal, fourth type of land ownership and use of fragmentation is prevalent. But 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. Likewise, Massikamae (2006) has claimed that parcel area information on the related documents can play vital role for planners, politicians, and decision makers. He further added the average size of the parcel could be used to compare the land use condition among different countries and also used for the assessment of land fragmentation.

## 2. LITERATURE REVIEW

This literature review deals with the present status of parcel fragmentation in Nepal. The purpose of literature review was to explore the existing knowledge & idea or information about the parcel fragmentation and parcel related information. This section has three distinct sub-sections for the need of study. In the first section, there is presentation of various on factor of parcel fragmentation. This is followed by second sub-section which explores parcel fragmentation on Nepalese context. Similarly in the third section factors of parcel fragmentation in Nepal have been reviewed.

Based on the literature review, the exiting gaps and lapses on the subject matter were identified and different types of factors or reasons were identified in the nation and beyond nations. The review of literature has been based on the national and international research reports, books, thesis, dissertation, research journals, proceedings and other research related

published and unpublished documents about the parcel fragmentation.

### **2.1. Factors of Parcel Fragmentation**

Various studies from the researchers around the globe have pointed out different reasons or factors that induce parcel fragmentation. These major factors causing parcel fragmentation across few countries are also examined in this study. Parcel or Land fragmentation may vary country to country and from region to region (Demetriou D. , 2013). According to him there were main four factors which play the catalytic role in parcel fragmentation. These four factors were inheritance, population growth, land markets and historical/ cultural factors. He claimed inheritance was the primary cause of land fragmentation, in which land fragmentation happen by the equal sub-division of parcel among all heirs or descendants. Due to this region, land fragmentation has become a continuous process and hence parcels getting smaller and irregular. Population growth was directly related to the inheritance. People wish to acquire a parcel not only for agricultural activities but for investment, enhancing personal prestige and status and also for future of family.

Another factor of parcel fragmentation is urbanization. Urbanization is the process of increasing people living in towns and cities due to the movement from rural to urban areas. Urban population growth is directly related to the natural growth, migration and boundary changes (Djurfeldt & Jirstrom, 2013). Natural growth means growth of population within the urban region and migration is coming from outside. Zhang (2013) also claimed that parcel fragmentation is especially more in the periphery of the rapidly urbanization area. The new urban areas were being built on the agricultural land which is located across the developed or developing cities (Labbe, 2011). The main reasons of migration from rural to urban area are opportunities for proper employment, education, knowledge

& technology transfer, better housing and suitable markets for agricultural products in urban areas (Maina Thuo, 2013). As the urban area provides the above- mentioned opportunities, in the meantime the urbanization process changes the parcel shape and size (Djurfeldt & Jirstrom, 2013). Such type of urbanization affects agricultural productivity (Rembold, 2002). Likewise, according to the King and Burton (2014) the main causes of land fragmentation were social, cultural, economic and physical process. After the land fragmentation, the fragmented piece of land is mostly used for new buildings, charities, religious organizations or used as dowries. Lusho & Papa (1998) were also agreed landowners land was divided due to the practice of parental land division 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.

The large amount of parcel fragmentation was caused by the residential development in various countries (Neal, Doye, & Brorson, 2012). According to You (2010), well understanding of land fragmentation helps policy makers to make policies that can solve the problems and also decide which measures are appropriate for reducing land fragmentation. He further explained that the causes of land fragmentation distinguished with regard to the persistence and emergence that was demand side and supply side. Natural and social facts such as inheritance, land scarcity, low land/labour ratio, population pressure and traditional agriculture are the supply side causes of land fragmentation. Similarly, equality principle, farm capability (low producing efficiency level and production method), living safeguard, topography, reducing the risk of production and difference of land quality including slope, altitude, water

retention capability, agro-climate conditions and soil type are the demand side causes of land fragmentation. Similarly, Bullard (2007) also agreed that the major factors of land fragmentation were population growth, laws of inheritance and poverty. He further explained that fragmentation results smaller parcels and could be attributed to a many owners or parcels, where single parcel was owned by many owners in separate shares or one land owner owned many parcels.

The laws of inheritance of parcel fragmentation vary in different cultures. In some countries, like in Germany due to the causes of inheritance, the land was undivided but inheritance law had played vital role in the parcel fragmentation in many other countries (Bullard, 2007). In the same matter, he added inheritance law was one of the main factors of parcel fragmentation in Italy and in France. The additional factors of parcel fragmentation in Italy were pointed out as; population growth, economic depression, and social function of land, construction of houses and desire of land in different locations. Bullard (2007) further noticed that, in France, the main reasons of parcel fragmentation were compulsory crop rotation, and the nature of the land market. Likewise, institutional, political, historical and social factors also played vital role in the parcel fragmentation (King & Burton, 2014). They further described that parcel fragmentation might be influenced by the four types of processes which were physical, economic, operational and socio-cultural. They again claimed that in socio-cultural process inheritance laws played vital role in the parcel fragmentation which facilitate the equal division of parcel among their heirs. In the economic process when the land price was high, it was obstacles in changing new technology. In the same way due to fence or ridge between parcels, construction of roads, canals, industries, railways and others in the parcels also played the vital role in parcel fragmentation which was considered as

operational process. According as the others, Van Hung, MacAulay & Marsh (2007) had also given different factors of parcel fragmentation such as historical & geographical issues, population pressure and patterns of inheritances. The fragmentation occurred due to the geographical condition such as hilly & upland area. High population growth also accelerates the parcel fragmentation in that area and farmers have more fragmented parcels. They further mentioned that farmers in different Countries like India, China, Nepal, Vietnam, Ghana, and others they want to divide the similar quality of land among their children that results land fragmentation.

Likewise, 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. In addition to the legal rights to do parcel fragmentation, there are some other reasons which drag the parcel to be more fragmented parcels that are; inheritance rights, population growth, land markets & cultural perspective (Demetriou D., 2013). Bizimana (2009) also agreed on those parcels were further fragmented with the increasing of population. The one more reason was also described by the Maina Thou (2013), as some landowner sales their high prized parcel of land to buy cheaper and bigger parcels in the ruler area and some land owners' sales portions of their parcels and construct houses in the remaining portions of the land which causes parcel fragmentation. The other factors which affect the land fragmentation was found to be land reforms, inheritance, transaction, environmental & ecological factors, social and cultural factors, operational and physical factors such as parcel distance from road, soil quality, land steepness, water availability, climate, topography, height & morphology (Rejael, Jamshidi, Mostafa, & Roosta, 2012). Similarly, they gave additional causes of parcel fragmentation such as, parental land division among their heirs make parcel smaller, irregular and insufficient to

do farming as well as due to the lack of basic developmental infrastructure in the rural area, people are moving from rural to urban area to get these things such as, good education, proper employment, transport facility, health save & security and also to live in the newly developed technology of environment. When people move from rural to urban area, they buy portion of land from a whole parcel to make home hence there occurs parcel fragmentation, so migration is another important factor of parcel fragmentation.

## **2.2. Parcel Fragmentation: Nepalese Context**

In Nepalese context, parcel fragmentation is prevalent in private land, customary lands and in some cases in public and government lands too. Nepal is a land locked country and located between the India & China. A Cadastral map is a map which shows the boundaries and ownership of land parcel and in addition unique identifying numbers of each parcel. According to the Land (Survey and Measurement) Act, 2019 BS, parcel is the piece of land surrounded in all directions by its boundaries and having similarity in ownership, use & enjoyment and kind of land within these parcel boundaries. The area of agricultural, residential and residential concern is covered in the Cadastral map. In the context of Nepal, the land record system is very old and the transformation towards modern cadastral system is very slow. In the starting period or in the 1951 BS, the Cadastral maps required for land administration were prepared by Chain Survey having lesser accuracy. Since 1980 BS, Plane Table, Plane Alidade and Chains had been used to make Cadastral maps for the improvement of map accuracy. Such prepared cadastral maps were not sufficiently accurate and up to date, so systematic Cadastral Surveying was started to prepare maps with full coverage where Plane Alidade & Chain were replaced by the Telescopic Alidade & Measuring Tapes.

In the initial time there was no national network of control points so island or free sheet Cadastral map were prepared on the basis of local control points in the 38 districts (Shrestha B. , 2005). After the establishment of national geodetic networks Cadastral mapping was performed based on those control points on the grid sheet in the 37 districts where free sheets cadastral mapping was not done. Currently, the government of Nepal has initiated using digital technology in the few parts of the country for the cadastral re- surveying purposes. In the digital technology of cadastral mapping, Total Station named instrument and its related software were used to make maps and to prepare cadastral related information. However, Nepal is just crawling towards the digital activities but Ali (2013) claimed different countries are using high resolution satellite imageries in the maintaining of parcel boundaries and the use of Cadastral map in Land Information System (LIS) which is also necessary in the Nepalese land administration system.

Parcels formed from the above-described technologies are located in Hill, Terai and Mountain regions. However, the parcels are located in different ecological zones but it is varied in total amount of parcels. out of the total number of parcels 46 percent were located in Hill ecological belt, 43 percent were located in Terai region and remaining 11 percent of parcels were situated in mountain area (Agriculture Census Monograph Nepal 2001/02, 2006). From the data it was pointed out that large numbers of parcels were found in the Hill belt compared to the Terai and Mountain region. Such types of parcels are holdings by the female land holders were reported only 6.8 percent but male holders were 93.2 percent out of the total land holders. Figure has shown the male dominant in the land ownership or land holding. Likewise, in the cooperation of female holders in different ecological zones were as, 9.9 percent out of the total parcels in the Hilly area, only 3.6 percent of the total parcels in the Terai and 6.1 percent in the mountain belt.



After describing the mapping history of parcels and its holdings, there is shown average parcels per farm and number of parcels per hectare in different ecological zones is shown in the following Table 1 which indicate situation of parcel fragmentation.

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

Centre Bureau of Statistics (CBS), Nepal (1994) has, mentioned that the parcel fragmentation information in the ecological regions of Nepal has been illustrated in above table. This table describes average parcel per farm and number of parcels per hectare in the different ecological belt. While comparing these data the height average parcels per farm was in mountain ecological region i.e., 4.63 number of parcels per farm. Similarly, 3.92 average parcels per farm in hills and lowest i.e., 3.85 in terai ecological region. Similarly, number of parcels per hectare was also seen greater i.e., 6.8 in mountain ecological belt. Further 5.1 parcels numbers per hectare in hills and 3.1 in terai ecological belt. As it observed that the highest number of average parcels per farm and number of parcels per hectare was in mountain region comparing than hill and terai, it is due to the topographical nature of land. In the undulation land, the available parcels were smaller and irregular in shape so there created more parcels in smaller area. Similarly, the average parcel per farm is 3.96 and number of parcels per hectare was 4.2 in Nepal.

### 2.3. Factors of parcel fragmentation in Nepal

In the above section 2.1, there is described various factors which played vital role to be

a parcel fragmentation in different countries. In the context of Nepal, to pull out the main reasons or factors of parcel fragmentation a field survey was done by making a questionnaire. The main respondents of this present study was included land administration expert, land owners, land brokers, housing & real estate company holders, land planners, lawyers & Lekhapadhi kanun Byajasau, In the questionnaire, there is given six alternatives such as; Distribution of Patriarchal Property, Unmanaged or unplanned Urbanization, lack of Legal Provision for Minimizing Parcel Fragmentation, Migration, Lack of Money and All the Specified Reasons as a reason of parcel fragmentation. These five types of reasons are chosen because such reasons had played directly or indirectly main roles in the parcel fragmentation in different countries. Respondents had given to choose one option among these six options that is helping in parcel fragmentation. After the collection of views from all respondents, the out is summarized on the following Table 2.

Table 2: Factors of Parcel Fragmentation.

SN	Reasons/Factors	No. of Respondents	Percent
1	Distribution of Patriarchal Property	13	3.5
2	Unmanaged Urbanization	40	10.8
3	Lack of legal provision for minimizing parcel fragmentation	26	7.0
4	Migration	2	.5
5	Lack of Money	5	1.3
6	All the specified reasons	286	76.9
<b>Total</b>		<b>372</b>	<b>100.0</b>

Source: Field Survey, 2016

In the above table 2, it has been illustrated the main factors of parcel fragmentation. The main reasons have been given to the participants as in the alternatives such as Distribution of patriarchal property, Unmanaged urbanization,

Lack of legal provision for minimizing parcel fragmentation, Migration, Lack of Money and all the specified reasons. On these alternatives, out of the 372 participants 13 respondents i.e., 3.5 % agreed on the reason of parcel fragmentation is due to distribution of patriarchal property. Similarly, 40 respondents i.e., 10.8 % agreed on the reason of parcel fragmentation is due to unmanaged urbanization. Likewise, 26 responders i.e., 7 % agreed on the reason of parcel fragmentation is due to lack of provision for minimizing parcel fragmentation. In addition, 2 or only 0.5 % respondents agreed on that migration is the main reason of parcel fragmentation and most of respondents i.e., 286 or 76.9 % agreed on the all above-described reasons played main roles in the parcel fragmentation. Therefore, from the study, it is indicated that distribution of patriarchal property, unmanaged urbanization, lack of legal provision, migration and lack of money all played the vital role in the parcel fragmentation. Likewise in Nepalese context, one main factor of parcel fragmentation is to solve the money crisis. Mostly the poor land owner sells their piece of land to cover the expenditure of child education, treatment, dowry and marriage and other cultural activities that causes parcel fragmentation.

In addition, respondents had to choose the option on; Are you agree or disagree on the statement " Migration increase parcel fragmentation"? The summarized output is shown in figure 1 below which is illustrating about the relationship between the parcel fragmentation and the migration. Out of 372 respondents 240 i.e., 64.5% totally agreed on that migration increases the parcel fragmentation. It means when people migrate from one place to another place, they buy piece of land in the migrated zone to make their own home as well as other purposes hence it increases parcel fragmentation. Likewise, 91 i.e., 24.5% respondents partially agree on that statement. Similarly, 15 i.e., 4% respondents neither

agreed or nor disagreed on those statements. But only 11 i.e., 3% respondents partially and 15 i.e., 4% respondents totally disagree on those statements. It means migration does not increase parcel fragmentation. So, a greater number of respondents or 64.5% of respondents are fully agreed on that statement hence it is declared migration increased parcel fragmentation.

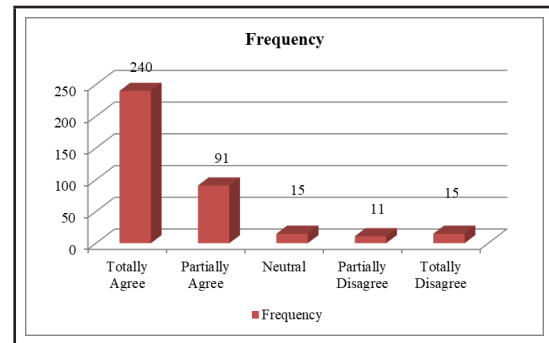


Figure 1: Migration Increases the Parcel Fragmentation

Source: Field Survey, 2016

### 3. STATUS OF PARCEL FRAGMENTATION IN NEPAL

Personal land is known as personal property. Every land owner has constitutional right to use, right to sell, right to buy land as their interest. Due to this constitutional rights parcel fragmentation is happening all over the nation. By these activities, the status of parcel fragmentation is different in different districts. The number of fragmented parcels of whole Nepal covering as mountain, hills & terai belts is shown in the table 2 as below. In this table, the number of parcels and number of land owners during the first survey of different districts is collected from the Survey Department. Likewise, number of parcels and number of land owners up to BS 2072 is collected from the annual report 2071/72 of Department of Land Revenue and Management. From these time periods data, the total change in parcel number and number of land owners is calculated and it has given the status of parcel fragmentation.

Table 3: Status of Parcel Fragmentation.

Districts	First Time Mapping		Till 2072 BS		Change in Parcel Numbers	Change in Land Owners
	Number of Parcels	Numbers of Land Owners	Number of Parcels	Numbers of Land Owners		
Jhapa	153137	25690	1457992	491351	1304855	465661
Ilam	148582	42749	195388	107847	46806	65098
Panchthar	170730	47596	234130	80417	63400	32821
Taplejunga	165595	44794	189283	61150	23718	16356
Morang	215693	42496	1410309	458053	1194616	415557
Sunsari	137795	22765	805933	491836	668138	469071
Dhankuta	137126	31312	167344	122538	30218	91226
Sankhuwasbha	261363	45835	402140	60220	140777	14385
Aokhaldhunga	291729	55538	293900	70546	2171	15008
Bhojpur	270860	64706	324782	104397	53922	39691
Udayapur	103385	4455	192933	108296	89548	103841
Mohattari	293827	70460	510640	212766	216813	142306
Sarlahi	271129	54507	515096	592237	243967	537730
Rautahat	358002	70016	596177	276684	238175	206668
Chitwan	80198	23696	424953	290680	344755	266984
Makwanpur	121414	33884	366959	118044	245545	84160
Sinduli	122744	14217	219479	105752	96735	91535
Ramechhap	270131	49400	318966	116373	48835	66973
Kavre	392294	52000	484261	252417	91967	200417
Dolakha	438770	59402	517797	102265	79027	42863
Sindhupalchok	463895	69060	535613	145072	71718	76012
Kathmandu	279344	91708	881115	652613	601771	560905
Lalitpur	169459	77237	368329	367220	198870	289983
Bhaktapur	159370	52283	219754	162033	60384	109750
Nuwakot	253906	40424	338100	148552	84194	108128
Dhading	311913	48810	384440	129253	72527	80443
Rasuwa	47437	5753	128830	12224	81393	6471
Nawalparasi	163302	19987	281935	124547	118633	104560
Rupandehi	473121	40029	1098220	330829	625099	290800



Kapilwastu	615604	36536	829460	169944	213856	133408
Gulmi	389221	66755	455567	105703	66346	38948
Tanahu	289109	47166	641269	249597	352160	202431
Gorkha	381606	58597	461270	124345	79664	65748
Lamjunga	296760	48617	326631	95593	29871	46976
Kaski	354374	50150	604520	297013	250146	246863
Parwat	331061	42713	374410	79903	43349	37190
Baglunga	367181	54415	660035	71050	292854	16635
Myagdi	136570	25985	147013	34112	10443	8127
Manang	21122	3833	57334	5375	36212	1542
Mustang	36470	3939	75884	5717	39414	1778
Dang	256636	21913	384425	152610	127789	130697
Banke	156227	15673	441495	52310	285268	36637
Bardiya	60755	7347	340573	161549	279818	154202
Surkhet	8889	21385	142682	89203	133793	67818
Salyan	242173	36845	301002	70787	58829	33942
Ropla	354977	42970	389107	61494	34130	18524
Pyuthan	251040	41597	315358	59458	64318	17861
Dailekha	266613	42475	299549	58943	32936	16468
Kalikot	199365	15679	206916	21510	7551	5831
Jumla	397234	15414	426802	25176	29568	9762
Dolpa	124219	6470	173325	8096	49106	1626
Humla	119690	12098	139702	20103	20012	8005
Kailali	73897	12768	327656	203826	253759	191058
Kanchanpur	34028	2600	179631	86246	145603	83646
Dadeldhura	156977	14410	278205	43051	121228	28641
Doti	295772	30947	390414	41855	94642	10908
Bajura	224616	16553	229336	19243	4720	2690
Bajhang	329344	25304	394122	26380	64778	1076
Darchula	144167	17146	146820	25838	2653	8692
Baitadi	477335	39027	515507	51751	38172	12724

Source: Survey Department & Annual Report of Department of Land Revenue Management 2071/72

From the above Table 3, it is observed that total numbers of parcels in the mountain regions are lower than the Terai and Hilly regions so it is concluded that parcel fragmentation is highest in Terai than Hilly and Mountain belt. The percentage of parcel fragmentation is calculated from the above data as follows;

Total number of parcels during the surveying time = 14119283

Total number of parcels up to the data collection time (2072 BS) = 24520848

$$\begin{aligned} \text{Percentage of parcel fragmentation} &= \frac{24520848}{14119283} \times 100 \\ &= 1.736 \times 100 \\ &= 173.6\% \end{aligned}$$

It means that 100 numbers of parcels became 173.6 parcels. In addition, the total numbers of parcels 14119283 were increased up to 24520848 parcels all over the Nepal due to parcel fragmentation during the 35 years. The initial cadastral surveying was started in 2021 BS and it was completed in 2054 BS. So, the parcel fragmentation was started from 2021 BS to 2072 BS in some districts and it was started from 2054 BS to 2072 BS in other remaining districts. Now the average was taken 51 years (2072 – 2021) and 18 years (2072 – 2054) and hence total time period of parcel fragmentation up to 2072 BS was calculated as 35 years.

As the percentage of parcel fragmentation, the rate of parcel fragmentation per day all over the Nepal is also calculated as below;

In 35 years, total number of parcels increased = 10401565

In 1 year, total number of parcels increased = 10401565/35 = 297188

In 12 months, total numbers of parcels increased = 297188

In 1 month, total numbers of parcels = 297188/12 = 24766

In 30 days, total numbers of parcels increased

= 24766

In 1 day total numbers of parcels increased = 24766/30 = 826

It means that 826 numbers of new parcels are adding per day due to the parcel fragmentation within the nation.

Different researchers have defined different types of methods to calculate Parcel fragmentation index such as Simpson Index, Average farm size index, Igbozurike's Index, Schmook Index and Januszewski's Index. To calculate the parcel fragmentation index different types of parameters are required but Januszewski index is simple, gives accurate result and only area is required to calculate the parcel fragmentation index. In this study parcel index was calculated by using the Januszewski index (JI) formula by using one parent parcel and its subdivision portions as a symbolic as below,



Figure 2: Fragmented Parcel

Source: Survey Office, Lalitpur

In the above figure 2 there were shown different parcels having their parcel numbers. These parcels were created by parcel fragmentation from one parcel. In the following Table there are shown object id, shape, parcel key, parcel number, district, vdc, ward number, shape length and shape area of the shown parcels.

Table 4: Attributes of Fragmented Parcels.

Object ID	Shape	Parcel Key	Parcel No.	District	VDC	Ward NO.	Shape Length	Shape Area
1	Polygon	<null>	608	25	32	1_1	34.16413	72.658804
2	Polygon	<null>	609	25	32	1_1	48.703359	145.823376
3	Polygon	<null>	610	25	32	1_1	24.199321	24.776049
4	Polygon	<null>	611	25	32	1_1	39.956092	47.865476
5	Polygon	<null>	612	25	32	1_1	50.8365	127.001209
6	Polygon	<null>	613	25	32	1_1	63.114836	152.377055
7	Polygon	<null>	614	25	32	1_1	72.893585	322.234531
8	Polygon	<null>	615	25	32	1_1	38.114341	86.017681
9	Polygon	<null>	616	25	32	1_1	46.468854	65.047733
10	Polygon	<null>	617	25	32	1_1	55.825242	158.081202
11	Polygon	<null>	618	25	32	1_1	61.337401	165.428125
12	Polygon	<null>	619	25	32	1_1	63.859656	182.941146
13	Polygon	<null>	620	25	32	1_1	84.52197	365.428714
14	Polygon	<null>	621	25	32	1_1	55.498528	141.326754

Source: Survey Office, Lalitpur

$$\begin{aligned}
 \text{Januszewski Index (JI)} &= \frac{\sqrt{\sum a} / \sum \sqrt{a}}{\sqrt{\sum a} / \sum \sqrt{a}}, \text{ where } a \text{ represent the parcel size.} \\
 &= \frac{\sqrt{72.66+145.82+24.78+47.86+127.00+152.34+322.2} \\
 &= \frac{3+86.00+65.04+158.08+165.43+182.95+365.43+141.33}{\sqrt{72.66} + \sqrt{145.78} + \sqrt{24.78} + \sqrt{47.86} + \sqrt{127.00} + \sqrt{152.34} + \sqrt{322.23} + \sqrt{86.00} + \sqrt{65.04} + \sqrt{158.08} + \sqrt{165.43} + \sqrt{182.95} + \sqrt{365.43} + \sqrt{141.33}} \\
 &= \frac{45.35}{161.35} \\
 &= 0.281
 \end{aligned}$$

According to the Jha, Nagarajan, & Prasanna (2005), the JI value lies between within the range 0 to 1. When its value is smaller or nearer to 0 then the parcel fragmentation indicates higher degree and when JI value is higher or nearer to 1 then parcel fragmentation refers lesser ratio of parcel division. From the above calculation, the JI value is obtained as 0.281 which is near to 0 so the parcel fragmentation index or ratio of parcel division is seen higher of that parcel.

This study was analysed by the number of parcels and number of land owners within the time period of first survey and till 2072 BS

of all districts of Nepal. The status of parcel fragmentation is seen different in individual ecological belt. It is seen highest in the Terai belt than in Hilly area and lowest in the Mountain region. The average percentage of parcel fragmentation was observed as 173.6%. It means 100 numbers of parcels became 173.6 parcels due to the fragmentation. The average time period was taken as 35 years. On the basis of this time period, 2 lakhs 97 thousand 1 hundred eighty-eight number of parcels were increased in one year. Likewise, 24 thousand 7 hundred sixty-six parcels in one months and 8 hundred fifty-nine number of

parcels were increased in one day due to the fragmentation all over the Nepal. It means 7 hundred twenty-six numbers of new parcels were added in the land administration in one day within the nation. From the study, the status of parcel fragmentation was also depended on different reasons of parcel fragmentation. It was concluded that the main reasons of parcel fragmentation were the distribution of patriarchal property, unmanaged urbanization, and lack of legal provision, migration, plot adjustment, parcel exchanging, and court decision and to solve the financial crisis. This study also identified that urban area was more fragmented compared to the urban oriented as well as rural areas.

#### 4. CONCLUSION/ RECOMMENDATION

The objective of this paper is to describe the meaning of parcel fragmentation, the main factors which plays vital role in the parcel fragmentation, the status of parcel fragmentation and the ways to reduce parcel fragmentation in Nepal. As the constitution has provided the rights to the private land owners to transfer, mortgage and to register land. Mostly poor land owners sell their piece of land to cover the expenditure of child education, treatment, dowry and marriage and also in other cultural activities that causes parcel fragmentation. From the study, the status of parcel fragmentation is observed highly dense and parcel fragmentation index is also obtained high from the calculated data. The high parcel fragmentation activities reduce agricultural land and also increases haphazard urbanization ultimately escalating land conflicts. Therefore, the government has to amend and implement the formulated land policy, land use policy, and land use act and recently formulated land use regulations to reduce the parcel fragmentation and encourages on the land consolidation process that help in the overall development of the nation.

#### REFERENCES

- Bullard, R. (2007). Land Consolidation and Rural Development. *Papers in Land Management*. Anglia Ruskin University, Cambridge & Chelmsford.
- Chapagain, D. (2004). *Land Tenure and Poverty: Status and Trends Land System in the Hills and Mountain of Nepal*. Kathmandu.
- Demetriou, D. (2014). *The Development of an Integrated Planning and Decision Support System for Land Consolidation*. Springer.
- Dijk, V., & T. (2003). *Dealing with Central Ureopean Land Fragmentation* . Eburon.
- Djurfeldt, A., & Jirstrom, M. (2013). Urbanization and Changes in Farm Sizes in Sub- Saharan Africa and Asia from a Geographical Perspective, A Review of the Literature. *Independent Science and partnership Council* , 1-40.
- King, R., & Burton, S. (2014). Land Fragmentation : Notes on Fundamental Rural Spatial Problem. pp. 1-20.
- Labbe, D. B. (2011). Understanding the Causes of Urban Fragmentation in Hanoi : The Case of New Urban Areas. *International Development Planning Review* , 273 - 292.
- Lusho, S., & Papa, D. (1998). *Land Fragmentation and Consolidation in Albania*. Madison: University of Wisconsin Madison.
- Maina Thuo, A. (2013). Impacts of Urbanization on Land Use Planning, Livelihood and Environment in the Nairobi Rural-UrbanFringe, Keney. *International Journal of Scientific and Technology Research* .

- Maasikamae, S. (2006). *Land Fragmentation and the Need for the Land Consolidation in Estonia*. Estonia: Estonia University of Life Sciences.
- Neal, K., Doye, D., & Brorson, B. (2012). Fragmentation of Agricultural Land Parcels. *Selected paper preparation at the southern Agricultural Economics Association Annual meeting, Birmingham*, (pp. 1-20).
- Ojalampi, S. (2006). Contested Lands: Land Disputes in Semi-arid Parts of Northern Tanzania. Helsinki, Tanzania: Department of Geography, Faculty of Science, University of Helsinki.
- Platonova, D., & Jankava, A. (2012). *Description of Land Fragmentation in Latvia and its Prevention Opportunities*. Latvia: Department of Land Management Geodesy, LLU.
- Shrestha, B. (1985). *Bhumi Lagat Registration and Kitta Napi*. Kathmandu: Sarada press, Kel tole.
- Tuladhar, A. (1996). Spatial Cadastral Boundary Concepts and Uncertainty in Parcel Based Information System. *International Archive of Photogrammetry and Remote Sensing*, (pp. 890-893). Vienna.
- You, L. (2010, March). Analysis of Land Fragmentation in People's Republic of China. Enschede, The Netherlands: International institute for Geo-information of science and Earth observation, Enschede, The Netherlands.
- Zhang, S. (2013). *Socio- ecological Drivers and Consequences of Land Fragmentation Under Condition of Rapid Urbanization*. Arizona State University.



### Author's Information

Name	: Dr Bharat Singh Air
Academic Qualification	: M.Sc., M.A., M.B.A, Ph.D.
Published paper/article	: Seven
E-mail	: air3bharatsingh@gmail.com