

EXPLORING THE NATURE OF LAND FRAGMENTATION IN THE RURAL SETTING OF THE KINGDOM OF BHUTAN


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ABSTRACT

Land fragmentation is primarily seen as an essential feature of the less-developed agriculture system. It is said to hinder agricultural development causing inefficiency in production. Bhutan is a small Himalayan country landlocked between China and India. Because of its rugged terrain, there is limited arable land, which accounts for only 7% of the total area, and most of the population depend on agriculture for their livelihood. The ongoing land fragmentation in Bhutan might have implications for food security in the near future because it threatens the small farmers and the agriculture sectors in producing enough food. Thus, it has become essential for Bhutan to make optimal use of the limited land while maintaining 60% forest coverage as per the constitutional. Therefore, this research seeks to explore the nature of land fragmentation in the kingdom of Bhutan by exploring how it is defined in the Bhutanese context, its trend and finding out its root causes and effects. The measures of how to improve the current situation are also presented.

This study involved both primary and secondary data. The primary data is collected from key-informants' semi-structured interview with the land professionals working with different organisations, focus group discussion with the local leaders and a structured interview with the households in the study area. The structured interview helped in portraying the perceptions of the households on land fragmentation in the study area. The secondary data collection includes a review of government reports, statistics, and legislations. Cadastral maps and land records were used to determine the trend of land fragmentation, distribution, and parcel sizes in the study area.

The study revealed that there is no legal definition of land fragmentation, but the respondents perceive it as sub-division of land. The results indicated the presence of physical and ownership land fragmentation in the study area. The inheritance practice of dividing land amongst the family members was the leading cause of land fragmentation. Conversion of chhuzhing to the residential area has become a cause and effect factor. Some of the concerns of land fragmentation included a reduction in agricultural production, fallowing of land, and landlessness. However, it demonstrates that land fragmentation allows every Bhutanese to own land, improving the independence of the member on the family land, and reducing intra family conflicts.

The study also portrays different legal strategies and social practices to improve the situation of land fragmentation in Bhutan. However, the current trend of land fragmentation calls for more preventive measures. Defining a minimum parcel size for agricultural land would not only prevent the land from being fragmented but protect agricultural land. Land consolidation was considered a useful tool; however, it remains questionable of how suitable it would be for a mountainous country like Bhutan. Therefore, it is essential to realise the main problems of land fragmentation to facilitate the policymakers to formulate appropriate interventions.

Keywords: Land fragmentation, small landholdings, agricultural land, inheritance, land conversion, Bhutan

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ABBREVIATION AND GLOSSARY OF BHUTANESE TERMS

ABBREVIATION

CID	Cadastral Information Division
Coops	Cooperatives
DoA	Department of Agriculture
DoLAM	Department of Land Administration and Management
DoSAM	Department of Surveying and Mapping
FG	Farmer's Group
FGD	Focus Group Discussion
GEF	Global Environment Facility
GLFI	Global Land Fragmentation Index
GNH	Gross National Happiness
HH	Household
LAP	Local Area Plan
LRO	Land Record Officer
MoAF	Ministry of Agriculture and Forest
NEC	National Environment Commission
NLCS	National Land Commission Secretariat
NLP	National Land Policy
NLUZ	National Land Use Zoning
NRP	National Rehabilitation Programme
NSB	National Statistical Bureau
NSSC	National Soil Service Centre
PHCB	Population & Housing Census of Bhutan
PSL	Priority Sector Lending
SLM	Sustainable Land Management
URC	Use Right Certificate
MoWHS	Ministry of Work and Human Settlement

GLOSSARY OF BHUTANESE TERMS

Chhuzhing	Wetland cultivation
Dzongkhag	District
Gewog	An administrative block which comprises a group of villages.
Gup	Head of the Gewog
Kamzhing	Cultivated rain-fed areas (dry land)
Kidu land	Land granted by His Majesty the King for the welfare of the people
LagThram	Land title
Thram	Land record
Throm	Urban area

1 INTRODUCTION

1.1 Land fragmentation

Land is a source of livelihood for most of the people in the world. It is the primary factor for agriculture and a source of wealth. Hence, it contributes to determining the living standard of the people. However, it is a finite resource. Due to increase in population, the increased demand on agriculture production can intensify the pressure and consequent degradation of the land resource (FAO & UNEP, 1999) because of the limited arable land while the human needs are not. Thus, undermining the livelihood of the people. As per Obsu (2012), the increasing population led to a reduction in the size of farmland due to land fragmentation. As per Lowder et al. (2016) globally, there are more than 475 million farms smaller than 2 hectares from approximately 570 million farms. The decrease of the farm size was seen prominent mostly in the low and lower-middle-income countries and entire South Asia. Moreover, the majority of the small farms are reported to be in Asia and Pacific regions which constitute 87 % of the world small farms (Thapa, 2010). However, besides the small land sizes, there are more parameters such as spatial distribution, the shape and number of parcels that attributed to land fragmentation (King & Burton, 1982).

Land fragmentation is a universal concern, although it is believed most closely associated with Europe. There are many studies documented on land fragmentation in different countries around the world. For instance in South Asia (Niroula & Thapa, 2005), China (Tan et al., 2006), Vietnam (Sundqvist & Andersson, 2006), Bangladesh (Rahman & Rahman, 2009), Ethiopia, Kenya, & Uganda (Flintan, 2011), India (Manjunatha et al., 2013), Nepal (Dhakal & Khanal, 2018), and Rwanda (Ntihinyurwa et al., 2019). These studies have concluded that the main factors triggering land fragmentation are population increase, inheritance, change in government policy, and land market. The privatisation of land in Central and Eastern Europe had led to land fragmentation, which further impacted agriculture growth and rural poverty (Rembold, 2003). In South Asia, the inheritance system of dividing an equal parcel of land among the household heirs is a typical phenomenon leading to a smaller landholding (Niroula & Thapa, 2005). However, in China, landholding fragmentation was considered a significant problem because of the increased population pressure and limited arable land (Tan et al., 2006). Besides, there are more possible reasons leading to land fragmentation, such as rugged landscape (Bentley, 1987) and land-use change (Kjelland et al., 2007).

Land fragmentation is considered prominent in many countries since the 17th century (Austin et al., 2012). It is primarily seen as an essential feature of the less-developed agriculture system (Blarel et al., 1992; Tan et al., 2006). It is a significant hindrance to agricultural development and mechanisation, causing inefficiency in production (Niroula & Thapa, 2005; Rahman & Rahman, 2009; Austin et al., 2012). However, potential positive effects of land fragmentation are noted by Heston & Kumar (1983). Land fragmentation is said to have a positive effect on agriculture production in developing countries. Ntihinyurwa et al. (2019) in a study on farmland fragmentation in Rwanda claims that land fragmentation has, in fact, a positive effect on food sustainability and food quality thus supporting food security at the household level. Land fragmentation increases product diversity, helps minimise the risk of crop failure and risk from natural disasters. Therefore, although land fragmentation is considered a problem because of its disadvantages, it is not a problem in all cases. It depends on the context of a region.

However, the downsides of land fragmentation are overstated, and policymakers disregard the benefits (Bentley, 1987). Given this, land management is essential. Land consolidation and land reforms were implemented to reduce land fragmentation in European countries (Van Dijk, 2003; Rembold, 2003). Researchers also explored the feasibility of land consolidation in African countries like Ghana, Kenya, Tanzania, Rwanda (Zaid, 2015; Asiama et al., 2017) in Asian countries like China (Wu, Liu, & Davis, 2005; Zeng et al., 2018) and India (Oldenburg, 1990) and many more countries. This strategy of land consolidation helps to optimise the use of machinery and labour to increase agricultural production and the income of the farmers (Lemmen et al., 2012).

1.2 Land fragmentation in the context of Bhutan

Bhutan is a small Himalayan country landlocked between India and China, with a geographical area of 38,394sq.km and a population of 735,553 (National Statistics Bureau [NSB], 2018). The arable land accounts for only 7% of the total area, as per the National Land Use Zoning (NLUZ) guideline (National Land Commission Secretariat[NLCS], 2018). Approximately 62% of the Bhutanese people rely on agriculture for their livelihood with most subsistence farming as per the Population, and Housing Census of Bhutan (PHCB) carried out in 2017 (NSB, 2018). Farmers in Bhutan live on agriculture by growing crops such as rice, wheat, maize, buckwheat, and potatoes. Agriculture practices in Bhutan are labour-intensive. The increase in the population and continuous land fragmentation threatens the small farmers and the agriculture sectors in producing enough food (Ministry of Agriculture and Forest[MoAF], 2015), especially when the land available for cultivation is minimal. As per the NSB (2017), the average farm size in Bhutan is 0.87 hectares (2.16 acres)¹, which is a limiting factor in large scale production.

The increase in conversion of limited agricultural land to other non-agriculture use, resulting from urbanisation and other development activities, is a concern. A total of 306.55 hectares of chhuzhing² (wetland cultivation) was lost to urban development and additional infrastructure development between 1998 to 2015 (National Environment Commission[NEC], 2016). Further, the conversion of chhuzhing to residential land in rural areas enormously encourages land fragmentation in Bhutan. Typically, every generation of children in rural Bhutan constructs their own houses on land inherited or fragmented from their parents as they get married and move out. A landowner can convert the inherited chhuzhing to residential land in a case that is the only chhuzhing land he/she possesses.

The Land Act of Bhutan, 2007, permits the sale and purchase of private registered land up to 0.04 hectares (0.10 acres). The continuous division of a land parcel of this size can result in landholding fragmentation. Especially when chhuzhing is shared during inheritance, it makes the land parcels too small for meaningful economic exploitation. Land fragmentation, including both inheritance and sale cases, has increased from 349 from 2014 to 3,102 in 2018 only in the rural areas. One of the consequences of the extreme land fragmentation is that the owners of such small parcels might sell it and migrate to urban areas for better opportunities ending up being landless.

Hence, small landholders can be vulnerable to the risk of being landless if continuous land fragmentation is experienced. As per the NLCS (2016), landlessness is considered as a significant cause and effect of poverty in rural areas in Bhutan, mostly because rural Bhutanese depend on agriculture for their livelihood. In some parts of the country, the poor are more susceptible to poverty as they depend on inadequate land.

¹ 1 hectare is equal to 2.47 acres.

² Chhuzhing means irrigated and terraced agricultural land for paddy-based cropping systems.

1.3 Research problem

Bhutan's rugged terrain with limited arable land, which accounts for only 7% of the total area, calls for sustainable use of scarce land resources. It has become essential for Bhutan to make optimal use of the limited land while maintaining the constitutional requirement of a 60% forest coverage of the total land area. The NLUZ guidelines (NLCS, 2018), highlights that 75.3% of the arable land available has already been registered on freehold ownership with a balance of only 24.7% (66,368.4 hectares) to meet all socio-economic development activities in the country.

The ever-increasing pressure on limited land is a concern for the country. The land fragmentation problem is adding to the pressure on land. Moreover, the problem is further heightened when *chhuzhing* is shared during inheritance. It makes the parcels too small for meaningful economic exploitation leading to lower productivity. Due to the progressive division of land, most farmers operate on a subsistence basis. Although land fragmentation is considered as a problem, there is not any empirical research carried out for Bhutan, given the small size of its arable land. The ongoing land fragmentation in Bhutan might have implications for food security in the near future. Thus, a clear understanding of the underlying causes and the resultant effects of land fragmentation is essential, and this study will be valuable for policymakers and the government organisations in formulating possible strategies.

1.4 Research objective and questions

1.4.1 General objective

The main objective is to explore the nature of land fragmentation through the perceptions of the public authorities at the national and district level, and local leaders and the households in the study area. The strategies to prevent land fragmentation will also be explored.

1.4.2 Sub-objectives

1. To describe the nature of land fragmentation
2. To identify the effects of land fragmentation.
3. To identify possible measures to address land fragmentation

1.4.3 Research questions

Sub-objective 1: To describe the nature of land fragmentation.

- i. How is land fragmentation defined in the laws, by the public authorities, the local leaders, and the households in the study area?
- ii. What are the characteristics of land fragmentation in the study area?
- iii. What is the trend of land fragmentation in the study area?
- iv. What are the causes of land fragmentation?

Sub-objective 2: To identify the effects of land fragmentation

- i. What are the positive effects of land fragmentation?
- ii. What are the negative effects of land fragmentation?
- iii. Is land fragmentation an issue to be addressed?

Sub-objective 3: To identify possible measures to address the land fragmentation?

- i. What are the legal and social practices to mitigate the negative effects of land fragmentation?
- ii. What are the legal and social practices to help mitigate further land fragmentation?
- iii. In what other ways can land fragmentation be prevented?

1.5 Thesis structure

This thesis is organised into six chapters, as illustrated below.

Chapter 1: Introduction

This chapter presents the research background and research problem. It also describes the main research objective, the sub-objectives, and the research questions of the study.

Chapter 2: Literature review

This chapter presents the review of relevant literature that support the main concepts of the study, such as the definition, the causes, effects of land fragmentation, and measures to curb the phenomenon. A conceptual framework with the main concept is presented here.

Chapter 3: Research Design and Methodology

This chapter discusses the background and justification of the study area. It further presents the data collection methods, the sampling and sample size, the source of data, the methods to analyse the data, the research design matrix and limitation to the study.

Chapter 4: Results

This chapter describes the findings from the analysis of the data collected from the fieldwork based on the research questions developed for each sub-objective.

Chapter 5: Discussion

In this chapter, the findings from the chapter 4 will be discussed referring to the scientific literature reviewed

Chapter 6: Conclusion and Recommendation

Finally, this chapter draws a conclusion based on the results and discussions from the previous chapters. It also provides recommendations for further studies.

2 LITERATURE REVIEW

2.1 Introduction

The chapter presents the literature review that deliberates on the concepts related to this study, as introduced in the previous chapter.

2.2 Definition and types of land fragmentation

Land fragmentation is viewed differently in different kinds of literature. It is defined as a situation where there exist numerous separate and scattered parcels owned by a household (Binns, 1950 cited in Bentley, 1987). Land fragmentation is also the division of land into smaller distinct parcels as per Dovring & Dovring, (1960) cited in Dhakal and Khanal (2018). It is more elucidated by Agarwal (1971) that land fragmentation involves the reduction in the sizes of the individual parcels and the average size of landholding and increasing the scattering of the parcels. It is also described as a situation whereby a household operates several owned or rented non-contiguous parcels at the same time as per Wu, Liu, & Davis (2005) cited in Austin et al. (2012) & Dhakal & Khanal (2018). King and Burton (1982) summarise land fragmentation in two senses. Firstly, the sub-division of farmland into smaller parcels which are no more economically beneficial (Niroula & Thapa, 2004; Dhakal & Khanal, 2018) and secondly, splitting of the individual holding into many non-contiguous parcels and intermixed with parcels owned by other households. He clarifies that the problem is further complicated when both types of land fragmentation coexist. Demetriou (2014) relates land fragmentation to parameters such as farm size, the number of parcels, parcel size, parcel shape, and the spatial distribution of the parcels. Hudecová et al. (2017) consider the inaccessibility to the parcels as another important indicator to determine land fragmentation.

Van Dijk (2003) discusses land fragmentation as i) parcelling and ii) the legal claims on the land. He describes the parcelling as a physical characteristic that can be seen while legal claim as an invisible aspect which entail the rights and ownership of the parcel. Hence, he categorises land fragmentation into four types. They are i) land ownership fragmentation, ii) land use fragmentation, iii) internal fragmentation, and iv) when there is a discrepancy between the ownership and use, as illustrated in *fig 1*. The land ownership fragmentation is when many owners share ownership of a piece of land. McPherson (1982) cited in Hartvigsen (2014) considers an excessive land fragmentation as when the number of parcels in a farm exceeded the landholding. The author further clarifies with an example of McPherson (1982) that if a farm landholding of 20 hectares has more than 20 parcels, then it is considered excessively fragmented. The land-use fragmentation refers to numbers of users of the land, including the tenants of the land. However, according to Ntihinyurwa et al. (2019), land-use fragmentation is when there is more land use on a single farm. Hence, in this study, the latter definition will be followed. The internal fragmentation is the fragmentation within a farm when it is divided into smaller land parcels. He states the internal fragmentation is concerned with the parcel size, shape, and the distance of the parcel from the farmstead. He justifies that models have proved that decreasing the distance of the parcel from the farmhouse saves time, better parcel shapes provided improved yield, and increased parcel size saves time as well increases the yield. This kind of fragmentation is considered as physical fragmentation by Ntihinyurwa et al. (2019).

The first and the second type of land fragmentation is more concerned with central Europe while the third and the fourth with western Europe (Demetriou, 2014). These different types of land fragmentation indicate that land fragmentation reduces when the number of owners and users reduce, the number of parcels per

farm decreases, and when the number of owners using their land increases. When the overlap between the landowners and user is smaller, it indicates that fewer landowners are using their land; hence the tenants play a significant role in agriculture land use, as illustrated in the diagram below.

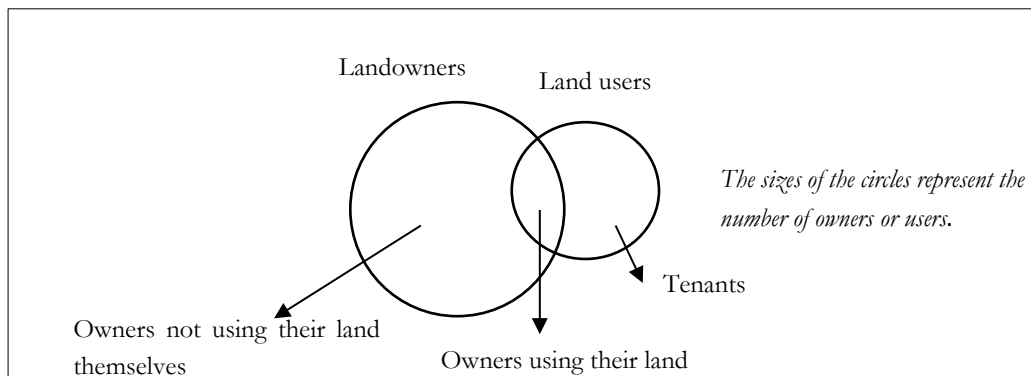


Fig 1: Diagram representing three types of land fragmentation (omits internal fragmentation): source Van Dijk (2003, p.17)

2.3 Causes of land fragmentation

Blarel et al. (1992) categorised the causes of land fragmentation into the supply side and the demand side. The supply side is the external factor causing imposition on farmers, which has negative effects on agriculture productivity while the demand-side factors are considered to have positive effects.

2.3.1 The supply-side factors

Factors such as population growth, partible inheritance, and land markets, were considered as supply-side factors causing land fragmentation (King & Burton, 1982; Bentley, 1987; Tan et al., 2006; Hartvigsen, 2014). The partible inheritance where a farmer desires to divide the land equally amongst the heirs was linked to high degrees of land fragmentation in many countries such as Greece, Cyprus, Medieval England, and the Netherlands (Bentley, 1987; Demetriou, 2014). This system of dividing an equal parcel of land among the household heirs is a typical phenomenon in South Asia too. Notably, the practice of the sub-dividing good and poor quality of land parcels among legal heirs (Niroula & Thapa, 2004; Hartvigsen, 2014). The parcels tend to become smaller and smaller as they are passed through successive generations. In Nepal (Dhakal & Khanal, 2018), land fragmentation is increasing due to the high population growth rate, development of infrastructure, and legal provisions of the inheritance system and land tenure systems. Fragmentation is further enhanced by urbanisation through unregulated house construction, on valuable arable land, for example, in Albania (Doko et al., 2015).

In Sub-Saharan Africa, the customary land tenure system, and the agricultural system were considered the leading cause of land fragmentation (Asiama et al., 2017). The customary freehold tenure restricts the farmers from selling the contiguous parcel to farmers who are willing to expand their farm mainly to keep the land for their children. Hence, farmers tend to buy farms away from their parcels, which leads to land fragmentation. Shifting cultivation was considered as another critical cause of land fragmentation, which involves farming for a shorter period and moving to another area. Since this requires forest clearance one after another, it causes land fragmentation.

The change in government policies that resulted in the transition from communal property systems to individual property system has emerged land fragmentation in Central and Eastern Europe (Van Dijk, 2003; FAO, 2003). Similarly, scarcity of land is said to increase landholding fragmentation in the sense that some farmer's desire for additional land encourages them to accept any available land (Bizimana et al., 2004). Land fragmentation in China is said to be caused mainly by the egalitarian principles of reallocating land to farmers to meet the population change (Tan et al., 2006). Another factor affecting land fragmentation was the land market. In the suburban areas in China, farmers fragment their land to diversify their crops because they have better access to markets (Tan et al., 2006).

2.3.2 Demand-side factors

The private benefit of demand-side land fragmentation exceeds its private costs (Blarel et al., 1992) thus, the demand-side factors contribute to the positive effects of land fragmentation, which will be described in the following section. The demand-side factors include different topography, different land quality (soil type, water retention capability), climatic diversity, and various locations.

2.4 Effects of land fragmentation

Studies on land fragmentation concluded that it has both positive and negative effects, although it is considered a negative aspect in general in the literature.

2.4.1 Positive effects

Bentley (1987) states that land fragmentation provides benefits from risk management, variety of ecozones, and crop scheduling. He mentioned that land fragmentation is advantageous, particularly in mountainous and monsoon areas. For instance, the Swiss Alps and Greek peninsula benefited from risk reduction due to multiple ecozones and soil quality. The variety of soil and growing conditions of several small and scattered parcels can help minimise the risk of crop failure because the risk of disasters also varies as the fragmented parcels are scattered in different locations. For instance, the destruction from hailstorm, drought, frost, flood, and diseases on the entire crop in one growing season is less in a fragmented land situation (Van Dijk, 2003). Several parcels within a farm holding enable crop rotation and thereby increasing the agriculture product diversity (Paul & Wa Githinji, 2018; Ntuhinyurwa et al., 2019). Moreover, better and improved distribution of labour is achieved due to the different growing seasons and hence increasing the efficiency of the labour force (Bentley, 1987).

Furthermore, land fragmentation helps in reducing conflicts concerning land ownership and use through increasing individual ownership. The findings confirm the positive effects on food security at the household level (Ntuhinyurwa et al., 2019). Hence, if land tenure security is well protected, it can increase the income of the farmer, primarily when people rely on agricultural production on small scales, the output of crops would increase directly. Moreover, Niroula & Thapa (2007) proved that smaller parcels produced a higher yield than the larger parcels signifying a positive impact.

2.4.2 Negative effects

Bentley (1987) argues that the downsides of land fragmentation are overstated and that the policymakers disregard the benefits. Land fragmentation is believed to cause difficulty in terms of managing the scattered and smaller parcels, which further hinders accommodating machinery and promoting large scale agricultural practices (Demetriou et al., 2013) and as a result, reduce the agricultural productivity. It can consume much

time and cost in travelling to reach out to the scattered and small parcels affecting crop output (Ali, Deininger & Ronchi, 2018). Moreover, it has been an obstacle to accommodate machines to smaller parcels (Bentley, 1987). More lands are wasted towards boundary constructions and developing paths and also increases additional production cost, which is because of the need for additional labour (Simons, 1985).

Land fragmentation is believed to have a significant effect on farming efficiency and productivity (Bizimana et al., 2004; Rahman and Rahman, 2009; Swai, 2016) because continuous sub-division of land leads to unsuitable small land size holdings. Small land sizes are challenging to operate for commercial purposes (Ntihinyurwa et al., 2019). A study in Nigeria (Austin et al., 2012) concludes that excessive land fragmentation has a negative effect on productivity because of low application of modern farming inputs. Likewise, in South Asia, land parcel fragmentation is leading to increased land degradation and impacting agriculture productivity (Niroula & Thapa, 2005). King & Burton (1982) highlights the concerns on having social and psychological effects such as social tension, which could have arisen due to disputes over ownership in multiple land ownership cases. Moreover, because of the unsuitable small land size holdings (Deininger et al., 2012), people tend to migrate to urban areas leaving the arable land uncultivated. Such a trend is prevalent in Western Balkan countries (Hartvigsen & FAO, 2018). This is further justified by Karouzis (1977) cited in Lazikova et al. (2017) who considers land fragmentation as one key factor causing land abandonment.

In some cases, the increasing population and large families leading to excessive land fragmentation was a concern for complete loss of land (Nayenga, 2003; Molle & Srijantr, 2003). Because when the land is divided among many members into smaller sizes, the land is over-used. The quality of soil is lowered and production reduced, which can impact food insecurity at the household level, and increase poverty.

2.5 Measurements of land fragmentation

The absence of a standard measure of land fragmentation led to difficulties in determining when land is fragmented (Bentley, 1987). Van Dijk (2003) argues that there is not a precise threshold that differentiates 'fragmented' from 'whole.' He supports the statement by saying that it is clear for an archaeologist to distinguish a 'whole' vast from a fragment of a vase, however, with land, it is complicated because there is no clear line defined between 'whole' and 'fragment'. Hence, different authors have attempted to standardise the measurement of fragmentation, and there are several methods to measure it.

The most common measures include the Simmons fragmentation index (Simons, 1964), the Januszewski index (Januszewski, 1968), and the Simpson index. Simmons's index of land fragmentation is measured by the sum of the squares of the size of the parcel, divided by the square of the farm size. An index of closer to zero means higher fragmentation, while the index value of one means consolidated. Januszewski fragmentation index divides the square root of the total area of the farm by the sum of the square roots of the parcel size. The Januszewski index value also ranges from 0 to 1. This fragmentation index has three properties: land fragmentation increases as the number of parcels increases, land fragmentation increases as the parcel sizes decrease, and fragmentation reduces when the area of parcel increases.

King and Burton (1982), relates land fragmentation to parameters such as farm size, the number of parcels, parcel size, parcel shape, and the spatial distribution of the parcels. However, Demetriou et al. (2013) argue that no index takes care of all the parameters. Therefore, the authors introduced a new method called Global Land Fragmentation Index (GLFI). They state that the new method considers all six land fragmentation parameters, is flexible and problem-specific. Indicators can be selected for a particular area, and different weights can be assigned to each indicator according to its importance for a certain problem.

2.6 Measures to prevent land fragmentation

In respect to the effects mentioned, there are three types of strategies to tackle land fragmentation (Van Dijk, 2003). They are legal provisions such as imposing restrictions in preventing land fragmentation, land management such as land consolidation and applying specific policies and programmes to protect agricultural land.

2.6.1 Legal provisions

Change in the legal provisions relating to inheritance, the minimum size for sub-division, and imposing ceiling to landholding are some approaches to prevent land fragmentation (Demetriou, 2014). However, it was considered as a violation of human rights to prevent the transfer of land to a nonfarmer or to impose a land ceiling in the EU countries (Demetriou, 2014). South Asian countries have also made efforts in preventing land fragmentation through legal restrictions. In India, parcels less than the standard area set by the law is considered fragmented and is not allowed to be transferred to anyone. Moreover, if a landowner is willing to sell his land, it is first offered to the adjacent landowner and the government if the adjoining landowner disagrees with buying (Bonner, 1987 as cited in Niroula & Thapa, 2005).

Similarly, in Nepal the land for sale is first offered to the adjacent landowners otherwise it is a violation of the law, and the adjoining owner can claim its right in the court (Shrestha, 2001 as cited in Niroula & Thapa, 2005). Such legal restriction has also been imposed in African countries. For instance, in Rwanda, the law forbids the sub-division of agriculture land below one hectare and does not allow registration of such land (Ntuhinyurwa et al., 2019). Other measures like promoting joint ownership, reducing the overall distance of the parcels from the farm and lowering transport cost were also suggested by Bentley (1987).

2.6.2 Land management strategy

The most used land management approaches to deal with land fragmentation were land consolidation, land banking, voluntary land exchange and cooperative farming over the world.

i. Land consolidation

Land consolidation was considered as one social and economic reform that has taken place in Western Europe with the first initiative in Denmark in 1750s (FAO, 2003b). Although the early initiation of land consolidation dated back to 1750s, land consolidation by law has evolved in Europe towards 1900. Land consolidation involved consolidating the smaller land parcels, rural developments facilities such as irrigation system, road construction, land levelling, and protection of agricultural land. The initial goals of land consolidation were to improve agricultural productivity and improve the living standard of the rural population (ILRI, 1959, cited in Dijk, 2003). Later, these tasks became multidimensional, which included a broader concept of nature and environmental conservation and regional development (Meuser, 1992 cited in Van Dijk, 2003; Hartvigsen, 2015). According to FAO (2003a), there are different types of land consolidation. They are simplified, voluntary, individual and comprehensive land consolidation.

a. Simplified land consolidation

This kind of land consolidation involves re-allocation, exchange of the farmlands, and providing additional land from the land banks. It includes provision for only some basic infrastructure.

b. **Voluntary land consolidation**

Voluntary land consolidation is primarily based on the mutual agreement of the landowners without any compulsion. Such land consolidation tends to be small and suitable to address local problems (FAO, 2003b). In Finland, the farm-based land consolidation which resembles the voluntary land consolidation was generally considered as a positive development because it strengthens the roles, co-operation, and initiative among the participants which have a positive impact on land consolidation (Sulonen et al., 2017). However, it is considered slow due to the unwillingness of landowners to accept, according to Zhou (1999). For instance, the author mentioned that in Denmark, the voluntary land consolidation in 1820 was ineffective, having been unable to agree on the consolidation plan by the peasant farmers. Similarly, slow progress was also observed by Zhou (1999) in France (1697-1888), Switzerland (1884-1911), India (1900-1951), and the Netherlands (before 1920).

c. **Individual land consolidation**

Individual land consolidation does not involve the government directly hence can sporadically take place and does not include the provision of public facilities. However, the government can play an essential role in encouraging consolidations to improve agricultural production.

d. **Comprehensive land consolidation**

Comprehensive land consolidation includes the re-allocation of farmlands and government intervention for rural developments such as construction of rural roads, irrigation and drainage systems, environmental protection, and other public facilities. Thus, this kind of land consolidation involves the participation of the landowners and many government agencies (FAO, 2003; Demetriou et al., 2012).

Although there are successful stories on land consolidation in the Europe countries, it is not the same in all the cases. Land consolidation is considered expensive, especially where land ownership is yet not recorded (Bentley, 1987). He argues that such a project is benefiting only certain part of the society. For example, in Mysore, India, only the wealthier farmers benefited from land consolidation. Niroula & Thapa, (2005) adds that land consolidation was unsatisfactory in India except for few states like Uttar Pradesh, Punjab and Haryana because of the resistance of the landowners, no proper land records, lack of technical skills, corrupt bureaucracy and legal loopholes. Also, in Bangladesh, the land consolidation project was withdrawn because of the denial from the landlords. In Sub-Saharan Africa, most land consolidation projects have failed because the customary land tenure and agricultural systems did not favour it (Asiama et al., 2017). Some land consolidation led to the breakdown of the customary land tenure. However, despite the breakdown, land consolidation yielded positive results in terms of increasing food production.

ii. **Land banking**

Land banking is an approach of acquiring agricultural land from landowners who accept to sell as per the normal market conditions and redistribute it, during land consolidation projects to ease the land consolidation and to ensure better results (Hartvigsen, 2015). Such land can be used for the improvement of other farms, establishing public facilities such as drainage, irrigation, recreational area, and road (Demetriou, 2014; Van Dijk, 2003; Lemmen et al., 2012) or for improvement of the existing facilities (FAO, 2003).

iii. Voluntary land exchange

Voluntary land exchange means exchanging parcels of land between the landowners, which would result in the grouping of the adjacent land parcels of a landowner (Demetriou, 2014). This kind of approach in tackling land fragmentation is less expensive and less time-consuming compared to the land consolidation approach, although it does not offer a broader impact as that of land consolidation. Voluntary land exchange approach was used in European countries such as the Netherlands, Hungary and Germany in the past.

iv. Cooperative farming

Cooperative farming is a land management approach, in which farmers pool their land resources together to cultivate more effectively and economically. Cooperative farming has played an essential role in European agriculture by contributing to better market access, improving rural employment and increasing households' income (Schermer et al., 2011). Similarly, this kind of approach was considered as a practical approach to land fragmentation due to the formation of bigger farming units and increase production in Asian countries (Niroula & Thapa, 2005). However, success was not constant. For instance, in India, farmers refused to cooperate mainly because of the fear of losing their rights on the land. In Nepal, the cooperative groups could not endure because of poor management and the conflicting interests within the farmers.

2.7 The conceptual framework

The conceptual framework portrayed in *fig 2* below provides an overview of the fundamental concepts for this study. It is designed based on the literature review. Land fragmentation has become a problem in Bhutan, yet not much attention was given towards understanding the causes and the implications of land fragmentation. Thus, this study shall help in bridging this gap by studying how it is defined, the leading causes and the effects of land fragmentation in Bhutan. The measures to reduce further land fragmentation will also be studied, which will help the policymakers in formulating possible strategies.

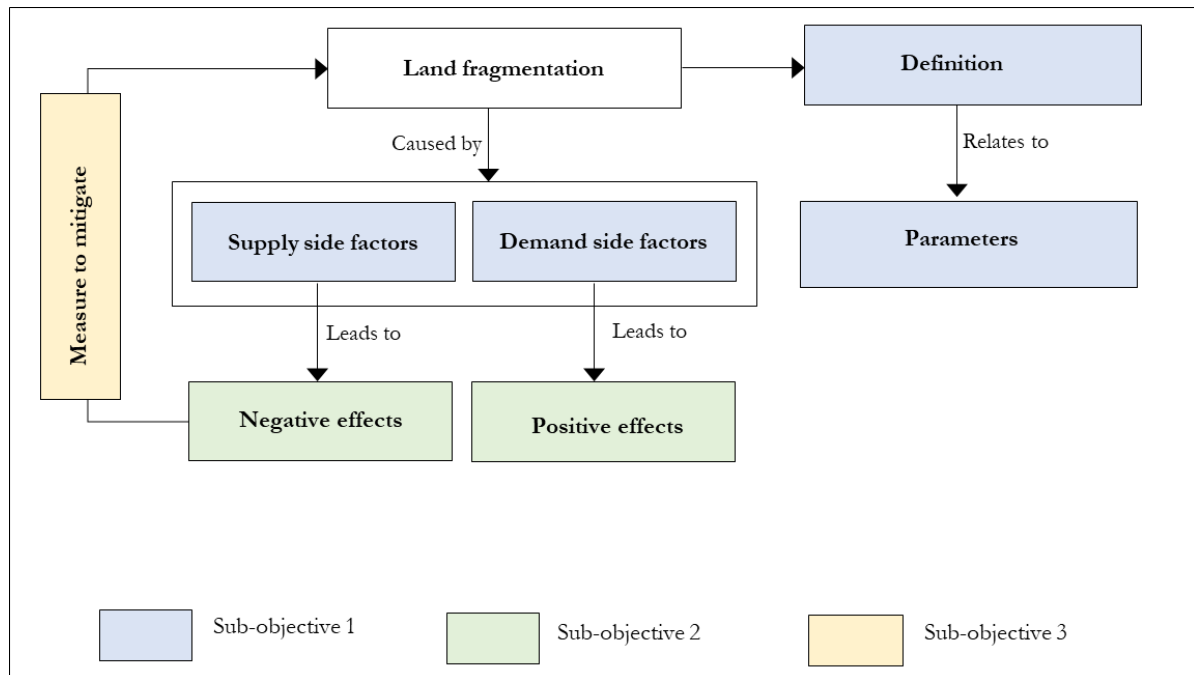


Fig 2: Conceptual diagram

3 RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter presents the research design and the methodology that answers the research objective and research questions outlined in chapter one. The chapter begins by describing the study area followed by the data collection methods, the sampling and sample size, the source of data, the data analysis and the research design matrix. The chapter also discusses the ethical considerations for this study.

3.2 Study area

Punakha Dzongkhag³ (district) is chosen as the study area for this research. It is situated in the western part of the country. It has a geographical area of approximately 1109.57 km², with altitudes ranging from 1300 m to 4800 m asl (MoAF, 2016). The annual rainfall varies from 500mm to 1500mm and has a subtropical climatic condition with warm and hot summers and cold winters. Due to the favourable location, soil, and climatic conditions, Punakha Dzongkhag is well known for growing rice, vegetables, and fruits. The significant portion of the agricultural land is chhuzhing cultivated mostly along the valleys of two main rivers (Pho Chhu and Mo Chhu), while Kamzhing⁴ is spread across the Dzongkhag. The essential annual crops grown are rice, wheat, maize, mustard, potato, chilli, and barley. Other vegetables include cabbages, brinjals, radish, leaves, and tomatoes (<http://www.punakha.gov.bt/about-dzongkhag>). Agricultural farming is the main source of income for the people of Punakha. Punakha is chosen as the research study area mainly because of the following three reasons:

- It has one of the highest agricultural lands in the country. About 4.27% of the district's total area is under agriculture while the rest is covered with forest, parks, glaciers, shrubs, built-up area and water bodies (MoAF, 2016).
- It holds one of the highest numbers of land sub-divisions received by the NLCS from 2014 till 2019 as of 8.04.2019.
- Accessibility: Considering the limited time for data collection, Punakha is the most suitable. It is approximately 85 km away from the capital city and takes around two and a half hrs to reach there.

Punakha is divided into eleven gewogs⁵ (blocks), namely Baarp, Chhubu, Dzomi, Goenshari, Guma, Kabjisa, Lingmukha, Shengana Bjime, Talo, Toepisa and Toewang. Amongst the eleven blocks, Guma Gewog is selected for this study as it is not possible to select all the blocks in the interest of time. The following reasons justify why Guma is selected.

- It holds the highest number of land sub-divisions among other blocks as of 8.04.2019.
- It has the highest number of households with landholding less than an acre, which accounts for 44%. The total household in Guma gewog is 816, with a population of 4288 (<http://www.punakha.gov.bt/index.php/gewogs/guma>).

³ A dzongkhag is an administrative and judicial district of Bhutan. Each dzongkhag is further divided into gewogs.

⁴ Kamzhing: Refers to cultivated rain fed areas (dry land)

⁵ Gewog: In Bhutan, a smaller administrative block is referred to as gewog which comprises a group of villages.

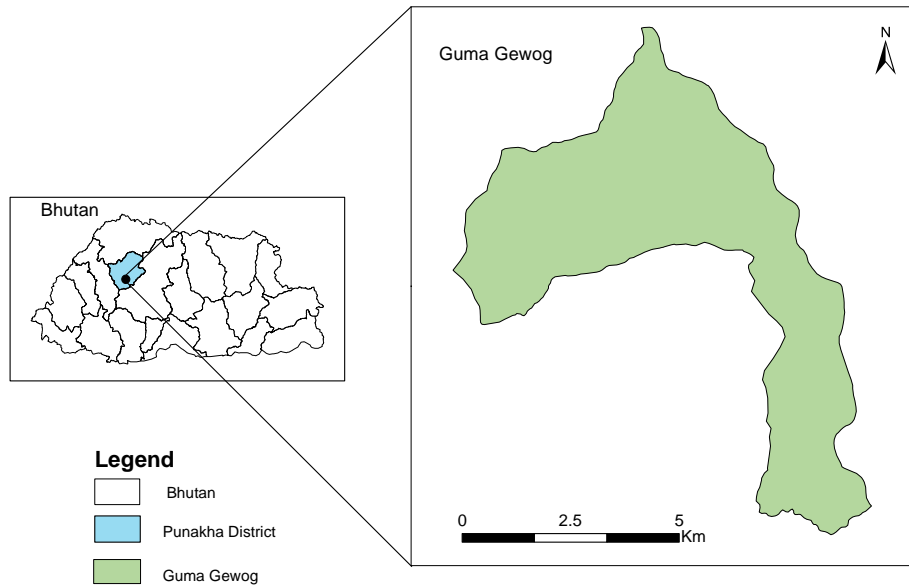


Fig 3: Study area

3.3 Data Collection Methods

This is an exploratory study seeking to understand the experiences and attitudes of people (Bricki & Green, 2007; Mohajan, 2018) towards the nature of land fragmentation in Bhutan. This approach was chosen to gain insight into the definitions, its root causes and the effects of land fragmentation in Bhutan because very little is known, and there is no prior study concerning it in Bhutan (Mcnabb & Sharpe, 2015). The research entails both primary and secondary data collection. The primary data was collected through a qualitative and quantitative approach. The qualitative approach helped in collecting data through a semi-structured interview with the Key-informants and Focus Group Discussion (FGD). The quantitative approach helped in collecting the opinions of the households (HHs) through a structured interview. The combination of qualitative and quantitative methods provided a better understanding of the problem (Creswell, 2014). The information obtained from the Key-informants and the FGD were compiled into multiple-choice and categorical questions to be asked to the HHs in the study area.

3.3.1 Primary data collection

a. Semi-structured interview with the key-informants

The semi-structured interview with the key-informants, involved in-depth interviews where the respondents were asked pre-set open-ended questions (Jamshed, 2014) accompanied by probing follow up questions to gather independent thoughts (Adams, 2015). It helped in gaining a rich understanding of the definition of land fragmentation, the causes and effects, and the possible measures to address the land fragmentation in Bhutan (Kallio et al., 2016).

The key-informants included officials from the national level working with the NLCS, Ministry of Agriculture and Forest (MoAF), Ministry of Work and Human Settlement (MoWHS), and the Land Record Officer (LRO) from the district level who are all responsible for land administration and management in Bhutan (Table 1).

Table 1: Key-informants for the semi-structured interview

Agency	Department/Division	No. of respondents
NLCS	Department of Land Administration and Management (DoLAM)	1
NLCS	Department of Survey and Mapping (DoSAM)	1
NLCS	Cadastral Information Division (CID)	1
MoAF	NSSC, Department of Agriculture (DoA)	1
MoWHS	Department of Human Settlement	1
District Administration	Land Sector	1

b. Focus group discussion (FGD)

According to Adams (2015), FGD engages a maximum of twelve people for a period up to two hours with open-ended questions that allow extended probing questions to make a detailed inquiry on the existing opinions and also to obtain new ideas. FGD enabled the researcher to discover the perceptions and understandings of the district head (Gup⁶) and other village representatives as they are the ones who are knowledgeable of the land fragmentation situation in their locality (Kumar & Ranjit, 2011). Moreover, this platform allowed the participants to freely discuss and share their views, which helped in gathering more practical information and insights about the scenario of land fragmentation, the causes, effects, and measures to curb the situation in the study area (Jackson II et al., 2007). A similar interview guide as that of key-informants, was used for the FGD; however, here focussing only on the study area.

c. Structured interview with the HHs

The structured interview was carried out using a predetermined set of close-ended questions along with some open-ended questions to interact with the respondents, which ensured data comparability (IndianScribes, 2018). The closed format questions are quick to answer while open format question gives freedom of expression, which leads to a lack of bias although more demanding and time-consuming (Walliman, 2011). The interview collected data such as title number, HH size, landholdings, and the perception of the HHs on the definition, causes, effects and measure to curb land fragmentation in the study area based on the data collected from key informants and FGD. Their opinions were compared with the responses from the key informants and the FGD.

KoBo Toolbox, an open-source tool, was used to interview the HHs using an android tablet face to face at their homes. Besides collecting the data from the HHs, the instrument served the purpose of collecting the location coordinates (GPS location) of the houses of the respondents which was used in determining the Euclidean distance of the land parcels from the house.

3.3.2 Secondary data collection

The secondary data, such as cadastral maps and the land records of the study area, were collected from the NLCS. Cadastral maps from 2008, and 2019 were used to analyse the trend and different characteristics of land fragmentation in the study area. At the same time, reports, books, and legislation were used from relevant government agencies, namely NLCS, MoAF, and NSB.

⁶ Gup means elected head of the Gewog

3.3.3 Sampling and sample size

The key-informants were selected using purposive sampling, based on their professional experiences and the ability to explain and provide better insights to achieve the objectives of this study (Kumar, 2011). A total of six key-informants were interviewed. The participants for the FGD was selected and organised with the help of the Gewog head. There are six participants, including the Gewog head and other five village representatives.

The sampling for the structured interview included the HHs within the study. The HHs were selected using a purposive sampling method where the representatives of the village helped in selecting the HHs who had experienced frequent land fragmentations. Snowball sampling was also used at times to help expedite the selection of the HHs. In total, 33 HHs were interviewed considering the limited time available for data collection. Moreover, a sample size of more than 30 qualifies to be a large sample size according to Daniel & Terrell, 1995 cited in "the causes and consequences of fragmentation of agriculture land: A case of Nawalparasi, Nepal" (Dhakal & Khanal, 2018).

3.4 Data analysis

The qualitative data obtained from the Key-informant's interview, FGD and open-ended questions from the structured interview were analysed using thematic analysis (Maguire & Delahunt, 2017). The closed-ended questions from the structured interview were processed using Kobo Toolbox and Microsoft Excel and analysed using descriptive statistics. The results were presented as graphs, tables, pie charts and text descriptions.

The spatial data, like cadastral maps and location coordinates, were processed using QGIS software. Spatial analysis was carried out to analyse the trend of land fragmentation in the study area by overlaying cadastral maps (shapefiles) of 2008 and 2019. The land details such as parcel identity number, parcel sizes, landholding, and the land type were generated from the land records of the study area using the title number and citizenship identity number obtained from the HHs. The parcel identity numbers were linked to the cadastral maps of 2019, and the GPS points and the Euclidean distance was calculated as shown in *fig 4*.

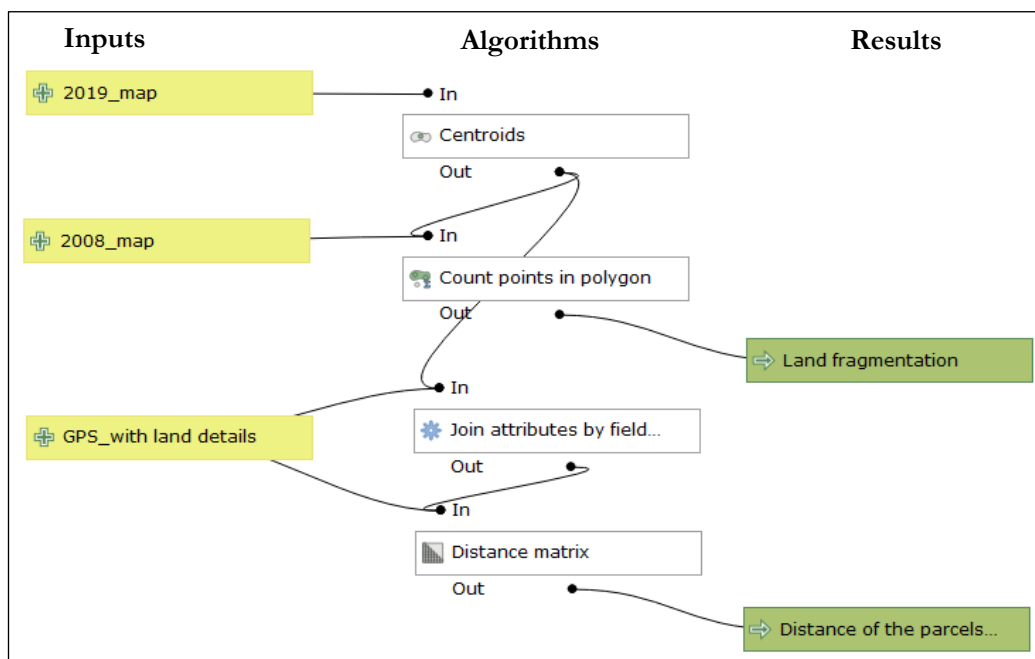


Fig 4: Workflow of the vector analysis

3.5 Ethical considerations

According to Bricki & Green (2007), consent and confidentiality are essential to be considered during any research. It is important to make the respondents adequately aware of the type of information that will be collected (Kumar, 2011). Hence, the respondents were briefed on the objective of the study. Verbal consent was sought from each respondent in meeting them and recording the interview. They were informed about maintaining confidentiality about their identity and the data collected because it is considered unethical to ignore it (Kumar, 2011). The researcher obtained consent from the local authority to interview the village representatives and the HHs before going to the field. The data collected was used only for academic purpose and not for any other purpose.

3.6 Research Design Matrix

The research matrix ([Appendix 1](#)) gives a summary of the research objectives and questions, the data collection methods, source of data, data analysis, and the anticipated results of the research. The operationalisation of variables ([Appendix 2](#)) further describes how each sub-objective is answered.

4 RESULTS

4.1 Introduction

This chapter presents the results obtained from the fieldwork. The result is presented according to the sub-objectives and the research questions designed in chapter one. The perceptions of the key-informants and the FGD are presented first, followed by the perception of the HHs in the study area. The key-informants provides a general idea about land fragmentation in Bhutan. The FGD provides insights into land fragmentation in the study area, and the HHs provides their opinions based on the results from the key-informants and FGD.

4.2 Sub-objective 1: Describing the nature of land fragmentation

This section describes how land fragmentation is defined in the Bhutanese context followed by the different characteristics determining land fragmentation, the trend and causes of land fragmentation in the study area.

4.2.1 Definition of land fragmentation

The term land fragmentation is not directly defined in any current laws in the country. However, it is indirectly mentioned in the legislation such as the Land Act of Bhutan, 2007 and Land Rules and Regulation of Bhutan, 2009 as the minimum parcel size for sub-division. The provision in the Land Act, 2007 states that *"the minimum parcel of land that shall be registered in a Thram⁷ is 0.10 acres."* The Land Rules and Regulation of Bhutan, 2009 states that *"in the event, the proposed transaction shall result in sub-division of land less than 0.10 acres for rural and 0.13 acres for Throm, such a transaction shall not be entertained."* However, the minimum size for sub-division in the Throm (urban areas) are defined by the Local Area Plans (LAPs). The Inheritance Act of Bhutan allows land fragmentation through "partitioning" of land where the family members can enjoy equal rights over land.

Perceptions from the officials working with the different government organisations revealed different definitions. An official from NLCS states *"land fragmentation is a physical process that is sub-division of land down to 0.10 acres through land conveyance."* While from the planning perspective, they view it as the division of land that occurs due to the different topography and mixed land types. He states, *"for instance, if the land of an owner is in two different kinds of landscape: plain and slope, during the planning phase these two land categories must be differentiated by fragmenting the land into non-developable and developable. Fragmentation also occurs when the land partly falls under buffer zones such as river buffer, stream buffer and high-tension buffers."* The official from the MoAF categorised land fragmentation into three types: i) land ownership fragmentation where the land is shared with family members, ii) sub-division of the land into smaller sizes and shapes and iii) use fragmentation where there exist different land types like agriculture, construction, and industrial.

To the FGD respondents, land fragmentation is the division of the land and getting dispersed over time. The responses of the HHs on the definition of land fragmentation was obtained through a multiple-choice answer, where they could choose more than one answer as presented in table 2. Majority of HHs (32 out of 33) responded that land fragmentation is the division of land. Approximately half of the HHs (16 out of 33) agreed that land fragmentation is also concerned with decreasing parcel size. Only one HH considered land fragmentation as the scattering of the parcels.

⁷ Thram is a Bhutanese term for land record as prescribed in the Land Act, 2007.

Table 2: The perception of the HHs on the definition of land fragmentation

Definition	Frequency	Percentage
Division of land parcel	32	97
Decreasing parcel size	16	48
Dispersed land parcels	1	3

The similarity and differences in the definition of land fragmentation between the three sources of information are illustrated in *table 3*.

Table 3: Similarities and difference in the definition of land fragmentation from a different perspective: Key-informants, FGD, and HHs.

Definition \ Respondents	Key-informants	FGD	HHs
Division of land	✓	✓	✓
Decreasing land size	✓	X	✓
Scattering of land parcel	✓	✓	✓
Land ownership, land use fragmentation	✓	X	X

✓ =mentioned X=Not mentioned

4.2.2 The characteristics of land fragmentation

The different characteristics of land fragmentation such as the number of parcels, landholding and the HH size, the land type, the shape and the sizes of the land parcels, and the distance of the parcels from the house are presented as follows.

Number of parcels per HH

It is evident from *fig 5* that only 18 % of the HHs (6 out of 33) owns 1 to 2 land parcels while rest of the HHs owns more than two parcels in the study area. Maximum owns more than 8 parcels which constitute 46 % of the total HHs. The mean number of parcels owned by the HH is 8. This result is generated from the land record with the help of HHs information like title number/citizenship identity number obtained during the interview.

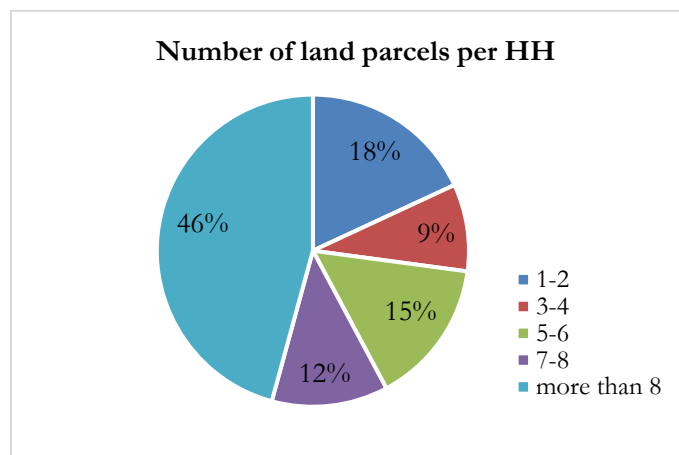


Fig 5: Number of parcels per HH

Landholding per HH and the household size

It was revealed that 19 out of 33 HHs (58%) have parcels with an area between 1 and 5 acres, and fewer HHs have a bigger size of parcels (*fig 6*). There are 7 HHs (21%) who own land parcels less than 1 acre. The average landholding size is 3.212 acres.

There is a total of 266 household members for 33 HHs, with an average of 8 members per HH. The minimum member is 2, and the maximum is 17. This information is obtained from the land record using the title number/citizenship identity number.

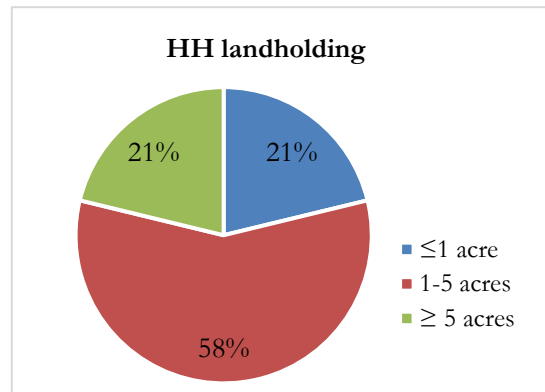


Fig 6: HH landholding

Land use

The result revealed that the land in the study area is used for agriculture and residential purpose only as obtained from the land records. Most of the parcels (62%) in the study area are used as chhuzhing for cultivating paddy. Only 1% is used for planting cardamom (*fig 7*), which is why no HH in the study area cultivate only for commercial purposes (*fig 8*). This result is obtained from the HHs through a multiple-choice answer.

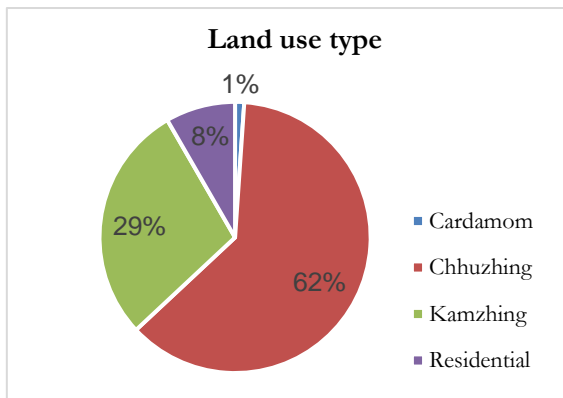


Fig 7: Types of land use

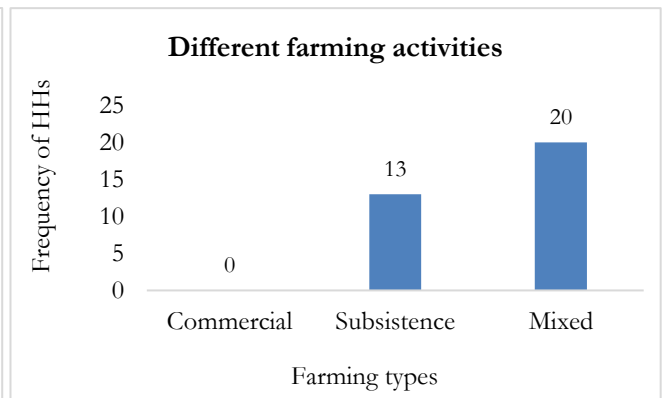


Fig 8: Different farming activities

The shape of the parcels

The results for the parcel shape was obtained via categorical answer, which revealed that most of the HHs have parcels with an irregular shape which accounts for 67%. There is no HHs who said their parcels are quite regular in shape. However, 33% of the HHs responded that the parcels they own are almost regular in shape (*table 4*)

Table 4: The shapes of the land parcels in the study area.

Shapes of the parcels	Frequency	Percentage
Yes, quite regular	0	0
Almost regular	11	33
No, not regular at all	22	67
Total	33	100

(Note: Irregular means not rectangular or square)

Distribution of the parcels: Distance and location

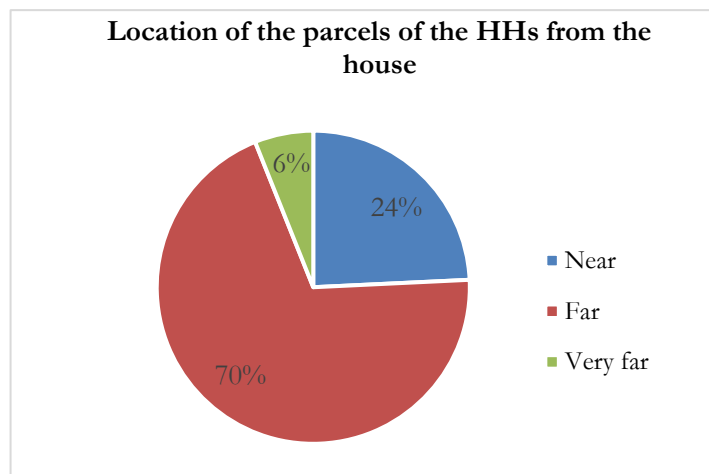
The Euclidean distance was estimated for the parcels owned by the interviewed HH (section 3.4). The average distance of the parcels from their house was 346 meters(m), with a maximum of 3425 m and a minimum of 9 m (Table 5).

Table 5: Distance of the parcels from the HHs in the study area (Derived from the map)

Range of distance in meters(m)	Frequency	Percentage
0-500	28	85
500-1000	10	30
1000 and above	11	33
Average estimated distance is 346 m		

(Note: The total number of interviewed HHs is 33. However, each HH can own parcels of different distances; hence the total HHs here will add up to be more than 33)

Most HHs (28 out of 33) have parcels of estimated distance with 0-500 m from the house while 10 HHs (30%) owns parcels with a distance of 500 -1000m. 11 HHs (33%) have parcels with a distance of 1000 m and above. This fact is further justified by 23 HHs (70%), saying that their parcels are located far (fig 9). There are only 2 HHs (6%) who responded that their parcels are located very far away from their house. A sample of parcel distribution is shown below with fig 10. One HH has 18 parcels with the distance ranging from 32 m to 771 meters. We can see that the parcels are scattered and are located between parcels owned by other HHs.

*Fig 9: Perception of the HHs on the location of the parcels from the house*

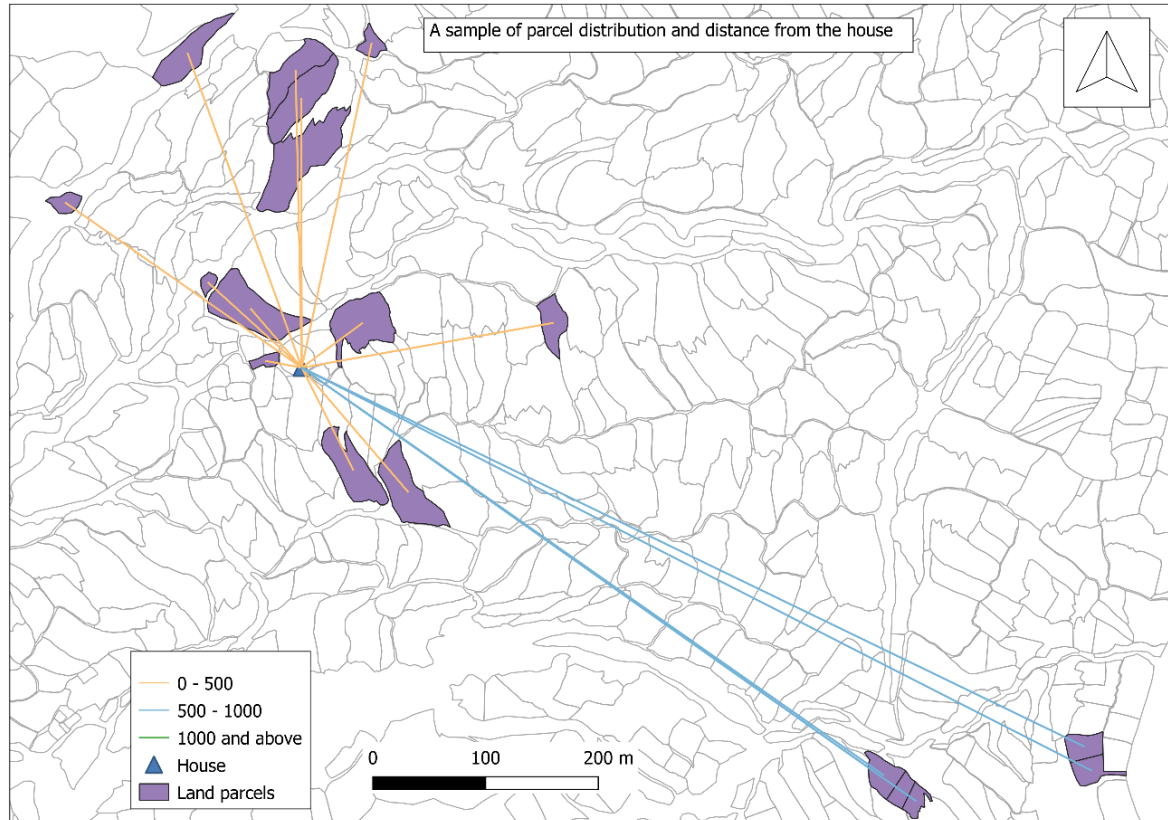


Fig 10: A sample distribution of parcels from the house

Parcel sizes

Regarding the size of the parcels, the average parcel size is 0.375 acres, while the maximum and the minimum sizes are 3.84 acres and 0.02 acres, respectively (table 6). The parcels sizes have been generated from the cadastral map. It has been revealed that maximum HHs have parcel sizes between 0.10 to 0.60 acres. While 19 HHs owns parcels below 0.10 acres, which is the minimum parcel size for land sub-division in Bhutan. Very less (8HHs) have parcels with bigger sizes of 1.20 acres and above. Overall, most of HHs have parcels less than 1 acre. This is further elucidated with a sample map shown below (fig 11)

Table 6: Number of parcels and HHs with respect to the parcel sizes.

Range of parcel size (Acres)	Parcel		HHs	
	Frequency	Percentage	Frequency	Percentage
0-0.10	37	14	19	58
0.10-0.30	117	43	29	88
0.30-0.60	78	29	29	88
0.60-1.20	27	10	17	52
1.20 and above	12	4	8	24
Total	271	100		
Average parcel size = 0.375acres Maximum size=3.84 acres				
The total area of the parcels =102 acres Minimum size=0.02 acres				

(The total number of interviewed HHs is 33. However, each HH can own parcels of different sizes; hence the total of HHs will add up to be more than 33)

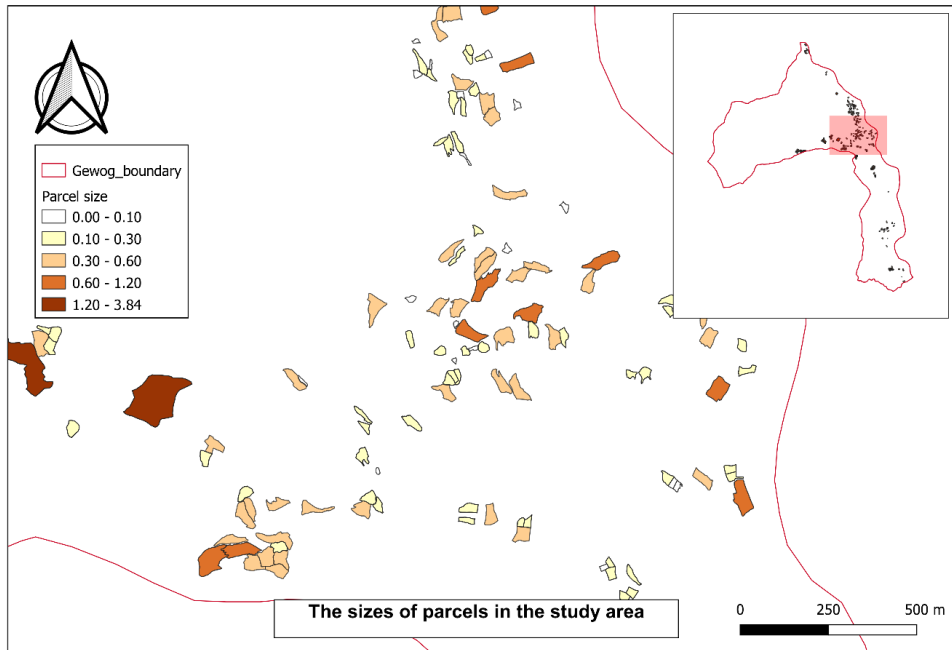


Fig 11: A sample map showing the sizes of the parcel in the study area
(The area shown is only a part of the study area for the purpose of visualising differences in parcel sizes)

4.2.3 The trend of land fragmentation in the study area

In 2008, there were a total of 3497 land parcels in the study area. The parcel number increased to 4117 in 2019 by almost 18 % of land fragmentation taking place. This has been obtained using the 2008 and 2019 shapes files of cadastral maps as described in section 3.4. The centroids of 2019 cadastral map were used to identify the sub-division in a parcel of the 2008 cadastral map and then illustrated with colours as shown in *fig 12*. For instance, the red colours are the ones with more fragmentation taking place. Meaning the parcel in 2008 has been fragmented to either 5, 6, 7 or 8 smaller parcels in 2019.

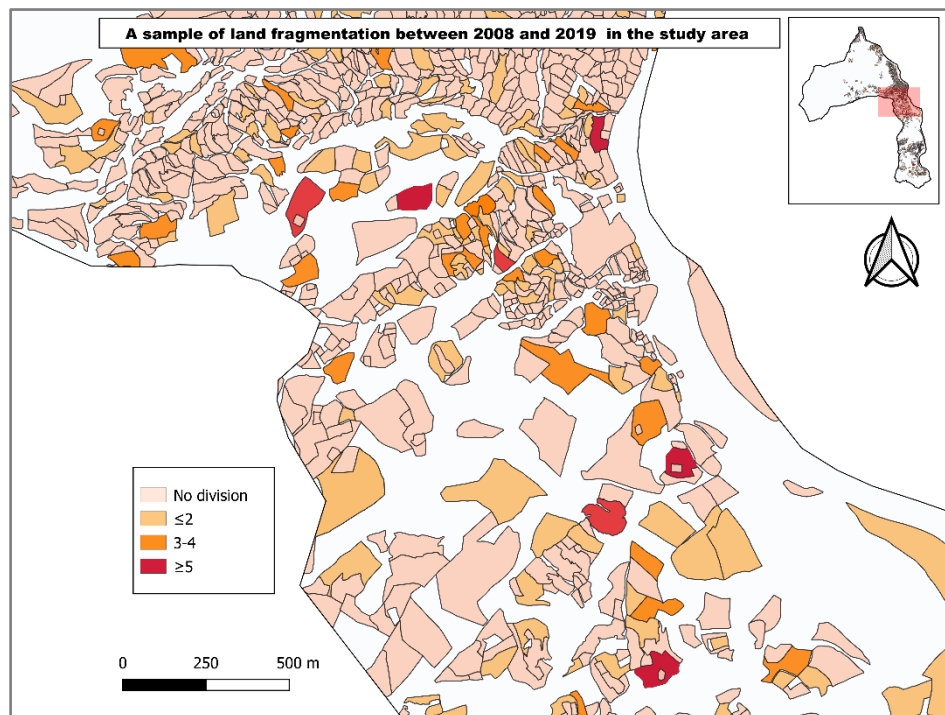


Fig 12: A case sample of land fragmentation between 2008 and 2019 in the study area. The area shown is only a part of the study area for the purpose of better visualisation

4.2.4 The causes of land fragmentation

The factors causing land fragmentation in Bhutan as per the key-informants and the FGD through an open discussion are listed in table 7.

Table 7: Different causes of land fragmentation in Bhutan

Causes	Respondents	Key-informants						FGD
		DoSAM, NLCS	DoLAM, NLCS	CID, NLCS	MoWHS	MoAF	LRO	
Inheritance system	✓	✓	✓	✓	✓	✓	✓	✓
Conversion of chhuzhing to other use	✓	✓	✓	✓	✓	✓	✓	✓
Infrastructure development	✓			✓	✓	✓	✓	
Sale of land	✓			✓	✓	✓		✓
Legal provisions in Land Act, 2007					✓	✓	✓	
Urbanisation			✓					✓
Population increase						✓	✓	
Difficult terrain					✓			
Natural factors						✓		

The respondents explained the causes of land fragmentation as follows:

a. Inheritance

The inheritance was perceived to be the primary factor causing land fragmentation in Bhutan. The inheritance system allows equal division of land amongst the siblings of a family. As the land is inherited from generation to generation, the land sizes reduce creating smaller and dispersed land parcels. However, the practice of inheriting land differed from region to region. In the western and the central part of the country, families practised matrilineal system of inheritance where the land is inherited through a daughter. While in the southern and eastern regions, the property is inherited from father to son. In some regions, the main heir inherits the main property while other siblings get a smaller share of land to build a house. However, today the properties are being equally divided amongst the siblings without gender bias.

b. Conversion of chhuzhing to other land use

The Land Act, of Bhutan, 2007, allows the conversion of chhuzhing to other land uses. In the last 14 years, between 2005 and 2018, there were over 342 acres of chhuzhing being converted to residential and other land uses in Bhutan (Source: NLCS: obtained on 28.01.2019). Chhuzhing conversion is recorded highest in the study area amongst all other 20 districts as per the 2019 performance audit report on food self-sufficiency & security. Hence, conversion of agricultural land to other land uses, notably residential was considered one major concern which encouraged land fragmentation in Bhutan. A key-informant state *"land fragmentation happens in chhuzhing as well. There is no control over land fragmentation on chhuzhing. For instance, Kabisa is a rural area where planning was carried out recently. All the chhuzhing are fragmented into 0.10 acres. No one will practice growing paddy in these small land parcels, because the whole intention is to construct a house."*

c. Infrastructure development

Infrastructure development, like the construction of road, especially when it cuts right in the middle of the parcel, which is happening across the country, was considered another factor leading to land fragmentation. Road constructions started only in 1960 as part of national economic development, and now, even the remotest part of the country has established numerous such infrastructures due to the rapid socio-economic growth in the country.

d. Sale of land

Another main factor causing land fragmentation was the sale of land. The key-informants indicated an increase in land fragmentation due to the sale of land in the urban and semi-urban areas. *"In the periphery of the urban area due to change in land use from agricultural to residential, the land is being fragmented and sold which is attributed due to what some call population exploitation/congestion"* (Key-informant, NLCS). Moreover, the speculation of the Kidu land⁸ had been reported. His Majesty, the King, grants land to the landless and the disadvantaged citizens of the country. However, people not honouring the grant, get involved in speculation of the land granted. The Kidu land is being fragmented to smaller sizes and sell it and gradually become landless and appear for Kidu grant.

e. Legal provisions in Land Act, 2007

Additionally, some officials responded that some legal provisions in the Land Act, 2007, in some way, encouraged land fragmentation. They expressed that there is rampant fragmentation of parcels to 0.10 acres as the Act allows it. This acreage was considered enough in the urban areas for residential purpose. However, it was considered unviable for agriculture practise in the rural areas to sustain a family (no defined threshold though). The 1979 Land Act of Bhutan holds a provision whereby the land is not allowed for any transaction if the family does not own more than 5 acres of land. However, this provision no more exists in the Land Act, 2007, and land fragmentation in the forms of the land transaction is happening.

f. Urbanisation

A key-informant stated, *"Once the huge chunk of the rural area comes under urban, the land use is different, i.e. residential, and commercial, and land gets fragmented so much."* Although there is a slow pace in population growth over the years, urbanisation continued to grow. In 2017, 37.8 % of the total population in Bhutan lived in urban areas compared to 30.9 % in 2015. The rapid rural to urban migration contributed towards fast urbanisation in Bhutan congesting the urban areas. The review of the 2005 and 2017 Population & Housing Census of Bhutan (PHCB) revealed an increase in the urban population from 12.9 % in 2005 to 24% in 2017 in the study area. Consequently, to the respondents of the FGD, land fragmentation in Punakha is also occurring because of the nearby town, which attracted more buyers.

g. Increase in population

The population increase was another factor and the fact that Bhutan has minimal arable land; there is immense pressure on it. The population density of Bhutan is 19 persons per km² and one of the lowest in the world. However, huge areas are remaining uninhabited due to the mountainous nature of the country. The population of Bhutan in 2017 was 735,553 with an increase of 16% from 2005 and mostly residing in rural areas. The population of Punakha district increased by 62 % from 2005 to 28,740 in 2017.

h. Difficult terrain and natural factors

Other factors such as steep terrain and natural factors can contribute to land fragmentation according to the key-informants. The key-informant from MoAF stated that *"natural cause such landslides, erosions, and mainly if there are gullies which without timely prevention, would lead to more prominent gullies, and thus it breaks the parcel into two or more."* Because of the difficult terrains and the limited land, the farmlands are usually small and scattered.

⁸ Kidu land: Land granted by His Majesty the King for the welfare of the people is called Kidu land. According to the Constitution of the Kingdom of Bhutan, only His Majesty the King has the authority to grant land to the people on freehold through a royal Decree.

Perceptions of the HHs on the causes of land fragmentation

The perception of the HHs on the causes of land fragmentation is presented in *table 8*, which was obtained through a multiple-choice question from which they could choose more than one answer. All 33 HHs (100 %) agreed to inheritance as the leading cause of land fragmentation. This is further justified by 100 % of the HHs who responded that inheriting land from their parents was the main mode of land acquisition in the study area, as shown in *Table 9*. There are 9 HHs out of 33 (27%) who reported sale/purchase as another reason for land fragmentation. Land conversion, infrastructures development, and population growth are other reasons responsible for land fragmentation. Finally, 3 out of 33 HHs considered urbanisation as another cause of land fragmentation. However, none responded to difficult topography and natural factors as causes of land fragmentation in the study area.

Table 8: Perception of HHs on the causes of land fragmentation

Causes of land fragmentation	Frequency	Percentage
Inheritance system	33	100
Sale/purchase	9	27
Conversion of agricultural land to other land use	6	18
Population growth	6	18
Infrastructure development	6	18
Urbanisation	3	9

Table 9: Modes of land acquisition in the study area

Land acquisition	Frequency	Percentage
Inheritance	33	100
Purchase	5	15
Government allotment	1	3

4.2.5 Summary of the results for sub-objective 1: Describing the nature of land fragmentation

In summary, land fragmentation is not defined in any current laws in the country. However, the study revealed that land fragmentation is the division of land into many smaller parcels. On the characteristics of land fragmentation, majority of the HHs in the study area owns more than two parcels; they have landholding between 1 to 5 acres. Majority of the parcels are irregular in shape (*table 4*); they are scattered and are landlocked by parcels owned by other HHs (*fig 10*). On average, the estimated distance of the parcels from their house was 346 m (*Table 5*). Most HHs have parcels sizes below 1 acre, while very few have sizes of 1.20 acres and above. On the trend of land fragmentation, approximately 18 % of the land has been fragmented between 2008 and 2019 in the study area. This trend concerns land administration, management and governance given the limited arable land. On the causes of land fragmentation, the inheritance system is the main cause. Conversion of chhuzhing to residential was another main cause because this can impact achieving food security and self-sufficiency goal of the country. Besides, the legal provision of allowing land fragmentation till 0.10 acres was a concern because smaller parcels are considered unviable for agriculture practises sustaining a family. The natural population growth, urbanisation, sale of land, infrastructure development are other causes that contribute to land fragmentation.

4.3 Sub-objective 2: To identify the effects of land fragmentation

The positive and negative effects of land fragmentation emerged from the discussion with the key-informants, and the FGD is illustrated in *table 10* and *table 11*, respectively and further elucidated in sections 4.3.1 and 4.3.2. The perception of the HHs is presented at the end of each sub-section.

4.3.1 The positive effects of land fragmentation

The key-informants and the FGD respondents mentioned that inheritance allowed the equal distribution of the land to the citizens, making every Bhutanese a landowner. Due to land fragmentation through inheritance, everybody can own land and further reducing conflicts within the family, thus increasing the land tenure security. This affiliates strongly with a significant quote of His Majesty the King *"The important feeling of attachment and belief in the future of the country, will only come about if the people have effective and secure ownership to land"* (His Majesty the King, September 24, 2007).

Also, some said that, in rural areas where the farm machinery is still limited and depend on farm labour, smaller farmlands are easier to manage and work. The other advantage raised was risk management, especially when there are land parcels spread out in different location, the risk can be reduced from diseases and natural disasters. *"Where there are parcels in different places or altitudes, you also have the advantage of growing different crops, and this will help you in taking advantage of varying crop harvest and bringing it to the market"* (key-informant, MoAF). Further, from an aesthetic point of view, smaller parcels with different crops grown were considered to add beauty to the landscape.

Table 10: Positive effects of land fragmentation identified by the key-informants and the FGD

Effects \ Respondents	Key informants						FGD
	DoSAM, NLCS	DoLAM, NLCS	CID, NLCS	MoWHS	MoAF	LRO	
Distribution of land	✓	✓	✓	✓		✓	✓
Easier to manage		✓			✓		
Risk management					✓		
Crop diversification					✓		
Improve aesthetic value					✓		

The perceptions of the HHs on the positive effects of land fragmentation

The perceptions of the HHs are obtained from a multiple-choice answer where they can choose more than one answer. All the 33 HHs agreed that land fragmentation through inheritance allows every individual to own land and reduce conflicts within the family (*fig 13*). Moreover, 6 HHs responded that owning land by each member can improve the independence of the member on the family and is easier to sell. In comparison, only fewer HHs (2 and 1) responded to the diversification of crops and easier to manage respectively as the advantages of land fragmentation. No HH considered risk management and aesthetic view as the advantages of land fragmentation in the study area.

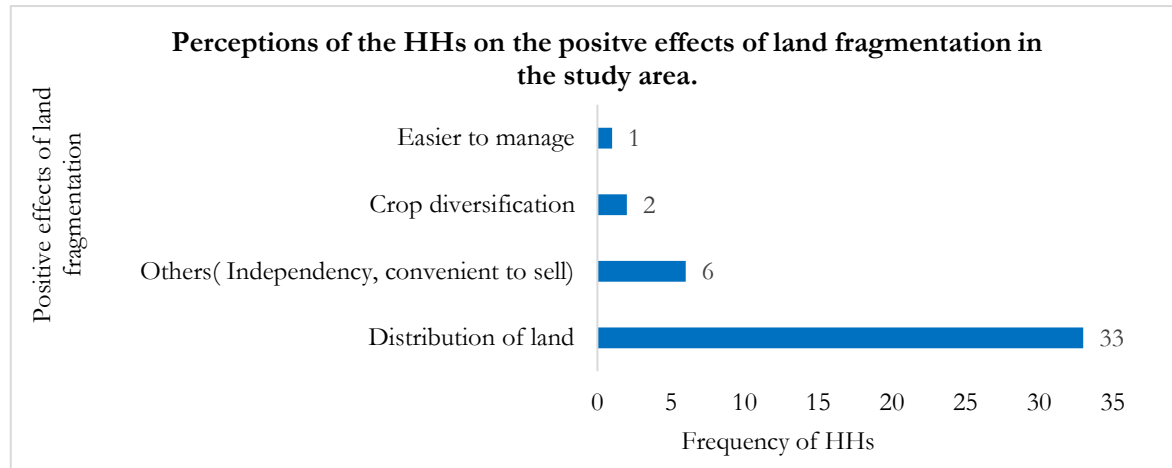


Fig 13: Perception of the HHs on the positive effects of land fragmentation.

4.3.2 The negative effects of land fragmentation

The negative effects of land fragmentation are decreasing agricultural productivity, land conversion, landlessness, fallowing of land, food insecurity, an obstacle to mechanisation/ commercialisation, difficult in planning, unsustainable agriculture practices, difficult to access credit and rise in disputes (Table 11).

Table 11: Negative effects of land fragmentation identified by the key-informants and FGD

Respondents Negative effects	Key informants						FGD
	DoSAM, NLCS	DoLAM, NLCS	CID, NLCS	MoWHS	MoAF	LRO	
The decrease in agricultural production	✓	✓			✓	✓	✓
Land conversion	✓		✓	✓	✓	✓	
Fallowing of land	✓	✓			✓		
Landlessness	✓		✓		✓		
Food insecurity				✓	✓		✓
Obstacle to mechanisation/ commercialisation	✓				✓		
Unsustainable agriculture practice		✓			✓		
Land disputes							✓
Limited access to credit							✓
Difficulty in rural planning				✓			

The respondents explained the negative effects as follows:

a. The decrease in agriculture production; fallow land; food insecurity

The disadvantage is mostly for agriculture use when the land loses its potential value for its optimal contribution. Most of the key-informants and the FGD respondents stated that there is a decrease in agricultural production due to land fragmentation. A respondent from the FGD stated that “*smaller land has become insufficient and is impacting production negatively because although the climate is favourable for growing different crops, the land is not enough for growing so.*”

A key-informant expressed that once the land is fragmented into smaller sizes, it becomes economically unviable for cultivation and to sustain the livelihood in rural areas. Hence, people migrate to urban areas leaving the land fallow⁹. Land fragmentation was one key factor causing fallowing of land in Bhutan. *"If you look from land fragmentation per se we cannot go for larger-scale production. We cannot go for efficient use of the land because we cannot deploy machines and we cannot go for mechanisation. All these contribute towards not increasing the productivity of the land and that further limits achieving the overall food self-sufficiency"* (key-informant, MoAF). The performance audit report, 2019 on food self-sufficiency reported that about 20,568 acres of wetland remained uncultivated out of 73,623 acres of wetland holdings in 2016. Similarly, about 283,083 acres of dry land was left uncultivated out of the 336,569 acres of dry landholdings in Bhutan.

b. Land conversion to other land use

It was reported that people fragment agricultural land until 0.10 acres and then get it converted to a residential area. More chhuzhing are lost as they are converted to dry land or residential land. The country aims to achieve rice self-sufficiency in the 12th FYP by increasing rice production and bringing fallow lands under cultivation. Today the country is only 47 % self-sufficient in rice. However, contrarily chhuzhing conversion to residential is occurring at the average growth rate of 24.36%.

c. Landlessness

Land fragmentation can lead to landlessness over a longer period due to inheritance from generation to generation or when it is being divided to be sold that is when the land will be insufficient to be used as farmland, therefore, increasing the cases of landless. Landlessness could further lead to poverty and other impacts, such as rural-urban migration and occupying state land *"I guess many people in rural areas firstly through inheritance land fragmentation occurs, and they do not have sufficient land and whatever they have is not enough to sustain themselves to spend on the children's education and what they do is sell the remaining area and come to urban area trying to look for some employment but actually land up being landless"* (key-informant, NLCS). There are 326 landless HHs out of 4100 HHs in Punakha District accounting to almost 8% accordingly to NLCS as of 9.12.2018

d. An obstacle to mechanisation and commercialisation

From agriculture point of view, it limits several opportunities, mainly the mechanisation. When the parcels are smaller, it is challenging to engage the farm machinery. Hence, it impacts the cost of farming and the cost of production, thus reducing the productivity of the land. *"The more land you have, the more it produces. So, lesser the land lesser is the production"* stated by a respondent of the FGD. *"Smaller farms do not allow large scale farming; hence we cannot take advantage of economies of scale. This is one drawback of smaller size farms."* (a key-informant)

e. Unsustainable agriculture practice

Due to smaller farmlands, unsustainable agriculture practice will prevail, such as shifting cultivation¹⁰ and use of huge quantities of fertilisers to increase the yield in rural areas. Such practises in a hilly country like Bhutan would lead to land degradations manifested in the form of serious soil erosions, flash floods, drying up of water sources, declining in crop yields and land productivity in some parts of the country in the longer run. Further, through soil erosion, farmers not only lose the productivity of their land but often results in the loss of land physically through landslides and slips. *"When we have smaller parcels, it is a quite discouraging"*

⁹ Fallow land is referred to as land that is not cultivated for one or more growing seasons and sometimes even up to ten years and more in order to let it regain its fertility (FAO, 2003a). However, in Bhutan, the situation is different. Some farmers keep their land fallow for a shorter period to get better yield while some abandoned land looking for better opportunities. The land is being left fallow for indefinite periods and this phenomenon is becoming a concern to the farmers and the country.

¹⁰ Is also known as slash and burn practice. It is one of the main cultivation practices in many regions of Bhutan. It is now legally banned but there are farmers who practise it.

factor for farmers in terms of land management and development because people feel that the land management technologies such as hedgerows and terracing further reduces their parcel size" (a key-informant). This discourages farmers from taking up land management activities that the National Soil Service Centre (NSSC) is initiating.

f. Disputes

Another disadvantage was the disputes amongst family members, although this is contrary to what the FGD respondents mentioned in section 4.3.1. *"Because there is not enough land for further inheritance, it leads to disputes within the family. In some instances, the cases involve time-consuming court processing. There are also dispute cases about the division of chhuzhing and conversion to residential and dry land. Although conversion is a problem, there are genuine cases, primarily because when every sibling is eligible for a share and when there is only one house. Resolving such disputes has become very difficult. Hence, to resolve the case, the only amicable solution is to convert the chhuzhing and distribute it to the siblings" (a respondent from FGD).*

g. Limited access to credits

The FGD respondents raised that there is difficulty in accessing credit because of small farmlands. Access to credit and loan facilities was one major factor for promoting agricultural production. However, currently in Bhutan, there is limited access to credit at the household level at an affordable rate. The only means to gain access to credit is through the financial institutions, which is expensive and require land or house as collateral.

h. Difficulty in rural planning

From the rural land planning perspective, having small and different types of land category in an area due to the difficult landscape of Bhutan was a challenge. The key-informant from MoWHS states, *"If the fragmentation goes to tiny parcels, even construction will be made difficult."*

Perceptions of the HHs on the negative effects of land fragmentation:

The perceptions of the HHs on the negative effects are obtained through a multiple-choice answer where they can choose more than one answer. The perception somehow deviates from the key-informants' opinions; however, their view acquaintances with that of the FGD. Most of the HHs responded that decrease of agricultural productivity was the major negative effects which constitute 29 out of 33 HHs, followed by landlessness (21 HHs) and land disputes (5 HHs) as other important negative effects of land fragmentation (*fig 14*). No HH responded to land conversion as an adverse effect, although it was an issue to the key-informants and FGD respondents. There are other factors which are not indicated by the key-informants and FGD but mentioned by the HH respondents (8 HHs). They include longer walking distance to the parcels as they are scattered, loss of land through boundary construction, and disputes with easement regarding footpath. The HHs raised many issues related to the distantly located parcels such as crop predation by wildlife, transportation issue, water shortage and theft of crops (fruits) which would ultimately lead to fallowing of land. The study revealed crop predation by wildlife, especially the wild boar, as the predominant issue. The lack of road connecting to all the farms was a problem, especially in carrying the farmyard manure and shortage of labour as farming in Bhutan is labour demanding.

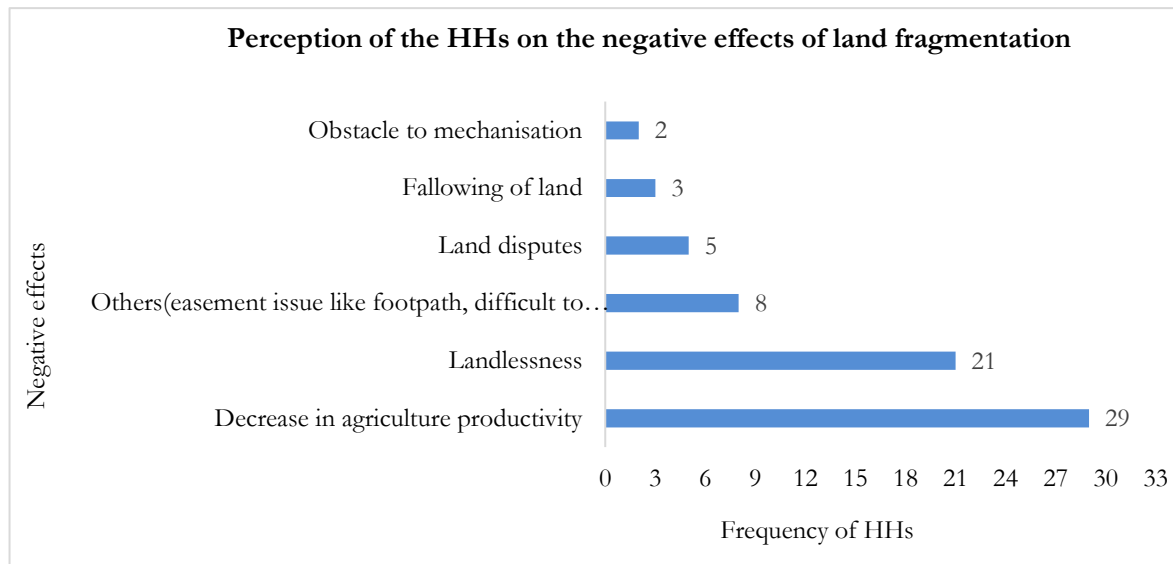


Fig 14: Perceptions of the HHs on the negative effects of the Land fragmentation

4.3.3 Is land fragmentation an issue to be addressed?

The key-informants and the FGD respondents considered land fragmentation as an issue in the country, considering the effects mentioned in section 4.3.2. However, they believed that it would be difficult to stop land fragmentation and would continue, mainly because of the limited land and the tradition of inheriting land. A key-informant stated *"From the human rights point of view, it will be inhuman because everyone has the right to own land. Hence, there should be a certain arrangement from the government for other alternatives to stop such practices."* In contrast, some felt that land fragmentation should stop at a certain point to make rational agricultural development. Stopping land conversion beyond certain acreage was recommended. This was predominantly for conserving chhuzhing. Continuous land fragmentation can make farm mechanisation impossible said a key-informant.

Perceptions of the HHs in considering if land fragmentation is an issue

The results obtained through a categorial question, presented in *table 12*, reveal only 5 of the 33 HHs (15%) who strongly agreed that land fragmentation is a problem and suggested the need to prevent it from further fragmentation. 15 HHs (45%) simply agreed to see it as a problem. There are 11 HHs who disagreed that land fragmentation is a problem and 2 HHs who strongly disagreed to it.

Table 12: Perceptions of the HHs in considering land fragmentation as an issue

Is land fragmentation an issue?	Frequency	Percentage
Strongly agree	5	15
Agree	15	45
Disagree	11	33
Strongly disagree	2	6
Total	33	100

4.3.4 Summary of the results of Sub-objective 2: Effects of land fragmentation

In summary, the study revealed that while land fragmentation is seen as a burden to a Himalayan country like Bhutan, there are also positive effects. Due to land fragmentation through inheritance, every Bhutanese can own land, reducing intra family conflicts and thus increasing the land tenure security. Other positive effects include easy to manage and crop diversification. However, the negative effects of land fragmentation such as decreasing productivity, landlessness, fallowing of land, hindering mechanisation/commercialisation, and rise in disputes were revealed in the study area from the HHs interview. Although the key-informants and the FGD respondents find land fragmentation as an issue to be addressed, there is a mixed response from the HHs. Only 15% of the HHs strongly agreed, and 45% of the HHs simply agreed that land fragmentation is a problem and suggested the need to prevent further fragmentation. There is also a good number of HHs (33%) who disagreed and 6% who strongly disagreed that land fragmentation is a problem.

4.4 Sub-objective 3: Possible measures to address the land fragmentation issues

To understand how the problems of land fragmentation are addressed and how it can be prevented in future, various measures were identified through a discussion with the key-informants and the FGD respondents. The measures are grouped as i) legal and social measures to mitigate the negative effects of land fragmentation, ii) the legal and social measure in force to prevent land fragmentation and iii) measures to prevent land fragmentation in the future. The perception of the HHs is presented at the end of each sub-section.

4.4.1 The legal and social measures to mitigate the negative effects of land fragmentation

The legal and social measures to mitigate the effects of land fragmentation obtained from the key-informants and the FGD are summarised in *table 13*.

Table 13: Legal and social measures to prevent the negative effects of land fragmentation

I. Legal measures	II. Social measures
a. Restriction on the conversion of chhuzhing to other land use	a. Sharecropping
b. Agricultural subsidies	b. Farmyard manure
c. Land grant	c. Exchange of registered land within the HHs
d. Cooperative farming (group farming)	
e. Exchange private land with government land	
f. Sustainable Land Management	
g. Not allowing the sale of Kidu land within ten years	
h. Improving irrigation system	
i. Access to credit	

I. Legal measures to mitigate the negative effects of land fragmentation

a. Restriction on the conversion of chhuzhing to other land use

The Land Act, 2007 allows conversion of chhuzhing to different land categories; however, it is subjected to thorough scrutiny and eligibility standards. Conversion of chhuzhing to dry land is feasible only upon technical assessment, including the availability of water, soil, and environmental conditions. If a landowner desires to convert chhuzhing to a residential area, only inherited chhuzhing up to 0.50 acres is allowed for conversion in rural areas. In case a house is not constructed within three years, the residential land is reverted to chhuzhing. To further streamline the criteria and to minimise the loss of chhuzhing to residential, the

allowable area for conversion was reduced to 0.10 acres. Moreover, it is not allowed if the landowner owns another dryland within the country. The key-informants and the FGD respondents considered this measure to prevent chhuzhing fragmentation and hence preservation of chhuzhing. It further helps in mitigating other negative effects of land fragmentation such as fallowing of land, food insecurity, and landlessness.

b. Agricultural subsidies to encourage farm production

As an incentive, the farmers in Bhutan are provided with agricultural subsidies such as seeds, seedlings, fertilisers, hiring of farm machinery, electrical fencing, compost structure, and prefabricated greenhouse towards increasing cash income of the farmers and thus improve their livelihoods. The MoAF ensures proper access and use of more productive agricultural inputs to encourage farm production. *"Whether it is land fragmentation or not, the MoAF aim to improve soil fertility. For that, there are certain transportation subsidies in terms of fertiliser inputs, but we encourage them to use farmyard manure. We promote green manuring in warmer areas and of course through intercropping leguminous crops. These are some of the measures we promote, especially now since we are embarking towards organic agriculture and focus more on bio-fertilisers."* (key-informant, MoAF)

c. Land grant

Landlessness is considered as a cause and effect of poverty in rural areas of Bhutan. In some rural areas, the poor are more vulnerable to poverty due to inadequate land. Thus, numerous land-related poverty interventions were initiated in the country. His Majesty, the Kings, granted land to the landless and near landless since 1997. This land reform not only helped in the enhancement of sustainable livelihoods of the rural people but additionally settled numerous land issues and significantly improved land administration. The regularisation of excess land (land occupied beyond what is registered in the title) was one form of the land grant. Another one was the National Rehabilitation Programme (NRP) mainly to rehabilitate the landless farmers and the socio-economically disadvantaged population. Use Right Certificate (URC) provides the use of land to the landless and socio-economically disadvantaged communities, youth and unemployed youth interested in undertaking economically productive activities to enhance livelihood opportunities.

d. Cooperative farming

The cooperatives (Coops) and farmers' groups (FGs) are agricultural enterprises operated by a group or groups of farmers voluntarily by pooling their land resources to take up agricultural farming on a bigger scale. The group initiative prevents the land from fragmenting because they pool adjacent land owned by different farmers as a single parcel for massive cultivation. *"But different education background and thinking attitude make it difficult to bring them on board together,"* said the key-informant from MoAF. The cooperative farming can play an important role in enhancing and achieving sustainable production. Moreover, it will play a major role in improving mechanisation, increase the income of smallholders, reducing fallowing of land, generate rural employment and, reduce rural-urban migration. Since its establishment in 2010, there are 67 farmers' cooperatives and 422 farmers' group in the country as of July 2018.

e. Exchanging private registered land with government land

Exchange of private registered land with the productive state land is another intervention to prevent fallowing of land. The exchange is permitted if private registered land falls within critical water catchment area; damaged by natural calamities such as floods, landslides, and erosions; extremely isolated parcels from the settlement; and unsuitable for cultivation due to unfavourable environmental or bio-physical condition.

f. Sustainable Land Management (SLM)

The NSSC under MoAF has been promoting SLM interventions since its establishment in 2006 through different projects funded by external donors such as the Global Environment Facility (GEF), World Bank, and UNDP. The SLM interventions, such as the construction of terrace and stone bunds, the establishment of hedgerows and orange basin, water source protection and development of check dams, were adopted. These interventions help reduce land degradation, enhance crop production, and contribute to mitigating climate change and improving ecosystem services.

g. Irrigation system

Inadequate irrigation facilities such as the lack of water source, damage to irrigation infrastructures, and limited water for irrigation was considered to cause fallowing of land in Bhutan, in fact as a major hindrance to enhance the production of crops. The drying of water sources and the delay in the monsoon rain had caused a shortage of irrigation water for the paddy plantation in 2016 in the study area. It had destroyed acres of chhuzhing. To this end, pumping water from the river helped farmers cultivate efficiently. More farmers have cultivated more fields than before due to the availability of water. Hence, improving the irrigation systems is one key priority towards enhancing domestic food production in Bhutan.

h. Not allowing Kidu land to be sold within ten years

The Land Act, 2007, does not permit the sale of Kidu land within ten years from its allotment or else is considered as an offence of misdemeanour. A key-informant stated, *"Because the main objective was to give land to landless, by stopping them from fragmenting, the land remains with them for at least ten years."* Preventing the sale of Kidu land may not be the only solution, but it will play its role. Ex Lyonpo Kinzang proposed in the Review of the Land Act, 2007 that only up to 60 % of the Kidu land should be allowed for transactions after ten years.

i. Access to credit

Access to credit is essential for effective and efficient agricultural production. Thus, with the implementation of Priority Sector lending (PSL) in 2018, the agriculture sector is anticipating some economic transformation in the coming years. The PSL does not require collateral and guarantor to get a loan, and the interest rate is lower than that of the financial institutions.

Perception of the HHs on the legal measures to mitigate the negative effects of land fragmentation

The perception of the HHs on the legal measures to mitigate the negative effects of land fragmentation was obtained via multiple-choice answer where they could choose more than one answer. To mitigate the effects on agricultural production, the perception of the HHs revealed that agricultural subsidy was the most used facility amongst others with 32 out of 33 HHs responding to it (*fig 15*). Only, 1 HH responded to irrigation facility as a means of enhancing agricultural productivity. A good number of HHs (10) indicated that the exchange of the uncultivable registered land with the state land helped in improving agricultural productivity. However, some HHs said that the process was time-consuming and is discouraging at times. None of the HHs was in favour of measures like controlling the conversion of chhuzhing to other land use and preventing the sale of Kidu land. The response from the HH reveals that there is no group farming at the moment in the study area.

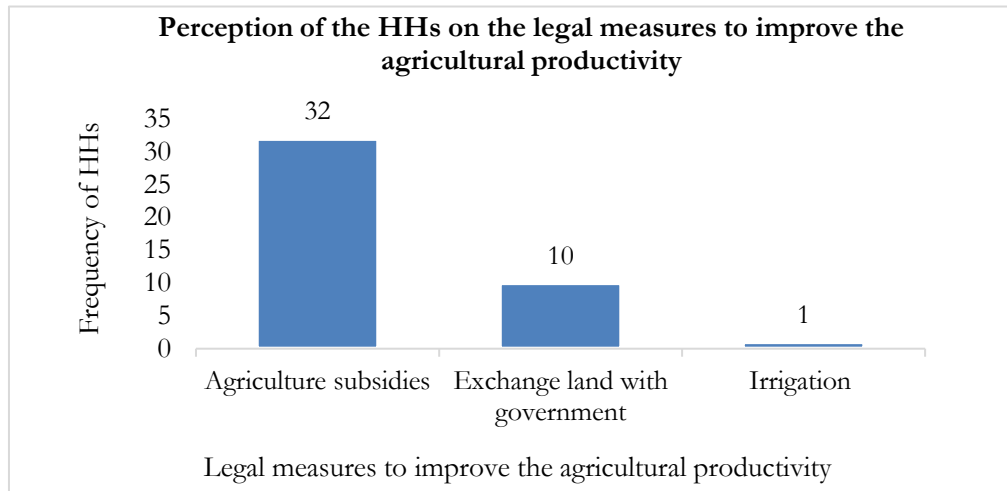


Fig 15: The perception of the HHs on the legal measures to improve the agricultural productivity in the study area

To reduce the effects on landlessness, as shown in *fig 16*, the land grant was perceived to be the most effective measures with 32 out of 33 HHs responding to it, followed by preventing the conversion of chhuzhing to other land use (17 HHs). No HH responded to rehabilitation programme as a measure to reduce landlessness.

To reduce the fallowing of land (*fig 17*), improving the irrigation system was perceived to be the most important measure with 31 out of 33 HHs responding to it. Facilities such as the construction of farm roads and preventive measures against wild animals were other necessary measures with 16 HHs and 15 HHs responding to it, respectively. Few HHs (7) responded that good access to drinking water and promoting SLM interventions such as terracing in the steeper area can encourage farmers to use the land and prevent from rural-urban migration.

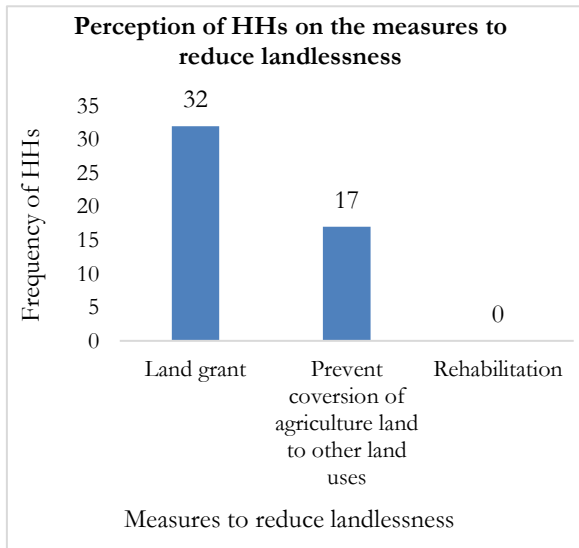


Fig 16: Perception of the HHs on the legal measures to reduce landlessness in the study area

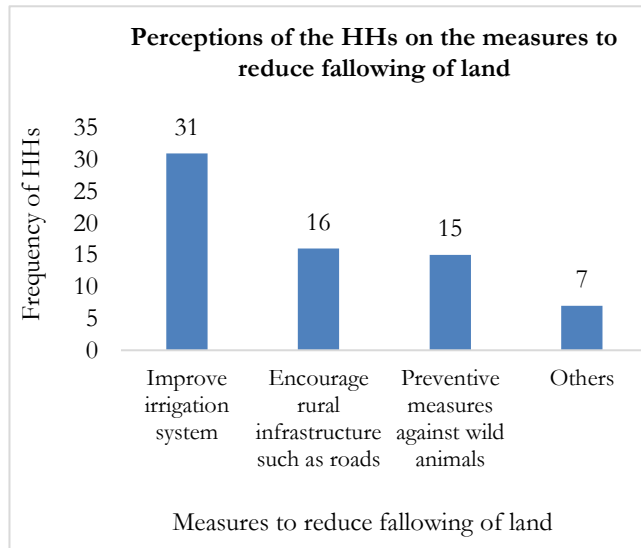


Fig 17: Perception of the HHs on the legal measures to reduce fallowing of land in the study area

II. Social measures to mitigate the negative effects of land fragmentation

The key-informants and the FGD respondents state that within the communities, there are certain arrangements like sharecropping of land and use of farmyard manure. *"Sharecropping is very powerful because even in my own family in the village we do not have enough land hence we lease someone's land who live in another district. They cannot come and cultivate, so in a way artificially or virtually our landholding is increased"* said a key-informant. Sharecropping is a farming approach in Bhutan whereby a HH cultivates on other's land and in turn share a part of the harvest usually 50% of the yield. It is mostly the landless families or who owned less land practising the sharecropping. However, sharecropping is declining as people migrate to towns looking for alternative employment and allowing the lands to remain fallow. The decreasing number of sharecroppers was considered one reason for the fallowing of land.

Another practice was the traditional farming of using organic fertilisers such as cattle manure, leaf litters and the crops residues over the fertiliser that contain chemicals. The farmers realise the negative impact of chemicals on the soil quality and reducing the return from the land over a longer period, although the advantage of time and weeds conquer the former. The exchange of land amongst the HHs voluntarily, which entail an exchange of parcels adjacent to their house or parcels (illustrated with an example *fig 18*) was said to make it convenient and more accessible to their land.

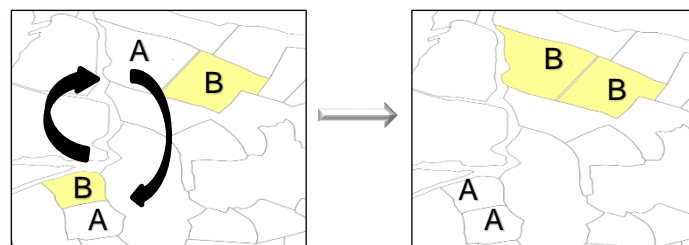


Fig 18: A sample (pseudo) for parcel exchange within HHs using 2019 cadastral map of the study area.

4.4.2 The legal and social measures to help mitigate further land fragmentation

The perceptions of the key-informants and FGD on the legal and social measures that are in place to prevent land fragmentation are presented in *table 14*, followed by the perceptions of the HHs obtained via multiple-choice questions where they can choose more than one answer.

Table 14: Measures that have helped prevent land fragmentation in Bhutan

Legal	Social
Restriction on the conversion of chhuzhing to other land use	Matrilineal inheritance
Minimum parcel size in the Land Act, 2007	Family ownership
Family ownership and joint ownership	Sharecropping

I. Legal measures

Almost the same measures as that of reducing the negative impacts of land fragmentation were reiterated. Restrictions on the conversion of chhuzhing to other land use, the minimum parcel sizes of 0.10 acres as per the Land Act, 2007 and the family/joint ownership were the main legal measures in place that helped prevent land fragmentation. Although some key-informants mentioned that the minimum parcel size of 0.10 acres was small for agricultural land fragmentation, they realised that it has contributed to preventing

land fragmentation ever since the Land Act, 2007 was enacted. Because in the absence of 0.10 acres, people would have fragmented even below that.

Family ownership as per the Land Act, 2007 means the ownership of the land belonging to the family members under one HH but registered in the name of the head of the family. In rural areas, usually, the lands are registered under family ownership. Joint ownership has collective ownership over a piece of land by more than one person. Such land can be transferred only upon consent of all the family members and co-owners, respectively.

II. Social measures

Family ownership is also regarded as a social-cultural practice besides being written in law. This kind of ownership will put a hindrance to fragmentation because even if one of the members disagree, sub-division will not happen. *"However, this practice is declining due to nuclear family pattern, leading to land fragmentation,"* said, one key-informant. Matrilineal inheritance is considered as another social practice which can hinder land fragmentation. As mentioned in the earlier section, the matrilineal inheritance allows land share only through daughters, which in a way can avert land fragmentation. Sharecropping can prevent not only fallowing of land and landlessness but also prevent land fragmentation. Back then, when the land is leased out, the landlords are happy to get their share every year without having to toil in the sun and rain, and hence they avoid selling the land.

Perception of the HHS on the legal and social measures to reduce land fragmentation

In response to the legal measures to reduce land fragmentation, all the 33 HHs responded that restricting the conversion of chhuzhing to other land use can play a significant role in curbing land fragmentation (*fig 19*). Besides, slightly more than half (17 HHs) stated the minimum parcel size of 0.10 acres as another legal measure that prevented from further land fragmentation. While some even said that the government should do away with this provision so that they can distribute land to everyone in the family even lesser than 0.10 acres. 6 HHs considered family and joint ownership as another means of preventing land fragmentation

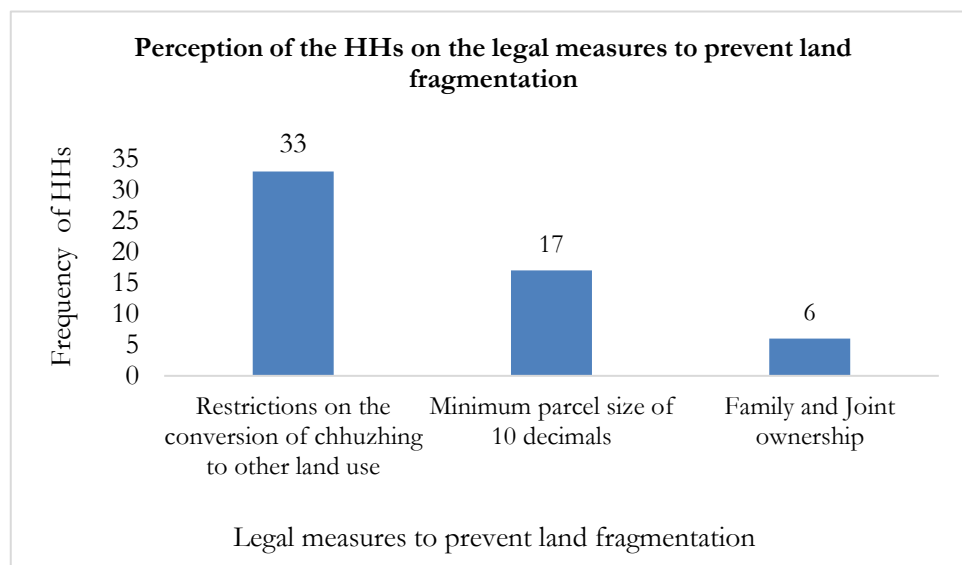


Fig 19: The perception of the HHs on the legal measures that are in place in reducing land fragmentation

In response to the social measures identified to prevent further land fragmentation, 25 HHs considered sharecropping as one effective social measure (Fig 20) even though sharecropping is dwindling over the years. Most of the rural land is registered under family ownership, and this is a traditional practice of holding land; however, only 6 HHs mentioned it while rest said it creates disputes and complication during inheritance. Matrilineal system of inheritance was intended to be a good social measure by almost half (16 HHs) than the present system of giving equal share. 4 HHs suggested giving land share only to the ones who will take care of the house and the ageing parents. They said this would limit land fragmentation as land will be distributed to only certain heirs.

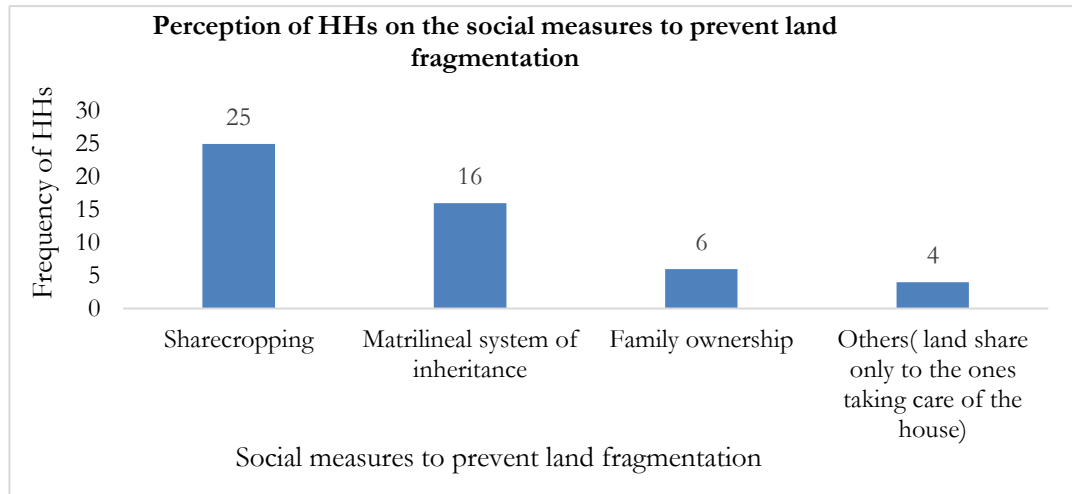


Fig 20: The perception of the HHs on the social measure in preventing land fragmentation.

4.4.3 In what other ways can land fragmentation be prevented?

Besides the existing laws and measures that are in place to prevent land fragmentation, new measures were found essential in preventing land fragmentation in future. Towards this idea, following new measures were revealed through discussion with the key-informants and the FGD respondents.

- a. Land consolidation
- b. Clearly define the minimum parcel size for agricultural land
- c. Protection of agricultural land
- d. Land banking
- e. Improving the farmer's awareness on the effects of land fragmentation and the legal standards to prevent land fragmentation

a. Land consolidation.

Land consolidation can be one solution to counter the land fragmentation issue and encourage commercial farming in Bhutan. The one allowed by law in Bhutan is consolidating adjacent land belonging to the same landowner and of the same land type. It can be pursued at various level to most of the key-informants and the respondents of the FGD so long there is a conducive legal framework in place. They stated that the law is very rigid at the moment. To this end, a key-informant said *"Between and among different landowners, I see much potential for commercial application and farm mechanisation, if land consolidation between and among the landowners is allowed. It is possible where the terrain is not steep. So, the key thing is the policy and law. Giving people the freedom of using the land that ensures them the best return is essential."* However, few Key-informants and the FGD respondents said it would be challenging to implement land consolidation for mass farming, unlike in other countries. This is

because every landowner has a closer tie to the land, and the fear of losing land will discourage from happening. While some think the rugged terrain of the country may also hinder the idea. The key-informant from the Punakha district said land consolidation would not be possible for Bhutan because people would not agree basically because of different landholding they possess.

b. Clearly define the minimum parcel size for agriculture land

Different minimum size for different land categories could be one solution to land fragmentation. Setting a larger parcel size for agricultural land fragmentation could curb land fragmentation. It was suggested that the existing Land Act requires appropriate amendments to formulate new rules and regulations for agricultural land fragmentation. *"0.10 acre is understood as the size of the minimum parcel for everything. We should have a minimum of parcels sizes for different land use. This is one limitation in the law that we need to address."* (A key-informant)

c. Protection of agricultural land

Formulation of National Land Policy (NLP) and the execution of National Land Use Zoning (NLUZ) will define the protected agricultural area, which will not be allowed for transaction or fragmentation. Amendment of Land Act will help safeguard agricultural land and prevent further land fragmentation. The NLP will help introduce precise rules and regulations to discourage land conversions and ensure land speculations will not influence agricultural landowners to convert their land and sell in the open market. The NLUZ exercise will enable the establishment of a harmonized national land-use system. It will help in delineating different land use and overall, towards optimal, and sustainable use of the limited land resource and ensure food security and economic self-reliance in the country.

d. Land banking

It was found that the MoAF is working on pooling all the fallow land for sustainable management and effective utilization. The government will lease such lands from the landowners to take up commercial farming.

e. Improving the farmer's awareness on the effects of land fragmentation and the legal standards to prevent land fragmentation

Making people aware of the situation and its effects are considered vital to prevent further land fragmentation. It was suggested that the provisions of the law must be made apparent to the people. Besides that, they suggested the participation of the local people in decision making because it would help make a better decision. A respondent from the FGD said, *"the views of the local government and local people are very important in making any laws and regulations because we are the ones who will be implementing them."*

Perception of the HHs on the new measures to prevent further land fragmentation

Most of the HHs suggested creating public awareness and educating them on the impacts of land fragmentation and dissemination of information to prevent it as the most effective one, followed by defining the minimum parcel size for agricultural land. However, the HHs were opposing the idea of land consolidation as a solution mainly because they said it might create disputes among the HHs.

4.4.4 Summary of the result for sub-objective 3

There are various approaches to address the issue of land fragmentation in Bhutan. Legal measures such as imposing restrictions on the conversion of chhuzhing and not allowing the sale of Kidu land within ten years will not only help preserve chhuzhing but also help mitigate many negative effects of land fragmentation such as fallowing of land, food insecurity, and landlessness. Providing agricultural subsidies, land grant, exchange of unproductive land with the state land, promoting SLM and rural facilities, measures against wild animals and providing access to credit are other important measures to increase the agricultural productivity. The registration of land on family and joint ownership can act as a hindrance to fragmentation because such land can be transferred only upon consent of the members/co-owners. Social measures like sharecropping, land exchange within the HHs and using organic fertilisers will help boost productivity. While the matrilineal system of inheritance along with the above social measure will help prevent further fragmentation. Besides the existing measures, land consolidation, protecting and defining the minimum parcel size for agriculture land, land banking, farmer's awareness on the effects of land fragmentation were proposed.

5 DISCUSSION

5.1 Introduction

In this chapter, the findings from chapter four will be discussed, referring to the literature reviewed for this study. The discussion is carried out according to the sub-objectives. Section 5.2 presents the discussion on the nature of land fragmentation, section 5.3 discusses the positive and the negative effects of land fragmentation, and section 5.3 discusses the measures to mitigate land fragmentation in Bhutan.

5.2 Sub-objective 1. Describing the nature of land fragmentation

Definition of land fragmentation

Land fragmentation is not defined in any current laws in the country. However, the Land Act 2007, mentions the minimum parcel size for sub-division as 0.10 acres. Since it is not legally defined, different definitions were revealed. Some said it is the division of land until 0.10 acres. While some said it is the division of land into smaller sizes through land conveyances and having non-contiguous land parcels. These definitions exist in the various scientific literature and carry a similar interpretation (Dovring & Dovring, 1960 cited in Dhakal & Khanal, 2018); Agarwal, 1971; King & Burton, 1982). However, in this study, the definitions are derived from the opinions of the respondents, which makes this study different and thus contributes to the literature. The definition of ownership and physical land fragmentation has a similar meaning as that of Van Dijk (2003). However, the land-use fragmentation has a different connotation in this study. It is defined as having many land-uses on a single farm (Ntuhinyurwa et al., 2019). Despite the different perceptions of defining land fragmentation, the concept boils down to one connotation of subdividing land into smaller parcels.

Characteristics and the trend of land fragmentation in the study area

An overview of the indicators that determined land fragmentation is presented in [Appendix 3](#). The findings indicated the presence of ownership and internal/physical fragmentation (Van Dijk, 2003; Ntuhinyurwa et al., 2019) in the study area. The smaller and irregular land parcels, which are discretely located, signified the presence of internal land fragmentation (King & Burton, 1982; Demetriou, 2014). The presence of irregular parcels is because of the sloping nature of the landscape. Moreover, there is no rural land planning, nor shape standardisation during sub-division in rural areas. Most HHs depend on average landholding of 3.212 acres (1.3 hectares) signifying a small farm (Lowder et al., 2016). The situation is intensified with the high HH sizes ranging from 2 to 17, which indicates the presence of land ownership fragmentation.

There is a lower land fragmentation in terms of distance, as most parcels are within 500 m from their house. However, the distance is varying, with a maximum of 3425 m and a minimum of 9 m. Due to the difficult landscape and the unavailability of road connecting to all farms, the walking distance could be more and time-consuming as indicated by Hudecová et al. (2017) and Ali et al. (2018). As argued by King & Burton (1982), the problem is further worsened because of the coexistence of both sub-division of land into economically non-beneficial and the presence of scattered and intermixed parcels. The analysis revealed approximately 18 % increase in the parcel numbers between 2008 and 2019 in the study area, meaning one land parcel in 2008 has been fragmented into 2 to 8 smaller parcels. The change does not appear to be immense, yet it signifies to be a problem for a small country like Bhutan where the arable land is very limited. This means more land sub-division and smaller parcels are expected in future if the inheritance system of dividing land amongst the family members continues. The HHs use their land only for agriculture purposes without multiple land-use on the same farm (Ntuhinyurwa et al., 2019) indicating a lower land-use

fragmentation. The presence of lower land-use fragmentation signifies that most farmers pursue subsistence farming.

Causes of land fragmentation

The inheritance system, together with the growing population on the limited land, had led to sub-division of family land as reported by Niroula & Thapa (2005) and Dhakal & Khanal (2018). The inheritance system was the main cause of land fragmentation in Bhutan because it allows equal division of land amongst the family members. It is being confirmed by 100 % HH's response declaring that they acquired their land through inheritance. Thus, with an increase in population, a higher level of fragmentation is anticipated through an increase in family size, which further encourages land division through inheritance. This has negative implications such as leading to smaller and dispersed parcels as underlined by Niroula & Thapa (2005).

In some cases, land-use change, infrastructure development, and sale of land were responsible for land fragmentation in the study area. A similar finding was featured by King & Burton (1982), Bentley (1987) and Kjelland et al. (2007). In the case of Bhutan, chhuzhing conversion to other land use has become a cause and effect factor and is a challenge as most depend on agriculture for their livelihood. Rapid conversion of chhuzhing to residential land was revealed with the highest recorded in the study area. It signifies that chhuzhing conversion to other land uses was widely preferred in the context of pressing demand for human settlement, and other socio-economic factors such as population growth and urbanisation. It has become apparent that such a trend will continue. In the process, we are losing huge chhuzhing, and this can impact achieving food security and self-sufficiency of the country. If this is not controlled, there can be chances of losing all the paddy fields.

Land fragmentation through sale/purchase happens because farmers tend to buy additional non-contiguous land to increase their landholding (Bentley, 1987) or to diversify their crops (Tan et al., 2006). In Bhutan, sale of chhuzhing (to get it converted to residential land) and Kidu land was revealed. This is because the land has gained exceptional economic value over time. Moreover, the speculation of the Kidu land plays a significant role in land fragmentation because the Kidu lands are fragmented into smaller sizes to be sold, and they again appear for Kidu, which becomes a vicious cycle.

5.3 Sub-objective 2: The effects of land fragmentation

Positive effects of land fragmentation

As highlighted by Bentley (1987), Van Dijk (2003), Demetriou (2014) and Paul & Wa Githinji (2018), both positive and negative effects of land fragmentation were revealed in the study area. Land distribution to every Bhutanese was the most significant positive effect of land fragmentation with a 100 % response from the HHs. Besides the opportunity of each member owning land, it is said to improve the independence of each member on the family and is more accessible to the market. It thus reduces conflicts within the family and increases land tenure security. This finding relates to the research of Ntihinyurwa et al. (2019) in Rwanda.

Crop diversification, as noted by Bentley (1987), was another positive effect which gave the benefit of growing various crops and bringing them to the market. It helps them to increase their income. While Bentley (1987) argues that land fragmentation cause difficulty in managing the scattered and smaller parcels, this study revealed that it was also of advantage in Bhutan. This is because, in rural areas where the farm machinery is still limited and depend on farm labour, smaller farmlands were easier to manage, and the labour distribution was improved (Bentley, 1987).

Negative effects of land fragmentation

The findings from the key informants and FGD reveal the decrease in agriculture production, land-use conversion, landlessness, and fallowing of land as the main negative effects in Bhutan. Unsustainable agriculture practice and difficulty in rural land planning were also raised because fragmented and scattered parcels obstructed spatial planning, and improving land-use planning and management (Rembold, 2003). However, the HHs perceive a decrease in agriculture production, and landlessness as the key negative effects amongst the above. The smaller farm is one possible reason for the reduction in agriculture production, as mentioned by Bizimana et al. (2004) and Rahman & Rahman (2009). Although the climate is favourable for growing different crops in the study area, insufficient land was reported. Thus, imposing a threat to food self-sufficiency and security. The findings contradict with Niroula & Thapa (2007); however, it supports Swai (2016), where he indicates the increase in agricultural productivity only with an increase in the farm size. This is because once the land is fragmented into smaller sizes, it becomes economically unviable for cultivation (Deininger et al., 2012) and difficult to sustain the rural livelihood.

Hence, people migrate to urban areas seeking greener pastures leaving the land fallow. This corresponds to Hartvigsen & FAO (2018) and Karouzis (1977) cited in Lazikova et al. (2017), where they consider land fragmentation as a key factor to the land abandonment. When the productive lands are left fallow, there is a reduction in production and with the current growth rate of 24.36 % of chhuzhing conversion to residential land in Bhutan, achieving rice self-sufficiency by 2023 is a farfetched dream because today Bhutan is only 47 percent rice self-sufficient. Land fragmentation causes landlessness (Molle & Srijantr, 2003), and it occurs when land is inherited from generation to generation or when it is being divided to be sold like in Bhutan. That is when the land will be insufficient (Nayenga, 2003). Landlessness can further lead to poverty, rural-urban migration, and occupation of empty state land like in Bhutan. The smaller land parcels in Bhutan also limits mechanisation/commercialisation (Demetriou et al., 2013; Austin et al., 2012) because it is difficult to engage the farm machinery. This has implications on the cost of farming and access to credit (Niroula & Thapa, 2005) at the household level at an affordable rate.

In some cases, HHs revealed impediments like disputes regarding land division, boundaries & easement, and loss of land through boundary construction. Thus land fragmentation stimulates social disharmony and break down. Similar ideas about the loss of land towards boundary constructions and developing paths were demonstrated by Simons (1985). While, King & Burton (1982) features the concern on disputes over multiple ownership, disputes amongst the family members, especially when there is inadequate land for further inheritance was discovered in the study area.

Is land fragmentation as an issue to be addressed?

Despite the advantages of land fragmentation, the negative aspect overstated, as argued by Bentley (1987). It was viewed as an issue in Bhutan considering the negative effects mentioned by the key-informants, the FGD respondents and a slight majority of the HHs (15 out of 33) agreed to see it as a problem. Responses from the HH are somehow mixed because almost half of the HHs (11) believed that land fragmentation is not an issue and would continue, mainly because of the limited land available and the inheritance system. It is also due to its dynamic land values; only a small piece of land can be afforded. Moreover, land fragmentation is a way to enhance social happiness and contentment among the general society. It was a bit confusing to determine their concern on land fragmentation. However, the result consequently gave an idea that it is a problem and requires necessary measures to address it, although it is not an alarming one.

5.4 Sub-objective 3: Measures to reduce land fragmentation

Legal and social measures in practice to mitigate land fragmentation

This study provides new insight as the measures to mitigate the effects of land fragmentation were explored than just focusing on the measures to prevent land fragmentation. Agriculture subsidies, exchange of unproductive land with the state land, encouraging rural facilities like farm roads, irrigation and preventive measures against wild animals were found useful in reducing the effects of land fragmentation in the study area. These can further help to reduce farmer's vulnerability to food insecurity, poverty, rural-urban migration, foster community vitality and vibrancy. The agricultural practices have changed and improved over the years; however, Bhutan still faces continued challenges of food self-sufficiency. The absence of a land-use policy impeding effective utilisation of land and an integrated approach to enhance food security have contributed to the challenge.

Imposing restrictions (Van Dijk, 2003; Demetriou, 2014) on the conversion and sale of chhuzhing and Kidu land was revealed to be effective in mitigating landlessness and fallowing of land in the study area. However, impositions such as the requirement to first offer the land to the adjoining landowner like in India and Nepal (Bonner, 1987; Shrestha, 2001 as cited in Niroula & Thapa, 2005) does not prevail in Bhutan. Preventing chhuzhing fragmentation can enhance rice production and improve the food supply. However, despite several approaches, our reliance on rice import is escalating, while the cultivable land is diminishing. This attributes to low return from the agricultural land and less contribution to the farmer's economy. Moreover, the tradition of families in rural Bhutan constructing their own house on inherited land as they marry and move out makes the implementation of the law difficult. The land grant to the landless helps in poverty alleviation, and it is an important aspect of the Gross National Happiness (GNH) development in Bhutan.

Social measures such as sharecropping, exchange of land within HHs, and use of organic fertilisers emerged from this study which adds to the current literature. Social measures encourage farmers' cooperation, improving the social hardships of the weaker population, and providing a platform to put forward and deliberate on the local knowledge to prevent land fragmentation. Land registration under family and joint ownership hinder physical land fragmentation as such land can be transferred only upon consent of all the members or co-owners although it is being argued that many owners over a piece of land signify ownership fragmentation (Van Dijk, 2003).

Other measures to prevent land fragmentation

Besides the current measures in Bhutan, more solutions were urged in preventing further land fragmentation. The perceptions of the respondents revealed strategies resembling that of Van Dijk (2003) in his dissertation "Dealing with Central European land fragmentation." Land consolidation was one primary solution in increasing the landholdings and consequently the production (FAO, 2003b). Bhutan allows consolidation of rural land that are physically contiguous, of the same land type and belonging to the same landowner. To this end, land consolidation between and amongst different landowners was proposed, by the key-informants. However, this would require a conducive legal framework and involve amendment of laws and acceptance of the landowners. The landowner's fear of losing land the steep terrain of Bhutan might, however, be a challenge. Moreover, the attitude of HHs on land consolidation seemed relaxed. Similar to the concept of land banking of FAO (2003), Van Dijk (2003), Lemmen et al. (2012), Demetriou (2014), and Hartvigsen (2015), Bhutan seeks to explore on pooling the fallow lands and bring under effective utilisation. This would ensure optimal and sustainable use of the limited land resource and ensure food security and economic self-reliance of the country. However, as underlined by Boliari (2013), it is essential to be clear

about the main problems of land fragmentation so that the policymakers can focus on the appropriate intervention because one strategy may not always be a solution to all land fragmentation.

5.5 Limitations to the study

Although land fragmentation is considered as an issue in the country, no prior study on this topic was carried out hence it was difficult to obtain literature related to the research topic in Bhutan thus creating a limitation on the study. Moreover, the lack of properly documented data on subjects related to this research added to the challenge. Due to limited time, the study was carried out at the lowest administrative area (Gewog) so that enough time is allocated for arranging the key informant's interview, FDG and the interview with the HHs. Confining to only one study area would have created a bias in generalising land fragmentation in Bhutan. Moreover, using different time series of the cadastral map would have shown a better pattern/trend in the increase of land fragmentation over the years in the study area. But, due to the lack of different versions of cadastral maps, it was impossible to do so. Nevertheless, this study can be a basis for future research on land fragmentation in Bhutan.

5.6 Revised conceptual framework

The conceptual framework shown in *fig 2* is revised based on the findings from this study, as shown in *fig 21*. The earlier conceptual framework presents the key concepts derived from the literature that guides this study while the revised framework provides the main findings from the study that responds to the key concepts identified in *fig 2*.

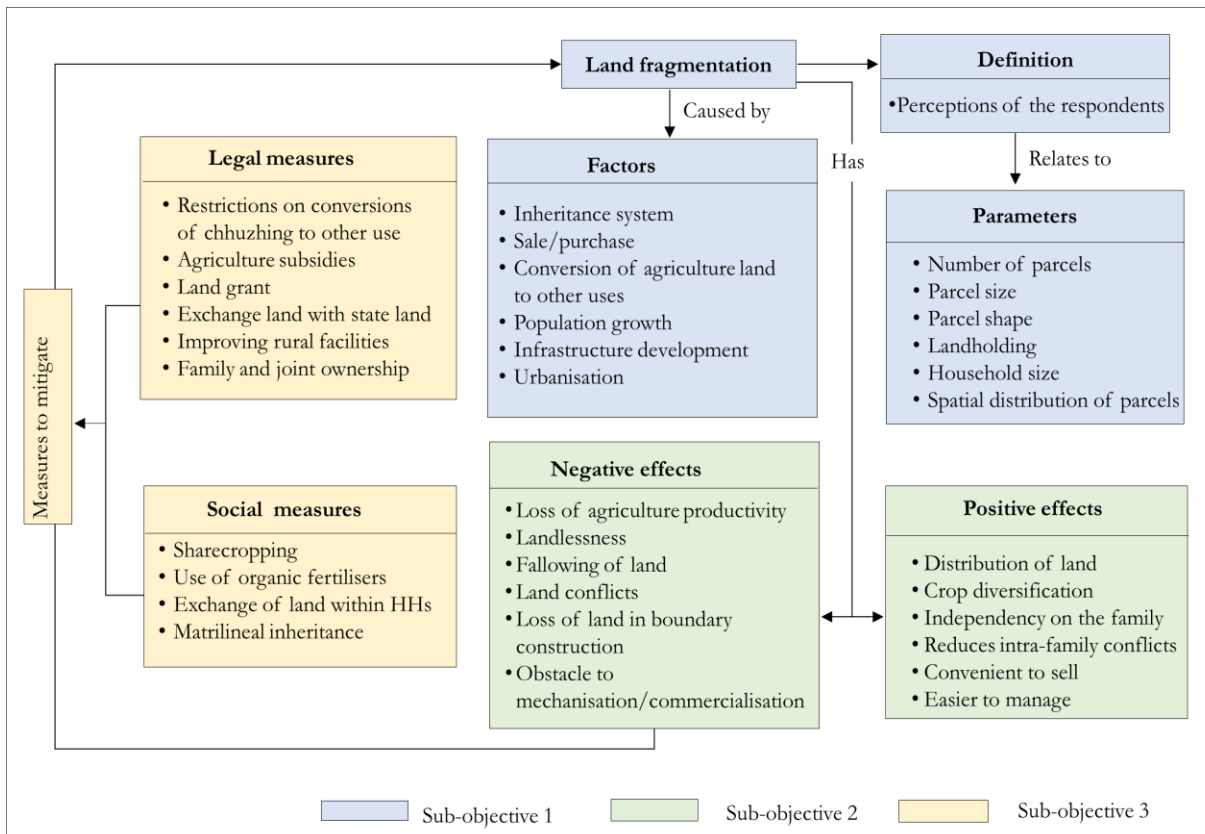


Fig 21: Revised conceptual diagram based on the results

6 CONCLUSION AND RECOMMENDATION

6.1 Introduction

This chapter presents the conclusion based on the results and discussions from the previous chapters. It also provides recommendations for the policymakers and further studies.

6.2 Conclusion

This study explores the nature of land fragmentation in the rural area of Bhutan based on primary and secondary data collection via interviews with the key-informants, FGD, and the HHs in one study area. The cadastral maps and the land records were used to analyse the existence and trend of land fragmentation. The study also achieved in finding out what land fragmentation is, its root causes, effects, and various strategies to deal within the context of Bhutan.

6.3 Sub-objective 1. Describing the nature of land fragmentation

Land fragmentation does not have a legal definition in Bhutan. Thus, different perceptions of public officials, the local leaders and the HHs were studied. In general, it was perceived as the division of land into smaller parcels through land conveyance. Land fragmentation existed in the study area in the form of ownership and physical fragmentation. The large HH size, lesser landholding, irregular shaped, smaller, and scattered land parcels contributed to determining land fragmentation in the study area. The current land fragmentation has become a concern on account of the growing pressure on the limited land and the threat it poses on the food security of the country.

The leading cause of land fragmentation in Bhutan is the inheritance system of dividing land amongst the family members. If this continues, a higher level of land fragmentation is expected in future, unless clear laws and regulations are put in place. The conversion of chhuzhing to residential was a primary cause, and effect of land fragmentation and this can impact achieving rice self-sufficiency goal of the country if continued. As the land parcels become smaller, they are unviable for agricultural practices. Moreover, when agriculture lands are lost, there is a reduction in food production. Thus, it is a challenge for the larger population who depend on agriculture for their livelihood.

6.4 Sub-objective 2: To identify the effects of land fragmentation

This study confirms the positive effects of land fragmentation in Bhutan as providing equal distribution of land and more importantly, improving the independence of the members on the family land. Thus, reducing conflicts within the family and increasing land tenure security. Smaller lands were perceived to be an advantage in terms of management and labour distribution.

However, land fragmentation also led to negative effects such as the reduction in agricultural production, land conversion, fallowing of land, and landlessness. When the rural population cannot sustain their livelihood, it leads to more issues such as poverty, rural-urban migration, illegal occupation of state land and unsustainable agriculture practice. Smaller land was insufficient and had compelled the rural population to constrain from commercialisation. That is why most of the Bhutanese farmers pursue subsistence farming. Abandonment of productive land and rural-urban migration was a serious concern in addition to the high growth rate of chhuzhing conversion. Leaving the lands fallow, can hamper the country's goal of achieving rice self-sufficiency. The study thus concludes that land fragmentation is an issue in Bhutan, although it is perceived as a phenomenon that cannot be stopped at once or eliminated.

6.5 Sub-objective 3: Measures to reduce land fragmentation

The existing legal measures relate to imposing restrictions on the conversion and sale of chhuzhing and speculation of Kidu land. Providing agricultural subsidies, and land grant to the landless and vulnerable groups have helped mitigate the effects of land fragmentation in certain aspects. Encouraging the exchange of unproductive land with the state land, and improving rural facilities, and measures against wild animals, discouraged fallowing of land. Although the minimum size of 0.10 acres seemed less for agriculture purpose, it was also perceived to have played a role in preventing fragmentation. Otherwise today more parcels of less than 0.10 acres would be prominent. Family and joint land ownership act as a hindrance to fragmentation as the transaction of land requires the consent of all the members/co-owners.

Social measures such as sharecropping, exchange of land within the HHs and the farming practice of using organic fertilisers were prevalent to increase crop production. The matrilineal inheritance, which is commonly practised in the western regions, is perceived to prevent further land fragmentation as land is being inherited only through daughters.

The current trend of land fragmentation calls for more preventive measures. Land consolidation, minimum parcel size for agricultural land, and protection of the agricultural land were proposed. However, it remains questionable of how suitable the tool of land consolidation will be for a mountainous country like Bhutan. Therefore, it is essential to understand the main problems of land fragmentation by the policymakers before applying it. The formulation of land-use policy and land-use zoning is expected to help introduce precise rules and regulations to discourage land conversions and define the protected agricultural land. Overall, these strategies will ensure optimal and sustainable use of the limited land resource and ensure food security and economic self-reliance of the country.

6.6 Recommendations

This study gives an insight into the land fragmentation scenario in Bhutan. Hence, it will help the policymakers to realise the causes and the effects of land fragmentation and propose appropriate policies, laws, and strategies to improve the situation. Stopping or minimising land fragmentation has become crucial for Bhutan considering the limited land available and most of the population depending on agriculture for their livelihood. To this end, the following recommendations are made:

- a. Prevent further fragmentation of productive agricultural land. It will not only prevent the farms from getting smaller and non-viable but also enhance agricultural productivity.
- b. Group farming within the villages to operate on a large scale by pooling their landholdings. Encouraging group farming can further solve the unemployment issue if the government backs the pooling with appropriate supports, and there is a good market available.
- c. Inclusion of provisions such as the minimum parcel size for agricultural land in the Land Act is seen crucial because when the prime agricultural land is fragmented into smaller sizes, the whole essence of using it as agricultural land is lost. Thus, an appropriate minimum size for agricultural land will make a significant impact in preventing land fragmentation and conserving agricultural land.
- d. Creating awareness and educating the people on the effect of land fragmentation is essential to make them understand the need to prevent it. Furthermore, their participation in decision making will benefit the rural communities at large.

6.7 Future research

There are limited studies on land issues in Bhutan; hence, there are several opportunities for further research, particularly on issues relating to land fragmentation. The current study will serve as a basis for further research on land fragmentation in Bhutan.

- There are different methods to quantify land fragmentation such as Simpson index, Januszewski index and Simmon's index. Besides, there is a modern method introduced by Demetriou et al. (2013) and is said to take care of all the land fragmentation parameters, is flexible and problem-specific. Hence, further research to quantify land fragmentation using the different methods covering a wider area would be recommended.
- This study revealed that land fragmentation impacts agriculture productivity. Hence, quantitative research to supplement this finding using appropriate methods/models in Bhutan is suggested.
- This study revealed that as the land is fragmented, the sizes of land become smaller and non-viable for agricultural production. However, there is no threshold defining it. Hence, a study to clearly define a minimum threshold, which will have the net return is essential for the policymakers to set a minimum parcel size for the agricultural land fragmentation.

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APPENDIX

Appendix 1: Research Matrix

General objective: To explore the nature of land fragmentation through the perceptions of the public authorities at the national and district level, and local leaders and the households in the study area.						
Sub-objectives	Research questions	Indicators (What do you want to measure)	Data sources	Techniques of data collection	Techniques of data analysis	Anticipated Results
1. To describe the nature of land fragmentation	1.1. How is land fragmentation defined by the laws, public authorities, and households in Bhutan?	<ul style="list-style-type: none"> Definition of land fragmentation 	<ul style="list-style-type: none"> Government documents, Government officials, Local leaders, HHs. 	<ul style="list-style-type: none"> Government documents review, Key-informant interview, FGD, Structured interview. 	<ul style="list-style-type: none"> Descriptive text 	<ul style="list-style-type: none"> Definition as per the law Similarities and differences in the definition of land fragmentation from a different perspective
	1.2. What are the characteristics of land fragmentation in the study area?	<ul style="list-style-type: none"> Different characteristics that determine land fragmentation Different forms of land fragmentation 	<ul style="list-style-type: none"> Land record and cadastral map from NLCS HHs 	<ul style="list-style-type: none"> Check land record for land information Cadastral map to help find the distance of the parcels and the distribution of parcels Structured interview with the HHs 	<ul style="list-style-type: none"> Descriptive statistics Descriptive text Spatial analysis 	<ul style="list-style-type: none"> The number of parcels per HH, landholding per HH, land-use types and parcels sizes in pie chart and tables. Distance to the parcels from the house (Table and map)
	1.3. What is the trend of land fragmentation in the study area?	<ul style="list-style-type: none"> Change in the size & number of parcels 	<ul style="list-style-type: none"> Cadastral maps from NLCS 	<ul style="list-style-type: none"> Cadastral maps (shapefile) for 2008 and 2019. 	<ul style="list-style-type: none"> Analysis by overlaying the 2008 and 2019 cadastral map. 	<ul style="list-style-type: none"> Map showing fragmentation in the study area
	1.4. What are the causes of land fragmentation?	<ul style="list-style-type: none"> The causes of land fragmentation 	<ul style="list-style-type: none"> Government officials Local leaders HHs Government documents 	<ul style="list-style-type: none"> Key-informant Interview FGD Structured interview Government document review 	<ul style="list-style-type: none"> Thematic analysis Descriptive statistics 	<ul style="list-style-type: none"> List of causes Perceptions of HHs in percentages & graph
2. To identify the effects of land fragmentation	2.1. What are the positive effects of land fragmentation?	<ul style="list-style-type: none"> Positive effects 	<ul style="list-style-type: none"> Government officials HHs local leaders 	<ul style="list-style-type: none"> Key-informant Interview FGD Structured interview 	<ul style="list-style-type: none"> Thematic analysis Descriptive statistics 	<ul style="list-style-type: none"> List of positive effects of land fragmentation. Perceptions of the HHs in percentages & graph

General objective: To explore the nature of land fragmentation through the perceptions of the public authorities at the national and district level, and local leaders and the households in the study area.						
Sub-objectives	Research questions	Indicators (What do you want to measure)	Data sources	Techniques of data collection	Techniques of data analysis	Anticipated Results
	2.2. What are the negative effects of land fragmentation?	<ul style="list-style-type: none"> • Negative effects 	<ul style="list-style-type: none"> • Government officials • Local leaders • HHs 	<ul style="list-style-type: none"> • Key-informant Interview • FGD 	<ul style="list-style-type: none"> • Thematic analysis • Descriptive statistics 	<ul style="list-style-type: none"> • List of negative effects of land fragmentation. • Perceptions of the HHs in percentages & graph
	2.3. Is land fragmentation an issue to be addressed?	<ul style="list-style-type: none"> • Public authority's perception • HH's perception 	<ul style="list-style-type: none"> • Government officials • Local leaders • HHs 	<ul style="list-style-type: none"> • Key-informant Interview • FGD • Structured interview 	<ul style="list-style-type: none"> • Description text • Descriptive statistics 	<ul style="list-style-type: none"> • Different perceptions on considering if land fragmentation is an issue to be addressed
3. To identify possible measures to address land fragmentation issue in Bhutan	3.1. What are the legal and social practices to mitigate the negative effects of land fragmentation?	<ul style="list-style-type: none"> • Legal and social arrangements to mitigate the negative effects 	<ul style="list-style-type: none"> • Government officials • Local leaders • HHs • Government documents 	<ul style="list-style-type: none"> • Key-informant Interview • FGD • Structured interview • Government document review 	<ul style="list-style-type: none"> • Thematic analysis • Descriptive statistics 	<ul style="list-style-type: none"> • List of legal and social measures to mitigate the effects of land fragmentation • Perceptions of HHs in a graph
	3.2. What are the legal and social practices to help mitigate further land fragmentation?	<ul style="list-style-type: none"> • Legal and social practices 	<ul style="list-style-type: none"> • Government officials • Local leaders • HHs • Government documents 	<ul style="list-style-type: none"> • Key informant Interview • FGD • Structured interview • Government document review 	<ul style="list-style-type: none"> • Thematic analysis • Descriptive statistics 	<ul style="list-style-type: none"> • List of legal and social measures to mitigate further land fragmentation • Perceptions of HHs in a graph
	3.3. In what other ways can land fragmentation be prevented?	<ul style="list-style-type: none"> • New measures 	<ul style="list-style-type: none"> • Government officials • Local leaders • HHs 	<ul style="list-style-type: none"> • Key informant Interview • FGD • Structured interview 	<ul style="list-style-type: none"> • Thematic analysis 	<ul style="list-style-type: none"> • List of new measures to prevent land fragmentation

Appendix 2: Operationalisation of variables

General objective: To explore the nature of land fragmentation through the perceptions of the public authorities at the national and district level, and local leaders and the households in the study area.					
Sub-objectives	Research questions	Concept	Indicators (What do you want to measure)	Variables (Deriving measurement)	Interview questions
1. To describe the nature of land fragmentation in the kingdom of Bhutan.	1.1. How is land fragmentation defined by the laws, public authorities, and HHs in Bhutan?	Nature of land fragmentation	<ul style="list-style-type: none"> Definition of land fragmentation 	<ul style="list-style-type: none"> Similarities and differences in the definition of land fragmentation from a different perspective 	<ul style="list-style-type: none"> Is the term land fragmentation defined in the laws? How is land fragmentation defined in your view?
	1.2. What are the characteristics of land fragmentation in the study area?		<ul style="list-style-type: none"> Different characteristics that determine land fragmentation Different forms of land fragmentation 	<ul style="list-style-type: none"> The number and size of parcels per HH, total HH landholding, HH size Land use types, land shapes, distribution of parcels: distance of the parcels from the house and location 	<ul style="list-style-type: none"> How far are the parcels located from the house? Are the shapes of the parcels regular or irregular? What is the size of the HH? (Other variables will be obtained from the cadastral map and land record)
	1.3. What is the trend of land fragmentation?		<ul style="list-style-type: none"> Change in the size & number of parcels and land use. 	<ul style="list-style-type: none"> Map showing land fragmentation in the study area 	(Derived from the cadastral map of 2008 and 2019)
	1.4. What are the causes of land fragmentation?		<ul style="list-style-type: none"> The cause of land fragmentation 	<ul style="list-style-type: none"> Different causes of land fragmentation. Perceptions of the HHs. 	<ul style="list-style-type: none"> What are the causes of land fragmentation? What is the common way of acquiring land? What purpose is the land used for?
2. To identify the effects of land fragmentation	2.1. What are the positive effects of land fragmentation?	Effects of land fragmentation	<ul style="list-style-type: none"> Positive effects 	<ul style="list-style-type: none"> List of positive effects of land fragmentation Perceptions of the HHs 	<ul style="list-style-type: none"> What are the benefits of having fragmented land?
	2.2. What are the negative effects of land fragmentation?		<ul style="list-style-type: none"> Negative effects 	<ul style="list-style-type: none"> List of negative effects of land fragmentation. Perceptions of the HHs 	<ul style="list-style-type: none"> What are the disadvantages of having fragmented land? Can land fragmentation cause landlessness? What are the problems related to the location of the land parcels?

General objective: To explore the nature of land fragmentation through the perceptions of the public authorities at the national and district level, and local leaders and the households in the study area.					
Sub-objectives	Research questions	Concept	Indicators (What do you want to measure)	Variables (Deriving measurement)	Interview questions
	2.3. Is land fragmentation an issue to be addressed?		<ul style="list-style-type: none"> Perception of the public authority, local leaders and HHs 	<ul style="list-style-type: none"> Different perceptions of considering if land fragmentation is an issue? 	<ul style="list-style-type: none"> Do you think land fragmentation will continue? Do you think land fragmentation should stop?
3. To identify possible measures to address land fragmentation issue in Bhutan	3.1. What are the legal and social practices to mitigate the negative effects of land fragmentation with a focus on landlessness?	Measures to mitigate land fragmentation issues	<ul style="list-style-type: none"> Legal and Social arrangements/practices 	<ul style="list-style-type: none"> Identified the legal and social practice to mitigate the effects of land fragmentation Perception of the HHs in graphs 	<ul style="list-style-type: none"> What measures are in place to address the negative effects of land fragmentation? What social practices are in place to help address the negative effects of land fragmentation? What measures are in practice to address the issue of landlessness?
	3.2. What are the legal and social practices to help mitigate further land fragmentation?		<ul style="list-style-type: none"> Legal and social arrangements/practices 	<ul style="list-style-type: none"> Identified legal and social measures to mitigate further land fragmentation Perceptions of the HHs 	<ul style="list-style-type: none"> What are the legal measures that help prevent land fragmentation? How can Land Act, 2007, play a role in curbing land fragmentation? What are some social measures that help in preventing land fragmentation?
	3.3. In what other ways can land fragmentation be prevented?		<ul style="list-style-type: none"> New measures/strategies to prevent further fragmentation 	<ul style="list-style-type: none"> List of new measures to prevent land fragmentation? 	<ul style="list-style-type: none"> What other measures/strategies would you propose to prevent further land fragmentation? Do you think land consolidation will work for Bhutan?

Appendix 3: Summary of the findings of land fragmentation in the study area

Indicators	Unit	Values	HHs in %	Type of fragmentation		Yes/No	Criteria to determine fragmentation
Total HHs interviewed		33		Land ownership fragmentation	Yes	Yes	<ul style="list-style-type: none"> • A large number of HH members • The number of parcels in a HH exceeds its landholding • Landholding less than 2 hectares (5 acres)
Total HH size (Members)		266					
Average HH size		8					
Average landholding	Acres	3.212					
Total number of parcels		271(Including houses)					
Landholding per HH	Acres	≤1	21				
		1-5	58				
		≥5	21				
Number of parcels per HH	Average	8		Internal / physical fragmentation	Parcel number	Yes	<ul style="list-style-type: none"> • The number of parcels in a HH is more than 2
	Minimum	1			Parcel size	Yes	<ul style="list-style-type: none"> • The parcels sizes are smaller than 1 hectare (2.47 acres)
	Maximum	22					
Average parcel sizes in acre	Acres	0.375			Distance	No	<ul style="list-style-type: none"> • The estimated distance is below 500 m
The distance of parcels from home	Meters	≤500	85				
		500-100	30				
		≥1000	33				
Parcel location	Average	4			Location	Yes	<ul style="list-style-type: none"> • Parcels are not adjacent and are in more than 2 different places
	Minimum	2					
	Maximum	10					
The shape of the parcels		Almost regular	33		Parcel shape	Yes	<ul style="list-style-type: none"> • Most of HHs have irregularly shaped parcels
		Not irregular at all	67				
Land use		Agriculture		Land use	No	No	<ul style="list-style-type: none"> • The land is used only for agriculture purpose besides the residential parcel they dwell on.
		Residential					

Adapted from Ntihinyurwa et al. (2019)

Note: 2.47 is equal to 1 hectare. There is no threshold to define when an agriculture land is fragmented in Bhutan. Hence, 1 hectare is used for the parcel size from Ntihinyurwa et al.,(2019) and 2 acres for the HH landholding size from Lowder, Scoet, & Raney (2016)

Appendix 4: Interview guide for key-informants

Interviewee:

Designation:

Department and agency:

Date:

A. Definition of land fragmentation

1. Is the term land fragmentation defined in the laws?
2. If yes, how is it defined and in which law? If no, do you have any idea, why?
3. What is land fragmentation in your view?

B. Causes of land fragmentation

4. What are the possible causes of land fragmentation in Bhutan?

C. Effect of land fragmentation

5. What are the advantages of land fragmentation in Bhutan?
6. What are the disadvantages of land fragmentation in Bhutan?
7. Do you think land fragmentation should stop? Explain

D. The measures to mitigate the negative effects of land fragmentation

8. What are the legal measures to mitigate the effects of land fragmentation in Bhutan?
9. Do you know any social practices in place to help address the effects of land fragmentation in Bhutan? Please mention them.

E. The measures to mitigate further land fragmentation

10. What are the legal instruments that help prevent further land fragmentation?
11. The Land Act, 2007 specifies 0.10 acres as the minimum size that can be sub-divided. Do you think this size can play a role in curbing land fragmentation? Please explain?

F. Other measures/recommendation

12. As an expert, what other measures would you propose to prevent land fragmentation?
8. Land consolidation is said to reduce land fragmentation. What do you think about it? Will it be feasible for Bhutan?

Appendix 5: Interview guide for FGD in the study area.

Date:

Location:

A. Definition of land fragmentation

1. Do you know if land fragmentation is defined in the laws? Please explain
2. How would you define land fragmentation in your view?

B. Causes of land fragmentation

3. Can you please mention the possible causes of land fragmentation in the study area?

C. Effect of land fragmentation

4. What are the advantages of land fragmentation? Please explain
5. What are the disadvantages of land fragmentation? Please explain.
6. Are there landless farmers reported in your block? How many?
7. Do you think land fragmentation should stop? Why?

D. The measures to mitigate the negative effects of land fragmentation

9. Please mention the legal measures that are in use to mitigate the effects of land fragmentation
10. What social practices are in place to help address the effects of land fragmentation?

E. The measures to mitigate land fragmentation

11. What are the legal instruments that help prevent land fragmentation?
12. What are the social practices in use to prevent land fragmentation?

F. Other measures/recommendation

13. As local leaders, what other measures would you propose to prevent land fragmentation?
 - a. The Land Act, 2007 is currently being reviewed. Given an opportunity what would you suggest be included which can help prevent further land fragmentation
14. Land consolidation is said to reduce land fragmentation. What do you think about it? Will it be feasible for Bhutan?

Appendix 6: Structured interview with the Households

A: Household and landholding information

1. Name:
2. Gender: Male ☐ Female ☐
3. Household size:
4. Tittle No:Or CID no: ...
5. How did you acquire the land?
Purchase ☐ Inheritance ☐ Gift ☐ Government allotment ☐
Others, please specify.....
6. Do you share the ownership of the land with someone outside your family?
Yes ☐ No ☐
If yes, why?.....
7. What are the rights to the land?
Freehold ☐ Leasehold ☐ Use right ☐
8. What activities are practised on the land?
Crop farming ☐ Animal keeping ☐ Mixed farming ☐
Others, please specify.....
9. What type of farming do you use?
Subsistence farming ☐ Commercial ☐
10. Are the shapes of the parcels regular or not? (regular means rectangular or square)
Yes, quite regular ☐ Almost regular ☐ No, not regular at all ☐
11. Is the land that you have enough to feed your family?
Yes ☐ No ☐
12. What is the main income source for your household?
Farming ☐ Non-farming ☐
If Non-farming, please specify

C: Definition of land fragmentation

13. What do you think land fragmentation is all about? (You can choose more than one answer)
 - a. Decreasing farm size ☐
 - b. Dispersed land parcels ☐
 - c. Division of land ☐
 - d. Others, please specify..... ☐

D: Causes of land fragmentation

14. What are the causes of land fragmentation? (You can choose more than one answer)
 - a. Inheritance system ☐
 - b. Population increase ☐
 - c. Sale and purchase ☐
 - d. Conversion of agriculture land to residential land ☐
 - e. Urbanisation ☐
 - f. Others, please specify..... ☐

E: Effects of land fragmentation

15. What are the advantages of land fragmentation? (You can choose more than one answer)
 - a. Distribution of land ☐
 - b. Crop diversification ☐
 - c. Easier to manage ☐
 - d. Others, please specify..... ☐
16. What problems do you face due to land fragmentation? (You can choose more than one answer)
 - a. Land disputes ☐
 - b. Decrease in agricultural production ☐

- c. Obstacle to mechanisation ☐
- d. Fallowing of land ☐
- e. Landlessness ☐
- f. Others, please specify.....

17. How far are your lands located from the house?

Far ☐ Near ☐ Very far ☐

18. What are the problems related to the location of your fields?

- a. Human-wildlife conflicts
- b. Fallowing of land
- c. Others, please specify.....

19. Is land fragmentation an urgent issue to be addressed.

Strongly agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐

Please explain your answer:

F: Measures to mitigate the effects of land fragmentation

20. What are the legal practices that are in use to reduce the effects of land fragmentation?

- a. Agriculture subsidies ☐
- b. Improving irrigation system ☐
- c. Exchange of land with productive state land ☐
- d. Others, please specify.....

21. What are the measures to reduce landlessness? (You can choose more than one answer)

- a. Land grant ☐
- b. Resettlement/Rehabilitation ☐
- c. Prevent the conversion of agricultural land to other land use ☐
- d. Others, please specify.....

22. What are the measures to reduce land abandonment? (You can choose more than one answer)

- a. Improve irrigation systems ☐
- b. Encourage rural infrastructure such as roads. ☐
- c. Preventive measures against wild animals ☐
- d. Others, please specify.....

23. What are some social measures to improve agricultural productivity?

.....

G: Measures to mitigate land fragmentation

24. What measures have the government taken to reduce land fragmentation?

- a. Family and joint ownership ☐
- b. Minimise land-use change from agriculture to the residential area ☐
- c. Land Act 2007 with 0.10 acres as the minimum parcel size ☐
- d. Others, please specify.....

25. What are the social practices to reduce land fragmentation?

- a. Family ownership ☐
- b. Land exchange within farmers ☐
- c. Sharecropping ☐
- d. Matrilineal inheritance ☐
- e. Others, please specify.....

26. How do you think further land fragmentation can be prevented in future?

- a. Land consolidation ☐
- b. Clearly define minimum parcel size for agriculture land. ☐
- c. Improving the farmer's awareness on the effects of land fragmentation and of the legal standards ☐
- d. Others.....

Appendix 7: Photos from data collection in the field



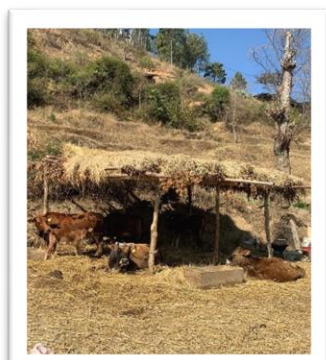
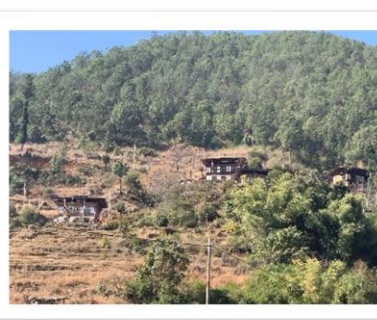
Focus group discussion with the local leaders at the Gup's office



Photo with the land record assistant and a village representative who helped me with field work



Photos from the interview with the households



Photos taken on the way to interview households