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Farmer field school and farmer knowledge acquisition in rice production: Experimental evaluation in China

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ABSTRACT

We collaborate with the Chinese Ministry of Agriculture (MOA) and conduct a randomized controlled trial (RCT) to examine the effects of farmer field schools (FFS) on the knowledge acquisition by farmers in rice production in Anhui, China. The intensification of China's agricultural production has raised widespread environmental concerns. Lack of advisory services to increase awareness and knowledge has been found to be the primary constraint to improving farming and environmental outcomes. However, training millions of small farmers is a significant challenge. To impart the knowledge of sustainable and low-carbon farm management, the MOA recently piloted a FFS program through its public extension system. A participatory approach to rural advisory services, FFS was initiated by the Food and Agriculture Organization during the late 1980s in Asia, and at present is being practiced in more than 90 developing countries. However, the effectiveness of the FFS program has not been conclusively demonstrated, and the results of previous impact evaluations have varied greatly according to evaluation methods. A major drawback of previous studies has been selective participation in the program, leading to biased estimates of program effects. We use an RCT to overcome these problems. The results are heterogeneous: FFS effectively improved farmers' knowledge of pest management and agro-environment; however, we find no effects on nutrient management and cultivation knowledge. Furthermore, the effects were smaller for female and old participants. Being a "best-design" approach of agricultural extension initiated by FAO, FFS faces challenges to be "best-fit" in China, where urbanization and agricultural transformation are emerging.

1. Introduction

The intensification of China's agricultural production has raised concerns about environmental stress. For example, previous studies have showed that Chinese farmers spray excessive amounts of pesticides, which is detrimental to their health (Pemsl et al., 2005). The high level of nitrogen fertilizer use has resulted in serious environmental stress by increasing greenhouse gas emissions and polluting ground and surface water through nitrogen leaching (Ju et al., 2009; Zhu and Chen, 2002). In 2010, nitrogen-fertilizer-related emissions constituted about seven percent of greenhouse gas (GHG) emissions from the entire Chinese economy and exceeded several-fold soil carbon gain resulting from N fertilizer use (Zhang et al., 2013). Recent studies reveal that groundwater abstraction also represents an important source of agricultural GHG emissions in China (Wang et al., 2012).

A lack of knowledge advisory services was found to be one of the primary reasons for unsustainable farming practices in China's agricultural production. Chinese farmers rely on their experience from the Green Revolution (1960–1980), which suggests that high volume use of agro-chemicals always leads to higher crop yields (Jia et al., 2013). Meanwhile, the accountability of delivering public extension services is low due to lack of funding since the late 1980s (Zhi et al., 2007). Many extension staff in county agricultural bureaus were taken off the government payroll and reassigned to township governments. Although Chinese government started a number of new initiatives in the mid-2000s to promote a demand-driven public agricultural extension system, the majority of extension staff are still overwhelmed by non-extension work (Hu et al., 2009).

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Agricultural extension programs in many developing countries are evolving and transforming towards participatory approaches that respond to farmers' heterogeneous and site-specific needs. Since the 1970s, the design of agricultural extension programs in developing countries has shifted from desk-bound bureaucracy to field-based agents who focused mainly on technology diffusion, such as Training and Visiting (T&V) (Picciotto and Anderson, 1997). T&V extension agents meet with a small group of contact farmers who are expected to disseminate information to the members of their communities and convey feedback to the agents, thus creating an interactive mechanism absent in the prior system (Birkhaeuser et al., 1991). However, given the prohibitive cost of establishing these programs and farmers' diversified needs, T&V was found unsuccessful after three decades of support from international donors such as the World Bank (Picciotto and Anderson, 1997).

Since the late 1980s, a number of development agencies such as Food and Agriculture Organizations (FAO) have promoted farmer field schools (FFS) as a more effective approach to transfer knowledge to farmers. FFS was first started in Indonesia in 1989 to disseminate Integrated Production and Pest Management (IPM) (Braun et al., 2006; CIP-UPWARD, 2003; Pontius et al., 2002). An FFS is a group of farmers (roughly 20–25) who meet periodically in a designated field throughout the major part of crop cycle. The farmers usually work in smaller subgroups and devote considerable time to agro-ecosystem analysis, in which they are encouraged to make observations of important processes and relationships. The FFS facilitator (typically an extension agent) encourages farmers to ask questions and seek to answers rather than lecturing or giving recommendations. Through group interactions, FFS participants sharpen their decision-making abilities and are empowered by learning leadership, communication, and management skills. By 2010, there were a multitude of FFS initiatives in more than 90 developing countries (Friis-Hansen and Duveskog, 2012).

Results of previous impact evaluations have varied greatly. Some studies show that FFS participants attained higher knowledge scores and exhibited better adoption of sustainable farm practices relative to a group of nonparticipants (Bunyatta et al., 2006; Godtland et al., 2004; Lund et al., 2010; Siddiqui et al., 2012). Other studies find little evidence of impacts on these outcomes (Feder et al., 2004a,b; Tripp et al., 2005).

A major drawback of most previous studies is that they did not properly control for potential differences between FFS participants and farmers in the comparison group. The observed difference could arise from the nonrandom geographic placement of the program or from the voluntary nature of participants in FFS. For instance, FFS villages were often purposively selected for their relative advantages in road infrastructure or due to history of pest outbreaks or reported problems (Lund et al., 2010; Siddiqui et al., 2012). In some settings, partly because of limited budgets a concentrated mass of farmers were selectively assigned to FFS training for high visibility and performance achieved by administrative units (Witt et al., 2008).

In studies that suggest farmers acquire knowledge through FFS participation, evidence on the heterogeneity of effects is often lacking; we do not know which groups of participants—such as gender groups or farmers who have secondary employment—are more responsive to the participatory approaches of FFS. This is important and relevant to Chinese agriculture because of the emerging role of off-farm employment and other opportunities for rural labor. During the 1980s and 1990s, approximately 200 million people in the rural labor force found jobs off farm, with the annual increase amounting to more than six million farmers (NBS, 2010). Estimates of the rise in the share of the rural labor force employed in off-farm sectors range from 35 percent to 40 percent during that time. By the mid-2000s, of China's more than 500 million rural laborers, 265 million had off-farm employment (Zhang et al., 2008). China is meeting the "Lewis turning point" in the transformation of its labor force (Cai and Du, 2011; Knight et al., 2011). Since FFS is a participatory program whose benefits are fully realized only if farmers are involved in training throughout the season, off-farm employment could affect program effectiveness. Moreover, identifying the groups of farmers who are more responsive to FFS can support future program targeting and is crucial for China if it wants FFS be an effective tool for agricultural and ecosystem advisory services.

Earlier impact assessments of FFS on farmers' knowledge acquisition have focused on one or two pieces of technology employed in specific settings. For example, most impact studies have concentrated on measuring knowledge impact on pest management (Godtland et al., 2004; Lund et al., 2010; Yang et al., 2008) and soil nutrient management (Bunyatta et al., 2006; Siddiqui et al., 2012; Tripp et al., 2005). Some studies examined the impact of FFS on farmers' attitude towards agro-ecosystem (Moumeni-Helali and Ahmadpour, 2013; Witt et al., 2008) and awareness of health hazards that are related to inappropriate farm practices (Lund et al., 2010). However, yield-enhancing farm management includes sophisticated and integrated technologies, such as soil formation, nutrient management, pest management, and irrigation, which are complementary to each other. To be a sustainable and make agricultural production low-carbon, farmers should also understand the potential environmental pollution associated with inappropriate farm practices. Scientists and policy makers need to understand farmers' potentially heterogeneous response to different parts of an integrated package of sustainable farm management delivered by FFS. This will aid curricular prescriptions and revisions, which will help ensure future FSS effectively disseminate information.

To ensure food security and sustainable agricultural production, China's Ministry of Agriculture (MOA) has tried to improve its agricultural extension, including initiating a pilot FFS program between 2010 and 2012. China's public agricultural extension is a top-down system. This system played an important role in facilitating adoption of new technologies by farmers in the 1970s and 1980s (Huang et al., 2009). However, it also faced increasing difficulty in meeting farmers' demand for technology starting in the early 1990s when China moved to a more market oriented economy. In response to these challenges, several institutional and management reforms have been implemented since the late 1990s (Hu et al., 2012; Huang et al., 2009). One of these reforms has been aimed at providing better services to farmers and stimulating technology adoption by separating commercial activities from public extension services. This increased the incentives and responsibilities of the extension staff, shifted personnel management from the township level to the county level, and increased budgetary support (Huang and Rozelle, 2014). In addition to the above efforts, the pilot FFS program has been implemented in more than ten provinces since 2010.

Recognizing the advantages of a rigorous evaluation that an RCT allows, we were invited by MOA to evaluate an FFS pilot program in rice in Anhui province in 2011. This provides a unique opportunity to study the effects of China's FFS program. Working with the MOA, we randomly assigned villages to FFS treatment and control groups and, within treatment villages, randomly assigned individual farmers to participate to mitigate potential selection biases that have affected nearly all the FFS evaluations to date.

The objective of this study is to examine the effects of FFS on farmers' knowledge acquisition in China's rice production. Specifically, we aim to answer two questions. First, does FFS successfully affect Chinese farmers' knowledge acquisition and identify the type of farmer who is more responsive to the training?

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