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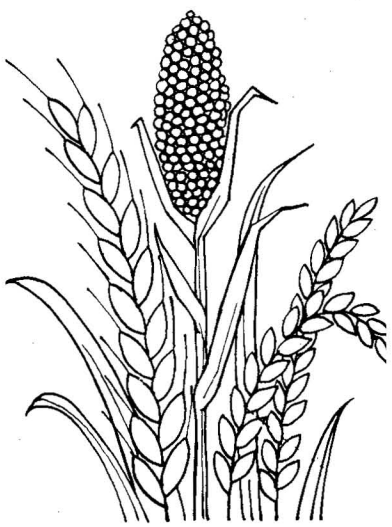

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A FACTOR ANALYSIS OF USE OF FERTILIZERS BY FARMERS*

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INTRODUCTION

Fertilizer is the spearhead of agricultural development. It is probably the single most important resource available for rapid increase in per acre yields. Hence, its scale of consumption has been rightly regarded as the yard-stick of agricultural prosperity of different countries in the world. In India, ever since planning has been used as a major tool for rapid economic growth, importance of fertilizers for agricultural development has been accepted. Consequently, concrete steps have been taken to augment the production and import of fertilizers as well as for their distribution throughout the country together with suitable credit facilities and extension services. Use of fertilizers has been accorded the topmost priority in the new strategy for agricultural production programme during the Fourth Five-Year Plan period. In this context of recognition of the importance of fertilizers use, the investigation and evaluation of factors affecting the use of fertilizers by farmers will be more instructive.

Hitherto, empirical studies of use of fertilizers have mainly concentrated on identifying the physical relationships between fertilizers as an input and the output of crops and on prescribing on the basis of these relations the optimum use of fertilizers.[1] While there have been a few studies on the implications of fertilizer programmes and problems of fertilizer consumption,[2] systematic empirical investigation of the factors which promote or retard farmers' use of fertilizers are few. That this knowledge is important needs hardly any emphasis. In fact, the central concern of extension agencies in rural areas is to know the interaction of various environmental factors and their influence on technological change to clarify the measures necessary to ensure fast enough and wide enough adoption of new techniques by farmers. As an input of high-yielding nature and one which can readily be quantified, the full ramifications of fertilizers as a technological change therefore merit immediate and broader evaluation.

The purpose of this study is to gain some precise empirical knowledge about the extent and nature of the interdependence of socio-economic factors and use of fertilizers by farmers with the help of factor analytic technique. This technique is applied in the hope that the results will be helpful in stimulating further empirical research into the complex inter-relationships governing the farmers' use of fertilizers. Regarding appropriateness of these tools for this type of study, it may be noted that the problem of multi-collinearity which is quite common among various socio-economic factors in Indian farm setting would make it difficult to apply commonly used regression techniques meaningfully to the data with farmers' quantity of fertilizers used as a dependent variable and socio-economic factors as

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1. See F. Yates, D. J. Finney, V. G. Panse and T. P. Abraham : The Use of Fertilizers on Foodgrains, I.C.A.R. Research Series, No. 1 and also Statistics of Crop Responses to Fertilizers, F.A.O., 1966.

2. See Factors Affecting Fertilizer Consumption, National Council of Applied Economic Research, New Delhi, 1965.

independent variables.[3] When the number of potential explanatory variables is very large and the useful variables that we need for meaningful interpretation purpose are overlaid with the multiple manifestations, researchers have found factor analytic techniques particularly useful to get complete picture of interactions among the variables.[4]

DATA AND VARIABLES

Data used in the study were obtained from a field investigation which the author undertook in connection with his Ph. D. study. The investigation was conducted in the year 1965 in two villages of South Kanara district of Mysore State. The investigation covered all the farmers in the villages, namely, Haleyangadi and Mundkoor, numbering 270. The villages are located on the rice monoculture coastal tract of Mysore State[5] and this feature of the tract made it easier to construct an index of fertilizers based on recommended dose of a crop. In selecting the villages, the sample was stratified in recognition of some of the cultural and other differences existing between the cultivators in the coastal area and the cultivators in the interior area of the district. Information germane to our interests included quantity of different types of fertilizers used and socio-economic characteristics of the individual farmers.

Fertilizers mainly consist of nitrogen (N), phosphorus (P_2O_5) and potassium (K_2O) compounds, and are used in different types of fertilizers.[6] Use of fertilizers can then be measured in three different ways : (1) total weight of different types of fertilizers used by the farmers, (2) total weight of plant nutrients contained in different types of fertilizers used by the farmers ($N+P_2O_5+K_2O$) and (3) weighted aggregate of plant nutrients contained in different types of fertilizers used by the farmers; weights being assigned on the basis of relative importance of plant nutrients judged on the basis of soil test data of a particular region. The

3. The rationale for the methodology used in this paper is discussed in detail in the paper on "A Principal Component Study of Technological Progressiveness of Farmers—Illustration of an Approach to Evaluation," V. M. Rao and N. S. Shetty, *The Econometric Annual* of the Indian Economic Association, Vol. XV, No. 4, 1968. For inter-correlation between various socio-economic factors, see "Socio-Economic Characteristics of Technologically Progressive Farmers," N. S. Shetty, *Journal of University of Bombay*, Vol. XXXV, Part-I, 1967.

4. See Henryson : "Applicability of Factor Analysis in the Behaviourial Science—A Methodological Study," Stockholm, 1954, p. 14. According to him, "Factor analysis supplies methods for reducing a large number of observed variables to a lesser number of, in some way, more fundamental variables or as they are usually called factors. This is usually done through the analysis of inter-correlations between the observed variables." Kendall made a useful distinction between analysis of *dependence* and analysis of *interdependence* in the multi-variable analysis. In the analysis of dependence, "we are interested in how a certain specified group depend on others." In the analysis of interdependence, "we are interested in how a group of variables are related among themselves." Factor analysis is of the latter type of multi-variate analysis. See M. G. Kendall, "Factor Analysis as a Statistical Technique," *Journal of Royal Statistical Society Series*, B, Vol. 12, 1950, pp. 60-73. For empirical treatment of these techniques see, "A Factor Analysis of the Inter-relationship Between Social and Political Variables/and Per Capita Gross National Product," I. Adelman and C. T. Morris, *Quarterly Journal of Economics*, Vol. LXXIX, No. 4, November, 1965, pp. 555-578. For an application of these techniques, in the area of agricultural economics, see V. M. Rao and N. S. Shetty, *op. cit.*

5. Paddy, the main food crop in the district, accounts for nearly 75 per cent of the cultivated area.

6. The main sources available for obtaining nitrogen are ammonium sulphate, urea, calcium, ammonium sulphate nitrate and ammonium nitrate. For phosphorus and potash, the available fertilizers are superphosphate, ammonium phosphate, sulphate of potash and muriate of potash. Paddy mixture is a complex fertilizer which contains all the three nutrients required for the crop growth.

first measure is, of course, inappropriate for any meaningful analysis, since we cannot construct an index of use of fertilizers in terms of recommended dose which is usually in terms of plant nutrients. Ideally, the last measure seems to be more objective and meaningful for the purpose in hand. However, in the absence of reliable necessary technical data (which are not available even among the extension staff) to derive meaningful weights, we have used as second best, the second measure in which use of fertilizers is expressed in terms of plant nutrients. Accordingly, we estimated nitrogen, phosphorus and potash contents of the fertilizers farmers used, to arrive at the total plant nutrient tonnage of individual farmers. We then constructed the index of use of fertilizers as the percentage of actual use to the doses recommended by the extension agencies in terms of the plant nutrients contained therein.[7] Intuitively, this measure assumes that these are the principal nutrients which directly affect the soil fertility and therefore they are the things that the farmers are really in need of. As a corollary to this, it also assumes that farmers are indifferent between various kinds of fertilizers as long as they contain the doses of the same "plant food."

Table I sets out the distribution of farmers according to the composite index of use of fertilizers by farmers. It will be seen from the table that nearly 52 per cent of the farmers studied have not so far adopted fertilizers. Among the adopters,

TABLE I—DISTRIBUTION OF FARMERS ACCORDING TO INDEX OF USE OF FERTILIZERS

Index	No. of farmers N = 274	Percentage of total number of farmers
Non-adopters	140	51.85
1—10	53	19.63
11—20	37	13.70
21—35	18	6.67
36—50	13	4.81
51—75	7	2.59
76—99	2	0.74
—100	0	—
For first crop only	26	9.63
For second crop only	43	19.93
For Third crop only	11	4.07
For more than one crop	31	11.48

7. It may be noted that the doses recommended by extension agencies are not necessarily optimum doses. In the absence of *ex-post facto* data either technical or economic, to determine individual farmer's optimum doses, this seems to be more appropriate for our purpose.

on the other hand, there exists a wide variation in the extent of doses of fertilizers used. Very few farmers used fertilizers in more than half of the recommended doses. Even the seasonal variations in the use of fertilizers are found to be very wide. It is needless to emphasize that unless the use of fertilizers by farmers is of a particular magnitude, it cannot have significant impact on crop production. It follows therefrom that the information presented in Table I does exhibit substantial intra-community variation to warrant an investigation of factors governing the observed inter-farm differences in the use of fertilizers.

As regards explanatory variables, on *a priori* and empirical grounds, we can list the main factors influencing the adoption of fertilizers into two broad categories.[8] These are (1) economic variables which include size of farm, irrigation facilities, farm and non-farm income, liquidity, availability of supplies and credit, profitability of change, attitude towards risk, price stabilization, and (2) sociological and demographic variables which include caste, education, age and contact with extension agencies. In our analysis, however, the selection of variables had to be adjusted to the availability of information, since the study is based on information already collected for a related but different study. The main factors included in the study along with their measures are listed in the Appendix.[9]

Most of the variables selected for the study do not need particular explanation. Size of holding is brought in by two variables, *viz.*, area of owned holding and that of cultivated holding. Education is taken into account in terms of educational level of farmers as well as the literary position in the family as a whole. Since income could not be directly included, a proxy is used to represent it, *viz.*, a very rough indicator of assets. Similarly as information on total outstanding debts was not collected, borrowings made by farmers in the year of investigation (1964-65) was used as an index of current commitments. Subsidiary occupation is included in the form of scores for different types of occupations. The scores have been assigned not to reflect so much the income potential of the occupations but to indicate their influence on farmers' knowledge of and contacts with the outside world. Similarly, for the variable "socio-economic status" we have taken simultaneous consideration of caste and size of cultivated holding.[10]

RESULTS AND INTERPRETATION

The literature on factor analysis contains a number of alternative methods and procedures for computation.[11] Among these, principal component method (also called Principal-Factor or Principal-Axis Solution) has several attractive features. Each factor (or principal component as Hotelling calls it) extracts the maximum amount of variance and gives the smallest possible residuals. The first factor so extracted explains as much as possible of the total variance in all variables. The second factor is chosen so as to be uncorrelated with the first, and to explain

8. For a useful summary of empirical works, see D. K. Desai, "Rapporteur's Report on Technological Change and Its Diffusion in Agriculture," *Indian Journal of Agricultural Economics*, Vol. XXI, No. 1, January-March, 1966, pp. 218-226.

9. For intuitive assumptions underlying some of these factors see N.S. Shetty, "Socio-Economic Characteristics of Technologically Progressive Farmers," *op. cit.*

10. For an alternative definition and procedure adopted for scoring of this variable, see Rao and Shetty, *op. cit.*

11. See B. Fruchter : Introduction to Factor Analysis, New York, 1954 ; L. L. Thurstone: Multiple Factor Analysis, University of Chicago, Chicago, U.S.A., 1961.

as much as possible of the residual total variance and so on. This helps in condensing the correlation matrix into the smallest number of orthogonal factors. This method also has the advantage of giving a mathematically unique (least squares) solution for a given correlation matrix.[12] We, however, preferred this method for the study mainly owing to the computational facilities available to us.

In an investigation of this type, it is often both possible and useful to regard factor analysis as a complementary technique to regression analysis in analysing the causal relations between the variables. For example, in our study, one could approach the problem first by finding out the principal factors of explanatory variables excluding the index of use of fertilizers and then by regressing the index of use of fertilizers on the principal factors obtained. Whether we can split off one (or more) from the other variables and consider it by itself when we postulate functional interdependence among these variables is however a moot point. It is also to be noted that influences of these variables on adoption of fertilizers are assumed to be latent, being incapable of direct observation and measurement. Hence researchers have generally used factor analysis as a statistical technique which can aid in preliminary investigations the interpretation of the relationships between a large number of interdependent variables. Accordingly, we have restricted our purpose in this study to apply factor analysis only to reduce a set of 16 interdependent variables to a smaller set of more meaningful, more nearly uncorrelated derived factors to gain some empirical insights concerning the underlying reasoning of the factors in particular relation to one of the variables, namely, the use of fertilizers by farmers.

The number of factors taken up for interpretation in factor analysis generally depends on their aggregative explanatory power and theoretical approach of the factor analyst.[13] Within the constraints of these criteria, researchers using factor analysis attempt to minimize the number of factors needed to provide a satisfactory explanation of the phenomena under investigation. Bearing these considerations in mind, we have confined the analysis to the first four factors which appeared sufficient and substantive for the purpose at hand. Table II presents

TABLE II—PERCENTAGE OF VARIANCE EXPLAINED BY THE FIRST FOUR FACTORS

Factors*	Index of use of fertilizers	All characteristics
F_1	67.75	47.18
F_2	2.62	14.26
F_3	7.75	10.60
F_4	3.95	8.18

* Factors are indicated by the symbol F with an appropriate subscript.

12. Introduction to Factor Analysis, *op. cit.* p. 99. Kendall gave to this method a pride of place in factor analysis because it has the optimum properties which other methods do not possess. See Kendall, *op. cit.* p. 63.

13. See M. G. Kendall : A Course in Multi-Variate Analysis, London, 1961, p. 11.

the percentage of variance explained by these factors. All the factors together explain nearly 83 per cent of variations in the index of use of fertilizers and 80 per cent of combined variations of all the variables covered in the analysis. It follows therefrom that the observed variations are represented *approximately* by the first four factors and hence the explanatory power of these factors can be regarded as fairly adequate.

Once sufficient factors have been obtained, an interesting next step is to try to identify the content and nature of the factors. For this purpose, the results of the principal factor analysis are summarized in the matrix of common factor coefficients presented in Table III. In the table, factor coefficients indicate the net correlations between each factor and observed variables. In factor analytic jargon, they are referred to as "factor loadings." The interpretation of the factor loading is made in terms of their squares which represent the proportion of the total unit variance of variables explained by each factor after allowing for the

TABLE III—MATRIX OF "FACTOR LOADINGS"

	Characteristics	F_1	F_2	F_3	F_4	h^2
1.	Index of adoption of fertilizers ..	.823	.162	.278	—.190	.821
2.	Subsidiary occupation	.891	—.316	—.162	—.149	.943
3.	Age	.878	—.265	—.260	.069	.913
4.	Size of cultivated holding	.849	—.218	.143	.066	.795
5.	Irrigated area	.839	—.199	—.012	.032	.745
6.	Fragmentation	.829	—.255	—.321	.555	.859
7.	Socio-economic status	.782	—.467	—.048	.232	.887
8.	Extension contacts	.753	—.217	.327	—.227	.773
9.	Educational level	.612	—.220	.334	—.162	.561
10.	Level of schooling in the family ..	.408	.792	—.041	—.121	.810
11.	Family literacy	.536	.681	—.116	—.271	.837
12.	Consumption units in the family ..	.433	.513	—.170	—.248	.540
13.	Owned holding	.475	—.169	.641	.110	.677
14.	Index of assets	.404	.294	.624	.469	.859
15.	Tenancy	.419	—.040	—.345	.671	.747
16.	Borrowings	.472	—.387	—.465	.520	.860

contributions of other factors. It may be seen from Table II that 68 per cent of inter-farm variations in the index of use of fertilizers are explained by Factor 1, an additional 3 per cent by Factor 2 and 8 per cent by Factor 3; the net contribution of Factor 4 is only 4 per cent.

The last column of Table III contains the sum of the squared factor loadings or "communality" of each variable. It indicates for each variable the proportion of its variance explained by all the four factors taken together and is represented by the standard symbol h^2. It is thus, analogous to R^2 in the regression analysis. High communality obtained in almost all cases indicates the high reliability of the results that we obtained.

Since the explanation for differences in the use of fertilizers is sought in terms of variables in the analysis other than the index of fertilizers, the first step in interpretation is to group the variables which are closely correlated with it into common factors. Each variable may reasonably be assigned to that factor with which it shows the closest linear relationship, *i.e.*, that factor in which it has the highest loading. Accordingly, the variables which are closely related are bunched together in a box for each factor presented in the table.

After the variables are bunched together into common factors, the second step in interpretation is to identify them by giving a reasonable explanation of the underlying forces which they may be interpreted to represent. It is needless here to emphasize that factor analysis cannot provide interpretation of what a particular factor represents. Interpretation has to be based on the knowledge of the socio-economic forces at work in the problem under study through one's experience of the field under investigation. The interpretations of the results of factor analysis, as is true of all scientific interpretations, are thus tentative.[14] In what follows, we make an attempt to identify the factors given in Table III.

The First Factor

The variables having their highest loadings in Factor 1 are three land oriented variables, namely, size of farm, irrigated area and fragmentation; and five farmer oriented variables, namely, subsidiary occupation, age, socio-economic status, extension contacts and level of education of the farmer. This factor also includes the index of use of fertilizers. Probably the land oriented variables are the main structural constraints governing the rate of technological progress at the farm level. The farmer oriented variables, on the other hand, seem to reflect the farmers' access to information and supply which makes the farmers technologically prosperous. Factor 1 can then reasonably be interpreted as "progressive prosperous farmer" factor influencing the index of use of fertilizer along with other variables.

14. Interpretation of factors often becomes a matter of keen controversy due to its subjective nature. To quote Thurstone, who pioneered the use of factor analysis, "The derived variables are of scientific interest only in so far as they represent processes or parameters that involve the fundamental concepts of the science involved." Further, factors are not eternal varieties. They may be transient factors because of local influence. To quote Thurstone once again, "factors cannot be expected to be invariant from one population to different population." If a factor be recognized and identified in a wide variety of situations and conditions, it is thought to represent a fundamental unity. See Multiple Factor Analysis, *op. cit.*, p. 61.

Intuitively, none of the associations observed with regard to different variables in this factor is surprising. To be more objective, verification of the interpretation of this factor is attempted by comparing the variables having high loadings in this factor between early adopters and late adopters of fertilizers.[15] It is believed *a posteriori* that the "progressive prosperous farmer" factor counts at the level of first encounter when knowledge of a new technique is being extended to rural areas; this factor becomes less important subsequently in farmers' innovation functions.[16] Table IV gives the average characteristics of early and late adopters of chemical fertilizers. "t" test is applied to examine the statistical significance of the differences of mean values between these groups. It will be seen from the table that the early adopters significantly differ from late adopters in relation to both farm structure and access to information and supply.[17] This interpretation is consistent with the particular juxtaposition of characteristics subsumed in Factor 1.

TABLE IV—AVERAGE CHARACTERISTICS OF EARLY AND LATE ADOPTERS OF CHEMICAL FERTILIZERS

Characteristics	Units	Early adopters N=16	Late adopters N=77	Estimated value of "t"
1. Subsidiary occupation	Scores	3.94	2.98	4.00**
2. Age	Years	48	50	0.28
3. Size of cultivated holding	Acres	9.35	3.04	5.62**
4. Irrigated area	Per cent	48.11	36.74	1.96*
5. Fragmentation	Number	2.38	3.03	2.36**
6. Socio-economic status	Scores	12.38	7.24	4.13**
7. Extension contacts	Scores	7.06	3.86	3.73**
8. Educational level	Years	10.16	1.75	7.28**

** Statistically significant at 0.01 probability level.
* Statistically significant at 0.05 probability level.

The Second Factor

The second factor is found to be relatively less important. It explains hardly 3 per cent of the variance of the index of use of fertilizers in relation to other variables. The variables highly loaded on this factor are family oriented, *viz.*, family

15. In the dissertation, farmers are classified into five groups—innovators, early adopters, early majority, late majority and laggards—on the basis of dispersion of farmers around mean date of adoption. For the purpose of above comparison, we designated the first two groups early adopters and the last two groups as late adopters.

16. See N. S. Shetty : Adoption of Improved Practices of Paddy Cultivation—An Economic Analysis of Technological Change, Ph.D. Thesis, University of Bombay, 1967.

17. For a detailed discussion of early adopters and late adopters, see "Agricultural Innovations : Leaders and Laggards" *Economic and Political Weekly*, Vol. III, No. 33, August 17, 1968.

literacy, level of schooling in the family and consumption units in the family.[18] It seems quite reasonable to interpret Factor 2 as indicative of family aspirations and needs. Both variables—family literacy and level of schooling—in fact represent the process of change in family outlook and breakdown of traditionalism in family life which tends to generate speedy receptivity to technological change in farming. The high loading observed in relation to consumption units in the family is a sufficient indicator of how economic pressure compels the farmers to grow two blades of grass where only one grew before. The finding that family aspirations manifested by family literacy and level of schooling in family determine partly the level of use of fertilizers tentatively supports the powerful current opinion which maintains that education is the chief missing component of agricultural development and that investment in human capital will result in more rapid rate of technological change in agriculture.[19] Underlying them is the intuitive assumption that education transforms the farmer's outlook and raises his aspirations and "achievement motivations" which are crucial for the speedy adoption of technological change. Thus, the second factor appears to reflect the fact that both "dynamic"and "transformation" aspects of education are instrumental in raising the level of fertilization in Indian agriculture.

The Third Factor

Factor 3 which accounts for 5 per cent of variance is mainly composed of two variables, namely, owned holding and index of assets. Both these variables have high loadings in this component and direct relation with the index of use of fertilizers. This factor obviously, thus, portrays ability in terms of investment needed to adopt fertilizers intensively. The ability of the farmer to invest in fertilizers not only involves additional outlay but also the capacity of the farmer to bear the uncertainty in accepting intensive use of fertilizers. By way of verification of this interpretation, the average values of both the variables having high loadings on this factor are compared as between heavy and moderate users of fertilizers.[20] Significant differences observed between the two groups appearing in Table V evidently render support to our interpretation of Factor 3.

TABLE V—AVERAGE CHARACTERISTICS OF HEAVY AND MODERATE USERS OF FERTILIZERS

Characteristics	Heavy users N=14	Moderate users N=90	Estimated value of "t"
1. Size of owned land holding ..	4.94	1.59	4.04**
2. Index of assets	11385	3290	2.56**

** Statistically significant at 0.01 probability level.
* Statistically significant at 0.05 probability level.

18. It is indeed interesting but difficult to find an explanation for the negative relation observed with respect to most of the variables in most of the cases in this factor. On *a priori* grounds we would rather expect positive relations. We are not however making any attempt to probe further on this since our purpose here is to identify the factors with the variables having high loadings and then explain their relations with fertilizer index.

19. See T. W. Schultz : Economic Value of Education, New York, 1963 and bibliography mentioned therein.

20. Farmers who used more than 45 per cent of recommended dose are heavy users of fertilizers and those who used less than 20 per cent of recommended dose are moderate users.

The Fourth Factor

An examination of Factor 4 shows a negative relation between the index of use of fertilizers and tenancy and borrowings. The loadings with respect to these variables on this factor are relatively high. The negative association of these variables and index of fertilizers evident in this factor is somewhat surprising. This appears to reflect the fact that farmers are unwilling to use fertilizers intensively when the extent of tenancy and borrowings is very high. One plausible explanation for the tenant farmers' unwillingness to use fertilizers intensively is their fear of the objection of landlords to the depletion of fertility of the soil by the use of fertilizers.[21] Similarly it is not implausible to expect farmers' unwillingness to use fertilizers intensively when farmers resort to internal capital rationing to avoid excessive commitments. Factor 4 can thus be identified as indicative of farmers' "unwillingness to invest" due to larger current commitments and insecurity of tenure of the land cultivated.

SUMMARY AND CONCLUSIONS

The purpose of this study is to determine the factors affecting the use of fertilizers among the farmers. In order to take into consideration the inter-relationship of various socio-economic characteristics of farmers and use of fertilizers by them, a principal component method of factor analysis is used in this study. The study is restricted to the analysis of first four factors which are found to be sufficient for the explanation of the observed inter-farm variations in the use of fertilizers. Factor 1 adumbrates a strong tendency for the level of use of fertilizers to be directly associated with the progressive prosperous farmers. Nearly 80 per cent of the inter-farm variations in the use of fertilizers is due to difference among the farmers in relation to farm structure and access to information and supply. Factor 2, which contributes insignificantly to the analysis, groups together three indicators of family aspirations and needs which influence to some extent the change in farming. The last two factors which account for 5 per cent and 3 per cent variations in the index of use of fertilizers, are attributable respectively to the differences in ability to invest (Factor 3) and willingness to invest (Factor 4). Relatively a small part of the variations attributable to ability and unwillingness to invest is somewhat surprising on *a priori* grounds. A plausible explanation for this would be that these obstacles are still dormant, due to the prevailing wide differences in farm structure and access to information and supply, as the latter is wiped out through effective extension efforts, the former may become more operative in giving rise to differences in the use of fertilizers among farmers.

21. Objections from landowners have been recorded as main hindrance for the adoption of chemical fertilizers for nearly 14 per cent of non-adopters among the sample farmers covered in the study. For further details, see Adoption of Improved Practices of Paddy Cultivation—An Economic Analysis of Technological Change, *op. cit.*

APPENDIX

List of Characteristics

Characteristics	*Description of Measurement*
1. Cultivated holding ..	Operational holding measured in acres.
2. Owned holding ..	Size of owned operational holding plus size of leased out land measured in acres.
3. Borrowings ..	Annual (current) borrowings both from institutional and non-institutional sources measured in rupee divided by the size of cultivated holding.
4. Irrigated area ..	The percentage of irrigated area to total cropped area.
5. Age ..	Age of the farmer in years.
6. Educational level ..	Educational level of the farmer in years of schooling.
7. Extension Contact ..	Extension contact of the farmer is measured in scores assigned as follows :

	Scores
(i) If a farmer does not know or is not aware of the extension officials in the villages ..	0
(ii) If he is aware of the presence of extension officials	1
(iii) If he knows and has met village level worker	
Contacts in the Year of Survey	
1—2 times	1
3—4 times	3
5—7 times	6
8 and above	10
(iv) If he knows and has met Block Development Officials	2
(v) Had a demonstration on his farm or saw such demonstration on other's fields ..	2
Total ..	15

8. Subsidiary occupation .. Scores assigned to the subsidiary occupation of the farmer as follows :

Occupation	*Score*
(i) Village officials and teaching	5
(ii) Business	4
(iii) No subsidiary occupation	3
(iv) Artisans	2
(v) Other labour (non-farm)	2
(vi) Agricultural labour	1

9. Fragmentation .. Number of plots per acre of cultivated holding.

10. Tenancy .. The percentage of area under tenancy to cultivated holding.

11. Family literacy .. School going children plus literate adults divided by non-infant children plus adults in the family multiplied by 100.

12. Level of schooling in family .. Total years of schooling of the farm family members divided by non-infant children plus adults.

13. Consumption units in the family Lusk's consumption coefficients are used as follows :

	Consumption units
Men above 14 years of age	1.00
Women above 14 years of age	0.83
Both 10 years but below 14	0.83
Both 6 years but below 10	0.73
Both 1 year but below 6	0.50

14. Index of assets .. Value of the following assets excluding lands in rupees divided by the number of the consumption units in the family :

(*a*) *Farm assets*
1 Livestock (draught cattle, milch cattle)
2 Production equipments (ploughing, irrigation, etc.)
3 Transport equipment
4 Farm houses
5 Others

(*b*) *Non-farm assets*
1 Residential building
2 Other assets.

15. Socio-economic status .. On the basis of cultivated holding, farmers were classified into three groups, namely, (*i*) small farmers with 0.01 to 2.50 acres of size of holding, (*ii*) medium farmers with 2.51 to 5 acres of holding and (*iii*) large farmers having holding above 5 acres.

The main cultivating castes are Brahmins, Saraswats, Bunts, Billawas, Christians, Muslims, and others. They have been ranked as follows :

Caste groups	*Rank*
Brahmins	5
Saraswats	4
Bunts, Jains, Christians & Muslims	3
Billawas	2
Others (Hindu low caste) farmers	1

Scores distributed in a two way classification given by the three size-classes and five caste groups are shown below :

Size Class	Caste groups				
	1	2	3	4	5
1. Small farmers ..	1	2	3	4	5
2. Medium farmers..	6	7	8	9	10
3. Large farmers ..	11	12	13	14	15