A Micro-Level Quantitative Analysis of Farmers' Coordination with Their Land, Family, and Occupational Status in Barddhaman District of West Bengal

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Abstract— **The livelihood of the farmers is now intensively dependent on their changing attachment to the land. The objective of the study is to analyze the psycho-social relationship of the farmers with land in Barddhaman District of West Bengal, India. The study has been formulated using the perception-based primary survey with the selection of sixty respondents of heterogeneous ages, genders, castes, classes, and farmers' occupational categories. The priority-based ranks of the quantity of land, number of family members, and monthly income are put into a triangle. The changing positions of the resultant triangles with the intersecting medians show the situation of the respondent with their varied relationships (high, moderate, and low) with the land. In the case of the sixty respondents, six categories of shapes of the triangles with changing centre of gravity have been found along with one equilibrium position situated in the mid-point where the graphical distance of the respondents from land, family, and occupational status other than agriculture is equal (in case of one specific respondent). The farmers' relation (in the triangles) with the land is inversely related to the farmers' relation with family and occupational status other than agriculture. Finally, 51.67 % of the farmers have been found who be highly attached to the land, 33.33 % are moderate and 15 % are included in the low-level attachment. The psycho-social relationship of the farmers with the land is statistically significant ($p<0.001$, n=60) which could be justifiably stabilized with the integrative development of agriculture and agrarian communities in the study area.**

Keywords— **respondents' categorization; agrarian background; farmers' responses; relational triangles; psycho-social relationship**

I. INTRODUCTION

A. *Conceptual Background: Participants' Observation*

Agriculture is a systematic framework for the connection between humans and plants. Farmers have been considering the inter-specific and psycho-social relationship between agriculture and related activities for many years, considering changes in their psychology and cognitive modules. The agricultural landscape, its practices, and its management were greatly impacted by the cognitive psychology and mental models of farmers [1]. In India, agriculture is the cornerstone of all economic activity, and a sizable portion of the population 54% works in agriculture and related fields [2]. According to the Reference [2], 17% of India's Gross Value Added (current price 2015-2016, 2011-12 series) comes from agriculture and related activities. Furthermore, India's agricultural sector contributes 2.6% and 1.7%, respectively, to global agricultural commerce in exports and imports. Thus, the psychological state of the impoverished farmers and their current cognitive nature regarding the land and related agricultural activities gain importance, and the realization of the agrarian communities' responses also reveals the pertinent conceptualization of the realistic psycho-social situation of the impoverished farmers. The current study indicates the psycho-social interaction between the land and the farmers as well as an integrated interspecific relationship between the

agricultural land and the agrarian classes of the studied area. How do farmers relate psychologically to the enslavement of agriculture in their day-to-day existence, and why are they closer to the land? The current study has examined these, offering improved opportunities for the growth of rural communities. To achieve these goals, the current study establishes background information regarding the real understanding of the relationship between agricultural land and agrarian communities in the specific study area. West Bengal is one of the most important agricultural states in India. The rice bowl of West Bengal, Barddhaman District, is the centre of agricultural activity in rural areas where farmers' relationships to their land are closely monitored. The impoverished agricultural communities' live hand to mouth, but because of their cognitive disposition, they are more inclined to cultivate land than engage in other activities. The purpose of the study is to understand how farmers respond to their cognitive abilities and psycho-social situations, as these factors build a connection between farmers and the land-oriented economy in the study area. The study area under consideration exhibits variability in the psycho-social aspects of agricultural communities, as well as variations in income generation during the seasons. The study area's social strata are also determined by the diverse economic structures that comprise large land owners, minor land owners, renters, and agricultural labourers from different castes, genders, religions, and age groups. This conceptual framework serves as the foundation for the study, which focuses on the socio-personal and behavioural identities of the agricultural communities and how they connect with the land in the study area through various activities. Additionally, the current study attempts to support policies that will improve the standard of living for impoverished farmers.

B. Studies on Farmers' Attitudes Towards Land

To comprehend the conceptualization of the issues, many literature evaluations have been introduced. Social psychologists have worked to establish a relationship between social space and human motives since the early 1900s. It is noted in the research on farmers' attachment to their land that how farmers form relationships with their land have implications for landscape management and food systems [3]. According to Reference [4], place attachment is the bond between people and their place. In Kisii County, Kenya, coffee farmers are older, on average, at 55 years old, and they have a strong attachment to their coffee plantations. This highlights the lifelong bond that exists between farmers and farms [5]. Reference [6] shows a study in the United States that formulated the identities and responses of farmers to the social and biophysical environment. The function of social capital in Sardinia, Italy's Arborea District is mentioned to implement adaptive responses to contextual changes for sustainable agricultural management [7]. In the study indicated by Reference [8], the affection of the farmers on the land helps to understand the socio-ecological connectedness of rural landholders. Reference [9] stated that the results pertain to the association between various selected personal, socio-economic, and psychological traits of dairy farmers and their entrepreneurial behaviour. It was found that the independent variables show a non-significant correlation between the respondents' entrepreneurial behaviour and the dairy farmers' occupation and family size. According to Reference [10], the infrastructure summarized the relationship between the personal, socio-economic, communicational, and psychological characteristics of dairy farmers with their entrepreneurial behaviour. The decision-making model, cross-scale and cross-level pressures, and temporal dynamics are the three unique significant models to understand the behaviour of farmers that are important to be investigated by the current research [11]. A descriptive study is carried out in the central area of Sari County, Iran, analyzing farmers' pro-environmental concerns and behaviours toward soil conservation [12]. According to Reference [13], the agricultural activities carried out by women farmers in Iran are related to the three fundamental criteria: economic, personal, and socio-psychological features. Reference [14] imparts a study on Bangladesh's important agricultural region, which is one of the most reliable places to gauge farmers' psychological health. The land and related activities are also linked to the farmers' mental health

and misery. They may harm themselves with emotional sensitivity even if their agricultural land is being indebted due to any kind of difficulty. A study conducted in rural Karnataka revealed that farmers' socioeconomic characteristics and psychological well-being are associated with each other [15]. In Karnataka, farmers' suicide tendencies are influenced by their socioeconomic and psychological characteristics, while socially conscious personalities and emotional anguish lead sensitive farmers toward suicide [16]. Additional studies corroborate this understanding of farmers' psychological attachment to their land. The relationship between the fifty farmers in the study villages of Metuge District, Cabo Delgado, and their perceptions of conservation agriculture or non-conservation agriculture was distinguished in the study shown in Reference [17]. From the perspective of the Indonesian citizens' attachment to their locations, the study in Reference [18] investigated agricultural land conservation measures. According to Reference [19], older farmers in the Republic of Ireland have deeply embedded relationships with their farms. The study associated with Reference [20] showed how Vietnam's farmers' society changed behaviourally and psychologically because of a market-oriented economy. The behavioural and economic elements governing the relationships among the farmers in conservation agriculture, considering their fluctuating income structures in Ishikawa Prefecture, Japan [21]. The association between the relocated farmers' places of land attachment and their relocation in Jiangsu, China, was also explored by the study indicated in Reference [22].

Based on the context of the previously mentioned literature review, the research's specific orientation emphasizes how a farmer's responses are related to a variety of factors, including their means of subsistence, the state of their farm, the care of their animals, sustainability, the climate, the market economy, and debt. In the research area of Samudragar Mouza in Purbasthali Block I in Barddhaman District in the state of West Bengal, India, a model is used to establish distinct tissue-specific responses to people's cognitive and psycho-social relationship with the land (2015-2016), so justifying the research gap. The land and related cultivation procedures are tied to the cognitive characteristics of the agricultural populations in the study area.

C. Objectives

The study conducts the principal objectives to,
1. Assess the present socio-personal characteristics of the respondents in the study area.
2. Describe the farmers' responses and the interrelationship between their land, family, and occupational status other than agriculture.
3. Analyze the level of psycho-social relationship of agrarian communities with the land and allied activities in the study area.
4. Build a general and conceptual model related to farmers' psycho-social relation with the land.

II. MATERIALS AND METHODS

A. Study Area

Samudragar Mouza (Jurisdiction List number: 180) in Purbasthali-I Community Development Block in Barddhaman District (undivided) is chosen as the study area (Fig. 1) because the area's impoverished agricultural populations mostly rely on land-related activities. One of the principal regions for paddy cultivation in Barddhaman is Samudragar Mouza, which is home to a particular population of farmers and agricultural labourers who are either directly or indirectly involved in land cultivation. The western alluvial plain of Bhagirathi-Hugli accounts for most cropping incidents throughout the year, making this district exceptional in terms of agricultural output. An average of 58% of the population in the area works in agriculture or related fields [23]. In the 1980s and beyond. A significant land reformation had an impact on

the allocation of agricultural lands and occupational structures in the rural districts of West Bengal in India [24]. In the rural districts of the Burdwan (former) District of West Bengal, the Panchayat governance system and the green revolution had a significant impact on the shifting scenarios of landholding ownership relations with the agrarian population [25]. The study area draws some perception-based knowledge on the responses of agricultural communities concerning their psycho-social interaction with the land to accomplish specific objectives and conceptualize the issue. The geographical area of Samudragar Mouza consists of 513.11 hectares. The eastern border of the study area is bounded by the older Bhagirathi-Hugli channel, which is commonly known as *Mari Ganga* (Dead Ganges). This area is an alluvial plain that is rich in fertile alluvial soil. Its climate is classified as tropical monsoon, with hot, humid summers and cold, dry winters. Most of this region is occupied by build-up and commercial areas (33.46%) and agricultural fields (56.96%). The study area has a total population of 13089 people, of which 6826 are male and 6263 are female. The primary economic activity of the population is agriculture, but they also work in household working activities and commercial activities [26]. This Mouza was also home to a sizable number of businesspeople and service providers. The government's attempt to provide 100 days of labour has not been fairly dispersed among the impoverished people.
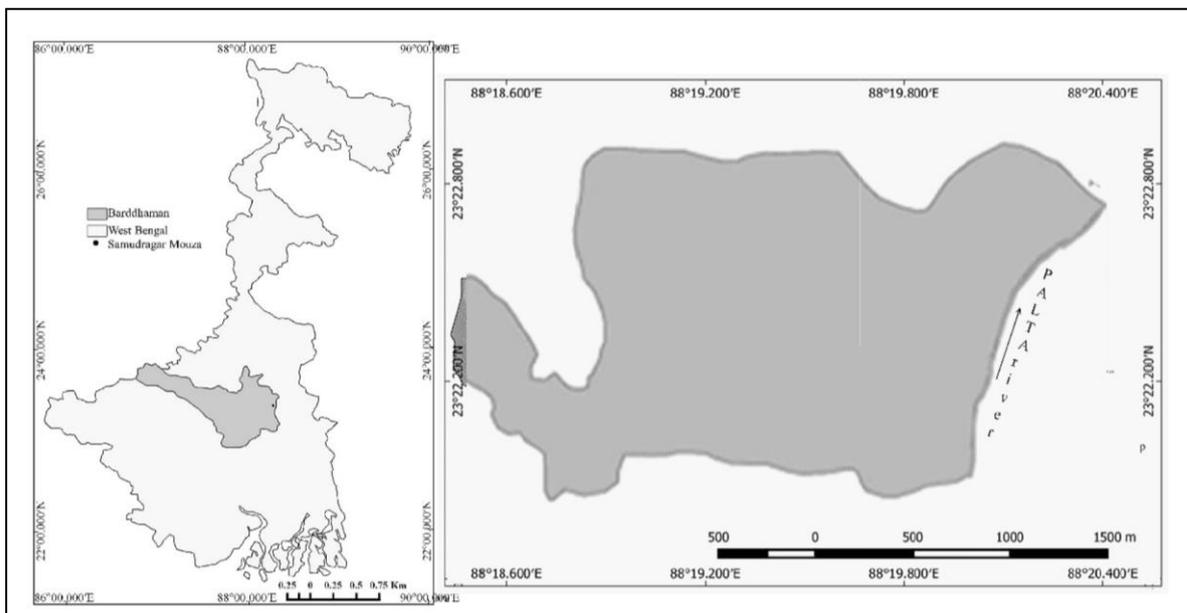

Fig. 1(a) Location of Samudragar mouza in Barddhaman district (undivided) of West Bengal Fig. 1(b) Map of Samudragar mouza
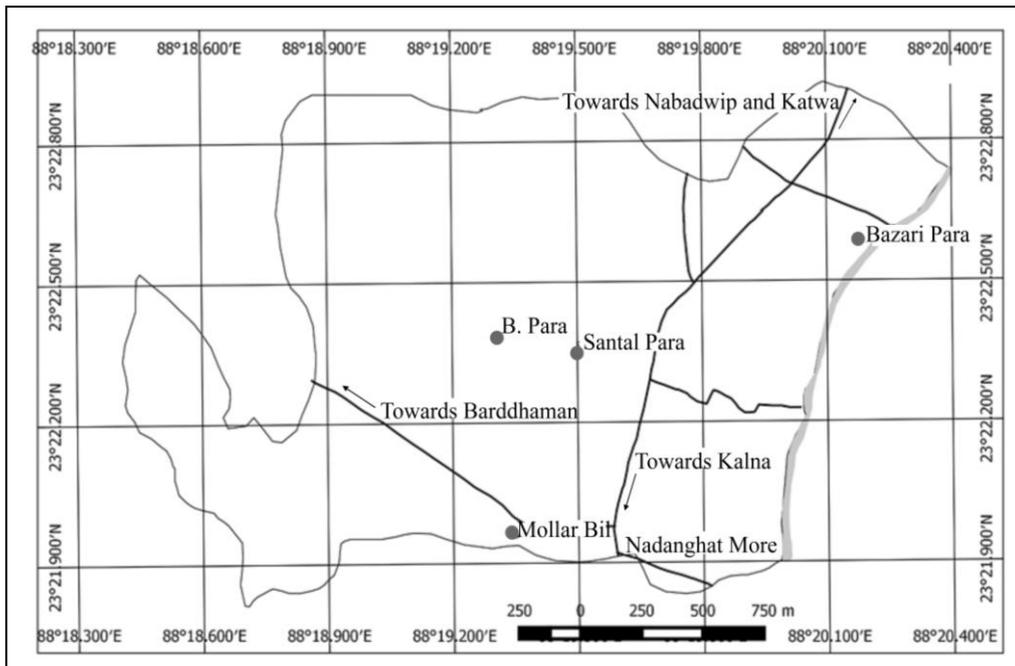
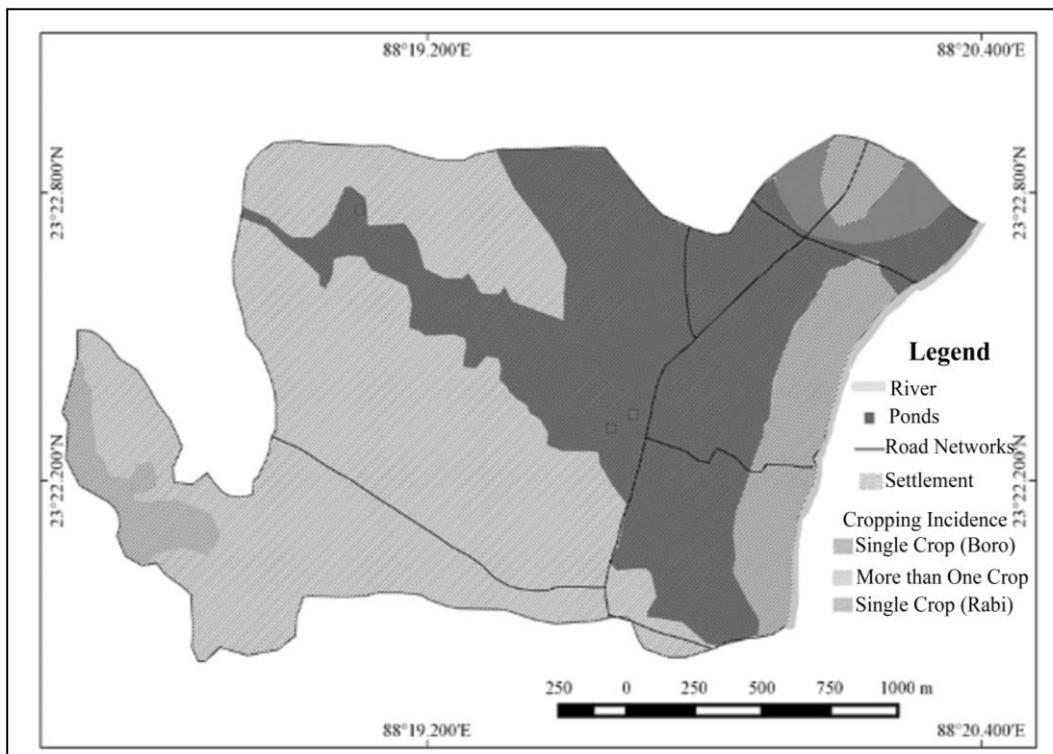Fig. 1(c) Location of community-based localities (*Para*) in the study area

Fig. 1(d) Cropping incidents performed by the farmers in the study area

Fig. 1 (a-d) Location map and cropping incidence of the study area

B. *Primary Survey and Secondary Data Collection*

The study was conducted using a primary survey technique conducted in March 2016, such as a perception survey, face-to-face interactions, and participants' observations. Relevant secondary databases have been collected also from the Census of India (2011) database.

1) Selection of Sample Size: In the present study, simple and purposive random sampling techniques have been employed for the primary survey. A total of 60 respondents of various castes, classes, genders, occupations, and ages were selected randomly to perform a face-to-face interaction with the local stakeholders to perceive the responses of agrarian communities about their psycho-social relationship with the land.

TABLE 1
Categorization of the Respondents

Caste	General	
	Scheduled Caste (S.C.) [27]	
	Scheduled Tribe (S.T.) [27]	
	Other Backward Classes (O.B.C.) [26]	
Religion	Hindu	
	Muslim	
Occupation	Landowners	Cultivators (Main)
		Cultivator (Marginal)
		Landowners other than Cultivators (Large)
		Landowners other than Cultivators (Small)
	Tenants	
	Agricultural Labourer (Main)	
	Agricultural Labourer (Marginal)	
Gender	Male	
	Female	
Age-Group in a year (Adult persons)	18-25	
	26-33	
	34-41	
	42-49	
	50-57	
	58-65	
	> 65	
Source [28] (modified by the authors)		

2) Methodological Framework: The study has employed the analysis of farmers' responses to build up a relative relationship between farmers and their land, family, and occupational status. The unstructured responses of the respondents are set up under a framework of structured responses [28]. Then, the structured responses of the farmers are categorized through Question-response-categories analyses [29]. Besides, spreadsheets and statistical software have been utilized for the analysis and representation of collected data. Fig. 2. Represents the generalized conceptual framework of the methodology of the study. Based on the total sample, 60 respondents (R_1 to R_{60}) are selected and then their psychological responses and occupational status are analyzed to build up a triangular model associated with the relationship between farmers' cognition and land use activities.
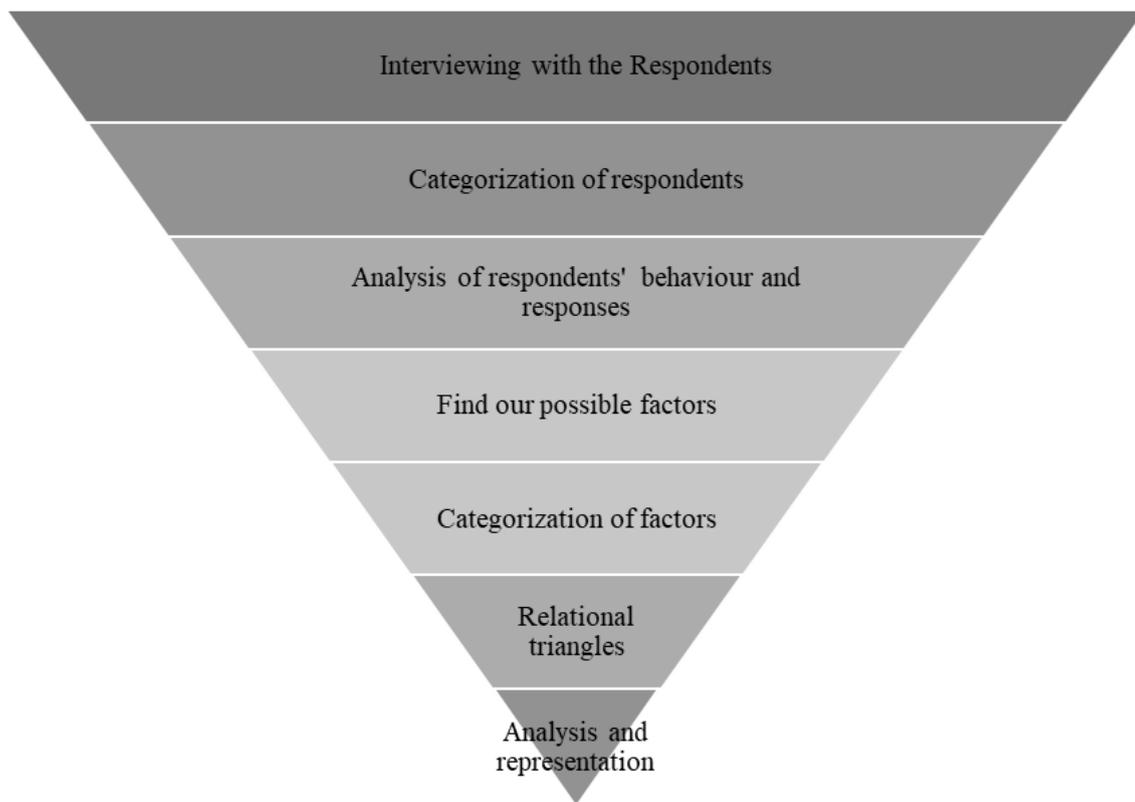
Fig. 2 The step-by-step methodological framework of the present study

The intersection of the three equal-length lines across a point of the triangle's centre of gravity is set up to be represented by the three psychological perceptions of each person's social background (Fig. 3). It is thought to represent the respondents' psychological equilibrium posture (Fig. 3). Alfred Weber successfully applied the Relational Triangle in social science research as a variant of the Locational Triangle [30] in his investigation of Industrial location theory. This kind of approach was used in earlier studies. The study associated with Reference [31] expressed specific parts of the human relational system using the Relational Triangle. It becomes possible to represent a wide variety of different kinds of relationships by varying both the area and the shape of the triangle of love [32]. The notion of developmental psychologists employed the triangle metaphor in the theory of human development to illustrate the social constitution of psychological development. This metaphor uses the three distinct relational triangles found in Behaviourism, namely the emotional, meditational, and socio-cognitive triangles [33]. A triangular shape showed interdependence, that material, relational, and subjective aspects of well-being are inextricably intertwined, according to the formulation of [34]. Furthermore, the study in the Reference [35] revealed the interaction design research triangle at the Umeå Institute of Design, Umeå University, in Sweden. The typology of community development trajectories was represented by a socio-ecological system of viewpoint of the triangles utilizing the following three parameters: 1. Resource base; 2. Connectivity; and 3. Social adaptation [36]. The theories, concepts, and facts of scientific advancement and psychological research have been used to illustrate the idea of the various forms of the epistemic triangle and the shifting relationship among factual, theoretical, and conceptual investigations at its vertices [37]. The study of counties of the Kerman province in Iran developed the evolving dimensions of the triangle aspect of agricultural sustainability indicators using the AMOEBA diagram [38]. Additionally, the figure (Fig. 4) below depicts the different shapes of the triangles based on the shifting positions of the farmers' psycho-social conditions within the dynamic nature of the physical and social environs.
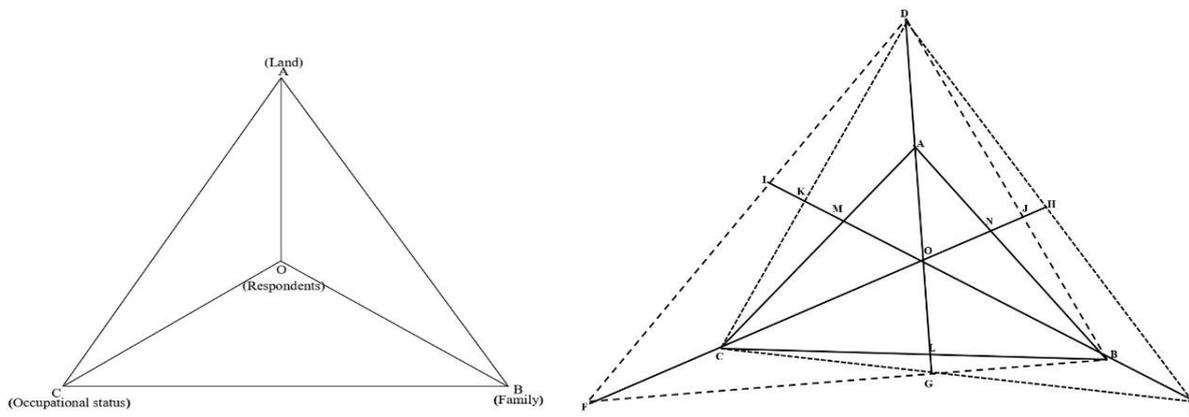
Here, OA = OB = OC.

Fig. 3 The triangular formation of farmers' psycho-social relationship with three basic aspects (Land, Family, and Occupational Status) Fig. 4 Changes in the structure of a Triangle

Based on Fig. 4 thirteen relationships have been formulated as follows.

(a) OA = OB > OC   (b) OA < OB = OC

(c) OA > OB > OC   (d) OA = OC < OB

(e) OA = OB < OC   (f) OA = OB = OC

(g) OA = OC > OB   (h) OA > OB < OC

(i) OA > OB = OC   (j) OA < OB < OC

(k) OA > OB < OC   (l) OC < OB > OA

(m) OA > OC < OB

Here, the Relational Triangle [35] is modified by the authors. The various changes occur in the shapes (Fig. 4) according to the change in the length of the intersecting lines of the triangle but the area remains the same. The triangle-based conceptual diagrams have been reconstructed to show the farmers' psycho-social relationship with the land, family, and occupational status in the Results and Discussion section (section 3).

To find out the correlations between the land, family, and occupational status (their absolute and distance value) Pearson's formula of r [39] has been used. Multiple linear Regression Model [40] has been used to identify the relationship between one dependent variable (Distance from respondents to land in the triangles) and two independent variables (distance from respondents to family and occupational status), weighted by the absolute quantity of land (in hectares) of the farmers. The F value in the jth one-way ANOVA [41] is also calculated concerning the F-statistic which follows the F-distribution with $K-1$, $N-K$ degree of freedom under the null hypothesis. The test of significance [42], [43] has been adopted to observe whether the relationship is significant or not.

III.   RESULTS AND DISCUSSION

  a.   *The Categorization of the Respondents Based on Their Agrarian Background*

Agrarian communities' psycho-social relationship with the land is shaped by both extrinsic and intrinsic motivation. According to the literature review, there are some distressing and disruptive conditions in the current agricultural situation in a globalized economy, and the farming communities adjacent to the land-cultivation processes have failed to maintain the stability and balance of their attachment to the land. Occasionally, farmers in emerging nations are compelled to abandon their farming pursuits and are constrained by their connection to the land. The psycho-social situations of farmers concerning their land are under consideration in the subject area. The primary elements of those relationships are determined by the potential causes that have been discovered via the examination of the farmers' perspectives on their relationship with the land.

Most of the respondents in the current study area are from an agrarian background, and the main boundaries of their socio-economic conditions to their current life circumstances are the land's cultivation processes. While different psychological states of the agrarians have been identified in the study area, the most significant criteria, with its ever-changing factors, revolve around the land and its cultivation process. Most of the respondents in the Mouza are cultivators, tenants, and agricultural labourers, and their primary way of life revolves around land-related activities like sowing, ploughing, and ripping. They are seasonal workers who manage the farming processes, and their societal and cognitive responses are always in line with the idea of making the land more productive. Currently, in 2015 and 2016, the agricultural community is always concerned about the debts they have incurred from their farming-related endeavours. The agricultural communities within the study region have been categorized into seven groups, including.

1. Landowners
   a. Cultivators (Main)
   b. Cultivators (Marginal)
   c. Landowners other than cultivators (Large)
   d. Landowners other than cultivators (Small)
   e. Tenants
2. Agricultural Labourers (Main)
3. Agricultural Labourers (Marginal).

b. *Socio-Personal Identities of the Respondents*

The representation of respondents with different socio-personal identities is based on the classification scheme described in Table 1. The categories of the farmers by age, gender, caste, occupation, and religion are depicted in the figures (Figs. 5, 6, 7, 8, 9). Most respondents in the study area identify as Hindu. Male respondents who are primarily classified as being between the ages of 34 and 41 expressed strong opinions regarding their day-to-day experiences in the agricultural land. Within the study area, the respondents comprise 30% of the general caste, 64% of SC, 3% of ST, and 8% of OBC. Out of all the respondents, 50% are main cultivators, 3% are marginal cultivators, 12% are landowners, 20% are tenants, and 15% are agricultural labourers (13 % main, and 2% marginal).
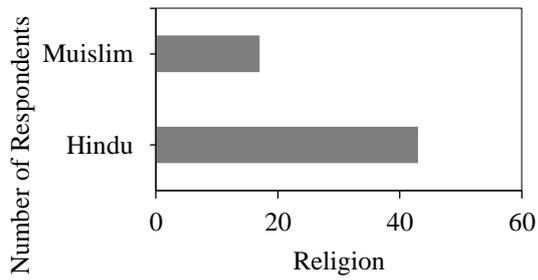
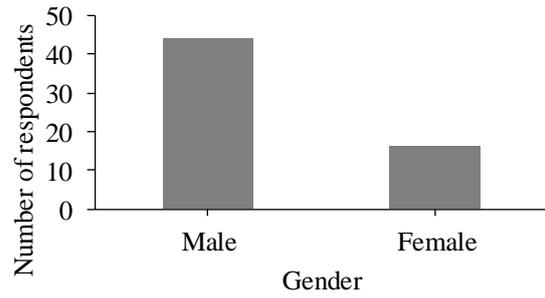Fig. 5 Male and female respondents

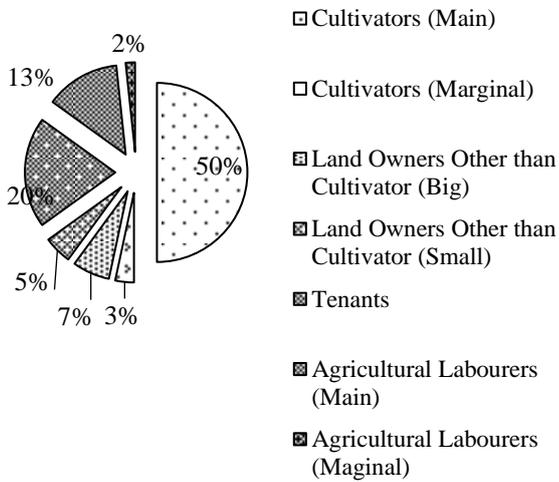Fig. 6 Religious types of the respondents
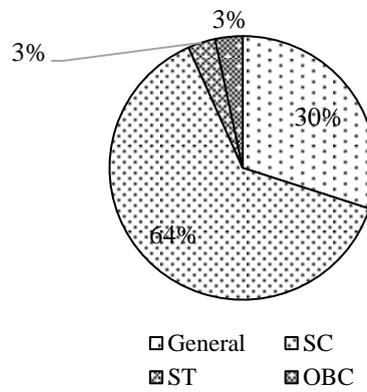

Fig. 7 Types of occupation
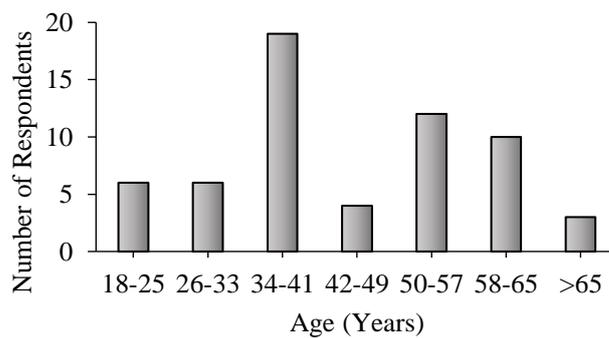

Fig. 8 Types of casts

Fig. 9 Age-specific numbers of the respondents

    c.   Nature of the Farmers' Responses

The study examines the cognitive responses of farmers from various castes, religions, occupational categories, genders, and age groups. Out of sixty comments, ten have been chosen and illustrated to show the relationships and responses from various perspectives within the agrarian culture. Farmer cognitive attitudes toward land, family, and status are primarily influenced by psychological and socioeconomic factors. Farmers are unable to separate themselves from their connection to the soil because of their obligations to it. Respondent 1, a 22-year-old Hindu farmer, stated that they experienced losses in field cultivation as well as difficulties with land ploughing during the *rabi* season (winter crops). The double-cropping cultivation results in a reduction of 500 rupees (rupees 4000/Bigha (1 Bigha = 0.1605 Hectares) as a cost and rupees 3500/Bigha as a benefit). The responders are troubled by the loss in land cultivation and land ploughing. Respondent 1, a 57-year-old Hindu Scheduled Caste farmer, stated that he had borrowed rupees 1 lakh for cultivation purposes from a local *samiti* (a kind of cooperative private organization prevalent in India, primarily in West Bengal); the loan was repaid seasonally; the flood of 2015 destroyed paddy and jute, while the destruction of *masur* (a type of pulse) and black gram occurred in 2016. The primary issues are the damage that natural catastrophes do to crops and the resulting debt that is created. Respondent-10, a 28-year-old Hindu Scheduled Caste cultivator, stated that she was receiving continuing treatment in Ranaghat at a cost of rupees 1500 to rupees 2000 per visit for a brain condition. Her family had taken out a 30,000-rupee debt from the bank. They paid the local middlemen twice as much in interest even though they did not receive any relief from the flood. The treatment for neurological issues had been paid for with a substantial sum of money. Financing and special flood aid have not yet been provided. Respondent-12, a 55-year-old Hindu Scheduled Caste farmer, stated that in 2006, the bank had given him credit for rupees 6,000 to be used for farming. It was not paid for up until today. Respondent 21, a 19-year-old Muslim farmer, discussed the labour and financing issues associated with farming. Respondent-24, a 45-year-old Hindu farmer from the Scheduled Tribe, discussed his issue with debt, which is a large source of worry for him and his family. Respondent-29, a 50-year-old Hindu Scheduled Caste farmer, discussed his 20-year-old son's heart operation, agricultural waste, and difficulties obtaining fertilizer over the preceding five years. A 35-year-old Hindu Scheduled Caste cultivator identified as Respondent-34 obtained an eight-year credit of rupees fifty thousand from the local *samiti* for house repairs. The 35-year-old Hindu Scheduled Caste tenant, Respondent-41, stated that the cost of agriculture was steadily rising faster than the cost of other components of her livelihood. In response, the respondent, a 54-year-old Muslim agricultural labourer from the General caste, stated that he had lost rupees 60,000 in the *Roseville* cheat fund (a private fundraising company located in West Bengal). These responses are provided here to provide insight into the farmers' perceptions and reactions about their livelihood concerns and land-cultivation difficulties.

    1) Farmers' Attachment to the Land: The statements provided by the respondents have been thoroughly examined, and their responses that confront criteria—such as their promises regarding financial limits, concerns regarding specific details of their debt, and susceptibility regarding their means of subsistence—are also stated here. The identities of the sixty respondents are listed as R1, R2, …, R60 following the temporal sequences of an interview during the survey. According to the respondents' prioritization of their land, family, and occupation, high priority is ranked 1, moderate priority is ranked 2, and low priority is ranked 3. Finally, some components have supported the psychosocial interaction between farmers and the land. Three suitable components—land, family, and occupational status (other than agriculture)—have been selected based on the categorization of the priority-based responses of the farmers.
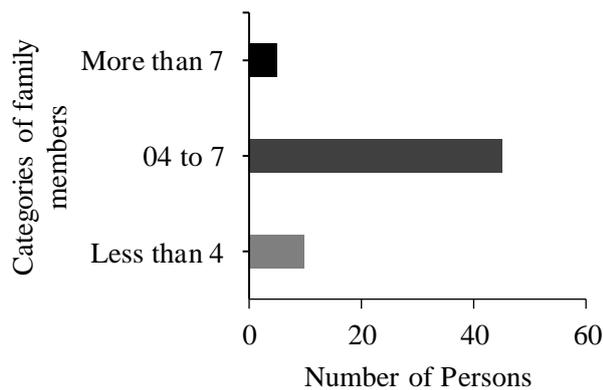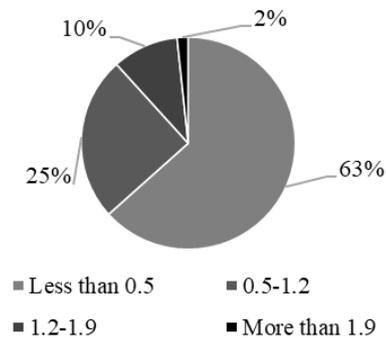
Fig. 10 Amount of land (%) of the farmers

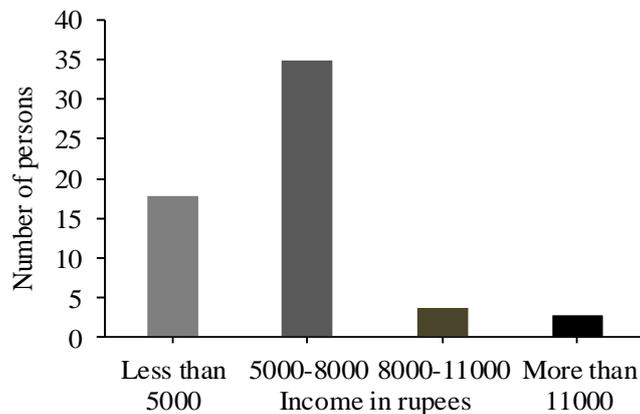Fig. 11 Family members of the farmers

Fig. 12 Monthly income of the farmers

The scenarios of the farmers' land area, family size, and monthly income are depicted in the figures (Figs. 10, 11, 12). Here, the land is represented in hectares, the family is represented by the members of the family, and the occupational status is indicated by the monthly income in rupees.

2) Construction of Relational Triangle (Correlation Between the Different Controlling Factors of Farmers' Relation with Land): The various triangle formations are located and depicted in the figures (Fig. 13 (a, b, c, d, e, f)) below, which are based on the responses provided by the respondents on the priority level of the land, family, and occupational status. Based on the degree of prioritizing, six classes are created from the triangles.
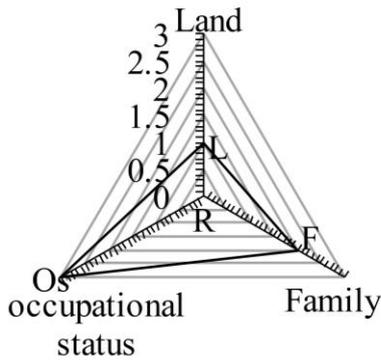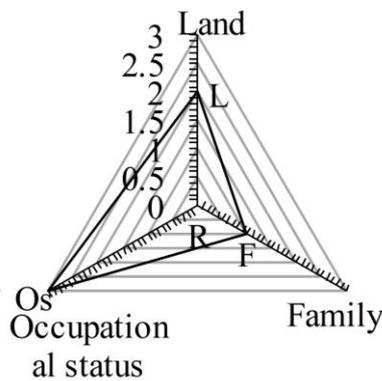
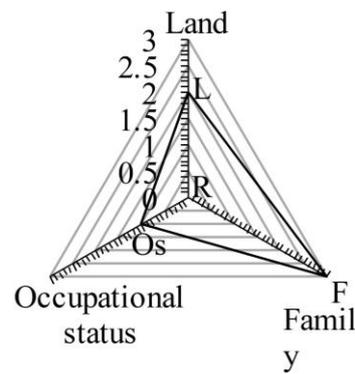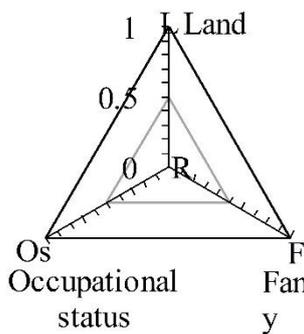Fig. 13 (a)   Fig. 13 (b)   Fig. 13 (c)

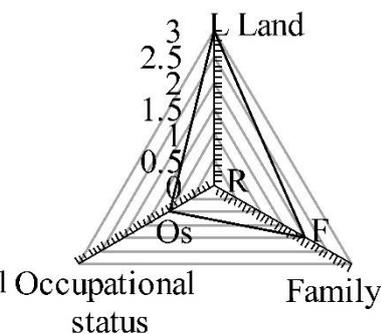Fig. 13 (d)   Fig. 13 (e)   Fig. 13 (f)
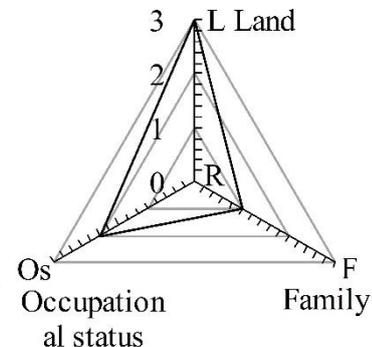
Fig. 13 (a) 1-2-3 combination (RL < RF < ROs) Fig. 13 (b) 2-1-3 combination (ROs > RL > RF) Fig. 13 (c) 2-3-1 combination (ROs < RF > RL) Fig. 13 (d) 1-1-1 combination (RL = RF = ROs) Fig. 13 (e) 3-2-1 combination (RF < RL > ROs) Fig. 13 (f) 3-1-2 combination (ROs < RL > RF)

Fig. 13 (a-f) Different combinations of the triangles based on the rank of priority on the land, family, and occupational status given by the farmers (Diagrams have been structured with 100 % Height and Width scale ratio in Microsoft Excel: 2013 and resolution would be fixed as represented here)

From each triangle's centre of gravity point to its vertices, the farmers view the distances as their measurements of priority (relational priority) based on the three components listed above. The six categories of triangles are found based on the provided ranks (Fig. 13 (a, b, c, d, e, f)). The responses are denoted by the letters R, L, F, and Os, and the distances that separate R from L, F, and Os—such as RL, RF, and ROs—represent the farmers' various relationships to land, families, and occupational status. The 1-2-3 category, which emphasizes the strong priority farmers place on their land and family, and less emphasis on occupational status, is depicted in Fig. 13(a). Family comes first, land comes second, and occupation comes last in Fig. 13(b). In Fig. 13 (c), the 2-3-1 combination is depicted, signifying a high priority for occupational status, a moderate priority for land, and a low value for family. The equal priority (1-1-1) on land, family, and occupational status is depicted in Fig. 13 (d). Next, Fig. 13 (e) prioritizes work status highly, family moderately, and land less. Fig. 13(f), the triangle, indicates that family comes first, followed by occupation somewhat, and land less. Table 2 lists and counts the number of farmers that are a part of each category or triangle.

TABLE 2
Categorization of Relational Triangles

Categorization of Triangles (Combination of the Rank of Priority)	No. of Respondents (R)	Graphical Distance (cm) from Land (R to L)[a]	Graphical Distance (cm) from Family (R to F)[b]	Graphical Distance (cm) from Occupational Status (R to Os)[c]	Relation(s)
1-2-3	30	0.65	1.25	1.9	RL < RF < ROs
2-1-3	18	1.3	0.6	1.9	ROs > RL > RF
2-3-1	2	1.3	1.9	0.6	ROs < RF > RL
1-1-1	1	1.6	1.6	1.6	RL = RF = ROs
3-2-1	3	1.9	1.3	0.6	RF < RL > ROs
3-1-2	6	2	0.6	1.2	ROs < RL > RF
[a] [b] [c] Relative distances have been measured from the center of each triangle (R) to the vertices (L, F, and O$_s$) in Fig. 13 (a-f) in Microsoft Excel: 2013 with 100 % height: 100 % width (Height and Width scale ratio).					
Source Authors' Calculation					

Based on the measurement of the distance from the center of gravity of each triangle to each of the vertices (shown in Table 5) the represented correlations are found below in Fig. 14 (a, b, c, d, e, f, g, h, i). Here, in the point distribution diagrams, the correlations between the absolute value of the land (in hectares), family (number of family members), and Occupational status (monthly income), as well as the distance value from the centre of gravity of each triangle to each of the vertices of the priority level of the land, family and occupational status given by the farmers have been shown. Based on the value of correlation coefficients (r) the following formulae of relationships are adopted. The value of 'r' in the Fig. 14 (a) is 0.3043 (positive relationship in between absolute value of land and family), in the Fig. 14 (b) is 0.7237 (positive relationship in between absolute land and absolute income/occupational status), in the Fig. 14 (c) -0.5719 (negative relationship in between distance value of land and distance value of family), in the Fig. 14 (d) -0.6535 (negative relationship in between distance value of land and distance value of occupational status), in the Fig. 14 (e) 0.1945 (positive relationship in between absolute value of land and distance value of family), in the Fig. 14 (f) 0.2200 (positive relationship in between the absolute land and distance value of occupation) in the Fig. 14 (g) -0.3303 (negative relationship in between absolute land and distance value of land), in the Fig. 14 (h) 0.0655 (positive relationship in between absolute family and distance value of land), lastly in the Fig. 14 (i) -0.2588 (negative relationship in between the absolute income/occupational status and distance value of land).
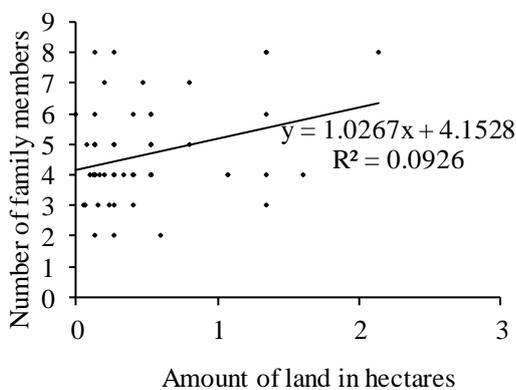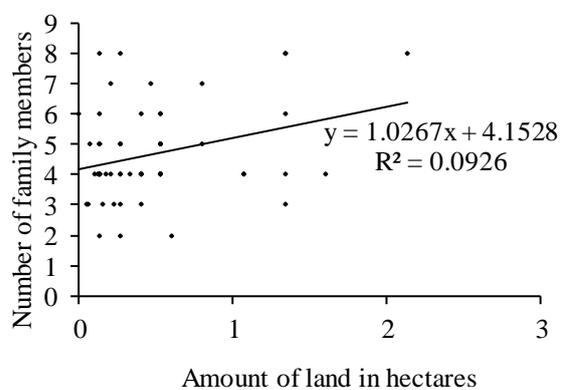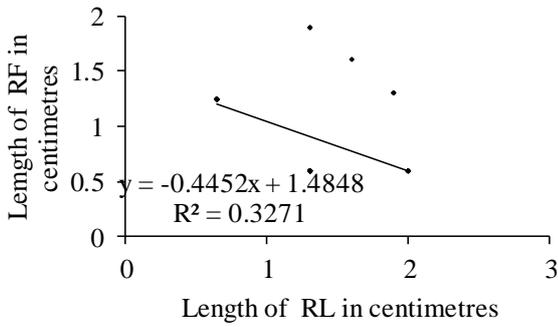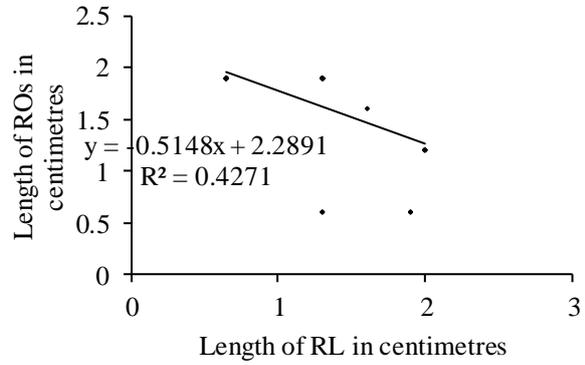

Fig. 14 (a)

Fig. 14 (b)

Fig. 14 (c)

Fig. 14 (d)
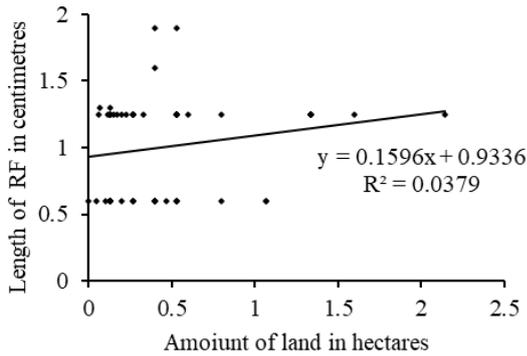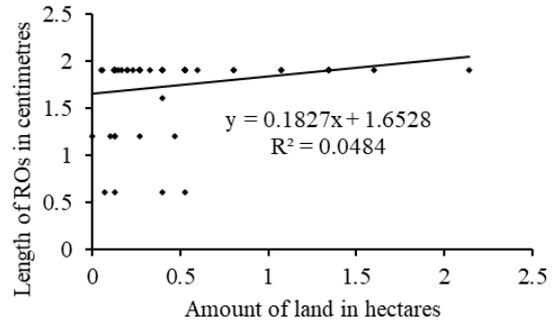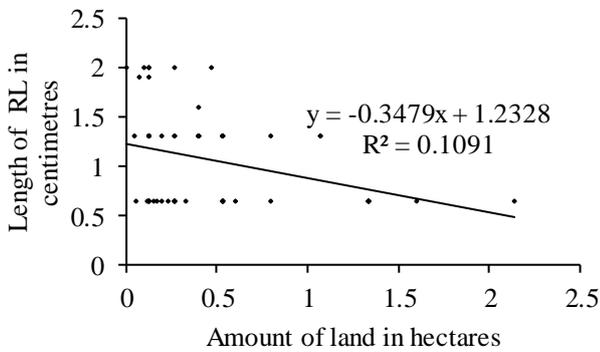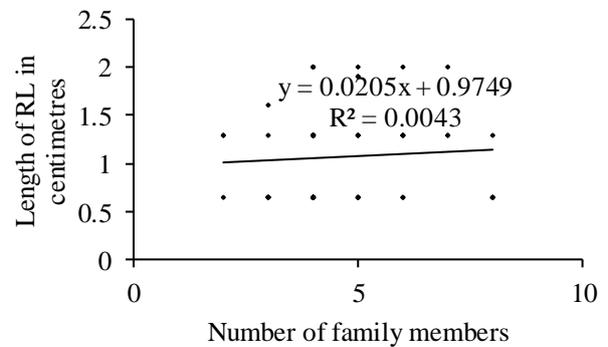

Fig. 14 (e)

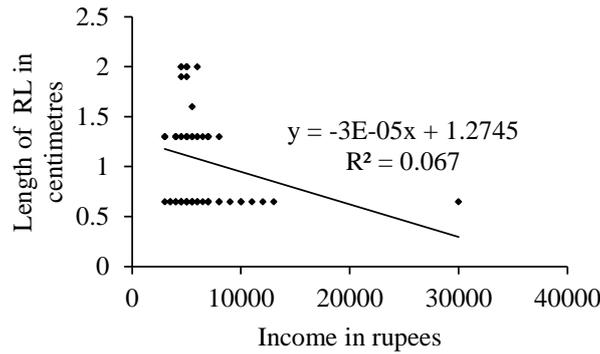Fig. 14 (f)

Fig. 14 (g)

Fig. 14 (h)

Fig. 14 (i)

Fig. 14 (a) Relationship between absolute amount of land and family members Fig. 14 (b) Relationship between absolute amount of land and monthly income Fig. 14 (c) Relationship between RL and RF Fig. 14 (d) Relationship between RL and RO$_s$ Fig. 14 (e) Relationship between absolute amount of land and RF Fig. 14 (f) Relationship between absolute amount of land and RO$_s$ Fig. 14 (g) Relationship between absolute amount of land and RL Fig. 14 (h) Relationship between family members and RL Fig. 14 (i) Relationship between occupational status and RL

Fig. 14 (a-i) Relationships between different absolute and distance values of land, family, and occupational status

TABLE 3
Correlation Matrix

Correlations[a]				
		RL	RF	ROs
Pearson Correlation	RL	1.000	-0.622	-0.524
	RF	-0.622	1.000	-0.275
	ROs	-0.524	-0.275	1.000
Sig. (1-tailed)	RL		0.000	0.000
	RF	0.000		0.017
	ROs	0.000	0.017	
N	RL	60	60	60
	RF	60	60	60
	ROs	60	60	60
[a]Weighted Least Squares Regression - Weighted by land				
Source Authors' Calculation				

Based on the relationship, the following formulae have been adopted.

$$L \propto F \underline{\hspace{2cm}} (1) \quad L \propto Os\,(I) \underline{\hspace{1.5cm}} (2)$$

$$RL \propto {}^1\!/_{RF} \underline{\hspace{1.5cm}} (3) \quad RL \propto {}^1\!/_{ROs} \underline{\hspace{1.5cm}} (4)$$

$$L \propto RF \underline{\hspace{1.5cm}} (5) \quad L \propto ROs \underline{\hspace{1.5cm}} (6)$$

$$L \propto {}^1\!/_{RL} \underline{\hspace{1.5cm}} (7) \quad F \propto RL \underline{\hspace{1.5cm}} (8)$$

$$Os(I) \propto {}^1\!/_{RL} \underline{\hspace{2cm}} (9)$$

From the above formulae 1 and 2, it is found that

$$L \propto F.Os(I) \underline{\hspace{2cm}} (10)$$

From the above formulae 3 and 4, it is found that,

$$RL \propto \frac{1}{(RF.ROs)} \underline{\hspace{2cm}} (11)$$

And from the formulae 5, 6, and 7, it is found that,

$$L \propto \frac{(RF.ROs)}{RL} \underline{\hspace{2cm}} (12)$$

Here, L = Amount of Land in hectares

F = Number of family members

Os (I) = Occupational status measured by monthly income in rupees

(When solving the formulae, percentage values of the amount of land, number of family members, and income in rupees (1 dollar = 63.66 rupees and 1 euro =78.57 rupees in Indian currency, 2015-2016) have been used to avoid the difference in the three units of measurement).

RL = Distance from R to L (Distance has been measured using the units of length in the triangles)

RF = Distance from R to F

ROs = Distance from R to Os

R = Respondents (located at the centre of gravity point in the triangles).

TABLE 4
Multiple Regression Model (Model Summary)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
RL	0.954[a]	0.909	0.906	0.08166
[a]Predictors: (Constant), ROs, RF				
Source Authors' calculation.				

The final equations 10, 11, and 12 indicate that the farmers' absolute land holdings are directly correlated with the number of family members and monthly income (multiplying F by Os/I). The amount of land is then found to depend on the farmers' relationships with land, family, and occupational status (again, based on the relationships of absolute and distance values). Afterwards, the farmers' relationships (in the triangles) with the land are inversely related to the farmers' relationships with family and occupational status (Proportion of RF and RI multiplied by RL). The farmers' psychosocial relationships are represented in the final formula (Formula 13). From these formulae 7, and 11, it is derived that, $RL \propto \frac{1}{(RF.ROs.L)}$ _____ (13). Therefore, it is considered that a farmer's relationship with their land (RL) depends on their relationship with their family's graphical distance, their occupational status, and the land's absolute value. The multiple regression model (Table 4) provides a mathematical representation of the kind of relationship found in Formula 13. The association between a farmer's relation to their land (RL), relationship to their family, and

occupational status has been demonstrated using the multiple linear regression model. In this case, a linear trend of interrelationships and this kind of relationship are represented by weighted multiple regression. The relationship between farmers and land, as represented by the graphical distance (RL) in the triangles between respondents (R) and land (L), is the dependent variable in Tables 3 and 4. The independent variables are the graphical distances (RF) between respondents (R) and their families (F) and their occupational status (ROs). In the multiple linear regression model method, the variables are weighted according to the absolute amount of land (measured in hectares). The Pearson's correlation coefficient (r) values for the relationships between RL and RF, RL and ROs, and RF and ROs are -0.622, -0524, and -0.275 in Table 3. The negative relationships indicate that farmers' high levels of relationship with the land tend to be correlated with their low levels of ties with their families and with their occupational status other than agriculture. The linear multiple regression model's R (Coefficient of Multiple Correlation) values are 0.954, as indicated by Table 4 above. One way to quantify the amount of the dependent variable's prediction (in this case, RL) is to use R. The R-value in this case suggests a strong degree of prediction. The value of the independent variables (RF and ROs) predicts 90.9% of the dependent variables, according to the R square value (Coefficient of Determinants), which is 0.909. The adjusted R square in this case is computed to be 0.906, and the standard error of the estimates is 0.08166.

TABLE 5
Analys of Variance (ANOVA)

ANOVA[a,b]					
Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	3.812	2	1.906	285.786	0.000[c]
Residual	0.380	57	0.007		
Total	4.192	59			
[a]Dependent Variable: RL					
[b]Weighted Least Squares Regression - Weighted by land					
[c]Predictors: (Constant), ROs, RF					
df = Degree of Freedom					
Source Authors' calculation					

The F-ratio in the above table (Table 5) shows that the independent variables statistically significantly predict the dependent variable, $F(2, 57) = 285.786$, $p < 0.001$ (shows that the regression model is a good fit for the data).

TABLE 6
Co-efficient Values

Coefficients[a,b]							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	3.782	0.127		29.860	0.000	3.529	4.036
RF	-0.940	0.047	-0.828	-19.970	0.000	-1.034	-0.846
ROs	-1.018	0.056	-0.752	-18.126	0.000	-1.131	-0.906

ªDependent Variable: RL
ᵇWeighted Least Squares Regression - Weighted by land
Source Authors' calculation

Table 6 presents the unstandardized coefficients, which show the degree of variation between the dependent and independent variables (the other variables are constant for each predictor). Considering the length of RF, -0.940 is the unstandardized coefficient for RF. It indicates that there is a 0.940 unit decrease in the distance of the relationship of land with farmers with a unit increase in the graphical distance of the relationship of the family with farmers (RF). Considering the length of ROs, the un-standardized coefficient for RF is equal to -1.018. It indicates that there is a 1.018 unit decrease in the graphical distance of the relationship of land with farmers with a unit increase in the distance of the relationship of occupational status with farmers (ROs). The sig. in Table 6 indicates that every independent variable coefficient deviates significantly from 0 (zero). Overall, using RF and ROs weighted by land area, the multiple regression model predicts the RL which has been significantly predicted by these covariates, $R^2 = 0.909$ (Table 4). $F (2, 57) = 285.786$, $p < 0.001$ (Table 5).

3. Degree (Level) of the Relationship of Farmers with the Land: The output triangles are taken into consideration when describing the extent (level) of the farmers' interaction with their land. The six triangle categories that pertain to the farmers' relationship with their land, family, and occupational status indicate the proportion of respondents that have a strong attachment to their land.
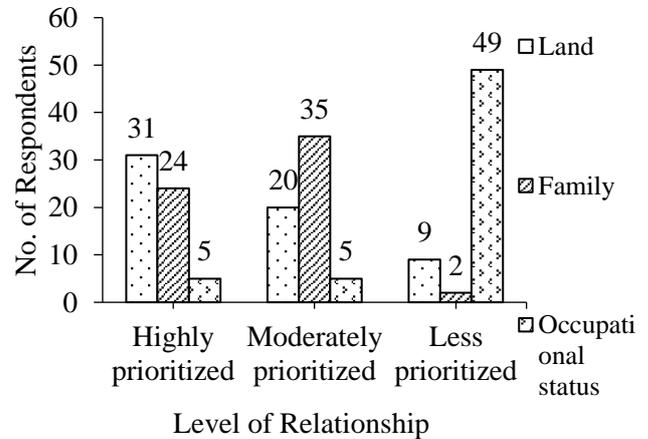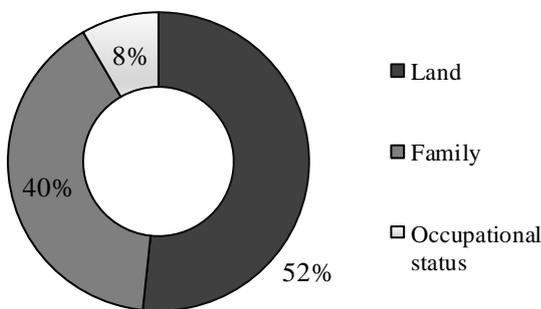

Fig. 15 Responses of farmers of their highly attachment with land, family, and occupational status Fig. 16 Level of relationships of farmers with land, family, and occupational status
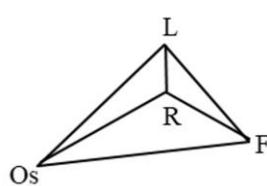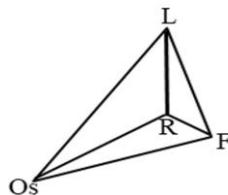

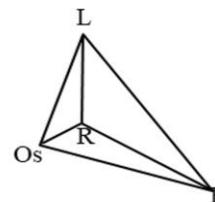Fig. 17 (a) $RL < RF < RO_S$ Fig. 17 (b) $RO_S > RL > RF$ Fig. 17 (c) $RO_S < RF > RL$
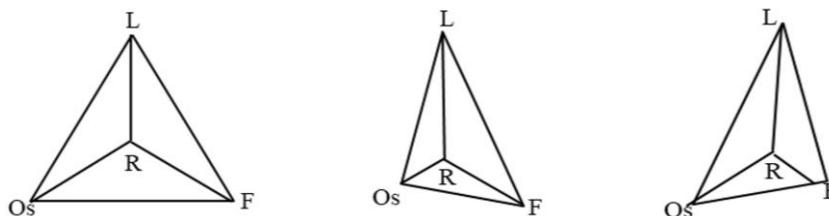
| Fig. 17 (d) RL = RF = ROs | Fig. 17 (e) RF < RL > ROs | Fig. 17 (f) ROs < RL > R |

Fig. 17 (a-f) Relational triangles (Diagrams are structured with 100 % Height and Width scale ratio in Microsoft Excel: 2013 and converted into document format and size would be fixed as represented here)

According to Fig. 15, 52% of farmers have a strong psycho-social attachment to their land, 42% to their family, and 8% to their occupational status. Therefore, it is evident from a significant number of responses from respondents who have a strong attachment to the land in the research area that farmers have a stronger bond with it than they do with their families and their employment. Fig. 16. also represents the level of relationships of farmers with land, family, and occupational status. Furthermore, the reference triangles of the respondents' psycho-social circumstances with the three components of land, family, and occupational status are shown in Fig. 17 (a, b, c, d, e, f). The discussion above suggests that there is a stronger qualitative and quantitative bond between the land and farmers in the Mouza. The bond between farmers and the land is stronger in the study area than in the other two components. The analysis of how the responses of the agrarian respondents were categorized supports the statement, as many of them (31, or nearly about 52%) indicated that land-based cultivation was more important to them than their family and occupation. The shorter the distance between the respondents and the three factors in the triangle, the stronger the relationship between the respondents and the factors, and vice versa. A comparison diagram has been used to illustrate the categorical analyses of the farmer's relationship with the land in this instance (Figs. 18, 19, 20, 21, 22).
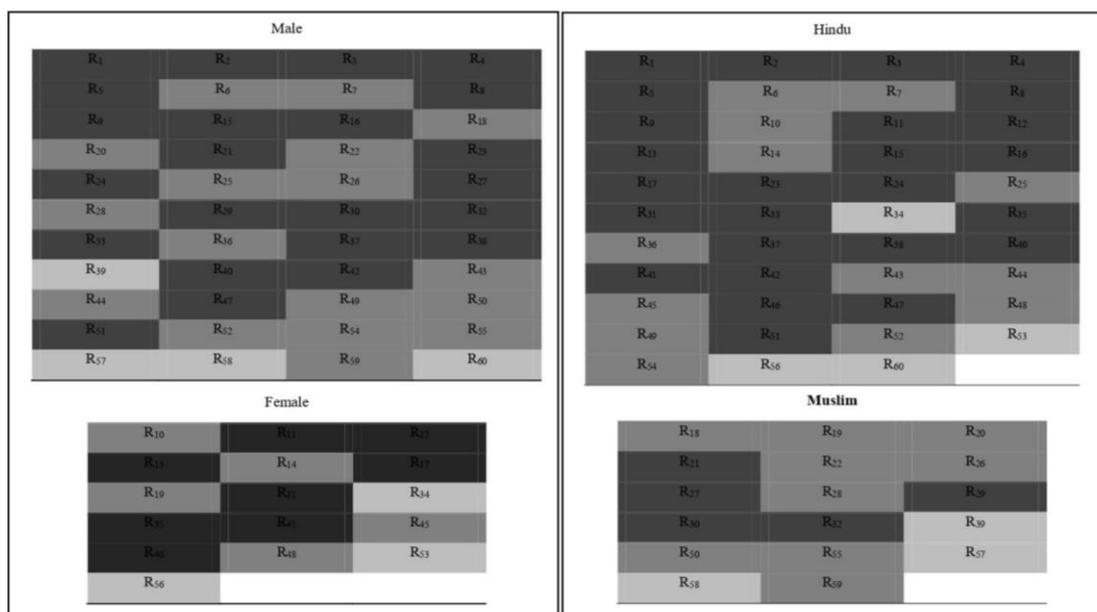

Fig. 18 Gender-wise categorization of farmers' responses about their relationship with the land Fig. 19 Religion-wise categorization of farmers' responses about their relationship with the land
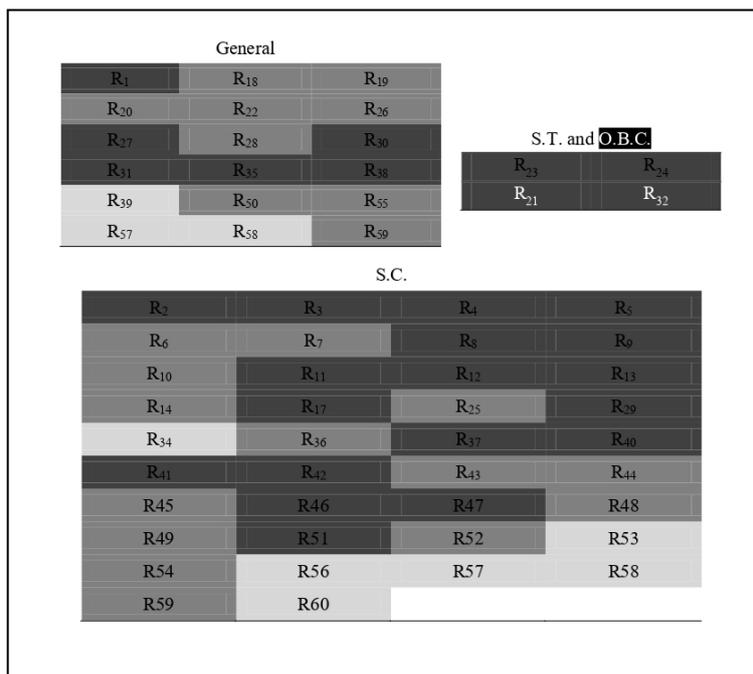
Fig. 20 Caste-wise categorization of farmers' responses about their relationship with the land
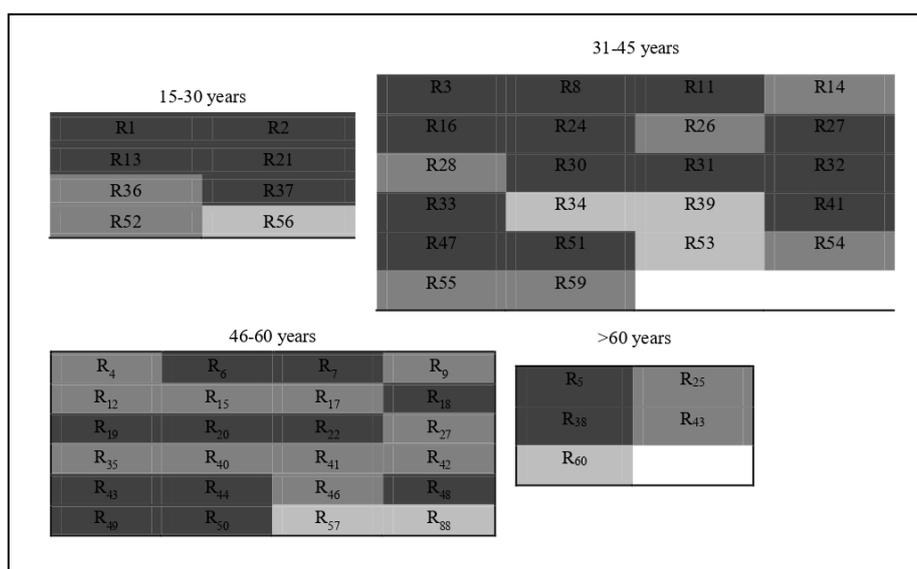

Fig. 21 Age-specific categorization of farmers' responses about their relationship with the land
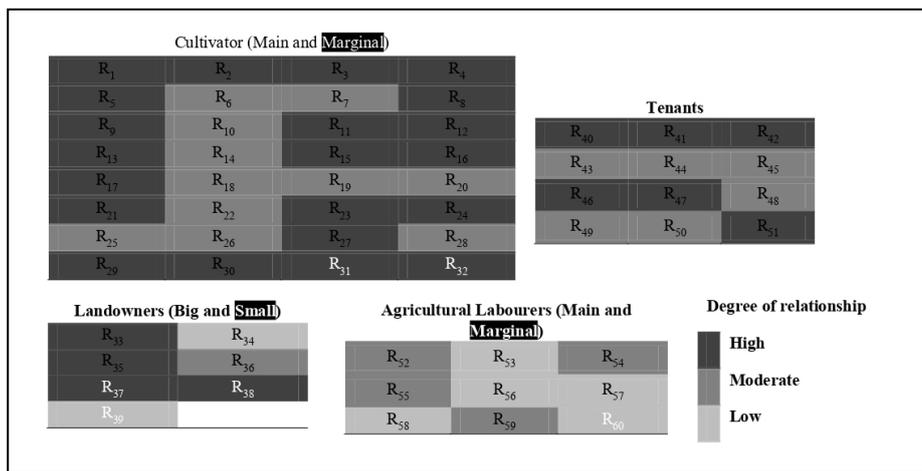
Fig. 22 Occupation-wise categorization of farmers' responses about their relationship with the land

IV CONCLUSION

Farmers' psycho-social attachment to the land and related activities have a strong correlation with the existing circumstances of the study area. Farmers of various ages, regardless of gender, schedule castes and tribes, other backward classes, Muslims, Hindus, and cultivators, as well as farmers of different ages, reply to questions on their psychological priorities regarding land, family, and occupational status other than agriculture. Here, most farmers (52%) have a strong bond with their land. A stronger bond between the farmers and the land is indicated by increasing distances in the triangles from the family and their occupational status, whereas the graphical distance is negatively correlated with the relative attachment level. Farmers and land have a comparable type of relationship, as depicted by the relational triangles. They have adjusted to the shifting social structure by being more meticulous in their subsistence farming. Some of the key hazardous situations in the study area have a significant impact on how farmers relate to the land in terms of their cognitive and psycho-social responses. Occasionally, farmers are unable to make the best choices regarding farming. However, they disapproved of going entirely from farming and related pursuits to any other kind of work. A significant association ($p<0.001$) is shown between their perceptions and correlations with the land. To improve the development of the agricultural sector and the prosperity of India's agrarian communities, the conclusion of the study makes recommendations for how to maintain and grow the relational knowledge between farmers and the land. as well as the implementation of developmental initiatives.

ACKNOWLEDGMENT

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