



Land structure and level of fragmentation in typical small-marginal agricultural holdings in India

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ABSTRACT

Farming in the Indian subcontinent is essentially small and marginal. With time, land size is fast declining and farmers are under pressure of generating more and more surplus under extreme resource competition. Land fragmentation has also increased severely in recent times, which might pose a threat to sustainability and food security soon by making agriculture unprofitable. The present study aims to portray the dismal condition of the land structure and level of land fragmentation of 141 small-marginal farming households in one of the most fertile agro-ecological villages of West Bengal in India, Rautari village in Chakdah block situated in Nadia district. Present investigation was conducted through well-structured field studies during 2016–17. The study reveals the existence of very traditional patriarchal land ownership patterns, and lack of women's inclusion from property ownership rights. Farmlands are extremely fragmented with a high value of Simpson Index. Moreover, farmers with high technical efficiency fragment it even more to accommodate a greater number of crops in one growing season. A positive relation between farm area and production is derived from field data. Based on the prevailing situation, indicated by results, the study designed a comprehensive community and land resources utilization plan for the development of the community in the study area. The proposed comprehensive community and land resources utilization plan is a structured tool for extension services which will strengthen the capacity building programs for small-marginal farmers.

Key words: Land fragmentation, Land ownership, Land structure, Resource competition, Simpson Index

Land is a vital resource in agricultural production and hence, land-related assets must be used with due conservation, preservation, and moderation. Small farmers dominate Indian agriculture having fragmented agricultural landholdings. The average size of landholding declined to 1.32 ha in 2000-01 from 2.30 ha in 1970-71, and the absolute number of operational holdings increased from about 70 million to 121 million. If this trend continues, the average size of holding in India would be mere 0.68 ha in 2020 and would further reduce 32 ha in 2030. Such radical fragmentation of agricultural landholdings has detrimental impact on the quality of life of farmers by reducing family income due to less production by volume. Land fragmentation, which is also known as pulverization, parcellation or scattering (Demetriou 2014) is defined in the literature as the situation in which a single farm consists of numerous spatially separated parcels (Demetriou 2014, Van Dijk 2003). Several scholars (Lusho and Papa 1998, Paudel 2001, Jha *et al.* 2005, Niroula and Thapa 2007, Hristov 2009, Monchun *et al.* 2010, Austin *et al.* 2012, Deininger *et al.* 2014) have explored impacts of land fragmentation

in greater details.

$$1 - \left[\frac{\sum_{j=1}^n a^2}{\left[\sum_{j=1}^n a \right]^2} \right] \quad (1)$$

where, a = Area of each fragment.

Our study aims to discuss the present situation of landholding structure and pattern of land distribution among the small-marginal farmers who primarily cultivate Aman paddy. Moreover, the article attempts to assess the land utilization pattern of the most efficient farmers (LEAD farmers) in the community. A comprehensive agricultural extension strategy is devised keeping in mind the considerations discussed above to combat the complications surrounding land fragmentation. Such a strategy can be replicated in other agro-ecological set-ups with appropriate modifications.

MATERIALS AND METHODS

The study was carried out at Rautari village in Chakdah block situated in Nadia district (22.53' and 24.70' N latitudes and 88.09' and 88.48' E longitude) of West Bengal. The data was obtained from the research project sanctioned from the Department of science and technology, the government

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Table 1 List of Natural livelihood assets (variables) used in the study

Natural livelihood assets	Unit of measurement	Form of the question in Questionnaire-based survey	Scale used
Cultivable land (CL)	Acres	What is the size of your cultivable land in 'Bigha' (local measurement units)? (Open-ended)	Ratio
Homestead land (HL)	Acres	What is the size of your homestead land in 'Katta/Decimal' (local measurement units)? (Open-ended)	Ratio
Pond area (PA)	Acres	What is the size of your Pond area in 'Katta/Decimal' (local measurement units)? (Open-ended)	Ratio
Home Built Area (HBA)	Acres	What is the size of your home built area 'Katta/Decimal' (local measurement units)? (Open-ended)	Ratio
Total size of holdings (TSH)	Acres	Derived	(TSH = CL+ HL + PA + HBA); Ratio
Number of land fragments (LFRAG)	Number	Do you have several fragments of your cultivable land? (Yes/No) If yes, then, How many fragments do you have? (Open ended)	Ratio
Size of land fragments (SFRAG)	Acres	What are the sizes of those fragments in 'Katta'? (Open ended)	Ratio
Average distance of fragments (AVFRAG)	Meters	What is the distance of each fragment from your current farm where you are standing? (Open ended)	Ratio
Crop diversity (CRPDIV)	Number of crops	How many crops do you cultivate in a year? (Open-ended)	Ratio
Simpson Index (SI)	Index	Derived	Ratio
Land Entitlement Proportion (LEP)	Proportion	Whether the land is jointly owned? If yes, how many owners are part of the land?	Ratio
Production (P)	Kilograms/per unit farm area	How much Aman rice do you produce?	Ratio

of India, for the doctoral research program (2013-2018). Field studies were conducted using a structured in-depth interview questionnaire during 2016-17. Table 1 summarizes the natural livelihood assets used for the study.

The numbers of small and marginal farming households under survey were 141. The sample size is calculated using Cochran's formula. The data collected was then analyzed using descriptive statistics in SPSS 20. To quantify the degree of land fragmentation, a variety of different methods and indicators are proposed. However, this study, used the standard index called the Simpson Index (equation 1) which captures the dissimilarities across farmed plots of land (Monchuk *et al.* 2010). It is calculated using the number of plots, and the size of fragments.

A farmer whose land fragments are of variable sizes will have a higher value of the Simpson Index. The value lies between 0 and 1.

RESULTS AND DISCUSSION

Structure of landholdings: Results indicate that the farmers on average have small-sized holdings. The participating farming households in our study have registered land under the system of state governments. Since, the law of property inheritance in India passes land rights to their siblings at each generation, the land gets fragmented further. However, there are many cases where the siblings may farm jointly. Depending upon the number of siblings,

the proportion of entitlement varies. While interviewing the households, it was found that not a single household had women with registered land rights. The patriarchy has led women in farming households in a bizarre situation. They are insecure and dependent on their male counterparts for their living. As they do not have their names on property rights, they find it difficult to seek loans from banks or government. It remains a challenge to empower rural women. Most of the households were farming as individuals, with frugal information sources. Few households were jointly farming (siblings) and were progressive by nature and had contacts with agricultural institutions as well as resource persons.

Simpson Index of land fragmentation for quantifying the level of land fragmentation: Like the prevailing situation of fragmentation in other parts of India, we found that Rautari has a very high Simpson Index with many fragmented plots. In some small-marginal farming households, the SI is 1.00, which indicates a need for the complete consolidation of land. These fragmented plots are utilized for growing multiple crops in a single crop-growing season as a strategy to increase their gross income as well as a mitigation option for handling risk events like crop failure due to environmental or market factors. In the study area, the fragmentation of farmland is both inherited and functional by nature. The Indian land inheritance system inevitably enables further fragmentation of plots in the succeeding generations. The functional fragmentation is

mainly meant for crop diversification. Crop diversification is an important risk management tool for augmentation of farm income stabilization, employment generation, conservation of natural resources, poverty alleviation and export promotion (Maji *et al.* 2015). Additionally, it fulfills household nutritional and fuel requirements, and organic supplements for farms. Inherited fragmentation gives autonomy to each heir to start their farm operations individually and earn their livelihood. However, in both cases, the land fragments and becomes smaller.

Existing measures for tackling land fragmentation:

There are two important considerations while addressing the concern of land fragmentation, one is consolidation of lands does not seem to have had an impactful effect in the Indian context (Basu 2014, Niroula and Thapa 2007) where the caste system is too complicated to handle the aftermath of consolidation. The second, fragmented landholdings enable a diversity of crops ushering alternative livelihood generation in case of crop failure and is good for enhancing biodiversity. However, it restricts the farmer to use traditional methods and limit productivity (Singh 1987).

In West Bengal, India, joint cultivation by a group of households was emphasized as an effective solution of land fragmentation. However, this model never succeeded, because it was not a tradition in the Bengali society (Ghosh 1983). However, land consolidation, especially voluntary consolidation is a failure (Pingali *et al.* 1987). It has several difficulties and is related to many complicated political and administrative issues. Some of the reasons discussed by Basu (2014) that have made land consolidation programs intensely difficult to implement include variation in land quality across plots, fear of eviction and losing a job due to farm mechanization facilitated by land consolidation, hesitation to change the existing arrangements due to their strong sentimental attachment to land parcels, lack of scientific land records, corrupt bureaucracy, and legal loopholes and lack of technical skill on the part of officials were other causes of failure of land consolidation in India.

Natural livelihood assets base of farmer entrepreneurs and the rest of the farming households: We observed that LEAD farmers utilize a higher percentage of land for cultivation purposes. The land entitlement proportion (LEP) in most cases indicate shared entitlement status. All farmer entrepreneurs have higher crop diversity and cultivate different kinds of crops year-round. With high crop diversity, the entrepreneurs have divided their lands into fragments to accommodate several crops showing high value of the Simpson Index of land fragmentation.

It is seen that the entrepreneurs have more cultivable land and total size of holdings than the rest of them. It is also observed that the farmer entrepreneurs have lesser land entitlement proportion than the others. Therefore, joint ownership can play a crucial role for entrepreneurship development amongst farmers. The farmer entrepreneurs have fragmented their lands to a great extent in order to accommodate maximum number of different crops in a year.

Relationship of farm productivity, farm area, and

household income: Farm size (ha)-production (kg/ha) relationship was estimated using farmer response data to the quantity of Aman paddy produced on their farms. The scatter plots indicate a slight although a non-significant increasing trend of farm production of Aman paddy with increasing farm area (Banerjee 1999) both in case of the sample (n=141) as well as farmer entrepreneurs (n=8), which is contrary to commonly found inverse farm size-productivity relationship (Barrett 1996 and Cornia 1985). Considering this positive increasing trend and current level of fragmentation recorded in the study, it would be extremely difficult for the small-marginal farmers to produce Aman paddy for profit as well as home-consumption.

In most cases, secondary occupation supplemented household income. Both the farmer entrepreneurs and rest of the farming households, having a secondary occupation, owned small stationery, equipment's, gift, cycle repair shops, some worked for schools as teachers in primary and secondary schools, etc. and therefore, the use of family labour is not as extensive as it is usually in other cases where farmers are solely farming for livelihood.

Comprehensive Community and Land Resources Utilization Plan (CCLRUP): The field-based observations and data are analyzed, and arguments are put forth to reveal a set of interventions and how those interventions may be achieved through extension support from different governmental and non-governmental aids. It has been organized into a schematic form called Comprehensive Community and Land Resources Utilization Plan (CCLRUP) for better comprehension and application.

Higher productivity than the state average: If we consider West Bengal's average production levels of Aman paddy then production levels are not the point of concern in the study area, however, improper marketing and diminishing returns are the main impediments to secured livelihood from farming in this region. It is, therefore, important that extension efforts be directed towards market-led extension. With the globalization of the market, a farmer will have to transform himself from mere 'producer' in the domestic market to 'producer-cum-seller' in a wider market sense to best realization of the returns for his investments, risks, and efforts (Sharma and Chand 2014).

Lower farm size as compared to national agricultural census 2010-11: Fragmentation has increased many folds because of simultaneous breaking down of the land into small plots for increasing the diversity of crops in one single cropping season. The Extension mediation must focus on motivating the farmers to form voluntary groups. Instilling the benefits of group dynamics and aiding them to deal with associated challenges is one very important task for the Extension agencies. Incentivizing farmers who farm in groups would encourage them to continue their endeavours. Farmer based organizations are good options to facilitate priority setting and decision-making in agricultural and community development programs and facilitate input distribution, credit, processing, and output marketing services.

Very high level of Simpson Index: Highly fragmented farms result in higher costs and unequal attention on plots. Usually, the larger fragment is used for paddy cultivation. Then, the rest of them are further broken into smaller plots to accommodate mustard and other seasonal vegetables. This situation strongly demands an intended change in the pattern of utilizing the land. The prevailing cultural diversity in India with complicated caste systems does not support land consolidation mediated by any law enforcement. However, voluntary group formation is the only way to start farming with viable farm size. Another indirect way to manage fragmentation is to initiate contract farming and collaborative farming. This needs contractual requirements for various farm operations and thus can increase joint farming. The joint activities could range from ploughing to harvesting operations and beyond.

Positive farm size-productivity relationship: Family labour is underutilized in the study area and most farmers hire seasonal labours for paddy cultivation. The skilled seasonal labours for aman paddy have become a scarce resource in recent times. However, engaging women workforce in different ways could be useful. The extension program in this community must focus on building the skills of household women so that they may engage in some income-generating or other productive activities. Educational programs on Homestead food production could be organized (Olney *et al.* 2009).

Patriarchal land ownership rights: In urban areas where women have gained autonomy over property rights and assets with several laws supporting women, the scenario in rural areas of India, still has land ownership being confined to men and later his son. Rural women suffer from acute financial insecurity and are dependent on her husband. Financial literacy is essential and should be a continuous process within the Extension strategy.

Entrepreneurs exploit the land even more: The entrepreneurs (LEAD farmers) in the study are the most efficient ones. However, they are also the ones who fragment their land into maximum number of plots. They should be the first set of farmers whom the extension must convince to farm jointly.

Joint ownership and farming are prevalent among entrepreneurs: The results indicate that the entrepreneurs already have higher rates of joint ownership and that they prefer farming together, therefore, motivating them for voluntary group formation would probably yield good results. This could act as an example for the rest of the farmers to follow the same path.

Higher rates of secondary occupations: Uncertain and unpredictable income in agriculture over the years has compelled farmers to look for alternative jobs. All farmers during the field survey have been stating 'low income from agriculture' as the sole reason for having an ancillary occupation. It's clear for the Extension perspectives that farm income has to be raised to ensure farmer's well-being. Considering the present high productivity of Aman paddy in the study area, updated market information for

paddy must reach them. This would ensure proper market channels and ensure good prices, sidestepping the local middlemen.

The small-marginal farmers have limited resources and they must produce enough to feed their families and the rest of the population. However, it is going to be difficult for the farmers in the coming years as the population grows and the land fragments further. With this, the per-unit land production might remain same but eventually, each farming household produces less and earns less. This is alarming as it leads to household food and income insecurity. The traditional role of extension personnel has been conveying research findings from scientists to the farmers and feeding back the impressions from the farmers to the scientists. However, this exercise needs to be more scientific and involve a substantial amount of research from the end of the extension scientist. The CCLRUP is one such attempt to systematically gather findings related to the problem of land fragmentation in this case and look for feasible solutions. From the viewpoint of extension services, as discussed within the CCLRUP, there is pressing need for capacity building programs focussing on how to deal with small-marginal holdings and yet farm profitably. The extension services must ensure a better participation rate in capacity building programs. Further, investigations on the implementation and acceptability of CCLRUP should be investigated and validated.

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