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FACTORS INFLUENCING THE ADOPTION OF CLIMATE RESILIENCE TECHNOLOGIES IN TILLABÉRY STATE OF NIGER

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ABSTRACT
Several climate change adaptation strategies have been proposed and disseminated to help rural farmers and herdsmen to build and reinforce their resilience capacity building. However, little is relatively known how socioeconomic factors affect rural farmers' resilience capacity building strategies. Data were randomly collected from 978 rural household heads located in the northern limit of the agro-pastoral zone, while multinomial logistic regression was used to model the impact of socio-economic characteristics on farmers and herdsmen resilience capacity building. Results reveal that herd rebuilding, targeted distribution, support for staple crop production, multiple purpose land uses and food for work are respectively 4.886, 3.321 and 2.397, 0.956 and 0.884 times less likely to be chosen than cash for work.

KEY WORDS
Adoption, resilience, climate change, packages, ordered multinomial logistic regression.

Climate change has been identified as major socioeconomic and environmental challenges to achieving sustainable development particularly in developing countries. Although several climate change adaptation strategies have been implemented by private and public agencies, little is relatively known about climate change adaptation and resilience capacity building as related targeted distribution, herd rebuilding, food and cash for work, support for crop production and multiple purpose land uses amongst rural farmers. Mutually inclusive adaptation of strategies amongst all partners is a key to build resilience capacity and thereby restoring sustainable development in the study area and beyond. A large body of studies has well documented that macro and micro levels should be implemented to enhance farmers and herders climate change adaptation resilience.

At macro level, previous studies have suggested that complex strategies based on farmers, government and development partners' concerted initiatives could be an excellent candidate to reduce negative externalities and enhance farmers' welfare. Understanding and maintaining household climate change resilience capacity is one challenge, while evaluating rural household preferences for climate change adaptation options is another challenge. Research also reported that communities and disaster reduction agents have respectively indigenous knowledge and scientific knowledge and that tremendous benefit can be achieved when they conjointly joined hand (Dube and Munsaka, 2018). The global level, the Paris Summit (2015) unanimously agrees that holding the global average temperatures well below 2°C, increasing ability to adapt to adverse impacts and financing mechanisms for climate change when once properly implemented could significantly reduce the adverse impact of climate change.

In 2010, the Niger government in collaboration with the United National Development Program (UNDP) has launched project aims at distributing climate change adaptation packages for the benefit of the most vulnerable local government identified in each State. Human capacity building has also been introduced to effectively empower farmers and herdsmen on how to use technology, thereby improving their capacity. In addition, thirteen exogenous climate change adaptation strategies were disseminated amongst rural farmers and results from a survey reveal that herd rebuilding, human capacity building, introduction of fishing, water and soil conservation management, introduction of leafy vegetable such as

Moringa oleifera, financial credit, forage seed marketing and introduction of agriculture inputs were the most important strategies(Tabbo and Amadou, 2017).

At micro level, it is important to determine factors influence household climate change adaptation, given that the potential benefit of scientific knowledge and technology and indigenous knowledge in climate change adaptation strategies has been well-documented. Such knowledge would be more useful for farmers, extension agent and government to make more reliable climate change adaptation decision. In addition, government needs information on farmers' perceptions and awareness capable of guiding program design for vulnerable household. Recent studies have suggested that crop-livestock diversification strategies such as millet, roselle, cassava, *Adansonia digita*, and goats should be promoted in semi-arid and arid zones to effectively reduce climate change negative effect (Amadou and Bana, 2020). A study by Amadou (2022) has also suggested that a myriad of agricultural innovations such as rainfed rice production, women's saving and credit scheme, land recovering via tree planting, Maradi red goat breeding, women' saving and credit scheme, honey harvesting via improved beehives, use of millet glumes in cassava production, cheese making, use of cassava for cattle fattening, processing peanuts into oil and cake, transforming shea butter in soap, use of annual and perennial crops for cattle fattening and use of semi-modern irrigation system in gardening once implemented at community level were capable to enhance significantly climate change adaptation. Furthermore, a study conducted in Ibecetan Ranch (Tahoua State, Niger) has pointed out that settlement, emergency destocking, prolific animal selection, water and soil conservation activities, strategic mobility, transhumance and mutual assistance are the most important endogenous climate change adaptation strategies for agro-pastoralists(Amadou and Baggnian, 2020).

Climate change resilience building capacity is also becoming increasingly advocated and reinforced amongst vulnerable rural household. However, there are relatively scanty studies geared towards investigating how farmers' socioeconomic factors affect household capacity to make climate change adaptation strategies. Determinants of climate change adaptation package when climate change happened are also poorly documented and actualized data to modeling pastoral and agro pastoral are not available. Moreover, there is no actual information on factor affecting rural household resilience building capacity and this present study will fill this knowledge gap, which is helpful to channel climate change adaptation package towards the most vulnerable households. The purpose of this research is to generate information on factors affecting rural household's climate change package adaptation decisions. Specific objectives include to determine socio economic characteristics of surveyed farmers and factors affecting rural households' climate change adaptation strategies.

METHODS OF RESEARCH

The authors assume that farmers are supposed to maximize their welfare when choosing climate change adaptation strategies. Farmers are often asked to repeatedly rank, to choose and rate these strategies. This process of ranking, choosing and rating is consistent with random utility, which is well-rooted in microeconomic theory. The outcome of the decision variable determines which model is appropriate for the modeling. Thus, multiple ordered responses are presented to respondents and could be appropriately handled by nested logit, mixed logit or probit capable of accounting for the pattern of similarity and dissimilarity amongst alternatives (Train, 2009). He also stated that ordered logit model has one utility with multiple alternatives to represent the level of that utility as compared to logit model. Thus, choice made by farmers can be mathematically written as follows:

$$y_t = X_t\beta + \varepsilon_t \qquad (1)$$

Where is $X_t\beta$ is observed component and ε_t is unobserved factors which are random and it is assumed to follow the distribution of ϵ.

This study was conducted in Abala local government located in Tillaberi State, Niger Republic. While a random sampling was used to select four villages (Badandan, Keltizembett, Kourfa and Tigzefen Rouafi), a stratified sampling using population as a strata criteria was employed to select respondents. In total, 978 respondents were retained by selecting randomly 145, 105, 488 and 250 respondents from Badandan, Keltizembett, Kourfa and Tigzefen Rouafi respectively.

A well-designed and structured questionnaire was used to collect data from respondents. Based on previous studies and information gathered via interview from farmers, seven-climate change adaptation strategies were retained and included in this study. Respondents were asked to assign a value ranging from one to seven to strategies presented. Herd rebuilding, support for staple crop production, support for leafy vegetable production, targeted distribution, multiple purpose land uses, food for work and cash for work were being considered in this study. Though Household economy approach (HEA) has been increasingly used as rapid ways to identify and help vulnerable household when crisis such as food shortage, drought and climate change had occurred, there is no well-documented studies to compare with alternative approaches. Data were also collected on respondents' socioeconomic characteristics by using HEA because it provides useful information towards classifying respondent either as very poor, poor, middle and rich income households. Primary data were collected via face-to-face interview with the household head to learn household perceptions about newly introduced climate change adaptation strategies. First, we conducted focused group simulation with community leaders, elders, women associations and youth groups. Secondly, we strategically selected vulnerable groups (poor and very poor households) and they were given a climate change package to reinforce their resilience capacity. Finally, par question, respondents were asked to rank their best adaptation strategies using the Likert scale approach.

Multinomial ordered logit capable of modeling ordered responses was used to analyze our data. Farmers' socioeconomic characteristics affecting climate change adaptation strategies were examined using ordered multinomial logit regression. The authors assume that the ordered logit is appropriate to model different climate change options on farmers' socioeconomics because the dependent variable is limited and ordered. By following Greene (2003) and Train (2009), the model can be mathematically represented as by the following index function:

$$y_t{}^* = X_t\beta + \varepsilon_t \text{ with } \varepsilon_t \sim (0, \Sigma) \qquad (2)$$

Where: $y_t{}^*$ represents various climate change strategies as shown in Figure1, X represent vector of independent variables ε_t represents stochastic term and β represent various parameters to be estimated by maximum likelihood estimation method. The multinomial ordered probit has been chosen because it is the most widely used model to fit ordered data. It is important to point out that $y_t{}^*$ is a latent variable, while y is observable and it represents various opinions about climate change strategies. Therefore, $y_t{}^*$ and y can be represented as follows:

$$y_t = \begin{cases} 1 \Rightarrow \text{Cash for work if } y_t{}^* \leq 1 \\ 2 \Rightarrow \text{Food for work if } \mu_1 < y_t{}^* \leq \mu_2 \\ 3 \Rightarrow \text{Multiple functional half moon if } \mu_2 < y_t{}^* \leq \mu_3 \\ 4 \Rightarrow \text{Targeted distribution if } \mu_3 < y_t{}^* \leq \mu_4 \\ 5 \Rightarrow \text{Support for vegetable production if } \mu_4 < y_t{}^* \leq \mu_5 \\ 6 \Rightarrow \text{Support for staple production if } \mu_5 < y_t{}^* \leq \mu_6 \\ 7 \Rightarrow \text{Herd rebuilding if } \mu_6 < y_t{}^* \end{cases} \qquad (3)$$

Where $\mu's$ are additionnel parameters to be estimated via maximum likelihood technique. If we assume that ε_t are independent, identically and normally distributed with covariance matrix Σ, then probabilities (y_t=1, 2… 7) can be expressed as follows:

Prob (y=0 | x)= $\Phi(-X_t\beta)$
Prob (y=1 | x)= $\Phi(\mu_1 - X_t\beta) - \Phi(-X_t\beta)$
Prob (y=2 | x)= $\Phi(\mu_2 - X_t\beta) - \Phi(\mu_1 - X_t\beta)$
Prob (y=3 | x)= $\Phi(\mu_3 - X_t\beta) - \Phi(\mu_2 - X_t\beta)$
Prob (y=4 | x)= $\Phi(\mu_4 - X_t\beta) - \Phi(\mu_3 - X_t\beta)$
Prob (y=5 | x)= $\Phi(\mu_5 - X_t\beta) - \Phi(\mu_4 - X_t\beta)$
Prob (y=6 | x)= $\Phi(\mu_6 - X_t\beta) - \Phi(\mu_5 - X_t\beta)$
Prob (y=7 | x)= $1 - \Phi(\mu_6 - X_t\beta)$ (4)

The loglikelihood function for the multinomial ordered probit model derived from equation (2) can be expressed as follows:

$$\mathcal{L}(\beta, \mu_1, \mu_2, \mu_3, \mu_4, \mu_5, \mu_6) = \sum_{y_{t=0}} log\left(\Phi(-X_t\beta)\right) + \sum_{y_t=1} \log(\Phi(\mu_1 - X_t\beta) - \Phi(-X_t\beta)) + \sum_{y_t=2} \log(\Phi(\mu_2 - X_t\beta) - \Phi(\mu_1 - X_t\beta)) + \sum_{y_t=3} \log\left(\Phi(\mu_3 - X_t\beta) - \Phi(\mu_2 - X_t\beta)\right) + \sum_{y_t=4} \log(\Phi(\mu_4 - X_t\beta) - \Phi(\mu_3 - X_t\beta) + \sum_{y_t=5} \log(\Phi(\mu_5 - X_t\beta) - \Phi(\mu_4 - X_t\beta)) + \sum_{y_t=6} \log(\Phi(\mu_6 - X_t\beta) - \Phi(\mu_5 - X_t\beta)) + \sum_{y_t=7} \log(1 - \Phi(\mu_6 - X_t\beta)) \quad (5)$$

$Where$ β are parameters for the vector X_t explanatory variables, $X_t\beta$ $is\ the\ index\ function$, while $\mu_1, \mu_2, \mu_3, \mu_4, \mu_5$ and μ_6 are threshold parameters. Polr package built in R software was used to estimate the model.

RESULTS AND DISCUSSION

This section reports results from data analysis. From Table 1 to Table 4 report results from our analysis. Table 1 shows that the distribution of the response variable. Thus, Table 1 indicates that cash for work (36.76%) is the most preferred strategies, followed by multiple purpose land uses (25.83%) and support for staple crop production (15.54%). The least preferred strategy is food for work (1.18%) followed by herd rebuilding (6.00%). This implies that cash for work is the dominant strategies, while food for work is the least dominant strategy for surveyed rural household. Figure 1 also depicts the distribution of the dependent variable. This agrees with the study of Tabbo and Amadou (2017) who reported that cash for work and introduction of leafy vegetable such as *Moringa oleifera* were the most important strategies when dealing with exogenous climate change adaptation. Furthermore, multiple land uses and support for crop and vegetable production have been widely researched and published. Previous studies have indicated that water and soil management are preferred (58%) by rural farmers, while (97%) farmers as their climate change adaptation strategies (Tabbo and Amadou, 2017) avoid support for vegetable production. A large body of studies have similarly reported that crop diversification and crop-livestock diversification are the dominant climate change adaptation strategies of rural farmers (Amadou and Bana 2020; Asare and Amungwa, 2021).

Table 1 – Response Variable Profile

n/n		Pooled		Very poor income household		Poor income household	
Ordered Value	Strategies	Frequency	%	Frequency	%	Frequency	%
1	Herd Rebuilding 7	56	6.00%	35	12.59%	14	2.83%
2	Support for staple crop production 6	145	15.54%	49	17.63%	64	12.93%
3	Targeted distribution 4	137	14.68%	84	30.22%	29	5.86%
4	Multiple purpose land uses 3	241	25.83%	54	19.42%	145	29.29%
5	Food for work 2	11	1.18%	1	0.36%	7	1.41%
6	Cash for work 1	343	36.76%	55	19.78%	236	47.68%

Table 2 reveals that most of the respondents are male (88%), married (62%) and having a household size of six members. They had an average age 42 years with 2 wives on average and 52% were classified as poor income household. This reveals that male-headed household, married, classified as poor income household and having large family size should be targeted for effective climate change resilience implementation. This is study is in line with previous studies of Amadou and Bana (2018) who reported similar predominance of male population (70%) and majority of farmers being married (80%) in determining impact of smart crop-livestock diversification as climate adaptation strategies on farmers' living conditions.

Table 2 – Reports Socioeconomics Characteristics of Surveyed Farmers

Variable	Definitions	Mean	SD
Gender	1 for male, 0 for female	0.88	0.54
Age	Years	42	15
Marital Status	1 for married, 0 otherwise	0.62	0.49
Spouses	Numbers	2	1
Socioeconomics groups	1 for poor income household, 0 otherwise	0.52	0.49
Household size	Numbers	6	4
Household head presence	1 if present last six months, 0 if absent than six months	1	-

Note: SD stands for standard deviation.

Table 3 presents results from factors affecting rural household climate change resilience building capacity. Table 3 indicates that household headed by female is more likely to move to higher category of climate change resilience building capacity than household headed by male is. Coefficient for age is positive and significant, indicating that younger farmers are more likely to move to higher category of climate change resilience capacity than older farmers. Coefficient for married with one wife is negative and significant, revealing that farmers married with one wife are less likely to move to higher category of climate change resilience building capacity than bachelor farmers are. Coefficient for village such as Keltizembett is positive and significant, indicating farmers located in Keltizembett village are more likely to move to higher category of climate change resilience building than farmers located in Tigzefeen Rouafi village. Coefficient for socioeconomics group such as poor income household is negative and significant relative to rich income household, showing that farmers living in poor income household are less likely to move to higher climate change resilience building capacity than those living in rich income household. Coefficients for herd rebuilding, support for staple crop production, targeted distribution, multiple purpose land uses and food work are negative and significant, revealing that these strategies are less likely to be chosen as compared to cash for work.

This result is well-supported by a research stating cash for asset as climate change adaptation as compared to food and cash for work is more promising and keeps producing successful stories (Tabbo and Amadou, 2017). This implies that unmarried young farmers living in Keltizembett village with higher income and working on cash for work should be targeted for effective climate change rebuilding capacity. Our results are similar to those reported by Gioto et al. (2018). They have found that household level of education, family size, income and age are strongly related to their food security status. Results obtained from farmers perceptions indicated that temperature rise, reduced amount of rainfall, low livestock prices, high food price, poor crop production, poor pasture and browse quality, and inadequate water for both domestic and livestock use are challenges of climate change resilience capacity. They have finally reported that results suggest that farmers have proposed solutions such as the increased advocacy, rainwater-harvesting structures, marketing linkages, timely early warning knowledge management, and eco-based farming practices to help farmers to build resilience capacity.

This result is not on line with a study by Saleem et al (2018) has reported that there is no single action making a city more resilient to climate change. They have stated that social and ecological resilience to climate change are inextricably linked and should be considered as integrated socio-ecological systems. They strongly believe that resilience is achieved through a number of actions, building upon each other over time. They have also concluded that these actions would be enhanced and progressed as peoples and institutions learn from past experiences and apply it to future decisions. Their findings are consistent with our study which has also used integrated approach to model climate change resilience building capacity.

This is conformity with a study by Mwungu et al (2018) have also recently studied the influence of socioeconomic factors, plot characteristics, food security, and climatic variables on the adoption of Climate-Smart Agriculture (CSA) technologies in southern Tanzania. They have concluded that slope of the plot, soil organic carbon (SOC) content; food security status, mean monthly precipitation and mean monthly temperature influenced the decision to adopt CSA technologies. They have also indicated that other factors such as literacy index, access to agricultural information, credit, livestock ownership, and assets endowment greatly influence adoption. Results further suggested complementarities in adoption between improved varieties and manure as well as agro forestry. Results finally suggested that increased access to agricultural information and credit to enhance adoption of CSA technologies. In recent studies have also indicated that practicing different land rehabilitation such as water and soil conservation could help landless farmers to develop climate change adaptation strategies, thereby increasing yields on agriculturally viable and marginal lands by selecting improved food and feed crops that could be suitable to changing environment (Alemayehu et al. 2018).

Table 3 – Determinants for rural household climate change resilience building capacity based on multinomial ordered Probit

Variables	Definitions	Pooled	Very poor income household	Poor income household
Strategy 1	Base: Cash for work	0.000	0.000	0.000
Strategy 7	Herd rebuilding	-4.866** (0.420)	-4.167** (0.711)	-6.473** (0.754)
Strategy 6	Support for staple crop production	-3.321** (0.399)	-3.023** (0.690)	-4.508** (0.699)
Strategy 4	Targeted distribution	-2.397** (0.392)	-1.602* (0.673)	-4.024** (0.692)
Strategy 3	Multiple purpose land uses	-0.956* (0.385)	-0.442 (0.668)	-2.323** (0.675)
Strategy 2	Food for work	-0.884* (0.384)	-0.416 (0.667)	-2.255** (0.674)
Gender	1 if Female, 0 if Male	0.215 (0.242)	0.223 (0.304)	0.001 (0.603)
Age	Age in numbers	0.060** (0.005)	0.046** (0.007)	0.077** (0.008)
Marital Status	Base: Bachelor	0.000	0.000	0.000
	1 if married with one wife	-0.913** (0.345)	-0.845** (0.526)	-0.644 (0.607)
	2 if married with more than one wife	-0.877 (0.548)	-1.116* (1.143)	-0.603 (0.832)
	3 if widow	-0.414 (0.391)	0.020 (0.584)	-1.208 (1.066)
	4 if Divorced	0.401 (0.427)	0.838 (0.633)	-0.079 (1.035)
Village	Base: TIGZEFEN ROUAFI	0.000	0.000	
	1 if village BADANDAN	0.003 (0.135)	-0.251 (0.252)	0.224 (0.188)
	2 if village KELTIZEMBETT	0.408** (0.149)	-0.240 (0.260)	0.373 (0.117)
	3 if village is KOURFA	-0.264 (0.097)	0.593* (0.279)	-0.292* (0.140)
Numbers of Spouses	Numbers	0.178 (0.297)	0.458 (0.703)	0.179 (0.391)
Socioeconomic groups	Base: Rich income household	0.000		
	1 if very poor income household	0.013 (0.039)		-
	2 if Poor income household	-0.255** (0.121)	-	-
	3 if Middle Income Household	0.132 (0.154)	-	-
Household size	Size in Numbers	0.016 (0.015)	-	-
N	-	933	278	506
-2Log-likelihood	-	2515.610	824.887	1164.404

*Note: *Strategy 5 such as support of leafy vegetable production was not chosen by farmers and therefore not used in the modeling; Numbers in parentheses are standard error; **, * stand respectively for 1% and 5% significant level.*

This finding fails to corroborate with a recent study by Abrham and Mekuyie (2022) has indicated that providing farmers with disease-resistant, drought-resistant and early-maturing crops and livestock breeds, building early warning systems before climate change shocks happened, soil and water management for small scale irrigation and enhancing vulnerable pastoral and agro pastoral communities in Ethiopia to access adult education would not only increase their understanding of climate change, but also enhance their capacity to develop environmentally friendly adoption measures. Herd rebuilding as climate change strategies was documented in previous studies. Thus, Tabbo and Amadou (2017) reported that 90% of rural households surveyed in Kao would favorably vote herd rebuilding as strategy for climate change. Assan (2014) has also stated that small livestock such as goat is better candidate when climate change and drought occurred, whereas sustainable development goals in rural areas could be achieved via livestock production in the face of changing climate that renders crop production difficult especially in arid climates like Zimbabwe. These results are not in conformity with our finding stating that single adaptation strategies such as cash for work is the best climate adaptation strategies in the study area.

CONCLUSION AND RECOMMENDATIONS

Many studies have reported how climate change adaptation strategies and resilience building capacity could help farmers to effectively cope with negative externalities caused by changing climate. However, few studies have attempted to analyze how farmers' socioeconomics characteristics influence their resilience building capacity. The objective of this paper is determined how farmers' socioeconomic factors influence climate change building capacity. Household economy approach was used to collect data from 978 farmers, while multinomial ordered logit was used to analyze ordered responses.

Results indicate that household headed married man, classified as poor income household and having large family size should be targeted for effective climate change resilience implementation. Results also suggest that female farmers living in Keltizembett village are more likely to move to higher category of climate change resilience building than male farmers living in Tigzefeen Rouafi village. Results also reveal that farmers married to one wife and living in poor household are less likely to move to higher category of climate change resilience building than unmarried farmers living in rich income household are. Results finally indicate that cash for work is the most preferred climate change package in the study area. Limitations of this study were to consider only one county and household economy approach as data collection tool should be considered with data collection technique. Future direction for research is repeat this study for three years by tracking a panel of households to model the stability of these parameters and to develop sustainability index overtime. These findings should be considered in future programs aim at aiding rural households to enhance their resilience building capacity and thereby stimulating and maintaining sustainable development in the study area and beyond.

REFERENCES

1. Abrham, T, Mekuyie, M. 2022. Effects of climate change on pastoral households in the Harshin District of the Somali Region, Ethiopia', Jàmbá: Journal of Disaster Risk Studies 14(1), a1202. https://doi. org/10.4102/jamba. v14i1.1202.
2. Amadou, Z. 2021. Managing strategies for Agricultural Innovations in Tahoua State, Niger Republic. Paper presented at the Fourth Annual Conference, Faculty of Management Sciences, held from 30th November to 2nd December at Usmanu Danfodiyo University, Sokoto, Nigeria.
3. Amadou, Z, Baggnian, I. 2020. Modeling Agro-pastoralists' Preferences for endogenous and exogenous climate change adaptation strategies in Ibecetan Ranch, Niger Republic, IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 13, Issue 12 Ser. II (December 2020), PP 10-18 www.iosrjournals.org.

4. Amadou, Z, Saley Bana, Z. 2020. Impact of Smart Crop-Livestock Diversification as Climate Change Adaptation Strategies on Farmers' Living Conditions, Tahoua State, Niger Republic. In: Leal Filho, W. (eds) Handbook of Climate Change Resilience. Springer, Cham. https://doi.org/10.1007/978-3-319-71025-9_122-2.
5. Alemayehu, N, Masafu, M, Ebro, A, Tegegne, A, Gebru, G. 2018. Climate Change and Variability in the Mixed Crop/Livestock Production Systems of Central Ethiopian Highland. In: Leal Filho, W. (eds) Handbook of Climate Change Resilience. Springer, Cham. https://doi.org/10.1007/978-3-319-71025-9_120-1.
6. Asare-Nuamah, P, Amungwa, A.F. 2021. Climate Change Adaptation Among Smallholder Farmers in Rural Ghana. In: Leal Filho, W., Oguge, N., Ayal, D., Adeleke, L., da Silva, I. (eds) African Handbook of Climate Change Adaptation. Springer, Cham. https://doi.org/10.1007/978-3-030-42091-8_279-1.
7. Assan, N. 2014. Goat production as a mitigation strategy to climate change vulnerability in semi-arid tropics. Sci J Anim Sci 3(11):258–267.
8. Dube E, Munsaka, E. 2018. The contribution of indigenous knowledge to disaster risk reduction activities in Zimbabwe: a big all to practitioners". Jàmbá 10(1):a493. https://doi.org/10.4102/ jamba.v10i1.49.
9. Gioto, V, Wandiga S, Oludhe, C. 2018. Determinants of Household Food Security Status and Challenges of Building Resilience to Climate Variability and Change Posed by Drought in Tharaka Nithi, Kenya". In: Leal Filho W. (eds) Handbook of Climate Change Resilience. Springer, Cham.
10. Mwungu C.M, Mwongera C, Shikuku K.M, Acosta M, Läderach P. 2018. Determinants of Adoption of Climate-Smart Agriculture Technologies at Farm Plot Level: An Assessment from Southern Tanzania". In: Leal Filho W. (eds) Handbook of Climate Change Resilience. Springer, Cham.
11. Saleem Khan A, MacManus K, Mills J, Madajewicz M, Ramasubramanian, L. 2018. Building Resilience of Urban Ecosystems and Communities to Sea-Level Rise: Jamaica Bay, New York City". In: Leal Filho W. (eds) Handbook of Climate Change Resilience. Springer, Cham
12. Tabbo, A.M, Amadou, Z. 2017. Assessing newly introduced climate change adaptation strategy packages among rural households: Evidence from Kaou local government area, Tahoua State, Niger Republic', Jàmbá: Journal of Disaster Risk Studies 9(1), a383. https://doi.org/10.4102/jamba. v9i1.38.
13. Train, K.E. 2009. Discrete choice methods with simulation". Cambridge University Press, New York.