DEVELOPING TOOLS FOR MEASURING PERCEPTION ON CLIMATE CHANGE AND ITS IMPACT ON INSECT-PESTS OF MAJOR STAPLE FOOD CROPS

M. Jaishi[1]*, K. Kafle[1], R.Subedi[1], A. Khanal[1], A. Poudel[1] and R. Paudel[2]
[1]Lamjung Campus, Institute of Agriculture and Animal Science, Tribhuvan University, Nepal
[2]Directorate of Extension (DoE), Institute of Agriculture and Animal Science, Tribhuvan University, Nepal
*mahesh@iaas.edu.np

ABSTRACT

The climate change discourse has been evolving globally, and it has generated new ideas, debates and interests within the community of experts in local context too. People's perceptions are critical components of the socio-cultural context within which people and societal system operate. People's perception can compel or constrain social, economic cultural and political action to address particular risks and are liable of great influence. Present study is contemplated to construct a measuring tool to elucidate people's perception about variability, causes, effect and impacts of climate change on production and productivity of major staple cereals of Nepal (Rice, maize wheat and potato) and standardized the same. Study was conducted on 15 different agro-ecological region of Nepal (n=900). As a result, screening and sorting from 105 statements collected and through content validation process final perception measuring instrument comprised of 70 statements was designed using equal appearing Likert scale. General criteria for perception scale construction related to item development, response set and statistical procedures are discussed. This scale was standardized for administration.

Keywords: Climate change, Likert scale, Perception

INTRODUCTION

Over the past decade, public opinion about climate change has become increasingly well documented (COIN, 2011). Awareness about climate change is very high, and a number of surveys have shown that the British, European and North American public express substantial concern about it. Beyond the fundamental findings about the level of concern, awareness and belief in human impact on the climate, some recent studies have attempted to delve deeper into public attitudes about climate change (Poortinga *et al*., 2011).Pidgeon and Fischhoff (2011) showed perception of people that most climate scientists agree climate change is happening. Gallup's (2009) findings stated that between 1998–2006, people are sure that scientists agreed climate change was happening, but during the first decade of 21th century, people were sure that the changing climate has greater uncertainty.

Rabe and Borick (2012) confirms opinion of existence and importance of global warming depends strongly on their perceptions of recent local climate variations, thus public confidence regarding climate change science is complex and not easy to discern from opinion poll data. Public perception of climate changes and its risk are critical to achieve the ambiguous targets of green house gas emission of many countries around the world. The public perception regarding climate change and climate change risk is psychological distance among public. These have provoked many varieties of hypotheses to reduce this distance and produce real, relevant, local and immediate perception on climate change (Spence *et al*., 2012). A study concerning the perception of people found that around 90% of British citizens were concerned about climate change (BBC, 2010). However, climate change continues to be a low priority issue for most people when contrasted with other societal issues such as the economy, education, or the threat of terrorism (Upham *et al*., 2009). In recent years the people's concern about climate change

has been shifted somewhat and generalized as accompanied by an increase in the number of people expressing uncertainty about the reality on the climate change (BBC, 2010).

Perception of an individual determines one's knowledge gain about any ideas and its acceptance, adoption, continuance and rejection as well. It also has a bearing with other requirements associated with the idea i.e. the psychological object under consideration (Sujeetha and Palaniswamy, 2014). The psychological object may be any symbol, phrase, slogan, person, institution, idea or ideal towards which the people may differ with respect to positive or negative effect (Shivaraj *et al.,* 2016). Perception is the organization, identification and interpretation of sensory information in order to represent and understand the environment (Bayle, 1988).

From these aforementioned statement, perception could be conceptualize as a cognitive process person make sense of stimuli from the environment, affect all senses, attitudes are defended as mental predisposition to act expressed by evaluating a particular entity with some degree of favor or disfavor. Risk perceptions of climate change are complex and multidimensional. Gender, political party, knowledge of the causes, impacts and responses to climate change, social norms, value orientations, affect and personal experience with extreme weather were all identified as significant predictors. Results also confirm that the factor analytic structure of climate change risk perceptions can be conceptualized along two key dimensions, namely: personal and societal risk judgments and that both dimensions have different psychological antecedents (Linden, 2014).

Over the past decade, public opinion about climate change has become increasingly well documented. Awareness about climate change is very high, and a number of surveys have shown that the public express substantial concern (Pidgeon, 2011). However, climate change continues to be a low priority issue for most people when contrasted with other societal issues such as the economy, education, or the threat of terrorism (Upham *et al.,* 2009). In recent years, level of reported concern about climate change has fallen somewhat, accompanied by an increase in the number of people expressing uncertainty about the reality of human influence on the climate (BBC, 2010).

Public perceptions of climate change are known to differ between nations and have fluctuated over time. Numerous plausible characterization of these variations and explanation for them, are to be found in literature. However, a clear pictures has not yet emerged as to the principal trend and pattern that have occurred over the past quarter century or the factors behind these changes (COIN, 2011). The ways in which individual, societal, and polities respond to climate change are in many cases contingent on many perceptions of its causes, consequences and implication. As such understanding of public opinion on climate change is critically important (Captick *et al.,* 2014).

This is a peculiar but inevitable result of the fact that the nature of human perception allows for a differentiation between real-world threats and the subjective perceptual experience of those threats (Pidgeon, Kasperson, & Slovic, 2003). Indeed, the perception of risk is a mental construct (Sjoberg, 2000). Slovic (1992) points out, the notion of "risk" is a human invention and as such, "it does not exist independent of our minds and culture". In a perceptual study conducted in 15 district of Nepal showed, changing climate is a challenge for both current and future generations. Climate change has increased its impacts by uncertainty and variability towards vulnerability of societies around the country (Kafle *et al.,* 2016). The purpose of this review is to report an analysis of recent research methodology best used related to measurement of perception in climate change. The emphasis is on perceptual measuring instrument rather than the results of research utilizing such tools so that researcher could use tools more appropriately and concisely.

MATERIALS AND METHODS

A national study of climate change risk perceptions was planned to conduct from January, 2016 to June, 2016 using face to face interview of Nepalese farmers using Likert scale. The selected psychological object of the study was 'impact of climate change'. The scale was designed to administer farmers' perception about climate change and its impact on insect-pest incidence on major staple food crops.

Likert scale is widely used in behavioral research to help researchers in the development of right perception scale. A Likert item is simply a statement where respondents evaluate a quantitative value on any kind of subjective or objective agreement/disagreement. Well-designed Likert items exhibit "symmetry" in that they contain equal numbers of positive and negative positions whose respective distances apart are bilaterally symmetric about the "neutral"/zero value (whether or not that value is presented as a candidate; and "Balance" in that the distance between each candidate value is the same, allowing for quantitative comparisons such as averaging being valid across items containing more than two candidate values. Holistic affective evaluations of global warming were gathered using separate, unipolar measures of negative and positive affect by using Likert scale (Leiserowitz, 2006).

Collection of perception items

Total of 105 items were collected, selected and distributed among the social scientist to comment whether the statements are capable of measuring the perception of farmers in major four dimensions of climate change viz; general knowledge about climate change, variability of climatic patterns, its effect on production and productivity of the major cereal crops. The statements were then screened, modified, revised and edited in accordance with the feedback.

The 105 selected statements were then subjected to opinion on 5-7 point continuums ranging from most relevant to least relevant. The list of statement then sent to judge comprised of scientist and faculties of IAAS. Out of 40, 30 people responded by sending their judgments. By applying the formula, the scale value t-value was computed for 70 statements.

Content validity of the scale

Content validation refers to the representativeness or adequacy of the content of a measuring instrument (Kerlinger, 2007). Content validation was carried out by subjecting the selected perception items to judge's opinion. Expert in the selected field of study the faculties, scientist, the judges. They were asked to indicate the extent to which each perception item covered. The response were obtained on a four point continuum of 'most relevantly covers' 'more relevantly covers' 'less relevantly covers' 'least relevantly covers'. Score 4, 3, 2 and 1 were given for the point on the continuum respectively. Totally 30 judge responded by sending their judgments. The content validity of the scale of the mean score was fixed by calculating the total score continuum divided by number of point continuum categories. The value obtained was 2.5 so if the overall mean score of the attitude items as rated by the judge was above 2.5 the scale will be declared as valid if not otherwise. In the present case, the overall mean score was worked out as 3.86 therefore, the constructed attitude scale is said to be valid.

Calculation of t-value and selection of final perception statements

The score of the individual statements were summed up to get the total score of the respondent. Based on the total score obtained, the respondents were arranged in descending order. The top 25 percent of the respondent with their total score were considered as the high group and the bottom

25 per cent as the lower group, so as these two groups provide criteria group in terms of evaluating the individual statements as suggested by Edward (1969). After computing the t-value for all the statements comprising of 5-7 point scale, 35 statements having lowest t-value excluded and remaining 70 statements were selected and included in the final scale.

RESULT AND DISCUSSION

Administration of scale

Seven point perception continuums of 'Strongly agree' to 'strongly disagree' were used as response categories postulated as in table below.

Table 1: Scale development for measurement of perception on climate change

Statement	Response continuum							
Positive	Strongly agree	(7)	6	5	4	3	2	Strongly Disagree (1)
Negative	Strongly Disagree	(1)	2	3	4	5	6	Strongly agree (7)

Attitude scale aims at constituting a system of objective appraisal (Bayle, 1988). The respondent's appreciation is substituted by an instrument formed in advance which must, automatically, without any human intervention indicate the intensity of the analyzed individual's opinion or attitudes. The general principles of these techniques is to present a series of standard proposal called 'items' to each subject and to ask them to indicate those they approve or disapprove of. All these results are then combined and the results of these combinations automatically determine the intensity of an individual's opinion or attitude. In considering the data needed, it is important to focus on what should be interviewed and how to structure the interview. These will depend on the research or policy questions that need to be answered, and the appropriate unit of analysis; are we interested in the farmer, the household, the plot of land, a particular crop, or the farm enterprise? These different units of analysis will lend themselves to different types of surveys. Broadly, the content of surveys that are used for analyses of climate change includes household surveys, provides different information and helps to answer different questions.

People's Knowledge of Climate Change

People's perception on Climate Change: Information, variability and causing events

Most of the population has heard about the term "climate change" .But their understanding of climate change, how frequently they heard about the term, what is the source of information and which elements of the CC they feel mostly changing are the three basic queries to know the peoples knowledge of CC. It is very important to know who the major sources of information are so that the research team suggests including in the dissemination of information regarding the matters of climate change. It is generally practice prevails that people interpret the climate change according to the particular climatic events they normally face in the area where they live. By administering the statement state in the table below indicates which of the climatic events more frequently they face changing.

Table 2: Knowledge and source of information of climate change

S.N.	Statement	Continuum					
1	Have you heard about the climate change	Very frequently	Frequent	Occasionally	Rarely	Very rarely	Never
2	From whom you heard about the climate change	Scientist	Teacher	Neighbor/ Friends		Mass media	DA
3	Which component of climate have you felt changing mostly	Temperature	Rainfall	Wind	Hail-storm	Lightening	

DA= Development agency

People perception on climatic variability

Increase in temperature and vents of erratic rainfall directly affect the agriculture and food supply through their effects on crops. Production varies due to rain brought by monsoon. Agriculture is sensitive to short-term changes in weather that affect the production of crops. Insufficient rain and increasing temperature cause drought, whereas intense rain in short period reduces ground water recharge by accelerating runoff and causes floods. Both the situations induce negative effects in the agriculture. The climate change also causes disruption in normal weather pattern changing intensity and duration of monsoon (Malla, 2008).

Farmers have a lot to be concerned about. Farmers are witnessing heavier and more erratic rainfall during the monsoon period, flooding their rice fields as a result (CGIAR/CCAFS, 2014). These extreme weather changes put a lot of stress on farmers' already fragile livelihoods and food security. People may experience a great deal of change in the weather e.g. irregular, insufficient or heavy rainfall and temperature increase. Change in pattern, timing amount and intensity of rainfall over the last 5 years. However, a clear variation may evident in different zones. So it is very important to know their agreement/disagreement through perception regarding extent of variability in 12 different parameter of climatic variability as shown in the table below.

Table 3: People's perception on extent of variability of climate change faced by farmers of Nepal

Item	Perceptual statement	SD	1	2	3	4	5	6	7	SA
4	Rainfall pattern has been changed	SD	1	2	3	4	5	6	7	SA
5	Timing of the rainfall is changing	SD	1	2	3	4	5	6	7	SA
6	Amount of rainfall is changing	SD	1	2	3	4	5	6	7	SA
7	Intensity of rainfall is changing	SD	1	2	3	4	5	6	7	SA
8	Summer temperature is changing	SD	1	2	3	4	5	6	7	SA
9	Hot waves is changing	SD	1	2	3	4	5	6	7	SA
10	Cold waves is changing	SD	1	2	3	4	5	6	7	SA
11	Winter temperature is changing	SD	1	2	3	4	5	6	7	SA
12	Overall of the annual temperature is changing	SD	1	2	3	4	5	6	7	SA
13	Hail-storm events is changing	SD	1	2	3	4	5	6	7	SA
14	Thunderstorm & Lightening events are changing	SD	1	2	3	4	5	6	7	SA
15	Wind velocity is changing	SD	1	2	3	4	5	6	7	SA

S.D. =Strongly agree, S.A.=strongly disagree

Perception on severity: Tools to measure the change in parameters

People experience how much they feel the climatic change in different parameters is one of the objectives of this study to analyze which of the parameters is affecting in what extent is measured in five continuums a great deal (5) to none (1). Twenty perceptual statements have been identified to measure the perceptual characteristics of the community people where they reside.

Table 4: Content of measurement of change in the parameters of climate change

Item	Parameters of climate change	A great deal	Much	Less	Little	None
		5	4	3	2	1
16	Early rainfall	5	4	3	2	1
17	Late rainfall	5	4	3	2	1
18	Increase the amount of rainfall	5	4	3	2	1
19	Decrease the amount of rainfall	5	4	3	2	1
20	Increase the downpour intensity of rain	5	4	3	2	1
21	Decrease downpour intensity of rain	5	4	3	2	1
22	Increase in summer temperature	5	4	3	2	1
23	Decrease in summer temperature	5	4	3	2	1
24	Increase in hot waves (No. of days)	5	4	3	2	1
25	Decrease in hot waves	5	4	3	2	1
26	Increase in winter temperature	5	4	3	2	1
27	Decrease in winter temperature	5	4	3	2	1
28	Increase in cold waves (No. of days)	5	4	3	2	1
29	Overall annual temperature	5	4	3	2	1
30	Increase in hail storm events	5	4	3	2	1
31	Decrease in hail storm	5	4	3	2	1
32	Increase in lightening events	5	4	3	2	1
33	Decrease in lightening events	5	4	3	2	1
34	Increase in Wind velocity	5	4	3	2	1
35	Decrease in wind velocity	5	4	3	2	1

Perception on effect of climate change on insect and disease pest

Climate change parameters: temperature, rainfall pattern and humidity have an impact on the development and distribution of pests and diseases (Malla, 2008). Increase in temperature and CO_2 will lead to an increase in population of pests and severity of diseases in presence of host plant. It increases the rate of reproductive cycle of insect and pest. The increase in insect population leads to demand for more use of pesticide, which unknowingly causes lots of harm to ecosystem as well as human society. Incidence of pest and diseases would be most severe in tropical region due to climate change. Pest and disease of plain ecosystem may gradually shift to hills and mountains.

Some pathogens of important crops from Terai zones has adapted in hills and mid-hills (eg. rust and foliar blight) that may adversely affect the agricultural production. It is enviable to know about the knowledge of insect and pest effect on major staple food crops. A total of 11 perceptual statements have been designed to measure the farmer's perception in major three ecological region through the country as shown in the table below.

Table 5: People's perception on effect of climate change on major cereal crops in Nepal

Item	Statement	SD	1	2	3	4	5	6	7	SA
36	CC affecting the insect pest incidents in rice	SD	1	2	3	4	5	6	7	SA
37	CC affecting the insect pest incidents in maize	SD	1	2	3	4	5	6	7	SA
38	CC affecting the insect pest incidents in wheat	SD	1	2	3	4	5	6	7	SA
39	CC affecting the insect pest incidents in potato	SD	1	2	3	4	5	6	7	SA
40	CC affecting the insect pest incidents in vegetable	SD	1	2	3	4	5	6	7	SA
41	CC affecting the disease pest incident in rice	SD	1	2	3	4	5	6	7	SA
42	CC affecting the disease pest incident in maize	SD	1	2	3	4	5	6	7	SA
43	CC affecting the disease pest incident in wheat	SD	1	2	3	4	5	6	7	SA
44	CC affecting the disease pest incident in potato	SD	1	2	3	4	5	6	7	SA
45	CC affecting the disease pest incident in vegetable	SD	1	2	3	4	5	6	7	SA
46	CC affecting soil salinity/acidity/alkalinity problem	SD	1	2	3	4	5	6	7	SA

Impact of climate change in production and productivity of major staple food

As we observe the growth of plant as well as the yield is primarily determined by the climatic settings of the particular topography, the major constraints of the plant growth and yields are rainfall, sun light, and temperature (Gurusamy, 2008). Productivity and quality of food production is also in question in Nepal as both of them are deteriorating.

Table 6: People's perception on impact of climate change faced by farmers of Nepal

Item	Statement	SD	1	2	3	4	5	6	7	SA
47	Production and productivity of rice has change	SD	1	2	3	4	5	6	7	SA
48	Production and productivity of maize has change	SD	1	2	3	4	5	6	7	SA
49	Production and productivity of wheat has changed	SD	1	2	3	4	5	6	7	SA
50	Production and productivity of potato has changed	SD	1	2	3	4	5	6	7	SA
51	Production and productivity of vegetable changed	SD	1	2	3	4	5	6	7	SA

Perception to measure overall impact of climate change

Often, researchers measure the overall perception in the development of a questionnaire that could cover all the possible topics of interest from impact on agriculture perspective. Data should be collected at individual-level, rather than just at the household or farm level, specifying the agricultural holding and the exact holder. This type of data collection will facilitate analyses on a broad range of dimensions of impact of climate change, such as region, land holding profession, caste and gender.

People's perception on the overall impact of climate change principally: loss of agricultural production, loss of trees/gardens/houses, loss of domestic animals and loss of income. Large regional variations may be observed in agricultural production losses, loss of trees/gardens/houses in drought areas, induction of settlement shift, frequency of drought, emergence of spring, drying of spring, crop failure and so on. To measure the overall impact of climate change total of 20 perceptual statement have been designed

Table 7: Scale developed for measuring the overall perception of climate change by farmers

Item no.	Statement	SD	1	2	3	4	5	6	7	SA
52	Agriculture production hampered	SD	1	2	3	4	5	6	7	SA
53	Loss of population and species of trees	SD	1	2	3	4	5	6	7	SA
54	Loss of population and species of animal	SD	1	2	3	4	5	6	7	SA
55	Depletion of ground water table	SD	1	2	3	4	5	6	7	SA
56	Rising water table	SD	1	2	3	4	5	6	7	SA
57	CC induce settlement shift/migration	SD	1	2	3	4	5	6	7	SA
58	Increase in frequency of drought	SD	1	2	3	4	5	6	7	SA
59	Increase in frequency of flood	SD	1	2	3	4	5	6	7	SA
60	Increase in river flow	SD	1	2	3	4	5	6	7	SA
61	New springs emergence	SD	1	2	3	4	5	6	7	SA
62	Drying of old springs	SD	1	2	3	4	5	6	7	SA
63	Incidence of crop failure	SD	1	2	3	4	5	6	7	SA
64	Increase in the evidence of the crop disease	SD	1	2	3	4	5	6	7	SA
65	Rapidly changing living condition	SD	1	2	3	4	5	6	7	SA
66	Change in fish diversity	SD	1	2	3	4	5	6	7	SA
67	Forest density decreasing	SD	1	2	3	4	5	6	7	SA
68	Uneven pattern of hydrological cycle	SD	1	2	3	4	5	6	7	SA
69	Irrigation scheduling and pattern is changing	SD	1	2	3	4	5	6	7	SA
70	Increasing trend of fallowing land	SD	1	2	3	4	5	6	7	SA

CONCLUSION

As there are very limited study and tools for measuring farmer's attitude pertaining to climate change. The present study will aid researchers in their research by adopting the scale developed. Describing the qualitative and quantitative methodologies, the study showed that six dimensions of instruments could provide useful information towards on climate change measure by farmers of Nepal. The perception scale developed through Equal Appearing Interval (EAI) method lead the study to make 70 statements for measuring the attitude of the farmers towards organic farming. Seventeen statements measuring the people's perceptions were identified, with holistic view. Assessments of the severity of impacts of climate change on production and productivity to measures local, regional and national level impacts of climate change are the major concern of scale. Further the rates of seriousness to plant insect and disease infection; water shortages, standards of living, threat around the scale of concern were discussed. This paper would serve as guidance for researcher and the

scholar that would like to engage in the study of perception of the people of climate change and its effects on major staple food production. The study is general and does not aim to be comprehensive and complete but it indicates the main challenges and tools identifiable for this type of study.

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