Developing an Instrument to Measure Malaysian Highland Farmers' Adaptation towards Climate Change

[1,2]Khairuddin Idris, [1,3]Asnarulkhadi Abu Samah, [1,2]Bahaman Abu Samah, [1]Hamizah Sahharon and [1]Hayrol Azril Mohamed Shaffril

[1]Institute for Social Science Studies, Universiti Putra Malaysia
[2]Faculty of Educational Studies, Universiti Putra Malaysia
[3]Faculty of Human Ecology, Universiti Putra Malaysia

Abstract

This paper aims to explicate the instrument development process for measuring Malaysian highland farmers' adaptation towards climate change. The process consisted five phases, namely understanding the background of study, comprehensive review of literature; detailed review of each item; establishing the reliability of instrument and strengthening the instrument. Based on the reliability analysis and validity procedures by the research team, several modifications were made. The finalized instrument contains a total of five sections, namely demographic (18 items), cognitive (12 items), practices (seven items), structure (nine items) and cost (15 items). Towards the end, the researchers planned to use the developed instrument to conduct a related study at three main highland farming areas in Malaysia namely Lojing, Cameron Highland and Kundasang.

Keywords: Instrument Development, Reliability, Validity, Community Development

Introduction

Multiple industries in Malaysia are found to be affected by the impacts of climate change. The aquaculture industry is affected by unstable rainfall patterns as it results in either drought or flood, while rising sea levels result in salinization of groundwater supplies and the movement of saline water further upstream in rivers affect the aquaculture harvests (Mohan Dey et al., 2016; Merino et al., 2012; IPCC, 2007). Various livestock reproductions, performances, qualities and quantities on the other hand, is affected by rising temperature (McKune et al., 2015; Schulze et al., 2016; Johannesen et al., 2013).

The agriculture sector is deeply affected by the effects of climate change, thus, scholars across the globe have placed their endeavor to gain a greater understanding on this issue. Much of the studies revolve around scientific and economic perspectives; studies by Md. Nasir et.al (2009) and IPCC (2007) concluded significant impacts of climate change on agricultural

productivities and country's food security; Chamhuri et al. (2009) concluded the impacts of sea level rise in agriculture productivities; Bocchiola (2015), Ye et al. (2015) and Seo et al. (2005) on the other hand confirmed the effects of temperature and precipitation rate on yields for agricultural commodities such as rice, wheat, corn, coconut, rubber and tea. In brief, these scenarios have led to a fact that not much studies on social viewpoint were conducted regarding to climate change.

Nowadays, an understanding over people's response towards climate change has become an important issue. As this phenomenon is expected to worsen in the future, strengthening the community's adaptation to climate change, especially those who rely heavily on weather stability is vital. To understand community adaptation ability is vital in this sense, as it allows us to identify their strengths, weaknesses, abilities, needs and interests in relation to climate change adaptation.

Prior to this, a valid and reliable instrument is needed but despite its mounting need, the number of existing instrument is still lacking. Against this backdrop, this study aims to develop an instrument to measure Malaysian highland farmers' adaptive capacity towards the climate change impacts.

The Instrument Development Process
The process consisted of five phases, namely 1) understanding the background of study; 2) comprehensive review of the literature; 3) judgmental reviews of each item; 4) the pilot test and 5) strengthening the instrument.

First phase – Understanding the background of study
Understanding the study's background is an important step in any instrument development process (Yeoh et al., 2016; Radhakrishna, 2007). Within this phase, efforts were placed to gain a clear understanding of the study's objectives and the gap, why is this instrument needed? Subsequently, the researchers tried to understand the background of highland farmers by referring to previous data of Hamdan et al. (2014). This process allowed a depth understanding on highland farmers' demographic background, particularly their educational and readability levels. The researchers then try to gain data on their farming background and the potential impacts of climate change on their farming activities.

Second phase – Comprehensive review of the literature
The first phase mainly involved reviews of literature and document analyses processes, which focused on seeking previous studies related to communities' adaptation towards climate change. The researchers relied on two main tasks, first, conducted an exhaustive search on online journals, indexing databases and search engines such as Science Direct, Scopus, Taylor and Francis, Emerald, Google and Yahoo; and second, sought printed journals, reports, monograph and documents from Universiti Putra Malaysia Library. Based on these tasks, the researchers decided to select a total of 18 related articles and documents, whereby studies by Shaffril et al. (2013); Shaffril et al. (2015) and International Union for Conservation of Nature and Natural Resources (2010) were referred to as the main sources. Via careful consideration of the literature reviews, the researchers developed a construct definition of each variable and offer detailed understandings. Furthermore, the reviews offered the best way to measure these variables.

The first draft of the questionnaire consisted five main sections, namely demographic, cognitive, practice, structure, and cost. The demographic section comprised of 19 items

mainly related to their general background and farming background. Among demographic items included were related to their age, gender, household size, education achievement, experience as a farmer and incomes generated from farming activities. For answering demographic related items, the respondents were given either an open-ended or a closed-ended option of answer.

The cognitive section consisted of twelve items. The cognitive perspective defined as the farmers' 1) sensitivity; 2) awareness of the changing climate; 3) its impact on the environment and their socio-economic routine. Therefore, included items were much related to these three factors. For example, the item statements asked were 'The temperature in my area is rising', 'The erratic weather has increased the number of pests in my farm' and 'My productivity (farming) is decreasing'. Within this section, the respondents were given an option of a five Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The practice section consisted of nine items. The researchers defined practices as the degree of highland farmers' willingness to change socially and economically in order to cope with the impacts of climate change. For example, items such as 'I like to learn new skills - that are not related to agricultural activities (e.g. entrepreneurial, vocational)', 'I have no problem in learning to use the latest agriculture technology' and 'If the bad weather persists, the possibility for me to venture into other industries is high' are enquired. Within this section, the respondents were given an option of a five Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The structure section consisted of twelve items. The researchers defined structure as the availability of supports and the type of supports that should be provided by local institutions, the government or community-based institutions. For example, such items enquired are 'The government agencies in this area provide weather information to farmers', 'The government agencies offer infrastructure restoration loans to farmers for damages caused by the impacts of climate change', and 'Decisions made by government agencies are in line with the farmers' needs and abilities. An option of a five Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) was provided for option of answer.

The cost section consisted of ten items. The researchers defined cost perspective as the farmers' economic or social loss caused by climate change. The development of this section was based on two types of loss – social (four items), and economic (six items). For example, the items enquired are 'Natural disasters have caused conflicts among the local community', 'Climate change has reduced agricultural productivities' and 'Climate change has reduced my farming productivities'. An option of a five Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) was used as an option of answer given to respondents.

Third phase – Detailed review of each item.
During this phase, the researchers reviewed in detail each item included in the instrument. This process allowed the researchers to check on the clarity of content coverage, the relevance of content of item for the proposed instrument, the wording and structure of items, and the appropriateness of the provided response scale.

After it was completed, the researchers decided that several modifications were needed. First, the researchers decided to add definition in the cost section. Rather than merely relying on social and economic loss, cost also refers to the farmers' personal loss, which reflected the impacts of climate change on the farmers as an individual. A total of five items represented personal loss in the instrument; for example, items such as 'Climate change affects my health', 'Climate change minimizes my recreational activities' and 'I am traumatized by the natural

disasters occurred in this area.' are enquired. An option of a five Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) is given to the respondents. Eventually, an addition of this section added the total items in cost section to 15.

Furthermore, the researchers decided to maintain all positive statements and excluded any negative statement as it may cause misperception among respondents and enumerators. The five Likert scale was maintained as an option for answer. As the context of the study focused on highland farmers living in rural areas, a five Likert scale is regarded as a simple, reliable, and valid measurement of self-reported data (Fabrigar & Wood, 2007). A simple option of answer is desired when it comes to older and less educated respondents.

The final version of the instrument was then presented to two community development studies experts in Universiti Putra Malaysia. They were given a one week time to review and provide constructive comments on the developed instrument. All in all, the experts were satisfied with the final version with exception of some grammatical errors that needed to be revised. Subsequently, after gone through all these viewing processes, the instrument is ready for a pilot test.

Fourth phase – establishing the reliability of instrument
Throughout the pre-test process, four trained and experienced enumerators were selected. A meeting was held for clarification on the developed instrument. They were explained on the option of answer provided to the respondents. Subsequently, they were asked to read each item in detail and were allowed to ask if anything was unclear to them. The meeting with enumerators ensured each item are pitched at their readability and familiarity level.

Prior to the pre-test process, a location visit was made in order to grasp the suitability of the selected areas and most importantly to ask permission from the area administrators for conducting a survey in their area. The pre-test process was conducted on March 2016, at Tanah Rata, Cameron Highland among 30 highland farmers. Moreover, the respondents were asked for their opinion regarding the suitability of each item to ensure the obtained data are able to fulfill the research objectives. The reliability analysis performed resulted in Cronbach alpha values that ranged between .536 to .904 (Table 1).

Fifth phase – strengthening the instrument
Based on the reliability results, the researchers made additional modifications. First, the Cronbach alpha value for the practice section did not exceed the recommended value of .700. To overcome this deficiency, based on 'if item deleted' analysis, the researchers excluded item number 1 and 9. Such effort increased the Cronbach alpha value to .768. Second, within the structure section, a multicollinearity problem occurred between item number 2 and 3, item number 6 and 7 and item number 11 and 12. To overcome this, the researchers decided to exclude item number 2 as it was almost similar to item number 3. A similar action was taken towards item no 7 as it was almost similar to item number 6. Item number 12 was removed as it carried a similar meaning to item number 11.

Table 1: Pre-test results and actions taken

Adaptation factors	Cronbach Alpha Value	Actions taken
Cognitive	.791	No actions were taken as it exceeded the recommended alpha value and no multicollinearity problem detected
Practices	.536	Items number 1 and 9 were removed

Structure	.904	Items number 2, 7 and 12 were removed
Cost	.886	No actions were taken as it exceeded the recommended alpha value and no multicollinearity problem detected

Conclusion

This study explains instrument development process that measure highland farmers' adaptation towards the impacts of climate change. Through several viewing processes, the drafted version of instrument consisted five main sections, namely demographic (18 items), cognitive (12 items), practices (nine items) and cost (15 items). The pre-test result reflected a need for improvement. Based on the reliability analysis, two items in the practices section were removed, while multicollinearity problems occurred in the practices section forced the researchers to remove three items. The finalized version of instrument consisted of demographic section (18 items), cognitive (12 items), practices (seven item), structure (nine items) and cost (15 items) (Table 2).

Table 2: The instrument

Factors	First draft of the instruments	Second draft of the instrument	Finalized instrument (after pilot test)
	Number of questions	Number of questions	Number of questions
Demographic	18	18	18
Cognitive	12	12	12
Practices	9	9	7
Structure	12	12	9
Cost	10	15	15

The newly developed instrument offers a foundation for future work regarding adaptation towards the impacts of climate change. Towards this end, the researchers planned to use the developed instrument for a data collection process among Lojing highland farmers – a highland area in Kelantan. As follows, the instrument will then be proceeded for other highland areas such as Cameron Highland (Pahang) and Kundasang (Sabah). These areas were selected as they were proven to be affected by the 'symptoms' of climate change such as the rising of temperature and the unstable rainfall patterns. The findings of this study can be a basis for model development and theoretical development, which better describe the highland farmers' adaptation ability towards climate change.

Corresponding Author
Khairuddin Idris
Universiti Putra Malaysia
43400 Serdang
Selangor Darul Ehsan
Malaysia

kidin@upm.edu.my or majudesa.desa@gmail.com

References
Bocchiola, D. (2015). Impact of potential climate change on crop yield and water footprint of rice in the Po valley of Italy. Agricultural Systems, 139, 223-237.

Chamhuri, S., A. Mahmudul, M. Wahid and Al-Amin, 2009 Climate Change, Agricultural Sustainability, Food Security and Poverty in Malaysia. IRBRP J., 5(6): 309-321.

Fabrigar L, Wood JK. Likert scalling. N.J. Salkind (Ed.), Encyclopedia of measurement and statistics, vol. 2 Sage, California (2007), pp. 536–540. 2007.

Hamdan, M., Man, N., Yassin, S.M., D'Silva, J.L., & Shaffril, H.A.M. (2014). Farmers' sensitivity towards the changing climate in Cameron Highland. Agricultural Journal, 9 (2), 120-126.

Intergovernmental Panel on Climate Change (2007). Fourth assessment report: synthesis. http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf. Accessed 17 November 2007.
International Union for Conservation of Nature and Natural Resources (2010). A framework for social adaptation to climate change. Retrieved December 15, 2015, from http://data.iucn.org/dbtw-wpd/edocs/2010–022.pdf

Johannesen, A.B., Nielsen, A., and Skonhoft, A. (2013). Livestock management at northern latitudes: Potential economic effects of climate change in sheep farming. Ecological Economics, 93, 239-248.

McKune, S.L., Borresen, E.C., Young, A.G., Auria Ryley, T.D., Russo, S.L., Camara, A.D., Coleman, M., Ryan, E.P (2015). Climate change through a gendered lens: Examining livestock holder food security. Global Food Security, 6, 1-8

Md Nasir, S. and A. Ahmad Makmom, 2009. Climate Change and Agricultural Development: Economic Impacts and Policy Responses, Academy of Sciences Malaysia .

Merino, G., Barange, M., Blanchard, J.L., Harle, J., Holmes, R., Allen, I., Allison, E.H., Badjeck, M.C., Dulvy, N.K., Holt, J., Jennings, S., Mullon, C., and Rodwell, L.D (2012). Can marine fisheries and aquaculture meet fish demand from a growing human population in a changing climate? Global Environmental Change, 22 (4), 795-806.

Mohan Dey, M., Rosegrant, M.W., Gosh, K., Chen, O.L., and Valmonte-Santos, R. (2016). Analysis of the economic impact of climate change and climate change adaptation strategies for fisheries sector in Pacific coral triangle countries: Model, estimation strategy, and baseline results. Marine Policy, 67,156-163

Radhakrishna, R.B. (2007). Tips for developing and testing questionnaires/instruments. Journal of Extension. Retrieved on 18 April 2016, from: http://www.joe.org/joe/2007february/tt2.php

Schulze, J., Frank, K., and Müller, B (2016). Governmental response to climate risk: Model-based assessment of livestock supplementation in drylands. Land Use Policy, 54, 47-57.

Seo, S. N., Mendelsohn, R and Munasinghe, M. (2005). Climate change and agriculture in Sri Lanka: A Ricardian valuation. Environment and Development Economics, 10, 581-596.

Shaffril, H.A.M., Abu Samah, B., D'Silva, J.L., &Yassin, S.M. (2013).The process of social adaptation towards climate change among Malaysian fishermen. International Journal of Climate Change Strategies and Management, 5 (1), 38-52.

Shaffril, H.A.M., D'Silva, J.L., Kamaruddin, N., Omar, S.Z., & Bolong, J. (2015). The coastal community awareness towards the climate change in Malaysia. International Journal of Climate Change Strategies and Management, 7 (4), 516-533.

Ye, Q., Yang, X., Dai, S., Chen, G., Li, Y., Zhang. C. (2015). Effects of climate change on suitable rice cropping areas, cropping systems and crop water requirements in southern China. Agricultural Water Management, 159, 35-44.

Yeoh, S.F., Ibrahim, R., Oxley, J., Hamid, T.A., Syed Abd. Rashid, S.N (2016). Development of a valid measurement instrument to understand self-regulatory driving practices among older drivers in Malaysia. Accident Analysis & Prevention, 92, 1-8