# Social Capital and Diffusion of Integrated Pest Management Technology: A Case Study in Central Luzon, Philippines[1]

**Florencia G. Palis[2], Stephen Morin[2, 3], and Mahabub Hossain[2]**

## Introduction

Social capital is a concept that can be utilized in any delivery approaches for the efficient transfer of agricultural technologies. Over the decades, technology adoption and diffusion in agriculture have always been a problem with no leap forward solutions in sight. Adoption is defined as a decision to continue full use of an innovation while diffusion is defined as the process by which an innovation spreads (Rogers 1995). Most studies conducted on this subject had always focused on individual attributes as factors contributing to successful adoption and diffusion of agricultural technologies. Human behavior, however, is the result of interactions and interrelations between people. Thus, using this concept enhances any approach to understanding technology adoption and diffusion in that it makes it more unified, holistic, and comprehensive by looking beyond the individual—at the individual in relation with another individual. It looks at the norms and values operating in social relations and it looks at the ethos of social relations.

One agricultural technology that has been promoted for more than two decades is the integrated pest management (IPM). It has been institutionalized to reduce the use of pesticides that caused harm to environment and human health, while sustaining food production (Pingali et al. 1994, Pingali and Roger 1995). From the 1970s to the late 1980s, IPM was focused on insect pests such that spraying of insecticide is warranted if the insect pest damage or insect pest population exceeds the economic threshold level (ETL) of a particular insect pest. The delivery was top-down through the traditional three-day lecture approach. However, in spite of the broad range of economic, environmental, and human health benefits of IPM, the technology did not gain widespread adoption among rice farmers (Goodell 1984; Wearing 1988; Palis 1990). But with the current IPM through the Farmer Field School (FFS), which used a farmer participatory approach and agro-ecosystem perspective, the technology was finally practiced among trained farmers, and to some extent, the non-trained farmers as well (Kenmore 1996; Palis 1998; Navarro et al. 1998, Mathoc 1999; Ooi 2000). Unlike with the transfer of technology (ToT) approach where it deals with the transfer of one knowledge system (scientists) to another (farmers), FFS emphasized experiential learning and enhancing farmers capacity to observe and make informed decisions. IPM through the FFS has gained success in many countries like in Indonesia, Philippines, Vietnam, Sri Lanka and Nepal (Kenmore 1996).

---

[1] Paper presented at the Social Research Conference, CIAT, Cali, Columbia, September 11-14, 2002.

[2] Anthropologists and Economist, Social Sciences Division, International Rice Research Institute (IRRI), Los Baños, Laguna, Philippines.
[3] United States Agency for International Development (USAID), Washington D.C.

Direct training of farmers with FFS is however too costly. In the Philippines, Quizon et al. (2001) estimated the training costs at US$47.6 per trained farmer. He noted that it would take over 34 years to have 3 million Filipino farmers attend at least one FFS at a total cost of about US$143 million. Thus, it is highly important to find an effective strategy in upscaling IPM with least cost, fastest and sustainable manner to reach farmers over a large geographical area.

This paper aims to introduce a perspective in facilitating the upscaling of IPM technology by employing the concept of social capital. Specifically, the study aims to: a) identify the effective sources of social capital that facilitates farmer sharing, learning and practice of IPM; b) assess the building up of social capital and its impact on the promotion of IPM adoption by understanding the process of farmer sharing and learning, and the spread of IPM practice; and c) utilize the identified effective sources of social capital in coming up with a strategy in up-scaling IPM in a swift, efficient, and spontaneous manner.

**Definition of Social Capital**

Social capital is a concept that bridges the disciplines of economics with other social sciences. The word “social” is closely associated with non-economists particularly sociologists and anthropologists, while the word “capital” is closely associated with economists. Social capital is defined in many ways depending on the discipline of the scientist who is defining it. Some of the definitions are:

“features of social life - networks, norms, and trust - that enable participants to act together more effectively to pursue shared objectives” (Putnam 1996).

"networks together with shared norms, values and understandings that facilitate co-operation within or among groups" (OECD definition, Cote and Healy 2001).

“….a variety of different entities, with two elements in common: they all consists of some aspects of social structure, and they facilitate certain actions of actors whether persons or corporate actors within the structure.” (Coleman 2000).

"Social capital refers to the institutions, relationships, and norms that shape the quality and quantity of a society's social interactions…it is the glue that holds them together." (World Bank Social Capital website).

Schuller et al. (2000) points out the following merits of social capital: a) It shifts the focus of analysis from the behavior of individual agents to the pattern of relations between agents, social units and institutions; b) It reinserts issues of value into the heart of social scientific discourse such as terms of trust, sharing and community which are central to it.; and c) It directly generates questions about the assumptions on human behavior on which analysis and policy are based. Thus, the concept of social capital directly challenges economic analyses that rely on the notion of maximizing individual self-interest as underpinning all behavior.

In this paper, we define social capital as resources derived from social relations such as networks, norms and trust that facilitate collective action. These resources are actually the products of the process of social relations. Social relations in turn are the products of enculturation. Hence, the sources of social capital and the type of social capital formed are largely determined by culture. Since culture among societies varies, the sources of social capital likewise differ. Though there may be some commonalities in some societies, most sources of social capital are distinctly associated in each society. In referencing Coleman, Fukuyama (1995; 1999) claims that the 'role of culture, and particularly spontaneous sociability, has been greatly underestimated by conventional economic analysis in explaining the large variations among societies that are otherwise at a similar level of development.'

## Research Methods

This study formed part of the Barangay (Village) Integrated Pest Management (BIPM) project, a collaborative project, which started in 1992 among biological and social scientists of IRRI, Philippine Rice Research Institute (PhilRice), Department of Agriculture (DA), and Food and Agriculture Organization (FAO). Entomologists, plant pathologists, economists and anthropologists worked together to determine the benefits, costs, institutional requirements, farmer training needs, and constraints to IPM implementation in irrigated rice ate the village level. In the process of collaboration, new questions emerged—how IPM spreads in the village, new objectives formulated—determine cultural pathways in facilitating IPM diffusion, and methodologies had evolved resulting to the integration of both quantitative and qualitative methods such as experiments, survey, GIS mapping, participant observation, case study, and direct observations.

### Research Design

A three-treatment experiment was conducted in the three villages of Nueva Ecija from 1992-1995 where each treatment corresponded to a village. These villages were chosen from the 11 identified potential sites after considering the following criteria: proximity to PhilRice, uniformity of soil characteristics, at least 30 farmers per village, high level of cooperation, presence of farmer organization, and planting synchrony within 30 days. Proximity to PhilRice was very important because of frequent monitoring activities on pests and natural enemies in the farmers' filed done by staff of IRRI entomology division and PhilRice.

Nueva Ecija is a province of Central Luzon, the rice granary of the Philippines. Farmers grow two rice crops a year: dry season (DS: December to May) and wet season (WS: June to October). The three treatments are as follows:

*Treatment 1: no early insecticide spraying (NES)*

The first treatment was the simple rule as a key element of IPM—the practice of no early insecticide spraying (NES). NES prescribed no insecticide spraying on the farmers' total rice farm area for the first forty days; as entomologists have demonstrated that insect attacks during this period does not affect yield, since the plant compensates any injury caused by the insect. It was implemented in La Torre, Talavera in the 1993 WS with 33 participating farmers. The farmers were chosen based on their proximity to the experimental site, which is a contiguous 60-ha rice area to ease farmers' fears that insects will transfer to their unsprayed fields if neighboring farmers sprayed (Palis, 1998).

There was difficulty in convincing NES farmers to withhold insecticide application for the first forty days on their entire rice farms. A strategy was devised as a way of convincing them to participate in the NES entire farm experiment following the approach of Heong et al. (1994). A mini-plot experiment in the farmers' fields was conducted during the 1992 WS. Fifteen farmers within the contiguous 60-ha experimental site consented to spare at least 500-$m^2$ plot from insecticide spraying for the first forty days after planting. The mini-plot experiment was repeated in the following 1993 DS. It was during this season that most of the 15 participating farmers stopped insecticide spraying on their entire farm, not only for the first 40 days, but for the whole duration of the crop. Technically, NES farmers are the 'no-insecticide-spray' farmers. When the NES was implemented in the 1993 WS, an additional 18 neighboring farmers were convinced to participate. Most of these additional farmers did not also spray their farms for the entire duration of 1993 DS. They imitated their farm neighbors, the 15 NES participating farmers. This resulted in no insecticide baseline information for the NES village in the DS. Seasonal monitoring was done until 1995 but was revisited in 2000 DS and WS.

NES village was revisited in 1999 and 2002, where a group of 25 non-NES farmers were randomly chosen to determine the spread of no-insecticide-spray practices.

*Treatment 2: with integrated pest management training (IPM)*

The second treatment was the integrated pest management (IPM) based on Farmer Field School (FFS) approach. IPM training was implemented in Matingkis, Munoz during 1993 DS with 28 participating farmers. These farmers were chosen from the Matingkis Multi-purpose Cooperative. The IPM training or FFS, lasted for 14 weeks (Feb.-May 1993), which is the entire growing season of the crop. It mainly consisted of weekly meetings that lasted half a day. Farmers tested IPM concepts or principles, such as growing a healthy crop, understanding and conserving natural enemies and regular field monitoring (preferably once a week) to determine necessary management actions through group experimentation in the field. FFS farmers were trained by fellow farmers from the nearby village of Bantug, Muñoz. These trainer farmers were trained by IPM experts from the FAO, IRRI and PhilRice.

Another set of 30 farmers in the village was randomly chosen to represent the internal control group, the non-trained farmers or non-FFS. They were selected from a village list of farmers, regardless of their affiliation to the village cooperative. Seasonal monitoring over time was done until 1995 for both FFS trained and non-trained farmers. Monitoring these non-FFS farmers provided information on the extent of the spread of IPM concepts and practices in the community.

The FFS village was revisited in 1999 to investigate the effective sources of social capital and further trace the diffusion process of IPM from the trained to the untrained farmers.

*Treatment 3: current practice (control)*

The third treatment was the control or current practice. Participants were 30 randomly chosen farmers from Sto. Rosario, Sto. Domingo, who represented those who used current insect pest control practices, which was merely chemical control. The farm activities of the sample farmers were regularly monitored and recorded from 1993 until 1995. In agreement with the local government, FFS was conducted in this village after the project.

## Data Collected and Techniques Used

Input-Output

Input-Output data of rice production were collected through household survey from the total 121 respondents of the three villages using a semi-structured questionnaire with personal interviews and field observations. Baseline survey was done in 1992 and regular periodic collection of the input-output data was done every season, until 1995 and 1999. Field observations were carried out to validate the data recorded through household surveys. The data includes:

- Rice farming practices by farm activities such as seedbed preparation, land preparation, crop establishment, crop care and maintenance, harvestingand threshing, haulingand drying, marketing as well as pest incidence and management practices.
- Amount and costs of all material inputs such as seeds, fertilizer, pesticides, machines, fuel, irrigation, among others;
- Llabor use and costs by farm activities classified by type, whether it is family, exchange or hired. Labor was measured in terms of man-days per hectare; and
- Yield and price of rice.

Pests and Natural Enemies

Entomologists from the Department of entomology at IRRI, together with some PhilRice staff monitored the population of pests and natural enemies present in the 58 farmer-cooperators at different stages of the plant using sweep nets and DVAC. The collection started in 1993 and ended in 1995, the end of the BIPM project. The data gathered here will verify if the farmers did the right decision with regards to their IPM practices, particularly in their pesticide usage.

Social Networks

The ego-centered network approach was used in determining farmers' personal network in the FFS village through informal and semi-structured interviews, key informant interviews, secondary data, and participant observation. The following questions were asked to the 58 farmers (28 FFS and 30 non-FFS) in relation to their day-to-day, face-to-face interaction with people in Matingkis in any normal day:

- Who do they usually meet and talk to everyday?
- What do they talk about?
- Where do they usually talk?
- What are their relationships to these people?

Farmers' organizations, membership, leadership, activities, and organization dynamics within the system were also explored through key informant interviews and gathering of secondary data.

Farm Map, Farm distance, GPS and GIS

The farm map generated by the *Matingkis* Irrigators Association was used. Using the Global Positioning System (GPS), strategic points in the farm map were located, and latitude and longitude of those specific points were noted. Through Geographic Information system (GIS), the farm distances between trained and non-trained farmers were measured and generated.

IPM Sharing from trained to non-trained farmers

The direction of information flow from a trained farmer to a non-trained farmer was explored through informal interviews using a semi-structured questionnaire, and field observations. FFS farmers were asked: a) To whom did they share information about IPM?, b) What is their relationship to persons whom they shared with?, and c) Why did they particularly share IPM to them?

IPM Learning by non-trained framers

The learning of the non-trained farmers about IPM was explored through informal interviews using a semi-structured questionnaire, and field observations. Non-FFS farmers were asked: a) Have they heard about IPM?, b) From whom did they hear about it?, c) Are they practicing IPM? (can be validated from the input-output survey), d) From whom did they learn IPM?; e) What is their relationship to persons from whom they learned IPM?; and e) How did they learn IPM?

Impact of IPM on the environment and human health

Historical information on the disappearance and reappearance of natural foods from the rice field environment, and perceived impact of IPM on the health of farmers and pesticide sprayers were gathered through a) interviews using a semi-structured questionnaire; b) focus group discussion; c) participatory mapping; and c) key informant interviews. Natural foods are foods from the paddy and the surrounding ecosystem such as fish, shrimps, and plants, among others.

**Data Analysis**

We used farm map, case presentations, direct quotations and observations were used in supporting qualitative inferences. We used graphical analysis and basic statistical tests like t-test, F-test, frequency distributions, chi-square test, Fisher's exact test, and logistic regression for quantitative inferences.

Historical changes of rice production inputs and output such as insecticide and herbicide usage, production, network data, among others, were shown using frequency distributions and graphical analyses by treatments. Chi-square and Fisher's exact tests were used in comparing proportions such as importance of personal networks, IPM sharing and IPM learning whenever is appropriate. Fisher's exact test was used in cases when cells had expected values of less than 5 observations. Cost and return analysis for each of the treatment group of farmers was also done over time, from 1992-1995. The t-test was used in comparing the mean differences on number of insecticide applications, yield, and net returns. The

F-test was applied in comparing variances of rice production and income to determine yield and income variability or stability. Comparison on yield and net returns were done before and after treatment implementation. Comparison across villages was not employed because there exist some site differences such as the topography and type of land, soil fertility and access to irrigation. For example, the NES village is a low-lying area, which is prone to flooding during WS, but it has the best access to irrigation during DS. Thus, it has the lowest yield during WS but has the highest yield during DS.

We used logistic regression analysis to estimate the probability of having a kin farm neighbor and non-kin farm neighbor within a gradation of 100 m to 500 m to quantitatively relate kin relation and farm distance; and further understand how social and spatial relations affect the growth and mechanisms of networks of interaction and interpersonal communication for learning process and knowledge acquisition of IPM. Spatial relation or field proximity is measured by physical distance in meters. The dependent variable is kin relation within a specified radius, where a farmer gets a value of 1 if he has a kin farm neighbor within a specified radius, otherwise 0 if he does not have one. The independent variable is the actual farm distance in meters.

In all the above quantifications, household map, farm map, case studies and other data gathered from participant observation, focus group discussions, and key informant interviews were used to supplement and give breadth to the cultural explanations of the resulting quantitative analyses.

## Results and Discussion

### Pre-treatment Use of Insecticides

All control farmers, and most of the NES and IPM-FFS farmers sprayed insecticides in both WS and DS at the baseline period (Table 2). The average number of insecticide application is statistically the same for all the participating farmers in both seasons. High insecticide usage, ranging from 1-7 insecticide applications, indicated a general perception that insects would cause harm by damaging the rice plant and consequently reduce yield and profit.

### Post-treatment Use of Insecticides

Insecticide spraying declined dramatically for both NES and IPM-FFS farmers to the extent that virtually no application was made in either season in the post-treatment years (Figures 1, 2 and 3). Control farmers on the one hand, continued to use insecticides in the belief that insecticides would ensure high yield. Palis (1998) found that farmers continuously spray insecticides in the belief that all insects are harmful and thereby lower yield. Entomological data showed very low pest pressure from 1992-1995 (IRRI BIPM Reports 1992-95).

### Yield and Net Returns

Farmers' yield from all the three treatments, before and after treatment implementation, was statistically the same. This implies that IPM sustains the same production level. In fact, Ramaswamy (1995) reported that IPM increased rice yield from 12 to 13% while Thrupp (1996) reported a 5-15% increase. This negates general farmers' perceptions that insects are important yield constraints (Litsinger et al. 1980, Heong and Escalada 1997). The average real net returns however increased for all the treatments: by 58% for NES in the WS; 11 to 43% for IPMin the WS and DS respectively; and by 26% for the Control in the DS (Table 5).

### Farmers' Social Capital

The major sources of social capital identified among Filipino farmers are kin networks, house neighborhood, farm neighborhood, and membership in a farmer's association. Table 4 shows the probability of farmers' daily social interaction in any ordinary day in the village. Results show that a farmer interacts more with his kin (0.70) than with a non-kin (0.30) implying that Filipino farmers' personal network is kin-based. This confirms the findings of Rolda (2001), Jocano (1997), Murray (1973), Bott (1957), and Barnes (1954) about the kin-based nature of network of relationship in a Filipino rural community. Kin interaction occurs regardless of whether the relative is a house neighbor (0.48) or a farm neighbor (0.44). Non-kin interaction, however, is more with a farm neighbor (0.51) than a house neighbor (0.15). Both kin and non-kin may also be house neighbors, farm neighbors, friends, fellow members of the village farmers' cooperative, and *kumpadre*.

Social capital operates in many levels in the village, particularly in agriculture and rural life. Lending money, exchanging favors, lending or exchanging food and labor are the common dynamic avenues in the building and creating closer social ties. One cultural avenue in the building of social capital in the Philippines in relation to technology sharing and learning is through *huntahan*.

*Huntahan* is the Filipino word for a group of two or more people holding a conversation or informal discussion. You can find people doing *huntahan* along the road, in the house neighborhood, in the variety or *sari-sari* store, in the market, in the farm and everywhere. Among the adults, *huntahan* is also called *tsismisan* (gossiping) or *kwentuhan* (conversing). The young people, on the other hand, call it *tsika*, *tsika-tsikahan,* and *kwentuhan*. *Huntahan* adds color to the Filipino farmers' everyday life in the village.

*Huntahan* in the neighborhood is a common scene where you often see people just sitting outside the house in a bamboo bench or under a tree talking, laughing, and sometimes playing cards, or drinking as depicted in Figure 4. Conversation in the house neighborhood is generally wider in scope and the more common topics discussed are family affairs, politics, "hot" events in the village, and gossips. In any case, when farming is discussed in these situations (i.e. playing cards and drinking), the new technologies introduced will more likely not get enough attention.

Farmers interact and converse among themselves in many occasions in the farm. Neighboring farmers gather themselves into small groups chatting while in the field as illustrated in Figure 5. This usually happens when they drain or let the water come into their fields. They also engage in discussions while resting in a hut (*kubo*) or pump house (*kubo ng bomba*) near the field, especially when there is a drizzle and farmers seek shelter from the rain. Other occasions when they walk through the fields going to their respective farms, when taking lunch, and when they go home together.

Discussion in the farm neighborhood focuses more on rice farming and other on-farm and off-farm livelihood prospects. It is common for farmers to discuss the growth and development of their rice crop, rice production problems and possible solutions to those problems, and other issues associated with the rice production enterprise. They compare the 'health' of their respective crops and seek advice from one another in handling symptoms, which they think are not good for the crop.

**Impact of Social Capital on Sharing of IPM Knowledge**

A trained farmer is more likely to share IPM technology with a relative (0.63) than with a non-relative (0.37) (Table 5). This confirms the findings of Rola (1998) and Tanzo (1996) that farmer sharing of agricultural technologies is more among relatives. Likewise, IPM sharing with both kin and non-kin will more likely take place in the farm (0.60) than in house neighborhood (0.18).

Farmer sharing of IPM from a trained farmer is more directed to his relative because:

- Kin talk to each other more than non-kin because they live and work near each other.
- Filipinos highly value kin relations.
- Filipinos are taught to be loyal, honest, and sincere to family and kinfolk.

*Pagkamatapat* (sincerity/loyalty) is highly encouraged, and even enjoined among kin members. There is trust existing among relatives, especially among members of the nuclear household. This is clearly illustrated in the case of Adong and tata Isyo showing the importance of source credibility in getting information. Non-trained kin members would never think that the trained kin would deceive them, nor just showing off.

*Ang Sabi ni Kuya (My brother says)*

*Sabi ni Adong, natuto ako ng IPM sa kuya ko na si Manong Isyo. Tinuruan niya ako kung paano makilala ang mga hayop na kaaway at ang mga kaibigan at iba pa. Sabi ni kuya, huwag na akong magbomba pag mas marami ang mga kaibigan. Kaya hindi na ako nagbomba.* (According to Adong, he learned PM from his older brother Manong Isyo. His brother taught him how to distinguish harmful insects from beneficial ones. He told me not to spray if the friendly insects outnumber the harmful ones. So I did not.)

*Baka sabihing ako ay mayabang (They might think I am boastful)*

According to Tata Isyo he did not share his IPM knowledge with his farm neighbors who are not his relatives. He said: *baka isipin nila na ako ay mayabang, hambog, at nagmamagaling sa kanila* (they might think I am boastful, a show-off, and more knowledgeable than them). This shows that a trained farmer (as exemplified by Tata Isyo) may not share his IPM knowledge with non-relatives for fear of being labeled negatively. In contrast, sharing with a kin is no problem because of the existing trust among kinfolk.

- Associated with loyalty is giving assistance to kin members first before anyone else especially the members of one's immediate family –'charity begins at home.'

A trained farmer sharing about IPM with a non-trained kin farmer is actually helping a relative in many ways such as financial assistance and minimizing exposure to pesticide hazards. The practice of IPM enables a farmer minimized his production costs and attain higher farm income; and saved from the drudgery of pesticide spraying which consequently reduced farmers' risks to pesticide health hazards.

- Loyalty is tied to another value--reciprocity. It is expected that those who are helped in their time of need will return the favor when the opportunity comes. We also call this *utang na loob* (debt of gratitude). So, a trained farmer sharing IPM with a non-trained kin farmer can also be regarded a form of repayment from *utang na loob* or depositing a help to be withdrawn later when need arises.

**IPM Learning by Non-trained Farmers**

According to the non-trained farmers, they learned about IPM more from trained farmers who are their farm neighbors (0.82) than house neighbors (0.30), indicating that IPM learning happens more in the field (Table 6). These farm neighbors can either be their kin (0.75) or non-kin (0.88).

The proverbial saying, "To see is to believe," was at work here. Farmers had to see before they finally adopted a technology. One farmer commented: "Pag hindi nakita, mag-iisip ang tao; pag nakita na, hindi na mag-iisip." (If you haven't seen it, you still have to think and evaluate; but if you have seen it, you don't have to do that). The element of doubt creeps in when a farmer just heard of it. He still needs to evaluate whether what they are saying is true. However, if he has a farm neighbor who is an IPM practitioner, he does not need to be convinced any more because he can validate new information through actual onsite observations. He can discuss his concerns with his neighbor and learn from him right there in the field.

IPM in fact became a common topic of conversation in the house and farm neighborhood, and during cooperative meetings. The awareness stimulated their curiosity and drove them to carefully observe what the neighboring IPM trained farmers are doing. Aside from observing these neighbors, the farmers became inquisitive and sought explanations for what they were doing. All these resulted in spontaneous discussions in the farm about IPM. Non-trained farmers then evaluated the outcome in the farms of the trained neighbors. The consequence was the spread and learning of IPM practices. Social learning in this case happened naturally.

Sharing and learning of IPM knowledge happen more in the farm than in the house neighborhood among both kin and non-kin primarily because:

- The discussion in the house neighborhood is wider in scope while that in the farm neighborhood is more focused on rice farming and other related farming issues;
- Farmers had actual observations, actual experimentation, and actual learning in the farm;

- Farmer interactions for both kin and non-kin happened more in the farm because Farmer's time is often spent in the farm—the farmers' workplace.

Rice farming is a strenuous activity, which involves a number of activities starting from seedbed preparation, land preparation, crop establishment, crop care and maintenance, harvesting, threshing, and postharvest activities. It takes 4-5 months of labor-intensive activities before a farmer reaps returns from his investment depending on whether the rice variety is early or late maturing. The farmer needs to visit his farm regularly to monitor the crop growth until harvest to ensure good yields, and thus, a farmer's time is most spent in the farm than in the residential neighborhood.

### Impact of Social Capital on IPM Diffusion

#### *FFS Village—Insecticide Use*

There was a strong spillover effect in terms of reductions in insecticide use (Figure 6). The proportion of insecticide users among the non-FFS farmers dropped considerably from more than 95% for both seasons in 1992 to 35% in 1995 DS and 29% in 1995 WS. In 1999, FFS farmers had zero insecticide application in the DS and less than 10% in the WS. The proportion of insecticide users among non-FFS farmers remained at 30% in both seasons of 1999.

According to the cooperative chairman, at the time the FFS was being conducted (1993 DS), the school lessons were being discussed in the cooperative meetings. But most of the untrained farmers did not believe in the IPM philosophy as reflected in their high pesticide use during the training period. But when the non-FFS farmers saw from their trained farm neighbors that IPM works, and that there are benefits derived from it, they became interested, resulting in their adoption of IPM practices (Figure 6). From the mouth of the cooperative chairman, "*Ang IPM ay kusang lumaganap sa barangay*" (IPM spontaneously spread in the village). Indeed, IPM naturally and swiftly spread in the village.

Logistic regression models were done to estimate the probability of having a kin farm neighbor and non-kin farm neighbor within a gradation of 100 m to 500 m radius. Table 7 shows that neighboring farm owners are more likely kin-related in farm location within the 100 to 300 meter radius while as the radius increased to 400 and 500 meters, farm owners were either kin related or non-kin related. Figure 7 demonstrates that kin related individuals work together, and that farm interaction can occur among both kin and non-kin farm neighbors, as shown in the grouping of five local kin groups. The egos, ego1-ego5 were trained farmers coming from different kin groupings. The nearest farm distance among non-trained farmers may come from a field owned by a relative or a non-relative as in the case of ego1: the nearest farm of his other son and one nephew was owned by ego5 who was not a relative. Information flowed first from a kin, but field observations and the farm *huntahan* can be done in surrounding farm neighbors, be it with a relative or a non-relative confirming the findings in Table 6.

#### *NES Village—Insecticide Use*

A set of 25 non-NES farmers was randomly chosen with consideration to distance from the NES contiguous 60-hectare experimental site in 2002 DS and WS. The majority of NES and non-NES farmers did not spray insecticides in both wet and dry seasons (Table 8). However, most of the non-NES farmers had practiced the no-insecticide spray on the average after 5 years of NES implementation. In fact there were a number of them who had no knowledge about the no-insecticide-spray practice. The slow diffusion in this village can be attributed to the location of participating farmers; their farms are located in a contiguous area, which confines or limits the sharing and learning of the NES technology among kin groups and non-kin owners within that area (Figure 8). Whereas, in the FFS village, the farms of participating farmers are geographically distributed (Figure 9) producing a fast and natural spread of the technology due to the presence of different clusters of kin groups found in the farm. This implies that the spontaneous sharing and learning about a new technology in the farm would be maximized when the farms of farmers practicing it are widely and spatially distributed. Kinship therefore is the radius of spontaneous sharing, whereas the farm is the radius of spontaneous diffusion, where both sharing and learning happen.

## Conclusion

The integration of qualitative and quantitative methods resulted in illumining insights about the investigated social phenomena—the impact of social capital on IPM diffusion. Both methods are complementary. The qualitative method gives substance, context, and meanings on the quantitative results. It also helps refine and gives focus on the questions to be included in the collection of quantitative data. In like manner, the quantitative method gives basic information in many issues and gives direction on what specific domains where in-depth understanding is needed through qualitative method.

The major sources of social capital identified among Filipino farmers are kin networks, house neighborhood, farm neighborhood, and membership in a farmer's association. Kinship holds primacy among the social relations of Filipino farmers. It is characterized by strong ties, mutual trust, and norms, which promote coordination and cooperation for mutual benefit. The kinship factor reduces transaction cost in the sharing of IPM. Secondary to kinship is farm neighbor relationship. The geographical dimension of farmers' activities is a major factor in determining the locations in which social interactions take place. The farm is the community space where sharing and learning of technologies like IPM happen for both kin and non-kin. In a society where farms of local kin groups are not located near each other, farm location is a critical factor to consider in planning a strategy to identify participants.

Both kinship ties and farm location are factors to consider in developing a sampling scheme to identify IPM participants. Kinship is the radius of spontaneous sharing, whereas the farm is the radius of spontaneous diffusion, where both sharing and learning happen. This in effect, results in a fast and spontaneous diffusion of IPM technology. Thus, social capital is a way of enhancing the efficiency of farmer-to-farmer extension. It reduces transaction cost, lower the cost of information, and at the same time facilitates cooperation, coordination and action—adoption of technologies.

**Acknowledgment**

We thank Drs. Prabhu L. Pingali, Dale Bottrell, Santiago Obien, Peter Kenmore, and Sam Fujisaka who were instrumental in the implementation of the study.

**References**

Barnes JA. 1954. Class and committees in a Norwegian island parish. Human Relations 7: 39-58.

Bott E. 1957. Family and social network. London: Tavistock.

Cañedo FM. 1980. Change Agents Perceived Credibility and Their Influence in the Innovation-Decision Process of Development Programs. PhD dissertation. Los Baños, Laguna (Philippines): University of the Philippines.

Coleman J. 2000. Social Capital in the Creation of Human Capital. In: Dasgupta P, Serageldin I, editors. Social Capital: A Multifaceted Perspective. Washington, D.C.: World Bank. p 13-39.

Cote S, Healy T. 2001. The Well-being of Nations. The Role of Human and Social Capital. Paris: Organisation for Economic Co-operation and Development.

Fukuyama F.1995. Social Capital and the Global Economy. Foreign Affairs. 4(5):89-103.

Goodell GE. 1984. Challenges to International Pest Management Research and Extension in the Third World: Do We Really Want IPM to Work? Bull. Entomol. Soc. Am. 30:18-26.

Heong KL, Escalada MM. 1997. Perception Change in Rice Pest Management: A Case Study of Farmers' Evaluation of Conflict Information. Journal of Applied Communications 81: 3-17.

IRRI SSD Survey. 1989. A Survey on the Overview of Pesticide Usage in Central Luzon, Philippines. Unpublished.

Jocano FL. 1997. Filipino Value System : A Cultural Definition. Manila (Philippines): Punlad Research House.

Kenmore PE. 1996. Integrated Pest Management in Rice: Biotechnology and Integrated Pest Management. UK: CAB International.

Litsinger JA, Price EC, Herrera RT. 1980. Small Farmer Pest Control Practices for Rainfed Rice, Corn, and Grain Legumes in Three Philippine provinces. Philippine Entomologist 4:65-86.

Mula R. 1999. Coping With Mother Nature: Households' Livelihood Security and Coping Strategies in a Situation of a Continuing Disaster in Tarlac, Philippines. MA Thesis. Wageningen University.

Murray F. 1973. Lowland Social Organization II: Ambilineal Kin Groups in A Central Luzon Barrio.

Ooi PAC. 2000. From Passive Observer to Pest Management Expert: Science Education and Farmers. In: Guijt I., Berdegue JA, Loevinsohn M, Hall F, editors. Deepening the Basis of Rural Resource Management. Proceedings of a Workshop, 16-18 February, 2000, ISNAR, The Hague, Netherlands. Netherlands: ISNAR and RIMISP. p. 167-178.

Palis FG. 1998. Changing Farmers' Perceptions and Practices: The Case of Insect Pest Control in Central Luzon, Philippines. Crop Protection 17(7):599-607.

Pingali PL, Marquez CB, Palis FG. 1994. Pesticides and Philippine Rice Farmer Health: A Medical and Economic Analysis. American Journal of Agriculture Economics. 76: 587-592.

Pingali PL and P. Rogers. 1995. Impact of Pesticides on Farmer Health and the Rice Environment. International Rice Research Institute, Philippines.

Putnam R. 1995. Bowling Alone: America's Declining Social Capital Journal of Democracy 6 (1) 65-78.

Quizon J, Feder G, Murgai F. 2001. A Note on the Sustainability of the Farmer Field School Approach to Agricultural Extension. Discussion paper.

Rogers E. 1995. Diffusion of Innovations. USA: Macmillan Company.

Rolda RS. 2001. A Commissioned Report to the Department of Agriculture. Department of Agriculture, Quezon City, Philippines.

Schuller T, Baron S, Field J. 2000. Social Capital: A Review and Critique. In: Baron S, Field J, Schuller T, editors. Social Capital: Critical Perspectives. UK: Oxford University Press. p 1-38.