

Population Mobility and Monsoon Anomalies in Pakistan

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Widespread migration attributed to natural disasters has received substantial attention in policy circles—particularly due to the substantive relief provided by international governments and organizations for emergency resources and shelter. Recent quantitative evidence demonstrates individual, permanent migration patterns are significantly affected by natural disasters (Halliday, 2006; Gray, 2009 ; Dillon, Mueller, and Salau, 2011; Clark and Mueller, 2012a, b). While previous work has quantified relationships between individual migration and climate, the conventional narrative surrounding the notion of environmental refugees concerns the displacement of entire households. To our knowledge there are no quantitative studies which differentiate the impacts of natural disasters on the mobility of individuals versus entire households (lending credence to displacement).

Our longitudinal survey provides a unique opportunity to understand how extant sedentary households use the migration of their members to manage risk, and to learn about the degree of environmental displacement in existence. It does so by covering detailed mobility patterns of individuals within households *and* of entire households in Pakistan over the past 21 years. This is a longer time period than previous studies have examined. Pakistan is also a key region that is perceived to be highly vulnerable to climate change and involuntary displacement.

Monsoon conditions can have severe implications on agricultural productivity and are the central focus of a broad range of Asian studies (Rosenzweig and Binswanger, 1993; Jayachandran, 2006). In 2010 alone, floods affected 20 million people, destroying an estimated crop value of 1 billion US dollars (IFRC, 2011). A reported 14 million people relocated elsewhere; approximately 200,000 moved to internal displacement camps funded by international donors (Walsh, 2011). Rainfall shortages during the monsoon also dampen productivity which can affect labor allocation decisions (Rosenzweig and Stark, 1989; Kochar, 1999; Rose, 2001). Effective application of inputs (such as fertilizer) can be compromised by miscalculations in precipitation conditions. A delayed monsoon affects the time of planting, which can reduce the photosynthetic period (or daily light exposure required by the plant). Furthermore, delaying the monsoon can affect multiple crop cycles throughout the season. In Pakistan, repeated planting of cotton then wheat on a given plot without respite is common. Finally, even farmers with irrigation face productivity issues associated with the salinity content of water from low water tables.

We use a unique longitudinal survey, the Pakistan Rural Household Survey (PRHS), and supplementary tracking studies conducted in 2001 and 2012 to monitor the permanent movement of individual household members and entire households over a twenty-one year period (1991-2012). The PRHS was a panel survey collected by the International Food Policy Research Institute (IFPRI) from 1986-1991. We use the final, 1991 survey as a baseline of individuals and

households for whom we monitor movement over 21 years. In 2001, the Pakistan Institute of Development Economics conducted a tracking survey in which they collected information on the timing of move, destination, and motivation for departure for each original member of the PRHS 1991 households. IFPRI, in collaboration with Innovative Development Strategies (a survey firm based in Pakistan) followed suit by conducting another tracking study in 2012. We use the tracking information to develop a panel of migration patterns at the individual level from 726 households originating from approximately 50 villages in the Punjab, Sindh, and NWFP provinces.

By collecting the GPS coordinates of each original household from the 1991 PRHS, we are also able to link the individual migration panel to weather station data collected by the Pakistan Metrological Association. We use precipitation data collected from the nearest weather station to each household to create variables related to the monsoon: monsoon onset and the total rainfall accumulated during the monsoon. Only weather stations that consistently measured precipitation during the monsoon months over the course of 1990 and 2012 were included. We use these variables to understand how advancements or delays in monsoon timing and deviations from average rainfall over the monsoon affect individual and household permanent migration decisions.

We apply several models to estimate the relationship between migration patterns and monsoon anomalies. First, we employ discrete-time event history models which exploit the person-year dataset to measure individual and household responsiveness to monsoons in a given year, controlling for baseline household wealth and demographic characteristics. We estimate two specifications for this model: a logit and a linear probability model (LPM). Two advantages of the LPM are that it relaxes distributional assumptions on the error term and allows for the identification of a household fixed effect. As a robustness check, we will check how sensitive our results are to the omission of key household variables by reporting the results from a household fixed effect model. One disadvantage in using the LPM is that predicted probabilities can fall outside the unit interval (Wooldridge, 2002). To address this concern, we will test the predictive power of the LPM in our own context as a form of validation. Second, we estimate a multinomial logit model to differentiate the impacts of monsoon anomalies on individual and household moves, local and long-distance moves, motivations for migration, and gender-differentiated migration. This methodology has been applied in recent work testing the responsiveness of mobility to climate in Ethiopia (Clark and Mueller, 2012a) and Bangladesh (Clark and Mueller 2012b).

The findings from this study will further build towards a consensus of the relationship between permanent migration and natural disasters. Furthermore, the study adds a novel contribution. By differentiating the relationships between natural disasters, the movement of individual household members, and entire household displacement, we are well positioned to provide evidence that challenges or supports the conventional narrative.

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