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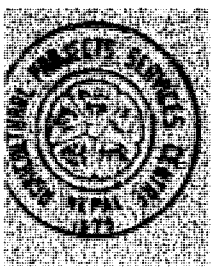
ADOPTION OF HIGH-YIELDING RICE PRACTICES

Shyam S. Khadka



HMG-U.S. AID-A/D/C PROJECT
STRENGTHENING INSTITUTIONAL CAPACITY IN THE
FOOD AND AGRICULTURAL SECTOR IN NEPAL

Foreword

This Research Paper Series is funded through the project, "Strengthening Institutional Capacity in the Food and Agricultural Sector in Nepal," which is a cooperative effort by the Ministry of Agriculture (MOA) of His Majesty's Government of Nepal and the Agricultural Development Council (ADC). This project has been made possible by substantial financial support from the U.S. Agency for International Development.

One of the most important components of this project is advanced training, at the Masters and Ph. D. levels, of young professional staff of agricultural agencies of the MOA and other related institutions. ADC Fellows have been selected for advanced training in Asia, Australia and the U.S.A. Most of them have written a thesis based on their research of a particular problem area in Nepal's agricultural and rural development. In addition, this project sponsors problem-oriented research activities which are carried out by the staff of agricultural agencies of the MOA and other related institutions with the cooperation of ADC staff.

The purpose of this Research Paper Series is to make the results of these research activities available to a larger audience, and to acquaint younger staff and students with advanced methods of research and statistical analysis. It is also hoped that the publication of this Series will stimulate discussion among policy-makers and thereby assist in the formulation of policies which are suitable to the development of Nepal's agriculture.

The views expressed in this Research Paper Series are those of the authors, and do not necessarily reflect the views of their respective parent institutions.

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ADOPTION OF HIGH-YIELDING RICE PRACTICES IN NAWALPARASI DISTRICT, NEPAL

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ADOPTION OF HIGH-YIELDING RICE PRACTICES IN NAWALPARASI DISTRICT, NEPAL

Shyam S. Khadka*

ABSTRACT

Seventy-nine farmers of Nawalparasi District of Nepal were interviewed to determine the factors influencing diffusion and adoption of HYV rice practices. Stepwise regression and sociometric techniques were used in addition to tabular analysis to examine the study's objectives. While knowledge of HYV rice seeds reached 100 percent nine years after its introduction in 1967, adoption levels for HYV rice seeds, fertilizer and pesticides in 1977 were 76, 22, and 56 percent respectively. Adoption began with the bigger and wealthier sections of the farming community, but spread quite steadily among medium and small farmers.

Socio-economic status was a dominant factor in village level interaction regarding information about HYV practices. Informal leaders (perceived best farmers and perceived best friends) greatly influenced other fellow farmers to adopt HYV rice technology.

Adoption behavior was most influenced by socio-economic status, knowledge of credit and input agencies, use of credit, and contact with extension agents. These four variables jointly explained 70 percent of the variation in adoption behavior. Non-adopters of the HYV rice technology lacked resources to invest in HYV technology or were "institutionally" precluded from taking advantage of the government HYV program.

The findings of this study indicate that influential farmers from lower and medium socio-economic strata should be involved to enhance the process of diffusion and adoption of modern technology.

Shyam S. Khadka is Monitoring and Evaluation Specialist at APROSC. This paper is based on his M.S. Thesis (Khadka 1979) submitted to the University of Queensland, Australia. The author wishes to express his appreciation to Dr. Michael B. Wallace and Dr. Som P. Pudasaini for valuable comments on an earlier draft of this paper.

INTRODUCTION

In many developing countries including Nepal progressive farmers became the favorites of development and were praised as "the venturesome, the rash, the daring and the risky" (Rogers and Shoemaker 1971), and development efforts of the last twenty years benefitted mainly a few of these progressive, wealthy, educated and informed farmers (Lele and Mellor 1972; Schluter 1971; Roling et al. 1976). The backward or socio-economically handicapped farmers who could not or did not adopt innovations were called "laggards" and were often described as lazy, traditional, uncooperative and distrustful of outsiders. However, it was realized at the end of the "First Decade of Development" that the result of enlisting progressive farmers and following the "easy to convince" strategy had led to the exclusion of millions of peasants from the process of agricultural development (Wharton 1969). Recently, however, a corrective view has emerged which emphasizes reaching those farmers who were left behind by the changes in agricultural development of the last two decades, and there is an increasing need to sustain this emphasis.

In Nepal, where 88 percent of the family farms are under 2.5 hectares and 94 percent of the population resides in rural areas (HMG Nepal 1971), increases in agricultural production must come primarily from the adoption of more productive technological innovations by millions of small farmers. In the past, the cause of non-adoption was believed to lie in the internal psychological traits of the farmers, and many other possible causes of non-adoption were ignored. Studies in Latin America have shown that the influence of psychological factors on adoption is small when compared to socio-economic structural factors (Havens 1975). Farmers' failure to adopt innovations is more likely to result from a lack of opportunities than from their resistance to change. In view of the urgent need to increase food production and to arrest the problem of widespread poverty, the factors affecting adoption or non-adoption of scientific inputs and practices are of major concern. The general purpose of this study is to identify such factors in the adoption of improved practices in rice farming in Nepal. The specific objectives are:

(i) to determine the adoption pattern of high-yielding rice farming practices in 1977;

(ii) to analyze interpersonal relationships in a village social system and their relationship to the diffusion and adoption of HYV rice practices; and

(iii) to examine the influence of socio-economic, personal, and situational factors on adoption.

METHODOLOGY

This study focusses on the adoption of improved practices in rice farming, so a complete enumeration of the households in two villages -- Sarawal and Gobriyan of Nawalparasi District of Nepal -- was carried out to obtain a comprehensive picture of adoption behavior. Seventy-nine farmers in these two villages were interviewed with a questionnaire to identify the factors associated with the diffusion and adoption of HYV rice practices. The factors affecting diffusion and adoption were identified and analyzed at two levels -- the village or social system level and the individual farmer level.

The dependent variable used for this study was an adoption index which was constructed by summing the numbers of years (up to 1978) each respondent had been using three innovations -- high-yielding rice varieties, chemical fertilizers, and pesticides. A farmer scored higher if he had adopted all three innovations, and adopted them earlier than others. Based on these adoption scores, respondents were placed in three categories: non-adopters (24 percent of the farmers), low-level adopters (54 percent), and high-level adopters (22 percent).

Socio-Economic Status (SES) was measured by the scale developed by Pareek and Trivedi (1964), with some modifications. Items included in this modified scale were land ownership, farm power and pesticide-sprayer educational attainment, housing status, occupation, and social participation. Guttman analysis was used to test the acceptibility of this modified scale. The coefficients of reproducibility and scalability were 0.89 and 0.58 respectively, indicating that this modified scale is quite acceptable. After scoring, respondents were classified as low SES (25 percent), medium SES (51 percent), and high SES (24 percent).

A sociometric test, which is a means for determining the degree to which individuals are accepted in a group, was used to discover and assess relationships among these individuals (Northway 1959). Three sociometric situations -- friendship, perceived best farmer, and farm consultation -- were analyzed as representative of the patterns of interpersonal relationships. These patterns were depicted using sociograms consisting of concentric circles which designate areas in which individuals are placed according to status. Persons with the highest sociometric scores were placed nearer the center and those with lesser scores were placed nearer the periphery.

Non-parametric statistics such as Chi-square, Kendall Tau b, and Tau c were used to analyze the data. Wherever Chi-square conditions were not fulfilled, Tau B and Tau c were used. Tau b is more appropriate for square tables and Tau c is better for rectangular tables.

Stepwise multiple regression was used to identify the most significant independent variables from the possible determinants of adoption behavior. This technique selects those variables which progressively give the largest R^2 values. R^2 is the coefficient of multiple determination, which measures the percentage of the variation in the dependent variable that can be explained by variation in the independent variables. An F-test was used to assess the significance of each variable's contribution to the R^2 value.

RESULTS

Awareness and Adoption

Complete data on awareness and adoption were collected for HYV rice seeds, while for fertilizer and pesticides, data were collected only on adoption over time. Knowledge of HYV rice seeds reached 100 percent by 1976, nine years after its introduction in the study area (Table 1). Adoption levels for HYV rice seeds, fertilizers, and pesticides in 1977 were 76.0, 21.5, and 55.6 percent respectively. Substantial adoption began early after 1972 and continued until 1976. However, the increase in the adoption of HYV seeds in 1977 was small.

Table 1. Awareness and Adoption of HYV Rice Seeds

Year	Awareness		Adoption	
	Percentage	Cumulative Percentage	Percentage	Cumulative Percentage
1967 or earlier	2.5	2.5	0.0	0.0
1968	2.5	5.0	1.3	1.3
1969	10.1	15.1	2.5	3.8
1970	13.9	29.0	3.8	7.7
1971	16.5	45.5	5.1	12.7
1972	10.1	55.6	16.5	29.2
1973	12.7	68.3	11.4	40.6
1974	5.1	73.4	10.1	50.7
1975	17.7	91.1	11.4	62.1
1976	8.9	100.0	10.1	72.2
1977	0.0	100.0	3.8	76.0

The slow adoption pattern for fertilizer suggests that many farmers in Nepal either cannot afford to use it or still are not aware of its economic benefits. However, there has been about a ten percent increase in fertilizer adoption after the introduction of a co-operative at Sarawal village in 1975-76. The adoption pattern for insecticides is encouraging, but much of the increase in their adoption may be attributable to the heavy infestation of Leptocorisa acuta (Ghandi bug) on rice plants in 1973.

Awareness and Socio-Economic Status

The data in Table 2 indicate that farmers in the high socio-economic group became aware of HYV rice seeds significantly earlier than those from the medium and lower socio-economic groups. By 1972, everyone from the high socio-economic group was aware of HYV seeds, but for the low socio-economic group, significant diffusion started only after 1974. Further analysis of the low socio-economic group members who became aware of HYV rice seeds after 1974 indicates that they were mostly socially deprived outlying lower caste members of the village community. This strongly suggests that socio-

economic status and caste membership play vital roles in determining individual farmers' access to information about innovations. This also reflects the inter-personal network that operates at the village level.

Table 2. Awareness and Socio-Economic Status

Awareness (Percent)

Socio-Economic Status (Sample Size)	1969 or earlier	1970	1971	1972	1973	1974	1975	1976/ 77
Low (20)	0.0	0.0	5.0	5.0	5.0	5.0	45.5	35.0
Medium (40)	15.0	20.0	17.5	5.0	22.5	7.5	12.5	0.0
High (19)	31.6	15.8	26.3	26.3	0.0	0.0	0.0	0.0

Kendall's Tau c = -0.60; P < .01

Adoption and Socio-Economic Status

Table 3 indicates that farmers in the high socio-economic group tended to adopt HYV rice seeds earlier than those in the medium and low socio-economic groups. The adoption of HYV rice seeds reached 100 percent by 1975 for the high socio-economic group, while the low socio-economic group began adoption only from 1973. Seventy percent of the farmers belonging to the low socio-economic group and 12.5 percent of the farmers belonging to the medium socio-economic group were non-adopters in 1977. Thus, an individual's socio-economic position strongly influences his access to information, which in turn influences adoption behavior.

Table 3. Adoption and Socio-Economic Status

Socio-Economic Status (Sample Size)	Adoption (percentages)							Non-adopter until 1977
	1970 or earlier	1971	1972	1973	1974	1975	1976	
Low (20)	0.0	0.0	0.0	5.0	0.0	5.0	20.0	70.0
Medium (40)	7.5	5.0	22.5	10.0	7.5	17.5	17.5	12.5
High (19)	15.8	10.5	21.1	21.1	26.3	5.3	0.0	0.0

Kendall's Tau c = -0.59; P < .01

Inter-Personal Relationships

Using socio-economic techniques, it is possible to identify inter-personal relationships among farmers at the village level. Figures 1, 2, and 3 are sociograms representing perceived best friendship pattern, perceived best farmer pattern and farm consultation pattern respectively. Farmers scoring above the mean number of choices were considered key communicators, and those who received no choices were considered non-communicators. The focus of the sociometric analysis was to determine if consultation regarding HYV rice practices follows the friendship pattern or the perceived best farmer pattern.

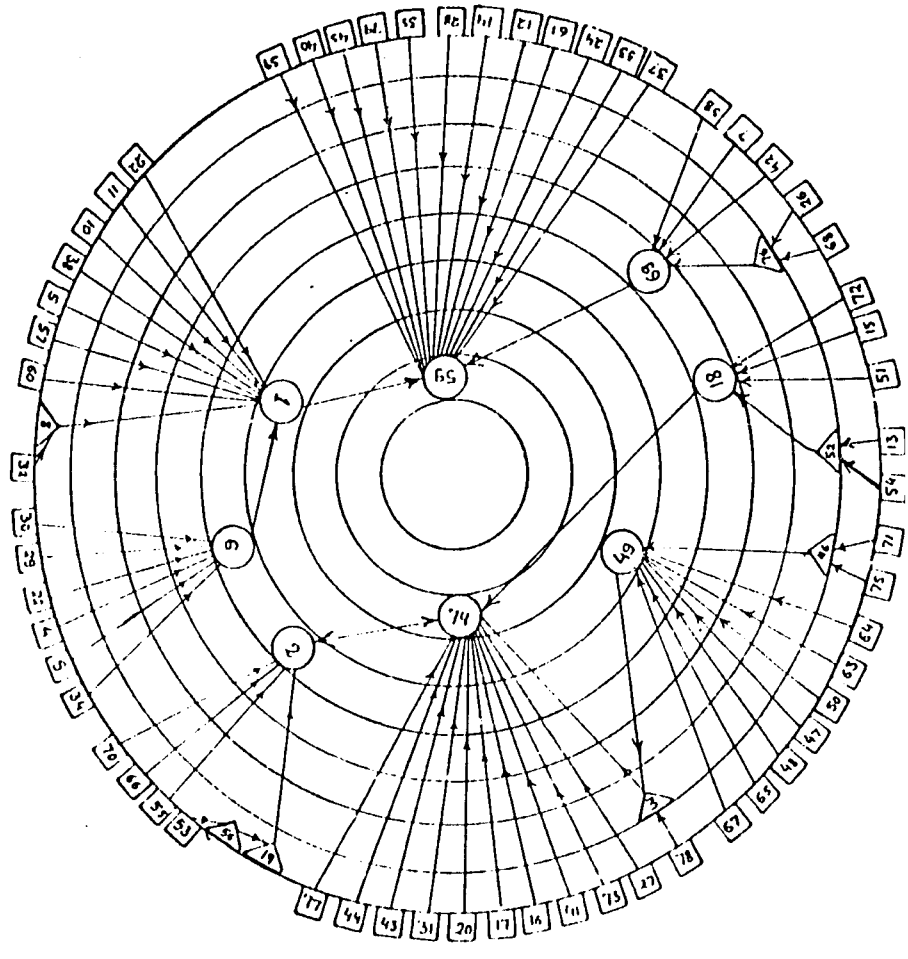
In the perceived best farmer and farm consultation pattern, the same person (No. 2) ranks first. Farmer No. 1, who ranks second in the perceived best farmer pattern, also occupies the same strategic position in the farm consultation pattern. This situation suggests that the perceived best farmer is most preferred for farm consultation by many village farmers.

Although perceived best farmers are most preferred for farm consultation, the prevalence of spoke-and-wheel patterns in both friendship and farm consultation indicates that other farmers who are prominent in the friendship pattern -- Nos. 49, 1, 6, and 59 -- also occupy strategic positions in the farm consultation pattern. This suggests that friendship networks play a major role in information flow for many farmers. However, the overall analysis indicates that the information flow for farm consultation on HYV rice practices followed the perceived best farmer pattern more closely than the friendship pattern. Informal leaders (perceived best farmers and perceived best friends) already play an important role in spreading information to other farmers regarding HYV practices, and they have potential for formally influencing other farmers.

Another striking point is that farmer No. 2 -- who is the Village Panchayat Chairman and an ex-officio member of the District Assembly -- ranks first in both the perceived best farmer pattern and the farm consultation pattern, but he does not enjoy the confidence of many as a friend in the friendship pattern. He may be less available as a friend because of his pre-occupation with Village and District Panchayat affairs. This also indicates that local leadership plays a substantial role in promoting diffusion of HYV rice practices.

Figure 1

Perceived Best Friend Pattern



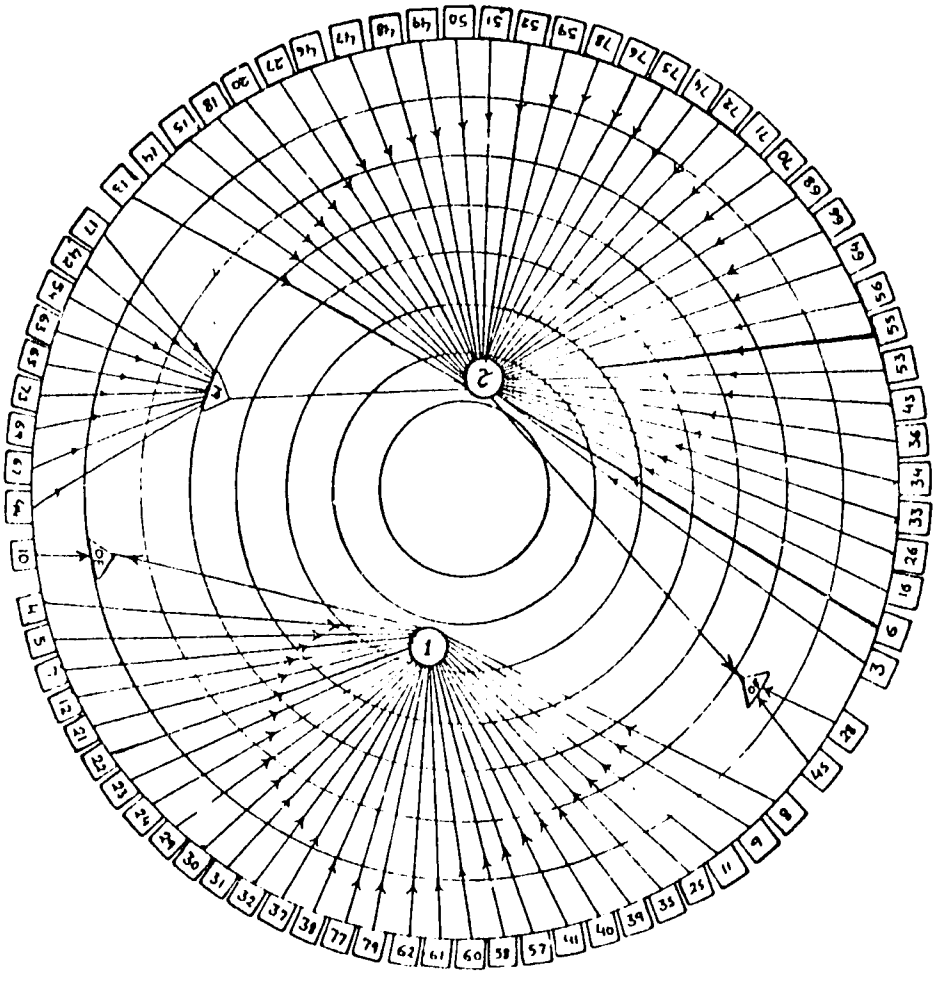
○ = Key Communicator

△ = Communicator

[ ] = Non-Communicator

Figure 2

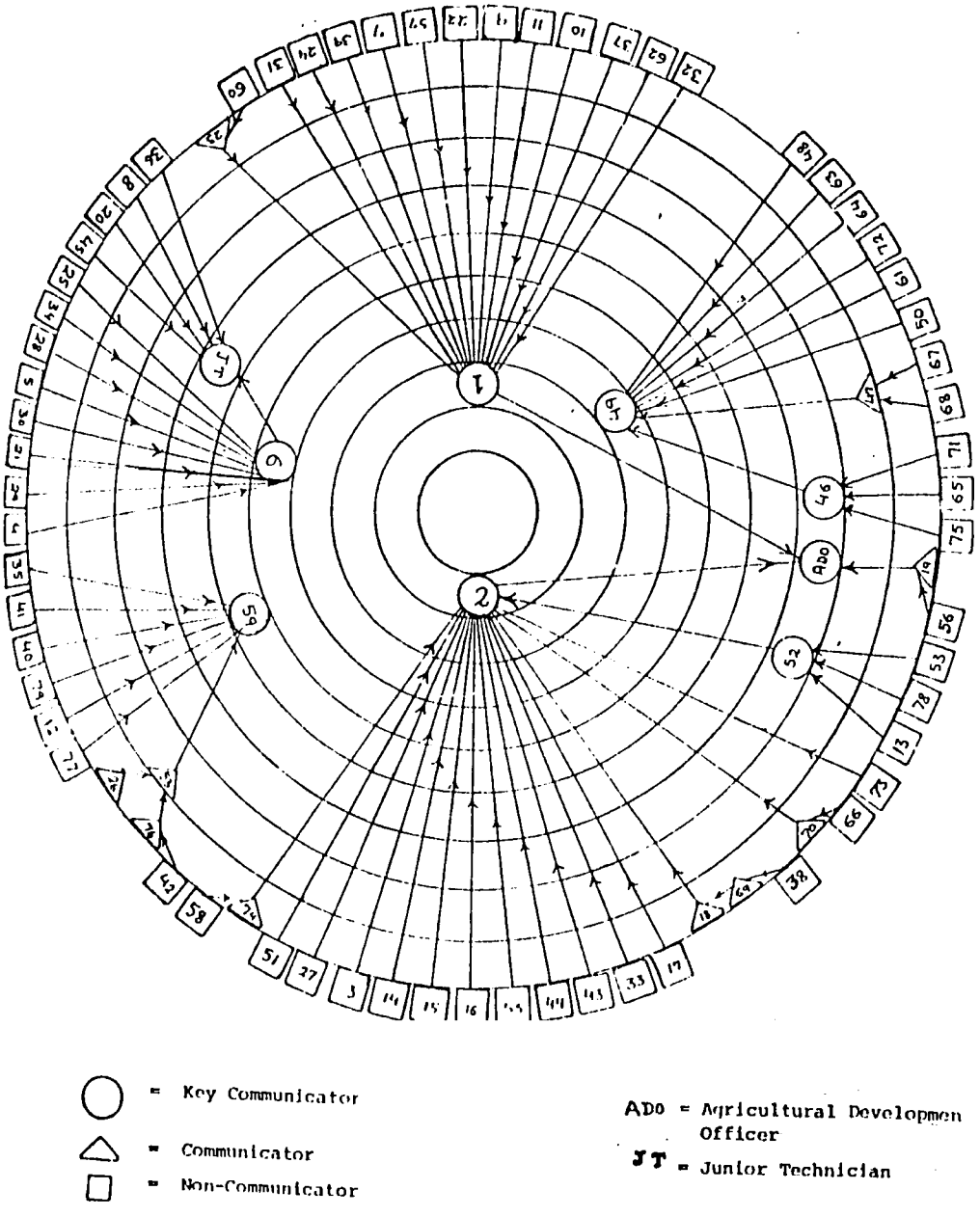
Perceived Best Farmer Pattern



- = Key Communicator
- = Communicator
- = Non-Communicator
- Op = Farmer from outside the sample

Figure 3

Farm Consultation Pattern



○ = Key Communicator

△ = Communicator

□ = Non-Communicator

ADO = Agricultural Development Officer

JT = Junior Technician

Socio-Economic Status and Information Flow

Socio-economic status is important in the social structure in rural communities, and the existence of different socio-economic classes in rural villages probably restricts the range of choices of individuals as sources of information. Figure 4 shows the group interaction process in terms of vertical and horizontal communication patterns, and the arrows indicate who seeks information from whom. Figure 4 also shows upward communication trends. Of the 19 farmers belonging to the low socio-economic group, seven preferred to seek information from people belonging to the same socio-economic group, while the remaining 12 tended to seek information from people belonging to the medium and high socio-economic groups.

Most of the farmers in the medium socio-economic group sought information from people in the high socio-economic group. Most of the people who were sought for information about HYV rice practices were perceived best farmers and perceived best friends. These best friends were also second-level best farmers. In the high socio-economic group, farmers preferred to consult with best farmers who belonged to their own socio-economic group. Otherwise they tended to contact extension agents (ADO and JT) directly regarding HYV rice practices.

Upward communication may be explained as a psychological substitute of communication behavior for upward mobility by aspiring low status farmers. The preference for upward communication may also result from the perception by lower status farmers of those with greater power and prestige as being instrumental to satisfying their needs.

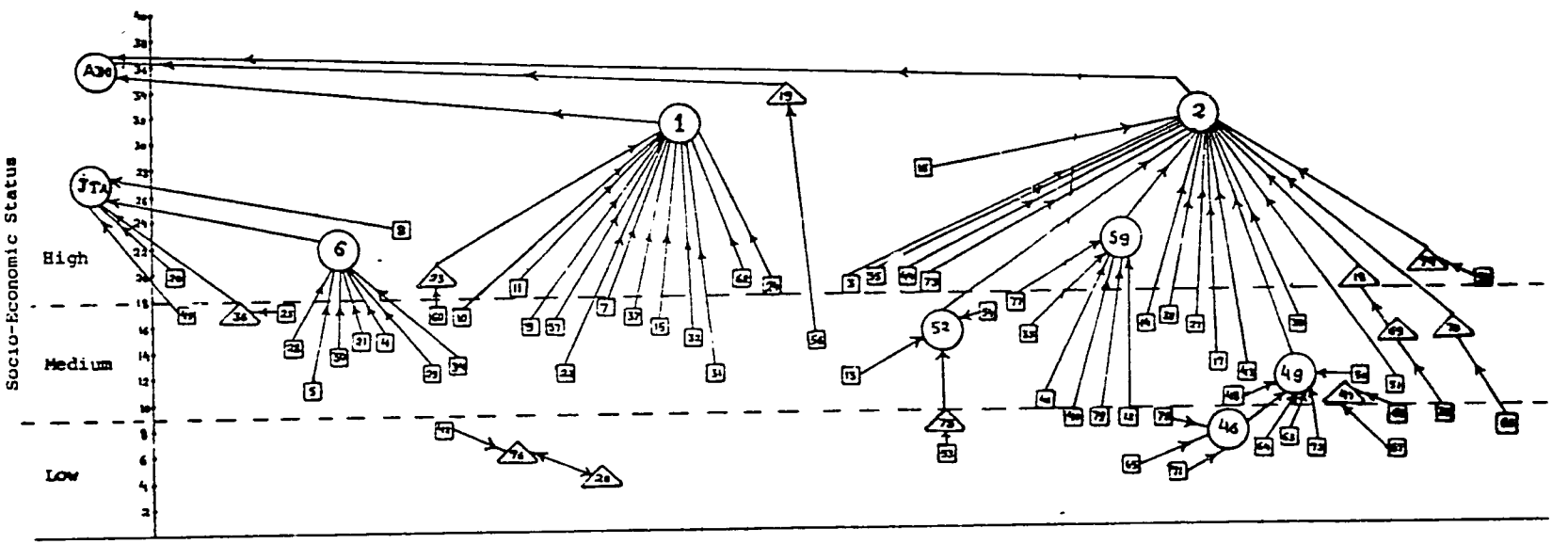
This analysis indicates that status barriers do exist in the information flow in rural Nepal. In fact, it is status proximity that determines the pattern of interaction in a social collective at least for the persons belonging to the higher socio-economic group.

Regression Results

The results of stepwise multiple regression analysis using eight independent variables are given in Table 4.

Figure 4

Communication Pattern and Socio-Economic Status



○ = Key Communicator

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ADo = Agricultural Development Officer

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Table 4. Stepwise Regression Results

Variables	R^2	Variance Explained	Beta Coeffi-cients	Standard errors	F Value
Socio-Economic Status	.5773	57.73	0.14	0.14	105.03*
Knowledge of Credit Agencies	.6616	8.43	0.77	1.79	18.93*
Use of Credit	.6981	3.64	0.78	2.58	9.04*
Contact with JTA	.7102	1.21	0.25	1.95	3.08
Attendance at Agricultural Exhibition	.7162	0.60	0.32	2.38	ns
Cosmopoliteness[a]	.7176	0.14	0.26	1.23	ns
Age	.7192	0.16	-0.17	0.06	ns
Attendance at Result Demonstration	.7196	0.03	-0.14	2.40	ns

a Cosmopoliteness was measured by respondents' contact with urban centres. Localiteness is the opposite of cosmopoliteness.

* Significant at the 0.01 level.

ns = not significant.

The computed R^2 value for the eight independent variables indicates that 71.96 percent of the variation in adoption is explained by the combined effect of these independent variables.

The variable contributing most to the multiple relationship was the composite scale of socio-economic status. This

variable alone explained 57.73 percent of the variation in the adoption behavior. Knowledge of credit and input agencies accounted for 8.43 percent of the variation in the dependent variable, and credit use explained 3.64 percent of the variation in adoption behavior. All three of these variables were statistically significant at the .01 level, and together they explained nearly 70 percent of the variation in adoption behavior. Other variables such as contact with JTA, Attendance at Agricultural Fair, Cosmopoliteness, Age, and Attendance at Result Demonstration were not statistically significant in explaining adoption behavior.

Analysis of Non-Adoption

Table 5 gives the characteristics of non-adopters.

Table 5. Factors Influencing Non-Adoption

(n = 19)

Factors	Non-adopter (Percent)
Low socio-economic status	73.7
1 ha or smaller land holdings	100.0
Localite behavior	94.7
Illiterate	94.7
No extension contact in the past year	94.7
No attendance at result demonstration in the past year	94.7
No knowledge of credit and input agencies	94.7
No use of institutional credit	100.0

Non-adopters had holdings so small (0.46 ha on average) that they could not provide even minimum support for their families at the present level of productivity. Most of them depend on wage employment. About 95 percent of them were illiterate and localite in their outlook. They did not use

institutional credit and services, they attracted no attention from extension workers and credit agencies, and they had negligible access to credit and information regarding HYV practices.

In view of the hierarchical nature of village social life in Nepal and the control of the dominant richer segments of the population over information flows, the first-hand information on HYV technology did not become available to less privileged groups, and most of them become aware of HYV rice practices only eight years after their introduction. Because nearly 70 percent of the variation in adoption behavior was explained by socio-economic status, knowledge of credit and input agencies, and use of credit, it can be concluded that the lack of response of non-adopters to HYV technology is less a function of conservative attitudes and more a reflection of the lack of resources to invest in HYV technology or the existence of a strong "institutional" bias against them.

POLICY IMPLICATIONS

Previous development efforts in Nepal were concentrated on a small number of larger, wealthy, educated and information-seeking farmers, while the majority were completely left at the mercy of natural diffusion processes. Though the multiplier effect occurred to some extent, 24 percent of the farmers in the sample were not using HYV technology even nine years after its introduction in the area, which indicates that this innovation hardly "trickled down" from the few progressive farmers to the rest of the community. Different approaches are needed for high level adopters, low adopters, and non-adopters if HYV technology is to become widespread.

High-level adopters are farmers who have adequate land and other resources and produce most of the marketed agricultural surplus. About half of them already use institutional credit, and almost all of them receive extension services. They have generally adopted HYV rice practices, and have realized increased production. Development efforts for this group should include: supplying information about more advanced technology; extending credit facilities to the remaining farmers; and supplying HYV seeds, fertilizers, and pesticides on time.

The low-level adopters are already undergoing the change process to some degree, but they would benefit more by adopting HYV technology at a higher level. However, they are handicapped because they do not have sufficient cash to invest in advanced HYV technology. Many farmers in this group already produce for the market. Most of these farmers do not have access to institutional credit and about half of them do not receive attention from extension agents. Their potential for accepting more advanced HYV technology and increasing production would be substantial if: technology appropriate for their resource base is developed and transferred to them; credit facilities are provided under more favorable terms; and HYV seeds, fertilizers, and pesticides are supplied on time.

The non-adopters of HYV rice technology include farmers whose holdings are so small that they can not provide even minimum support for their families at the present level of productivity. Institutional credit and services are not used by this group, they receive no attention from extension agents, and they have restricted access to information regarding HYV technology. However, their potential for accepting HYV technology for increasing production would be substantial if support were provided to this group to enable them to purchase modern inputs. This should be supplemented by providing information on HYV technology directly to them.

These farmers often believe that HYV technology, credit, and input facilities are meant only for bigger and wealthier farmers, so development efforts at the outset must convince them that information and credit are available for them. Once they are convinced, efforts should be directed towards teaching them how to adopt improved practices. Efforts are required to develop profitable innovations appropriate to small farmers' resources.

Enhancing the Diffusion Process

The pattern of inter-personal relationships prevalent in village society indicates that informal leaders (perceived best farmers and perceived best friends) play a substantial role in spreading information about HYV technology to other farmers. However, these informal channels of communication have not been formally utilized by development agents. Moreover, farmers from the low socio-economic group were more status-proximity conscious in their interpersonal relation-

ships than medium and high status farmers. Influential farmers who represent disadvantaged segments of the village community should be involved in development activities because they can significantly affect decision-making in the under-privileged sections of villages. Development workers should work with informal leaders throughout the social structure to increase the diffusion and adoption of innovations.

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