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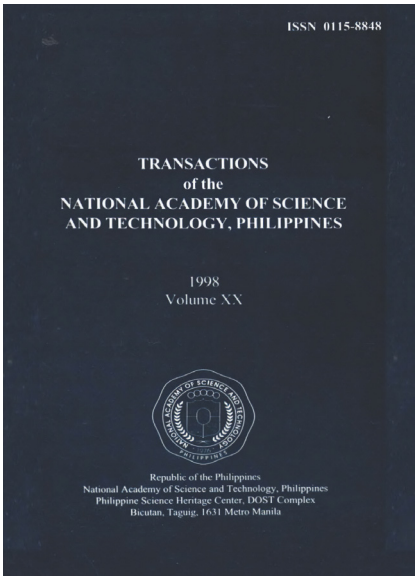

The Adoption of Improved Mungbean Varieties in Two Rice-Based Villages in the Philippines: A Network Analysis

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THE ADOPTION OF IMPROVED MUNGBEAN VARIETIES IN TWO RICE-BASED VILLAGES IN THE PHILIPPINES: A NETWORK ANALYSIS

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ABSTRACT

The communication networks among 173 rice-mungbean farmers in two rural villages (rainfed and irrigated) in Pangasinan were analyzed and related to their adoption of improved rice-mungbean technology. The incorporation of network variables with non-network variables (e.g., socio-economic, agricultural, etc.) greatly contributed to understanding the significantly higher adoption in Nancayasan compared to Carosucan. The Nancayasan farmers had significantly higher spatial distance scores, or they interacted with more dispersed farmers within the village, and had higher betweenness centrality scores or there were more information 'brokers' or liaisons that mediated agricultural information flow in the village. Nancayasan is also near the Urdaneta market where farmers actively seek vital market information and supply of new varieties from market traders.

The blockmodelling analysis vividly highlighted shortcomings of the diffusionist paradigm's concept of information flow, from innovators/leaders to others throughout the community. Results revealed the potential disadvantage of groups of farmer-cooperators turning into a "select group", isolated from other groups in the community and having little or no reciprocated ties with them, hence limiting the spread of adoption. In the stepwise regression analysis, five social network variables influenced adoption: connectedness; reciprocity; and heterogeneity in television ownership, radio use, and credit availment.

Key words: Rice-mungbean technology, rainfed rice-based farms, technology adoption, communication or social network analysis, blockmodelling analysis.

INTRODUCTION

Transactions in a village are intertwined in various interlocking and overlapping networks of social relationships, within which there is an exchange of goods, services, mutual supports, and information. Hence, social structures can

impede or facilitate the diffusion and adoption of new ideas in a community system (Stuart 1981). Premised on the convergence model of communication (Rogers and Kincaid 1981) and using the social network analysis approach (Wasserman and Faust 1992; Rice and Richards 1985), this research attempted to analyze the effect of the communication structures of two rural communities (rainfed and irrigated) on the farmers' adoption of improved rice-mungbean technology.

Network analysis is a type of research in which the sociometric data about communication flows or patterns are analyzed by using interpersonal relationships as the units of analysis (Rogers and Kincaid 1981). Hence, the effects of networks or communication exchange relations on behavior change 'contextualized' respondents in a social structure, a reality often neglected by past diffusion-adoption studies which attributed adoption mainly to various socio-economic and pyschological traits of farmers, and on the characteristics of the innovation (Feder, Just, and Zilberman 1985; Herdt and Capule 1983).

MATERIALS AND METHODS

Sites and Respondents

The population of the study consisted of 173 farmers from two major mungbean-growing villages in the province of Pangasinan: 77 in Carosucan, Sta. Barbara and 96 in Nancayasan, Urdaneta. These comprised 73% and 70% of the population of the villages, respectively. The distance between the villages is approximately 18 kilometers.

Carosucan is a rainfed village with 142 ha which has been the target of various sustained and intensive crop-livestock and women development programs under the IRRI-Asian Rice Farming Systems Network since 1984. It was a pilot area for on-farm trials of rainfed rice-mungbean cropping systems using mainly the Pag-asa variety series (3, 5, and 7). Nancayasan is a larger (604.18 ha) irrigated village where a few farmers have been involved in the MDAP project of DA-PCARRD promoting the Taiwan Green variety in 1987. However, growing of the Pag-asa varieties began as early as 1980 by a retired DA technician who got the seeds from IPB and gave the seeds to four farmer-cooperators.

The sampling unit consisted of all rainfed rice farmers-residents in the two villages who have planted improved mungbean varieties for at least five years. The communication structures in the villages were measured though personal interviews with sociometric survey questions from November 1992 to March 1993.

Using snowball sampling, five random farmers from the master list were asked to name five villages with whom they frequently consulted with regarding rice-mungbean cropping technology. The named villagers formed the second phase of the interview and they were likewise asked to name their five sociometric peers. This procedure went on until the possible sample was exhausted in the

villages. The responses were coded in who-to-whom binary sociomatrices. Non-participant observation, social interaction with some residents, use of key informants, and immersion in the villages were used to study the dynamics of social interaction.

Variables and Data Analysis

Adoption, the dependent variable, was measured by the planting of improved rice and mungbean variety and the practice of 10 recommended cultural practices. Higher scores indicated higher adoption.

The independent variables consisted of 32 non-network variables or the demographic, agricultural, socio-economic, media exposure, and agricultural program participation profiles of farmers; 32 network variables measuring their similarity or homogeneity in these non-network traits; and seven communication network variables. The network measures were spatial distance, strength, reciprocity, connectedness, and three measures of centrality: indegree, closeness, and betweenness.

Centrality scores measured 'prestige' or 'power'. Higher indegree centrality measured the number of ties received from others, hence pinpointing the opinion leaders or sociometric leaders in the network. Higher closeness scores indicated that farmers were closer to all the communication ties. Higher betweenness scores indicated that more communication passed through the farmers, thus increasing their control over information. Betweeneess measures were used in the study to identify the liaison, information 'brokers', or gatekeepers in the network.

Higher spatial distance score indicated that the five members of the farmer's personal network were widely dispersed in the village. Higher strength score indicated that the farmer interacted more frequently with his/her sociometric peers. Higher reciprocity score indicated that more of his five sociometric choices also returned his communication interaction. Higher connectedness meant that the farmer was linked to more individuals in the whole network or system.

Network analysis including blockmodelling was done using UCINET4 (Borgatti, Everett, and Freeman 1992). The means of both villages in all the independent and dependent variables were compared using the Fisher's *t*-test. A stepwise regression analysis was employed to determine the predictive values of the independent variables to adoption behavior.

RESULTS AND DISCUSSION

Information Networks in the Village

Nature of communication network links. Family and kin or clan exerted a strong influence in the communication process in the villages. Of the 865 links in both villages, the sociometric links of farmers involved members of the immediate family (14.8%), relatives (32%), and non-relatives (53%), specifically neighbors.

First contact and seed supply of improved mungbean seeds. Majority of the farmers first heard about the new varieties and secured their first batch of seeds through interpersonal contacts (co-farmers and relatives) within and outside the village. Only 12 percent (e.g., cooperators) learned about the varieties from research agencies and 9 percent obtained their first seed supply from these agencies.

Dynamics of seed exchange. Improved seeds were exchanged primarily through a network of co-farmers mainly through exchange labor during mungbean harvesting. Harvesting became a family effort and community activity, even a yearly ritual, involving co-farmers in the village and in neighboring villages or kins. Almost two-thirds (67%) hired from 1-10 farm hands and 22 (17%) even employed as many as 26-30 workers, especially in large farms. Farmers were paid in kind – 1/5 of their seed harvest – rather than cash. Harvesters alternated in harvesting mungbean in each other's fields in the traditional 'bayanihan' (unity) spirit, bound by kinship and friendships. Even the relatively better-off farmers and farmer-leaders actively worked as exchange-laborers in neighboring or farther villages to avail of newer varieties they had reconnoitered beforehand or heard from other farmers and traders. Hence, exchange labor and seed payment schemes served as effective venues for seed exchange and improved seed dissemination especially for low-resource farmers.

Role of government seed growers vis-à-vis commercial traders. Of the other sources of seed technology, a fifth of the farmers unexpectedly regarded traders more positively than the legitimate seed growers in both villages who sold seeds commercially. They adopted an observe-and-see attitude towards seed growers, often comparing their farms with that of non-seed growers whom they considered farmer-leaders. Whoever had good crop stands and obtained better yields was considered more credible, and from whom they asked for seeds through seed exchange. There have been cases when seed growers who did not share seeds had their farms 'sabotaged' or mixed with seeds of other varieties or 'off types'.

Adoption

Stepwise regression analysis of independent variables on adoption. Stepwise regression analysis showed that four variables accounted for 10.8 percent of the adoption of improved rice varieties; seven variables accounted for 25 percent of the adoption of improved mungbean varieties; and 10 variables accounted for 53.7 percent of the adoption of improved mungbean technology. Five social network variables, namely: connectedness; reciprocity; and heterogeneity in television ownership, radio use, and credit availment, influenced adoption (Table 1).

Higher adopting village. The higher adoption rate in Nancayasan despite the more intensive agricultural programs in Carosucan can be attributed to a number of factors. In network analysis terms, this is because Nancayasan farmers had significantly higher spatial distance scores or they interacted with more dispersed farmers within the village rather than just with close neighbors as in Carosucan.

There were also more 'information brokers' connecting information flow between villagers in Nancayasan (9) compared to Carosucan (5) and its number one farmer-leader was connected to more farmers in the village (35%) than the number one farmer-leader in Carosucan (21%).

Being near the Urdaneta market, the Nancayasasn farmers also networked heavily with another previously 'unrecognized' group – the market traders. The traders served three important purposes: as ready and accessible source of seeds, as technology information brokers, and as 'lookout' for new sources of good

Table 1. Summary of best predictor variables of adoption of rice-mungbean technology from stepwise regression analysis.

Variables	Adoption of agricultural innovation		
	Rice variety R2 change	Mungbean variety R2 change	Mungo technology R2 change
Demographic variables			
Educational attainment			.005(+)
Agriculture variables			
Farm location		.108(–)	.093(+)
Farm area planted to mungbean		.025(–)	
Role of women in mungbean farming		.009(+)	
Credit availability			.013(–)
Socio-economic			
Farm assets	.010(+)		.247(+)
Gross income from mungbean		.034(+)	
Organization membership		.057(+)	.014(+)
Communication exposure			
Interpersonal contact-DA staff	.069(+)		
Radio ownership	.013(+)		
Magazine ownership			.012(–)
Magazine use			.038(+)
Interpersonal communication network			
Reciprocity		.007(+)	.006(–)
Connectedness			.075(+)
Proximity			
Heterogeneity-television ownership	.016(+)		
Heterogeneity-radio use		.006(+)	
Heterogeneity-credit availment			.006(+)
R2	10.8%	24.6%	53.7%
F-value	5.0932	7.7263**	18.7856

**Highly significant at 1% level of probability;

planting materials. As technology information brokers, traders, especially the *sukis,* provided the actively information-seeking Nancayasan farmers with up-to-date market information about new and popular varieties, their relative prices and supply and demand. As part of 'customer service', they also gathered valuable production technology from other farmers with good harvest and shared these with farmer-buyers. Further, they served as 'unofficial lookouts' of potential farms in other villages where farmers could possibly work as exchange laborers during harvest to secure seeds of a good variety.

Higher adopters. Higher adopters interacted more without side subsystems through interpersonal contacts in the DA and other research agencies, and through their participation in agriculture programs. They were also more heterogeneous in media use and age. The highest adopters were also the groups found spatially near the village entrance or the more accessible areas of the villages.

Blockmodelling Results

The blockmodelling analysis which grouped the 'structually equivalent' farmers showed that the high adopters in each village constituted a small closely knit and highly interacting group who communicated almost exclusively with others who had similar communication patterns as themselves. This fact was glaring because the blocks of 'highest' adopters in both villages stood 'apart' in the graphed image matrices, neither interacting or being interacted upon by other mid-range and low adoption blocks. They did not receive any directed ties, contrary to expectations that they would be sought out by the three other blocks in the villages (Tables 2, 3; Figures 1, 2).

These imply three things (1) In practice, the higher adopters tended to group themselves together and interacted most frequently with similar others (kin members and closer neighbors), hence, reinforcing their knowledge and information of new agricultural technologies. Higher adoption in this sense, bred higher adoption among a group socially and physically close to each other; (2) Farmers *may not always* seek information from farmers whose advice they valued or whom they considered farmer-leaders of 'best farmers' (e.g., DA technicians in the villages, seed growers) but they keenly observed their farms and consciously or unconsciously adopted improved practices through 'imitation' rather than active information exchange; and (3) There were conspicuously no reciprocal links to the high adopter groups, hence there is a potential of high adopter groups turning into a 'select exclusive' group, unable to 'radiate' and diffuse technology to the village networks as the program planners assumed.

CONCLUSION

Farmers who were connected to more communication links in the village tended to adopt improved mungbean technology and those with more reciprocated links with sociometric peers also tended to adopt improved mungbean varieties.

Table 2. Blockmodel partition for Barangay Carosucan.

Block	N = 77	Farmer-members
1	17	1 2 3 **4** 5 6 **7** 8 **9** **10** **11** **12** 13 14 17 62 70
2	25	16 19 24 25 43 45 46 47 48 49 50 51 **52** **53** **55** **56** 57 **58** 60 **61** **63** 66 67 68 71
3	23	15 18 20 21 **22** 23 **26** 27 28 29 30 31 32 33 **34** 35 **36** 37 **38** 39 40 41 42
4	12	44 54 59 64 65 69 72 73 74 75 76 77

Bold and underlined = sociometric leader and liaison/information broker
Bold = sociometric leader
Underlined = liaison/information broker.

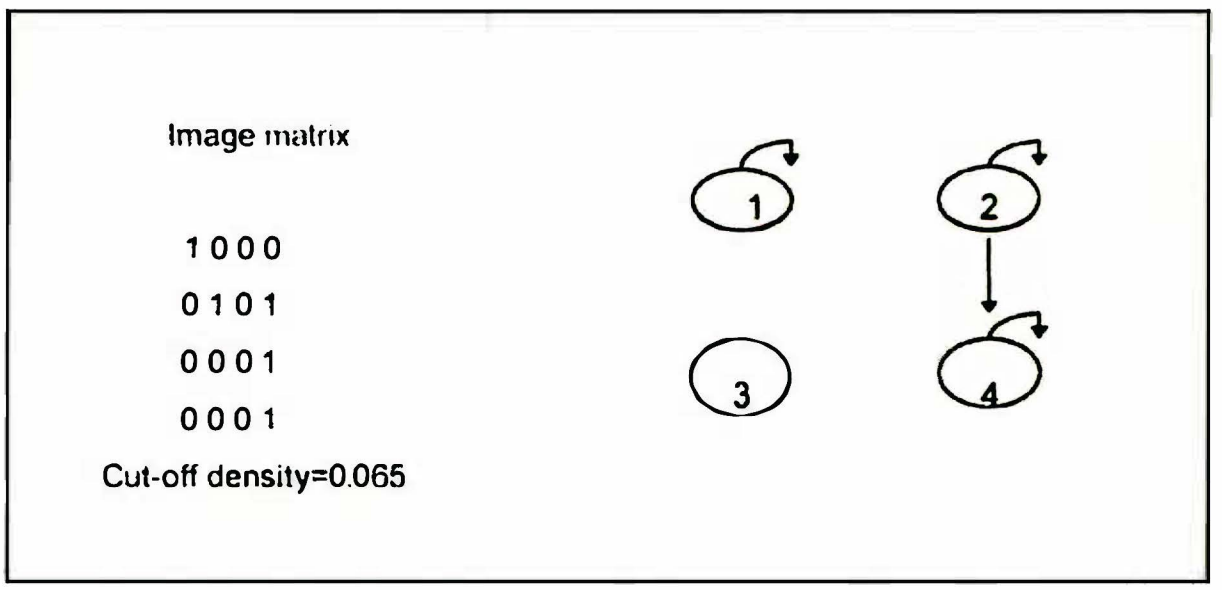

Figure 1. Sociogram of the information exchange for Carosucan.

For improved mungbean technology to diffuse faster to the system, the ideal network structure is an open system of information exchange: from the outside subsystem (e.g., DA staff and other researchers) to the blocks or groups of farmers within the villages and between the blocks especially among the high and low adopters. This can be accomplished in various ways like: the involvement of the sociometric leader farmers in other blocks as farmer-cooperators in agriculture programs; the diffusion of information to sociometric leaders in other blocks who may not be cooperators; the involvement of farmers in the less physically accessible areas of the village; and the greater involvement of boundary spanners or those with internal and external networks (e.g. Farmer #11 in Carosucan and Farmer #65 in Nancayasan) who served as 'liaisons' or 'gatekeepers' between the village network and the environment (outside subsystem) in technology dissemination.

Table 3. Blockmodel partition for Barangay Nancayasan.

Block	N =96	Farmer-members
1	24	1 **2** 3 4 5 6 7 8 9 10 11 12 13 **14** 15 16 17 18 19 20 21 **26** 37 48
2	29	34 35 53 50 **61** 62 **65** 66 69 71 75 76 77 78 79 80 81 82 83 **84** 86 **87** 88 90 92 93 94 95 **96**
3	26	38 40 41 **42** 43 44 45 49 51 52 54 55 56 57 58 59 **63** 64 67 68 70 72 73 74 89 91
4	17	22 23 24 25 **27** 28 29 30 31 32 33 36 39 46 47 50 85

Bold and underlined = sociometric leader and liaison/information broker
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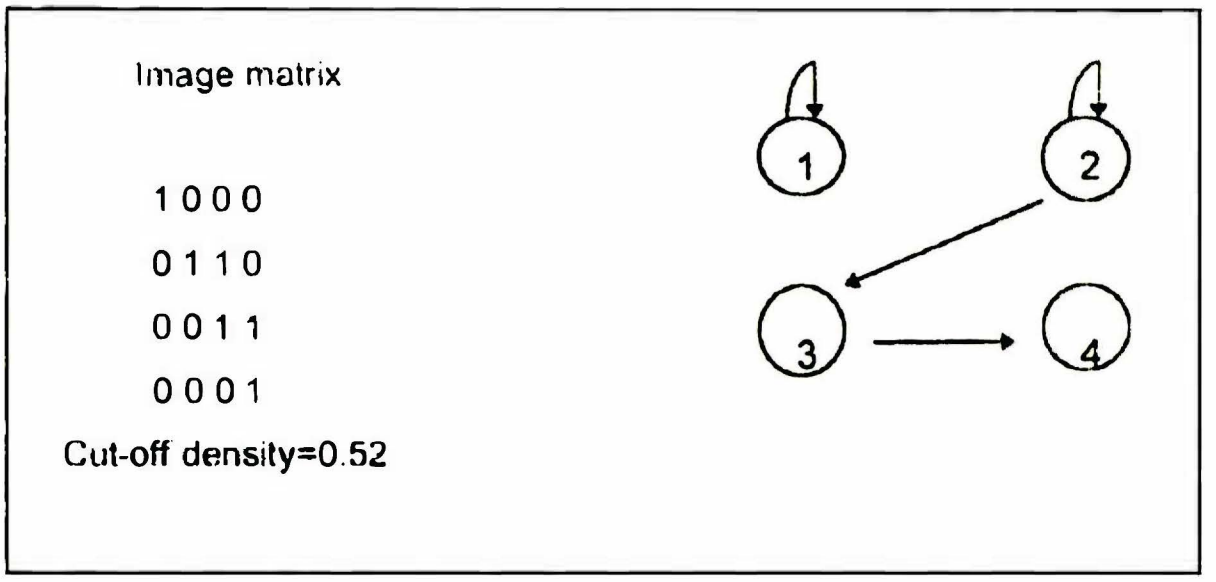

Figure 2. Sociogram of the information exchange in Nancayasan.

A major factor in changing the situation, however, will have to come from the research and extension agencies themselves in the selection or involvement of farmers in on-farm trials. There have been attempts to increase farmer participation in the design, management, and implementation of on-farm trials (e.g., CIAT's projects on farmer-managed trials; see Ashby et al. 1989), the involvement of non-selected groups of farmers but the whole village, and the targeting of the so called non-innovative 'laggards' (Rolings, Ascroft, and Wa Chege 1981). Development workers need reorientation from placing the full responsibility of adoption on farmers but on their own planning and implementation of extension projects.

Overall, the results showed the importance of communication network variables; interpersonal communication; heterogeneity, especially for age and mass media use, over homogeneity variables; and the openness of the system to other subsystems. It also shows the richness which network variables can add to otherwise static data in understanding and predicting the adoption of rice-mungbean technology.

Implications and Recommendations for Agricultural Research and Extension Strategies

Farmers vs. extensionists as information sources. In small farming systems, farmer-to-farmer information transfer is responsible for increased awareness of information on varieties. But the extensionists are still needed for their technical expertise, especially on new technological inputs beyond farmers' experience (e.g., chemicals, pesticides).

Role of market traders. Extension agencies can probably explore the possibility of involving market traders in their training programs on mungbean seed production and marketing or in the long run, increase the flow of market information among farmers so they would not depend solely on market traders, especially unscrupulous ones. The study showed that some traders actually were important in passing on vital market information and in acting unconsciously or unintentionally as 'technology information brokers' about mungbean technology. A disadvantage to this is the lack of agriculture background and training of traders and the possibility for them to pass on inaccurate information (e.g., varietal name, production technology) or their monopoly of market information.

Seed exchange: a community tradition vs. breeders' innovation. While promoting improved varieties, development planners should also consider the role of traditional seed exchange in the communities. Farmer-to-farmer seed-exchange within and outside the village through kinship or exchange labor during harvest was prevalent. While this can not assure the genetic purity of seeds, and may lead to losing the identity of the breeding agency and the incentive for farmers to buy new seeds, the system fosters cooperation, mutual assistance, and helps the poor farmers access improved seeds they would not normally be able to afford from the market. Totally supplanting seed exchange for other systems that require farmers to purchase new seeds every planting would marginalize them further rather than improve their productivity. Or it can promote higher productivity among a few select farmers while marginalizing those farmers who cannot afford the new seeds.

The solution can start from the supply side by strengthening sources of seeds like farmer cooperatives which produce legume and rice seeds through institutional support. For farmers to appreciate improved seeds better, the extension service could help expound the differences of seed categories just like in rice (e.g., registered, certified), the importance of improved varieties, and the advantage of maintaining pure stands of varieties separately in the fields to avoid mixtures and ensure higher yields.

Rice, R.E., and W.D. Richards, Jr. 1985. An overview of network analysis methods. In B. Dervin and M.J. Voigt (eds.) Progress in Communication Science, No. 6 Norwood, New Jersey, Ablex Publishing Co.

Rogers, E.M., and D.L. Kincaid. 1981. Communication Networks: Towards a New Paradigm for Research. New York, Free Press.

Rolings, N.G., J. Ascroft, and F. Wa Chege. 1981. The diffusion of innovations and the issue of equity in rural development. In B.R. Crouch and S. Chamala (eds.), Extension Education and Rural Development. New York, John Wiley and Sons.

Stuart, T.H. 1985. Rural women's communication networks, participation, and system performance in a Philippine nutrition project: A comparative study of two barangays. Ph.D. dissertation. University of the Philippines Los Baños.

Warriner, G.K., and T.M. Moul. 1992. Kinship and personal communication network influences on the adoption of agriculture conservation technology. *Journal of Rural Studies* 8(3): 279-291.

Wasserman, S., and K. Faust. 1992. Social Network Analysis: Methods and Applications. Cambridge, Cambridge University Press.