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Evaluation of Value-Added Agricultural Advisory Services

Case Study of Agriclinics in Southern India

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ABSTRACT

Introduction of private enterprises to deliver agricultural advisory services is seen as a strategy to increase the coverage and effectiveness of the pluralistic extension system in developing countries. The Indian national program of agriclinics and agribusiness centers, started in 2002, aims to provide farmers with a reliable alternative to the private input dealer by subsidizing technically trained agricultural graduates to establish their own agricultural input shops and agriclinic laboratories. In 2008, Tamil Nadu state began its own version of the program, called Agriclinics cum Mini Soil Testing Laboratories, which provides subsidized funding to establish soil testing laboratories by primary agricultural cooperative banks (PACBs) or independent agricultural graduates. This paper evaluates farmers' usage of the program using data collected from a survey conducted in November 2010 of 393 households across 11 agriclinics in 2 districts of Tamil Nadu. The agriclinics fill an important need of farmers by providing agricultural inputs and are becoming a key information source for farmers as well. However, farmers' awareness of and demand for the soil testing service is low. Given that the agriclinic program is a private form of advisory service, its success depends, among other things, on farmers' willingness to pay for soil testing services. Farmers who have tested their soil and followed the advice of the soil testing service provider are willing to pay more for the service. The paper also explores the extent to which certain extension services can or should be privatized in India. Results indicate that farmers who are willing to pay more for soil testing are those who do not have formal any schooling, are not members of farmer-based organizations (FBOs), have larger land holdings, and live further from the agriclinic. Farmers who use the soil testing service at agriclinics are likely to be members of FBOs, to use extension services, and not belong to the population groups scheduled caste/tribe. The results also show that the agriclinics are an important knowledge intermediary for farmers. But greater awareness of the potential benefits of soil testing and of agriclinics themselves within farming communities is required.

Keywords: public–private partnership, privatization, agricultural extension and advisory services, soil testing, agriclinic, willingness to pay

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ABBREVIATIONS AND ACRONYMS

ACABC	agriclinic and agribusiness centers
ATMA	Agricultural Technology Management Agency
DAESI	diploma in agricultural extension services for input dealers
FBO	farmer-based organization
ICAR	Indian Council of Agricultural Research
INR	Indian rupees
KVK	Krishi Vigyan Kendra (farm science center)
MANAGE	National Institute of Agriculture Extension Management
NABARD	National Bank for Agriculture and Rural Development
NGO	nongovernmental organization
NSSO	National Sample Survey Organization
NTI	nodal training institute
PACB	primary agricultural cooperative bank
RKVY	Rashtriya Krishi Vikas Yojana (National Agriculture Development Programme)
SAU	state agricultural university
SAMETI	state agricultural management and extension training institute
SFAC	Small Farmers Agribusiness Consortium
TANFED	Tamil Nadu Cooperative Marketing Federation Limited
TNAU	Tamil Nadu Agricultural University
WTP	willingness to pay

1. INTRODUCTION

The agricultural sector is knowledge intensive. To improve and sustain farm productivity, farmers require information on new technologies, best practices, inputs, and postharvest information related to marketing and prices. The traditional information broker between the farmer and some of this information has been the public-sector agricultural extension agent. But over the past few decades public-sector extension has received much criticism due to limited reach and relevance, and high cost of operation (Feder et al. 2001, Anderson and Feder 2004). With the changing focus of agricultural extension and with the commercialization of agricultural technology and research, the private sector is now playing a larger role in advisory services (Swanson 2008; Rivera and Alex 2004). Privatization of extension services is a popular agricultural extension reform option in many countries, including developed countries such as the Netherlands and New Zealand. This is partly because privatization addresses the issues of fiscal sustainability and poor accountability faced by public-sector agricultural extension (Feder et al. 2001). Private extension provides targeted information as required by the client, the farmer, thus improving the client orientation of advisory services.

Yet several questions remain before private approaches to extension can be scaled up and scaled out in developing countries. Is there adequate demand from farmers for private extension to be a viable alternative to public-sector extension? What are the characteristics of farmers who demand private extension services? How much are they willing to pay for such services? What types of services are more in demand than others? Which extension services does the private sector provide and which does it not provide? In private extension, what is the moral hazard in linking advisory services with the sale of commodities or inputs? How effective can the subsidies given to the private sector in developing a culture of private extension be? In this paper we attempt to answer some of these questions using a case study of the agriclinics program in two districts of Tamil Nadu in southern India.

As the questions highlight, a number of issues need to be considered when introducing private extension and advisory approaches in a developing country. First, the information provided through privatized extension and advisory services depends on the nature of that information, where higher excludability and rivalry increase the chance for the private sector to be involved. For example, information related to common-good issues, like the environment or natural resource management, tends not to be addressed through the private sector. Second, by privatizing extension, governments recognize information as a commodity. But this focus may neglect the value of extension for educational, human, and social capital development, like formation of farmer groups (Bloome 1993). Third, a private extension model may have limited impact in resource-poor areas, where farmers are unable and may be less willing to pay for information (Sulaiman and Sadamate 2000). So while the private-sector presence in extension and advisory services may be useful for large-scale and commercial farmers, for small-scale and marginal farmers the private sector may even be detrimental and unlikely to serve their interests (Swanson and Rajalahti 2010).

While the Indian government is increasingly considering the role of the private sector in agricultural extension, the 2003 survey of the National Sample Survey Organization (NSSO) showed that the 282,000[2] private input dealers already play a large role in the provision of information to farmers (NSSO 2005). The National Commission for Farmers noted that "today the farmer depends on the input dealer who sells seeds, pesticides and fertilizers for technical advice. In many *suicide hot spot*[1] areas, the input dealer is also the money lender, the scientist, agricultural expert, counselor and buyer, all rolled into one" (2006, 23). Despite reliance on the private input dealer for information, it is difficult for small and marginal landholder farmers to hold private input dealers accountable for errors. Also private input dealers tend not to be technically competent (Swanson 2008). It is widely held that private input dealers in India do not have the technical capacity or training to support farmers appropriately—so much so that in

[1] *Suicide hot spots* are areas in the states of Andhra Pradesh and Maharashtra, among others, where large numbers of farmers have committed suicide in the last two decades due to failed crops and increasing debt.

2003 the National Institute of Agricultural Extension Management (MANAGE) initiated a diploma in agricultural extension services for input dealers, known as DAESI.[2]

While training input dealers may improve the information they give farmers, the agriclinic and agribusiness centers (ACABC) program intends to develop another source of reliable information. The ACABC program, launched in 2002, is a public–private partnership in agricultural extension and advisory services. The ACABC program aims to supplement the pubic extension system, increase the availability of input supply, provide reliable advice and services to farmers outside commercial interests, and provide employment to agriculture graduates (India, Planning Commission 2006). The role of an agriclinic is to provide expert services and advice to farmers on such matters as cropping practices, technology, and crop protection from pests and diseases; an agribusiness center would provide inputs for sale, farm equipment for hire, and other services. The central government provides 25 percent of the cost to start up an agriclinic by a qualified individual (one who has a degree or diploma in agriculture).

In 2008 Tamil Nadu state initiated a program whereby agriclinics were established with soil testing laboratories attached to primary agricultural cooperative banks (PACBs) and also independently. The Tamil Nadu Agriclinic cum Mini Soil Testing Laboratories program was funded by the National Agriculture Development Programme, also known as Rashtriya Krishi Vigyan Yojana (RKVY). Arrangements have now been made for the agriclinic operators to receive training under ACABC. The Tamil Nadu agriclinics provide a number of services, including soil testing, which may influence knowledgeable application of inputs like fertilizer, result in increased productivity, and reduce input costs. Additionally, agricultural inputs like fertilizer and seed are sold through the agriclinics. The operator realizes income from soil testing and from the sale of inputs. Finally, advisory services, like pest and disease management advice, are also offered to farmers either at cost or free of charge. While policymakers are scouting for various models of public–private partnerships and are willing to invest in nurturing the role of the private extension culture, they do not have adequate information to support or revise their decisions. There are several descriptive studies addressing agriclinics, but very limited empirical information exists on their benefits to the farmers. This paper aims to fill this gap. In addition, lessons learned from implementing public–private extension models such as agriclinics could provide valuable insights for their replication elsewhere in the developing world.

This paper examines the use of agriclinics by farmers in two districts of Tamil Nadu state in southern India, in a private extension approach that is linked to the purchase of inputs. The main objective of the study is to examine farmers' use of and benefits from agriclinics, with specific reference to the soil testing service. The paper compares PACB agriclinics with independent agriclinics; and the farmers who tested their soil and those that did not test their soil at an agriclinic, by examining their production cost and outcomes, perception, and value of the agriclinic service. The paper analyzes the effect of soil testing on rice production for the 2009 crop season and estimates farmers' willingness to pay (WTP) for the soil testing service using a contingent valuation technique. It also compares the input purchases and use of other advisory services from agriclinics of farmers who used the soil testing service with the purchases and advisory service use of farmers who did not test their soil. Characteristics of those farmers who tested their soil are determined using a logistic regression.

This paper is organized as follows: The next section describes the background and current literature related to the ACABC program in India and the Agriclinics cum Mini Soil Testing Laboratories program in Tamil Nadu. Section 3 explains the methodology used in this study and describes the study area and the data. Section 4 presents the results, including use of soil testing, WTP for soil testing, input purchases, and extension use at the agriclinics. Section 5 discusses policy implications from the results of the study. Section 6 concludes with some additional remarks.

[2] See www.manage.gov.in/daesi/.

2. BACKGROUND TO THE STUDY

In India, agricultural extension and advisory services are pluralistic, involving the public, private, and civil society sectors. However, policy actions continue to focus mainly on the public-sector extension system. The Indian 10th and 11th five-year plans (2002–2007 and 2007–2012, respectively) stress the need to strengthen agricultural extension as a key to reducing the yield gap in farmers' fields (India, Planning Commission 2001; India, Planning Commission 2006). In the last decade, a number of reforms have been introduced to improve the performance of public-sector extension. These include the Support to State Extension Programs for Extension Reform program, which is institutionalized through the Agricultural Technology Management Agency (ATMA); the mass media program, which focuses on public television and radio to disseminate agricultural information; and the Kisan Call Centre program, which provides a toll-free number for farmers to call and speak to experts. ACABC is also a national program but is a unique initiative of the central government.

While the other programs support existing public institutions, ACABC subsidizes private enterprises. But international experiences of extension privatization show that incentives are needed for extension provision to be responsive to farmers' needs, well-trained personnel who will provide quality services, and public-sector investment in education and training (Chapman and Tripp 2003). To be successful, ultimately farmer demand is needed. This section of the paper reviews the existing literature on the guidelines and impact of the national ACABC program and of the state-level program as currently operating in Tamil Nadu.

National ACABC Program Operation

The national level ACABC program aims to provide agricultural extension and advisory services to farmers at the village level through technically trained agricultural graduates, known as *agripreneurs*. The ACABC program evolved from the perceived need of farmers for locally available, reliable, effective, and knowledgeable third-party advice (India, Planning Commission 2006). It is in this capacity that the agriclinics and agribusiness centers aim to play an important role. Several agencies are involved in the implementation of the program, including the Ministry of Agriculture, the Small Farmers Agribusiness Consortium (SFAC), MANAGE, and the National Bank for Agriculture and Rural Development (NABARD).

The role of the agriclinics is to provide expert services and advice to farmers, while agribusiness centers attached to them would sell inputs and provide farm equipment for hire. There are about 20 types of ventures eligible to be established under the program, including soil, water quality, and inputs testing laboratories; plant protection service centers; maintenance, repair, and custom hiring of agricultural equipment; extension consultancy services; postharvest management centers; and vermiculture units. As of July 26, 2011, about 9,257 ACABCs had been established nationwide (Agriclinics and Agribusiness Centers 2011). Across the country, Uttar Pradesh state has the highest number of ACABCs while the northeastern states have been less successful in establishing them (see Figure 2.1). In order to establish an agriclinic or agribusiness center, each agripreneur candidate must complete a two-month free residential training course at an identified nodal training institute (NTI). As of July, 26, 2011, about 25,494 people had completed the training. The NTIs include state agricultural universities (SAUs), Indian Council of Agricultural Research (ICAR) organizations, nongovernmental organizations (NGOs), agribusiness companies, state agricultural management and extension training institutes (SAMETIs), and other state and national institutes (Chandra Shekara and Kanaka Durga 2007). One year of posttraining (hand-holding) support is provided by the NTIs to the agripreneur to establish the agriventure (agriclinic, agribusiness center, or combined venture), with a startup loan of 1,000,000 Indian rupees (INR, approximately US$22,134[3]) for individual projects and up to INR 5,000,000 (about $110,668) for group projects. The candidates obtain these loans from any nationalized bank, regional rural bank, or

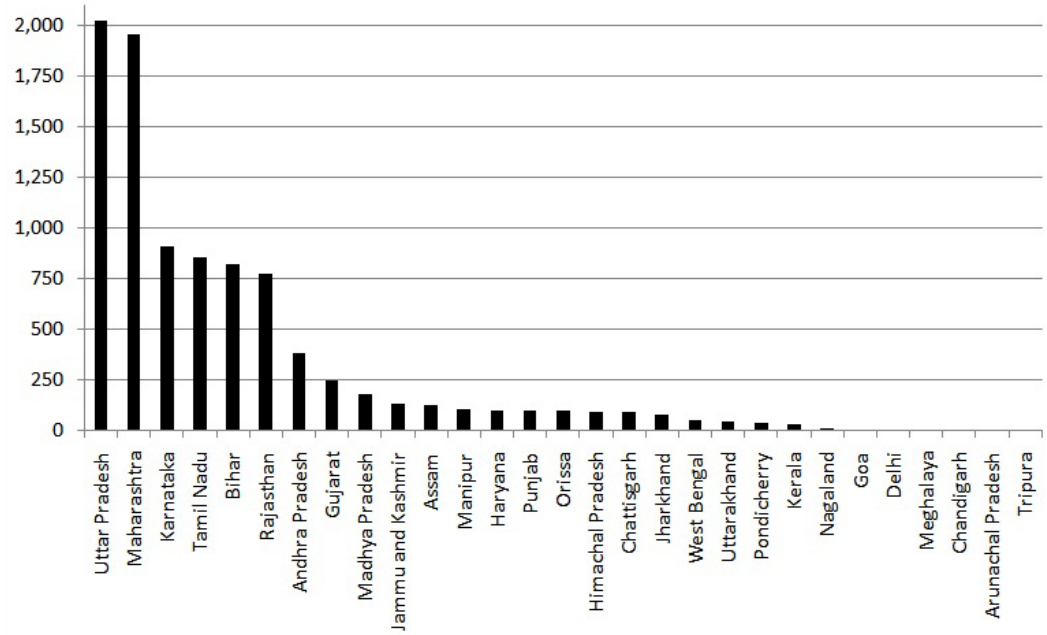
[3] All dollar amounts are in US dollars.

cooperative bank, or they can finance the enterprise themselves (Chandra Shekara and Kanaka Durga 2007).

Despite the ambitions of the program, the Working Group on Agricultural Extension (2007) highlighted some constraints to the program at the end of the Indian 10th five-year plan. There was lack of awareness about the program and lack of cooperation from commercial banks in promoting agriventures. Poor-quality training was identified in some of the training institutes, coupled with poor hand-holding support. This was exacerbated by the absence of dedicated nodal officers at the NTI level for coordinating the program and inadequate funds for training and hand-holding activities. Also the credit package for the agripreneurs for starting agriventures was considered unattractive. In addition there were complicated procedures for obtaining licenses for the sale of inputs coupled with absence of agribusiness companies in the initiative.

In 2010, the ACABC program was revised to address some of these issues. The revisions to the program have broadened the eligibility of people who can apply for training in addition to offering increased subsidies. Eligible people for the course now include graduates or diploma holders in agriculture or allied subjects degree/ diploma holders, biological science graduates with post graduation in agriculture or allied subjects; degree, diploma or post graduate holders in areas with more than 60 percent of course content in agriculture and allied subjects; and those who have taken agriculture-related courses in class 12[4] with at least 55 percent marks. Other public-extension programs—including Krishi Vigyan Kendras (KVK, or farm science centers), the district-level ATMA, and Panchayati Raj (decentralized local government) institutions—will provide surprise or periodic visits to ACABCs (Gupta 2010). Training subsidies provided to each NTI have also been revised, with an additional 10 percent per trainee for the northeast and hill states of Jammu and Kashmir, Uttarakhand, and Himachal Pradesh. Incentives are provided to the NTI if the trained agripreneur establishes a venture. Above a 50 percent success rate, INR 2,000 (about $44.30) is given to the NTI for each additional venture established.

Figure 2.1—Number of ACABC ventures across India by state, as of July 26, 2011



Source: Agriclinics and Agribusiness Centers 2011.

[4] Equivalent to 12th grade in the United States.

Tamil Nadu State Agriclinics cum Mini Soil Testing Laboratories Program

Starting in 2007–2008, the state of Tamil Nadu has implemented an adapted model of the ACABC program, funded by RKVY (Tamil Nadu, Agriculture Department 2008b). Tamil Nadu promotes a program titled Agriclinics cum Mini Soil Testing Laboratories across the state. Each agriclinic is set up at a cost of INR 600,000 (approximately $13,162), with an INR 300,000 (about $6,581) subsidy. The program was initiated by the Tamil Nadu Agricultural University (TNAU), which recognized declining soil organic matter and imbalanced nutrients in soils across the state (Tamil Nadu, Agriculture Department 2008a). The 2007–2008 plans were for establishing agriclinics in an initial 224 blocks (a block is an administrative unit below the district level). In 2008 the plan extended to the remaining 161 blocks of Tamil Nadu. These agriclinics test the soil pH, electrical conductivity, soil nutrients, and irrigation water quality. Soil health cards are given with recommendations on nutrient management (Tamil Nadu, Agriculture Department 2008a). The cost for each soil and water sample analysis is INR 50 (about $1.10). The agriclinic may also give advice on crop selection, agricultural inputs, best farming practices, value addition, marketing, crop insurance, and credit access, and it may also facilitate custom hiring of farm machinery (Tamil Nadu, Agriculture Department 2008b).

Eligible participants in the Tamil Nadu agriclinic program include not only graduates in agriculture but also retired technical officers from the state or central department of agriculture; retired scientists of SAUs and ICAR institutions; diploma holders in agriculture, horticulture, and agricultural engineering; and PACBs, which are found in each block of the state (Tamil Nadu, Agriculture Department 2008b). The state government aims to convert the PACBs into integrated service centers where credit, extension, and inputs can be accessed. As such, 150 selected PACBs will have agriclinics attached (Tamil Nadu, Department of Cooperation 2009).

Evaluation of the ACABC Program

A few studies have examined the national ACABC program, including an independent midterm evaluation of the national ACABC program's qualitative impacts (Global AgriSystem 2008), based on interviews with 10 farmers who used services from each of 200 agriclinics across 12 states. On average, agriclinics serve around 30 villages each, with an average of 19 farmers per village. But these numbers vary greatly between states; for example, in Gujarat agriclinics serve 75 farmers per village, while in Maharashtra they serve 47 farmers per village. According to the majority of farmers surveyed, the agriclinics gave benefits of increased productivity and optimum usage of farm inputs and plant protection. Most farmers were "very satisfied" with the services provided (Global AgriSystem 2008). Nearly all ventures were self-financed (70 percent) with only 30 percent having taken loans from banks. Of the graduates who undertook the two-month training, 47 percent did not start a venture (Global AgriSystem 2008). There were complaints of high interest rates on loans, bankers' resistance to financing ventures, and many banks did not know about the scheme (Karjagi et al. 2009). Another problem was lack of support from the NTIs. The NTIs in turn highlighted lack of funds to support agripreneurs in the hand-holding phase (post-training) as the reason they were unable to fully support the agripreneurs in setting up their businesses. Competition from established private input dealers was a major problem, followed by farmers' asking for products on credit with a low repayment rate (Karjagi et al. 2009).

An impact study from MANAGE surveyed 11 ACABCs in Varanasi district in the state of Uttar Pradesh and Sangli district in Maharashtra state (Chandra Shekara and Kanaka Durga 2007). Farmers who utilized the ACABC services were interviewed from each venture. Each ACABC provided advice and a number of services to farmers, including input supply, soil testing, and diagnosis of pests and diseases. In Varanasi, farmers received the advisory services for free, while in Sangli district these services were paid for. Around one-third of farmers utilized services such as soil testing, diagnosis of pests and diseases, and demonstration of the latest techniques. Agripreneurs "frequently visited" farmers "as and when required." Of the 11 ACABCs, 91 percent provided soil inputs, more than one-third provided soil testing services and free and paid advisory services and one-fourth organized demonstrations on the latest technology. As a result of using the agriclinics, 10 percent of participating

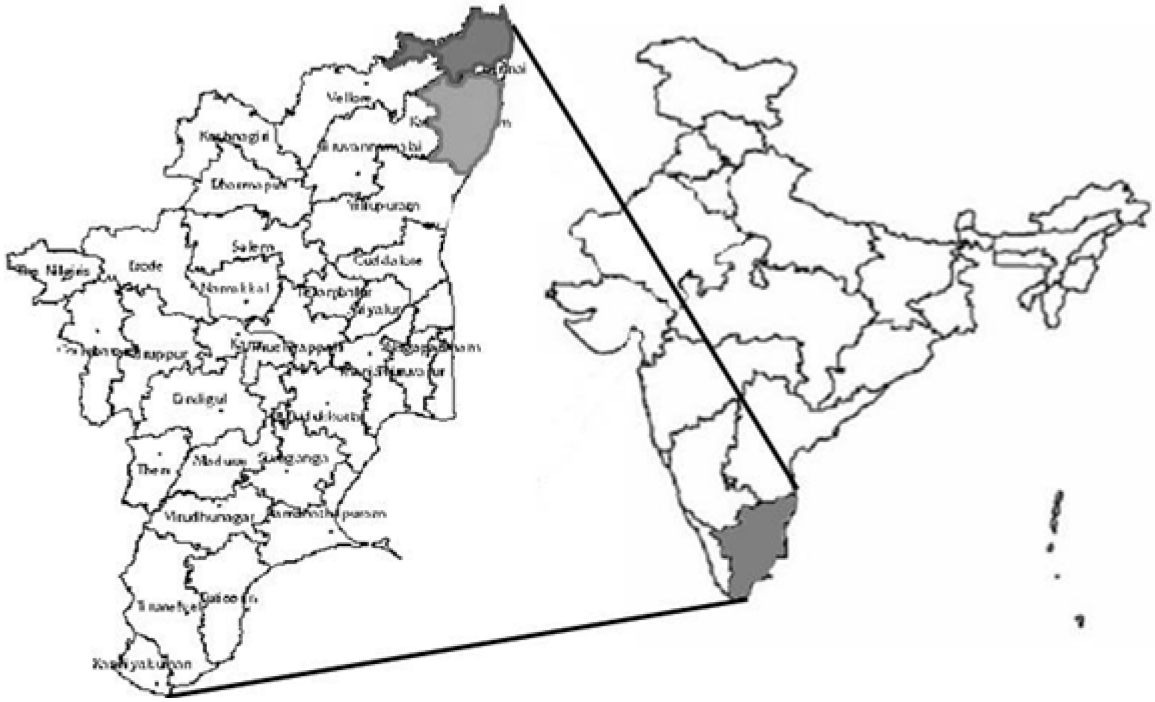
farmers in Varanasi changed their cropping patterns, while 37 percent in Sangli did so. The majority of participating farmers in Sangli said their sugarcane yields had increased by 13 percent, while in Varanasi the majority reported that wheat yields had increased by 22 percent. About 65 percent of farmers said their income had increased due to utilizing services from the ACABC. The survey also found that farmers were more likely to adopt improved technologies after receiving services from the ACABC. In terms of agripreneurs' business operation, most revenue was generated through the sale of inputs. In Varanasi all agripreneurs were financed by banks, while in Sangli 66 percent of agripreneurs were financed by banks and 34 percent were self-financed. On average, the study found that the agripreneur earned an average monthly income of INR 7,950 (about $176) and covered 38 villages and 3,013 farmers.

These studies show that the ACABC program provides an additional avenue through which farmers can purchase inputs and receive advice from a technically trained source. The advantage of the ACABC program is that it takes a problem-solving approach to farmers' needs, which is not as strong in the public-sector extension system. As a public–private extension model, accountability to farmers is hopefully greater. However, farmers are required to pay for services such as soil testing and, in some instances, advice, so the value of the service must be relevant for farmers to be willing to pay. These studies did not survey those farmers, who were in the same geographic service area as the ACABC, but were not accessing the agriclinic services. It is still uncertain the characteristics of farmers who were participating. The midterm evaluation provided no indication of the characteristics of those farmers who accessed services. The MANAGE study found that irrigated (81 percent) rather than dryland farmers are using ACABC services but did not look into access by landholding size or gender. Therefore, it is not known what population of farmers is reached by and likely to use services at ACABCs. This is knowledge that would help planners target programs to farmers who are not currently being served. While the midterm evaluation and the MANAGE study reported that farmers said they had increase in income from using the agriclinics, the increase was not quantified. Further exploration of the value of ACABC to farmers and their impact at the farm level is needed. Due to the recent implementation of the Tamil Nadu Agriclinics cum Mini Soil Testing Laboratories program, hereafter referred to as agriclinics, the authors believe this is a first study to examine the functioning of these agriclinics as established in this state.

3. Data and Methodology

Data for the study were obtained from a household survey conducted by the International Food Policy Research Institute (IFPRI) in November 2010. Tamil Nadu was chosen as the focus of the study because of the unique implementation model in operation, whereby the state has utilized national funds to introduce a program titled Agriclinics cum Mini Soil Testing Laboratories. These agriclinics have been established by individuals and by PACBs. The districts chosen for study were Kancheepuram and Tiruvallur (see Figure 3.1). These two districts are next to each other, have a similar cropping pattern, and contain PACB agriclinics and independent agriclinics.

Figure 3.1—Map of study area districts in Tamil Nadu state



Source: Authors.
Note: Tiruvallur in darker gray, Kancheepuram in lighter gray.

In both districts agriculture is the main occupation and rice is the major crop. The average annual rainfall in Kancheepuram district is 1,213.3 millimeters, while in Tiruvallur it is 1,104.4 millimeters.

The agriclinics chosen for the study were all of those in the two districts that were in place and serving farmers before and during the October 2009–February 2010 crop season (*samba* season 2009). In Kancheepuram district, five agriclinics attached to PACBs were selected. In Tiruvallur district, three agriclinics attached to PACBs and three independent agriclinics were selected (Table 3.1).

Table 3.1—Survey sample

District	Number of agriclinics	Number of PACB agriclinics	Number of independent agriclinics	Respondents who tested soil	Respondents who did not test soil	Total respondents
Kancheepuram	5	5	0	72	107	179
Tiruvallur	6	3	3	54	160	214
Total	11	8	3	126	267	393

Source: Authors.

From each agriclinic, 20 farmers who had used the soil testing service at the agriclinic and 20 farmers who had not used the soil testing service at the agriclinic were surveyed. Farmers who had tested their soil were selected randomly from the agriclinics' soil testing database. But many of the farmers who were listed as having tested their soils at the agriclinics had either not tested their soil or had not received any results of the soil testing. These selected farmers were replaced from the soil testing database. Even though all agriclinics had a soil testing laboratory, only one of the three independent agriclinics had conducted any soil testing. Because there were not sufficient numbers of soil testers at independent agriclinics, instead users of any service, including input purchase and advisory services, were surveyed from a random sample of clients. At the PACB agriclinics, non–soil testers were randomly sampled from the database of PACB members. Non-users at independent agriclinics were randomly selected from the villages the independent agriclinic operators identified as being in their service area and from the Department of Agriculture list of farmers. A total of 393 farm households were surveyed, with 179 households in Kancheepuram district and 214 households in Tiruvallur district (see Table 3.1). The three agripreneurs at the independent agriclinics and the eight operators at the PACB agriclinics were also interviewed about their experience of operating the agriclinics. Descriptive statistics were computed from the data.

Soil testing and input purchase are the major services provided at the agriclinics. Advisory services are also provided at the agriclinics, on crop diversification, crop production, and pest and disease management. Due to the integration of a number of services, the agriclinics offer farmers a one-stop shop, run by a trained operator. Input purchase is the main service used at agriclinics, but farmers can also ask the agriclinic operator about other farm-related issues.

Determinants of Soil Testing

Private extension and advisory approaches may only reach or target specific groups of farmers that are able and willing to pay for services. It is hypothesized that different factors will influence farmers' use of the soil testing service. Identification of these factors could help target farmer groups and also elicit the farmers likely to use agriclinic services. A logistic regression model was therefore specified and estimated to understand the determinants of using the soil testing service at the agriclinic.

It is hypothesized that testing soil at an agriclinic will be affected by the sex and age of the individual. It is expected that education will influence soil testing, with schooling there may be greater understanding of the benefits and greater likelihood of testing soil. Members of an FBO are expected to be more likely to test their soil due to the influence of other farmers and greater awareness of soil testing within the group. With higher agricultural income, soil testing may be more likely because the capacity to implement and undertake soil testing is greater. If any extension service is used, awareness about soil testing might be greater, so soil testing may be more likely. With greater proportion of irrigated area and larger land area under improved seed varieties, it is hypothesized that soil testing is more likely, since greater investment in these two improvements may increase the value of soil testing. Also, higher use of fertilizer may increase chances of soil testing, since soil testing directly influences fertilizer use. Belonging to the social groupings known as scheduled caste or scheduled tribe (SC/ST) may reduce likelihood of soil testing due to social differences. A greater total area of land cultivated may positively influence soil testing because fertilizer costs will be greater. Being closer to an agriclinic will probably positively affect soil testing by making it more convenient. A district dummy variable was also included to accommodate differences between the two sampled districts.

Willingness to Pay

Private extension and advisory services require farmers to pay for extension services or advice. In agriclinics, farmers are required to pay INR 50 (about $1.10) to test a sample of soil. A contingent valuation technique was used to assess the respondents' willingness to pay (WTP) for soil testing. The respondents were presented with a well-described hypothetical situation about the soil testing service and its potential effects. The respondents were then asked to choose whether or not they would pay for soil testing at a specified price. A structured bidding procedure was used. For example, if the respondent declined an initial high offer then the soil testing price was lowered and the respondent was asked to consider the new offer. The offer was lowered successively until a bid was accepted or until the lowest offer was reached. An ordered probit model was estimated to determine significant variables related to respondents' WTP.

The WTP was estimated using a multivariate ordered probit model using 13 explanatory variables (see Table 3.2). It is hypothesized that WTP for soil testing at an agriclinic will be different depending on the sex and age of the individual. It is expected that education will influence WTP, with schooling there may be a greater understanding of the benefits and therefore greater WTP for soil testing. Members of an FBO are expected to have a higher WTP due to the influence of other farmers and greater awareness of soil testing because of discussions within the group. With higher agricultural income, WTP may be higher, since the capacity to pay is greater. If any extension service is used, WTP for soil testing might be greater. With larger land area under improved seed varieties and proportion of irrigated area, WTP may be more likely as greater investment in these two improvements may increase the value of soil testing. Larger land area cultivated increase WTP as fertilizer costs will be greater, which is influenced by soil testing. Also, higher use of fertilizer may increase WTP, since soil testing directly influences fertilizer application. Belonging to the social groupings SC/ST may reduce WTP due to social differences. Agriclinics that are closer to clients will increase WTP, as it may be more convenient. A district dummy variable was also included to accommodate differences between the two sampled districts.

Table 3.2—Description of explanatory variables for logistic regression model and ordered probit model

Variable name	Variable description	Mean	Standard deviation
Male head	Sex (male = 1, female = 0)	0.95	0.21
Age head	Age in years	51.78	9.83
No education	Attended school (none = 1, any = 0)	0.16	0.37
Member of FBO	Member of FBO (1 = yes, 0 = no)	0.43	0.50
Agricultural income	Gross income from rice in *samba* 2009 (INR)	112,765.3	90,427.87
Extension use	Used extension (1 = yes, 0 = no)	0.81	0.39
Proportion irrigated	Proportion of irrigated land (acres)	0.99	0.24
Proportion improved	Proportion land under improved seed varieties (acres)	0.98	0.19
Fertilizer per acre	Fertilizer used per acre in *samba* 2009 (kg)	200.46	172.06
Schedule caste/tribe	Scheduled caste or tribe (1 = yes, 0 = no)	0.09	0.29
Total area	Total acreage cultivated in *samba* 2009	6.37	4.48
Distance	Distance to nearest agriclinic	4.08	3.53
District	District (1 = Kancheepuram, 0 = Tiruvallur)	0.55	0.50

Source: Authors.

4. RESULTS AND DISCUSSION

The main focus of the Tamil Nadu agriclinics is the provision of a soil testing service. Soil testing aims to support appropriate use of fertilizer by improving soil nutrient management strategies. This ensures that fertilizer is applied at the right time and in the right quantity, which could improve soil health and fertility. But the agriclinics also provide inputs, such as fertilizer and some seeds and other chemicals. In addition, agriclinics provide advisory services, not only associated with the soil testing results but also related to crop production, for example pest and disease management. The results discussed below consider the extent to which farmers are using each of these services at agriclinics and the satisfaction and benefit they get from using these services.

Sociodemographic Statistics

This section analyzes the household data in terms of (1) the individual characteristics of the respondents and (2) landownership and cultivation for the *samba* crop season of 2009.

Table 4.1 describes some of the characteristics of the household heads. Most household heads were males and members of a PACB. The primary income source was agriculture for most. Forty-three percent of household heads were members of FBOs, with more FBO members in Kancheepuram (54 percent) than in Tiruvallur (33 percent). The average age of household head was 51.5 years (standard deviation 9.9). By district, gender of respondents was similar (93 percent male in Kancheepuram, 97 percent in Tiruvallur), as were education level (secondary education was 52 percent in Kancheepuram, 47 percent in Tiruvallur), agriculture as the primary income source (98 percent in Kancheepuram, 96 percent Tiruvallur), and marital status (97 percent married in Kancheepuram, 99 percent in Tiruvallur).

Table 4.1—Descriptive data of respondents

Variable	Percentage
Gender—male	91
Education	
No school education	16
Primary (1–5)	24
Secondary (6–12)	49
Tertiary	11
Age (years)	
25–40	16
41–50	27
51–60	29
> 60	27
Other characteristics	
Scheduled caste/tribe status	9
Below poverty line status	1.4
Member of PACB	89
Income source agriculture	97
Member of FBO	43
Married	98

Source: Authors.
Note: $n = 393$.

As shown in Table 4.2, the average landownership for each household was 6.9 acres, with a minimum of 0.6 acre and a maximum of 45 acres (standard deviation 5.23). By district, Kancheepuram had smaller average landownership (5.8 acres) than Tiruvallur (7.8 acres). The average cultivated land for one plot (a contiguous piece of land under the same cropping pattern) was 6.2 acres (Kancheepuram 5.5 acres, Tiruvallur 7.1 acres). The majority of Indian farmers (81 percent) have small or marginal land size (5 acres or less), thus placing farmers in these two districts in the semi-medium category in terms of average farm size (NSSO 2006).

Table 4.2—Landownership and cultivation of respondents

Variable	Acres (average) for *samba* 2009	Standard deviation
Landownership	6.9	5.23
Kancheepuram landownership	5.8	4.44
Tiruvallur landownership	7.8	5.61
Cultivated landholding	6.2	4.41
Kancheepuram cultivated landholding	5.5	4.40
Tiruvallur cultivated landholding	7.1	4.40

Source: Authors.
Note: $n = 393$.

Most plots in the surveyed area were irrigated using groundwater with tube wells or dug wells (77 percent). Ponds and tank irrigation accounted for 16 percent, while only 1 percent of plots were rainfed. In comparison, rainfed farming is said to account for about 60 percent of Indian agriculture (NRAA 2011).

The main crop grown in *samba* season 2009 was rice (99 percent). The average output was 11,588 kilograms per cultivated plot (average 6.2 acres). By district, rice output per acre was similar, with 1,873.0 kilograms per acre in Kancheepuram and 1,830.1 in Tiruvallur. A t-test shows that there is no significant difference in rice output (kilograms per acre) between the two districts: $t(391) = 1.19$, $p = 0.2346$.

Soil Testing at Agriclinics

The knowledgeable and judicious application of fertilizer to improve soil nutrients, guided by soil testing, is the main objective of the Tamil Nadu agriclinic program. Thus, the soil testing service is an important component of agriclinic operation. Of all respondents, 33 percent had tested their soil ($n = 126$). Of those who tested soil, 91.3 percent had tested soil at one of the eight PACB agriclinics ($n = 115$), 7.1 percent at one of the three independent agriclinics in Tiruvallur district ($n = 9$) and 1.6 percent at state department of agriculture offices ($n = 2$). The major reasons the farmers reported for not testing soil were that they had no need for soil testing (41 percent), were unable to find soil testing laboratories at the right time (37 percent), did not know about the soil testing service (16 percent), or could not find the time to test their soil (5 percent).

All the agriclinic operators identified lack of awareness and lack of interest on the part of the farmers as the reasons for the low demand for soil testing services at agriclinics. While improving knowledge of the benefits of soil testing in farming communities may be a first step, a number of service issues were also identified. Across the agriclinics, there were inaccuracies in the soil testing databases. In some cases, farmers whose names had been recorded as having tested their soils had not done so. When farmers receive a loan from a PACB, a soil testing fee is sometimes collected with a receipt requesting the farmer to bring a soil sample to the agriclinic for testing. At PACB agriclinics the operator receives a monthly salary of INR 5,000 (about $113) from the bank, which is supported through the services provided by the agriclinic, namely soil and water testing fees and agricultural input sales. Thus, PACBs tend to push soil testing as a prerequisite for loan approval for their members. However, as the survey found, there were farmers who had not brought their soil for testing. In some instances, those who had given soil samples had not received the results of the test. This reflects poor service from the agriclinics in addition to lack of interest among farmers to follow up the results of the soil test. The independent agriclinics had low or no soil testing participation despite having soil testing laboratories. There were only nine soil testers from one of the three studied independent agriclinics in Tiruvallur in 2009. The possible benefits of soil testing were not valued. Soil testing is sometimes seen by farmers to be only for problematic soils and not necessary for regularly cultivated land.

Despite the need to create awareness of the agriclinics and their soil testing service, in only 15 percent of cases did the agriclinic operator visit the clients, mostly when required. In some cases, PACB agriclinic operators were used for other assignments within the PACB. While the independent agriclinics also faced problems of lack of awareness and low demand for soil testing, they faced the additional difficulty of competing with established agricultural input dealers, who provided credit-based sales. The independent agriclinics did not have the financial capacity to provide farm inputs on credit.

At the independent agriclinics farmers reported the major purpose for soil testing was to find out about soil nutrients, while at the PACB agriclinics farmers reported the major purpose for soil testing was not only to find out about soil nutrients (53 percent) but also because the bank required it (45 percent). On average, a greater number of soil samples were obtained at the PACB agriclinics than at the independent ones (5 samples compared with 2 in 2009). Prices and distance to the different agriclinics did not vary much, but the average distance to the independent agriclinics was greater than to the PACB agriclinics (6.8 kilometers compared with 4.2 kilometers). All farmers who tested soil at the independent agriclinic were satisfied with soil testing. However, at the PACB agriclinics, 32 percent were not satisfied with the soil testing service. The major reasons for lack of satisfaction at the PACB agriclinics included untimely information (46 percent), the consequence of the information was not satisfactory (26 percent), the information needed was not received (17 percent) or had inadequate detail (6 percent), or there was poor service (6 percent).

Farmers who tested their soil received advice and other information with the soil testing results, as shown in Table 4.3. Only five respondents said they did not receive any information with the soil test results. Most farmers received information on use of fertilizers. The main information was fertilizer use (53.7 percent), followed by crop suitability (18.5 percent) and soil problems (12.2 percent). The provision of advice and additional information with the soil testing results is an important value addition of the agriclinic service, which can support the individual queries of each farmer. But it was found that only 48 percent of farmers who tested their soil had followed the advice from the soil test results. This percentage was similar between independent and PACB agriclinics. While few in number, all the soil testers of the independent agriclinic planned to test their soil the following season. At the PACB agriclinic, only 38 percent of soil testers planned to test their soil the next season.

Table 4.3—Information received by farmers with soil testing results

Information	PACB agriclinic (%)	Independent agriclinic (%)	State extension office (%)
None	2.4	0	0
Use of fertilizer	53.7	90.0	66.7
Crop suitability	18.5	0	33.3
Soil problems	12.2	10.0	0
Irrigation	7.3	0	0
General advice	3.9	0	0
Disease problem	1.5	0	0
New seed varieties	0.5	0	0

Source: Authors.

Tables 4.4 and 4.5 present descriptive statistics of partial farm budget of production costs, yield, and income for rice in the *samba* season 2009 by respondents who tested or did not test their soil (Table 4.4) and those who followed or did not follow the advice of the soil test results (Table 4.5). The potential for targeted application of fertilizer through soil testing may affect input costs and crop yield, resulting in differences in net income.

Table 4.4—Partial farm budgets for rice production, plots with soil tested versus not tested, *samba* season 2009

	Plots with soil tested		Plots with soil not tested	
	Mean	Std dev	Mean	Std dev
Total area (acres)	6.90	6.00	5.90	3.60
Total production (100 kg)	137.10	115.60	111.50	70.00
Average price (INR/100 kg)	955.90	177.60	985.90	152.60
Gross income total (INR)	128,853.50	109,285.40	108,897.00	66,551.40
Gross income/acre (INR)	19,999.60	14,747.70	18,653.80	4,602.43
Quantity fertilizer (kg)	1,157.30	834.60	1,151.80	816.30
Fertilizer cost (INR)	11,189.10	11,368.80	8,413.00	6,727.70
Quantity fertilizer/acre (kg)	236.96	299.83	203.98	94.01
Total inputs (INR)	10,601.90	24,538.60	34,745.20	55,709.50
Net income (INR)	88,266.90	84,852.80	75,119.20	49,938.10
Net income/acre	12,912.10	9,234.00	12,830.60	4,138.30

Source: Authors' calculations.

Table 4.5—Partial farm budgets for rice production, plots with soil test advice followed versus not followed, *samba* season 2009

	Plots with soil test advice followed		Plots with soil test advice not followed	
	Mean	Std dev	Mean	Std dev
Total area (acres)	5.92	4.73	8.02	7.03
Total production (100 kg)	122.96	98.88	153.03	131.17
Average price (INR/100 kg)	944.02	227.14	969.35	95.77
Gross income total (INR)	113,534.30	94,973.31	146,170.80	122,460.10
Gross income/acre (INR)	19,031.34	3,646.70	21,094.17	21,247.22
Quantity fertilizer (kg)	823.80	583.86	1,576.36	916.85
Fertilizer cost (INR)	7,561.55	7,120.79	15,734.36	13,483.17
Quantity fertilizer/acre (kg)	160.78	57.55	332.67	429.82
Total inputs (INR)	39,481.25	39,231.55	45,945.82	22,878.75
Net income (INR)	77,265.56	62,483.54	100,224.90	103,286.60
Net income/acre (INR)	12,674.88	3,333.36	13,170.02	12,952.89

Source: Authors' calculations.

The anticipated outcome of soil testing is changes in fertilizer use. Yield should not be significantly affected and may hypothetically increase as appropriate soil nutrients are achieved. A t-test shows no significant difference in quantity of fertilizer per acre (kilograms) means between those who tested their soil and those who did not, but there is a significant difference in fertilizer purchased between those who followed soil test advice and those who did not: $t(86) = -2.77$, $p = 0.0068$. Fertilizer cost per acre is significantly different between soil that is tested and not tested: $t(392) = 2.34$, $p = 0.0199$. Fertilizer cost per acre is significantly different between plots where the soil testing advice was followed and those where it was not: $t(93) = -2.48$, $p = 0.0148$. This suggests that if advice from soil test results is followed, fertilizer costs could be reduced. There are also significant yield differences (of 100 kilograms per acre) between plots where the soil was tested and those where it was not: $t(386) = 3.39$, $p = 0.0008$. But this difference is not seen between plots where advice was followed and those where it was not. A t-test further shows that net income (INR per acre from rice) during *samba* 2009 was not significantly different for tested versus non-tested plots. Likewise, net income was not significantly different for plots where advice was followed versus those where it was not.

In summary, the results show that soil testing is an underutilized service of the agriclinics. Awareness about the soil testing service needs to be created to improve demand for soil testing, but improvement is also needed in the service orientation of the agriclinics, particularly the PACB sites. In

order to generate revenue at PACB agriclinics, farmers are requested to test soil when taking loans, but follow-up from the agriclinic is lacking. While PACB agriclinics have strong client bases from their respective banks, at the independent agriclinics there is no soil testing being carried out. All the operators describe a lack of farmer awareness of and need for soil testing. Of those farmers who did test their soil, only 48 percent followed the soil testing recommendations. There was significant difference in fertilizer costs between those who tested their soil and followed the advice and those who tested their soil but did not follow the recommendations. If farmers are aware of a direct benefit of testing their soil, this may increase their value of the soil testing service. The next section seeks to understand which farmers are using the soil testing service and whether farmers value this service.

Determinants of Testing Soil at an Agriclinic

Agricultural extension and advisory services may target specific groups of farmers, such as rural and farm women, small and marginal subsistence farmers, medium-scale farmers, commercial farmers, or rural youth (Swanson 2008). The characteristics of these groups will influence how extension and advisory services direct their programs because the information sought and the access to and use of extension will differ across these groups. For example, the Indian NSSO 2003 survey showed that access to information varied by farm landholding size: Smallholders used less extension from fewer sources than did medium- and large-scale landholders (Adhiguru et al. 2009). A key question is therefore, what are the characteristics of farmers who are using the soil testing service at agriclinics? Of the services provided at agriclinics, soil testing was chosen as the focus because it is the major objective of the Tamil Nadu agriclinic program.

Table 4.6 shows some differences in sociodemographic variables between those who tested their soil and those who did not. There are also some differences between those who followed soil testing advice and those who did not. Soil testers tended to be older, members of FBOs, have secondary education, and larger landholding size than non–soil testers. Those soil testers who followed the advice were mostly male, were not members of SC/ST, were not members of FBO, had less education, were younger, and had smaller land area cultivated than those who did not follow soil testing advice.

Table 4.6—Descriptive statistics of agriclinic users who test their soil, do not test, comply with the advice, and do not comply

	Soil testers	Non–soil testers	Comply with advice	Do not comply with advice
Observations	126	267	60	66
Variable	**Percentage**			
Gender—male	92.8	96.6	96.7	89.2
Age (years)	52.9	51.8	50.6	54.9
Sch. caste/tribe status	4.8	11.5	1.7	7.7
Member of FBO	61.6	34.5	46.7	73.9
Education				
No school education	15.3	16.6	21.7	10.9
Primary (1–5)	19.4	25.7	23.3	15.6
Secondary (6–12)	53.2	48.3	43.3	60.9
Tertiary	12.1	9.4	11.7	12.5
Age (years)				
25–40	9.2	19.7	15.8	3.2
41–50	27.5	27.5	28.1	27.0
51–60	34.2	26.2	42.1	28.6
> 60	29.2	26.6	14.0	41.3
	Mean			
Cultivated landholding *samba* 2009	7.1 (SD 5.7)	6.0 (SD 3.7)	6.4 (SD 4.8)	7.8 (SD 6.3)

Source: Authors' calculations.

A t-test was conducted to compare the variables in Table 4.6 for soil testers and non–soil testers, and for those who complied with soil test advice and those who did not. There was significant difference in means for membership in FBOs for soil testers and non–soil testers. For respondents who were members of an FBO, there was also significant difference between those who complied with advice from soil testing and those who did not. These results suggest that membership in an FBO influences whether soil is tested or not and whether advice is followed or not. Cultivated landholding and SC/ST status were significant for soil testing only, while advice followed was significant by age in years. While Table 4.6 gives some initial indication of characteristics of users of the soil testing service at agriclinics, a logistic regression model was developed to further explore determinants of soil testing at an agriclinic (see Table 4.7). The 13 explanatory variables from Table 3.2 were used in this model.

Table 4.7—Estimated results of logistic regression model for determinants of soil testing

Soil testing	Coefficient (std err)
Male head	-0.700
	-(0.579)
Age head	0.002
	(0.013)
No education	0.053
	(0.392)
Member of FBO	0.655
	(0.257)**
Agricultural income	1.25e-06
	(2.12e-06)
Extension use	1.122
	(0.472)**
Proportion improved	0.648
	(0.993)
Proportion irrigated	-0.472
	-(0.584)
Fertilizer per acre	0.002
	(0.001)**
Scheduled caste/tribe	-1.040
	-(0.596)*
Total area	0.059
	(0.045)
Distance	-0.002
	-(0.034)
District	0.621
	-(0.252)**
Constant	-2.852
	-(1.352)**
	Number obs = 358
Wald $chi^2(13) = 36.64$, Prob > $chi^2 = 0.0005$	
	Pseudo $R^2 = 0.1110$
	Log-likelihood = -198.440

Source: Authors' calculations.
Notes: *, **, and *** mean significant at 0.10, 0.05, and 0.01, respectively. Standard errors robust to heteroskedasticity.

The variables that significantly affect soil testing are membership in an FBO, use of extension, fertilizer per acre, SC/ST status, and district. Members of FBOs are more likely to test their soil; this may be because interaction of farmers in the group increases awareness of the various extension services and potential benefits. This suggests that farmer networks could be an important way of increasing awareness about soil testing. Those respondents who used extension were more likely to test their soil; this may be because those who access more information sources have greater understanding and awareness about soil

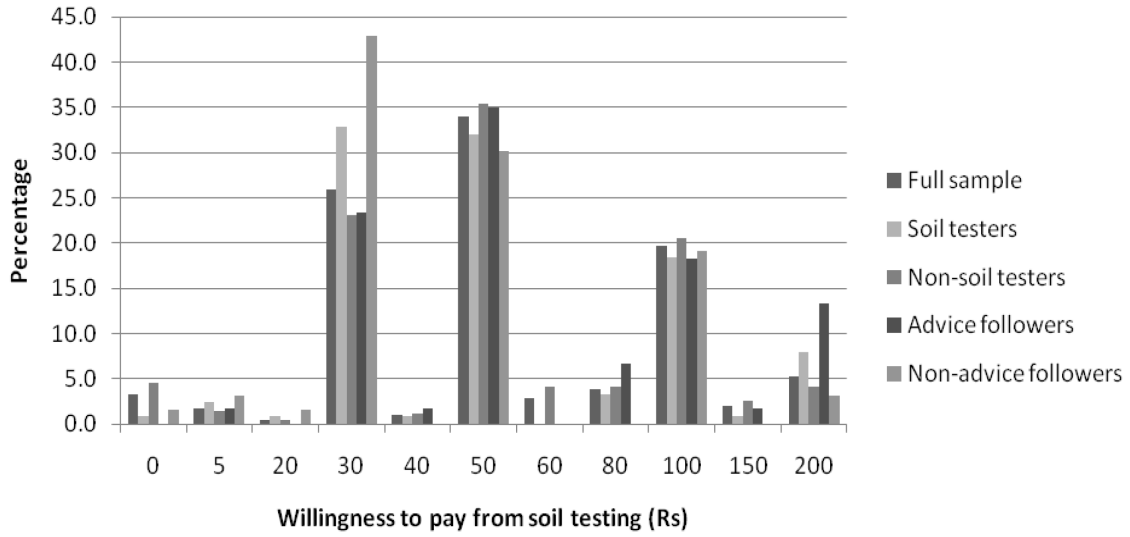
testing and its potential benefits. Those who apply more fertilizer per acre are more likely to test their soil; since soil testing advice should directly influence application of fertilizer, those who apply more fertilizer may receive more benefit from soil testing. Members of SC/STs are less likely to test their soil, which reflects social differences associated with these social groupings. District is also a significant variable, whereby soil testing is more likely to occur in Kancheepuram than in Tiruvallur. These results suggest that the formation of FBOs could help to encourage the use of extension services like soil testing at agriclinics. Those farmers with low information search behavior (meaning those who do not use any extension to support their farm enterprise) would require an active approach by the agriclinic operators to encourage them to learn about the services available at agriclinics.

Willingness to Pay for Soil Testing

Traditionally, public-sector extension services have been provided free of cost as a public good to rural communities. However, in order to recover some cost, some services may require payment. Currently soil testing services are provided by a number of agencies, including the state department of agriculture, for a charge of INR 10 (about $0.23). Considering the existence of this less expensive service, farmers may not be willing to pay for soil testing at the agriclinic, which costs INR 50 (approximately $1.13). However, the number of public soil testing laboratories is small. Also the previous section shows that there is a lack of demand for soil testing at the agriclinics. This section examines whether farmers value soil testing once the potential effects of the service have been described. This is achieved by examining farmers' WTP for soil testing. Characterization of farmers who are willing to pay will also guide which, and by how much, extension services could be or should be privatized and for which target groups within farming communities. For example, Sulaiman and Sadamate (2000) found that 48 percent of 720 farmers surveyed across three Indian states were willing to pay for agricultural information and that higher satisfaction with their primary source of information, larger area and income, and larger percentage of area under irrigation were variables that increased farmers' WTP. In the present study, the potential effects of soil testing were explained to respondents before they were asked about their WTP for the service using a bidding game.

The results of the bidding game are presented in Figure 4.1. Results indicate that 35 percent of respondents were willing to pay the current price of INR 50, while 27 percent were willing to pay INR 30 (about $0.68). Thirty-four percent were willing to pay more than the established price of INR 50, with 20 percent willing to pay INR 100 (about $2.25). When disaggregating the data by soil testers and non–soil testers, no large differences emerged. However, when disaggregating by whether the soil testing advice was followed or not, non–advice followers were willing to pay less than those who had followed the soil testing advice. Only 22 percent of non–advice followers were willing to pay more than INR 50, whereas 30 percent of advice followers were willing to pay more than the current established price. These results suggest that those who have followed the advice of soil testing, and may have received some positive outcome, were more willing to pay for soil testing. Those who did not follow the advice, because the information was either not relevant or not available in a timely manner, were less willing to pay more than the established price. Follow-up of soil testing recommendations by agriclinic operators with farmers may therefore be useful to encourage them to undertake changes in their soil nutrient management practices.

Figure 4.1—Willingness to pay for soil testing



Source: Authors.

The variables that significantly differentiate respondents' WTP for soil testing are no education, member of FBO, total area, distance, and district (Table 4.8). A farmer with no schooling is likely willing to pay more for soil testing. Schooled farmers may be better able to diagnose soil problems themselves or may be more aware of and able to seek out other services available to address their specific problems. Members of FBOs are less likely to be willing to pay more for soil testing. Similar to schooling, being a member of a FBO may increase the farmer's understanding and capacity to manage and seek out information related to soil issues, thus reducing WTP for the agriclinic soil testing service. Those farmers with a larger total landholding area are willing to pay more for soil testing. With larger land area, input costs will be greater, so farmers may invest more in activities like soil testing to improve soil nutrients, potentially improving yield and reducing input costs. Farmers who live further away from an agriclinic are willing to pay more because they may have less access to relevant services that are close by. By district, those in Tiruvallur are willing to pay more for soil testing. District characteristics including greater landholding size, more groundwater irrigation, and fewer members of FBOs may account for this difference.

Table 4.9 shows the impact on WTP for soil testing as the payment values for soil testing change. There is a 6 percent chance that farmers who do not have education would not be willing to pay INR 100 for testing their soil. There is a 0.2 percent chance that farmers who are members of FBOs would be willing to test their soils at INR 50. However, the chances are that members of FBOs would not be willing to pay higher amounts (greater than INR 100) for testing soil (Table 4.9). If total area farmed increases by 10 percent or the farmer's distance from an agriclinic increases by 10 percent, there is a 10 percent increase in the chance that the farmer would be willing to pay INR 100 to test his or her soil.

Table 4.8—Estimated results of ordered probit model for willingness to pay for soil testing

WTP	Coefficient	P-values
Intercept 1	-2.17	-
Intercept 2	-1.88	-
Intercept 3	0.09	-
Intercept 4	0.13	-
Intercept 5	1.13	-
Intercept 6	1.22	-
Intercept 7	1.34	-
Intercept 8	2.27	-
Intercept 9	2.48	-
Male head	0.60	0.134
Age head	-0.002	-(0.706)
No education	0.28	0.068*
Member of FBO	-0.28	-(0.026)**
Gross income	-2.32e-08	-(0.986)
Extension use	-0.07	-(0.683)
Proportion irrigated	0.02	0.961
Proportion improved	0.002	0.997
Fertilizer per acre	-0.0002	-(0.470)
Scheduled caste/tribe	0.17	0.404
Total area	0.06	0.041**
Distance	0.04	0.005**
District	-0.38	-(0.003)**
Number of obs = 351, Wald $chi^2(14) = 62.76$, Prob > $chi^2 = 0.0000$, Pseudo $R^2 = 0.0568$, Log-likelihood = -537.868		

Source: Authors' calculations.
Notes: *, **, and *** mean significant at 0.10, 0.05, and 0.01, respectively.

Table 4.9—Estimated marginal effects of significant variables from ordered probit model

Variable	INR 30	INR 50	INR 100	INR 200
No education	-0.09	-0.01	0.06	0.03
Member of FBO	0.09	0.002	-0.06	-0.02
Total area	-0.02	-0.001	0.01	0.004
Distance	-0.01	-0.001	0.01	0.003
District	0.12	0.003	-0.08	-0.03

Source: Authors' calculations.

Once the potential effects of soil testing had been described, most farmers were willing to pay the standard price of INR 50. This suggests that farmers value the soil testing service and are willing to pay for it, but only if awareness is created. Those who had followed the advice of soil testing were willing to pay more than those who had not. The ordered probit model (Table 4.8) shows that certain characteristics of farmers influence how willing they are to pay for soil testing. When private extension is offered, it is important to understand which farmers are willing and able to use the private service so that the public sector is able to support those who are not.

Input Purchase at Agriclinics

While one of the main objectives of the Tamil Nadu agriclinics program is the provision of soil testing services, the agriclinics also sell agricultural input items, such as fertilizer, other chemicals, seed, and agricultural equipment. In India, the private input dealer plays a large role in providing information to farmers (NSSO 2005), so a trained input supplier offered at an agriclinic could have important on-farm outcomes. The soil testing laboratory could also influence the amount and application of inputs, particularly fertilizer. This section examines the source of inputs purchased by the respondents for the *samba* season in 2009, to determine if the Tamil Nadu agriclinics had become a source for farm inputs.

The most-purchased fertilizers were urea (29 percent), potash (29 percent), di-ammonium phosphate (21 percent), and complex fertilizers (19 percent). Among all respondents, fertilizer was mostly purchased from agriclinics (47 percent at PACB agriclinics and 9 percent at independent agriclinics), followed by private input dealers (44 percent). PACB agriclinics were preferred fertilizer vendors because of proximity (36 percent) and timely availability (20 percent). Before the agriclinic program, PACBs were responsible for supplying inputs to farmers, which could explain their high use as vendor in this survey. PACBs provide credit to farmers for agriculture and allied activities, distribute inputs such as fertilizer, and also run outlets under the public distribution system. The Tamil Nadu government considers PACBs the center for provision of an integrated package of services to farmers, including credit, insurance, inputs, marketing, and extension (Tamil Nadu, Department of Cooperation 2009). The inputs are supplied to PACBs from the Tamil Nadu Cooperative Marketing Federation Limited (TANFED). The crop loans issued by PACBs consist of a cash portion and in-kind advances. The in-kind portion includes fertilizers, pesticides, seed, and agricultural implements, which are supplied by TANFED and distributed through PACBs. The agriclinics attached to the PACBs now manage the distribution of these inputs. Preference for the sale of fertilizer at PACB agriclinics is given to PACB members who have taken a bank loan.

Disaggregating fertilizer purchases by farmers who tested soil at agriclinics and those who did not test soil shows some differences. Agriclinic soil testers bought fertilizer mostly at the agriclinic (62 percent, with 61 percent at PACB agriclinics and 1 percent at independent agriclinics). This is a smaller percentage than non-soil testers (52 percent, with 40 percent at PACB agriclinics and 12 percent at independent agriclinics). A chi-square test shows there is a significant relationship between where the fertilizer was purchased and whether the farmer did soil testing. It is important to note that non–soil testers also purchased fertilizer from agriclinics. This shows that the fertilizer supply at PACB agriclinics is valued independently from the agriclinic soil testing service. Comparing fertilizer purchases between PACB agriclinic soil testers and independent agriclinic soil testers also shows differences. Those who tested their soil at the PACB agriclinics bought their fertilizer mostly at the PACB agriclinics (65 percent), followed by private input dealers (32 percent). Conversely, those who tested their soil at the independent agriclinic bought their fertilizer mostly from private input dealers (88 percent).
Of other chemicals (weed killers, fungicides, herbicides, and pesticides), 90 percent were purchased from private input dealers, followed by agriclinics (9 percent). The major reasons for choice of private input dealers were timely availability (59 percent), quality assurance (22 percent), and proximity (18 percent). At the PACB agriclinic the major reasons were timeliness (45 percent) and proximity (18 percent). At the independent agriclinic, the reasons were timeliness (58 percent) and quality assurance (32 percent). Of PACB agriclinic soil testers, 4 percent purchased other chemicals at the PACB agriclinic, while at the independent agriclinics only one soil tester bought any other chemicals from the independent agriclinic. Similarly, seed was purchased mostly from private input dealers (89 percent), then agriclinics (6 percent). The major reasons for purchasing seed from private input dealers were timeliness (54 percent), quality assurance (30 percent), and proximity (15 percent). The major reasons for choice of PACB agriclinics for seed purchase were similarly timeliness (58 percent), quality (17 percent), and proximity (17 percent). At the independent agriclinics, the major reasons for the choice were quality (43 percent) and timeliness (36 percent).

In this section, farmers' valuation of timely input supply is highlighted by the high rate of fertilizer purchase at PACB agriclinics. Most farmers who complied with soil testing advice purchased fertilizer from agriclinics. A trained operator who provides advice through soil testing to potentially guide fertilizer use is valuable to the farmer. Private input dealers generally do not offer this same integration of advisory service, with diagnostic tests, and input supply. More important, the PACB agriclinic provides timely availability, quality products, and proximity to the buyer. This is an area for the agriclinic operators to expand if they are to compete with the local input dealers. Without taking a good share of the market for other services, the viability of agriclinics could be doubtful. We further examine this aspect below.

Use of Other Advisory Services at Agriclinics

Agriclinics play a role as a source of inputs (mainly fertilizer) to farmers. However, the role of agriclinics is not seen purely as that of an agribusiness for the sale of inputs. The added value that agriclinics bring is that the trained operator also provides advisory services. In the agriclinics in this study, these included soil testing services, with soil testing laboratories in each agriclinic and consequent recommendation for soil nutrient management. Free advice on pest and disease management and on crop production and diversification was also provided in some of the agriclinics. It is therefore important to examine whether agriclinics are used as a source of advice to support farmers in their farming enterprise.

Of all respondents, 16 percent had not accessed any source of extension or advisory service in the last 12 months. About 70 percent of the respondents found no need for these services and 30 percent of them said they were unable to find extension staff at the right time. Extension use is greater in these districts than at the national level as reported in the NSSO 2003 survey, which found that 60 percent of farmers had not accessed any source of information to support their farming enterprise (NSSO 2005).

Those who did not test their soil used mostly progressive farmers (28 percent) and private input dealers (26 percent) as sources for information. PACB agriclinics were the third-most-used source (13 percent) by non–soil testers, followed by the government extension officer (10 percent). Most of these sources were used for information on new seed varieties, pest and disease management, and fertilizer use (see Table 4.10). Television and print media accounted for 9 percent and 8 percent of information, respectively. Farmers who tested their soil at either PACB or independent agriclinics also used other information sources. When agriclinics are not included, the main sources of information for farmers were progressive farmers (42 percent), private input dealers (28 percent), government extension officers (8 percent), television (7 percent), and print media (6 percent). The NSSO 2003 survey obtained similar results: The primary information source was progressive farmers, followed by input dealers (NSSO, 2005). The interesting situation here, particularly for farmers who did not test their soil, is that the PACB agriclinics are the third-most-used source of information. In terms of access to information and communication technologies, only 2 percent of respondents accessed the Internet, but 71 percent owned mobile phones, of whom only 4.7 percent accessed market price information.

Table 4.10—Information sought from the major extension providers

Extension provider	Pest manage-ment (%)	Fertilizer use (%)	New seed variety (%)	Disease problems (%)	Irrigation (%)	Marketing advice (%)	Soil health (%)	Weather (%)	Credit support (%)	General advice (%)
Progressive farmer	23.0	18.8	22.1	9.4	7.9	6.9	0.2	0.0	0.0	11.7
Input dealer	34.0	11.3	20.4	22.5	0.7	1.7	0.9	0.2	0.0	8.4
PACB agriclinic	17.0	23.1	18.2	14.04	1.9	1.1	0.8	0.4	19.3	3.8

Source: Authors.

Table 4.11 summarizes the main reasons for farmers' use of various extension and advisory services. The major reason progressive farmers were used as information sources was that they were close by, which was also the main reason for use of PACB agriclinics. The input dealer was available at an appropriate time. During the cropping season 23 percent of farmers were in contact with extension provider every two weeks, 22 percent daily, 19 percent weekly, and 18 percent monthly. Of the farmers who received these services, 99 percent were either very satisfied or satisfied. The information sought was mainly about pest management, new seed varieties, fertilizer use, and disease problems (Table 4.10). At the PACB agriclinics the information sought was mainly on fertilizer use, which was also the main topic for information sought from progressive farmers. At the private input dealer the main topic for information sought from was pest management (Table 4.10).

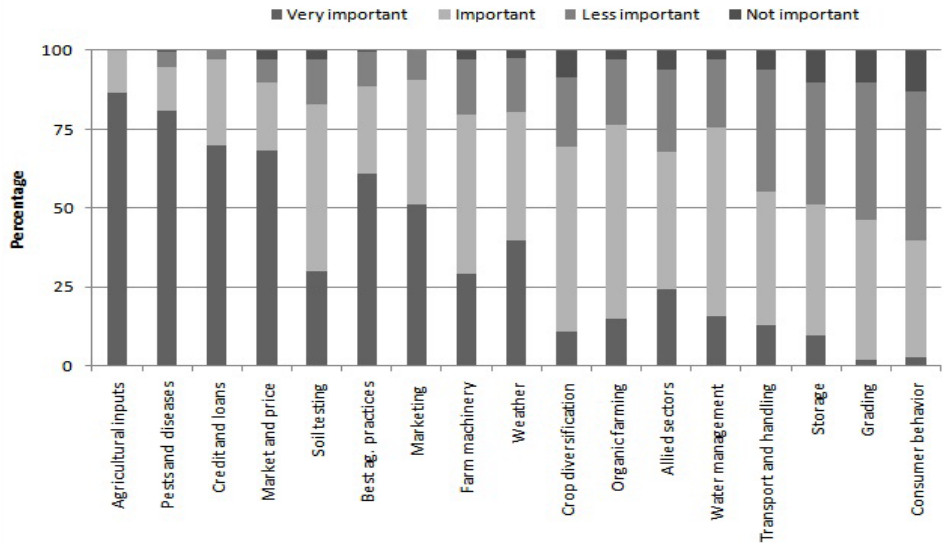
Table 4.11—Main reason for accessing extension and advisory services from the major extension providers

Extension provider	Proximity (%)	Lowest price (%)	Quality assured (%)	Timely availability (%)	Only option (%)	Comes to field (%)
Progressive farmer	79.3	0.4	5.3	7.3	6.5	0.8
Input dealer	2.9	0.0	26.2	63.6	2.9	1.0
PACB agriclinic	43.4	1.6	24.6	15.6	12.3	0.0

Source: Authors.

By examining the information needs of farmers, the relevance of the service provided by the agriclinics can be considered (see Figure 4.2). Most respondents considered information about the availability and price of agricultural inputs very important, followed by pest and disease management. Credit and loan availability was assigned an importance similar to that of market and price information. Information on best agricultural practices was also considered very important. These needs reflect the information sought from extension providers (Table 4.10). Farmers who tested their soil had information needs that were similar to the needs those who did not test. As expected, however, those who tested their soil considered the soil testing service and results mostly 'very important', whereas those who did not test their soil considered it mostly *important*.

Figure 4.2—Information needs by importance as listed by respondents

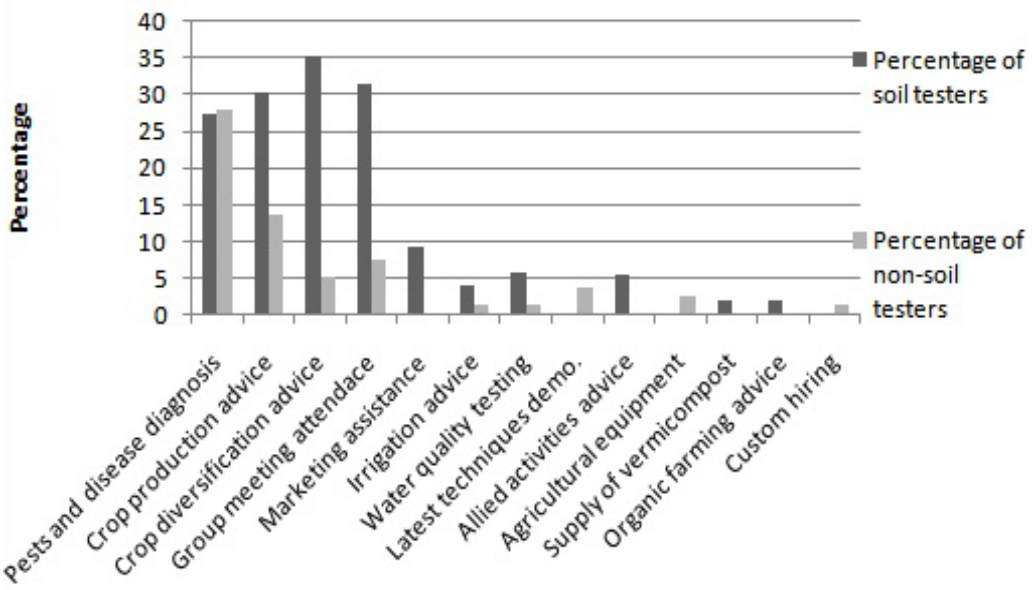


Source: Authors.
Note: $n = 393$.

The agriclinics provide services and advice that reflect some of the information needs that farmers identified as very important, namely providing agricultural inputs. In addition, many of the agriclinics provide additional services. While the main activity of the agriclinics is soil testing and selling inputs, six of the eight PACB agriclinics and one of the three independent agriclinics also carried out field trials, and three of the PACB agriclinics and one of the independent agriclinics provided diagnosis of pests and diseases.

Of the 68 percent of respondents who had not tested their soil, 40 percent did not know about agriclinics. But more than half of respondents who had not tested their soil at the agriclinics had visited an agriclinic (57 percent), mostly to purchase inputs. Pest and disease diagnosis, advice on crop production and diversification, and group meetings (which were organized by the State Department of Agriculture at some PACB agriclinics) were other services accessed (Figure 4.3). When a farmer tested their soil at the agriclinic they also used other services available there. Those who did not test their soil also accessed similar services as soil testers, though they tended to use fewer services. Of those who received advice from the agriclinic, 58 percent used the advice in their farming enterprise. Overall, 57 percent of agriclinic users said their production knowledge improved, and 42 percent said their use of inputs improved (Table 4.12). As a result of using services at agriclinics, perceived changes (improved production, improved production knowledge, improved use of inputs, and changed cropping pattern) were reported more often by soil testers than by non–soil testers who nevertheless used the agriclinic (Table 4.12). Of those who utilized any service at the agriclinics, 25 percent were satisfied with the overall service provided by the agriclinics. The suggested improvements to agriclinics were mostly related to increasing the variety of inputs, including fertilizer (29 percent), seeds (32 percent), and herbicide (13 percent). Giving more general advice and marketing advice were also suggested by 13 percent and 8 percent, respectively.

Figure 4.3—Services accessed at the agriclinics by soil testers and non–soil testers



Source: Authors.

Table 4.12—Perceived changes in farming enterprise as judged by respondents

Perceived changes	All agriclinic users %	Soil testers at agriclinics %	Non–soil testers but users of other agriclinic services %
Improved production	21	30	14
Improved production knowledge	57	72	48
Improved use of inputs	42	47	30
Changed cropping pattern	6	9	4

Source: Authors.

The results show that farmers used agriclinics as a source of information, even those farmers who did not test their soil. Most information sought related to fertilizer use, new seed varieties, and pest management. These results show that agriclinics are becoming a source of advice for farmers. As mentioned above, the scope of information that farmers consider important is not fully addressed in the agriclinics, so there is room to expand the advisory services, provided the operator has the technical expertise to address those services. Inclusion of a wider range of inputs will increase the agriclinics' ability to compete with private input dealers, which in the long run could increase the viability of the agriclinics.

5. POLICY IMPLICATIONS

The Tamil Nadu Agriclinics cum Mini Soil Testing Laboratories program examined in this paper is a policy-supported private extension approach that links input sale with advisory services, which includes soil testing. However, international experience in encouraging private extension approaches has found insufficient accountability to farmers; varying quality and services offered, and selective reach to only certain categories of farmers remain major challenges (Feder et al., 2011). A key issue for policymakers therefore is whether supporting a private approach to agricultural extension in the agriclinics adds value to the pluralistic system of extension in India. However, the results show that quality of services and farmer demand for soil testing are limiting factors in the Tamil Nadu Agriclinic cum Mini Soil Testing Laboratories program.

Reaching Clients and Client Demand for Soil Testing

Demand for and awareness of the soil testing service, which has the capacity to support appropriate fertilizer use, and sustain soil health, is currently not very great. Independent agriclinics particularly struggle in finding clients to test soil. Because of the client base at the banks, PACB agriclinics are able to test more soil than at independent agriclinics. However, the service provided by the PACB agriclinics, which encourage clients to test soil as part of loan requirement, is not satisfactorily viewed by farmers, with less than half ready to test their soil again. The agriclinic operators need to follow-up with the farmer so that the farmer trusts the advice to follow it. But the contingent valuation shows that farmers are willing to pay for soil testing once they are aware of the potential benefits of this service. Incentives and resources are needed for the agriclinic operators to improve the soil testing service. This requires further capacity building and incentives of the agriclinic operator to engage with farmers. Targeted subsidies for specific activities at the agriclinics could support the incentive of operators to interact with farmers, visiting their fields, and providing timely and reliable results, for example soil test results. Continued training and education to build the capacity of agriclinic operators will be an important investment for the public sector. The agriclinic operators now receive training under the national ACABC scheme, which is a positive step. Stronger partnerships and integration of activities with other agencies, could improve awareness within farming communities to improve demand for the soil testing service.

Type of Clientele Using the Soil Testing Service

International experience of private extension suggests that it is not a substitute for public extension, because it tends to be mostly present in areas where commercial agriculture is already present, and farmers have the capacity and willingness to pay for advisory services that they require. Issues of public welfare and equity are important to consider in private extension (Hanson and Just 2001). The results showed that certain categories of farmers are not testing their soil at agriclinics. Smaller landholders and those belonging to S/ST social groupings used the soil testing services less. Membership to FBO is a relevant factor in accessing soil testing at agriclinics. Encouraging the formation of farmer groups could be an important way to create awareness of soil testing, and encourage farmers to utilize soil testing service. This could be supported by the public or civil society sector in partnership with the agriclinics.

Other Services Offered

The agriclinic services are limited to soil testing, input sale and some advisory service depending on the operator and farmer interest. The specific service of soil testing, integrated with fertilizer supply is an important value addition of the agriclinics as it could guide fertilizer application and improve soil health. The results show that the PACB agriclinics are more successful than independent agriclinics in providing a one-stop-shop approach, as they are attached to the banks and input subsidies go through the PACB agriclinic. Currently independent agriclinics face strong competition from private input dealers, and act

mainly as input vendors. As input supply is an important farmer need, expanding types of inputs stocked beyond fertilizer could encourage more farmers to visit agriclinics, and learn about other services available, like soil testing. Seed variety selection and pest and disease management were identified by farmers as important needs, which the agriclinic could also specialize. Market price information is considered an important need of farmers. The web portal Agmarknet[5] provides price information of the regulated markets in India, which could be accessed at agriclinics if Internet is made available. The results show that the private input dealer still plays a large role in advisory service in this study area, but PACB agriclinics are becoming a used source of extension and advisory service as well.

Accountability and Monitoring

When extension services become privatized, minimum rules and regulations are needed to define the conditions under which extension activities can take place and set some standards for service delivery (Rivera and Alex, 2004). To ensure quality control at the agriclinics, the soil testing service is monitored by the state department of agriculture, which examines the number of soil and water samples tested and other inputs sold. But the soil testing database is inaccurate, with poor timely delivery of results. There is a greater need for more active monitoring of the agriclinic soil testing service to ensure quality. This could also be supported through appropriate incentives for the agriclinic operators to improve soil testing and capacity building. Understanding the challenges of encouraging farmers to test soil, and the factors that influence farmers decision-making to undertake soil testing, will better work to support the agriclinics' service.

[5] http://agmarknet.nic.in/.

6. CONCLUDING REMARKS

The results presented here suggest that embedding advisory service in input sale in the policy-supported private extension approach of the Agriclinics cum Mini Soil Testing Laboratories in Tamil Nadu is a useful way of reaching farmers, whose most important information needs relate to agri-inputs. The integration of services in one location increases convenience for farmers, who highlight proximity as an important condition for selecting input vendor and advisory service. Nevertheless private extension does not substitute for public extension, as it reaches only certain clientele and focuses on specific services. Also demand for the services is required from farmers and capacity and motivation of the operator to provide quality services is needed for effective and quality operation. To prevent the agriclinics from becoming another input dealer, without reliable advisory service based on appropriate diagnostic tests, greater linkages of agriclinics to other programs of extension and advisory services, capacity building and training, and more effective continuous monitoring is needed. The results from this study can be used to help improve the agriclinics initiative from both demand and supply sides of the services they offer. More research is needed to understand variability in use of private agriclinics and agribusinesses across the different states and farming systems of India.

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