FINANCING SMALL-FARM DEVELOPMENT IN INDIA*

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Small-farm credit is important in public programs of developing countries. It is supported to finance increased productivity through modernization and to replace the exploitive moneylender. However, expectations often exceed performance. Indian research suggests the discrepancy may be traced to failure to account for the needs of liquidity management. It suggests, too, that programs that are designed to account for liquidity management can lead to modernization and to improved viability of small farms as well.

Small-farm families comprise about one-fifth of India's 547 million people. The demographic characteristics of India, the macro constraints associated with economic growth and development [12], and the limited land space of the country insure that in the foreseeable future India's small-farm population will remain a large percentage of total population generally and rural population in particular. The Fourth Five-Year Plan recognized that small-farm problems are persistent rather than transitory. The Plan provided Rs. 115 crores (A$76.79 million) specifically for small farmers and agricultural labourers, 4·21 per cent of the total outlay [14]. The Small-Farm Development Agencies (SFDA) Program is the first major public sector program designed specifically for small-farm development. The Program subsidizes 25 per cent of improved production inputs, and provides loans from the SFDA through co-operative credit institutions and commercial banks. SFDA is intended to benefit about two million small farmers, a small proportion indeed, relative to the total small-farm population of India.

The basic problems of small farms in India are chronic low income and malnutrition. A vicious cycle of poverty is generated by small land holdings, inadequate resource position and unfavourable tenurial status. Low production and consumption, low returns on savings, high cost indebtedness, and credit constraints have been reported as causes of restricted growth of small-farm firms [15, 23]. A study by Gilpatrick reports empirical information on the differences in production, consumption, marketing and financial characteristics of five groups of small farmers, classified by the criterion of adequacy of net income to meet customary standards of living [2]. Theoretical bases for these differences have been discussed by Long [18] and Miracle [19]. Wharton [29] developed an analytical model to study response behaviour of subsistence farmers to risk and uncertainty associated with technological innovations in the context of survival. Baker [5] has outlined a financial

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reserves management approach to analyse economic growth and development problems of small farms. We propose to apply this approach specifically to the modernization of small farms in District Badaun, U.P.

The Role of Credit

Recent reviews of literature suggest existing credit programs are limited in reaching small farmers [13, 21, 23]. Co-operative credit societies have often failed to survive and survivors have often failed to reach substantial numbers of small farmers [3, 8, 26]. Nor is the record significantly better for commercial banks or specialized agencies [26]. Rates of default have been high, suggesting program rejection by small farmers. Various proposals have been made either to improve existing programs or to replace them altogether [2, 23, 26].

The revealed limitations of credit programs are world-wide [20], not specific to the Indian situation. Hence it is reasonable to search for an explanation on the basis of principle rather than of institutional failure. Some suggest that small farmers' response to economic opportunity is limited or even negative. However, Professor Jones [16] and Professor Schultz [25] have seriously challenged the inert peasantry concept, contending that subsistence farmers are rational decision makers who respond positively to rewarding economic opportunities. Subsequent studies have produced evidence which now is convincing that small farmers do in fact respond sensitively and positively to economic incentives [6, 7, 17].

For India, many reports reveal that a large majority of small farmers have not adopted high yielding crop varieties which appear to promise rewarding economic opportunities [13, 22, 24]. Other studies suggest that small farmers would respond more favourably but for lack of capital [9, 11]. The role of credit, then, is visualized as one of reducing the capital constraint on the growth of small farms. It generally is argued that more credit, reduced cost of loans, and more technical assistance would accelerate the economic growth of small farms [23]. Credit programs in India have striven to do just that: provide loans at low interest costs, move toward a 'credit package approach', and link loans to provision of production inputs and repayment to output. Yet loan defaults are still increasing at an alarming rate [3, 23].

Thus on the one hand, we have rational decision makers (small farmers) willing to respond to economic opportunities but constrained by lack of capital. Yet these same small farmers reject publicly supported credit programs (PSCP) either by not participating or by defaulting in repayment and thus leaving the program. There is no simple explanation for the paradox. However, it has been suggested that the answer may lie in a discrepancy between the role of credit as seen by policy makers and the role ascribed to credit by small farmers [5].

In common with most credit programs for small farmers, India's programs limit the use of loan proceeds to production purposes, or even further, to the purchase of 'improved inputs'. But the small farmer must finance both production and consumption activities. Operating at a near-subsistence level, he also must provide for adverse contingencies in either his business or his household. Finally, the seasonal nature of farming produces problems of managing seasonal cash deficits and surpluses. In summary, the small farmer must (1) counter risk and uncertainty with little external assistance, and (2) manage seasonal deficits with limited cash flows.

In his production organization, the small farmer can diversify his enterprises and keep his resource organization flexible. In his marketing organization he may have options in forward commitments. But both sets of alternatives are limited. Some crops must be produced to meet food consumption requirements. The farm already is diversified. Moreover, diversification and flexibility provide at best the means to counter uncertainty in production aspects of the firm. Uncertainty that affects consumption activities is not provided for. The best and perhaps only means to provide for adverse outcomes in consumption are in liquidity, i.e., the ability to generate cash on demand.

A Theory of Liquidity Management

It is analytically useful as well as plausible to conceive the firm as a collection of assets with an aggregate value that exceeds the sum of values attainable by separate sale of the assets. It is a plausible concept. Were the relation of the aggregate to the parts not thus, the separable assets would be disposed of and the firm would disappear. It is an analytically useful concept. It provides the logical basis for ascribing liquidity values to assets, as well as production value.

In Figure 1 we suggest a conceptual mode for identifying the 'liquidity value' of an asset within a firm. The expected sales value of the asset is measured on the horizontal axis. This is the value that appears in the firm's balance sheet. The asset's contribution to after-sale value of the firm appears on the vertical axis. The ray, OL, is drawn from the origin, equidistant from the axes. An asset with sales value equal to the diminution in value of the firm is defined as 'perfectly liquid'. In a rationally organized firm, no asset would be found with an expected sales value greater than its contribution to firm value. Instead, the asset would have been sold and the proceeds found in cash. In practice, virtually all assets will be found with (separate) sales values less than the values they contribute to the value of the firm. OL constitutes a limiting relation between an asset's value and its contribution to firm value. Sale of the asset can in general be expected to diminish the value of the firm by more than the expected proceeds of the sale. That is, its value to the firm would lie on or above OL (*e.g.,* OA).

Even cash in the balance sheet of the firm may contribute more to firm value than the actual sum of dollars. Access to balance sheet cash is immediate and at zero transaction cost. Hence cash has a liquidity value. Firms are found to borrow even while retaining cash balances. As such assets as crops and livestock mature, the expected value of cash proceeds from their sale increases relative to their value in current (non-cash) form. As the firm's cash supply increases the liquidity value of further increments of cash diminishes. The more liquid the non-cash aggregate (i.e. the more substitutable for cash), the lower the liquidity value of cash. We suggest that in general, an asset in the balance sheet of a firm produces two contributions: an expected stream of income, through productivity of the asset; and a contribution to credit, through rules by which lenders translate asset value into credit limits for the decision maker. Credit, defined as borrowing capacity, can substitute for cash as a source of liquidity, even though credit does not

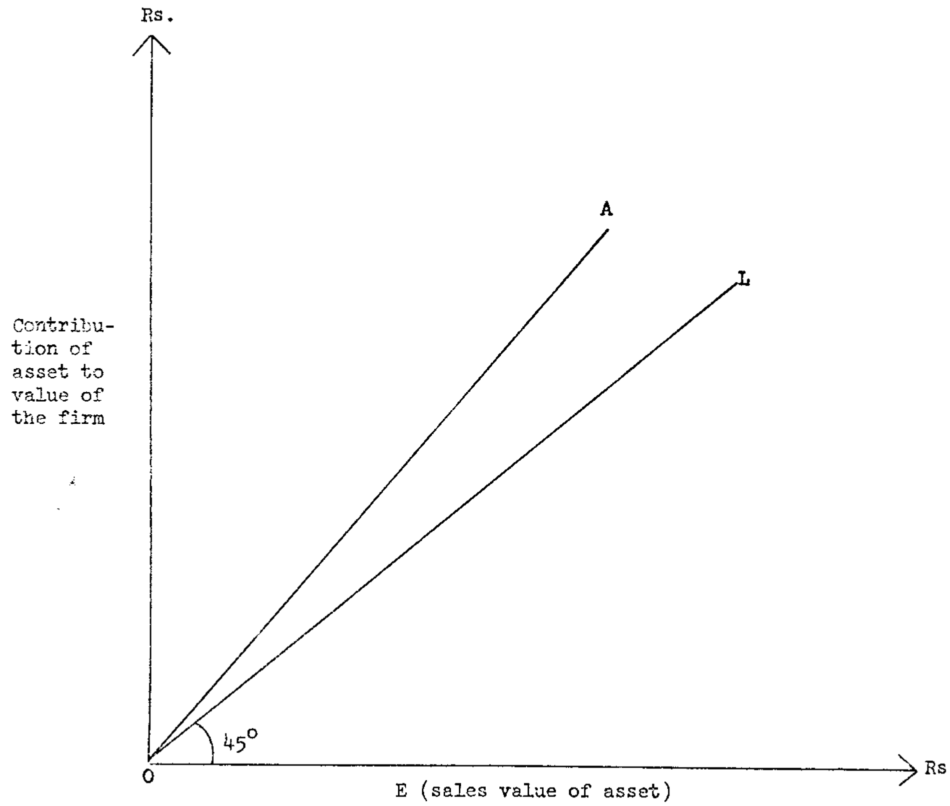

Figure 1

appear in a conventional balance sheet for the firm. Credit can be used to produce loan proceeds without actually disposing of balance sheet assets. Hence credit is an important source of liquidity. Given an increase in reliable access to loans, the small farmer can be expected to commit more cash to production, relying upon unused credit as a contingency source of cash.

In less developed countries, sources of liquidity for small farms are limited. Insurance options scarcely exist even against common hazards. Assets of the small farm are generally fixed and essential for the farm's operation. For example, land, bullocks, and a few implements are the usual assets of the small farms. The saleability of these assets is very low and subject to high transaction costs. Hence they have limited liquidity value. Conventionally defined, liquid assets of the firm include cash, gold, and jewellery. Cash is a nearly perfect source of liquidity since it can be converted to use with zero transaction costs. The other 'liquid' assets are subject to transaction costs that may be excessive. Hence credit, if reliable, versatile, and easily accessible, provides an unusually valuable source of liquidity. But the small farm typically is denied such credit except for the high-cost moneylender. Hence he is forced to restrict his commitment of cash to preserve some liquidity in this form.

Such behaviour explains the high percentage of liquid assets in the financial organization that so surprise some observers [1]. Moreover, it explains the widespread failure of PSCP credit that is limited in use and that is perceived as temporary and unreliable by the small farmer. So conceived the PSCP fail to replace the informal lenders who are regarded as a source of liquidity reserve. Nor do they lead to any further commitment of the small farmer's cash resources.

The behavioural assumptions in liquidity management can be represented as in Figures 2a and 2b, relating to cash and credit, respectively. In each case, the value of liquidity, shown on the vertical axis, is related to the amount of cash (2a) or credit (2b) used (read left to right) or reserved (read right to left) as shown on the horizontal axis. The relation is shown as nonlinear, to reflect the plausible assumption of diminishing returns from either as the percentage reserved increases. On the other hand, it is plausible to expect the liquidity value to reach extremely high levels as the firm is drained of liquidity in either form.

An interesting implication of Figures 2a and 2b lies in the perception that the rationally organized firm may well borrow in the presence of a positive cash balance. Such a result could not be explained with conventional firm theory, given a rate of interest greater than zero, despite frequent observation of just such behaviour.

The heights and slopes of relations such as those of Figures 2a and 2b clearly reflect subjective responses of the decision maker to uncertainties in his economic environment. For the cautious, the relations will be higher and perhaps more steeply sloped than for the less cautious. Yet the relations will be affected also by the structure of assets in the firm. For an aggregate of assets with a high liquidity content (i.e. small deviations from OL, in Figure 1), the height of the relations in Figures 2a and 2b will be lessened, *ceteris paribus*. Moreover, the more secure, versatile and cheaper the access to credit, the lower would be the function in Figure 2a, relative to the function in Figure 2b. Even in the absence of precise numerical estimates for parameters of Figures 2a and 2b, it is important to recognize the qualitative relationships. And it may well be better to use some judgment estimates of the parameters

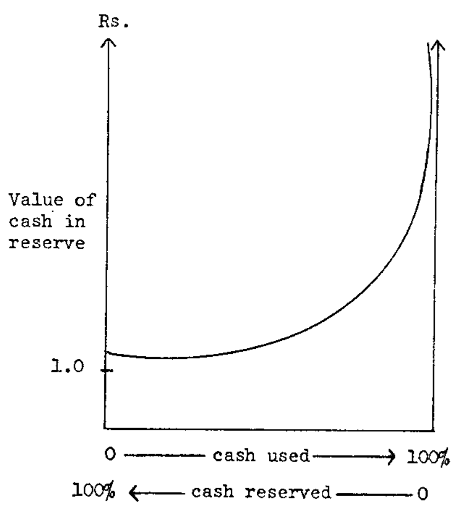

Figure 2A

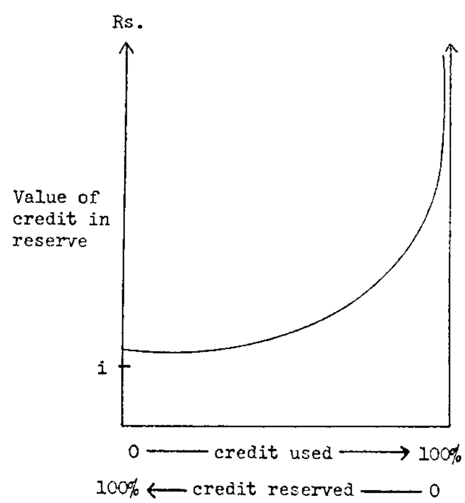

Figure 2B

than to ignore the relations, thus assigning zero values to cash and credit in reserve. On this basis we have introduced this theory of liquidity into the model of a small farm typical of Badaun District, U.P.

Modelling the Small Farm [10]

In Table 1 we list the rows that describe the conventional constraints and requirements that condition alternatives selected in an optimal plan. Badaun District provides two distinctly different crop seasons: a wet season, June-November; and a dry season, December-May. Hence the model year is specified from 1 June through 31 May, and divided into the two equal time intervals. Land is limited to 1·7 hectares, of which 0·57 is committed to a sugarcane contract, leaving 1·13 hectares to be allocated among the other crops identified under 'crop inventories'.

TABLE 1

Constraints and Requirements for a Small Farm Typical of Badaun District, U.P. (excluding liquidity management)

Row Description	Relation[a]	Quantity	Unit
Land: wet season	L	1·7	hectare
dry season	L	1·7	hectare
Labour: wet season	L	132·0	day
dry season	L	132·0	day
Crop inventories			
Local maize: wet season	E	1·0	quintal
dry season	E	1·0	quintal
HYV maize: dry season	E	0·0	quintal
Paddy: wet season	E	1·35	quintal
dry season	E	1·35	quintal
Local wheat: wet season	E	10·0	quintal
dry season	E	0·0	quintal
HYV wheat: dry season	E	0·0	quintal
Sugarcane: dry season	E	0·0	quintal
Household crop requirements			
Local maize: wet season	E	1·5	quintal
dry season	E	1·5	quintal
Paddy: wet season	E	1·35	quintal
dry season	E	1·35	quintal
Wheat: wet season	E	5·50	quintal
dry season	E	5·50	quintal
Wheat inventory limit			
HYV	E	5·0	quintal
Sugarcane contract	E	0·57	hectare
Household cash requirements			
wet season	E	500·0	rupee
dry season	E	500·0	rupee
Cash available			
wet season	E	1000·0	rupee
dry season	E	0·0	rupee
31st May	E	0·0	rupee

[a] L: equal to or less than; E: equal to.

Allocable labour resident on the farm amounts to 132 man-day equivalents in each season. The year is started with Rs. 1,000 in cash, plus the inventories as listed in the 'Quantity' column. In this semi-subsistence unit, seasonal household requirements are given for maize, paddy and wheat. In addition, cash is required as indicated. It is an accounting convenience, as well as a precision measure, to identify the last day (31 May) separately from the rest of the dry season.

In Table 2 we list the columns that describe alternatives conventionally conceived for the use of resources and for meeting specified requirements. Paddy and maize are wet season crops; wheat, dry season. Sugarcane uses land in both seasons. Alternatives in maize

TABLE 2

Production, Marketing and Consumption Alternatives for a Small Farm Typical of Badaun District, U.P.

Column description	Unit
Produce	
Paddy	hectare
Sugarcane	hectare
Local variety maize	hectare
Local variety wheat	hectare
HYV maize (level 1)	hectare
HYV maize (level 2)	hectare
HYV wheat (level 1)	hectare
HYV wheat (level 2)	hectare
Sell	
Local variety maize	quintal
HYV maize	quintal
Paddy	quintal
HYV wheat	quintal
Local variety wheat	quintal
Sugarcane	quintal
Buy	
Maize: wet season	quintal
Wheat: wet season	quintal
Wheat: dry season	quintal
Consume	
Maize: wet season	quintal
Maize: dry seasan	quintal
Paddy: wet season	quintal
Paddy: dry season	quintal
Wheat: wet season	quintal
Wheat: dry season	quintal
Develop inventory capacity	
Local wheat	quintal
HYV wheat	quintal
Hire labour	
wet season	day
dry season	day
Meet household cash expenses	
wet season	rupee
dry season	rupee

and wheat are differentiated between local and HYV (high yield variety) seeds, the HYVs further differentiated as to intensify of resource use. At Level 1, HYV maize uses 155 days of labour and Rs. 160·60 per hectare, producing 10·61 quintals. Level 2 maize uses 229 days of labour and Rs. 275 per hectare, yielding 15·87 quintals. Comparable requirements for Level 1 HYV wheat are 135 days of labour and Rs. 389.25 per hectare; for Level 2, 176 days and Rs. 593.25. At Level 1, the HYV wheat yield is 29·306 quintals; at Level 2, 40·727 quintals.

Sales of maize provide cash in the dry season, as do sales of paddy. Wheat sales do not provide cash until the last day of the model year. The same is true for sugarcane. Hence while wheat and sugarcane sales add to the value of the objective function, they do not add cash that can be used within the model year. The model provides for the purchase of maize in either season and for wheat in the dry season, as an alternative means of meeting the requirements specified as listed under 'Consume'. The other crop consumption requirements can be met only by on-farm production. Labour can be hired in each season, at Rs. 2.70 per day.

In Table 3 we show the matrix detail (rows and columns) for the management of moneylender credit [10]. Coefficients in the objective function, Z, are numerical estimates that correspond to values on the vertical axis of Figure 2b. The sixth column describes an allocation that retains all wet season moneylender credit in reserve. None is available for borrowing. At this high level of reserve, the value of an increment of credit in reserve is relatively low (0·40). The seventh column reflects an increased value of a unit of reserved credit when 20 per cent is allocated to the credit account, from where it is available for borrowing and 80 per cent to reserve.[1] The allocation is shown in the first column. As the proportion reserved is reduced, the value of a reserved credit increment increases. The parameter specifications in Table 3 are numerical counterpoints to the relationships displayed in Figure 2b. The values in Z constitute opportunity costs, to which the decision to borrow is subject. The loan proceeds must produce a payoff sufficient to repay not only principal and interest but also to cover this opportunity cost. The opportunity cost increases as the amount borrowed increases. The maximum of moneylender credit is Rs. 1,250.

Table 4 provides the same matrix detail for the management of PSCP credit. Whether reserved PSCP credit has a value (as suggested in Z2 of Table 4) depends on the small farmer's perception of the credit. If the program is dependable and allows a wide range for use of loan proceeds that are easily accessible, the value can be greatly increased. In applying the sub-matrix described in Table 4, the value ascribed to reserved PSCP credit was varied from 0, as in Z1, to the values shown in Z2, as properties of the program were varied. The last two rows of Tables 3 and 4 describe the way liquidity reserve requirements can be met with moneylender and PSCP credit, respectively. Total PSCP credit is specified as Rs. 850.

[1] In the model actually run, the allocation intervals were at 10 per cent instead of the 20 per cent intervals shown in Tables 3, 4 and 6 [10]. The values of coefficients for excluded vectors lie between the values reported here and are generally consistent with the nonlinearities of Figures 2a and 2b.

TABLE 3

Management Vectors for Moneylender Credit: Small Farm in Badaun District, U.P., by Season[a]

Row description	Allocate ML credit S1 reserve at (%)					Value S1 ML credit in reserve at (%)					Allocate ML credit S2 reserve at (%)					Value S2 ML credit in reserve at (%)					Constraint	
	80	60	40	20	0	100	80	60	40	20	80	60	40	20	0	100	80	60	40	20	R	L
ML credit: S1	1	1	1	1	1	1															L	1250
S2											1	1	1	1	1	1					L	1250
ML credit account																						
S1	−·2	−·4	−·6	−·8	−1																E	0
S2											−·2	−·4	−·6	−·8	−1						E	0
ML credit reserve																						
S1: 80%	−·8						1														E	0
60%		−·6						1													E	0
40%			−·4						1												E	0
20%				−·2						1											E	0
S2: 80%											−·8						1				E	0
60%												−·6						1			E	0
40%													−·4						1		E	0
20%														−·2						1	E	0
Liquidity reserve requirement																						
S1						1	1	1	1	1											G	1000
S2																1	1	1	1	1	G	1000
Z						0·40	0·45	0·57	0·82	1·30						0·40	0·45	0·57	0·82	1·30	E	M

[a] S1: wet season; S2: dry season.

TABLE 4

Management Vectors for PSCP Credit: Small Farm in Badaun District, U.P., by Season[a]

Row description	Allocate PSCP credit S1 reserve at (%)					Value S1 PSCP credit in reserve at (%)					Allocate PSCP credit S2 reserve at (%)					Value S2 PSCP credit in reserve at (%)					Constraint	
	80	60	40	20	0	100	80	60	40	20	80	60	40	20	0	100	80	60	40	20	R	L
PSCP credit:																						
S1	1	1	1	1	1	1															L	850
S2											1	1	1	1	1	1					L	850
PSCP credit account																						
S1	−·2	−·4	−·6	−·8	−1																E	0
S2											−·2	−·4	−·6	−·8	−1						E	0
PSCP credit reserve																						
S1: 80%	−·8						1														E	0
60%		−·6						1													E	0
40%			−·4						1												E	0
20%				−·2						1											E	0
S2: 80%											−·8						1				E	0
60%												−·6						1			E	0
40%													−·4						1		E	0
20%														−·2						1	E	0
Liquidity reserve requirement																						
S1						1	1	1	1	1											G	1000
S2																1	1	1	1	1	M	1000
Z1						0	0	0	0	0						0	0	0	0	0	E	M
Z2						0·45	0·50	0·62	0·85	1·35						0·45	0·50	0·62	0·82	1·35	E	M

[a] S1: wet season; S2: dry season.

The options and constraints in debt management are described in Table 5. Borrowing from the moneylender (ML) is described in columns 1 and 2 for wet and dry seasons, respectively. Wet season borrowing provides cash in the cash account for the first day of the wet season, absorbing ML credit account and generating a debt balance at the moneylender. The positive coefficient in the PSCP credit account reflects an assumption that the PSCP credit agency responds to debt owed the moneylender by reducing the credit available at PSCP. Dry season borrowing is strictly analogous to wet season borrowing. Borrowing from PSCP in either season is logically similar to borrowing from the moneylender. However, coefficients differ. The debt payment options are described in the last four columns. The debt balance is reduced as cash is drawn from either the cash account or from cash supply. It is important to note that the credit accounts are made available subject to the opportunity costs represented in values of credit reserve, as indicated in Tables 3 and 4. There are no objective function values in Table 5, owing to the fact that the costs of debt management are completely specified in the cash and cash account rows.

The matrix detail for cash management is provided in Table 6. Beginning cash is specified at Rs. 1,000. This amount is available for use in production and consumption, according to vectors described in general terms in Tables 1 and 2 and in debt payment, as described in Table 5. They are not shown in Table 6. Nor are additions to cash from marketing and borrowing. The first five columns of Table 6 show how wet season cash is allocated between cash account and cash reserve, where the reserve is valued as shown in the next five columns. Dry season cash is subject to the same allocation. The dry season cash

TABLE 5

Debt Management Vectors: Small Farm in Badaun District, U.P., by season[a]

Row description	Borrow from				Repay				Constraint	
	ML		PSCP		ML		PSCP			
	S1	S2	S1	S2	S1	S2	S1	S2	R	L
Cash 31 May					0·70	1·25		1·25	E	0
Cash account										
S1	−1		−1						E	0
S2		−1		−1	1·045		1·045		E	0
ML credit account										
S1	1		1						E	0
S2		1		1					E	0
ML debt balance										
S1	−1				1				E	0
S2		−1				1			E	0
PSCP credit account										
S1	1		1						E	0
S2		1		1					E	0
PSCP debt balance										
S1			−1				1		E	0
S2				−1				1	E	0

[a] S1: wet season; S2: dry season.

TABLE 6

Cash Management Vectors: Small Farm in Badaun District, U.P., by Season[a]

Row description	Allocate S1 cash reserve at (%)					Value S1 cash in reserve at (%)					Allocate S2 cash reserve at (%)					Value S2 cash in reserve at (%)					T. cash:			Constraint	
	80	60	40	20	0	100	80	60	40	20	80	60	40	20	0	100	80	60	40	20	S1 S2	S2 31	31 Z	R	L
Cash: S1	1	1	1	1	1	1																		E	1000
S2											1	1	1	1	1	1								E	0
31 May																						–1	1	E	0
Cash account																									
S1	–·2	–·4	–·6	–·8	–1																1			E	0
S2											–·2	–·4	–·6	–·8	–1						–1	1		E	0
Cash reserve																									
S1: 80%	–·8						1																	E	0
60%		–·6						1																E	0
40%			–·4						1															E	0
20%				–·2						1														E	0
S2: 80%											–·8						1							E	0
60%												–·6						1						E	0
40%													–·4						1					E	0
20%														–·2						1				E	0
Liquidity reserve requirement																									
S1						1	1	1	1	1														G	1000
S2																1	1	1	1	1				G	1000
Z1						1·10	1·15	1·27	1·52	2·00						1·10	1·15	1·27	1·52	2·00			1	E	M

[a] S1: wet season; S2: dry season.

account is provided by transfer from the wet season. Cash at the end of the model period (31 May) is supplied by transfer from the dry season cash account. The amount of 31 May cash left after requirements are met on that day are transferred to the objective function, Z.

The objective function then is maximized. It contains the terminal cash flow, as shown in the last column of Table 6. The activity level of this vector will describe the value productivity of the plan. The value of Z also includes the value of cash and credit reserves. These values must be subtracted from Z to provide a return figure that could be interpreted in an accounting sense.

TABLE 7

Summary of Selected Results from Optima in Solutions with Varied Specifications in Financial Environment of Small Farm in Uttar Pradesh, India: Beginning Cash at Rs. 1000 unless otherwise specified.

Specifications on financial constraints of the small farmer	HYV wheat area (ha)	HYV wheat sales (qls)	Rs. borrowed money-lender	Rs. borrowed PSCP	Cash reserved (Rs.)	Net Cash Flow
No liquidity specifications						
1. Moneylender only	0·82	17·55	674·20			1251·90
2. Moneylender + PSCP	0·82	17·55		655·96		1390·94
Liquidity specifications						
3. Moneylender only	0·39	4·14	540·61		317·35	578·26
4. Moneylender + restricted PSCP[a]	0·43	4·81	340·83	188·94	317·35	640·01
5. Moneylender + non-restricted PSCP[b]	0·77	11·01		679·74	208·67	1010·10
Moneylender only, with cash at						
3a Rs. 900	0·29	2·19	662·10		307·35	398·92
3b Rs. 800	0·16		732·05		280·65	213·13
3c Rs. 700			INFEASIBLE			
Moneylender + restricted PSCP, cash at						
4a Rs. 900	0·34	3·18	367·16	278·94	307·35	490·08
4b Rs. 800	0·23	1·10	387·47	330·00	283·88	314·55
4c Rs. 700			INFEASIBLE			
Moneylender + non-restricted PSCP, cash at						
5a Rs. 900[b]	0·61	8·03		848·22	307·34	703·40
5b Rs. 800[b]	0·51	6·14		953·53	297·35	551·34
5c Rs. 700[b, c]	0·39	4·14		1053·94	287·35	395·93

[a] Solutions from these specifications are in rough accord with averages from survey of randomly sampled small farms in the district [2]. Plan 4 provides for more HYV wheat than actual average (0·43 *vs.* 0·15) but the total in wheat is much the same (0·74 *vs.* 0·72).

[b] These solutions are obtained with the use of objective function, Z2 (positive values for reserved PSCP credit).

[c] Feasible solutions are attained with beginning cash as low as Rs. 500, though none produced a net cash flow as high as the level of beginning cash, even if reserved cash is added to net cash flow.

Model Solutions

In Table 7 we summarize some of the results from solutions of the model under varied specifications. The numbers in the left column identify plans: five basic plans, with Plans 3, 4 and 5 subject to further variations in the level of beginning cash.

In Plans 1 and 3, as well as in 3a, 3b and 3c, PSCP credit is set at zero, to represent the financial environment of the small farmer without a PSCP. In Plans 1 and 2, the liquidity reserve requirements are set at zero, and no values are given for liquidity reserves. Hence Plans 1 and 2 are consistent with results from 'conventionally' specified linear programming models.

The objective function, Z2 (Table 4), is used in generating Plan 5 and its variants, 5a, 5b and 5c. Otherwise, Z1 is used in all plans reported in Table 7. In models that include liquidity management requirements and vectors (Plans 3, 4, 5 and their variants), the objective function contains coefficients in activities that value liquidity sources in reserve—cash and credit, as indicated in Table 7. We have subtracted from Z the value of liquid reserves, to get the 'net cash flow' values reported in Table 7.

For Plan 1, without liquidity management vectors or requirements, the small farmer has access only to informal lenders (*i.e.* ML credit). At optimum, the small farmer produces sugarcane at the required minimum, paddy and local maize sufficient for household requirements, and plants 0·82 hectares to HYV wheat. The wheat crop produces the household requirements and 17·55 quintals for sale. In this specification, the small farmer borrows Rs. 674.20 from the moneylender. Net cash flow amounts to Rs. 1,251.90.

Plan 2 retains the naïve assumption on liquidity management (zero value for liquidity and no liquidity requirements). A PSCP is introduced into the financial environment of the small farmer, with properties similar to the program that actually does exist in the district. In the solution, the small farmer switches his borrowing to the PSCP and borrows Rs. 20 less than in Plan 1. Even so, he keeps 0·82 hectares in HYV wheat and his net cash flow increases by about Rs. 140. If the small farmer responds in this naïve manner, we could predict a higher cash flow from introducing the PSCP, but no change in the production organization of the small farm. We stress, however, that there is little reason to accept this version of small farmer behaviour. Indeed, it is precisely the failure of this assumption that is most likely to account for the widespread disappointing record of PSCPs.

In remaining versions of the model, a total liquidity requirement is specified, at a minimum of Rs. 1,000. The amount accords in general with observed values in liquid assets. The requirement is increased with adoption of HYVs, reflecting the risks added to the small farm organization by increased requirements for labour and for cash to buy fertilizer and seed. The rate of increase in risk is assumed.[2] No observations were available. The liquidity requirements could be met with either cash or credit, or by a combination of these two sources. In fact,

[2] For example, the liquidity requirement for the dry season was increased by Rs. 293 per hectare of HYV wheat. HYV maize increased the liquidity requirement in the wet season by Rs. 263 per hectare.

both sources of liquidity are valued at 'prices' that increase as the amount of liquidity diminishes.

For Plan 3 the small farmer is restricted to the moneylender as a source of loans. In the optimum plan, with the more realistic specification on liquidity management, HYV wheat is reduced to 0·39 hectares. Wheat sales are reduced to 4·14 quintals. The small farmer borrows Rs. 540 from the moneylender, reserving Rs 1,959 and Rs. 317 of credit and cash, respectively. A net cash flow of Rs. 578 is produced by the optimum organization, less than the cash with which he began the year. But to the cash flow must be added the Rs. 317 held in reserve.

In Plan 4, a PSCP is added to financing alternatives available to the small farmer, though with zero value for PSCP credit held in reserve (Z1 in Table 4). The solution is especially interesting in that it roughly accords with the sample average of surveyed small farmers in the district. HYV wheat is planted in 0·43 hectares, providing sales of 4·81 quintals. The small farmer borrows Rs. 341 and Rs. 189 from the moneylender and PSCP, respectively, reserving Rs. 317.35 in cash to contribute to his liquidity requirements. His net cash flow is Rs. 640, to which we add the Rs. 317 in cash reserve, to compare with the Rs. 1,000 with which he began the year.

In Plan 5, loans at the PSCP agency are made available without constraint as to use of loan proceeds. Hence the *value* of liquidity in the form of PSCP credit is increased (see Z2 in Table 4), reflecting an assumption that the small farmer perceives the modified PSCP as permanent, and that he values the credit more because of unrestricted usage of loan proceeds. The new specification increases the area in HYV wheat to 0·77 hectares, approaching the level reached with the 'naïve' specifications of the first two versions of the model. Sales amount to about 11 quintals. Borrowing is confined to the PSCP, at about Rs. 680. Reserved cash declines to Rs. 209. An important objective of the PSCP is to induce a larger commitment of small farmer resources to the small farm organization. The model reveals the linkages required to produce this result: a more highly valued credit source, allowing credit in reserve to substitute for cash in reserve. It also is important to note that this is the only specification that produced a net cash flow as great as the beginning cash specification—even without adding in the reserved cash.

Remaining versions of the model vary the amount of beginning cash. Plans 3a, 3b and 3c are comparable with Plan 3; 4a, 4b and 4c, with 4. In both cases, the small farm organization proves infeasible with less than Rs. 800 in beginning cash. Moreover, the diminution of beginning cash, after a year's operation, increases as the amount of beginning cash is reduced. By introducing the PSCP, the rate of diminution is reduced and the area planted to HYV wheat increased. But still the small farm is not viable in the long run. The PSCP would only extend the length of life somewhat for the small farm.

By removing restrictions on use of loan funds (Plans 5, 5a, 5b and 5c), the area of HYV wheat is increased and the rate of diminution in cash reduced still further. In Plan 5, as indicated, the small farm organization is made viable in terms of net cash flow, and the cash supply even increases somewhat. In fact, beginning cash could be reduced to Rs. 700 before the farm would eventually run down, given rigorous adherence to the requirements of the model, including living expenses. With unrestricted use of loan proceeds, the program is feasible with beginning cash reduced to as low as Rs. 500. On the other hand, note that at lower values of beginning cash, the modified PSCP has little or no effect on the amount of cash reserved (and hence the amount committed to the farm organization).

Further runs were made with an increase of 5 per cent in the value of PSCP credit in reserve and a decrease of 5 per cent in the value of cash in reserve. The results are not included in Table 7. As would be expected, the commitment of cash to the organization of the small farm increased markedly. The area planted to HYV wheat returned to 0·82 hectares and net cash flow reached Rs. 1,131, approaching the level generated by the 'naïve' model that produced Plans 1 and 2. Clearly, it is important to search for properties of a PSCP that induces the small farmer to substitute credit for cash in liquidity management, committing the 'liberated' cash to his farm organization.

Policy Implications

When liquidity requirements and values are ignored, the model solutions suggest that PSCPs are likely to have little effect on introduction of HYV wheat. (Compare Plans 1 and 2 in Table 7.) The slight improvement in net cash flow, shown for Plan 2, results from lowered borrowing costs in Plan 2. However, this comparison may seriously understate results that are attainable with PSCPs. With the more reasonable behavioural assumptions of Plan 3, the area planted to HYV wheat is sharply reduced, as is the net cash flow. Indeed, the net cash flow plus cash reserve is less than the beginning cash supply in the results of Plan 3. However Plan 4, introducing the PSCP, modestly increases the area planted to HYV wheat and nearly restores beginning cash (net cash flow, Rs. 640.01 plus cash reserved, Rs. 317.35). As noted in Table 7, this result is of special interest, inasmuch as it roughly accords with observed results in Badaun District. Hence we can use it as a basis for comparing results from a 'synthesized' improvement in PSCPs.

Plan 5 and its variants presume a PSCP that leads the cultivator to value PSCP credit in reserve. This may be due to increased reliability of the loan source, easier and/or cheaper access, less restrictions on use of loan proceeds, etc. The reservation values are shown in Z2, in Table 4. The results are rather dramatic. Plan 5 nearly doubles the area planted to HYV wheat and generates a net cash flow that exceeds beginning cash and still provides a small cash reserve at the end of the year.

Plan 5a reveals that under the improved PSCP the small farm remains 'viable' even when beginning cash is reduced to Rs. 900 (net cash flow plus reserved cash exceeds beginning cash). Indeed, feasible solutions are generated for beginning cash as low as Rs. 500, though clearly the small farm would ultimately fail at less than Rs. 900, unless some improvement materialized in the economic environment or the internal requirements of the small farm.

The model results do not in themselves produce prescriptions for improvement in PSCP credit. They do suggest payoffs attainable if PSCPs can be improved. It is apparent from elsewhere that improvements might well be available from lessened restrictions in access and use of loan proceeds. At the same time, sanctions would be needed to hold default in check. Yet default too might be reduced by a program more highly valued by the cultivator.

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