Original Research Article

COVID-19 and its Effect on Natural capital of Small and Marginal Farmers

ABSTRACT

Aim: The main aim of this research is to study COVID-19 effect on natural capital of small and marginal farmers..
Study design: Ex post facto research design
Place and Duration of Study: North western zone of Tamil Nadu includes Krishnagiri, Dharmapuri, Salem and Namakkal districts, India.
Two years (2021-2022)
Methodology: From the selected north western zone of Tamil Nadu, 320 respondents were purposively selected for conducting the study. Cochran sample size estimation used for the study to determine the sample size of the respondents. Due to its higher natural connectivity and diverse crop cultivation, north western zone of Tamil Nadu has been purposively selected for the district. Data were collected from small and marginal farmers during COVID-19 pandemic. Paper-Pencil survey method was used to collect data from the farmers. Paired t-test and eta squared statistic was computed to determine the intense of COVID-19 pandemic on small and marginal farmers. A comparative analysis was made among farmers before as well as during COVID-19 pandemic.
Results: Three fifth of the respondents (60.30 %) fall under 25 to 50 per cent proportion of natural capital whereas above one third of the respondents (36.90 %) comes under the category of below 25 per cent proportion of natural capital and a very meager amount of the respondents (2.80 %) fall under the proportion of 50 to 75 per cent. None of the respondents comes under the category of 75 to 100 per cent proportion of natural capital. During COVID-19 pandemic, slightly more than half of the respondents (53.10 %) belongs to 25 to 50 per cent proportion followed by below quadrant proportion (45.60 %). Paired t-test results (t value: 12.905, P-value: <0.001) shows that there was a statistically significant difference in the overall natural capital of small and marginal farmers when before COVID-19 pandemic compared with during COVID-19 pandemic.
Conclusion: COVID-19 pandemic shows larger effect (eta squared value= 0.343) on natural capital of small and marginal farmers. Strategies like diverse crop cultivation, a plan to value added products of perishable produce or a tie up with manufacturing industries for sale and higher livestock possession with fullest use of integrated resources to be followed by small and marginal farmers to ensure sustainable maintenance of natural resources.

Keywords: COVID-19, Effect, Natural capital, Small and Marginal farmers.

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1. INTRODUCTION

COVID -19 pandemic is a global phenomenon that is heavily affecting the lives, livelihoods and wellbeing of the entire population, the degree and severity of its effects are different among group and sectors. As the pandemic engulfed the world, international borders abruptly closed and social distancing requirements and restrictions to movement were imposed within and between countries (Laborde *et al,* 2020). COVID-19 lockdown

disrupted food system, impacting farmers, food producers, traders and consumers. Wieser *et al* (2020) stated that the pandemic heavily affected the rural livelihoods, by which their half of the income has been reduced.

Dixon *et al* (2021) investigated the effects of the COVID-19 pandemic on regional agri-food systems and found that rural livelihoods and food security were impacted by disruptions to local labour markets, creating difficulties in ensuring perishable farm produce was transported to markets and found disruptions to input supply chains such as seeds and fertilizers. The cost of cultivation has been increasing (Srivastava *et al,* 2020) and yields of rice and wheat have been stagnating (Madhukar *et al,* 2020), resulting in more than half of agricultural households being in debt (India – Situation Assessment Survey of Agricultural households, 2013).

Jaacks *et al* stated that about half of the farmers reported that the lockdown had affected their ability to sow for the upcoming season due to labour not being available and not being able to access or afford inputs such as seeds, fertilizer, and pesticides. Thus farmers in India were severely impacted by COVID-19 pandemic. Thus COVID-19 pandemic creates risky environment for farmers to manage their income sources, generally majority of the marginal farmers were risk aversers and small farmers take moderate risks (Mohanraj *et al,* 2023).It is important to study the livelihoods of small and marginal farmers during COVID-19 pandemic. Livelihood encompasses the capabilities, assets and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from the stresses and shocks and maintain or enhance its capabilities and assets both now and in the future without undermining the natural resource base (Chambers & Conway, 1992). Sustainable livelihood will be computed using five capitals such as natural capital, physical capital, financial capital, human capital and social capital (DFID, 2002). Each capital contributes its significant role in the livelihood assessment of small and marginal farmers.

Harvey *et al* (2018) stated that the small holders are one of the most vulnerable social groups to the climate change. It has been observed that 95 per cent of the small holders experienced the impacts of rising temperature including unpredictable rainfall and extreme weather events on crop yields, pest and disease incidence, income generation and in some cases food security. Of the farmers perceived change in climate and environment, 46 % indicated that they changed their farming practices in response to climate change. It is important to study the natural capital of small and marginal farmers. Thus the environment and climate change shows significant impacts on small holders; it changes the cropping pattern and type of crop to be cultivated. However, farmers are prepared to deal with the negative repercussions of climate change, but they were unable to handle the COVID-19 pandemic's effects.

It is crucial to understand how their farming practices and preferred crop cultivation have changed as a result of the COVID-19 pandemic.It is need of the hour to study the natural capital of small and marginal farmers. Thus, the natural capital of the sustainable livelihood determines soil fertility, forest resources, water resources, grazing resource, land quality type, irrigation facility, type of crop to be cultivated and farming system. The study focus on COVID-19 impact on natural capital, it includes land use change, change in land ownership, change in cropping pattern and change in integrated farming system (IFS), change in irrigation source and change in livestock possession. The intense of COVID -19 pandemic on natural capital of small and marginal farmers could be analyzed to know the change in the environment. Hence, the objective of the study is to assess the COVID-19 impact on natural capital of small and marginal farmers.The magnitude of COVID-19 pandemic on natural capital could be analysed to mitigate the forthcoming effects in future, thus it makes farmers to be prepared to face the risks associated with future epidemic.

2. METHODOLOGY

Ex post facto research design has been adopted for the study. Ex-post-facto research is a systematic empirical enquiry in which the scientist does not have direct control

over independent variables because their manifestations have already occurred or because they are inherently not manipulatable. Inferences about relations among variables are made, without direct intervention, from a concomitant variation of independent and dependent variables (Kerlinger, 1973). The detailed survey to measure COVID-19 Impacts on natural capital of small and marginal farmers has been conducted in North western zone of Tamil Nadu. Due to its higher natural connectivity and richer crop cultivation like flowers, fruits, vegetables and cereals, this zone has been purposively selected for the study. This zone covers four districts namely Krishnagiri, Dharmapuri, Salem and Namakkal. Cochran (1977) formula used to calculate an ideal sample size to determine the final number of respondents. Equal proportion of population from each district has been selected for the study and 80 respondents from each district, thus approximately 320 farmers have been selected for the study to measure the intense of COVID-19 pandemic. Data were collected by using a well-structured and pre-tested interview schedule by employing personal interview method. Index has been computed for the study with various components such as land resources, farming system, irrigation source and livestock composition. To standardize an index, a reliability (0.84) and validity (0.32) check have been made. Natural capital index was measured using the formula

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$$\textit{Natural Capital Index (NCI)} = \frac{Score\ related\ to\ land\ resource + farming\ system + source\ of\ irrigation + Livestock\ composition}{Maximum\ possible\ score\ of\ natural\ capital} \times 100$$

Final index score quantified into quadrant proportions to measure the status of natural capital of small and marginal farmers in each district.The responses were scored, quantified, categorized and tabulated using statistical methods like descriptive statistics and paired t-test. Paired t-test was used to determine the effect of COVID-19 pandemic and the magnitude of intense of COVID-19 pandemic calculated using eta squared statistics.

3. RESULTS AND DISCUSSION

Natural capital of small and marginal farmers assessed using their land resources, farming system, irrigation source and livestock possession. Land resources includes land ownership and land size whereas farming system of small and marginal farmers were assessed using the indicators like Integrated Farming System (IFS), Cropping system and type of crops to be cultivated. Natural capital also includes irrigation source and livestock possession. Hence, the indicators of natural capital were assessed using two response categories to know the status of natural capital before COVID-19 pandemic and during COVID-19 pandemic. The extent of COVID-19 effect on natural capital was assessed using the following indicators.

3.1. Land Resource Index (LRI)

3.1.1. Land ownership

Land ownership refers to the property rights of small and marginal farmers. It includes the farmer's possession details regarding their ownership, share and joint farming and leased in/ out process. The results are furnished in the table 1.

Table 1 Distribution of respondents according to their land ownership.

(n=320)

S.No.	Category	Before COVID-19		During COVID-19	
		No	Per cent	No	Per cent
1.	Own land	318	99.40	307	95.9
2.	Share and joint farming	02	0.60	13	4.1

3.	Leased in	0	0	0	0
	Total	**320**	**100.00**	**320**	**100.00**

From the table 1, it could be inferred that an overwhelming majority of the respondents (99.40 %) had own land followed by share and joint farming (0.60 %) before COVID-19 pandemic whereas an overwhelming majority of the respondents (95.90 %) had own land followed by share and joint farming (4.10 %) during COVID-19. As most of the small and marginal farmers had their own land as their source of income depends mainly on their land cultivation, thus the farmers main business was crop cultivation and marketing of their produce at fair price.

3.1.2. Land size

Land size refers to the area under the cultivation of agricultural / horticultural crops during COVID-19 pandemic. Land size classification results are given in the table 2.

Table 2 Distribution of respondents according to their land size.

(n=320)

S.No.	Category	Before COVID-19		During COVID-19	
		No	**Per cent**	**No**	**Per cent**
1.	Less than one acre	08	2.50	13	4.10
2.	1 – 2.47 acre	201	62.80	198	61.90
3.	2.47 – 4.94 acres	111	34.70	109	34.00
	Total	**320**	**100.00**	**320**	**100.00**

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From the above table of Land size, it could be inferred that slightly above three fifth of the respondents (62.80%) falls under the category of 1 to 2.47 acres followed by the category of 2.47 to 4.94 acres (34.70 %) before COVID-19 pandemic, the same has been reflected during COVID-19 pandemic, thus there is no change in land size when compared to before COVID-19 pandemic. Thus the respondents of the study fall under the category of small and marginal farmers.

3.1.3. Land Resource Index (LRI)

Land resource Index consists of land ownership and land size. The results of land resources were classified as quartile based on the total score obtained from both land ownership and land size. The results are furnished in the table 3.

Table 3 Distribution of respondents according to their Land Resource Index (LRI).

(n=320)

S.No.	Category	Before COVID-19		During COVID-19	
		No	**Per cent**	**No**	**Per cent**
1	Below 25 per cent	115	35.90	118	36.90

2	25 per cent to 50 per cent	142	44.40	138	43.10
3	50 per cent to 75 per cent	49	15.30	50	15.60
4	75 per cent to 100 per cent	14	4.40	14	4.40
	Total	**320**	**100.00**	**320**	**100.00**

From the above table, it has been concluded that above two fifth of the respondents (44.40 %) comes under the category of quadrant to half of the proportion followed by the category of below quadrant proportion (35.90 %) , half to 75 per cent of the proportion (15.30 %) and 75 to 100 per cent of the proportion (4.40 %) before COVID-19 pandemic whereas during COVID-19 pandemic, it has been observed that little more than two fifth of the respondents (43.10 %) comes under the category of quadrant to half of the proportion followed by below quadrant proportion (36.90 %), half to 75 per cent of the proportion (15.60 %) and 75 to 100 per cent of the proportion (4.40 %). From the results, it is clear that there is no change among land resources before as well as during capital, thus the COVID-19 pandemic didn't affect the land asset of the respondents.

3.2. Farming system

3.2.1. Integrated Farming System

Integrated Farming System (IFS) maintains the sustainable agricultural system, thus the components integrated with agriculture, horticulture, livestock and sericulture. The results of the Integrated Farming System (IFS) are furnished in the table 4.

Table 4 Distribution of respondents according to their Integrated Farming System.

(n=320)

S.No.	Category	Before COVID-19		During COVID-19	
		No	**Per cent**	**No**	**Per cent**
1.	Agriculture/ Horticulture	5	1.60	10	3.13
2.	Agriculture+ Horticulture	16	5.00	20	6.25
3.	Agriculture + Animal husbandry	26	8.00	51	15.94
4.	Agriculture + Horticulture + Animal husbandry	268	83.80	232	72.5
5.	Agriculture + Horticulture + Sericulture + Animal husbandry	5	1.60	7	2.19
	Total	**320**	**100.00**	**320**	**100.00**

From the table 4 , it could be found that majority of the respondents (83.80) comes under the category of Agriculture + Horticulture + Animal husbandry followed by Agriculture + Animal husbandry (8.00 %), Agriculture + Horticulture (5.00 %), Agriculture or Horticulture alone (1.60 %) and Agriculture + Horticulture + Sericulture + Animal husbandry (1.60 %) before COVID-19 pandemic whereas during COVID-19 pandemic, it has been observed that nearly three fourth of the respondents (72.50 %) fall under Agriculture + Horticulture + Animal husbandry followed by Agriculture + Animal husbandry (15.94 %), Agriculture + Horticulture (6.25 %), Agriculture or Horticulture alone (3.13 %) and Agriculture +

Horticulture + Sericulture + Animal husbandry. From the results, it is clear that majority of the respondents' follows three systems of farming namely Agriculture + Horticulture + Animal husbandry. Thus the respondents were interested in growing both agricultural and horticultural crops before as well as during COVID-19 pandemic with their livestock components.

3.2.2. Cropping System

Cropping system refers to the crops, crop sequence and the management techniques to be cultivated on a particular agricultural field over the years. The results of cropping system are furnished in table 5.

Table 5 Distribution of respondents according to their Cropping System.

(n=320)

S.No.	Category	Before COVID-19		During COVID-19	
		No	**Per cent**	**No**	**Per cent**
1.	Single cropping	13	4.10	49	15.31
2.	Double cropping	303	94.68	268	83.75
3.	Multiple cropping	04	1.22	3	0.94
	Total	**320**	**100.00**	**320**	**100.00**

From the table 5, most of the respondents (94.68 %) follow double cropping system followed by single cropping (4.10 %) and multiple cropping (1.22 %) before COVID-19 pandemic whereas during COVID-19, it has been observed that majority of the respondents (83.75 %) follow double cropping system followed by single cropping (15.31 %) and multiple cropping (0.94 %). From the results, it is clear that there is gradual decrease in double cropping and a gradual increase in single cropping due to the fear of failure in crop harvest, so the meagre amount of the respondents confined their crop cultivation during COVID-19 pandemic.

3.2.3. Type of crop cultivated

Types of crops preferred by the farmers were cultivated in the field. Both agricultural and horticultural preference of the crops by small and marginal farmers were furnished in the table 6.

Table 6 Distribution of respondents according to type of crop cultivated.

(n=320)

S.No.	Category	Before COVID-19		During COVID-19	
		No	**Per cent**	**No**	**Per cent**
I	**Agricultural crops**				
1.	Cereals/millets	252	78.80	194	60.60
2.	Pulses	93	29.10	46	14.4
3.	Oilseeds	130	40.60	121	37.80
4.	Commercial crops	127	39.70	117	36.60

5.	Cash crops	85	26.60	63	19.70
II	**Horticultural crops**				
1.	Fruit crops	114	35.60	40	12.5
2.	Vegetables	227	70.90	258	80.6
3.	Flowers	166	51.90	193	60.30
4.	Plantation crops	34	10.60	32	10.00

Multiple responses obtained

It is evident from the above table, nearly four fifth of the respondents (78.80 %) had concerted on cultivating cereals and millets such as rice, ragi, sorghum and maize. Two fifth of the respondents (40.60 %) had concentrated on cultivating oilseeds mainly Groundnut crop. Nearly two fifth of the respondents (39.70 %) fascinated towards cultivating commercial crops like cotton and turmeric followed by cash crops (26.60) and pulses (29.10 %). Concerning horticultural crops, above two third of the respondents cultivating vegetables such as tomato, brinjal, bhendi, chilli, radish, onion, bitter gourd, bottle gourd, cabbage and cauliflower (70.90 %). About half of the respondents (51.90 %) focused on cultivating flower crops such as jasmine, tuberose, chrysanthemum, rose, oleander followed by cultivation of fruits (35.60 %) like banana and mango and plantation crops such as coconut and arecanut (10.60 %)

During COVID-19 pandemic, it has been observed that three fifth of the respondents (60.60 %) had cultivated cereals like rice, ragi, sorghum and maize whereas above one third of the respondents (37.80 %) had cultivated oilseeds like Groundnut followed by cultivation of commercial crops like cotton and turmeric (39.70 %). Above one fourth of the respondents (26.60 %) had cultivated pulses like red gram and black gram followed by cash crops like sugarcane (19.70 %). Due to closure of sugar industries during COVID-19 pandemic, farmers those invested in sugarcane cultivation experienced total loss.

Regarding cultivation of horticultural crops during COVID-19 pandemic, three fifth of the respondents (60.80 %) fascinated towards cultivating flower crops like jasmine, tuberose, chrysanthemum, rose and oleander. Due to COVID-19 pandemic, flower markets were withered, farmers had no place to sale their produce and also they can't able to store their produce due to its high perishability and their investment becomes vanished, thus the farmers could not able to enjoy any profit. Four fifth of the respondents (80.60 %) had cultivated various vegetables like tomato, brinjal, bhendi, chilli, onion and some cucurbits, thus the markets were closed and the commission agents who procured their produce directly from the field also not available, so the farmers can't able to sell their produce at fair price, the perishable produce were completely wasted, some of the produce were gave to nearby households at free of cost and the farmers didn't earn any profit, thus their investment becomes total loss. A meagre amount of the respondents cultivated fruits like mango (12.50 %) and plantation crops like coconut and arecanut (10.00 %) during COVID-19 pandemic.

3.2.4. Farming system Index.

Farming system Index comprises of three components includes Integrated Farming System, cropping system and type of crops cultivated. The results of farming system were classified as quartile based on the total score obtained from Integrated Farming System, Cropping system and type of crops to be cultivated. The results are furnished in the table 7.

Table 7 Distribution of respondents according to their Farming System Index (FSI).

(n=320)

S.No.	Category	Before COVID-19		During COVID-19	
		No	**Per cent**	**No**	**Per cent**
1	Below 25 per cent	255	79.70	266	83.10
2	25 per cent to 50 per cent	65	20.30	54	16.90
3	50 per cent to 75 per cent	0	0.00	0	0.00
4	75 per cent to 100 per cent	0	0.00	0	0.00
	Total	**320**	**100.00**	**320**	**100.00**

It is evident from the above table that nearly four fifth of the respondents (79.70 %) had cultivated under the category of below quadrant proportion of small and marginal farmers followed by 25 to 50 per cent proportion of small and marginal farmers (20.30%) before COVID-19 whereas during COVID-19, it has been observed that majority of the respondents (83.10 %) fall under the category of quadrant proportion of small and marginal farmers followed by 25 to 50 per cent proportion of small and marginal farmers (16.90 %). Thus the small and marginal farmers were having very low farming system before as well as during COVID-19 pandemic, thus they should focus on multiple cropping system, diversified cultivation of crops and different combinations of Integrated Farming System (IFS) to enhance their living standards and to gain diversified source of income.

3.3. Irrigation Index

Irrigation is the means of applying water to the field. Irrigation index illustrates various source of irrigation preferred by the farmers to irrigate their field. The results are furnished in the table 8.

Table 8 Distribution of respondents according to their irrigation type.

(n=320)

S.No.	Category	Before COVID-19		During COVID-19	
		No	**Per cent**	**No**	**Per cent**
I	**Surface Irrigation**				
1.	Open well	115	35.90	110	34.40
2.	Bore well	320	100.00	320	100.00
3.	Canal	24	7.50	30	9.40
4.	Water tank	0	0	0	0
5.	River	0	0	0	0
6.	Pond	0	0	0	0

II	**Sub surface Irrigation**				
1.	Drip	244	76.30	244	76.30
2.	Sprinkler	0	0	0	0

Multiple responses obtained

From the table 8, it is concluded that cent per cent of the respondents (100.00 %) irrigated their field through bore well followed by open well (35.90 %) and canal (7.50 %). During COVID-19 pandemic, it has been observed that cent per cent of the respondents preferred bore well (100.00 %) to irrigate their field followed by open well (34.40 %) and canal (9.40 %).

Regarding subsurface irrigation, it has been observed that slightly above three fourth of the respondents (76.30 %) utilized drip for irrigating their field before as well as during COVID-19 pandemic. Thus irrigation through drip considered as the most efficient and nutrient delivery system by the farmers and so it is mostly preferred by the respondents to irrigate their field.

3.4. Livestock possession

Livestock components include farm animals such as cow, buffalo, bullock, goat/ sheep and poultry. It illustrates the asset includes no. of farm animals possessed by small and marginal farmer before as well as during COVID-19 pandemic. The results are furnished in the table 9.

Table 9 Distribution of respondents according to their livestock possession.

(n=320)

S.No.	Category	Before COVID-19		During COVID-19	
		No	**Per cent**	**No**	**Per cent**
I	**Cows**				
1.	Up to 2	50	15.6	164	51.2
2.	3-4	242	75.6	136	42.5
3.	5-6	20	6.3	10	3.1
4.	>6	4	1.3	0	0
II	**Buffaloes**				
1.	Upto 2	6	1.90	6	1.90
2.	3 -4	8	2.50	4	1.30
III	**Bullocks**				
1.	Upto 2	0	0	0	0

2.	3 -4	0	0	0	0
IV	**Goats/ Sheep**				
1.	Up to 3	169	52.8	180	56.30
2.	3-6	77	24.1	19	5.90
3.	>6	4	1.3	6	1.9
V	**Poultry**				
1.	Up to 5	184	57.5	173	54.10
2.	5 – 10	77	24.1	39	12.20
3.	>10	2	0.6	1	0.3

Multiple responses obtained

It is evident from the table 10, thus the livestock components includes five different categories such as cow, buffalo, bullock, Goat/ sheep and poultry. Nearly three fourth of the respondents (75.60 %) possessed 3 to 4 cows followed by up to 2 cows (15.60 %), 5 to 6 cows (6.30 %) and more than 6 cows (1.30%). Very meagre amount of the respondents possessed up to 2 buffaloes (1.90 %) and 3 to 4 buffaloes (2.50 %). None of the respondents possessed bullocks. Less than three fifth of the respondents (56.30 %) had possessed goats/ sheep up to 3 followed by 3 to 6 (24.10 %) and more than 6 (1.30 %). Less than three fifth of the respondents (57.50 %) had possessed poultry up to 5 (57.50 %) followed by 5 to 10 no's (24.10 %) and more than 10 no's (0.60 %) before COVID-19 pandemic.

During COVID-19 pandemic, slightly more than half of the respondents (51.20 %) possessed cow up to 2 followed by 3 to 4 cows (42.50 %), 5 to 6 cows (3.10 %) and more than 6 cows (1.30 %). Negligible amount of the respondents possessed buffaloes up to 2.00 (1.90 %) and 3 to 4 (1.30 %). None of the respondents possessed bullocks. Less than three fifth of the respondents (56.30 %) possessed sheep / goat up to 3 (56.30 %) followed by 3 to 6 (5.90 %) and more than 6 (1.90 %). Above half of the respondents (54.10 %) had possessed poultry up to 5 (54.10 %) followed by 5 to 10 no's of poultry (12.20 %) and more than 10 no's (0.3 %).

From the results, it is clear that the possession of cows, buffaloes, goats/sheep and poultry has shown decreasing trend during COVID-19 pandemic when compared to before COVID-19 pandemic. Thus the COVID-19 pandemic indirectly impacts the livestock possession of small and marginal farmers due to feed shortage and inadequate maintenance of livestock and poultry.

3.5 Overall Natural capital

Based on the total score of natural capital, the natural capital index has been classified as quartile. The results are given in the table 10.

It is furnished from the above table, before COVID-19 pandemic, with regard to overall natural capital, three fifth of the respondents (60.30 %) fall under 25 to 50 per cent proportion of natural capital whereas above one third of the respondents (36.90 %) comes under the category of below 25 per cent proportion of natural capital and a very meagre amount of the respondents (2.80 %) fall under the proportion of 50 to 75 per cent. None of the respondents comes under the category of 75 to 100 per cent proportion of natural capital. During COVID-19 pandemic, slightly more than half of the respondents (53.10 %) belongs to 25 to 50 per cent proportion followed by below quadrant proportion (45.60

%).Negligible amount of the respondents (53.10 %) belongs to 50 to 75 per cent proportion. None of the respondents belongs to 75 to 100 per cent proportion.

Paired t-test results (t value: 12.905, P-value: <0.001) shows that there was a statistically significant difference in the overall natural capital of small and marginal farmers when before COVID-19 pandemic compared with during COVID-19 pandemic. Based on the calculated eta squared statistic value, it could be concluded that COVID-19 pandemic shows larger effect (eta squared value= 0.343) on overall natural capital of small and marginal farmers. The larger effect could be because of perishable crop cultivation during COVID-19 pandemic, change in integrated farming system and livestock possession.

The district wise analysis illustrated that in krishnagiri district; nearly half of the respondents (47.50 %) fall under the proportion of below 25 per cent of natural capital whereas slightly more than half of the respondents (51.20 %) fall under the proportion of 25 to 50 per cent proportion of natural capital. Only a negligible amount of the respondents (1.30 %) comes under the proportion of 50 to 75 per cent. None of the respondents fall under 75 to 100 per cent proportion of natural capital. During COVID-19 pandemic, slightly above three fifth of the respondents (61.30 %) fall under below quadrant proportion followed by 25 to 50 per cent proportion (38.80 %). None of the respondents belongs to the category of 50 to 75 per cent proportion and 75 to 100 per cent proportion.

With regard to Dharmapuri district, before COVID-19 pandemic, it has been observed that less than three fifth of the respondents (57.50 %) fall under below 25 per cent proportion of natural capital. Little above one third of the respondents (35.00 %) comes under the proportion of 25 per cent to 50 per cent proportion. Meagre amount of the respondents (7.50 %) fall under the proportion of 50 to 75 per cent. None of the respondents belong to the category of 75 to 100 per cent proportion. During COVID-19 pandemic, it has been observed that two third of the respondents (66.30 %) fall under below quadrant proportion whereas more than one fourth of the respondents (28. 70 %) comes under 25 to 50 per cent proportion and a very meagre amount of the respondents (5.00 %) belongs to 50 to 75 per cent proportion.

Regarding Salem district, before COVID-19 pandemic, it has been concluded that vast majority of the respondents (87.50 %) belongs to 25 to 50 per cent proportion followed by very little amount of the respondents belongs to the category of below quadrant proportion. None of the respondents belongs to 50 to 75 per cent and 75 to 100 per cent proportion of natural capital. During COVID-19 pandemic, it has been observed that above four fifth of the respondents (82.50 %) belongs to the category of 25 to 50 per cent proportion followed by below quadrant proportion (17.50 %).None of the respondents belongs to the category of 50 to 75 per cent and 75 to 100 per cent proportion of natural capital.

From district wise analysis, before COVID-19 pandemic, it could be observed that in namakkal district slightly above two third of the respondents (67.50 %) belongs to the proportion of 25 to 50 per cent followed by below quadrant proportion (30.00 %) and a very meagre amount of the respondents (2.50 %) belongs to 50 to 75 per cent proportion. None of the respondents belongs to 75 to 100 per cent proportion. During COVID-19 pandemic, slightly above three fifth of the respondents (62.50 %) belongs to 25 to 50 per cent proportion followed by below quadrant proportion (37.50 %).None of the respondents belongs to 50 to 75 per cent proportion and 75 to 100 per cent proportion.

Thus district wise paired t – test was carried out to show the COVID-19 impact on natural capital of small and marginal farmers. The result shows that there was statistically significant difference in the natural capital of all the districts namely krishnagiri (t value: 4.268, P-value: <0.001), Dharmapuri (t value: 4.268, P-value: <0.001), Salem (t value: 4.268, P-value: <0.001) and Namakkal (t value: 4.268, P-value: <0.001) when before COVID-19 pandemic compared to during COVID-19 pandemic. It is concluded that the COVID-19 pandemic shows significant impact on the natural capital of small and marginal farmers.

4. CONCLUSION

From the analysis, it has been concluded that there was larger effect of COVID-19 pandemic (eta squared value= 0.343) on natural capital of small and marginal farmers during COVID-19 pandemic when compared to before COVID-19 pandemic. It is observed that small and marginal farmers had poor land resources and they followed dual cropping system, single cropping pattern and medium livestock possession. Due to mono cropping system, soil fertility was affected and lack of fullest use of integrated resources, leads to inadequate use of natural resources. Lack of diverse crop cultivation and reduced livestock possession observed during COVID-19 pandemic. Hence, strategies like diverse crop cultivation, alternatives to the perishable crop cultivation or a plan to value added products of perishable produce, a tie up with manufacturing industries for sale of their produce and higher livestock possession with fullest use of integrated systems to be followed by small and marginal farmers to ensure sustainable maintenance of natural resources.

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Table 10. Distribution of the respondents according to their overall natural capital

(n=320)

S.No.	Category	Krishnagiri (n= 80)				Dharmapuri (n= 80)				Salem (n= 80)				Namakkal (n= 80)				Overall (n= 320)			
		Before COVID-19		During COVID-19		Before COVID-19		During COVID-19		Before COVID-19		During COVID-19		Before COVID-19		During COVID-19		Before COVID-19		During COVID-19	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
1	Below 25 per cent	38	47.50	49	61.30	46	57.50	53	66.30	10	12.5	14	17.50	24	30.00	30	37.50	118	36.90	146	45.60
2	25 to 50 per cent	41	51.20	31	38.80	28	35.00	23	28.70	70	87.50	66	82.50	54	67.50	50	62.50	193	60.30	170	53.10
3	50 to 75 per cent	1	1.30	0	0	6	7.50	4	5.00	0	0	0	0	2	2.50	0	0	9	2.80	4	1.30
4	75 to 100 per cent	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		80	**100.00**	**80**	**100.00**	**80**	**100.00**	**80**	**100.00**	**80**	**100.00**	**80**	**100.00**	**80**	**100.00**	**80**	**100.00**	**320**	**100.00**	**320**	**100.00**
		t value: 4.268		P vale: 0.000		t value: 4.569		P vale: 0.000		t value: 9.940		P vale: 0.000		t value: 7.616		P vale: 0.000		t value: 12.905		P vale: 0.000	