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A socio-psychological model for analyzing climate change adaptation: A case study of Sri Lankan paddy farmers

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ABSTRACT

Farmers in developing countries are among the most vulnerable to climate change effects, particularly drought. However, little research has focused on the psychological mechanisms that facilitate or constrain agricultural adaptation behavior. Drawing on the protection motivation theory from health promotion research, we propose a risk, coping, and social appraisal (RCSA) model of adaptation decisions. To test the model, we assessed drought risk perceptions, efficacy beliefs, village identification, and perceived descriptive norms among a sample of 192 paddy farmers from five villages in the dry zone of Sri Lanka. Results revealed that the RCSA model was a better predictor of agricultural adaptation intention than a strictly demographic model. Efficacy beliefs were the strongest predictor of behavioral intentions, with descriptive norms also consistently relating to intentions. Drought risk perceptions related only to intention to adopt one of the behaviors, while village identification related only to a very communal behavior. The results have implications for agricultural extension officers, irrigation officers, and water management officials in their efforts to assist farmers in adapting to limited water resources.

1. Background

In the developed world, climate change mitigation (i.e., reduction of greenhouse gas emissions) has received much of the attention in the public discussion and in the academic literature. However, the effects of climate change are already being felt and are especially problematic in low latitude, less developed countries (Schneider et al., 2007), where heavy reliance on subsistence farming results in livelihoods closely tied to environmental changes. In these regions, farmers are faced with the need to adapt their agricultural practices to cope with climate change. A growing body of literature has identified that farmers in developing countries perceive that environmental conditions have changed, and are adopting alternative agricultural strategies to adapt to these changes (Bryan et al., 2009; Keshavarz et al., 2010; Mertz et al., 2009; Senaratne and Scarborough, 2011; Thomas et al., 2007).

There is a widely recognized need for additional programs and policies to facilitate new or further adaptations to climate and other environmental changes in developing countries (IPCC, 2007). An understanding of how best to educate, support, and encourage these behaviors among farmers may facilitate development of these programs and policies. Recent research has examined the factors that influence the uptake of agricultural adaptation actions, with much of the work focusing on demographic predictors, economic constraints, and climate forecasts (Below et al., 2012; Bryan et al., 2009; Deressa et al., 2009; Di Falco et al., 2011; Vogel and O'Brien, 2006; Ziervogel et al., 2006). However, little is known about the individual perceptions and community characteristics that influence climate change adaptation. As such, a deeper understanding of the psycho-social factors that underlie individual adaptation to climate change in developing countries is needed (American Psychological Association Task Force on the Interface between Psychology and Global Climate Change, 2009).

Climate change adaptation has generally been defined as an adjustment to existing practices to reduce impacts of current or future climate changes (Grothmann and Patt, 2005; Osbahr et al., 2010; Smit and Pilifosova, 2003). Agricultural adaptation involves changes to farm production practices such as altering the timing of planting, changing the type of seed planted, changing the type of

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crop planted, and changing the way irrigation is used (Smit and Skinner, 2002); as well as other non-farm activities that lessen climate change impacts on the family such as diversification of income and migration (Smit and Skinner, 2002; Thomas et al., 2007; Ziervogel et al., 2006). Although some have conceptualized adaptation to climate change as including capacity building actions such as information provision and farmer training programs (Adger et al., 2005), for the purpose of this analysis we focus our attention on the direct actions individuals take to reduce the risk of climate change, in line with the definition offered by Smit and Skinner (2002). In particular, we narrow our focus to on-farm adaptation actions, as these are among the most important in the agricultural adaptation realm (Howden et al., 2007). Specifically, the current paper focuses on changes to cultivation practices adopted by small scale Sri Lankan paddy farmers that may facilitate adaptation to climate change impacts, with a focus on drought impacts.

2. Socio-psychological model

Due to the multi-scalar aspect of climate change effects (Bryant et al., 2000; Cash et al., 2006), studies of adaptation have necessarily been multi-focal, with climate modelers, geographers, and economists weighing in on the issue. However, relatively little research has been conducted on the psychological variables that influence adoption of adaptation behaviors and more work is needed (American Psychological Association Task Force on the Interface between Psychology and Global Climate Change, 2009; Below et al., 2012). The psychological work in this area has drawn heavily on protection motivation theory (PMT) which was developed within the health promotion literature and has been shown to predict numerous health-related behaviors (Floyd et al., 2000; Milne et al., 2000; Rippetoe and Rogers, 1987; Rogers and Prentice-Dunn, 1997; Rogers, 1983).

According to PMT, people facing a potential threat make two appraisals (Rippetoe and Rogers, 1987; Rogers and Prentice-Dunn, 1997; Rogers, 1983). In the threat appraisal, people estimate the risk of the threat: the likelihood of the threat occurring and the severity should it occur. If the threat is deemed to be high risk, people engage in protection motivation (intent to protect themselves from the threat). In the coping appraisal, people evaluate the extent to which they can cope with the threat by assessing their capability of taking action (self-efficacy; Bandura, 2000), and the anticipated effectiveness of the action in reducing the threat (response efficacy; Bandura, 1977). If a person feels capable of coping with the threat, then they will intend to take protective action (in this case adopt adaptation behaviors). If a person feels incapable of coping with the threat, then maladaptive actions will be taken that reduce the risk (e.g., fear), without reducing the actual threat (Rippetoe and Rogers, 1987). Although generally conceived of and tested as a mediation model with independent influences of risk perceptions and efficacy beliefs on behavior (Floyd et al., 2000; Milne et al., 2000; Rippetoe and Rogers, 1987), the PMT model could also be viewed as a moderation model. In some of the original work on PMT, interaction effects between the threat appraisal and the coping appraisal are implied and have been tested under the assumption that among people who perceive a high threat, those with high efficacy will be more likely to adopt adaptive coping behavior, while those who are low in efficacy will be more likely to adapt maladaptive coping behaviors (Rippetoe and Rogers, 1987). Those who perceive a low threat may be unlikely to adopt adaptive coping behaviors, regardless of their level of efficacy.

Several researchers have theorized that the PMT could serve as a useful foundation for a psychological model of individual adaptation to climate change (American Psychological Association Task Force on the Interface between Psychology and Global Climate Change, 2009; Grothmann and Patt, 2005; Reser and Swim, 2011; c.f. Kroemker and Mosler, 2002 who propose a similar model). Applying this theory to agricultural adaptation, farmers who perceive that climate change will occur in the future and that the effects will be severe will rate climate change as a serious threat and will be more likely to intend to, and later take, protective action to adapt to climate change. If farmers feel capable of adopting a new behavior (e.g., planting a new seed variety) and believe that new behavior will be effective in adapting to climate change effects, they will be more likely to adopt that behavior.

Although the applications of PMT to climate change adaptation have been mostly theoretical, Grothmann and Patt (2005) interpreted the results of two case studies in relation to their extension of the PMT model. Using a sample of German residents, Grothmann and Patt (2005) found that their extended PMT model was more effective at predicting actions to prevent future flood losses than a strictly socio-economic model of adaptation, which included only demographic variables (Grothmann and Reusswig, 2006). Grothmann and Patt also conducted a qualitative test of the model among Zimbabwean farmers and found that perceived lack of adaptive capacity (self-efficacy) and response efficacy seemed to be associated with low levels of intention to adopt actions to adapt to drought.

Esham and Garforth (2013) extended this work to the study of farmers in the intermediary climate zone of Sri Lanka. In their study, risk perceptions and efficacy beliefs were important predictors of the total number of agricultural adaptation behaviors adopted. Interestingly, Esham and Garforth (2013) also included an item assessing "social networking," which was operationalized as how often the respondent discusses climate change and adaptation options with other farmers. Results showed that farmers who more often discussed climate change and adaptation options with others had adopted more adaptation behaviors themselves. This is one of the first findings to suggest that incorporating a social component into the PMT may be useful.

Grothman and Patt's (2005) and Esham and Garforth's (2013) results importantly show the potential for PMT-based models in predicting adaptation actions among farmers in developing countries. However, agricultural practices in many developing countries are social in nature and the current extensions of the PMT do not fully capture these dynamics. Esham and Garforth's (2013) study begins to touch on the importance of social networking and shows the potential for social considerations to play a larger role in PMT applications to agricultural adaptation. For example, in Sri Lanka, during times of extreme water scarcity, farmers have been known to practice *Bethma*, a traditional practice of communal cultivation where farmers whose fields share a field canal will band together and farm the fields closest to the head of the canal and leave fields downstream fallow (Thiruchelvam, 2005). The land at the head of the canal is temporarily redistributed among landowners so that each farmer can cultivate one small plot (Van der Mollen, 2001). Farmers share inputs and outputs in a predetermined fashion. Whether or not communal behaviors, such as Bethma, are practiced and the success of these behaviors may depend on the level of social cohesion and engagement among community members (Pretty, 2003; Thiruchelvam, 2005). Community members who do not get along with each other are less likely to work together effectively. Furthermore, even individual adaptation decisions that impact the availability of irrigation water have collective implications for all who draw on that water source, further underscoring the collective nature of agriculture. Water is commonly viewed as a common pool resource, which is subject to conflicts over individual vs. collective interests and present-day vs. future needs (Joireman et al., 2004; Meinzen-Dick and Bakker, 1999; Ostrom, 2009). Research on