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Mobilization of Finance Capital and its Influence on the Adaptive Capacity of Coastal Farmers in Central Kerala, India

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Abstract

Coastal farming communities in Central Kerala have been scaling down agriculture due to lack of financial capital to overcome the stress imposed by climate change. Boosting adaptive capacity by augmenting financial capital is therefore essential to rejuvenate coastal agriculture. This paper attempts to analyze how local farmer's adaptive capacity is influenced by financial capital using primary data collected from 160 households scattered in four coastal villages in Kerala with the help of semi-structured questionnaire. Major sources of finance like level of income, non-farming income, income from other sources, lease value received from aquaculture and access to credit were finalized for the study based on previous studies and ranking methods. Empirical evidences revealed that since 30 percent of households could only earn below Rs. 30,000 per month, they could not plan adaptation actions meaningfully. 55 per cent earned non-farming income and 79 percent of the head of household has multiple sources of income. 11.62 percent of households earns an average monthly income of Rs. 64,500 from abroad and 36 per cent have access to bank loans. Around 40 percent of households are either aquaculture farmers or promoters. Aquaculture entrepreneurs and non-resident workers have higher financial entitlements and better adaptive capacity.

***Key words*:** Finance capital, Adaptive capacity, Climate change, Coastal agriculture

The mounting impacts of climate change are validated increasingly in the sluggishness of agriculture globally. IPCC has warned that global warming 1.5 °C increase in global average temperature with climate change could affect all regions of the world in different ways [1-2]. Similar warnings are also issued for Indian agriculture also [3]. Empirical studies affirmed that an increase in temperature by 1.5 °C and a decrease in the precipitation by 2 mm would reduce rice yield in India by three to fifteen percent [4]. Since Indian agriculture is expected to experience significant crop and productivity losses in future due to climate change, revival from these environmental stresses is of utmost priority to policy makers and communities [5]. Economists have emphasized that timely flow of financial capital to agriculture is essential to boost farm performance, adaptive capacity and adaptation of farmers to climate change. Inflow of financial capital equips farmers to adjust production strategies, recover from climate risks and manage adaptation actions [6-7]. Following the warnings of academicians and agricultural scientists, several measures of mitigation and adaptation were proposed to develop climate smart agriculture in India [8-9]. In spite of formal warnings and state support, coastal wetland agriculture in Kerala has responded marginally to adaptation process. Commercial uses of coastal wetlands for accelerating industrial growth have been one of the major causes of resource degradation and social conflicts in Central Kerala [10]. Several studies pointed out that climate and non-climatic stressors cumulatively contributed to declining trend in wetland agriculture in Kerala [11-12]. Conversion of wetlands for raising commercial crops, coconut plantations, reclamations for infrastructure development, construction of barriers for preventing saline water intrusion etc. also caused deceleration of wetland agriculture [13]. Development projects in the private sector like the international container transhipment terminal, also converted wetlands and displaced coastal farmers [14].

Restoration of Kerala's climate-torn coastal agriculture faces several challenges. First, majority of farmers still use a traditional seed called *Pokkali* which tenders low yields due to climate variability. Second, farmers are reluctant to invest on climate resilient seeds and other related investments. Since this crop is grown during June- September, high fluctuations in temperature during pre-monsoon and precipitations during monsoon and post monsoon periods have affected salinity regulations and crop yields maliciously. As a result, total area

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of coastal farm land for *Pokkali* rice cultivation in Central Kerala declined from 25000 hectares to 9000 hectares in 1990s and further reduced to 5000 hectares in 2000 [15]. Third, the low level of adaptive capacity of households to mobilise financial capital from internal and external sources is extremely poor. Any attempt to revive coastal agriculture therefore must primarily focus on strengthening the adaptive capacity at the farm level [16]. Adaptive capacity, broadly understood as capabilities of individuals and communities to manage hardships of climate change, empowers them to take advantages of new opportunities through planning adaptation actions [17-20]. The selection of adaptation strategies by farmers depends on their adaptive capacity and control over tangible and intangible resources [21-22]. Adaptive capacity development of farms depends on the timely procurement of financial capital at different stages of the supply chain. Datta and Behera [23] have identified assets and capitals as indicators of adaptive capacity, both at national and local levels. Assets include both tangible capitals (natural, physical and financial) as well as intangible ones (human and social) [24]. Several economists supported this view and built empirical evidences to demonstrate how capital assets support adaptive capacities at local level [25-28]. Studies conducted to assess the role of capitals and assets on adaptive capacity of farmers in India also supported these claims [29-32].

Even though, farmers' target mainly on locally relevant variables to increase adaptive capacities, it is observed that lack of financial capital continues to constrain their adaptation decisions. Autonomous adaptation undertaken by farming households is the outcome of the decision taken by head of household based on his/her past experiences and quick evaluation of extreme climate events. Most often he mobilizes and allocates financial resources directly into channels that enhance adaptive capacity. The paper examines how inflows of finance capital influence adaptive capacity and adaptation actions at the household level.

MATERIALS AND METHODS

Coastal wetland agriculture is commonly practiced in three districts of Central Kerala. This study was conducted in four coastal panchayaths of Ernakulam District. Two Panchayaths -Kuzhuppuily and Kottuvally- lie on the northern side and two- Chellanam and Kumbalangi- on the south. Among these, Kuzhupuiily and Chellanam Panchayaths are located close to the sea while Kottuvally and Kumbalangi lie little far from the sea, on the banks of Cochin estuary. Three per cent of the population and around seven per cent of cultivators of Ernakulam district live in the selected study villages (https://censusindia.gov.in).

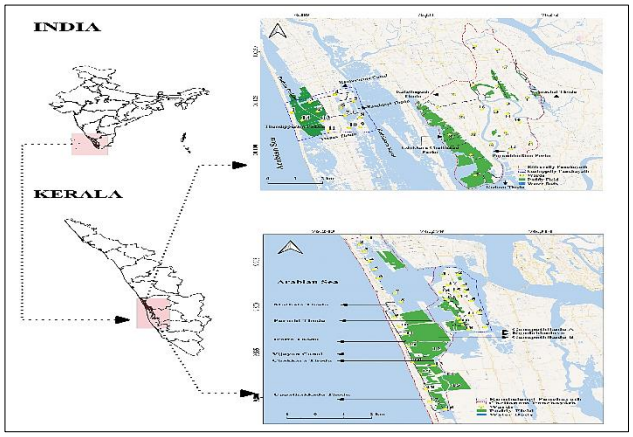

Fig 1 Location map of study area

Kuzhupilly is a small coastal village situated on the northern side of Ernakulam District with a total population of 23858. Agriculture is undertaken by 718 households in 232.72 hectares under the banner of 16 farmer associations. Paddy fields are inter-connected through 20 sluice gates which draw water from nearby canals and local inlets. Kottuvally Panchayath, located about 17 Kilometres to the east of Kuzhuppilly, has a population of 34352. 277 farming households cultivate an area of 293 hectares of wetland with the help of 59 sluice gates under eight farmer association. Chellanam Panchayath lies on the southern side of the district. The total population of this village is 32978. Agriculture is practiced by 1196 households in 841.0 hectares under 12 farmer association. Paddy fields are inter-connected by 16 sluice gates through which water is drawn from the nearby water bodies. Kumbalangi is an island located about 15 kilometres afar from the Cochin bar mouth has a population of 24601. Agriculture is practiced in 249.80 hectares by 5 farmer association.

Sources of data

The study used both primary and secondary data for assessment. Purposive sampling techniques were employed to identify people affected by climate change. A total of 160 farmers, 40 samples each from four study stations, were selected and interviewed using semi-structured questionnaires. The data collected included their socio-economic characteristics, income sources, access to credit etc. Institutional level interviews were also conducted at the level of producer associations, self-help groups and formal local state institutions. Office bearers of 16 farmer associations in Kuzhuppuily, eight in Kottuvally, 13 in Chellanam and five in Kumbalangi were interviewed. Simple descriptive statistics are used to indicate financial capitals.

Nature of data

Financial capital mobilisation is a process of accessing financial resources to make essential investments for developing climate resilient agriculture [33-34]. Financial resources for local adaptations could ideally come from the households, producer cooperatives, community-based organizations, the private sector, philanthropy and the state [35]. At the household level, farmer's financial capacity is initially drawn from household income. Steady flow of income from agriculture motivates farmers to adopt adaptation measures to climate change and prompts them to choose climate-resilient crops and technologies [36-38]. The second source from where farmers tap financial resources is non-farming income from contract work, construction, carpentry and casual labour. Households diverting higher proportion of income could support high adaptive capacity since they could easily switch between livelihood sources in times of climate crisis. Households with diversified assets and livelihood activities typically have higher adaptive capacity [39]. Third, income from salaried jobs, skilled non–farm jobs, remittance and safety net transfers also act as potential sources of financial asset. These sources of income are less affected by climate change and improve capacity to adapt to climate risks. Fourth, savings and loans obtained from various sources influence farmer's adaptive capacity [40]. Fifth, financially stable farmers are able to employ enough workforce on farms and save crops from total damage. Such allocations and farm management offer timely adoption of modern technologies and innovations at the farm level [41]. Households allocating their human capital in diverse income generating activities are on the rise in coastal villages affected by climate change. Diverse employment opportunities generate higher options to work in

alternate occupations even if some activities got affected by climate change [42].

Six, the age-old practice of lease markets of coastal wetlands for aquaculture offers ample financial stability for farmers to adapt to climate change. Lease amount is an additional income of farmers. The lease value is determined by various factors like distance of farm from sluice gate, sales value of paddy and aquaculture of previous year and quality of water and soil. Certain portion of the lease value is used for maintenance of the sluice gate and related expenditures. Higher lease value offers higher adaptative capacity to farmers. It is pointed out that diverse portfolio of financial assets not only uplift households' financial conditions but also reduce climatic shocks and risks [43-44. Seven, subsidies offered by state government for farm operations, building and repairing sluice-gates, purchasing extra seeds to replace damaged seeds due to excess rain, rebuilding the damaged inner bunds are also helpful to supplement adaptive capacity. Finally, access to credits is an important means of adjusting income deficits in times of low harvest, drought and floods [45]. Majority of farmers have weak access to both formal and informal credits, especially during unfavourable climate. Some of them have been regularly availing of loans drawn from formal credit suppliers, rural cooperatives/banks, NGOs, and informal credits from friends, relatives and neighbour farmers. Access to formal and informal credit increases cash flow and allows farmers to increase the adaptive capacity. According to Desersa *et al*. [46], credit expedites timely purchase of farm inputs and streamline farm operations.

The items listed above, although do not exhaust the full set of factors influencing financial capital of the households, are included in this analysis based on the insights of field surveys. We observed that changing climate has risen cost of farm operations and management, replacement costs of damaged seeds, repair and maintenance of damaged infrastructure, restoration of degraded lands and water quality and above all wage bill to undertake these activities. This obviously would drain the already limited financial capital of individual farmers and government.

Data analysis

Selection and ranking of adaptive capacity indicators

Asset categories and the selection of potential variables were based on pilot surveys conducted in the study areas and insights from previous empirical research [47-50]. In order to determine the indicators for estimating financial adaptive capacity index, a semi structured interview was conducted. Each respondent ranked indicators of financial capital category and revealed which indicator contributed to the asset capital from most to least.

Normalization and construction of index

Information for scoring was generated based on previous studies on adaptive capacity assessment [51-53]. This was done by considering the relative importance of one element over the other. Lack of access to a particular determinant was scored zero and access to the factor was scored 1. If elements contribute equally, they were assigned similar scores while those with strong importance were assigned higher scores. Following this logic, 'higher income' of the household was scored higher as opposed to lower income. Similarly, low-income households with restricted access to formal sources of finance will have low adaptive capacity development.

After pinpointing major determinants of financial assets and flows that influence adaptive capacities, the study proceeds to analyze the nature of relationships between adaptive capacity and financial capital using the minmax normalization method [54]). This method each variable is decomposed into an identical range between zero and one, with a score of 0 being the worst rank for a specific indicator and a score of 1 being the best. All other values are then scaled between the minimum and maximum values. This scaling procedure ultimately subtracts the minimum value (X_{Min}) and divides by the range of the indicator values (the maximum value (X_{Max}) subtracts the minimum value (X_{Min}), as illustrated by the following equation.

$$X_{i0\ to\ 1} = X_i - X_{Min} \ / X_{Max - X_{Min}}$$

Where X_i represents the individual data point to be transformed

X_{Min} the lowest value for that indicator

X_{Max} the highest value for that indicator

X_i, 0 to1 the new value to be calculated, i.e., the normalised data point within the range of 0 to 1

Normalization was done so as to aggregate and categories the farming household according to their livelihood. The scores for all indicators are presented in (Table 1).

Table 1 Distribution of scores and potential sources of financial capital of households

Sources and indicators	Income cluster (Rs.)	Score	Normalized scores
Household Income	Below 30000	1	0
	30000 - 40000	2	0.20
	40000 - 50000	3	0.40
	50000 - 60000	4	0.60
	60000 - 70000	5	0.80
	Above 70000	6	1
Non-Farm income	Yes	1	1
	No	0	0
Other income sources (HOH)	1	1	0
	2	2	0.50
	More than 2	3	1
Other income sources (family members)	1	1	0
	2	2	0.50
	More than 2	3	1
Lease amount	Below 5000	1	0
	5000 - 10000	2	0.25
	10000 - 20000	3	0.50
	20000 - 30000	4	0.75
	Above 30000	5	1
Credit Sources	Individual	1	0
	Friends and relatives	2	0.50
	Bank	3	1

Assigning weights

According to Swanson *et al*. [55], the literature does not provide a definite direction for attributing weights of indicators. Weights calculated following Iyengar and Sudarshan [56] are presented in (Table 2).

Table 2 Weights of indicators of adaptive capacity

Indicator financial adaptive capacity	Variance of sub indicators	$C = \frac{1}{1\sqrt{VarSi + \cdots 1/VarSi6}}$	Weights
Income	0.0504	4.4510	0.2420
Non-farm income	0.2490	2.0036	0.1089
Number of other income sources of head of household	0.1042	3.0977	0.1684
Number of other income sources of family members	0.0786	3.5667	0.1939
Lease amount	0.1000	3.1608	0.1719
Access to credit source	0.2253	2.1066	0.1145
		C=0.0543	

Where;

$$C = \frac{1}{\sqrt{\frac{1}{\sqrt{VarS1}} + \frac{1}{\sqrt{VarS2}} + \frac{1}{\sqrt{VarS3}} + \frac{1}{\sqrt{VarS4}} + \frac{1}{\sqrt{VarS6}}}}$$

The financial adaptive capacity index is then estimated by multiplying weights with their respective normalized values of selected indicator of financial capacity and summing up these values. The process is illustrated in the equation below:

$$Wj = \frac{C}{\sqrt{variance}\ \text{Si}}$$
$$where\ i = 1\ to\ 6$$

Where W_1…… W_6 = Weight of sum of variance of each sub indicator

The financial adaptive capacity index Y is then calculated using:

$$Y = W_1S_1 + W_2S_2 + W_3S_3 + W_4S_4 + W_5S_5 + W_6S_6$$

Where S_1, S_2, S_3, S_4, S_5, S_6 represent aggregate indices of income level, non-farm income, number of income sources of head of household, number of income sources of other family members, lease value and access to credit sources respectively. Finally, the analysis classified various households according to the level of adaptive capacity to climate change into three ranges as shown in (Table 3) using Singh and Singh *et al*. [57].

Table 3 Range of adaptive capacities

Range of financial adaptive capacity	Levels of FADC
0.00–0.15	Low
0.16–0.29	Moderate
>0.30	High

RESULTS AND DISCUSSION

Adaptive capacity of coastal farmers is influenced by, among other things, social and economic characteristics. (Table 4) presents the major social and economic features which influence the adaptation decisions of sample farmers in the study area.

Table 4 Social economic characteristics of farmers

Categories	Number	Percentage
Community		
Christian	60	38
Hindu	85	53
Muslim	15	9
Age		
30-40	9	5.63
40-50	53	33.13
50-60	60	37.50
Above 60	38	23.75
Education		
Below primary level	46	28.75
SSLC	56	35.00
Plus two	31	19.38
Plus-two with diploma	3	1.88
Degree	24	15.00
Size of Land (in acres)		
No land	7	4.375
Less than one	18	11.25
Less than 1-2	90	56.25
Above 2	45	28.12
Job categories		
Business + Aquaculture	27	16.88
Causal employment + farming	24	15.00
Aquaculture	22	13.75
Farm and fish worker	19	11.88
Govt Job	18	11.25
Farmworker	16	10.00
Both farming	12	7.50
Self-employed	13	8.13
Female worker	5	3.13
Professionals	4	2.50

Most of the wetland holdings (53%) in the study region are owned by Hindu communities while 38 per cent by Christian and nine per cent by Muslim communities. Surprisingly, younger generations are not attracted to agriculture anymore. 37.5 per cent of farmers is between 50-60 age group; 33.13 per cent lies between 40-50 age group are and 23.75 per cent is above 60 age group. Similarly, 28.75 per cent farmers has primary education. 35 per cent has SSLC education and 15 per cent has graduation. The distribution of area cultivated by farmers during the study period reveals that 56 per cent of households are holding land between one acre to two acres. About 28 per cent of farmers hold above 2 acreages and 11per cent hold less than one acre in this study region. (Table) 4 also highlights a high degree of occupational diversity in study sites and our survey narratives revealed that the major cause for such diversification is climate change. There is a strong tendency to diversify into aquaculture in the study sites. For instance, around 30 per cent of farmers are engaged in aquaculture along with other activities. 15 per cent of households combines paddy cultivation and local work like a petty business, casual jobs, work in culture farms etc. The remaining households have turned to other jobs. Income from paddy cultivation alone do not generate sufficient income to run the family and forces farmers to undertake other non-farm jobs.

Table 5 The major indicators of financial capital of farming households in the study region

Indicators of financial capital	Income cluster (Rs.)	Number	Percent
Household Income	Below 30000	48	30
	30000 - 40000	31	19.37
	40000 - 50000	26	16.25
	50000 - 60000	12	7.50
	60000 - 70000	11	6.88
	Above 70000	32	20.00
Non-Farm income	Yes	88	55.0
	No	72	45.0
Other income sources (HOH)	1	18	11.25
	2	126	78.75
	More than 2	16	10.00
Other income sources (family members)	1	100	62.5
	2	44	27.5
	More than 2	16	10
Lease amount	Below 5000	43	26.87
	5000 -10000	25	15.62
	10000 - 20000	23	14.37
	20000 - 30000	37	23.12
	Above 30000	32	20.0
Credit Sources	Individual	62	38.75
	Friends and relative	41	25.62
	Bank	57	35.62

The (Table 5) presents the major sources and indicators of financial capital of farming households in the study region. About 30 per cent of farmers are having average monthly income below Rs.30,000 and it is obvious that they cannot set apart large sums of money to adaptation activities. 20 percent of households in the highest income category earns an income above Rs. 70,000 per month. From the survey, 55 per cent of farmers are having income from non-farming sources. 79 percent of heads of the household have two sources of income. Similarly, around 27 percent of farmers in the study area received lease value of Rs. 5000 or below while 23 percent got an amount between Rs. 20000 and 30000. 20 percent earned above Rs. 30000. In addition to these sources, farmers also borrow money from money lenders, friends and relatives and local banks to meet adaptation expenses. Survey showed that 38.75 per cent borrowed from friends and relatives while 35.62 per cent borrowed from banks.

(Table 6) shows the distribution of the income sources of the farmers. Farmers mobilized finance through their employment diversification, other income sources and credits. The highest income (43.87%) is derived from aquaculture. Income from non-farm jobs is 24 percent followed by Income from other family members is 18.87 per cent and income from abroad is around 12 percent. Lease amount is only 1.45 per cent.

Table 6 Distribution of income sources of the farmers

Income portfolio	Income (Rs.)	Percentage	Per capita income
Income from aquaculture	34,08,500	43.87	42080.25
Income from Non-farm	18,79,000	24.19	28907.69
Income of the other family members	14,66,000	18.87	37589.74
NRI income	9,03,000	11.62	64500.00
Lease out income	1,12,700	1.45	3130.56

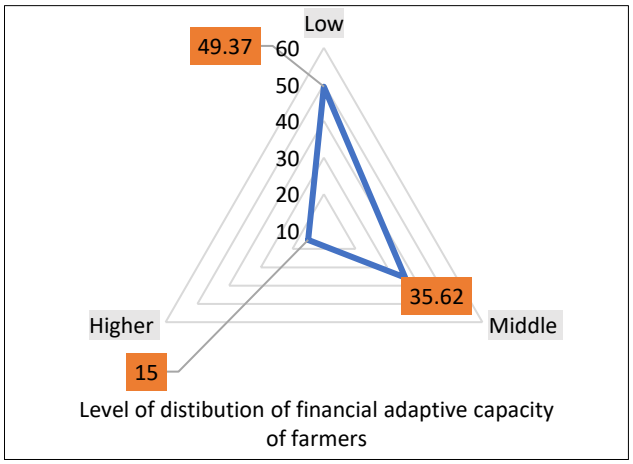

Fig 2 Depicts the level of adaptive capacities of farmers to financial capital

Financial adaptive capacity index of coastal farming households

The data depicted in (Table 7) presents the distribution of financial adaptive capacity index of selected farmers in the study area. It is interesting to note that 49 percent of households has low adaptive capacity to manage climate change while 36 percent has middle level capacity to adapt. Only 15 percent of households possess higher adaptive capacity. The findings are presented in (Fig 2).

Table 7 Financial adaptive capacity index of coastal farmers in Ernakulam District

Level of adaptive capacity of farmers	Number	Percent
Low	79	49.37
Middle	57	35.62
Higher	24	15

This figure clearly shows the percentage distribution of financial adaptive capacity of farmers in the study region. Nearly fifty percent of farmers are lower financial adaptive capacity. 35.62 percent of farmers are moderate level of

adaptative capacity and only 15 percent farmer are a high financial adaptative capacity of farmers.

Financial capital is necessary for farmers to execute autonomous adaptation to climate change effectively. These resources are normally mobilized by farming households both from internal and external sources. An attempt is made in this paper to examine different potentially important internal streams of financial resources for autonomous adaptation. The factors influencing financial adaptive capacity of the farmer is detailed in the paper using primary surveys covering 160 respondents in the coastal district of Ernakulam Kerala. Detailed illustration of their socio-economic characteristics, revealed the respondents' financial capabilities and the potential to access financial adaptive capital. Hindu caste land owners who traditionally received large proportion of coastal wetlands from rulers and ancestors still retain more than fifty percent of the total cultivable land. Coastal wetlands in the southern region are still controlled by Christian farmers. The tendency of Muslim entrepreneurs purchasing wetlands for aquaculture is seen in the northern study areas of the district. Although climate change has affected coastal farmers in different ways, the ability to access financial capital for adaptation differs across social groups. As climate change has made local agriculture increasingly fragile, taping financial income from their occupations to execute autonomous adaptation would be difficult. Since 30 percent of households could only earn below Rs. 30,000 per month, they cannot plan adaptation activities in meaningful ways. This means that most of the households in the district have a relatively low financial adaptive capacity and external financial assistance is essential for their participation in adaptation programmes. Highest monthly income of above Rs. 70,000 is earned only by 20 percent of households.

Non-farming income is earned by around 55 per cent of farmers. The study confirmed that the number of income sources of households has increased as a result of climate change. 79 percent of the head of household has more than two sources of income. This trend in work participation is due to the increasing climate change vulnerability and may not assist financial capital mobilization process at all. The study confirmed low access to credit in the district. Mobilizing finance from relatives and friends also have serious limitation as they also face similar climate threats and therefore face similar financial constraints in finance mobilization. Two major emerging groups in the district who could make significant participation in adaptation programmes are the aquaculture entrepreneurs and non-resident workers. Around 40 percent of households are either aquaculture farmers or actively engaged as promoters of aquaculture industry by leasing out their lands to potential aquaculture contractors. Similarly,11.62 percent households have an average monthly income of Rs. 64500 from abroad.

CONCLUSION

Hence, farming households and aquaculture entrepreneurs could collectively lead adaptation actions with limited financial resources at their disposal. About 36 per cent of farmers have taken bank loans. The study revealed that coastal farmers adapt to climate variability and extremes in diverse ways. Despite government support for farm-level operations, low level of financial assets and adaptative capacity force farmers' transitions from paddy to aquaculture. Climate extremes and variabilities, along with fragile coastal wetland ecosystem services and low financial capital will continue to haunt coastal farmers of the district in future. We, therefore, suggest that the government should ensure local adaptation by promoting a balanced mix of financial capital along with natural, physical, social and human capital to increase adaptive capacity of farming households through appropriate institutional reforms and collective action.

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