

Reprinted from:
Artha-Vikas,
Journal of Econ-
omic Development
July, 1974

July, 1974

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IN SMALL FARMER ADOPTION OF THE NEW CEREAL VARIETIES

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Occasional Paper No. 61
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Research supported by Contract No. AID/csd-2805
"The Impact of New Technology on Rural Employment and Income Distribution"
Cornell University and the United States Agency for International Development

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Michael G. G. Schluter and Gokul O. Parikh

The importance of co-operative credit in adoption is not universal, nor is it immediately obvious why co-operative credit should be so vital for small farmer adoption. With rates of return on the new varieties often so high, are farmers unable to find any alternative credit source for a short period?

This paper argues that small farmers may be unable to borrow from traditional sources for adoption owing to an inelastic supply of credit, and unwilling to borrow from these sources owing to the uncertainty of returns from the new varieties. Macro-economic data for Gujarat State show that widespread adoption of new varieties requires huge expansion in the supply of co-operative credit. Micro-economic data indicate that co-operative credit becomes important after the initial phase of the diffusion process, and under conditions where a high degree of uncertainty is involved in adoption.

I.

A large number of micro studies have shown that small farmers have lagged in adoption of the new seed varieties, and that there is a close relationship between adoption by small farmers and use of co-operative credit in many areas (21, 32). Co-operatives are also becoming the most important sources of agricultural credit (18). However, the importance of co-operative credit in adoption is not universal and many aspects of this relationship are ill-defined. This paper will examine three main questions to bring the issues more sharply into focus.

1. Why should we expect to find co-operative credit an important factor in small farmer adoption behaviour?

2. a) In macro-terms, is it possible to have rapid diffusion of the new varieties, especially on small farms, in the absence of a large increase in the supply of co-operative credit?

b) In micro-terms, does availability of co-operative credit influence the adoption behaviour of the individual small farmer?

*This paper was written while Michael Schluter was associated with the Indian Institute of Management for research on his Ph.D. dissertation entitled, "The Interaction of Credit and Uncertainty in Determining Resource Allocation and Incomes on Small Farms, Surat District, India." Gokul O. Parikh is an economist on the staff of the Gujarat State Co-operative Bank, Ahmedabad.

The authors are grateful to John W. Mellor and Guntant M. Desai for their comments on an earlier draft of this paper, and to Gujarat State Co-operative Bank, for making survey data for Mehsana District available for additional analysis.

3. To what extent and under what conditions may co-operative credit be used to accelerate adoption of new varieties by small farmers?

In Section II we present a conceptual model showing the place of co-operative credit in the small farmer's overall supply and demand for capital, and we examine empirically the assumptions on which this model rests. In Section III we test the implications of the model in macro terms for the role of credit in adoption, using districtwise data for Gujarat State. In Section IV we test the implications of the model in micro terms, using the results of a large number of regional micro studies, and survey data for 225 farmers in Mehsana District of North Gujarat, and 120 farmers in Surat District of South Gujarat. In conclusion we draw on this analysis to show under what conditions co-operative credit may be used to accelerate diffusion of the new varieties to small farms.

II.

The place of co-operative credit in the individual small farmer's demand and supply of capital is illustrated in Figure 1. This simple model rests on three propositions:

(i) The supply of funds from savings and traditional sources is highly inelastic for small farmers (i.e. that BS_1 is close to being horizontal).

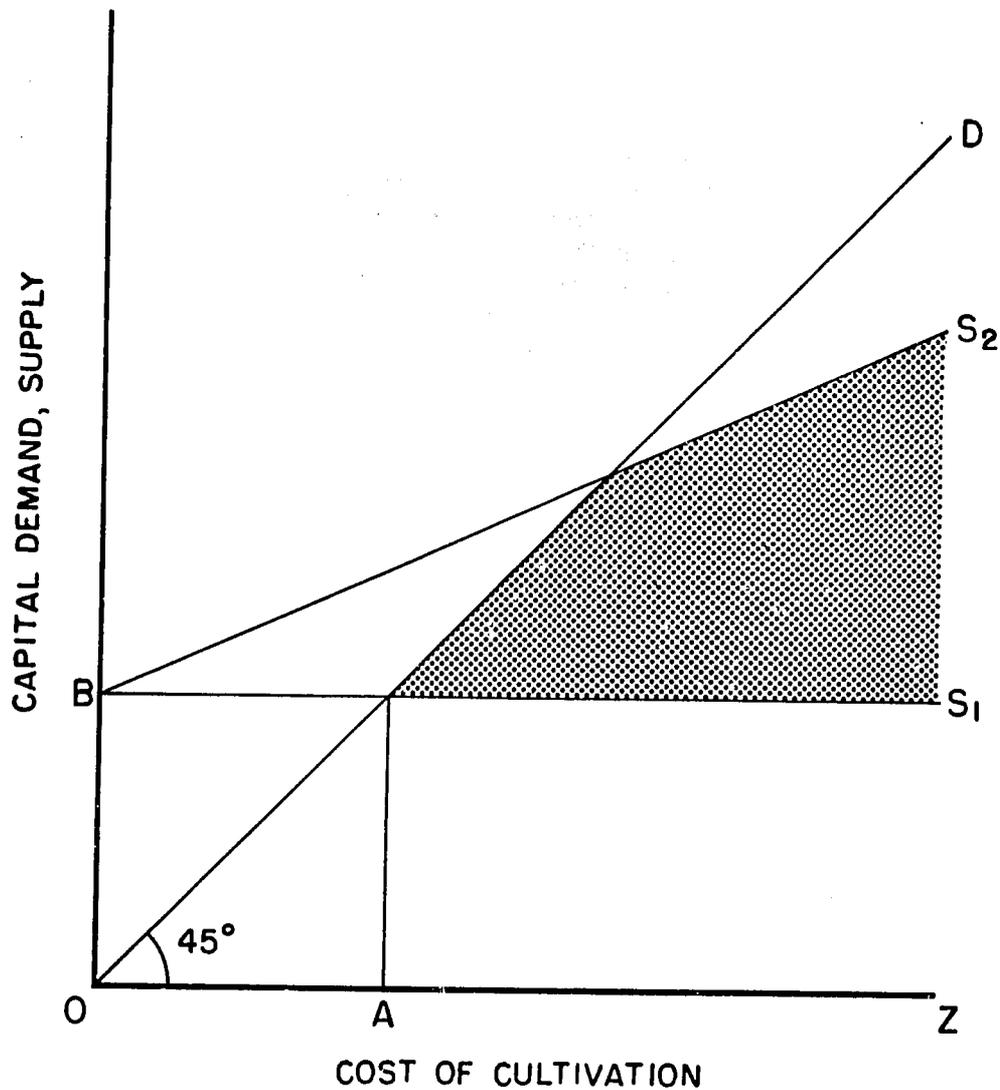
(ii) Small farmers generally find these sources adequate prior to technological change (i.e. they lie to the left of A on OZ).

(iii) Co-operative credit does not meet full costs of cultivation, although under the crop loan system the amount a farmer can borrow is related to costs of cultivation (i.e. BS_2 slopes upwards, but is not as steep as OD). This last proposition is not discussed further as the evidence is clear on this point (24).

Both savings and credit from traditional sources such as moneylenders are likely to be highly inelastic for small farmers, even with the possibility of high rates of return. Small farmers' debt to income ratio is high (30), and they must borrow for a large part of both production and consumption requirements in the kharif season (31). Their level of consumption is generally so low that there is little scope to forego consumption to allow additional funds for production (34). Available evidence also indicates that small farmers often cannot increase their loans from moneylenders; in a part of Surat District where moneylenders are still the main source of credit, over 50 percent of farmers indicated they could obtain little or no additional credit from a moneylender, and could not increase borrowings from relatives. Government pressure is causing most moneylenders in the area to contract operations, so that supply from this source is unlikely to expand rapidly to meet a growing demand for adoption of new varieties.

Evidence from both Surat and Mehsana support the second proposition that small farmers borrow little from co-operatives until there is technological change, leading to a substantial increase in costs of cultivation. In Mehsana, only 50 percent of small farmers had joined the co-operatives, and only 29 percent had taken loans. The main reasons given by small farmers both for non-membership and non-borrowing were adequate income and past-saving, and non-farm source of income (see Table 1). In Surat, two adjacent areas were surveyed, both well covered by

FIGURE 1. THE PLACE OF COOPERATIVE CREDIT IN THE
'SMALL FARMERS DEMAND AND SUPPLY OF
CAPITAL



Where, OD is demand for capital

BS_1 is the supply of funds available from savings, and borrowable for production from friends, relatives, moneylenders and traders

BS_2 is the total supply of capital, including what is available from the co-operatives

The shaded area shows the demand for co-operative credit.

efficient co-operatives, but with the difference that in one and not the other there were irrigation facilities and the new technology had been introduced. In the irrigated area, 77 percent of small farmers had joined the co-operative, whereas only 28 percent had joined in the other area. It is in the context of technological change that traditional sources of finance are found wanting.

As our model implies, the rate of interest is unlikely to account for the importance of credit in adoption. In order to argue that the rate of interest is a significant factor, it is necessary to demonstrate that rates of return on additional capital used to grow the new varieties are consistently close to the 10 percent to 50 range, which represents the difference in interest rates between moneylenders and co-operatives (30, 34). Therefore we estimated the rates of return on additional capital employed in growing the new varieties from a large number of micro studies as shown in Tables 2 and 3. It is clear that in almost all cases the new varieties are either extremely profitable or extremely unprofitable. In only 2 of the 43 cases for which data were available was the rate of return between zero percent and 50 percent. On the basis of this evidence, it seems most unlikely that the low rate of interest is what causes farmers to rely so heavily on co-operative credit in adoption.

III.

Co-operative credit becomes important at a secondary stage in the diffusion process. An examination of a large number of micro studies, undertaken mainly in 1966 and 1967, concludes that "the owned funds of the sample cultivators needed to be supplemented only marginally by borrowings in order to meet the input expenses of the high-yielding varieties" (10). However, surveys of micro studies covering slightly later periods find "a close relationship between co-operative credit and adoption" (32) and stress that "the increased cash expenditure on HYV paddy was met by a higher level of borrowing by participant farmers," much of it from the co-operatives (21).

We suggest that co-operative credit plays an important role in adoption when small farmers begin to adopt new varieties, and large farmers expand their acreage under the new varieties beyond the initial trial stage. In Surat district, in the early stages of adoption, only large farmers experimented with the new varieties (see Table 4), and they put only a small proportion of the acreage under the new seeds (34). Over a two or three year period, as the profitability of the new variety became clear, small farmers began to adopt and large farmers increased their acreage under the new variety. Initially, farmers' additional credit requirement is small as a percentage of total credit used on the farm. It is only in the secondary stages of adoption that large and small farmers alike require a quantity of capital that represents a significantly large proportional increase.

Macro data for Gujarat State confirms that rapid expansion in acreage under new varieties occurs only with huge expansion in the supply of co-operative credit. Ninety-four percent of HYV acreage in Gujarat was under new wheat or bajra varieties in 1970-71. Therefore, in Table 5 we ranked districts by percentage of area under bajra and wheat sown to new varieties in 1970-71, and estimated for each district the growth in advances from primary credit societies over the period of the HYVP, 1965-66 - 1970-71. Table 5 shows that spectacular growth of advances may occur in the absence of rapid diffusion of the new varieties. For

Table 1. Reasons Given by Sample Farmers for Non-Membership and Not Borrowing from Co-operatives in Mehsana District, 1969-70

Reasons	Percent of farmers reporting this reason for							
	Non-membership				Non-borrowing			
	Small	Medium	Big	Total	Small	Medium	Big	Total
I. No need								
i) Adequate income and past savings	67	69	87	72	75	78	80	77
ii) Non-farm source of income	42	23	13	30	31	-	-	11
iii) Other source of finance	8	23	27	17	13	28	20	20
iv) Land leased out	17	8	20	14	19	22	-	16
II. Dislike for co-operative credit								
i) No faith in co-operatives	-	4	7	3	-	-	-	-
ii) Inadequate finance	8	8	13	9	6	-	-	2
iii) Inefficient management	8	12	-	8	-	33	20	18
iv) Dislike for recovery procedure	36	27	33	23	23	23	20	25
v) Credit limit related to security	14	12	33	17	-	11	-	5
III. Defaulter of the society	-	-	-	-	13	17	20	16

Source of data: 14.

Table 2. Rates of Return on New Rice Varieties in India, 1966-1971

District and Year	Main Variety	Total expenditure per acre		Net returns per acre		Additional working capital expenditure		Rate of return
		HYV	Local	HYV	Local	5=1-2	6=3-4	
		1	2	3	4	7=6+5		
1966-67								
Thanjavur (16)	ADT-27	139	118	395	227	21	168	800%
Karnal (16)	TN-1	113	54	491	348	60	143	238%
Cuttack (9)	TN-1	296	82	646	377	214	269	126%
Ernakulam (16)	TN-3	365	226	692	792	139	-100	-72%
Mahar. Dist. (20)	TN-1	194	126	251	310	68	-49	-72%
Krishna (16)	TN-1	202	101	482	565	101	-83	-82%
Mandhya (29)	TN-65	426	293	789	1124	233	-335	-101%
Kolaba (16)	TN-1	128	68	132	269	61	-157	-224%
1967-68								
Thanjavur (17)	ADT-27	183	139	NA	NA	44	133	302%
Sibsagar (17)	TN-1	NA	NA	NA	NA	62	206	252%
W. Godavari (17)	IR-8	294	138	NA	NA	156	163	104%
Saharanpur (17)	TN-1	159	87	NA	NA	72	54	75%
Birbhum ¹ (17)	TN-1	401	221	NA	NA	180	-60	-33%
Varanasi (17)	TN-1	159	125	NA	NA	34	-58	-171%
Amritsar ² (17)	TN-1	214	169	NA	NA	45	-175	-389%
Raipur (17)	TN-1	104	110	NA	NA	-6	-340	-
1968-69								
Sibsagar (Aunt.) (5)	TN-1	129	80	1195	316	49	879	1794%
Sibsagar (Rabi) (5)	TN-1	150	81	718	471	69	247	358%
E. Godavari (Rabi)(3)	IR-8	583	408	877	251	175	426	243%
Sambalpur (17)	TN-1	289	154	542	274	135	268	199%
W. Godavari (Rabi)(3)	IR-8	745	579	467	195	167	228	172%
Amritsar (28)	IR-8	284	157	618	382	127	236	126%
Birbhum (13)	IR-8	391	147	732	400	244	242	99%
Saharanpur (37)	IR-8	295	233	658	605	62	53	85%
W. Godavari (2)	IR-8	514	321	440	376	193	64	33%
E. Godavari (2)	IR-8	529	239	283	292	276	-7	-3%
1971-72								
Surat (34)	Masuri	353	290	608	507	63	101	160%

1. Refers to all HYV. IR-8 above was considerably more profitable.

2. Compared with Basmati.

Note: For each variety, net returns per acre is defined as average gross returns, estimated as average price multiplied by average yield, minus average expenditure on variable inputs as defined in each study (see Appendix A).

Table 3. Rates of Return on New Wheat, Bajra and Maize Varieties in India, 1966-1971

District and Year	Main Variety	Total expenditure per acre		Net returns per acre		Additional working capital expenditure		Rate of return
		HYV	Local	HYV	Local	5=1-2	net returns	
		1	2	3	4			
<u>Wheat</u>								
Saharanpur (15) 1967	Mexican	197	207	533	339	- 10	194	--
Amritsar (26) 1967	Lerma Rojo	137	124	353	204	13	149	1146%
Aligarh (12) 1967	HYV	334	219	781	434	115	347	301%
Tikamgadh (6) 1967	HYV	318	150	520	93	168	427	254%
Udaipur (4) 1967	HYV	434	318	707	480	116	227	196%
Karnal (36) 1967	Mexican	225	110	607	460	115	207	180%
Surat (34) 1971	S-227	233	160	350	220	73	130	178%
Kota Dist. (30) 1968	S-227	338	221	264	140	117	124	105%
Amritsar (26) 1967	S-227	390	124	247	204	266	43	16%
<u>Bajra</u>								
Karnal (17) 1967	Hybrid	182	17	NA	NA	165	232	140%
Kaira (17) 1967	Hybrid	249	115	NA	NA	134	138	106%
Nasik (17) 1967	Hybrid	190	47	NA	NA	143	134	94%
Mehsana (17) 1967	Hybrid	174	93	167	121	82	66	80%
Ahmedabad (11) 1968	Hybrid	254	132	180	93	122	87	71%
<u>Maize</u>								
Saran (10) 1968	Hybrid	197	92	231	131	105	100	95%
Aligarh (16) 1966	Hybrid	257	119	78	226	138	-148	-107%

Note: Definitions as in Table 2.

Table 4. Percentage of Farmers Adopting High-Yielding Rice Varieties on any Part of their Irrigated Rice Acreage by Farm Size, Among Sample Farmers in Surat District, 1968-69 to 1972-73

Net cultivated acreage	1968-69	1969-70	1970-71	1971-72	1972-73
	----- PERCENT -----				
0-2	0	0	50	65	55
2-5	4	46	74	65	74
5-10	21	43	61	61	71
Over 10	20	36	82	82	82

Source: 34.

example, in Bhavnagar, Surendranagar and Junagadh districts, where less than 25 percent of bajra and wheat acreage was under new varieties in 1970-71, growth in advances over the period of HYVP was over 90 percent.

However, Table 4 also indicates that rapid diffusion of the new varieties is dependent on co-operative credit. In all the six districts where over 40 percent of bajra and wheat acreage was sown to new varieties, there was a huge expansion in advances of co-operative credit, ranging from 52 percent to 296 percent. With membership almost static, this expansion reflects an increase in the percentage of members borrowing, an increase in the size of loan per borrower, or both.

IV.

Profitability and some degree of certainty are preconditions for small farmers to decide to adopt. Co-operative credit then becomes significant in determining the ability to adopt.

The importance of both profitability and uncertainty emerges from the analysis of 10 districts in Table 6. In all three cases of a high level of small farmer adoption (Thanjavur, W. Godavari (rabi) and Surat), the rate of return on additional capital employed was in excess of 65 percent. However, the high profitability and low small farmer adoption in Cuttack District in 1966 underlines that the degree of uncertainty is also important. The recent introduction of the new variety, and the weather variability of the kharif season may both have contributed to a high degree of uncertainty in that situation. The higher levels of adoption in both East and West Godavari in the rabi season may be due not only to greater profitability but also to lower uncertainty, as disease and adverse weather conditions are less prevalent in the rabi season.

Table 5. Increase in Acreage under New Bajra and Wheat Varieties as a Percentage of Total Bajra and Wheat Acreage and Percentage Increase in Advances from Primary Credit Societies from 1965-66 to 1970-71, by District for Gujarat State (Excluding Dangs and Gandhinagar)

District	% of Bajra and Wheat Acreage, under HYV 1970-71	% Increase in Advances 1965-66 - 1970-71
Bulsar	65.16	296.18
Ahmedabad	62.32	89.94
Surat	59.79	51.66
Kaira	55.33	88.04
Rajkot	52.21	258.40
Amreli	42.04	115.38
Baroda	37.75	30.84
Panchmahals	35.42	59.96
Mehsana	35.15	43.55
Sabakantha	31.84	176.40
Jamnagar	27.87	91.69
Surendranagar	24.00	136.86
Junagadh	23.93	134.44
Bhavnager	23.34	85.16
Broach	9.40	70.29
Kutch	9.19	27.00
Banaskantha	8.04	-59.37

Sources: Gujarat State Co-operative Bank
Gujarat State Agricultural Statistical Office
Gujarat State Income Unit

Table 5. Capital Requirement, Profitability and Small Farmer Adoption of New Rice Varieties in Nine Districts 1966-71

District	Year & ₁ season	Main variety	% increase in working capital for HYV	Rate of return on additional working capital used	% small farmers adopting ₂
Thanjavur (17)	'67 K	Adt-27	31	302	High
Surat (34)	'71 K	Masuri	17	67	63
W. Godavari (2)	'68 R	IR-8	41	172	59
E. Godavari (2)	'68 R	IR-8	50	243	39
A district of Maharashtra (20)	'66 K	TN-1	54	-72	36
Varanasi (1)	'67 K	TN-1	27	-171	23
E. Godavari (3)	'68 K	IR-8	45	-3	16
W. Godavari (3)	'68 K	IR-8	54	33	10
Cuttack (7)	'66 K	TN-1	261	126	10

Notes: 1. K= Kharif, R= Rabi

2. A small farmer 'adopted' if he put any part of his rice acreage under a new variety.

Other definitions are the same as those used in Tables 2 and 3.

To examine more closely the role of co-operative credit in situations where it was profitable to adopt, we analyzed farmer's adoption behaviour for hybrid bajra in Mehsana (14), and HYV rice and wheat in Surat (34), using a linear regression model. Area under the new variety was the dependent variable; independent variables used in the model and the results of the estimated equations are shown in Table 7. We also examined adoption of HYV wheat in Mehsana using tabular analysis because a regression model was not feasible (see Table 8). Value of non-farm assets is used in the Surat data as a measure of a farmer's capacity to bear uncertainty. For Mehsana, these data were not available.

Availability of co-operative credit was especially important for small farmers in situations involving a high degree of uncertainty. The significant negative coefficient for gross cropped acreage (a proxy variable for farm size) in the equation for the new rice variety, shows that a relatively high proportion of small farmers had adopted the new variety. The significant coefficients for both availability of co-operative credit and value of non-farm assets suggest that it was mainly those small farmers able to bear uncertainty and with access to co-operative credit who had adopted. In contrast for wheat, which involves much less uncertainty as a rabi crop, neither value of assets nor availability of co-operative credit were positively related to adoption. Greater availability of funds in the rabi season, after the year's main crop sales at the end of the kharif season, was another factor in the lack of significance of co-operative credit for adoption of HYV wheat.

In Mehsana, availability of co-operative credit was a significant factor in adoption of hybrid bajra and new wheat varieties, both of which involved a high degree of uncertainty. For bajra in Mehsana, the uncertainty involved in cultivation of the new variety has been demonstrated to be high (33). For wheat, uncertainty was due to the recent introduction of the variety, and a well irrigation system largely dependent on an uncertain electricity supply.

Why is co-operative credit of special importance for adoption in situations involving a high degree of uncertainty? The inability of farmers to borrow from traditional sources to finance innovation was argued above. Small farmers also may be unwilling to use traditional credit sources, even when they are able to. In the event of crop failure, a farmer often falls back on a moneylender to finance essential production and consumption expenditure until the next harvest. If the farmer borrows additional capital from a moneylender to finance the adoption of new varieties, and the crop fails, he may not be able to borrow any more from this source, and may have no other source of credit with which to meet an emergency. In contrast, repayment of co-operative loans are more flexible, as loans are frequently changed from short to medium term in the event of crop failure, and traditional credit sources are still available until the next harvest.

v.

Our analysis suggests that co-operatives may be an especially effective policy instrument to accelerate diffusion of the new varieties to small farms under the following conditions:

- (i) Where a profitable innovation has been introduced.

Table 7. Estimated Regression Equations Showing Factors Influencing Adoption of Hybrid Bajra in Mehsana District, 1969-70, and High Yielding Rice and Wheat Varieties in Surat District, 1971-72.

District Crop	Mehsana		Surat			
	Bajra		Rice		Wheat	
Factor Influencing Acreage under HYV	Reg'n Coeffic.	Est. t Value	Reg'n Coeffic.	Est. t Value	Reg'n Coeffic.	Est. t Value
Acreage under crop	0.406	5.24**	0.661	6.59**	0.541	3.84**
Gross cropped acreage	-0.034	-1.43	-0.056	-2.17*	0.006	0.29
Credit available from the co-operative ¹	0.324	4.05**	0.182	2.02*	-0.114	-1.57
Non-agric. income ('000 Rs.)	0.210	1.33	0.089	1.38	-0.016	-1.28
Dairying income ('000 Rs.)	2.890	4.85**	0.100	1.54	0.073	1.53
Non-farm assets ('000 Rs.)	-	-	0.020	2.52**	-0.005	-0.89
No. family members available for farm work ²	0.010	0.55	0.011	0.10	-0.009	-0.74
Educational level of family decision maker ³ (in years)	0.775	2.13*	0.005	-0.12	0.076	3.23**
Home consumption re- quirement (in mds.) ⁴	0.007	4.59**	0.005	0.53	0.009	0.55
Value of kharif crop sales	-	-	-	-	-0.030	-0.75
No. of observations (farmers)						
	n= 212		n= 59		n= 50	
Multiple correlation coefficient	$r^2 = 0.43$		$r^2 = 0.76$		$r^2 = 0.54$	

*Significant at 5% level

**Significant at 0.5% level

- Notes: 1. For Mehsana, defined as the maximum amount a farmer can borrow from the co-operative under the crop loan system with his existing cropping pattern, assuming he puts all bajra and wheat acreage under HYV. For Surat, defined as the maximum amount the co-operative Society said it would be willing to lend the farmer for variable inputs based on acreage, cropping pattern, assets, character of the farmer, etc.
2. For Mehsana, number of family members was used as a proxy variable.
3. For Mehsana, literate (=1) or illiterate (=0) was used as a proxy variable.
4. In Gujarat, 1 maund is equal to 20 kg. approximately.

Sources of Data: 14, 34.

Table 8. Factor Influencing Adoption of High Yielding Wheat Varieties in Mehsana District, 1969-70

Farm size (G.C.A.) Factor	0-5		Over 5	
	Adopters ¹	Non-adopters	Adopters	Non-adopters
Credit available from co-operative	469	213	1196	811
Non-agricultural income	558	268	364	279
Dairying income	185	164	295	213
Home consumption requirement (in mds.)	6.0	8.5	54.0	46.8
% of farmers adopting	48.15%		16.30%	

Source of Data: 14.

¹An adopter is defined as any farmer with some part of his wheat acreage under HYV.

Other variables are defined as in Table 7.

(ii) In the second phase of the diffusion process, when small farmers begin to adopt.

(iii) In the kharif season, when crop diseases and weather variability lead to the highest levels of uncertainty, and capital available from own funds is at a minimum.

In areas without technological change, the role of co-operative credit for small farmers is limited by an absence of demand. Small farmers can meet costs of cultivation from traditional sources and in many cases find the disadvantages of changing to co-operative credit greater than the advantages (14, 35). In areas with technological change, supply constraints may inhibit adoption; attention should be focused in these areas on improvement in management practices of the primary credit societies.

The importance of co-operative credit in situations of high uncertainty suggests that co-operative institutions should take account more explicitly of uncertainty in policy regarding the repayment of loans. To the extent that

co-operatives follow a flexible policy, they allow individuals to shift uncertainty from themselves onto an institution which is well placed to balance risks between regions and over time. However, a more flexible policy will increase the need for careful supervision of loans, and may increase the number of bad debts which have to be written off, especially in the event of an unsuitable variety being introduced, or extremely adverse weather conditions. To pay for these policies, the normal interest rate could be raised; we have argued above that in most cases this would make little difference to borrowing as the returns on the new varieties are so high, and supply from other sources highly inelastic.

Stimulus to demand for co-operative credit from small farmers by more flexible repayment policies, and more ready access in areas where demand exists, would accelerate diffusion of the new varieties to small farms. Thus the credit co-operatives would become a more effective mechanism both to increase the production of foodgrains, and to reduce income disparities in rural areas.

Appendix A

Items Included in Expenditure per Acre for Tables 2, 3 and 6

1. Studies including only cash costs of cultivation, Nos. 7, 8, 13, 29.
2. Studies including variable inputs -- seed, fertilizers, organic manure, pesticides, casual labour charges, irrigation (whether payment in cash or kind), Nos. 16, 17, 26 (4 and 34 also include imputed value of family labour).
3. Studies using definition in 2, but including land revenue and rent paid to landlord, Nos. 15, 28, 37.
4. Studies using cost A₁, as defined in the Farm Management Studies (i.e. all costs except interest payments and imputed value of family labour), Nos. 2, 3, 12, 16, 20, 38.
5. Studies using cost A₂, as defined in the Farm Management Studies (include all costs except imputed value of family labour), Nos. 5, 11, 39.

References

1. Allahabad, University of, "H.Y.V.P. in Varanasi District (Kharif 1967-68)," A.E.R.C., Allahabad, India, 1968.
2. Andhra University, "Report on the Study of the H.Y.V.P. (Kharif 1968-69: Phase II)," A.E.R.C., Waltair, India, 1969.
3. _____, "Report on the Study of the H.Y.V.P. (Rabi 1968-69: Phase III)," A.E.R.C., Waltair, India, 1969.
4. Archarya, S. S., "Comparative Efficiency of H.Y.V.P., A Case Study of Udaipur District," Economic and Political Weekly, Vol. IV, No. 44, November 1, 1969, p. 1755.
5. Assam Agricultural University, "Report on H.Y.V.P. in Sibsagar District (1968-69)," A.E.R.C., Jorhat, India, 1969.
6. Athavale, M. C., "A Study of H.Y.V.P. in Tikamgarh District, Rabi 1967-68 (Wheat)," A.E.R.C., Jabalpur, India, 1968.
7. Choudhury, B. K., "A Study of H.Y.V.P. in the District of Cuttack, Orissa with Special Reference to Credit," A.E.R.C., Visva-Bharati, Santiniketan, India, 1967.
8. _____, and G. Cjha, "A Study of H.Y.V.P. in the District of Saran, Bihar with Reference to Hybrid Maize (Kharif) 1968-69," A.E.R.C., Visva-Bharati, Santiniketan, India, 1969.
9. Desai, B. M. and M. D. Desai, "New Strategy of Agricultural Development in Operation. (A Case Study in the Kaira District in Gujarat)," A.E.R.C., Sardar Patel University, Vallabh Vidyanagar, India, 1968.
10. Desai, Mahendra D. and Bharat D. Naik, "Prospects of Demand for Short-Term Institutional Credit for High-Yielding Varieties," Indian Journal of Agricultural Economics, Vol. XXVI, No. 4, Oct.-Dec. 1971, p. 458.
11. Dharap, V. S., "A Study of the Hybrid Bajra Programme in the Ahmedabad District, Gujarat (Kharif 1968-69)," A.E.R.C., Sardar Patel University, Vallabh Vidyanagar, India, 1969.
12. Dixit, D. A. and P. P. Singh, "Impact of High Yielding Varieties on Human Labour Inputs," Agricultural Situation in India, Vol. XXIV, No. 12, March 1970.
13. Ghosh, M. G., "A Study of H.Y.V.P. in the District of Birbhum West Bengal with Reference to Kharif Paddy, 1968-69," A.E.R.C., Visva-Bharati, Santiniketan, 1969.

14. Gujarat State Co-operative Bank, Data Collected in 1969-70 as part of a Survey of Farmer's Response to Short-Term Co-operative Credit in Gujarat.
15. Gupta, D. P., "A Study of Mexican Wheat in Saharanpur District (U.P.)," A.E.R.C., University of Delhi, 1968.
16. India, Government of, Report of the High Yielding Varieties Programme (Studies in Eight Districts Kharif 1966-67), Directorate of Economics and Statistics, Ministry of Food, Agriculture, and Community Development and Co-operation, 1968.
17. _____, Report of the High-Yielding Varieties Programme (Kharif 1967-68), Directorate of Economics and Statistics, Ministry of Food, Agriculture, and Community Development and Co-operation, 1969.
18. Jain, H. C., "Growth and Recent Trends in the Institutional Credit in India," Paper, Indian Journal of Agricultural Economics, Vol. XXVI, No. 4, Oct.-Dec. 1971, p. 555.
19. Lele, Uma J., "Role of Credit and Marketing Functions in Agricultural Development," Paper, International Economic Association Conference, The Place of Agriculture in the Development of Underdeveloped Countries, Bad Godesberg, Germany, 1972.
20. Muranjan, S. W., "A Study of H.Y.V.P. in a District of Maharashtra (Paddy) 1966-67," Gokhale Institute of Politics and Economics, Poona, India, 1968.
21. Muttiah, G., "The Green Revolution - Participation by Small versus Large Farmers," paper presented at Seminar on Rural Development for Weaker Sections, Indian Society of Agricultural Economics and Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad, India, October, 1972.
22. Ojha, G., "Small Farmers and the H.Y.V.P.," Economic and Political Weekly, Vol. V, No. 14, April 4, 1970, p. 603.
23. Parikh, G. O. and R. D. Sevak, "Relative Profitability of Improved and Deshi Wheat: A Case Study," Industrial March, Jan.- March, 1971, pp. 48-50.
24. _____ and U. S. Sharma, "Some Reflections on Co-operative Short-Term Credit," Paper presented at 2nd Gujarat Economic Conference, Vallabh Vidyanagar, India, 1970.
25. _____, "Co-operative Credit and New Technology," unpublished paper.
26. Rao, A. P., "A Study of Mexican Wheat in Amritsar District (Punjab) Rabi 1967-68," A.E.R.C., University of Delhi, 1968.
27. _____, "Report on H.Y.V.P. in Saharanpur District (U.P.), With Reference to IR-8 Paddy," A.E.R.C., University of Delhi, 1969.

28. Rao, P.V.G.K., "Economic Aspects of H.Y.V.P. in Punjab," A.E.R.C., Delhi University, 1969.
29. Rajapurohit, A. R., "Study of H.Y.V.P. in a District of Mysore, Paddy (Rabi 1966-67)," Gokhale Institute of Politics and Economics, Poona, 1968.
30. Reserve Bank of India, All-India Rural Credit Survey, Vol. I (The Survey Report), Bombay, 1956.
31. _____, Report of the All-India Rural Credit Review Committee, Bombay, 1969.
32. Schluter, Michael G. G. and John W. Mellor, "New Seed Varieties and the Small Farm," Economic and Political Weekly, Review of Agriculture, March 25, 1972, p. A-31.
33. _____ and Richard W. Longhurst, "Some Aspects of the Suitability of High Yielding Rice and Bajra Varieties for the Small Farm, Thanjavur and Mehsana Districts, India," Occasional Paper No. 57, Dept. of Agricultural Economics, Cornell University, USAID-Employment and Income Distribution Project, 1972.
34. _____, Data collected as part of doctoral research from Cornell University on the subject, "Raising Incomes of Small Farms in India," Ithaca, N. Y.
35. Sharma, R. K., "Co-operative Credit in the Package Programme. A Study in Aligarh District, Uttar Pradesh", A.E.R.C., University of Delhi, 1966.
36. _____, "A Study of Mexican Wheat in Karnal District (Haryana) Rabi 1967-68", A.E.R.C., University of Delhi, 1968.
37. _____, "A Study of IR-8 Paddy in Karnal District (Haryana State), Kharif 1968", A.E.R.C., University of Delhi, 1969.
38. Tripathy, R. N. and B. Samuel, "Economics of High Yielding Varieties in I.A.D.P. A Study of Sambalapur District in Orissa", Economic and Political Weekly, Vol. IV, No, 43, October 25, 1969, p. 1719.
39. Tyagi, D. S. and V. N. Misra, "A Study of the H.Y.V.P. in the Kota District, Rajasthan (Rabi 1968-69)", A.E.R.C., Sardar Patel University, 1969.
40. Vyas, V. S., D. S. Tyagi, V. N. Misra, "Significance of the New Strategy of Agricultural Development for Small Farmers", A.E.R.C., Sardar Patel University, Vallabh Vidyanagar, 1968.

A.E.R.C. = Agro-Economic Research Centre
 H.Y.V.P. = High-Yielding Varieties Programme