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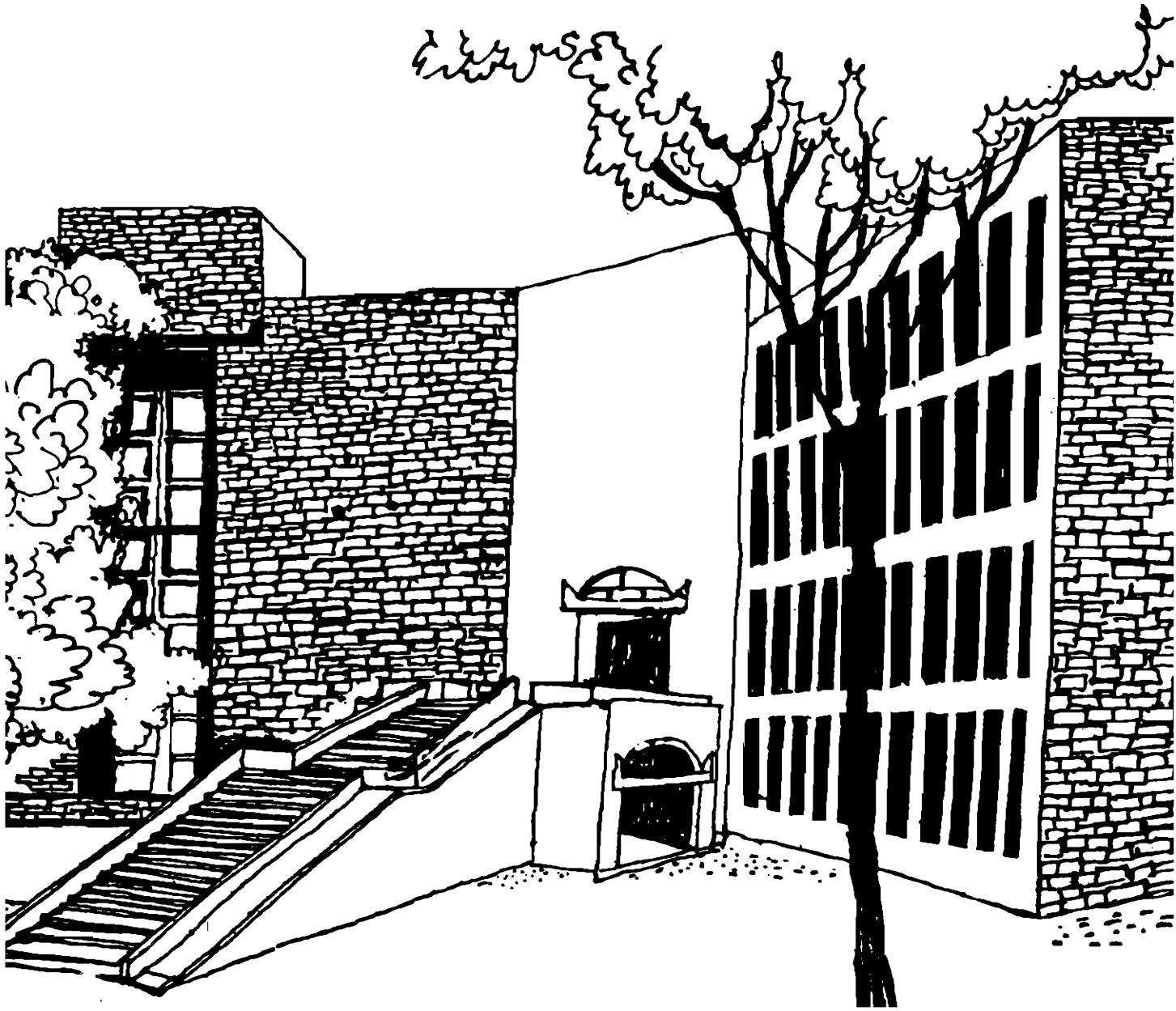

A FRAMEWORK FOR ANALYSING CONSUMER-ORIENTATION OF BIOTECHNOLOGISTS

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ABSTRACT

Evaluation of agricultural technology development and commercial product development revealed that only a small percentage of the new products developed have succeeded in the market.

Analysis of the reasons for product success or failure showed that the major factor was a poor understanding of consumer needs by the people involved in the product development. In other words lack of '*consumer orientation*' of scientists could be the major reason for failure of many products.

Consumer orientation is defined by four dimensions. They are [1] *information generation* from consumers, [2] *provision of information* to the consumers, [3] *integration* of different functional areas, and [4] *Responsiveness to the needs* of the consumers.

If consumer orientation and product success are assumed to be positively correlated, then the process which increase the consumer orientation of scientists need to be spelt out.

Scientists deal with different consumers participating in the process of product development. These consumers can be clubbed into two groups based on the level of control that organization can have on them, [1] those who are inside the organization, called '*internal consumers*' and [2] outside the organization, referred as '*external consumers*'.

These consumers have preferences for various product attributes which may be *complimentary*, or *contradictory*. Presence of a long chain of consumers and contradicting attribute preferences could complicate the process of defining the product attributes. Incorporating the attributes of those who really consume the product may become even more difficult. Because, many who articulate one set of attributes may actually not consume the product. Scientists have to devise ways to decide which preferences to be taken into account, how much and in what sequence.

Further, the production, distribution, and utilization processes may also generate *externalities* for various systems. For example, replacement of chemical pesticides by biological products such as *B thuringiensis*, NPV, and other plant derivatives could generate a *positive externality* for farmers, end users and ecological systems, and the pesticide firm may consider it as a *negative externality* for them. Hence, the nature of externality could develop support or opposition from the clients based on their perception and the actual impact of the product on them.

Consumer orientation in an organization could depend on two major factors. viz -- [1] *scientists-specific factors* such as their interest in type of problems, background, etc., and [2] *organizational-specific factors* such as performance evaluation criteria used, the incentive and disincentive mechanisms used and the perception and preferences of individual scientists about these mechanisms.

In the present investigation our *objectives* are to explore the differences in the consumer orientation process between successful and less successful products and to understand the influence of scientist-specific, and organizational-specific variables on the consumer orientation process.

We expect that this study could throw *new insights* about the processes and factors influencing scientists consumer orientation. The findings could help in developing *policy measures* to influence the behaviour of the scientists to get closer to the consumers, listen to their voice and look beyond.

A FRAMEWORK FOR ANALYSING CLIENT-ORIENTATION OF BIOTECHNOLOGISTS

1.0 INTRODUCTION

Only a small percentage of the new products have succeeded in the market[1]. This phenomenon has been reported to be a persistent problem and this trend has not changed over a period [Cooper & Kleinschmidt 1987; Rothwell 1992]. Analysis of product success and failure reveal that the major reason for product failure is poor understanding of the consumer requirements resulting in a product not being focused on consumer needs [eg. Cooper 1979; Maidique & Zirger 1984, 1985; von Hippel 1986; Whitley 1988]. Organizational processes were cited as the main factor for lack of interaction and understanding between consumers and the researchers involved in product development [Gupta *et al.* 1985, 1986; Lawrence & Lorsch 1967; Souder 1980].

Especially to utilize the scientific insights, they have to be developed into products [Datta 1991; Hardy 1989; Roling 1992]. The scientists involved in product development should have a good understanding of the technology, consumer needs and the ability to match the technology with the consumer needs [Abernathy & Clark 1985; Band 1991]. Scientists develop technologies often on the basis of ideas gleaned from published sources or their hunches or occasional feedback from extension wings (where available). Seldom, there is a direct link between the scientists developing the technology and the final consumers who may potentially use the same. An understanding of how scientists become familiar with consumer

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[1] Most of the research studies are form United States of America [Booz-Allen, and Hamilton 1968, 1982; Cooper 1979; Crawford 1982]. Findings of these studies showed wide variability in product success. Booz-Allen Hamilton reported that for every 100 projects that enter development 63 per cent are killed and of the 37 per cent remaining 25 become commercial success and 12 become failures. These studies have used only commercial criteria for evaluation from the view point of organizations.

needs, would help in developing mechanisms for satisfying the identified or generated needs [Ramachandran 1992; von Hippel 1986].

Contemporary product development is predominantly carried out by organizations. Organizational processes influence the behaviour of scientists in selecting and solving problems, mobilizing resources and contacting consumers for fine tuning the product design [Krishnaiah 1993; Lambright & Teich 1981; Van de Ven 1988].

The major objective of this study is to develop insights about the process of client orientation of the scientists involved in biotechnological agri-inputs development. The insights gained would be useful to develop organizational systems and policies for incorporating consumer needs in product development.

For example,

a) Way back in 1965, a scientist at National Chemical Laboratory, Pune, elucidated the bitter principle of neem [*Azadiracta indica*] called *nimin*. But the country failed to capitalise on the lead [Nadkarni 1993].

b) DNA finger printing technique developed at centre for Molecular Biology, Hyderabad. This has also not been converted in to commercial venture [Chakrabarthi & Bhargava 1990].

c) Tamil Nadu Agricultural university is working on biofertilizers for the past two decades, still the product has not become a common input in pulses [Seetharaman & Pichholia 1993]. My Preliminary field visit it was found that *Rhizobium* is gaining market and growing at about 12 per cent.

Modern biotechnological[2] products have been chosen for the study because (1) it is an emerging technology with considerable potential for a wide range of applications [DBT 1993], (2) same infrastructure, equipments, skills and laboratory facilities can be used for a wide range of products, (3) various ethical, safety, and equity problems which influence the use of this option will get public support in future [eg. Bunders 1990; Hardy 1985; Kenney & Buttel 1985], (4) this technology attracts scientists from wide range of disciplines, as well as from the basic sciences [Jones 1990], and (4) lack of biotechnological advancement may lead to dependence on developed countries in future [Kumar 1988].

The scope of the analysis has been restricted to agriculture input because of the opportunity to study how different organizations develop products for different socio-ecological settings[3].

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[2] Modern biotechnology can be defined as integrated utilization of knowledge and techniques which involve the use of living organisms in part or full, biological process and/or systems for providing goods and services [Farrington & Greeley 1989; Hardy 1989; Sasson 1988].

[3] Detailed discussion on Indian National Agricultural Research System is available in Balaguru and Raman (1988).

1.1 STUDY OBJECTIVES[4]

(1) To study the extent to which differences in client orientation[5] of scientists involved in the biotechnological agri-inputs development[6] explain success and failure of new products.

(2) To understand the process of client orientation of the scientists.

(3) To explain the influence of '*scientist-specific*' factors on the client orientation process.

(4) To study the effect of '*organizational-specific*' factors on client orientation of the scientists.

2.0 NEW PRODUCT DEVELOPMENT

The client-oriented new product development would involve, (1) a two way flow of information between scientists and farmers, (2) developing prototype products and its testing for various user conditions, and (3) monitoring the performance in the field for further fine tuning. This simple system of direct interaction between scientist and farmers can be depicted as in figure I.

However, in reality the system would have more players. Between the farmers and scientists there would be different functions such as scaling up, production, extension, marketing, and distribution. These functional specializations by division of labour could improve the efficiency of product delivery, but pose problems in (1) coordination across the

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[4] Discussion related to objective one is presented in section 3.1. Discussion pertaining to objective is in section 3.2 [subsections 3.2.1; 3.2.2; 3.2.3; and 3.2.4]. The section 3.3, deals with scientist-specific factors, and section 3.4, is about organizational-specific variables.

[5] Discussion on client orientation is presented in section 3.2.

[6] Here after referred to as scientists

functional areas, and (2) trade-offs in product attribute preferences because of strong biases of sectoral interests in the organization [eg. Gupta *et al.* 1986; Szakonyi 1988; Wind 1981]. For example, in case of biofertilizers, the *production system* may prefer product attributes such as higher volume, larger lots, and high multiplication rate, while *distribution system* [Montgomery 1975; Rao & McLaughlin 1989 (these studies are from consumer goods)] may prefer attributes such as longer shelf life and varying packet sizes.

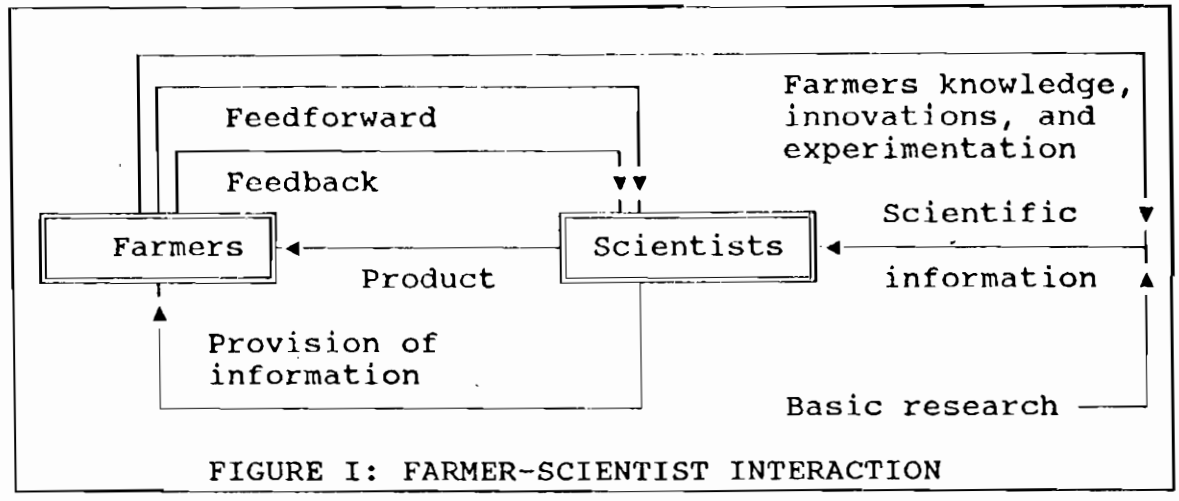


FIGURE I: FARMER-SCIENTIST INTERACTION

The above intermediate functions are either carried out by the product developing organization internally or through other organizations. The location of the functions inside or outside the organization poses different problems for coordination. Hence, they can be treated differently. The functionaries located inside the organization can be called '*internal consumers*' and those located outside the organization are called '*external consumers*'. The external consumers can be intermediaries and final [Band 1991; Juran & Gryna 1993].

Agriculture R&D organizations can be commercial for profit or otherwise and non commercial organizations. Based on the sources of capital they can be classified as government funded, non governmental and farmer owned organizations. There can be other criteria for classifying these organizations. We restrict to the above two dimensions namely - profitability and ownership [Cernea 1987; Damonpour 1991; Murray & Motanari 1986].

The nature of intermediation between scientists and internal and external consumers can take different forms as illustrated in figure II.

The challenge is to specify or distinguish the functional from the not so functional ways of assessing consumer preferences by the scientists.

3.0 FRAMEWORK FOR ANALYSIS

3.1 MEASUREMENT OF PRODUCT SUCCESS

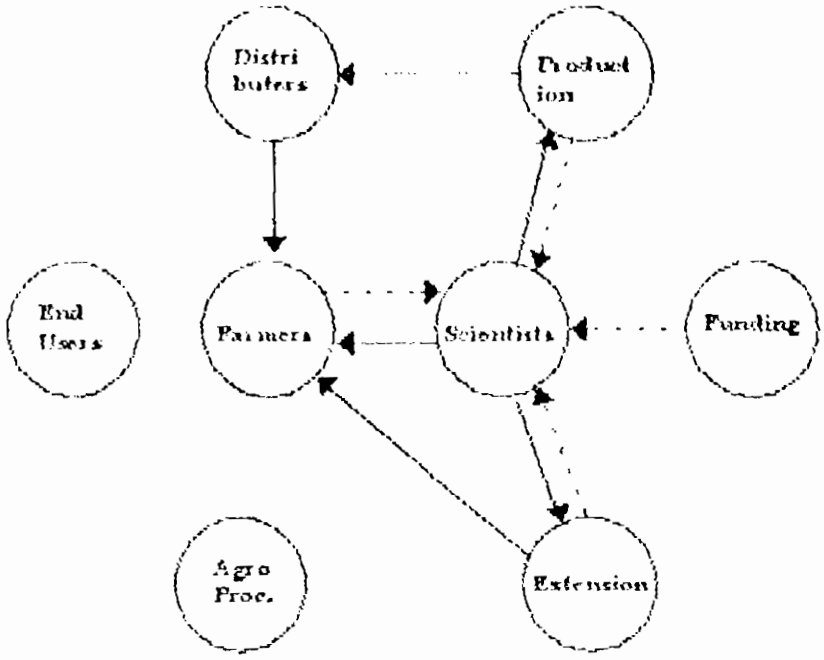
The first objective is to find out the extent to which the differences i client orientation of scientists explain the product success or failure. Product success is a multidimensional construct [Cooper 1983; Cooper & Kleinschmidt 1987; Crawford 1987; Pickle & Frienlander 1967; Deshpande, Farley & Webster, Jr 1993]. The variability could be on a continuous scale. The criteria used by farmers, organizations, scientists etc., would differ depending upon the respective expectations out of the product.

The commonly used product performance criteria are (1) financial (2) technical (3) market and (4) overall subjective judgements. The variables and measurements for product success are presented in table I.

We would like to compare the product development programmes of non profit and commercial organizations. Hence, a product success score [Ambastha 1986] would be constructed using the following formula for all products launched in the past three years by the organization.

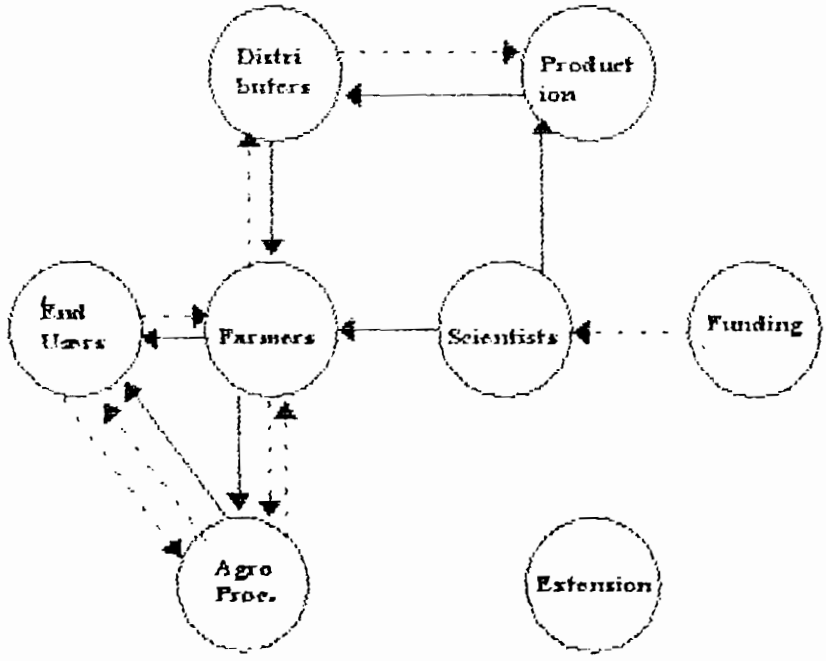
$$\text{Success Index} = \frac{\text{Product score - mean score for organization}}{\text{Standard deviation of product scores}}$$

University Product Development



- - - - - Information generation from clients

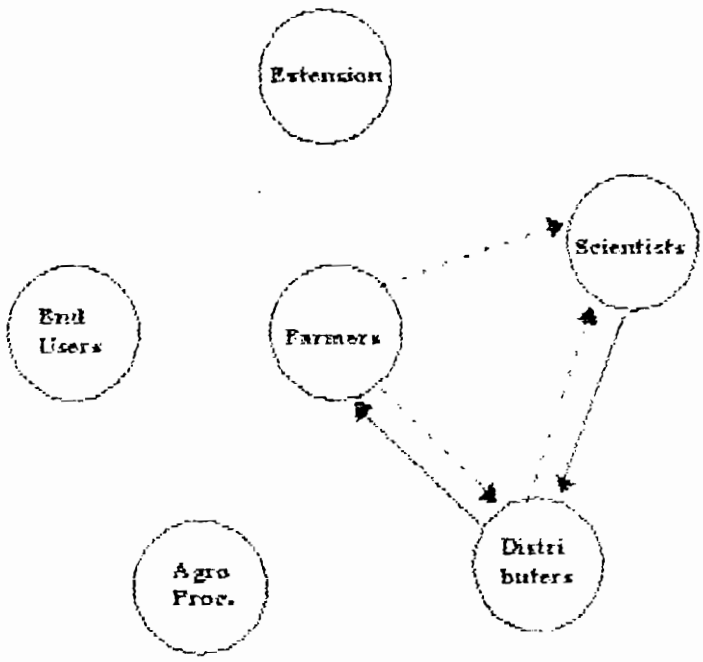
——— Information provision to clients



Financial flow

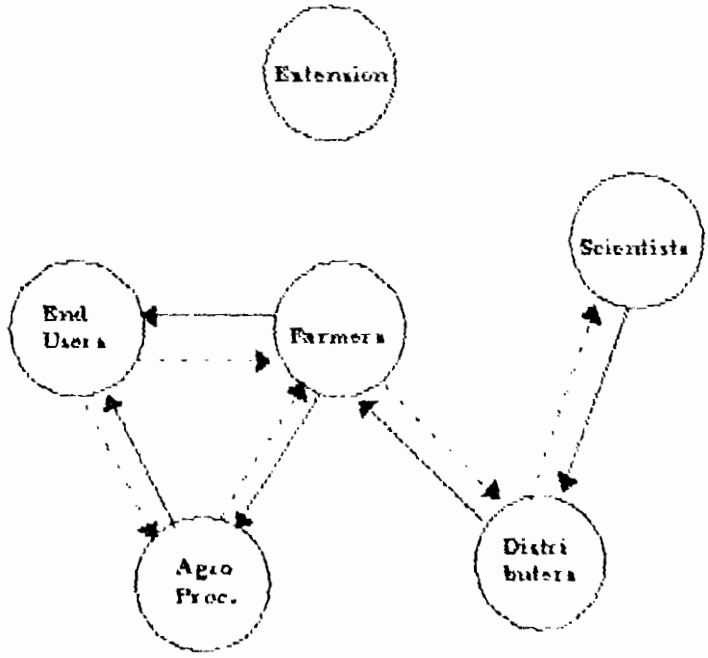
Product flow

Commercial Product Development



- - - - - Information generation from clients

——— Information provision to clients



- - - - - Financial flow

——— Product flow

TABLE I: CRITERIA FOR MEASURING PRODUCT SUCCESS

S.No.	CONSUMER	TYPE OF MEASURE	MEASUREMENT
1.	Organization level	Financial	Profitability Profit from new product/ total product Payback period Extent of risk Initial investment
		Technical	Meeting quality standards Infrastructural requirement Complementarity with existing tools and equipments
		Market	Growth of sales/adoption New product area/total area Meeting sales objectives Market share
		Strategic	Opening new markets Opening new technological Areas Time taken to develop
		Subjective	Overall success judgement
2.	Internal Consumers/ Intermediate users		
	a) Research and Development		Product performance measures
	b) Production		Technical measures Regular demand Inventory levels
	c) Marketing		Market measures
	d) Distribution		Financial profitability Potential profit Opportunity cost of stockings

Continued....

Continuation of table I

S.No.	CONSUMER	TYPE OF MEASURE	MEASUREMENT
		Technical	Shelf life Quality Packaging Transportation
		Market	Package size Price Product uniqueness Delivery reliability Delivery timing
3.	External Consumers/ Final Consumers		
	Farmers	Financial	Profitability Cost
		Technical	Performance Compatibility with other practices Use of household resources
		Market	Availability Distance travelled for purchase Package size Guidelines provided for use
		Output	Market

3.2 CLIENT ORIENTATION

The second objective of the present study is understanding the client orientation process of scientists. Client orientation can be seen as a process with four dimensions. They are (1) feedforward and feedback from the consumers, (2) provision of information to the consumers, (3) interfunctional coordination, and (4) responsiveness to needs of the consumers [Shapiro 1988; Kohli & Jaworski 1990; Joworski & Kohli 1993; Narver & Slater 1990; Deshpande, Farley & Webster 1993; Ruekert 1992; Metha & Joag 1982].

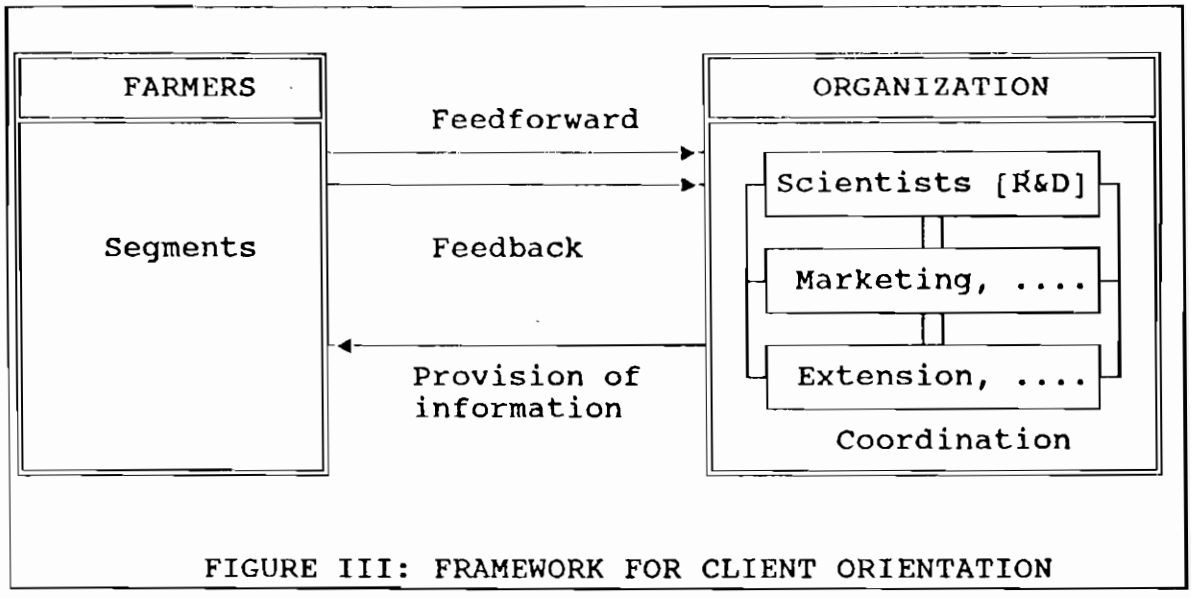


FIGURE III: FRAMEWORK FOR CLIENT ORIENTATION

The interaction between the scientists and farmers involves two way communication. It can be divided in to (1) *feedforward*, i.e. information generation from the farmers for product development, and (2) *feedback*, i.e. collection of information during and after the product use.

The second component is *coordination* between the different disciplines/departments inside the organization. Coordination would involve two way communication between scientists in biotechnology and other functionaries in carrying out the business harmoniously.

The third component is responsiveness to client needs. It would include how problems are selected, how problems are defined, generation of evaluation criteria, resource mobilization etc.,

To identify the variables and for focusing our data collection pertaining to the phenomenon under investigation, *articulation-response model* [Gupta, Patil & Singh 1992] has been extended. The model has been extended to incorporate endogenous innovation by another study [Pastakia 1993]. Present study would extend the model to exogenous innovation and integrate with farmers innovations. The extended model would be analyzed for scientists' responsiveness.

3.2.1 Information Generation From Farmers

The first dimension of client orientation is generation of information from the consumers. This part of the sub-model attempts to evaluate how information about the farmers' needs and insights or innovations are collected. The needs may be felt or unfelt by the farmers, the felt needs may be articulated or unarticulated. These communications may be direct to scientists, to other agencies like extension, input industry, government etc., and some times undirected [Caro 1993; Gupta, Patil & Singh 1992; Wheelwright & Clark 1992].

Figure IV, depicts the model for farmers. This is for convenience in presentation. This model could be adapted for each class of the consumer and analyses.

The information flow can be direct or indirect from farmers to scientists. Further the market intelligence system [Kotler 1988] can be classified as (a) formal and (b) informal.

The formal intelligence system would consist of methods like (1) market research, Which may be targeted or exploratory, (2) market intelligence which mainly uses mass communication sources, such as farmer magazines, newspapers etc.

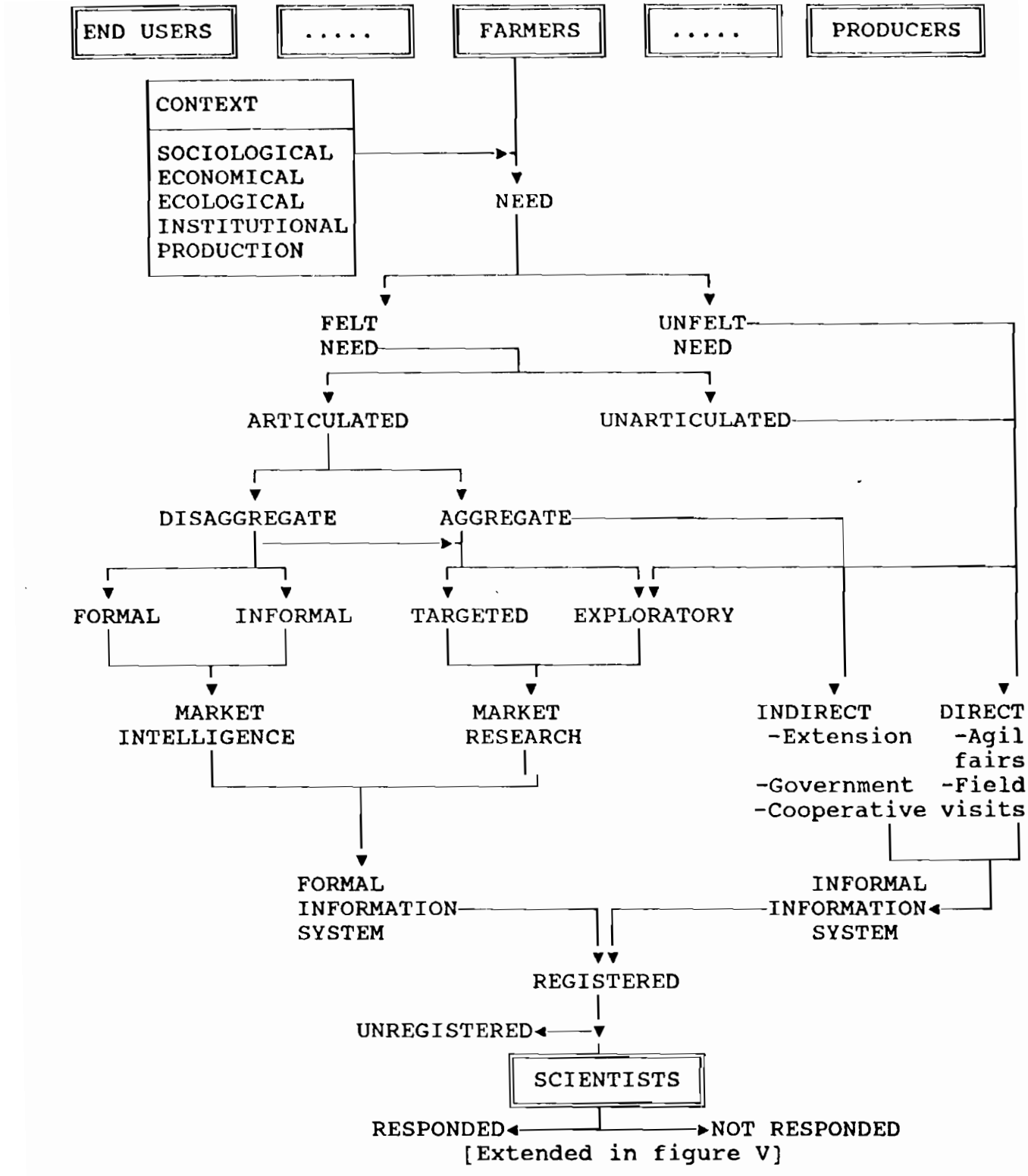


FIGURE IV: EXTENSION OF ARTICULATION RESPONSE MODEL FOR INFORMATION GENERATION

The informal intelligence system refers to the procedures such as farmer meetings, agriculture fairs etc. These methods provide more opportunity to explore unfelt and unarticulated needs. Dependence on a few methods of information may filter certain type of data and might lead to a biased view of the market. Excessive use of market research has been reported to have detrimental effect on the organization's innovativeness.

Table II, provides lists of constructs and measurement of variables.

Depending upon the access provided by the organizations for data, indirect measures like travel plans, travel allowance claims, duration of the visits etc., would also be used.

TABLE II: CONSTRUCTS AND VARIABLES FOR INFORMATION GENERATION

S No.	CONSTRUCT	VARIABLES
1.	Source of the problem	Previous research work Technical literature Problems in practical application Personal curiosity Problems posed by the farmers Students from farming families From extension From agro-processing Problems spotted during the farm visit Foreign journal Peers From Students research Funding agency Distribution channels Supervisor Directed by facilities available.
2.	Information Sources for identifying product attributes	Contact farmers Other farmers Scientists in the department Scientists outside department Other Institutions Extension staff Distribution channels Household Consumers Funding Agencies Production units Marketing Other governmental agencies

Continued...

Continuation of table II.

S No.	CONSTRUCT	VARIABLES
3.	Information Collection Methods	Targeted market research Exploratory market research Scanning new papers Farmers magazines Commodity journals Government Publications Syndicated information Farmer meets Agriculture fairs Field visits Extension Service Cooperatives Farmer Organizations Non-governmental agencies Contact farmers Students
4.	Timeliness of information	Perception about the availability of required information Initiation of ad hoc market research etc.

3.2.2 Information Provision to Farmers

The second dimension in client orientation process is provision of information to the consumers. In the present system of information provision, scientists communicate to extension and in turn extension communicate with the contact farmers. In case of commercial R&D the information is passed on to marketing wings and then communicated to farmers by representatives and through advertisements.

Evaluation of linkages between natural scientists and social scientists (agriculture extension) shows that they are weak [Biggs & Farrington 1991]. These weak linkages are prominent especially in the contexts such as non monetary technology development, location specific research, and high variability production systems (eg. drought prone region) [Gupta personal communication].

Our interest is to know the audience considered by the scientists, what channels they use with what frequency etc. Table III, provides information feedback constructs and variables.

Indirect measures such as number of newspaper articles written, number of field visits made, agriculture fairs conducted etc. also would be considered.

TABLE III: CONSTRUCTS AND VARIABLES FOR INFORMATION PROVISION

S.No.	CONSTRUCT	VARIABLES
1.	Direct communication [personal]	Farmer meets Agriculture fairs Field visits Farmers training
2.	Direct communication [impersonal]	News papers Magazines Radio Television Book-lets
3.	Indirect communication	Through Extension Input agencies
4.	Audience Considered	Contact farmers only Other farmers also Cooperatives Farmer organizations Non-governmental agencies Agro-processing units Distribution channels Input agencies
5.	Channels used	Personal contact Extension Radio Television Booklets News papers Farmer magazines Distribution channels

3.2.3 Coordination Between Functional Areas

Third component of client orientation process is coordination between functional areas. Coordination is a process whereby functions, activities, decisions of different departments/divisions/disciplines are unified in order to achieve a common goal [Lawrence & Lorsch 1967; van de Ven, Belberg & Koening 1976]. Scientists coordinate various functions for a specific project using different mechanisms.

Organizational hierarchy, i.e. two or more functions reporting to the same person, and information flows are through the formal occupation. There are less interactions between functions at junior levels. This mechanism may not be efficient for development of new product [Khandwala 1977; Tushman & Nadler 1985].

Project leadership based coordination is another mechanism. Project coordinator may use his personal skills to interact with other functionaries, mobilize resources and organize the product development project. However, the evidence about the efficiency of project leader *per se* as an integrating mechanism is contradictory[7]. The attributes of the leader more than his authority seems to play greater role.

Project team, is another mechanism where members from different functional areas join together for a specific task and once the task is completed the members go back to the parent department. Decisions are taken by team members jointly. The size, composition, and age of the team are reported to have an impact on the nature of the coordination.

Networking is another mechanism of coordination where the transactions between members are more on voluntary basis rather than on structural basis [Drucker 1988].

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[7] For example, Clark and Fujimoto [1991] and Howell and Higgins [1990] strongly argued that presence of product leader, On the other hand Chakrabarti [1974] argued that simple presence of project leader could not lead to coordination because the effectiveness of the product development depend on the individuals personality traits.

The constructs and variables used in coordination are presented in table IV.

Though many mechanisms have been available in the literature, preliminary observation from the exploratory field work in company shows that product development is considered as a sequential process rather than coordinated effort between the functions. New product projects are initiated by the R&D and after certain stage the idea/concept/product is transferred to the downstream activity. This process is time consuming and even at the advanced stages of product it may have to be abandoned due to constraints at that stage. Removing the constraints would require time and cost.

TABLE IV: CONSTRUCTS AND VARIABLES FOR COORDINATION

S.No.	CONSTRUCTS	VARIABLES
1.	Team composition	
	a) Process of team formation	Voluntary Administrative Mandatory Statuary Resource Cooptation
	b) Flexibility about coopting specialists from within or outside the organization	
2.	Preferences for Team Members	
	a) Members preferences regarding composition of team	Agronomist Agriculture Extension Agriculture Economists Biotechnologist Biochemist Plant breeder Pathologist Microbiologist Entomologist Plant physiologist Marketing specialist Production specialist
	b) Process of ascertaining preferences	
3.	Size of the Team	Number of members Fixed Variable Variable over product development cycle

Continued..

Continuation of the table IV.

S.No.	CONSTRUCTS	VARIABLES
4.	Team meetings	
	a) Regularity of meetings	Ad hoc Whenever necessary Regular intervals Calender based
	b) Periodicity	Daily Weekly Fortnightly Monthly Bimonthly Quarterly Half yearly Annual
6.	Communication between functional areas	Scientists in the dept. Scientists outside dept. Scientists from other institutes Scientists from other countries
	Flexibility	Permission for Communication
	Opportunities	Conferences
	Technological support	Telephone Intercoms E mail

Continued..

Continuation of table IV.

S. No.	CONSTRUCTS	VARIABLES
7.	Priority of Scientists for interaction	Scientists in the dept. Scientists outside dept. Scientists from other institutes Scientists from other countries
	Priority regarding task	High risk Practical problems Application oriented Long term/Short term
8.	Project leader	

3.2.4 Responsiveness to Needs of the Farmers

Fourth dimension of client orientation, responsiveness refers to the actions taken by the scientists to satisfy the consumer needs [Caro 1993; Viglizzo 1993]. Figure V, provides the model. The model starts with registration of information from farmers (extension of articulation response model (Gupta 1992].

Out of the registered needs only some problems would be taken up for research. The selected needs would be defined as broader problems and they may be prioritised. The criteria used for prioritising the problems would decide the nature of problem selection for further processing [Caro 1993].

The prioritized problems might be screened for selecting a specific problem for analysis. Then the problem might be broken down into small researchable questions.

At this stage a resource assessment would be made for availability of resources such as specialists, technical skills, finance, information etc [Fox, Pate & Pondy 1976]. Depending on the availability or non availability of these resources in the organization, they may be mobilized internally, or by establishing different relationship with other organizations. Resources not available inside the organization can be either developed internally in the long run or left without notice [Sonnenberg 1993].

The team might generate ideas internally, or externally by building upon existing solutions, such as farmer innovations [Singh 1985; Pastakia 1993; von Hippel 1986]. New ideas may be generated using techniques like brain storming and suggestions from staff. Ideas so generated will be screened using a set of criteria.

The ideas can be actionable currently or may not be actionable. Actionable ideas would be taken for further investigation, some unactionable ideas may generate agenda for basic research.

These actionable ideas would be developed in to product concept and tested for acceptance by target farmers. Then laboratory level product will be developed and tested. These tests may be carried out in laboratory, or centralised/dispersed research stations and fields of the farmers.

The outcomes could be then scaled up for commercial production and launched.

This process is not sequential. It is highly iterative and considerable interaction between internal consumers, external consumers and scientists is essential for bringing a common understanding among them [Urban & Hauser 1980; Urban, Hauser & Dholakia 1987]. Table V, presents the constructs and variables proposed for analyzing responsiveness.

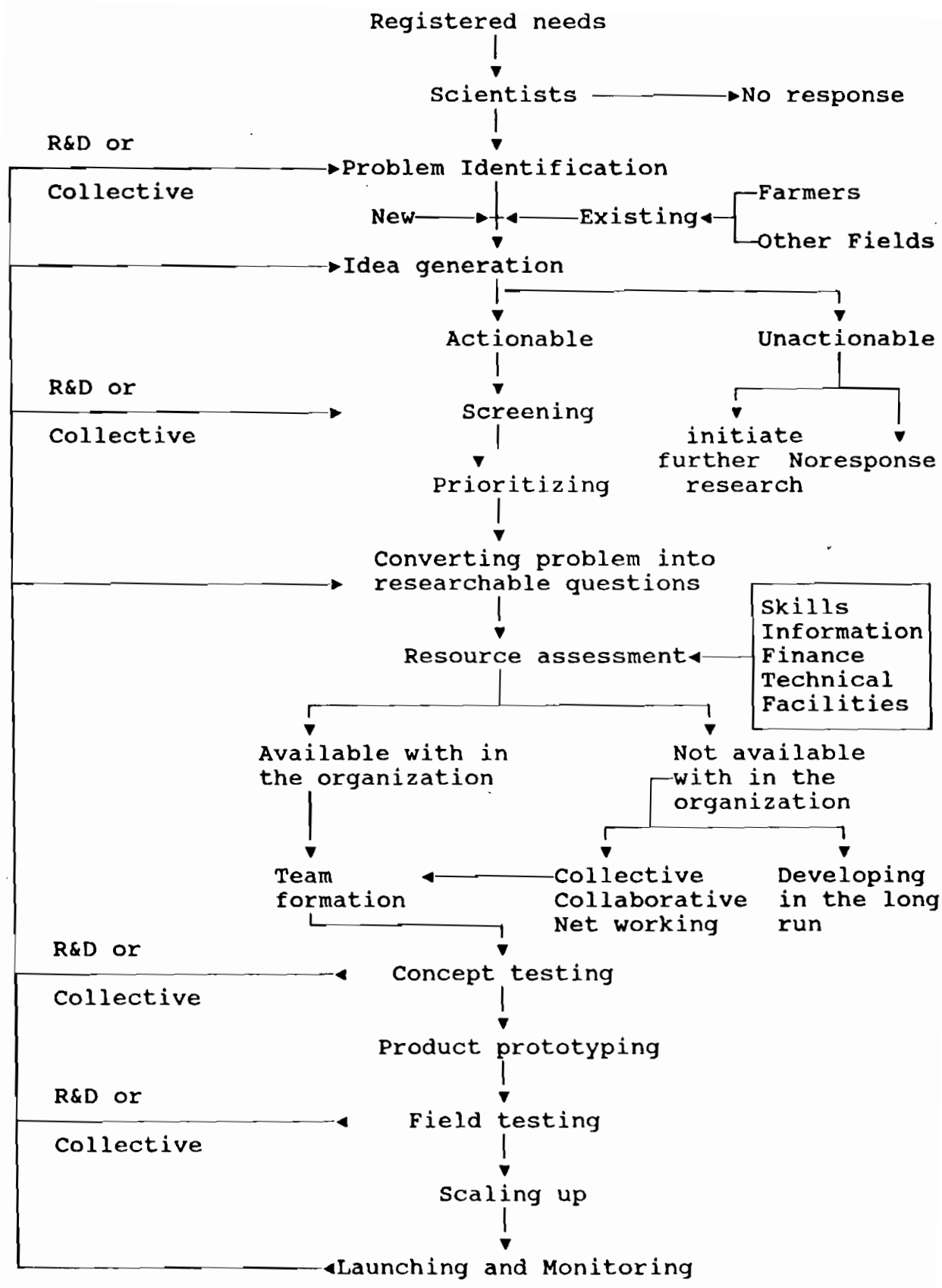

FIGURE V: RESPONSIVENASS TO THE FARMERS NEEDS

Table V: CONSTRUCTS AND VARIABLES FOR SCIENTISTS-RESPONSIVENESS

S.No.	CONSTRUCTS	VARIABLES
1.	Target Segments	Local socio-ecological niches Focus on specific target segment of farmers Diffused segments
2.	Criteria used for prioritizing	
3.	Sources of criteria used for prioritizing	
4,	Trials conducted	Laboratory trials Pot cultures Experimental Station trials On-farm trials Multinational trials National coordinated trials
5.	Number of trials	
6.	Number of seasons	
7.	Definition of resource requirements	Skills - internal - external Financial - internal - external Technical facilities
8.	Number of complaints	
9.	Actions taken against complaints	
10.	Redressal mechanism	
11.	Product adaptation overtime	
12.	Sources of ideas	Internal External
13.	Action taken for non-actionable ideas	

3.3 SCIENTIST-SPECIFIC VARIABLES

The third objective of the present investigation is to explain the influence of 'scientist-specific' factors on the client orientation process. Many scientists qualified in basic sciences such as biochemistry, physiology etc., are entering the field of biotechnology product development. The higher education and emphasis on publication oriented research reduces incentives for generating practical technologies [Raman 1989]. The problems selected, the reference groups, journals preferred for publication and reference etc., are governed by the socialization process. Hence, these factors could have strong influence on scientist-farmer communication.

It was reported in many studies that the interaction between scientists and farmers is impaired by status differences in terms of education and perceived superiority [eg. Biggs 1989; Kaimowitz 1989]

Biotechnology being research intensive, many related specializations are offered only in few institutions. These new areas of specialization offered are dominantly occupied by urban students. The difference in background namely urban/rural might also influence their ability to communicate with farmers [Gaillard 19].

Experience in product development over a period would also have impact on the nature of interaction scientists would have with farmers.

The scientists-specific construct and variables have been listed in table VI.

Table VI: SCIENTIST-SPECIFIC CONSTRUCTS AND VARIABLES

S.No.	CONSTRUCT	VARIABLES
1.	Orientation	Basic research Applied research
2.	Background	Urban/rural Peasant family/others
3.	Qualification	Agriculture/others level of qualification
4.	Age	Years
5.	Experience	Years

3.4 ORGANIZATIONAL-SPECIFIC VARIABLES

The fourth objective is to study the effect of '*organizational specific*' factors on client orientation of the scientists. As scientists are working in the organizational settings, organization related variables would also guide the behaviour of the scientists [Tushman & Nadler 1986]. The performance evaluation criteria should reflect the required outcomes and tailored to match the individuals responsibilities. Performance evaluation criteria involve (1) outcome, (2) input, and (3) process variables. The importance attributed to the variables by the management and the perceived importance given by the scientists could influence the behaviour of the scientists [March & Simon 1958].

Incentive systems consist of various mechanisms such as (1) monetary and non monetary, (2) extrinsic and intrinsic, (3) short term and long term, and (4) individual and group. In practice, these incentives are used in various combinations. It was reported that the short term, individual, financial outcome focused incentives have curbed innovativeness [Anderson 1982; Parasuraman 1981].

Our focus is on the incentive mechanisms used by the organizations involved in product development, perception of scientists about incentives, and influence of these variables on the client orientation. Table VII, presents a set of constructs and variables for incentive systems for scientists.

Table VII: ORGANIZATIONAL-SPECIFIC VARIABLES AND CONSTRUCTS

S.No.	CONSTRUCT	VARIABLES
1	Type of Organization	Private Commercial Private non commercial Govt. commercial Govt. non commercial Farmer owned commercial Farmer owned non commercial Quasi government Small/Large
2.	Performance Evaluation Criteria	Educational qualifications Experience Participation in training Involvement in on-the-job training Oral and written communication Interpersonal relation Leadership Project management capabilities Analytical ability Organization and work activity Keeping up with the scientific literature Ability to define research problem Ability to design, undertake and interpret experiments Timely reporting of results Effective documentation for potential users Active participation in professional meetings Effective training of support and junior staff Collaboration with other researchers on teams Joint activities with extension workers Publication of scientific journal articles Publication of conference reports and papers Books written Books edited

Continued...

Continuation of the table VII.

S.No.	CONSTRUCT	VARIABLES
2.	Performance Criteria [Continued]	Research abstracts Extension publications Radio programmes Television programmes News articles Patents Varieties released Prototypes produced Proposals accepted Honours and awards from - Professionals - Clients Widespread acceptance of product developed Citation of papers published
3.	Incentive Systems	Publicity in news papers, in house publications Commendation in the organizational gathering Plaques and certificates Letters of praise Gifts and honorific titles Trips to conferences Journal subscription Scholarships in the teams name Asked to take on difficult challenges Increasing variety of work Seeking team advice on other problems Top managers showing interest, Top managers paying visits to the laboratory Increased freedom at work Consultants to other teams Professionally stimulating environment Grant for personal research Rewarded team as a whole

Continued...

Continuation of the table VII.

S.No.	CONSTRUCT	VARIABLES
4.	Criteria for Promotion	Number of papers in professionals journals Number of projects completed Strict seniority Publications in the farmer journals Participation in the extension activities Number of M.Sc. students guided Number of P.hD. students guided Papers in the professional conferences Training programmes conducted

4.0 METHODOLOGY

4.1 RESEARCH PROCESS

Case study method is proposed for the present investigation to develop an indepth understanding of the phenomenon. Further, I propose to use multiple measures of variables in order to increase the validity of measurements. Both 'qualitative' and 'quantitative' data would be used complementarily. The research design is presented in figure VI.

4.2 SELECTION OF ORGANIZATIONS

The list of organizations involved in biotechnological agri- input was generated using the database published by Biotechnology Consortium India Limited [BCIL 1992]. The organizations, which have already launched some products would be selected. For this various published sources of information would be used. To represent different types of organizations, they have been classified on two dimensions viz -- (a) commercial and non-commercial organizations and (b) Ownership based on funding of research and development viz. governmental, non governmental and user owned organization (table VIII).

Table VIII: TYPE OF ORGANIZATIONS

	Commercial	Non commercial
Private	1	2
Government	3	4
Farmer owned	5	6

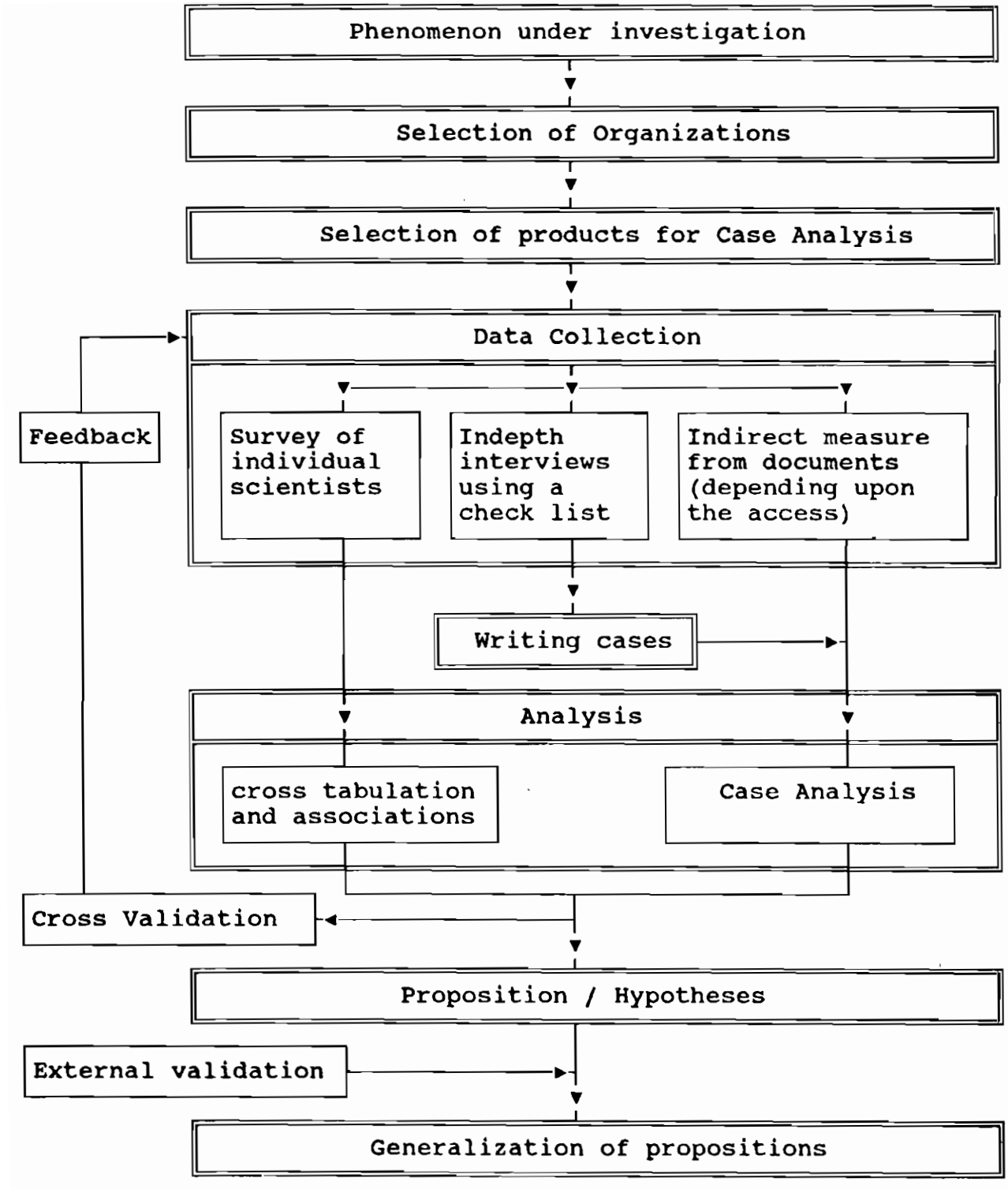

FIGURE VI: RESEARCH PROCESSFIGURE V: RESPONSIVENESS OF THE SCIENTISTS TO FARMER NEEDS

One case would be selected from each class of organizations. The selection would be judgemental and with further consideration like access to data.

4.3 SELECTION OF PRODUCTS

All products launched by the organization and any product withdrawn after launch would be considered. These products would be categorized into two groups using two criteria of success (1) financial and (2) the annual growth of sales/adoption of the product.

One successful and one failed product from each of the selected organization would be considered for case study.

4.4 DATA COLLECTION

Three types of data would be solicited, they are (1) survey data on preferences of scientists on sources information, channels of information, incentives used by the organizations, performance criteria used by the organizations etc. and (2) indepth interviews would be used to collect data about the responsiveness, process of selection of ideas, resource mobilization etc. and (3) indirect measures using documents and published sources.

4.5 DATA ANALYSIS

As the sample size is small and selected more based on judgement, analysis would be restricted to 'non- parametric' statistical techniques like Spearman Rank Correlation. The qualitative data would be subjected to 'content' analysis. The cases would be compared and contrasted between successful and failed products and across organizations.

As the study is exploratory in nature, hypothesis testing in the classical sense may not be possible, hence the attempt would be to generate propositions and hypotheses based on the insights gained from the case studies.

4.6 VALIDATION OF DATA

Use of multiple measures would reflect the cross validation of the data to certain extent [Jick 1979; Zaltman, Lemasters & Heffring 1982]. Different measures of the variables

would be reconciled, and unexplainable deviations would be presented to the respondents for classification.

4.7 DELIMITATION OF THE STUDY

A longitudinal study would have been more suitable for understanding the process of client orientation. An iterative data collection and feedback procedure could generate greater reliability of estimates. However, because of resource constraints we limit to one feedback.

If we could control the effects of product on its success by selecting same product across organizations, it might provide more insights about the organizational processes. We could not do so because of non availability of organizations having same product.

We have limited our scope to scientists only, more insights may be possible, if we could use dyadic interactions.

Generalization of findings would be tentative because a large sample study with different technologies, organizational settings

and product markets may have to conducted for external validation.

4.8 IMPLICATIONS

The study could throw new insights about the process and factors influencing scientists client orientation. This could be used for developing policy measures to influence the behaviour of the scientists. This study may provide ways and means to develop competitive advantage of the organizations by enabling focused product development.

For academia the findings may provide a framework for client orientations and some new approaches to measurements of behavioral variables. Further, this investigation could generate new propositions, hypotheses and questions for future investigation. The study may integrate two streams of literature (a) commercial new product development and (b) evaluation studies of agriculture research, which have been developed independently.

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