P-ISSN: 2618-0723
E-ISSN: 2618-0731

NAAS Rating: 5.04
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 8; Issue 2; February 2025; Page No. 381-386

Received: 02-12-2024
Accepted: 08-01-2025

Indexed Journal
Peer Reviewed Journal

Challenges and constraints in farmer's adaptation to climate change: A sectoral analysis

[1]Ashish Yadav, [1]AP Verma, [1]Gaurav Mishra, [1]Ashutosh Suryavanshi, [1]Nirmal Chandra, [1]BP Mishra, [1]BK Gupta, [1]Dheeraj Mishra, [1]PK Ojha, [1]Divya Katiyar, [2]Gaurav Shukla and [3]Abhishek Kalia

[1]Department of Agricultural Extension, College of Agriculture, BUAT, Banda, Uttar Pradesh, India

[2]Department of Statistics and Computer Science, College of Agriculture, BUAT, Banda, Uttar Pradesh, India

[3]Department of Basic and Social Science, College of Forestry, BUAT, Banda, Uttar Pradesh, India

DOI: https://www.doi.org/10.33545/26180723.2025.v8.i2f.1662

Corresponding Author: AP Verma

Abstract

This paper explores the constraints faced by farmers in the Banda District of Bundelkhand region of Uttar Pradesh, India while adapting to climate variability. Data was collected from 180 randomly selected farmers through structured interview schedule. The region is highly vulnerable to climate change, primarily relying on rainfed agriculture, which amplify socio-economic challenges. The study categorizes constraints into personal, institutional, technical, weather-related, crop-variety-related, labour-related, and economic barriers that hinders effective climate adaptation strategies. Among personal constraints, illiteracy (2.88 wms) and fragmented landholdings (1.89 wms) were identified as significant challenges, limiting access to climate-related information and impeding the adoption of adaptive measures such as soil conservation and diversified farming. Institutional constraints, including poor extension services (2.68 wms) and limited access to credit (1.80 wms), further increased the difficulties faced by farmers. Additionally, high input costs and distant agricultural supply centres hinder timely and efficient decision-making. Weather-related constraints, particularly unreliable weather forecasting (2.50 wms) and unpredictable monsoon (1.74 wms), significantly affect agricultural planning. Crop-related constraints such as non-availability of the insect-pest and disease-tolerant varieties (2.40 wms), high input costs (1.96 wms), restrict farmers' capacity to mitigate risks. The paper also highlights labour-related challenges, including high labour costs (2.22 wms) and financial limitations in hiring adequate manpower (2.52 wms) for adaptive agricultural practices. Non-farm income diversification is another crucial adaptation strategy, but low wages (2.52 wms), and poor skills (2.00 wms) restrict its effectiveness. Livestock farming also faces significant obstacles, with feed shortages (2.38 wms), susceptibility of high-yielding breeds (2.33 wms) to climate stress, and breeding issues being major concerns. Statistical analysis suggests that socio-demographic factors such as landholding size, herd size, milk production, and annual income have a strong correlation with the ability to overcome climate adaptation constraints. The findings emphasize the need for improved agricultural extension services, access to institutional credit, better weather forecasting systems, and increased availability of climate-resilient crops. Addressing these challenges is crucial to strengthening the resilience of farmers in the face of climate variability.

Keywords: Adaptation strategies, weighted mean score, constraints, climate variability

Introduction

Farmers implement various adaptation measures promptly to address the changing climate in the research area. Throughout this process, farmers encounter multiple constraints affecting their selection of climate change adaptation options, which are classified into personal, institutional, and technological categories. Table 33 delineates the limitations influencing the selection of adaption strategies employed by the respondents in the research area. Illiteracy and the limited extent of fragmented landholdings emerged as the most significant personal constraints affecting the respondents' coping strategies in response to climate change in the study area, ranked first and second with weighted mean scores of 2.88 and 1.89, respectively. Illiteracy obstructs respondents' access to knowledge from diverse sources regarding the mitigation of climate change risks. The limited educational attainment restricts access to climate change knowledge from diverse sources, and inadequate comprehension heightens these populations' susceptibility to climate risks. The limited size of fragmented landholdings hinders respondents from using diverse coping strategies such as soil and water conservation, varied farming, cultivation of drought-resistant cultivars, and usage of available weather information. The results of the current study align with those of Satishkumar *et al*. (2013) [14]. Furthermore, insufficient technical expertise about suitable adaptation tactics and a shortage of labor in the study were the third and fourth principal restrictions, with mean scores of 1.74 and 1.71, respectively. Liang *et al*. (2013) [9] discovered that farmers are more aware of local climate variability concerns. Nonetheless, their comprehension of the significance of adaptation to their livelihoods is constrained. They possess insufficient understanding of the appropriate contacts and sources for climate change adaptation information. The lack of labour to implement adaptation

strategies for enhancing resistance to climatic variability is a significant barrier encountered by the respondents in the research area.

Table 1: Distribution of respondents according to personal constraints to choice of Climate Change Adaptation Strategies (n=180)

Sl. No.	Personal constraints to choice of climate change adaptation strategies	Most severe constraints		Severe constraints		Least severe constraint		Score	WMS	Rank
		f	%	f	%	f	%			
1.	Illiteracy	163	90.55	14	7.78	3	1.67	520	2.88	I
2.	Small-size fragmented landholding	5	2.77	151	83.89	24	13.34	341	1.89	II
3.	Scarcity of labour	15	8.34	104	57.77	61	33.89	314	1.74	III
4.	Inadequate technical know-how on appropriate adaptation strategies	9	5.00	110	61.12	61	33.88	308	1.71	IV

Institutional constraints to choice of climate change adaptation strategies

Institutional restrictions (Table 1) presented hurdles to responders in executing adaptive capability to climatic variability. In the rainfed region, a significant majority of respondents (72.77%) reported inadequate access to information from state government extension services and informal institutions such as private input traders and non-profit organizations focused on climate risk management, with a weighted mean score of 2.68, ranking first. The extension services in India have extensive reach to the populace, although encountering several challenges in timely access to the agricultural community, particularly in rainfed areas. Institutional credit is a crucial feature that enables farmers to cultivate land and use adaptive measures to mitigate the consequences of climate change, especially in rainfed areas. This is the sole method to obtain credit with the minimal interest rates relative to other disorganized lending industries in India. In the research area, 68.33% of farmers indicated that the lack of institutional financing was a significant limitation to implementing adaptation measures, with a weighted mean score of 1.80, ranking it second. Farmers indicated that if such facilities were made accessible during or after the cropping season, they would be ineffective, as soil and water conservation measures and other agricultural strategies must be implemented before to the cropping season. The acquisition of necessary resources for land cultivation and the implementation of adaptive measures to climate variability mostly hinges on credit availability.

The results are in conformity with the study of Deressa *et al.* (2008) [2], Onyeneke and Madukwe (2010) [10], Satishkumar *et al.* (2013) [14], and Tambo and Abdoulaye (2013) [15]. High cost of fertilizer and other inputs (52.77%), and high distance of agricultural input supply shops (52.23%) were the other institutional constraints reported by the respondents with a weightage mean score of 1.79 and 1.77 and ranked 3rd and 4th, respectively.

Table 2: Distribution of respondents according to Institutional constraints to choice of Climate Change Adaptation Strategies (n=180)

Sl. No.	Institutional constraints to choice of climate change adaptation strategies	Most severe constraints		Severe constraints		Least severe constraint		Score	WMS	Rank
		f	%	f	%	f	%			
1.	Poor extension service on climate risk management	131	72.77	42	23.34	7	8.89	484	2.68	I
2.	Non-availability of institutional credit	11	6.11	123	68.33	46	25.56	325	1.80	II
3.	High cost of fertilizer and other inputs	20	11.11	103	57.22	57	31.67	323	1.79	III
4.	High distance of agricultural input supply shops	23	12.77	94	52.23	63	35.00	320	1.77	IV

Weather related constraints to choice of climate change adaptation strategies

Farmers predominantly depend on their indigenous knowledge for weather information due to its reliability, which has been cultivated over centuries of experience "(Satishkumar *et al.* 2013) [14]". Approximately 56.11% of respondents (Table 2) indicated that insufficient access to information regarding weather forecasting technology and its poor reliability constituted the most significant barriers to implementing adaptive measures for climate change, with a weighted mean score of 2.50, ranking it first. This was followed by the unpredictable monsoon, regarded as the second most critical issue, with a weighted mean score of 1.74. The results align with previous research by Shankar, which identified the lack of location-specific climate forecasts, inadequate reliability and accuracy of these forecasts, insufficient extension services regarding climate predictions, media forecasts that do not meet operational requirements, and low confidence in climate predictions as significant issues reported by farmers.

The other constraints as reported by the respondents were heavy rainfall and hailstorm in a short period and insufficient funds from Govt. for climate information like early warning systems, automatic weather stations etc. With a weightage mean score of 1.68 and 1.60 and ranked 3rd and 4th, respectively. This corroborates the findings of Fagariba *et al.* (2018) [3].

Table 3: Distribution of respondents according to weather-related constraints to choice of Climate Change Adaptation Strategies (n=180)

Sl. No.	"Weather-related constraints to choice of climate change adaptation strategies"	Most severe constraints		Severe constraints		Least severe constraint		Score	WMS	Rank
		f	%	f	%	f	%			
1.	"Inadequate access to climate information and poor reliability"	101	56.11	68	37.77	11	6.12	450	2.50	I
2.	Unpredictable monsoon	6	2.33	122	67.78	52	28.89	314	1.74	II
3.	"Insufficient funds from Govt. for climate information like early warning systems, Automatic weather stations, etc."	11	6.11	86	47.77	83	46.12	288	1.60	IV
4.	Heavy rainfall and hailstorms in a short span of time	19	10.55	86	47.78	75	41.67	304	1.68	III

"Crop varieties related constraints to choice of climate change adaptation strategies"

It was further revealed (Table 3) that non-availability of the insect-pest and disease-tolerant varieties, high cost of the varieties, non-availability of late and early sown verities, and non-availability of drought, salinity, water-logging/flooding/submergence tolerant varieties were perceived as the major constraints with a weightage mean score of 2.40, 1.96, 1.76, 1.62 and ranked 1st, 2nd, 3rd and 4th respectively. The high cost, coupled with the unavailability of improved technologies of crop varieties that are resistant to insect pests and diseases, climatic stress, and variability militate against the choice of crop varieties as a coping strategy to combat the effect of climate change in the study area. The study conducted by Otitoju and Enete (2016) [11] is in line with the present study.

Table 4: Distribution of respondents according to crop varieties related constraints to choice of Climate Change Adaptation Strategies (n=180)

Sl. No.	Crop varieties related constraints to choice of climate change adaptation strategies	Most severe constraints		Severe constraints		Least severe constraint		Score	WMS	Rank
		f	%	f	%	f	%			
1.	Non-availability of the insect-pest and disease-tolerant varieties	87	48.33	78	43.33	15	8.34	432	2.40	I
2.	High cost of the varieties	33	18.33	107	59.44	40	22.23	353	1.96	II
3.	Non-availability of late and early sown varieties	12	6.66	88	48.89	80	44.45	292	1.62	IV
4.	Non-availability of drought, Salinity, water logging/flooding/submergence tolerant varieties	28	15.55	81	45.00	71	39.45	317	1.76	III

Change in planting and harvesting time of crop related constraints to choice of climate change adaptation strategies

Further, (Table 4) revealed that high input costs due to changes in planting dates followed by in-accurate agro-metrological information to decide the date of harvesting and time of dissemination of agro-meteorological information were the top most constraints as reported by the respondent with a weightage mean score of "2.38, 2.33, 1.84 and ranked 1st, 2nd and 3rd," respectively. Other constraints faced by respondents in the study area due to changes in planting and harvesting time of crops were poor storage and processing facilities, difficulties in shifting to different cropping patterns in a short period of time, poor mechanization and other needed machinery, decrease in crop yield, inadequate access to seeds as per change in planting schedule with a weightage mean score of "1.82, 1.77, 1.73, 1.70, 1.61 and ranked 4th, 5th, 6th, 7th and 8th" respectively. Changes in the planting and harvesting time of crops restrict the respondents from take appropriate decisions on time against the choice of climate change adaptation strategies.

Table 5: Distribution of respondents according to change in planting and harvesting time of crops related constraints to choice of Climate Change Adaptation Strategies (n=180)

Sl. No.	Change in planting and harvesting time of crops related constraints to choice of climate change adaptation strategies	Most severe constraints		Severe constraints		Least severe constraint		Score	WMS	Rank
		f	%	f	%	f	%			
1.	High input cost due to change in planting dates	92	51.12	66	36.66	22	12.22	430	2.38	I
2.	"Difficulties in shifting to different cropping patterns in a short period of time"	11	6.11	116	64.46	53	29.44	318	1.77	V
3.	Decrease in crop yield	22	12.22	82	45.55	76	42.23	306	1.70	VII
4.	Inadequate access to seeds as per change in planting schedule	16	8.88	79	43.89	85	47.23	291	1.61	VIII
5.	Inaccurate agro-metrological information to decide the date of harvesting	77	42.77	86	47.78	17	9.45	420	2.33	II
6.	Time of dissemination of agro-meteorological information	19	10.55	114	63.33	47	26.12	332	1.84	III
7.	Poor storage and processing facilities	31	17.23	86	47.77	63	35.00	328	1.82	IV
8.	Poor mechanization and other needed machinery	23	12.78	87	48.34	70	38.88	313	1.73	VI

"Labour cost and availability related constraints to choice of climate change adaptation strategies"

The results revealed that (Table 5) inadequate finance and credit facilities to meet the labour requirement were the most important constraints faced by respondents in the choice of climate change adaptation strategies followed by the high cost of labour in applying the mulching material and poor family human assets with a weightage mean score of 2.52, 2.22, 1.68 and ranked 1st, 2nd, and 3rd, respectively. The other constraints which hinder the coping capacity of

respondents to choice of climate change adaptation strategies were the low durability of the mulching materials, use of labour to protect the grazing of the crop field, harsh working conditions for labour, low availability and productivity of labour with a weightage mean score of 1.66, 1.50, 1.48, 1.36 and ranked 4th, 5th 6th, and 7th, respectively.

Table 6: Distribution of respondents according to Labour cost and availability related constraints to choice of Climate Change Adaptation Strategies (n=180)

Sl. No.	Labour cost and availability related constraints choice of climate change adaptation strategies	Most severe constraints		Severe constraints		Least severe constraint		Score	WMS	Rank
		f	%	f	%	f	%			
1.	Inadequate finance and credit facilities to meet the labour requirement	111	61.67	53	29.45	16	8.88	455	2.52	I
2.	Poor family human assets	15	8.33	92	51.11	73	40.56	302	1.68	III
3.	Harsh working conditions for labour	9	5.00	69	38.33	102	56.67	267	1.48	VI
4.	Low availability and productivity of labour	3	1.66	59	32.78	118	65.56	245	1.36	VII
5.	Use of labour to protect the grazing of the crop field	9	5.00	72	40.00	99	60.00	270	1.50	V
6.	High cost of labour in applying the mulching material	67	37.22	86	47.78	27	15.00	400	2.22	II
7.	Low durability of the mulching materials	9	5.00	102	56.66	69	38.34	300	1.66	IV

Mixed cropping, crop rotation and use of inter-cropping related constraints to choice of climate change adaptation strategies

The results (Table 6) revealed that complications of crop management and harvesting practices followed by varying life cycles of the crop grown, vulnerability to insect-pest and diseases of crops were the most significant and important constraints which influence the respondent's choice of climate change adaptation strategies with a weightage mean score of 2.25, 2.14, 2.13 and ranked 1st, 2nd, 3rd, respectively. The other constraints were depletion of the soil nutrient, problem of separating seed crop yield, inadequate farm input supplies, crops competing for nutrients due to mixed or intercropping, poor extension delivery services on agronomic practices, non-availability of labour, depletion of the groundwater table due to increased cropping intensity with a weightage mean score of "1.96, 1.85, 1.75, 1.72, 1.62, 1.52, 1.45 and ranked 4th, 5th, 6th, 7th, 8th, 9th and 10th", respectively. The studies conducted by "Farauta *et al.* (2011) [4] and Chukwudumebi and Agwu (2013) [1]" also found that a lack of financial resources was the major constraint in adapting to changing climate.

Table 7: "Distribution of respondents according to Mixed cropping, Crop rotation, and Use of inter-cropping related constraints to choice of Climate Change Adaptation Strategies (n=180)"

Sl. No.	Mixed cropping, crop rotation, and use of inter-cropping related constraints to choice of climate change adaptation strategies	Most severe constraints		Severe constraints		Least severe constraint		Score	WMS	Rank
		f	%	f	%	f	%			
1.	Vulnerability to insect pest and diseases of crops	63	35.00	78	43.33	39	21.67	384	2.13	III
2.	Crops compete for nutrient due to mixed or intercropping	13	7.22	104	57.78	63	35.00	310	1.72	VII
3.	Depletion of the soil nutrient	83	46.11	7	3.89	90	50.00	353	1.96	IV
4.	Poor extension delivery services on agronomic practices	27	15	59	32.77	94	52.23	293	1.62	VIII
5.	Varying life cycle of the crop grown	61	33.88	84	46.67	35	19.45	386	2.14	II
6.	Inadequate farm input supplies	25	13.88	86	47.78	69	38.34	316	1.75	VI
7.	Depletion of the groundwater table due to increased cropping intensity	5	2.77	71	39.45	104	57.78	261	1.45	X
8.	Non-availability of labour	12	6.66	70	38.89	98	54.45	274	1.52	IX
9.	Complications of crop management and harvesting practices	70	38.88	85	47.23	25	13.89	405	2.25	I
10.	The problem of separating seed crop yield	18	10.00	118	65.55	44	24.45	324	1.85	V

Non-farm income diversification related constraints to choice of climate change adaptation strategies

The results revealed (Table 7) that low wages and poor working conditions followed by poor skills to adjust in non-farm income diversification activities and inadequate training were the most important constraints as perceived by the respondents to cope with the choice of climate change adaptation strategies with a weightage mean score of 2.52, 2, 1.90 and ranked 1st, 2nd and 3rd, respectively. Other constraints as reported by the respondents were looking for an extra job opportunity but being unable to find it and government policies due to taxes with a weightage mean score of 1.87, 1.79 and ranked 4th and 5th, respectively.

Table 8: Distribution of respondents according to non-farm income diversification related constraints to choice of Climate Change Adaptation Strategies (n=180)

Sl. No	Non-farm income diversification related constraints to choice of climate change adaptation strategies	Most severe constraints		Severe constraints		Least severe constraint		Score	WMS	Rank
		f	%	f	%	f	%			
1.	Low wages and poor conditions of work	111	61.67	53	29.45	16	8.88	455	2.52	I
2.	Poor skills to adjust in non-farm income diversification activities	39	21.66	102	56.67	39	21.67	360	2.00	II
3.	Looking for an extra job opportunity but unable to find it	30	16.66	97	53.89	53	29.45	337	1.87	IV
4.	Government policies due to taxes	17	9.44	109	60.56	54	30.00	323	1.79	V
5.	Inadequate training	30	16.66	102	56.67	48	26.67	342	1.90	III

Livestock farming related constraints to choice of climate change adaptation strategies

An in-depth examination of Table 8 indicated that the primary constraint was the Shortage of feed and fodder, with a weighted mean score of 2.38, followed by the susceptibility of high-yielding breeds to climatic stress/heat stress and repeat breeding, with weighted mean scores of 2.33 and 2.30, ranked 1st, 2nd, and 3rd, respectively. Respondents regarded it as a primary restraint, as it directly impacted animal productivity and their living security. Repeated breeding diminishes the productive lifespan of animals and reduces farmers' income due to escalating health management costs associated with treating these animals. Additional constraints identified by respondents in the study area included the lack of quality animal breeds, anoestrous issues in animals, and the year-round unavailability of improved fodder seeds, which were ranked as the 4th, 5th, and 6th constraints with mean weight scores of 2.25, 2.18, and 2.15, respectively. The research aligns with the findings of Kant *et al.* (2015) [7, 8].

Table 9: Distribution of respondents according to livestock farming-related constraints to choice of Climate Change Adaptation Strategies (n=180)

Sl. No	Livestock farming related constraints to choice of climate change adaptation strategies	Most severe constraints		Severe constraints		Least severe constraint		Score	WMS	Rank
1.	Shortage of feed and fodder	100	55.55	50	27.78	30	16.67	430	2.38	I
2.	Susceptibility of high-yielding breed to climatic stress/heat stress	90	50.00	61	33.89	29	16.11	421	2.33	II
3.	Non-availability of improved fodder seeds round the year	63	35.00	82	45.56	35	19.44	388	2.15	VI
4.	Non-availability of good animal breed	81	45.00	63	35.00	36	20.00	405	2.25	IV
5.	The anoestrous problem in animals	74	41.11	66	36.67	40	22.22	394	2.18	V
6.	Repeat breeding	83	46.11	68	37.78	29	16.11	414	2.30	III

Relationship between socio-demographic profile characteristics and constraints to farmers' choice of climate change adaptation strategies

The findings indicated that (Table 9) "There is no significant correlation between certain socio-demographic characteristics of the respondent and the limitations to the selection of adaptation strategies employed by the respondent." The respondent's landholding, herd size, milk production, and annual income were the sole socio-demographic characteristics that exhibited a strong positive correlation with the constraints to selecting climate change adaptation strategies in the study area. This indicates that constraints to selecting climate change adaptation strategies escalate with larger landholdings, herd sizes, milk production, and annual incomes, suggesting that respondents with more favorable socio-demographic characteristics encountered fewer constraints in choosing climate change adaptation strategies compared to those with less advantageous profiles in the study area.

Table 10: PPMC Correlation between socio-demographic profile characteristics and Constraints to Farmers' choice of Climate Change Adaptation Strategies (n=180)

Sl. No.	Variable	R-value	P-value
1.	Age	-0.028	0.729
2.	Education	-0.047	0.215
3.	Family type	0.122	0.128
4.	Family size	-0.074	0.345
5.	Occupation	-0.037	0.201
6.	Landholding	0.170*	0.034
7.	Herd size	0.189*	0.039
8.	Milk Production	0.113*	0.021
9.	Annual Income	0.121*	0.032
10.	Experience	0.134	0.116

*Correlation is significant at the 0.05 level (2-tailed)

Conclusion

The research underscores the considerable challenges encountered by farmers in the Banda District of Bundelkhand, Uttar Pradesh, in adjusting to climate unpredictability. Significant problems encompass personal, institutional, technical, meteorological, varietal, labour, and economic obstacles. Illiteracy (2.88 WMS) and tiny fragmented landholdings (1.89 WMS) were identified as the principal barriers among personal restrictions, hindering farmers' access to climate adaptation options. Institutional constraints, like inadequate extension services (2.68 WMS) and restricted finance access (1.80 WMS), impede farmers from implementing resilience-enhancing techniques. Weather-related obstacles, such as inaccurate weather predictions (2.50 WMS) and erratic monsoons (1.74 WMS), considerably hinder agricultural planning. Moreover, limitations concerning crop types, like the lack of insect-pest-resistant seeds (2.40 WMS) and elevated input costs (1.96 WMS), hinder farmers' capacity to execute adaptation strategies efficiently. Labour-related constraints provide significant issues, with elevated expenses (2.22 WMS) and insufficient financial resources to satisfy labour requirements (2.52 WMS) identified as primary obstacles. Additionally, limitations in altering planting and harvesting dates, including elevated input costs (2.38 WMS) and imprecise agro-meteorological data (2.33 WMS), further intensify farmers' challenges in adaptation. Restricted prospects for non-farm income diversification, stemming from low salaries (2.52 WMS) and insufficient skills (2.00 WMS), exacerbate economic vulnerabilities. Livestock production has challenges including fodder shortages (2.38 WMS) and heat stress vulnerability of high-yielding breeds (2.33 WMS). The study concludes that socio-demographic parameters such as landholding size, herd size, milk production, and annual income affect farmers' capacity to surmount these restraints. Enhancing extension services, expanding access to institutional credit, advancing climate forecasting systems, and promoting resilient agricultural technology are vital for augmenting climate adaption capacity. Holistically addressing these concerns can enhance agricultural sustainability and resilience in climate-vulnerable areas.

References

1. Chukwudumebi LE, Agwu EA. Constraints to climate change adaptation and food security in West Africa: the case of Nigeria, Sierra Leone and Liberia. In: Impacts World 2013 International Conference on Climate Change Effects; 2013 May; Potsdam.
2. Deressa TM, Hassan RM, Ringler C. Measuring Ethiopian farmers' vulnerability to climate change across regional states. Intl Food Policy Res Inst; 2008.
3. Fagariba CJ, Song S, Soule Baoro SKG. Climate change adaptation strategies and constraints in Northern Ghana: Evidence of farmers in Sissala West District. Sustainability. 2018;10(5):1484.
4. Farauta BK, Egbule CL, Idrisa YL, Agu VC. Farmers' perceptions of climate change and adaptation strategies in Northern Nigeria: An empirical assessment. African Technology Policy Studies Network Research Paper. 2011;15:1-32.
5. Ige GO, Akinnagbe OM, Odefadehan OO, Ogunbusuyi OP. Constraints to farmers' choice of climate change adaptation strategies in Ondo State of Nigeria. In: African Handbook of Climate Change Adaptation; 2020. p. 1-15.
6. Jose E, Meena HR, Verma AP. Case studies of dairy-based farmer producer companies in Kerala. Int J Curr Microbiol App Sci. 2019;8(1):501-505.
7. Kant KK, Sankhala GS, Prasad KP. Constraints perceived by the dairy farmers in adapting to changing climate in Western Dry Region of India. 2015.
8. Kant K, Sankhala G, Prasad K. Constraints perceived by the dairy farmers in adapting to changing climate in Western Dry Region of India. Indian J Dairy Sci. 2015;68(4):399-407.
9. Liang L, Li L, Liu C, Cuo L. Climate change in the Tibetan Plateau Three Rivers Source Region: 1960-2009. Int J Climatol. 2013;33(13).
10. Onyeneke RU, Madukwe DK. Adaptation measures by crop farmers in the southeast rainforest zone of Nigeria to climate change. Science World J. 2010;5(1).
11. Otitoju MA, Enete AA. Climate change adaptation: Uncovering constraints to the use of adaptation strategies among food crop farmers in South-west, Nigeria using principal component analysis (PCA). Cogent Food Agric. 2016;2(1):1178692.
12. Panchbhai GJ, Siddiqui MF, Sawant MN, Verma AP, Parmeswaranaik J. Constraints faced by co-operative dairy farmers in adoption of recommended dairy management practices. Int J Curr Microbiol App Sci. 2017;6(3):1962-1966.
13. Parameswaranaik J, Verma AP, Sawant MN. Adaptation strategies of dairy farmers to combat climate variability in Karnataka State, India. Int J Curr Microbiol Appl Sci. 2017;6(11):3091-3094.
14. Satishkumar N, Tevari P, Singh A. A study on constraints faced by farmers in adapting to climate change in rainfed agriculture. J Hum Ecol. 2013;44(1):23-28.
15. Tambo JA, Abdoulaye T. Smallholder farmers' perceptions of and adaptations to climate change in the Nigerian savanna. Reg Environ Change. 2013;13:375-388.
16. Upadhyay S, Singh VK, Verma AP, Verma AK, Asha K. Constraints analysis in hybrid paddy farming in eastern zone of Uttar Pradesh using Garrett ranking technique. Int J Curr Microbiol Appl Sci. 2021;10(02):791-796.
17. Verma AK, Singh VK, Asha K, Dubey SK, Verma AP. Constraints perceived by the members and non-members towards functioning of FPO-AKPCL in Kannauj District of Uttar Pradesh. 2021.
18. Verma AP. Farmers' attitude towards e-choupal: A critical investigation in Gonda district of Uttar Pradesh. Int J Agric Sci. 2016;ISSN 0975-3710.
19. Verma AP, Ansari MA, Parameswaranaik J. Constraints Perceived by Farmers in the Use of e-choupal. Res J Agric Sci. 2017;8(6):1513-1514.
20. Verma AP, Meena HR, Patel D. Perceived effectiveness of educational module on brucellosis in dairy animals. Indian J Ext Educ. 2019;55(2):43-47.
21. Verma AP, Meena HR, Patel D, Sawant M, Meena BS. Development of a mobile application to control Brucellosis and its effect in Knowledge gain among the commercial dairy farmers of Northern India. Indian J Dairy Sci. 2020;73(4).
22. Verma AP, Meena H, Patel D, Kar P. Constraints perceived by field veterinarians for providing animal health services in Haryana and Punjab state. Int J Livestock Res. 2020;10(3):152-159.
23. Verma AP, Yadav VR, Patel D, Roy N. Relevance and utility of different training needs of input dealers in Jhansi District of Bundelkhand Region. Asian J Agric Ext Econ Sociol. 2019;37(4):1-8.