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Coconut Growers' Knowledge and Perceptions on Climate Change and Adaptation Strategies in Puttalam District of Sri Lanka

Ruvani S. W. Godage[1], Bandara Gajanayake[2]

[1]Technology Transfer Officer, Technology Transfer Division, Coconut Research Institute, Sri Lanka
[2]Professor, Department of Plantation Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka

Email: ruvanigodage@gmail.com

Abstract

Climate change and extreme weather events are significantly affecting the productivity of coconut in Sri Lankan coconut-growing areas, which ultimately will threaten the livelihoods of the coconut-cultivating community. The present study was undertaken to determine coconut growers' knowledge and perceptions about climate change and adaptation strategies. The study was conducted in Puttalam district, which is more vulnerable to climate change impacts in the country using 140 coconut growers as the sample. The findings of the study emphasized that many growers have a fairly high knowledge and informed perceptions about climate change and its impacts. Further, out of five independent variables, namely age, education and farming experience were found to be positively related, while landholding and land ownership were negatively related to coconut growers' knowledge and perceptions on climate change. The higher the educational attainment, the knowledge and perceptions on climate change were significantly higher among the respondents. Moreover, growers' knowledge was positively and significantly associated with their perceptions and adaptation measures. The study highlighted coconut growers' poor adaptation in most of the recommended strategies on climate change. Hence, further studies on other constraints which may limit the proper adaptation of climate change measures should be conducted.

Keywords: Adaptation strategies, climate change, coconut growers' knowledge, perceptions

Introduction

Coconut (*Cocos nucifera* L.) is one of the most widely grown perennial plantation crops in Sri Lanka and is extensively cultivated in all the tropical regions of the world (Somasiri et al., 1994). It spreads over 400,000 ha of land area in all administrative districts of Sri Lanka except those at elevations above 750 masl (Central Bank of Sri Lanka, 2016; Somasiri et al., 1994). Coconut is considered as a multipurpose crop providing food, shelter, oil, medicine, fuel, building materials and beverage. Therefore, coconut is interwoven with the lives of the local people and considered as the "tree of life".

Annual nut production in Sri Lanka was 2,623 million in 2018 (Central Bank Sri Lanka, 2019). The coconut industry generates employment for nearly 500,000 people, contributing to nearly 0.6% of gross domestic production and 1.0% of foreign exchange earnings (Central Bank Sri Lanka, 2019; Liyanage, 1999). It is cultivated in all three agro-climatic zones of Sri Lanka, 30% in the wet zone, 50% in the intermediate zone and 20% in the dry zone. Coconut performs well under a mean annual temperature range of 27°C – 29°C and a mean annual rainfall of 1,250-2,500 mm/year (Ranasinghe, 2012). The main coconut growing area consists of three administrative districts within the "Coconut Triangle"; Kurunegala, Puttalam and Gampaha representing 57% of the total coconut lands. The Southern Province contains about 12% of the coconut cultivated lands and is identified as the "Mini-Coconut Triangle" consisting of Galle, Matara and Hambantota administrative districts. The remaining coconut areas are distributed throughout the country, except for the central upcountry where the climate is not suitable for growing coconut (Department of Census and Statistics, 2002; Karunanayake, 1976).

Effects of Climate Change on Agriculture and Coconut Sector in Sri Lanka

Climate change has been emphasized by the Intergovernmental Panel on Climate Change, IPCC

(2007, United Kingdom, European Commission, Belgian government) as any change in climate over time that arises as a result of both human activity and natural variability. It is an inevitable phenomenon that is being experienced globally in various forms, namely temperature rise, sea-level rise, droughts, floods, hurricanes, landslides and increase in thunder activity due to greenhouse gas emissions (Esham and Garforth, 2013; Goyal, 2004).

Climate change continues to adversely affect the livelihoods of people in developing countries where a large proportion of the population is heavily dependent on agriculture (Esham and Garforth, 2013). Nevertheless, the extent of the impact of climate change on agriculture can be minimized by improving the knowledge level, changing the perceptions and improving the level of farmers' adaptation with climate-smart strategies (Acquah et al., 2011).

Being a tropical country, Sri Lanka is highly vulnerable to the impacts of climate change. Few studies have attempted to quantify the impact of climate change on crops in terms of yield reduction and economic loss (Costa et al., 2003; Fernando et al., 2007; Wijeratne et al., 2007). Lobell, et. al. emphasized that perennial cropping systems are more vulnerable to climate change because they are long-established (Lobell, et al., 2006); but, at present, there are few studies conducted for plantation agriculture.

It is identified that climate change is projected to increase atmospheric CO_2 concentration and temperatures, and affects rainfall patterns. It has been established that the major climatic variables which influence coconut yield are rainfall, evapotranspiration, temperature, solar radiation, sunshine hours, relative humidity and wind velocity. The prevailing total amount of rainfall and minimum air temperature is significantly correlated with the percentage of button nuts shedding (Peiris and Thattil, 1998; Peiris et al., 1995, 2000) which significantly affects nut yield. Also, coconut performs better with no moisture stress, and it performs moderately well where there is a minimum period of moisture stress (Somasiri et al., 1994).

Further, it has been identified that the reproductive development in coconut is more sensitive to high-temperature stress and water stress than vegetative development and the principal harmful effects are reported on nut sets (Coconut Research Institute, 2014). The most important yield-determining factor in coconut is nut setting. Reduced nut setting can be observed due to heat stress and long dry spells in coconut plantations in the dry-intermediate and dry zones, even if irrigation is practiced.

Coconut is perennial in nature and the assessment of the impact of climate change is challenging. Coconut growers' knowledge and perceptions about climate change strongly affect how they deal with climate-induced risks and uncertainties, especially on undertaking specific measures or coping strategies to mitigate the adverse impact of climate change on coconut. Hence, Raghuvanshi et al. (2017) indicated that farmers' perceptions are critical for mitigating the adverse impact of climate change on agriculture.

Coconut growers and coconut cultivation in Puttalam district of Sri Lanka

Puttalam district is situated in the North-Western province and spreads over 3,072 km2 of total lands and 70,983.5 planted hectares (175,404 Ac), totaling around 10.5 million palms. The main agro-ecological zones of this area are Low country Intermediate (IL1, IL3) and Low country Dry (DL1, DL3). The mean annual rainfall is 1,300 mm which varies from 1,200 mm to 1,600 mm and the mean annual temperature is 30.5°C which varies from 29°C to 32°C.

A sizeable proportion of the Puttalam district population mainly depends on the agriculture sector. However, the district has been affected by an extended period of drought and severe heat stress which limits coconut productivity, and ultimately threatens people's livelihoods in rural areas. Hence, the coconut growers of this district are more vulnerable to climate change impacts than growers in other parts of the country.

Methodology

The study was conducted in Puttalam district of Sri Lanka. The study respondents comprised of 140 coconut growers, selected according to a stratified random sampling method representing the district. The heads of the selected households or their spouses were interviewed using both a 10-point Likert scale and a pretested semi-structured questionnaire. Group discussions were also conducted with randomly selected groups of coconut growers in the district. The 10-point Likert scale questionnaire was designed to assess the coconut growers' knowledge, perception and adoption of impacts of climate change. Semi-structured questions were used to elicit socio-demographic information on coconut growers' including level of education, age, gender, years of farming experience, landholding, family size and land ownership.

Coconut growers were provided with a list of 14 statements to assess their knowledge level on the impacts of climate change. Each statement was set against a ten-point "Likert Scale" ranging from 'extremely knowledgeable' (10) to 'extremely poor in knowledge or unknown' (0). This way the respondents' level of knowledge was weighted. Similarly, growers were provided with a list of 32 statements to assess their level of perceptions by indicating their perceptions against a ten-point "Likert Scale" ranging from 'extremely perceived' (10) to 'extremely poor in perception or not perceived' (0). In addition, growers were provided with a list of 13 statements to evaluate the adoption levels of adaptation measures against a ten-point "Likert Scale" ranging from 'extremely adopted' (10) to 'extremely poor in adoption or not adopted' (0) (Advisory Circulars A, B, C series, Coconut Research Institute, 2018).

Once all the responses were coded based on the 10-point Likert Scale, correlation analysis was performed to find out the relationships in coconut growers' knowledge, perception and adaptation level on climate change. The association between independent variables (Age, Land Holding, Education, Farming Experience, Land Ownership) and dependent

variables (coconut growers' knowledge and perceptions) was also analyzed. Finally, the impact of independent variables on the dependent variables was determined using regression analysis.

Result and Discussion

Socio-demographic profile of the coconut growers in Puttalam district

This socio-demographic profile of the farm households (Table 1) is believed to have differential impacts on the growers' perceptions about climate change and their adaptation ability. The age of the grower represents their experience in farming. The experienced growers are expected to have a higher probability of perceiving climate change as they are exposed to past and present climatic conditions over a longer horizon of their life span. The majority of the respondents (57.86%) were more than 50 years old followed by 39.28% of growers in the "40-50 year" age category and very low percent (2.86%) of growers were in "30-40 year" age category. Gender-wise, the composition of the study sample reveals that the large majority (85.71%) were males; and that 62.86% of the growers had 2-3 members in their families. As regards land holding, 80.71% of growers had "2-25Ac" category land holding, 17.86% were in the "25-50Ac" category and 1.43% had "50-100Ac" category landholding. Achieving higher levels of education helps growers to access information on improved technology and resources. It is evident that the majority (55%) of growers in the study sample were educated up to G.C.E. (A/L) followed by 22.86% were educated up to G.C.E. (O/L), 17.14% were Diploma or Graduates and only 5% were educated up to Grade 8. As regards their farming experience, 59.28% of the respondents had only "5-10 year" farming experience, the rest (32.14%) had "11-20 year" farming experience and only 4.28% of the respondents have been farming more than "30 years" Further, the majority of respondents (97.86%) reported owning their land.

Table 1. Socio-demographic profile of the coconut growers

No	Variables	Frequency	Percentage (%)
1	**Age (Years)**		
	<30	0	0
	30-40	4	2.86
	40-50	55	39.28
	>50	81	57.86
2	**Gender**		
	Male	120	85.71
	Female	20	14.29
3	**Landholding (Acres)**		
	<2Ac(<0.8ha)	0	0
	2-25Ac (0.8-10.1ha)	113	80.71
	25-50Ac (10.1-20.2 ha)	25	17.86
	50-100Ac (20.2-40.5 ha)	2	1.43
	>100Ac (>40.5ha)	0	0
4	**Family Size**		
	2-3	88	62.86
	4-5	46	32.86
	6-7	6	4.28
	>7	0	0
5	**Education**		
	Up to Grade 5	0	0
	Up to Grade 8	7	5
	Up to O/L	32	22.86
	Up to A/L	77	55
	Diploma/Graduate	24	17.14
6	**Farming Experience (Years)**		
	<5	1	0.71
	5-10	83	59.28
	11-20	45	32.14
	21-30	5	3.57
	>30	6	4.28
7	**Land Ownership**		
	Own	137	97.86
	Common	2	1.43
	Rent/Tenant	1	0.71

Coconut growers' knowledge or understanding about climate change

Clarifying the growers' knowledge about climate change has been a major theme of research on growers' perceptions of climate change. The findings of Yearly (2000) and Lowe et al. (2006) emphasized that public knowledge of climate change has demonstrated that people are sensitive to the information they are given and from whom.

Several key insights appeared when coconut growers were asked about their understandings of climate change. As shown in Table 2, a large majority (90.1%) of the respondents believed that deforestation has a big impact on increasing temperature and ultimately it significantly contributes to climate change. Further, they broadly perceived that human activities are the leading cause of climate change (88.6%) followed by burning fossil fuel as vehicle fuel, oil and gases cause air pollution and increase in atmospheric temperature (81.8%). The emission of greenhouse gases boosts temperature (63.3%) causing a negative impact on climate change. Moreover, 76% and 74.6% of the respondents indicated that rapid urbanization and lifestyle changes, and increase in population growth, respectively affect climate change (74.6%). Heavy application of inorganic fertilizers (especially N containing fertilizers) (55.3%) was also reported to cause climate change.

The vast majority of the growers recognized that they are currently experiencing the impacts of climate change (86.4%) and climate change is a threat to sustainable development (79.1%). In addition, about 66% of the respondents recognized

Table 2. Coconut growers' knowledge or understanding of the impacts of climate change

No	Knowledge on Climate Change Dimensions	Growers' Knowledge (%) (N = 140)
1	Deforestation has a big impact on the increase in temperature	90.1
2	Human activities are the leading factor for climate change	88.6
3	We are currently experiencing the impacts of climate change	86.4
4	Burning vehicle fuels, oil and gases cause air pollution and an increase in atmospheric temperature	81.8
5	Climate change is a threat to sustainable development	79.1
6	Rapid urbanization and changes in lifestyle have an effect on climate change	76.0
7	Increased population growth has an effect on climate change	74.6
8	Climate change leads to coastal erosion	66.6
9	Climate change causes increases in the intensity of extreme weather events (eg: heat waves, tornadoes, cyclones, heavy rainfalls)	65.6
10	Greenhouse gas emission causes boost in temperature	63.3
11	Climate change causes a rise in sea levels	62.5
12	Greenhouse gas emissions have an impact on climate change	62.5
13	Climate change causes changes in wind velocity and wind directions	58.7
14	Heavy use of fertilizers (especially N-containing fertilizers) causes climate change	55.3

Note: sum of percentages does not equal to zero as respondents have multiple answers.

that climate change leads to coastal erosion and increases the occurrence of extreme weather events (eg: heat waves, tornadoes, cyclones, heavy rainfall). Further, 59-62% had recognized that climate change causes a rise in sea levels and changes in wind velocity and wind directions.

Perception of coconut growers about climate change

Perceptions will shape the knowledge, but knowledge also shapes perceptions about an object, phenomenon or event. Adger et al. (2009) indicated that the farmers' perceptions of long-term or short-term climate changes are crucial pre-indicator in the adaptation process. Therefore, coconut growers' perceptions about climate change strongly affect how they understand and deal with climate-induced risks and uncertainties and undertake specific measures to mitigate adverse impacts of climate change on coconut cultivation.

The percentage analysis of coconut growers' perception about different dimensions of climate change was given in Table 3. It could be observed that while surveying in the field, coconut growers' in the Puttalam district were unaware of the term "climate change" or "global warming" and such trends globally, but they well understand overall changes in temperature and rainfall over time.

Table 3 indicates that the majority of the growers (more than 70%) perceived a slight increase in atmospheric temperature over time, changes in precipitation patterns and volume, changing the length of dry periods and rainy periods, slight changes in the monsoon periods as well as inter-monsoon rainy periods. The same majority perceived a continuing decline in coconut yield, yellowing and drooping of more coconut fronds during dry periods, wilting and drying of more coconut fronds during dry periods and lowering of groundwater levels in their estates over the last 5-10 years. Some 37.8% of the respondents perceived the occurrence of inflorescence abortion during dry periods and about 25.7% perceived that more palms died during the dry periods over the last five years.

Studies by Sampei and Aoyagi-Usui (2009) and Akter and Bennett (2009) emphasized that exposure to mass media increases awareness and concern about the damage associated with climate change. Further, Isham (2002) revealed that social capital plays a significant role in information exchange and it is significantly associated with climate-change perceptions. Results showed that 62.8% of respondents have mass-media exposure to climate change and 69.1% reported having access to social capital (farm-to-farm extension and the number of relatives/ volunteer workers in the village). Additionally, 69.3% of growers have perceived an increase in coconut pest and disease infestations during the last 5 years due to climate change. More than half of the respondents also perceived an increase of pest and disease infestations on other agricultural crops during the last 5 years due to climate change.

Based on observations related to climate-change dimensions, it can be concluded that the majority of the respondents have felt that there have been significant changes in various parameters of climate change. The findings of Maddison (2006) emphasized that adaptation to climate change requires a two-step process, 1) farmers should first notice that climate has changed, and 2) they have to identify useful adaptation strategies and then implement them.

Table 3. Coconut growers' perceptions on climate change and its impacts

No	Perception on Climate Change Dimensions (General)	Growers' Perceptions (%) (N = 140)
1	I feel that climate change is really happening	84.8
2	I feel that the atmospheric temperature has been increasing over the past 10 years	80.6
3	I have noticed the change in rainfall over the past 10 years	79.8
4	I have noticed changes in rainfall seasonality over the last 5 years	77.4
5	I have noticed the climate change influences agricultural yields negatively	77.3
6	I have noticed the fluctuation (increase/ decrease) in amount of rainfall over the last 5 years	76.6
7	I think that climate change is more harmful than beneficial, in general	76.3
8	I believe that climate change poses threats to food security	76.1
9	I have noticed longer dry periods and short rainy periods over the last 5 years	75.3
10	I have noticed that NEM and SWM monsoon seasons were not starting at correct time over the last 5 years	73.0
11	I have noticed that increase in heavy rains over the last 5 years	71.5
12	I have noticed that the inter monsoon rains were not starting at correct time over the last 5 years	70.3
13	I have noticed the increase in run off over the last 5 years	64.2
14	I have noticed an increase in drought conditions in different agro ecological regions over the last 10 years	63.0
15	I feel that there is no impact of floods on coconut cultivation over the past 10 years	59.4
16	I fell that there is no impact of floods on livelihood and household over the past 10 years	53.8
17	I feel that there are not any harmful effects to coconut cultivation over the past 10 years due to droughts conditions	6.1
18	I believe that climate change has no serious cause for economic depression to our country	6.1
19	I feel that there is no impact of droughts on livelihood and household over the past 10 years	5.7
	Climate Change Dimensions (On coconut)	
20	I have noticed the decline in coconut yield during last 5-10 years in my estate	73.8
21	I have noticed the yellowing and drooping of more number of coconut fronds during dry periods	73.8
22	I have noticed the falling of more number of button nuts during dry periods over the last 5 years	72.8
23	I have noticed the lowering of the ground water level in my estate over the last 5-10 years	72.0
24	I have noticed the wilting and drying of more number of coconut fronds during dry periods	70.8
25	I have noticed the increase of pest and disease infestations on coconut during last 5 years due to climate change	69.3
26	I have access to social capital (farm-to-farm extension and the no. of relatives/ volunteer workers in the village)	69.1
27	I have exposure to mass media about climate change	62.8
28	I have noticed that changing fertilizer type into organic may help to reduce the effects of climate change	62.7
29	I have not noticed any effect to intercropping under coconut due to climate change over the last 5-10 years	60.8
30	I have noticed an increase in pest and disease infestations on other agricultural crops during the last 5 years due to climate change	56.7
31	I have noticed inflorescence abortion during dry periods over the last 5 years	37.8
32	I have noticed the death of more number of palms during dry periods over the last 5 years	25.7

Adaptation strategies to climate change

Adaptation to climate change is defined as any adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC 2007). There are several potential adaptation options to reduce moderate to severe climatic risks in agriculture. FAO (2010) stated that adaptation options that sustainably increase productivity, enhance resilience to climatic stresses and reduce greenhouse gas emissions are known as climate-smart agricultural technologies, practices and services.

Coconut growers who observed different variations in the climate over 5 to 10 years, were further asked to describe the farm-level adaptation measures undertaken in response to climate change. The results of the study demonstrated that there was a wide range of adaptation measures practiced by the coconut growers in Puttalam district to cope up with the adverse impact of climate change (Table 4).

The study findings indicated that most growers (74.9%) had applied moisture conservation methods in their estates. Further, 62.6% of growers had built and used a hose/sprinkler/drip irrigation system during dry periods to cope with adverse impacts of climate change, 54.1% had used tube wells and 18.6% had practiced manual watering during dry periods. It was observed that 49% had practiced agroforestry system to reduce the temperature in the estate. These findings are supported by Gbetibouo (2009) that building water-conservation/harvesting schemes is a popular adaptation strategy adopted by those who are experiencing the effects of decreased precipitation. The coconut at each stage of nut development is sensitive to soil moisture availability and temperature to varying degrees. Coconuts are primarily grown as a rain-fed crop, and studies showed that the proportion of button nuts (female flowers after fertilization) that fall prematurely from the inflorescence was closely related to total rainfall and the minimum air temperature (Peiris and Thattil, 1998, Peiris et al., 1995). The optimum temperature for pollen germination of coconuts was around 28°C in laboratory studies, while the maximum can go up to 39.7°C (Ransinghe et al., 2015). Relative humidity and temperature also play a key role in nut development (Kumar et al., 2009). The available soil moisture is mainly determined by climate, hydrology and drainage, which is considered key factor that determines coconut production. Further Somasiri et al. emphasized that coconuts perform well in the absence of moisture stress and are produced moderately under a minimum period of moisture stress (Somasiri et al., 1994). The survey showed that 37.6% of the respondents practiced rainwater harvesting methods, 29.1% practiced soil conservation methods and 15.8% had constructed irrigation well in their estates. Furthermore, results revealed that 63.7% had applied organic manure to improve the soil conditions. Specifically, organic manure helps to retain moisture for a long period in the soil as well as increase soil nutrient status. There were 55.2% of respondents who planted drought-tolerant varieties. In addition, 59.1% of growers reported access to agricultural extension services for coconut, intercropping and livestock production. Some (35.5%) even had access to weather forecasting. The survey results revealed that only 2.7% of growers go for off-farm occupation during dry seasons. Dhanya and Ramachandran (2016) emphasized that climate change is recognized as one of the leading challenges affecting the performance of agriculture and associated livelihoods.

Concerning growers' adaptation measures, 10 out of 13 statements adaptation levels were less than 60% (somewhat adopted). Out of these 10 statements, 7 statements hold less than 50% (poorly adapted) adaptation level. This reveals that there may be other possible constraints that limit the coconut

Table 4. Adaptation measures practiced by the coconut growers

No	Adaptation Measures on Climate Change	Adopted growers' (%) (N = 140)
1	Apply moisture conservation methods in the estate	74.9
2	Apply organic manure to improve the soil conditions	63.7
3	Use of hose/sprinkler/drip irrigation system during dry periods	62.6
4	Access to agricultural extension services provided for coconut, intercropping and livestock production	59.1
5	Plant drought-tolerant varieties	55.2
6	Use of tube wells	54.1
7	Practice making agroforestry system to reduce temperature in the estate	49.0
8	Practice rainwater harvesting methods in the estate	37.6
9	Access to information on weather forecasting	35.5
10	Practice soil conservation methods in the estate	29.1
11	Practice manual watering during dry periods	18.6
12	Construct irrigation well in the estate	15.8
13	Go for off-farm occupation during dry seasons	2.7

growers' proper adaptation and capacity to maintain essential adaptation measures to cope with the negative impacts of climate change.

Relationship between Coconut Growers' Socio-Demographic Characteristics and their Knowledge and Perceptions about Climate Change in Puttalam District

Correlation coefficients were calculated to determine the relationship between selected independent variables (Age, Landholding size, Education, Farming experience, Land ownership) and dependent variables such as coconut growers' knowledge and perceptions. After that, a t-test was used to determine the significance of the relationship between the two variables. The results obtained are presented in Table 5.

Findings expressed in Table 5 reveal that out of the five independent variables age, education and farming experience were found to be positively related while landholding and land ownership were negatively related to coconut growers' knowledge levels and perceptions on climate change. However, only the education level was found to be highly correlated with the coconut growers' knowledge and perceptions on climate change. A study by Graft and Onumah (2011) also proved that education has a significant positive effect on the perception of the farmers about climate change.

Table 5. Relationship between Socio-Demographic Characteristics and their Knowledge, Perceptions about Climate Change

No	Independent Variable	Knowledge "Spearman's rho" value	Perceptions "Spearman's rho" value
1	Age	0.153	0.001
2	Land Holding	- 0.030	-0.064
3	Education	0.678**	0.379**
4	Farming Experience	0.111	0.157
5	Land Ownership	- 0.008	-0.023

** *Correlation is significant at the 0.01 level (2-tailed)*

Relationship between Coconut Growers' Knowledge, Perceptions and Adaptation Measures about Climate Change

The correlation coefficient was calculated to find out the relationship among the growers' knowledge, perceptions and their adaptation options practiced (Table 6).

Findings expressed in Table 6 reveal that the coconut growers' knowledge was significantly correlated with their perceptions and adaptation measures. Further, their climate risk perceptions were also found to be markedly related to their adaptation measures.

Table 6. Relationship between Coconut Growers' Knowledge, Perceptions and Adaptation Measures about Climate Change

	"Spearman's rho" value
Knowledge Vs. Perceptions	0.750**
Knowledge Vs. Adaptation measures	0.284**
Perceptions Vs. Adaptation measures	0.289**

**Correlation is significant at the 0.01 level (2-tailed)*

Regression Analysis: Impact of independent variables on dependent variables

Finally, through this study, an attempt was made to find out the association between independent variables (i.e. age, landholding, education, farming experience and land ownership) and dependent variables (coconut growers' knowledge and perceptions) as well as the impact of independent variables on the dependent variables. First, Ordinal Logistic Regression Analysis was done to test the association of independent variables with the dependent variables of the study. The results of the study are shown in Table 7.

Table 7. Association of independent variables with dependent variables

Growers' Knowledge (as dependent variable)		Sig. value
Model Fitting Information		0.000
Goodness-of-Fit	Pearson value	1.000
Pseudo R-square	Nagelkerke	0.758
Test of Parallel Lines		0.000

Growers' Perception (as dependent variable)		Sig. value
Model Fitting Information		0.000
Goodness-of-Fit	Pearson value	1.000
Pseudo R-square	Nagelkerke	0.644
Test of Parallel Lines		0.103

As indicated in Table 7, selected independent variables have a stronger association or relationship with the coconut growers' knowledge and perceptions. Further, Multiple Regression analysis was performed and the coefficient of determination (R2) (Table 8) was calculated to find out the contribution of all the independent variables on the dependent variables related to the coconut growers' knowledge and perceptions about climate change.

Table 8 shows that the coefficient of determination (R2) is 0.431 for coconut growers' knowledge about climate

Table 8. Coefficient of determination (R^2) of Multiple Regression Analysis

Dependent Variable	R^2
Coconut Growers' Knowledge	0.431
Coconut Growers' Perception	0.217

change, meaning that only 43.1% of the variation in the dependent variable could be ascribed to all five independent variables considered in the study. With R2 0.217 for coconut growers' perceptions about climate change, so only 21.7% of the variation in the dependent variable could be ascribed to independent variables considered in the study. The remaining 56.9% and 78.3% variations in the respective dependent variables of this study could be ascribed to other factors or variables not considered in this study. Hence, there may be other dominant or extraneous factors that must be studied to arrive at a valid and reliable conclusion about the factors which contribute to the coconut growers' knowledge and perceptions about climate change.

Conclusion

At present climate change has emerged as one of the most prominent factors for coconut cultivation in Sri Lanka. Climate changes and extreme weather events will cause coconut production losses in the major coconut growing areas of the country and ultimately threaten coconut-based livelihoods, which in turn will have adverse effects on national food security as well as the country's economy. The degree, frequency and nature of climatic changes can have serious consequences for coconut cultivation and different farming practices in Puttalam district of Sri Lanka. Hence, to cope with the negative impacts of climate change, practicing suitable adaptation measures is important. This study uses primary farm-level data from Puttalam district in Sri Lanka to analyze the coconut growers' knowledge, perceptions and their adaptive capacities and measures to the changes in climate.

The study findings have highlighted that coconut growers' knowledge and perceptions about climate change are fairly high. They also display a fairly good understanding of various dimensions that contribute to climate change such as rainfall pattern and fluctuations, increase in temperature, changes in rainy periods and monsoon seasons, and several others. However, their low level of adaptation to climate change should be further studied focusing on other constraints which may limit coconut growers' adaptation of practices that can mitigate climate change.

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