



Climate Change Impacts on the Livelihood of North Eastern Zone Tribes of Tamil Nadu, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study was conducted in the North eastern zone of Tamil Nadu during July – September 2023, with the objectives to assess the awareness and perception level of the local tribes on the impact of climate change on their livelihood, to assess the extent of the climate change impacts on their livelihood activities and to study their present adaptation strategies. It is an Ex-post facto research conducted in Tiruvannamalai district of the North eastern zone of Tamil Nadu considering its large volume of tribal population. Two tribal dominant villages viz., Nammiyampattu and Kovilur were identified for this study. The sample size was sixty active tribal respondents selected from the above study villages. Data were collected using structured and standardised interview schedule. Percentage analysis was done to get meaningful interpretation of the results. The respondents were having good level of awareness and perception on the local climate based livelihood issues. They incurred a remarkable income loss on their livelihood activities viz., from farming, livestock

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management, honey bee collection, construction work, business and field labour. The respondents have not followed any scientific adaptation strategies. Government intervention in price fixing, providing interest free loans, subsidies and educational training programmes are suggested

Keywords: Climate change; impact; livelihood; awareness; perception; tribes.

1. INTRODUCTION

The most vulnerable group in the society are the 'tribes' who depend on natural resources for livelihoods. Human activities are causing tremendous pressure on the natural resources and poses challenges on their livelihood securities.

Scientists at global level paying attention to study the effects of climate change and its variability on agricultural production.

Wildcat [1] pointed out that the wealth and the health of the local tribes are threatened due to climate change. In the same line, Epstein [2] opined that the livelihood of the native tribes are most affected due to climate change as they live very close to natural environment. McLean (2010) stated that the livelihood and the food security of the indigenous communities are most affected due to the global level climate change. The climate change impacts are very severe in tropical areas, where most of the developing nations are located [3]. Further, Maldonado et al. [4] stated that the tribes in the coastal areas of USA are forced to relocate due to climate change.

Sejian [5] stated that the pastures are damaged by extreme high temperature. In this line Rani *et al.* [6] stated that local crop yield is reduced due to high local temperature. The circumstances of extreme rainfall leads to higher flooding [7]. India's agriculture being dependent mostly on rainfall, its potential consequence on the economy and livelihood security of rural people are very severe [8].

In India, the native tribes are most cornered by climate change as their entire life is dependent on natural resources [9]. The tribal communities are leading their life in close association with nature and hence they are deeply affected. Here, Ghosh et al. [10] stated that these changing circumstances have created serious impacts on the tribes' livelihood activities.

Regarding the management practices, Minj [11] sought for an in-depth study to assess the

climate change impact on the native food system. Ghanghas et al. [12] pointed out that the local extension workers need to be trained on the proper remedial measures on climate change. Sai et al. [13] reported about local tribes' own strategies such as repairing the surface water storage structures, provision of vaccination and quality fodder to their animals. Vijayabhinandana et al. [14] recommended better educational training programmes on the sustainable management of their own ecosystem. Arunachalam (2023) stated that appropriate policy measures are required on the forest collections like, honey, wild edible fruits, vegetables and tubers

In order to assess the vulnerability of the climate change, we need to analyze the awareness and perception of the local tribes on the impact of climate changes and the factors of those changes. Keeping this mind the present study was carried out with the following specific objectives.

1. To assess the awareness and perception level of the local tribes on the impact climate change on their livelihood.
2. To study the extent of the climate change impacts on their livelihood activities along with their present adaptation strategies.

2. MATERIALS AND METHODS

Ex-post fact research design was adopted for the present study. The study was conducted in the North Eastern Zone of Tamil Nadu considering its larger population of tribal communities among the seven agro climatic zones of Tamil Nadu.

From this zone, the Tiruvannamalai district was identified for the study considering the maximum tribal population in this district. Again on the same criteria the villages viz., 'Nammiyampattu' from Polur block and 'Kovilur' from Cheyyar block were selected for the study purpose. The tribes viz, Vellala gounder, Malayala gounder and Pooosari gounder were the most prominent tribes in both villages [15].

From each village thirty tribal respondents having vast experience in the local livelihood activities,

ecological and socio-cultural aspects were identified. Totally there were sixty tribal respondents, among whom the present study was conducted.

The steps of the investigation are given below

1. In the first step, the climate based impacts of the local livelihood system were documented by employing the PRA methods such as focused group discussion, seasonal calendar, time line and interactive group meetings with the local tribes. The expertise of the local extension workers, social workers and tribal development authorities were also utilized for the documentation purpose
2. Secondly, the level of awareness and perception of the native tribes were assessed on these documented impacts. The perceived responses of the local tribes were also studied about the extent of the climate change impacts on their livelihood activities along with their present adaptation strategies. The above assessment were carried out among the 60 tribal respondents selected from the study villages by using structured and standardized interview schedule. The data were collected during July – August 2023.
3. Finally, based on the above results, appropriate policy recommendations, suggestions and strategies were proposed by involving the eminent personalities and experts in this field.

3. RESULTS AND DISCUSSION

The major findings are discussed in the following sub headings.

3.1 Respondents' Awareness and Perception on the Impact of Climate Change on their Livelihood

The findings are given in the Table 1. It is found that cent per cent of the respondents were aware that profitable traditional millet cultivation is almost disappeared now due to the changing climatic conditions, on which 73.33 percentage of the respondents possessed with right perception. During the survey, it is understood that the remunerative livelihood activities with in the

village is reduced due to the extended rainfall season, and as local ecosystem fails to support financially, now they are working as laborers outside. Here cent percentage of respondents were well aware about the prevalence of this issue and on which they strongly agree for the cause of the issue. The local wild edible fruits and medicinal plants once provided promising income for the local tribes. Here almost cent percentage of the respondents were aware about this issue and majority of the respondents had right perception on this issue.

It is also noted that 95.00 percentage of the respondents were well aware about the fact that the wild edible mushroom is gradually disappearing due to the erratic climate change. Here 23.33 percentage of the respondents agree for the cause of this issue. There were few local forest products / forest collections which once provided promising income for the local tribes now failed to give the same. This fact was aware by 95.00 percentage of the respondent and almost the same percentage of the respondent (91.67 per cent) have agreed for the cause of the issue. Erratic wind behaviour coupled with the higher temperature affects crop pollination, yield potential and honey collection. Here about three fourth (76.67 per cent) of the respondents were well aware about this issue and they also had right perception about this particular issue.

Paddy cultivation was one of the major livelihood activities among the local tribes. They cultivate local traditional varieties and few respondents have also cultivated high yielding varieties. The local system experiences erratic wind behaviour now a days, due to high intensity deforestation which leads to crop lodging and also crop dried up majorly. Consequently the crop yield is also reduced. Here most of the respondents (83.33 per cent) were aware about this issue and three fourth (75.00 per cent) of the respondents were seen with good perception about this issue. In addition to the above, the local major crops failed to give profitable returns owing to heavy rainfall and erratic wind behaviour. Here a vast majority of the respondents (76.67 per cent) have agreed for the cause of issue.

Different parts of local trees and local plants were previously sold in the outside market which fetched them sustaining income. Now due to erotic changes in the climatic factors, their quality is very much deteriorated and more over low priced alternatives also available in the outside

market. Here about seventy percentage (71.67 per cent) of the respondents were aware about this issue and two-fifth of the respondents (40.00 per cent) were with good perception about this issue. The local tree bark were sold in the outside market which is being used as cooking spices and also its fibre is being used for the preparation of traditional dresses. Due to the high intensity rainfall, the tree bark lost its potential market quality. Here, about one-fourth of the respondents (23.33 per cent) were aware about this and only 11.67 percentage were seen with good perception about this issue. The local tribes widely felt that they failed to achieve the usual yield from the local tubers with good market quality due to the water logging situations during the times of unseasonal and erratic rainfall. Here only few respondents (11.67 per cent) were well aware about this issue and none of the respondents agreed for the cause of this issue.

3.2 Extent of the Impact of Climate Change on the Livelihood Activities as Perceived by the Respondents

The perceived impact of the respondents on their livelihood activities were studied with regard to the income loss in farming, livestock management, honey bee collection, construction work, business and field labour, as they are their major income generating avenues among the local tribes. The related findings are given in Table 2.

3.2.1 Farming

It is reported that 35.00 per cent of the respondents earned a regular annual income of Rs 50000 to Rs 1 lakh through farming. Twenty per cent of the respondents earned an income up to Rs. 50000. About ten per cent of the respondents (11.67 per cent) earned an annual income above Rs. 1 lakh. The reported income loss due to the varying climatic factors are up to 30.00 per cent (23.33 per cent), above 30.00 to 60.00 per cent (26.67 per cent) and above 60.00 to 90.00 per cent (18.33 per cent). The reported contributing climatic factors are low rainfall (41.67 per cent) and high temperature (26.67). The respondents offered their suggestions to mitigate their income loss. They requested for interest free loans and subsidies (35.00 per cent) and fixing remunerative market price for their local commodities (33.33 per cent).

3.2.2 Field labour

There were two income categories seen viz., up to Rs 30000 (23.33 per cent) and above Rs 30000 to Rs 60000 (13.33 per cent). The reported income loss from working as farm labours due to unfavourable climatic change are above 30.00 to 60.00 per cent (20.00 per cent) and above 60.00 to 90.00 per cent (16.67 per cent). The contributory climatic factors for the reported income loss are unseasonal high rainfall (23.33 per cent) and low rainfall (13.33 per cent). They respondents also offered few suggestions to solve the reported income loss. One-fourth of the respondents (23.33 per cent) requested for govt supported transportation and about ten percentage of the respondents (13.33 per cent) requested remunerative employment opportunities.

3.2.3 Livestock

There were three income categories seen viz., up to Rs.30000 (13.33 per cent), above Rs. 30000 to Rs. 60000 (20.00 per cent) and above Rs. 60000 (16.67 per cent). The reported income loss from livestock management due to unfavourable climatic change are up to 30.00 per cent (23.33 per cent) above 30.00 to 60.00 per cent (16.67 per cent) and above 60.00 to 90.00 per cent (10.00 per cent). The contributory climatic factors for the above income loss are unseasonal high rainfall (31.67 per cent) and high temperature (18.33 per cent). The respondent offered few suggestions, Viz., training on advanced profitable livestock and poultry management practices (33.33 per cent) and training on better health management for their birds and animals (16.67 per cent).

3.2.4 Business

Nursery management is their local prime business activity. Two income categories are seen Viz., Rs 20000 to Rs 30000 and above Rs. 30000 to Rs. 60000. The reported income loss due to climatic factors are up to 30.00 per cent (05.00 per cent) and above 30.00 to 60.00 per cent (01.67 per cent). The extreme unfavourable higher temperature was reported as the contributing climatic factor (06.67 per cent). The respondents requested for interest free loan and government subsidies (06.67 per cent) so as to manage the income.

Table 1. Distribution of the respondents according to their awareness and perception of the impact of climate change on their livelihood (n= 60)

Sl. No	Climatic issues	Awareness				Perception			
		Yes		No		Agree		Disagree	
		No	%	No	%	No	%	No	%
1.	The yield of paddy crop is reduced due to erratic wind behaviour	50	83.33	10	16.67	45	75.00	15	25.00
2.	Profitable traditional millet cultivation is almost disappeared now due to the changing climatic conditions	60	100.00	00	00	44	73.33	16	26.67
3.	The local major crops failed to give profitable returns due to crop lodging issues owing to heavy rainfall and erratic wind behaviour now a days	46	76.67	14	23.33	32	53.33	28	41.67
4.	Erratic changes in wind flow direction affects crop pollination and consequently higher yield loss	43	71.67	17	28.33	31	51.67	29	48.33
5.	Honey collection was affected due to higher temperature coupled with erratic wind behaviour	46	76.67	14	23.33	38	63.33	22	36.67
6.	The local wild edible fruits once provided promising income almost vanished from the locality due to varying higher temperature coupled with deforestation	57	95.00	03	05.00	38	63.33	22	36.67
7.	The local medicinal plants once provided rich income disappeared due to deforestation coupled with resultant unfavorable variations in climate change	58	96.67	02	03.33	32	53.33	28	41.67
8.	The local tubers fail to give usual yield with marketable quality due to continuous water logging on the unseasonal and erratic rainfall	07	11.67	53	88.33	00	00	60	100.00
9.	Declined quality of local tree / plant parts on the changing climatic factors (Higher Temperature, unseasonal rainfall, unfavorable higher RH), coupled with suitable low-priced alternatives in the outside market	43	71.67	17	28.33	24	40.00	36	60.00
10.	Wild edible mushroom disappearing trend due erratic climate change	57	95.00	03	05.00	14	23.33	46	76.66
11.	Tree bark quality very much affected due to higher intensity rainfall	14	23.33	46	76.66	07	11.67	53	88.33

Sl. No	Climatic issues	Awareness				Perception			
		Yes		No		Agree		Disagree	
		No	%	No	%	No	%	No	%
12.	Remunerative livelihood activities within the village is reduced due extended rainfall season	60	100.00	00	00	60	100.00	00	00
13.	Market value of the local forest products are very much affected due to changing climatic conditions	57	95.00	03	05.00	55	91.67	05	08.33
14.	As local ecosystem fails to support financially, now working as laborers outside	60	100.00	00	00	60	100.00	00	00

Table. 2. Impact of climate change on the livelihood activities (n= 60)

Sl. No	Regular livelihood activities	Normal regular Income / per year			Influence of climate change (Income loss)			Contributory climatic factors (*)			Suggestions (**)		
		Income	No	%	Influence	No	%	Contributory factors	No	%	Suggestions	No	%
1.	Farming	Up to 50000	13	21.67	Up to 30 %	14	23.33	2	16	26.67	3	21	35.00
		>50000 -1 Lakh	21	35.00	> 30-60 %	16	26.67	1	25	41.67	2	20	33.33
		> 1 Lakh	7	11.67	> 60-90 %	11	18.33						
2.	Field labour	Up to 30000	14	23.33	> 30-60 %	12	20.00	1	8	13.33	4	14	23.33
		>30000-60000	8	13.33	> 60-90 %	10	16.67	3	14	23.33	5	8	13.33
3.	Livestock	< 30000	8	13.33	Up to 30 %	14	23.33	2	11	18.33	7	10	16.67
		>30000-60000	12	20.00	> 30-60 %	10	16.67	3	19	31.67	6	20	33.33
		>60 Lakh	10	16.67	> 60-90 %	6	10.00						
4.	Business	20000-30000	2	03.33	Up to 30 %	3	05.00	2	4	06.67	3	4	06.67
		>30000-60000	2	03.33	> 30-60 %	1	01.67						
5.	Construction worker	10000-20000	2	3.33	Up to 30 %	4	06.67	2	3	05.00	5	6	10.00
		>20000-30000	4	6.67	> 30-60 %	2	03.33	5	3	05.00			
6.	Honey bee collection	10000-15000	3	5	> 30-60 %	4	06.67	3	4	06.67	2	3	05.00
		>15000-18000	4	6.67	> 60-90 %	3	05.00	5	3	05.00	8	4	06.67
* - Climatic factors					** - Suggestions								
1. Low rainfall					1. Provided water facilities								
2. High temperature					2. Fix remunerative market price for their commodities								
3. Unseasonal high rainfall					3. Interest free loan & subsidy								
4. Deforestation					4. Govt supported transportation								
5. Erratic wind behaviour					5. Remunerative employment opportunities								
					6. Training on modern profitable livestock / poultry management								
					7. Training on better health management for birds and animals								
					8. Training on modern methods of maintaining honey bee colonies								

Table 3. Existing adaptation strategies of the respondents

Sl. No	Issues	No	Per cent	Management strategies being adopted	No	Per cent
a.	Low income in farming and honey bee collection	15	25.00	Migrates to another work place like coffee estate or building workers for income.	15	25.00
b.	High cost of health management for their birds and animals	10	16.67	More dependence on herbal treatment	10	16.67
c.	Peacock attack the field during flowering stage and grain maturity stage	20	33.33	A separate labour allotted to drive away peacock	20	33.33
d.	Uncertainty in the time of water distribution service by pipelines	15	25.00	Store and use in required time	12	25.00

3.2.5 Construction worker

Two income categories are seen Viz., Rs 10000 to Rs 20000 and above Rs. 20000 to Rs. 30000. The income loss due to the unfavourable climatic change are up to 30.00 per cent (06.67 per cent) and above 30.00 to 60.00 per cent (03.33 per cent). The contributory climatic factors for the income loss are high temperature and erratic wind behaviour (05.00 per cent). The respondents requested for the provision of gainful employment opportunities (10.00 per cent) to solve these issues locally.

3.2.6 Honey collection

Two income categories are seen here Viz., Rs 10000 to Rs 15000 and above Rs 15000 to Rs 18000. The reported income loss from honey collection due to unfavourable climatic conduction are 30.00 to 60.00 per cent (06.67 per cent) and above 60.00 to 90.00 per cent (05.00 per cent). The tribals respondents reported two unfavourable climatic factors causing income loss from honey collocation. Here few respondents (06.67 per cent) mentioned about the unseasonal high rainfall as the prime contributory climatic factor and the erratic wind behaviour which drives away the honey bee colonies (05.00 per cent). The tribals respondents offered few suggestions to mitigate the income loss such as training on modern methods of maintaining honey bee colonies (06.67 per cent) and fixing remunerative market price for their produce (05.00 per cent).

3.3 Existing Adaptation Strategies of the Respondents

The adaptation strategies of the respondents on the changing climatic factors have been studied and presented Table 3.

The findings in the Table 3, reveals that one-fourth of respondent (25.00 per cent) mentioned about their poor employment opportunities and less income from farming and honey bee collection. Here some of the respondents managed by moving to some other work place like coffee estates or building workers for their income (25.00 per cent). About one-fifth of the respondents (16.67 per cent) mentioned about high cost of health management practices for their birds and animals which was managed by local herbal treatments (16.67 per cent). About one-third of the respondents (33.33 per cent) mentioned about crop damage due to the peacock attack during flowering stage and grain maturity stage. Here most of the respondents have engaged separate labor to drive away the peacock (33.33 per cent).

The local natural surface water resources have almost dried up due to poor rainfall distribution and other human mismanagement activities of natural resources. Due this, the local tribes are depending upon the pipeline water distribution system extended by the local panchayat, and the distribution timing also very much uncertain here. About one fourth of the respondents (25.00 per cent) have reported about the timing of water service by pipelines as an issue for them. The respondent managed this issue by storing the

water in big containers and using it in the required time (25.00 per cent).

3.4 Suggestions for Stabilizing the Livelihood Activities

Based on our discussion and with the local tribal leaders, local extension workers, social workers and experts in tribal research, the following suggestions are made

- Government intervention to simplify the procedure on the forest collections like Honey, wild plantations, wild edible vegetables, fruits and medicinal plants.
- As these natural vegetation / resources are almost in endangered conditions, government should come out with necessary schemes to rejuvenate them in their natural setting.
- Necessary policy measures are required to fix price for their produce /commodities.
- Appropriate educational training programmes may be organized on the modern methods of crop cultivation, plant protection, animal health management and value addition from the local forest produce / vegetation like, wild mushroom, wild edible fruits, vegetables, medicinal plants and honey
- Adequate measures are required to rejuvenate the natural surface water resources, which is the prime important factor to maintain / sustain their livelihood activities besides their socio cultural values.
- An exhaustive research is required to identify potentially viable self employment projects inside their localities so as to sustain their income generation and also to arrest their migration to outside areas to work as construction workers / field labourers.
- Due to unusual circumstances of climate change, they face lot of health complications. The human and animal productivity and work efficiency are very much reduced now a days. Government or the local NGOs may consider this issue and provide suitable remedial measures.
- Due to climate change they face different crop production issues like, sudden outbreak of pest and diseases, crop lodging, crop drying, flower drop, stunted growth, delay or postponement in planting, poor yield poor, market value and loss of

natural aroma and taste in the local crop produce. They have to be given adequate trainings to manage these issues.

- Government / local banks and cooperatives should come forward to provide interest free or low interest loans and other subsidies so as to promote their own livelihood ventures and sustain their income generation activities.

4. CONCLUSION

It is understood that the climate change affected the livelihood of the native tribes. Their awareness and perception level on the documented issues were appreciable. They have good perceptual understanding of these issues. Further, it is understood that the unfavourable higher temperature, erratic rainfall distribution, changes in wind behaviour and relative humidity were the major contributing factors for their income loss in livelihood activities in farming, livestock management, honey bee collection, construction work, business and field labour. It is understood that their income loss in the above livelihood activities were in the range of 10 to 30 per cent of their regular annual income. It is recommended to form a separate tribal development cell to monitor the climate change affecting the livelihood of the native tribes and also to provide climate oriented need based trainings to local tribes to sustain their livelihood activities.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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