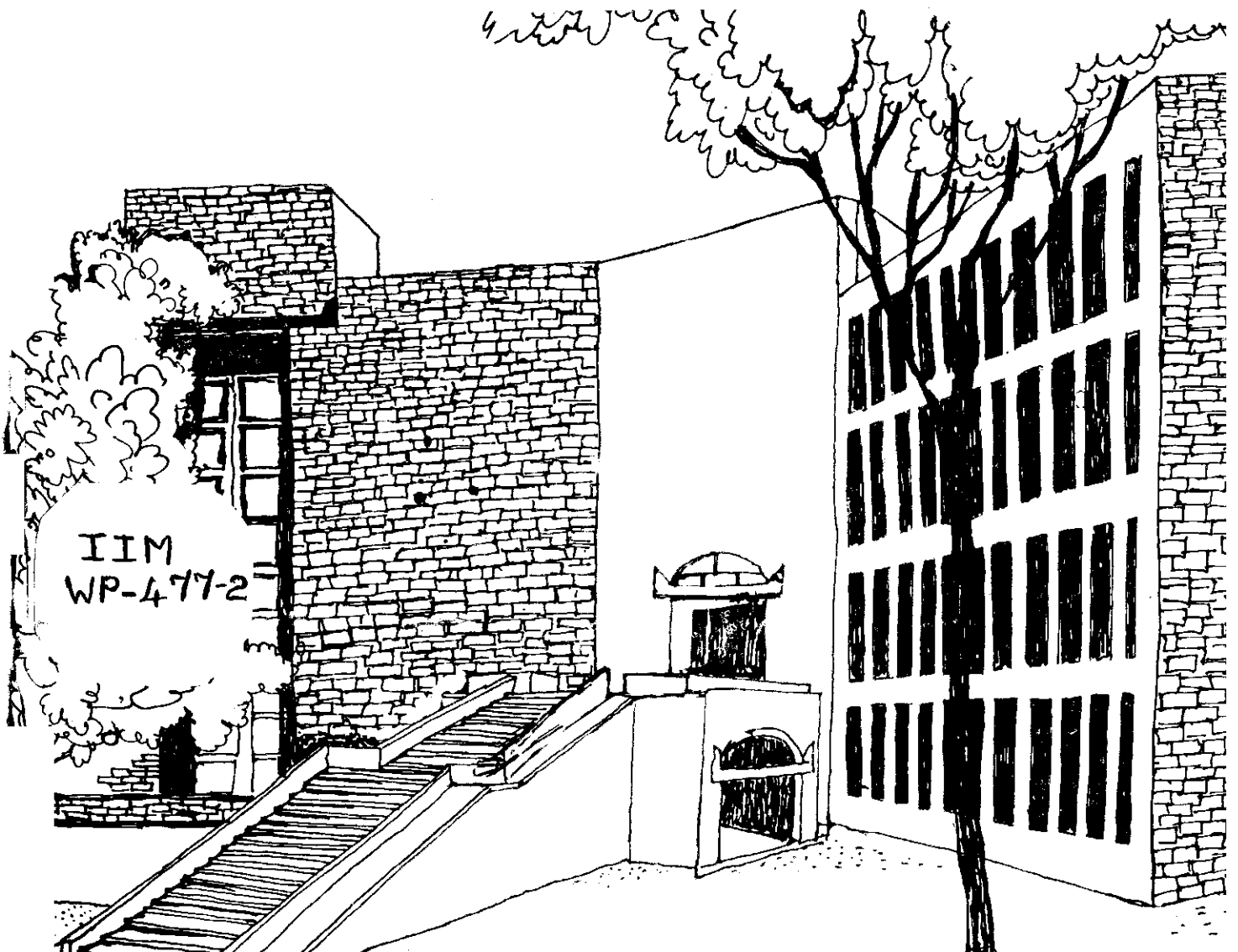




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# Working Paper



TECHNOLOGY TRANSFER IN AGRICULTURE --  
CASE OF HYBRID BAJRA.

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## CHAPTER 1

### INTRODUCTION

- 1.1 Agriculture, in principle, deals with manipulation of natural resources to the best advantage of the people. These include the physical ones like land, water, climate, and the biological ones like livestock and human resources. The economic system prevalent in the country provides ownership of land by peasants. For agricultural development these farmers are to be supported in their efforts for production. The support agriculture needs has to be comprehensive in regard to policies for all these, and also for the organizations. The policy support has to be relevant to the natural resources, infrastructural needs, as well as to the input-output marketing. The areas of policy support to agriculture extends on one hand to input manufacture, and on the other to output processing industry. Ultimately, these relate to policy in regard to terms of trade between agriculture and industry, as well as the balance to be achieved between the national imperatives for agricultural production and welfare of the targetted people (principally consumers and the weaker sections which in India, in a wide and relative sense includes all rural people).
- 1.2 The organizational needs to support agricultural development are manyfold and areas to be covered are large and numerous. These organizations have to be firstly for implementation of policies; / <sup>policies</sup> in regard to land and use of water dictate the need and the structure of the organizations to implement these policies.

Infrastructural facilities like road, railway, energy resources and distribution, organized markets, credit, educational, and medical facilities, necessitate their creation and maintenance. Organization to implement policy in regard to ownership of land is obviously necessary. Organizations, sponsored, supported or even owned by government for manufacture and marketing of inputs are crucial for development. To make the natural resources more productive, an enormous research support, and an organization thereof, are important for any type of agricultural development. In countries with low literacy, with poor development of communication media, organization for reaching the required messages to the producers is a vital link in the agricultural system.

1.3 The development <sup>of</sup> traditional type of agriculture is usually associated with detection of existing known resources in the local environment and using them, for example land and labour. Land has been the main factor leading to increased production for centuries. Use of organic manures was also one which was developed locally, in which conceptual knowledge of the process of biological growth was applied for increasing productivity. Likewise, farmers have used irrigation water for stabilizing or increasing production. Development of hand tools and animal drawn equipment also helped increase production. The processes of technology transfer of such distant past is difficult to identify, but it has to be recognized that as far as the use of the local resources and related technology are concerned, long periods were involved, which as per current

expectations would be defined as a stagnant state. Low density of population then prevailing and slow demographic growth did not stimulate farm productivity. The share of market economy was not high and production was quite commonly in excess of demand. Migration of population to new areas for cultivation was one of the solutions to balance demand and supply of food.

- 1.4 The agricultural development as perceived today, however, requires, addition of exogenous resources in the cycle of events. Even exploitation of local resource of land needed intervention, in the form of capital and technology, raising not only problems of organization for these inputs per se, but also of the process of their transfer, coordination, and interrelated issues.
- 1.5 The broad areas of activities supporting agricultural development are research, education, extension, supply, marketing, and processing. In addition, the socio-economic situation plays its role. Identification, separation and development of distinct organizational systems for these have been taking place since the beginning of agricultural development programmes. The organizations which have developed for agricultural developmental activities are now fairly well known. The research and education have been assigned to the agricultural universities. While the state departments of agriculture (animal husbandry and others) are to be incharge of extension, supervision, and regulatory functions with the added responsibility of coordination of supply of inputs. Supplies have



to be from institutions developed for the purposes such as and banks for credit, cooperatives and public corporations cooperatives for seeds, fertilizers, etc. as also the privately owned channels for these. Organizations for marketing of output, and processing are important as also institutions for price regulations.

- 1.6 A large number and types of agricultural development programmes are underway in India. They extend from simple ones like enlargement of the use of traditional inputs like land and water to complex ones like aerial spraying for crop protection, (both in its technological content and management skill). These not only require development of advanced technology, but also a transfer process needing specialized organizational capacity and coordination at the same time.
- 1.7 The main programmes of technology transfer in agriculture currently in vogue in the country are the following:

Land and soil	Reclamation
	Soil conservation
	Soil fertility improvement by
	a) Organic nutrients
	b) Fertilizers (and bio-fertilizers)
	c) Soil amendments
Water	Introduction of canal irrigation and water lifts
	Irrigation water use
Crops	Varietal development
	Plant protection
	Agronomic practices (related to both soil and crop) including labour saving devices
	Post-harvest technology

- 1.8 These programmes need to be first viewed in terms of some of their characteristics which are important from the needs they generate on the organizational systems through which they operate. Some of these needs would relate to transfer of knowledge alone (to be adapted with the locally available resources), while others necessitate exogenous inputs, or may require specialized knowledge on the part of those concerned with the transfer process.
- 1.9 For an understanding of the current problems of technology transfer in agriculture in India, it is first necessary to group the types of technologies according to the systems which generate them and also differentiate in terms of their transfer process (Chart IA and IB). The latter would help our understanding of why some transfers have taken place in shorter period than others. Such an understanding would help in identifying the reasons why there have been successful and rapid transfers in some cases and not in others, though both may be operating in identical environment, through the same systems, and even the same organizations. Generally in agricultural development, the new technology is identified in terms of use of seeds, fertilizers, plant protection, agricultural machinery, agronomic practices, etc. It is generally believed that they have characteristics which are suitable for transfer through the same system. They - with the possible exception of machinery - all generally originate on research farms and are transferred to the farmers through the extension system. However each of these technologies differs considerably in the transfer process,

particularly in regard to the links and inter-phase they may have with different systems supporting agricultural development. The latter aspect though implicit in technology transfer, is often not emphasized in the studies on agricultural development processes.

1.10 The demand on the systems by various programmes of agricultural development varies according to the nature of the product itself in terms of 1) production process, and 2) to transfer process. For example, certain production processes of inputs required for agricultural development programmes are complex and little known in the country of use. These will have to be matched to the needs of the country of use. There would be, however, certain programmes based on production processes developed in the country of its use - thus creating less demands on the systems with linkages abroad. Even in such cases, production technology has to be continuously developed for which an organization would be needed. Further, sometimes simple programmes may be generated by use of knowledge developed locally (without a new system support) and which can be adapted by the farmers within the existing systems of supply and distribution of knowledge/product; most of the early development of agriculture, was by processes developed in this manner. Nowadays, the product needed to be transferred may be such as would need a special treatment for its very innovation and production, as well as the transfer process itself, and may in extreme cases be such as to necessitate a specialized service both for product development (certainly) and for transfer. The characteristics in terms of production system and transfer system

of products/knowledge for agricultural development programmes in the country are summarized in the accompanying charts. Chart 1A indicates some basic groups of production systems while Chart 1B is in respect of characteristic groups of transfer systems.

- 1.11 The so-called "non-enterprise" system (a misnomer), such as the one for agricultural development is yet to receive adequate attention with regard to its management. Their genesis in colonial times, the principles adapted for these systems then, have often been obliterated or twisted, resulting in a rather confounded situation. The state departments of agriculture created in the early part of this century were started with the concept of a functional organization, extending right from the secretariat to agricultural college on one side, and the extension agency on the other. Increasing specializations were positively envisaged in the teaching and research wing, giving it a staff type of organization. In the extension side, however, a line type of an organization was evident and lack of specialization extended to merging of such functions of agricultural extension with its many distinct needs, like accounts and administration. Even in the teaching and research wing, the various specialists have also to perform in addition to their specialized tasks, other supporting functions. With the changes in government after Independence, and entry of generalist administrators at the helm of affairs concerning agriculture, the supporting services like accounts and administration were emphasized. This philosophy permeated so widely and deeply, that the main agricultural functions were generally not reviewed or supervised. Whatever supervision existed was for administration,

accounts and audit. The inspection and evaluation forms provided to supervising officers over the decades, (and in some states even now) stand testimony to this lack of emphasis on specialization. Accountability for accounts and administration was easily understood, documented and varified while a similar exercise for specialization was - and perhaps is even today - like treading on unknown grounds. This kind of development also fitted well in the socio-economic environment where farming was "only proverbially" considered a "noble" profession. Advising farmers seemed to be, everybody's business in the official hierarchy and the higher the officer, the lesser the knowledge of local farming situation he possessed. Creation of community development department with general objectives and multi-purpose village level workers at the village level in a line organization was a result of this philosophy of management. In this environment, the organization which needed specialization was continuously tried to be 'lined' up to solve management problems like that of promotions which are easy to solve in line organizations (like revenue and police departments with sets of rules evolved over a century), but is unfit in organizations with specializations. The state departments of agriculture and the agricultural universities in view of this heritage, continues to face these problems in some form or other. In retrospect, one may also state that where the organizational environment was not suited to specialization, recourse to formations of numerous committees was a tangential growth or swellings to avoid the rigours of development and management of

specialized organizations requiring an entirely different approach to management.

- 1.12. There are not many publications of Indian origin describing the organizations involved in agricultural development. General descriptions of these organizations, which are available, while they serve a particular purpose, are not adequate for a comprehensive understanding of their organizational structure. Several attempts to evaluate individual programmes have been made. These are continuous and on-going efforts. These try to detect reasons for lack of progress, which may turn out to be administrative, organizational, socio-economic, or rarely the technology itself.
- 1.13. Greater stress has been, however, laid in studying the differences in adoption pattern of farmers. Studies have been done on economic, educational, social aspects of farmer groups. Essentially these studies are for determining factors affecting adoption behaviour of farmers. These studies have got momentum from two sources: one, the need for an academic understanding of the prevailing situation, and the other, from a social consciousness of unequal advantages which the transfer systems have generated in segments of the farming community with more resources, even though technology was neutral in this regard. (In an economic system which confers an advantage to those already with resources, this cannot be considered as an unexpected happening). These studies had objectives of their own, and it can

be concluded that our understanding of differential adoption of improved agricultural practices by farmers has advanced considerably. However, many problems remain unanswered. For example why in the same area, one technology transfer has been rapid, and not the other. Taking the country as a whole, transfer of HYV of wheat and paddy have been more rapid than of maize, bajra and jowar. Questions arise as to whether their technologies (though all are under the common banner of HYV) differ in some fundamental ways needing special attention.

Chart 1A

Characteristics of Production Systems for  
Product/Knowledge for Agricultural Development

	Production System	Examples of	
		Knowledge	Product
Product/knowledge from private farms	Other than users' farm	Traditional agronomic practices	Hybrid seed
	Users' farm		Non-hybrid seed, organic manures
Product/knowledge from other than private farms	Agricultural research system	Use of fertilizers Use of pesticides proper use of canal irrigation soil tests	Crop variety
	Industry base products		Fortilizers pesticides agr. machinery

## Chart 1B

Characteristics of Agricultural Technology with Regard to  
Transfer Systems

		Agr. Technology	
Product not to accompany	Extension system alone	External extension system	i) Spacing of crop rows ii) Time of sowing iii) Time of harvesting iv) Contour planting
		Specific extension system	i) Land development (including soil conservation) ii) Soil testing
Product to accompany	Supply system alone	General supply system	i) Improved bullock driven implements ii) Seeds
		Specific supply system	
Product to accompany	Supply system	General	i) Improved seeds
	Extension system	General	
	Supply system	General	
	Extension system	Specific	
	Supply system	Specific	i) Hybrid seeds ii) Mechanized agricultural equipment (e.g. tractor, pump, etc.
	Extension system	General	iii) Fertilizers iv) Pesticides v) Irrigation
	Supply system	Specific	i) Aerial spraying ii) Anhydrous ammonia
	Extension system	Specific	iii) Artificial insemination



CHAPTER II  
OBJECTIVES AND METHODOLOGY

- 2.1 The research organizations like Indian Council of Agricultural Research, agricultural universities, etc., in the country have been known to have developed their own pattern of organization and working. The research results provide the base for the agricultural growth, but for achieving this growth, not only the results per se, but the system under which research develops also influence. These research results, until they reach the recipients go through a channel of extension system which in recent times have become complex and this often influences the information reaching the farmers. Other systems also operate in the total process of transfer of technology. Input supply system, (sometimes as a part of extension system), is a necessary part of the agricultural development programmes.
- 2.2 It cannot be said, yet, that the stage is reached when overlaps between these systems do not exist. As late as 1976, the National Commission on Agriculture observed that research was in some states still with departments of agriculture. Likewise, "these institutions are becoming increasingly interested in actual supply of requirements of farmers"<sup>1</sup>. In respect of agricultural research and education, the boundaries of the two organizations, namely the department of agriculture, and the agricultural university have been clearly defined by the same Commission.

<sup>1</sup> National Commission on Agriculture Report, Pt. XIV, p.188.

- 2.3 The different aspects of transfer and to some extent the individual operating systems have been studied, but it has to be realized that transfer of technology is not a result of only individual systems operating independently. It is a result of several interlinked systems. This aspect has not received adequate attention. For an understanding of the problem under review, it is necessary to restate the basic outline of the research, education and extension systems supporting development. Similar but brief outline of the supply and marketing systems commonly prevalent is also attempted.
- 2.4 The organizations attending to the main functions of research, education, and extension have undergone major changes. In respect of the states to be reviewed, they will be described in historical perspective in a later section. It is, however, necessary to state the basic outlines of these organizations so as to make the subsequent chapters relevant and easier to understand. While describing the outline, the focus has been on the systems related to field crops which cover a very large proportion of the cultivated land in the country.
- 2.5 In a study confined to a few cases of systems for technology transfer, in agriculture, it is hardly feasible, nor necessary, to provide a complete description of all the systems involved at all levels extending from the national to the village and their coordination and integration. Focus has been on systems prevalent in the states under reference. At the same time, it would be inappropriate to

ignore the relevance of institutions and systems outside the states, to the cases studied. Consequently important aspects of all the systems have been identified and described.

2.6 There are scores of crops which are yet untouched by these systems. There are the plantation crops like tea, and cigarette tobacco where quality of products have greater significance, and are historically linked with exports. For these, various operating systems are integrated more clearly and not only inter-linked but even inter-locked. The dependence of such planters on government in regard to research, extension and supply has been minimal. These fall outside our purview as the case of technology transfer considered is of field crops.

2.7 In understanding the two cases of transfer of technology, one can examine the various systems in the present context alone or look at these systems in a historical perspective also highlighting the major changes during the period. The differences between two agro-climatically nearly comparable states are important, particularly so when the time span is fairly long as in the case of hybrid bajra development programme. In the case of both hybrid bajra and maize the percentage of area covered in 15 years in all over India, is 15 per cent. In contrast, in Gujarat spread of bajra was over four times than the figure quoted but only 15 per cent in Rajasthan. An examination of the systems and major changes thereof during the period, therefore, becomes necessary to understand if alterations in

the organizational systems are associated with periods of rapid growth, stagnation or retardation in spread of hybrids and the related factor of yields and consequently production. The changes if any in the system of technology transfer have to be also viewed from possible resultant problem areas of coordination, implementation or new problems.

2.8 In a study of the organizational system in agricultural development, one is faced with the problem of selection of case of technology transfer. There is a whole range of types of technology (Chart 1A) and their transfer systems (Chart 1B). In selecting the technology, we were guided by the situational analyses. At first we preferred seed technology as it has made maximum impact on Indian agriculture in recent times. Moreover, this technology involves both types of farmers, seed producers and consumers. From the five main cereals, those with HYVs which were not hybrids, i.e., wheat and rice, were not preferred, as their seed production and supply system do not attract changes in organizational systems. Out of these cases of transfer, hybrid bajra and maize were selected. Both these had added advantages of being grown in adjoining states with similar agro-climatic condition but substantial differences in hybrid coverage. Both of these are essentially rainfed crops. Out of these two, maize is one which has processing industry to support its growth. Jawar is agro-economically a more complex crop with varieties extending from pure fodder types to grain types with intermediate dual

purpose ones all sown in large areas, and its hybrids are only designed for grain. Looking to the diversity of agricultural technology, it is realized that the two cases of transfer of HYV of bajra and maize selected for the study cannot answer all questions related to agricultural development organizations. These cases are however important, as these are major crops of the arid and semi-arid climatic zones which occupy a large part of the country. The understanding of their problems will go a long way in developing suitable plans for agriculture of these zones, which so far have been mainly dependent on irrigation for their development.

- 2.9 The selection of the comparable states was guided by proximity and contrasting performance in spread of hybrids. For the case of hybrid bajra, Gujarat and Rajasthan were selected, and for hybrid maize, Uttar Pradesh and Bihar were found suitable. Though Karnataka was not comparable to the latter two, it was included for the study of agricultural systems related to hybrid maize due to almost complete coverage by hybrids accompanied by an increase in area under the crop.
- 2.10 For the two selected crops, various organizations which were involved in the programme for their spread were identified. Then organizational details were obtained from various publications of the concerned institutions. In regard to state departments of agriculture, such structural plans were readily available but for agricultural universities these were drawn. Simultaneously suitably designed questionnaires and personal interviews were used to solicit information on institutions participating in the programme. The latter, has been the major source

of information. On the basis of information thus compiled, the organizational charts and linkages were identified and described. It was not always possible to show the final charts to those who had supplied the informations, but whenever it was possible they were also consulted.

## CHAPTER III

### HIGH YIELDING VARIETIES AND AGRO-CLIMATIC FACTORS

3.1 Before commencing the discussion on the organizational systems related to the spread of hybrid bajra and maize, we need to examine the prevailing status of all HYV of all the cereal crops for which such varieties have been released. These are wheat, rice, maize, jowar, and bajra. The first two are often referred to as superior cereals. Apart from the socio-economic overtones implied in such a classification, it is observed that these two crops yield more per ha than the other three so called inferior cereals. The national average per ha yields are in the order in which they are listed above. The introduction of HYV for these crops have not been of the same type and were released in different years. The HYVs for wheat and rice are not hybrids in the accepted sense, and seeds are not required to be replaced by users each year. On the other hand, for maize, jowar, and bajra the HYVs are hybrids. In all these crops new varieties have been introduced in succession. This has considerable relevance to the stress generated in the organizational system for development of these crops. In regard to all the HYVs, it is generally believed - and there are evidence to support it in the many local studies - that the spread of these varieties have been for irrigated areas, and better rainfall areas. The belief that there is a strong association between extent of irrigation and differences in coverage of HYVs has clouded our understanding of the problems. As to whether the HYV programme in the country shows this characteristics and whether it is verifiable is

necessary to be ascertained. Such generalized analysis can help our understanding of and approach to the various participating systems in the programme. In this chapter, a statistical analysis of the relationship of the extent of spread of HYVs across the states of the Union, and some of the relevant agro-climatic factors on which the common assumptions regarding relative spread of HYVs have been based, are examined.

- 3.2 The coverage of HYVs in the country has been widely different for different cereal crops and between states. The wide differences are easily seen in Table 3.1. The coverage of HYV is largest for wheat (68.5 per cent) followed by rice (32.7 per cent). From the remaining, bajra and maize has 18.9 and 18.2 per cent of the area under HYV and the minimum coverage is for jowar (13.5 per cent). As can be seen from the same table the coverages for these crops vary widely between states.
- 3.3 In regard to wheat, more than one species are under cultivation. In the northern wheat belt, the aestivum predominates and is largely irrigated. In the central and southern regions, durums are also grown as unirrigated crop on residual moisture. The limited success of HYV in these latter regions lead to a lowering of average coverage, even when irrigated wheat farmers of many states have almost completely accepted the HYVs. In comparison the wheat, rice is grown under much varied agro-climatic conditions. To take care of different types of stresses experienced, thousands of varieties of paddy have been developed and adapted for the local ecological niches. Irrigation can be one of the numerous factors influencing rice cultivation. Much research will be needed to provide HYV well adapted to all these varied conditions.



- 3.4 Unlike the two crops of wheat and rice, jowar, maize and bajra are predominantly unirrigated crops, largely grown in arid and semi-arid regions of the country. Another distinguishing feature is the greater dependence of farmers on these crops, not only for human food, but also for cattle fodder. In many of the climatic zones growing bajra, maize and jowar, cattle breeding and mixed farming are important because of the availability of fodder. Any type of development including that of HYV, if it is likely to influence this agricultural base, can have far reaching implications on the socio-economic structure of the area. It must be recognized however, that in the over enthusiasm generated for (human) food production by HYV, this dual context of the programme has been inadequately attended.
- 3.5 Out of all the cereal crops, maize had the earliest start in the availability of hybrid varieties as compared to all others. In spite of this longer time span available for its development, area coverage by maize hybrids has remained low. This crop is irrigated to a larger extent than jowar and bajra. The extent to which irrigation extends to fodder maize and grain crops, separately, needs to be assessed for a proper understanding of the spread of the new varieties. Inadequate data base does not permit this analysis.
- 3.6 For both jowar and bajra, the percentage of irrigated area is smallest (about five per cent, Table 3.1) and the proportion of area under HYV is much larger. This indicates, the suitability of HYVs to unirrigated crop area, (or the suitability of certain rainfed areas where the hybrids are grown). As to what these areas are, can be

only known when disaggregated data become available.

- 3.7 Before approaching the study of the organizational systems in the spread of HYV in the country, it is important to try to identify technological constraints which may be operating in restricting the spread of these varieties to certain crops and certain states. This would be a proper subject for analysis by the plant breeders and agronomists in their day-to-day work at these micro levels. However, one can possibly identify some factors which may be responsible for the extent of spread at the macro level. Here, one can only consider the more obvious determinants and those for which data are available.
- 3.8 The methodology adopted, is that of determining coefficient of correlation of the cross-sectional data of percentage spread of HYV in various states with a few independent factors possibly influencing the spread. The general belief is that availability of irrigation influences the spread of HYV, but it would be more reliable to arrive at conclusions based on statistical analysis. The coefficients of correlation of extent of crop area irrigated and extent of spread of HYV are, therefore, worked out. The analysis is also extended to independent variables of annual precipitation and evapo-transpiration in the states. The zero order correlation matrix is given in the Table 3.2.
- 3.9 It can be seen that only for paddy, the  $r$ -value is of significant magnitude (0.77) for irrigated areas and percentage coverages by HYV in states. In all other cereals these values are low. Strangely enough it is also very low ( $r = 0.16$ ) for wheat. This and the

negative  $r$ -values for jowar ( $-0.36$ ) are difficult to explain. (Low coefficients of correlation between irrigated area and area under HYV of major cereals, except rice, have been also very recently reported for the districts of Gujarat State<sup>1</sup>). The area of rice has a large share in total, and, therefore, high values, ( $r = 0.74$ ) of percentage of irrigated area and extent of spread for all these crops together is to be expected.

3.10 Regarding  $r$ -values for annual precipitation and HYV coverage, only in case of jowar it is somewhat high ( $0.60$ ). For all other crops the extent of spread of HYV is not correlated with annual precipitation. It is similar for relevant evapo-transpiration of each crop's season. Besides the low positive correlation of extent of spread of HYV and evapo-transpiration for rice, bajra, maize, and wheat, the high negative  $r$ -value ( $-0.81$ ) for jowar (accompanied by low  $r$ -value for spread of HYV and area irrigated) is not possible to explain. However, some factors are highlighted with regard to jowar crop. These are: 1) considerable (though not yet numerically estimated) area of jowar is grown for fodder, 2) sowing time of the crop and pest incidence are related, making the susceptible HYVs less adaptable, and 3) the prevalent grain sorghums in parts of the country have longer maturity period providing them an inherent advantage in yield.

3.11 The above correlation analysis does not lead us to support the prevailing view that HYV coverage is dependent on availability of irrigation. Only the case of paddy supported this prevalent view. Secondly, the factors of precipitation and potential evapo-transpirations also do not generally indicate significant correlation with extent of

<sup>1</sup> P.S. George and Krishna Kumar, "Growth and Instability in Gujarat Agriculture" (Working Paper 412, Indian Institute of Management Ahmedabad 1982).

spread of HYVs.

### 3.12 Multiple Regression Analysis

3.12.1 The analysis is further extended by formulating multiple regression equations incorporating the same factors as for correlation study. The equation models are as follows:

$$\begin{aligned} X_{HYV} &= a + b_1 Y_{Ir} + b_2 Y_p + b_3 Y_{pe} + u \\ &= a + b_1 Y_{Ir} + b_2 Y_p + u \\ &= a + b_1 Y_{Ir} + b_2 Y_{pe} + u \end{aligned}$$

Where:

- $X_{HYV}$  = Percentage of area under HYV of crop(s) in various states
- $Y_{Ir}$  = Percentage of irrigated area of the crop(s) in the same states
- $Y_p$  = Annual average precipitation (mm) in the same states
- $Y_{pe}$  = Potential evapo-transpiration (mm) in Kharif for crops other than wheat, and annual for all crops
- $a$  = Constant
- $b_1$  to  $b_3$  = Regression coefficients
- $u$  = Residual term

3. 3.12.2 The relevant statistics are given in Appendix III. From amongst the crops studied, rice has reasonably high  $R^2$  values (0.61), but low  $t$  statistics for independent variables of precipitation and potential evapo-transpiration, but significant for percentage of irrigated area. Jowar also has relatively high  $R^2$  value but not very significant  $t$  statistics.

In none of the other cereal crops  $R^2$  values are of sufficient magnitude to ascribe any relationship between the variables analysed. As in case of zero order coefficient of correlation, due to the influences of rice on all crops,  $R^2$  values for all these cereals together are relatively high. The  $t$  statistics are significant for irrigation alone.

3.12.3 The above analysis has been done with a limited data base. It would have been better if a time series data were also available. Nevertheless for our purpose, it seems clear that irrigation endowment of a region, is not closely associated with spread of HYV for most of the crops. This conclusion is further supported by the actual extent of spread of HYV bajra to a far greater extent than its irrigated area would warrant. A similar situation prevails in most of the states for almost all the cereal crops. For knowing the causes of variations in spread of HYV in various states, we must, therefore, look to other factors possibly the organizational systems supporting development.

Table 3.1

State-wise Percentage of Area Covered by HYVs  
(Average coverage of 1975-76, 1976-77<sup>1</sup> over crop area of  
1976-77 for wheat, rice and jowar<sup>2</sup> and over 1973-74 for  
maize and bajra)

State	Wheat	Rice	Jowar	Maize	Bajra
Andhra Pradesh	99.9	63.1	7.4	30.2	33.6
Assam	96.3	16.6	-	-	-
Bihar	60.0	16.6	-	34.5	0.1
Gujarat	65.9	37.6	5.6	18.7	62.2
Haryana	84.9	54.5	0.1	17.2	26.2
Himachal Pradesh	81.6	75.1	-	27.0	-
Karnataka	28.7	50.7	26.1	99.9	36.8
Kerala	-	30.4	-	-	-
Madhya Pradesh	28.7	25.3	15.6	6.8	12.5
Maharashtra	87.7	46.5	17.7	77.2	13.5
Orissa	-	11.9	9.0	40.4	-
Punjab	88.6	81.4	0.1	21.7	35.0
Rajasthan	48.3	26.4	0.7	0.3	5.0
Tamil Nadu	-	88.2	9.5	-	26.3
Uttar Pradesh	71.2	35.2	0.1	1.6	4.8
West Bengal	99.9	22.5	-	0.1	-
<u>India</u>					
Percentage of area under HYV	68.5	32.7	13.5	18.2	18.9
Percentage of irrigated area (1975-76) <sup>4</sup>	61.2	38.2	5.0	16.1	5.5
Area under crop 1976-77 <sup>2</sup> (Lakh ha.)	212.0	325.1	157.7	60.2 (1973-74) <sup>3</sup>	136.5 (1973-74) <sup>3</sup>

- Sources: 1. Table Fertilizer Statistics 1977-78  
2. Table 5, Indian Agriculture in Brief (17th ed.), New Delhi, Ministry of Agriculture.  
3. Agricultural Statistics Madhya Pradesh, 1974, p.187  
4. Ibid, Table 2.13.

Table 3.2

Zero Order Correlation Matrix for Percentage of Area under HYV in States (Average) (1975-76, 1976-77) and other Selected Variables

		x	Ir	P	Po	
					June-October	November-May
		Percentage of area under HYV	Percentage of Irrigated area of the crop	Annual Precipitation in mm	Potential Evapo-transpiration (mm)	
<u>Paddy</u>	x	1.000	0.774	-0.123	0.328	
	Ir		1.000	-0.299	0.556	
	P			1.000	-0.786	
	Po				1.000	
<u>Jowar</u>	x	1.000	-0.361	0.599	-0.805	
	Ir		1.000	-0.365	0.315	
	P			1.000	-0.761	
	Po				1.000	
<u>Bajra</u>	x	1.000	0.269	-0.296	0.122	
	Ir		1.000	-0.415	0.371	
	P			1.000	-0.803	
	Po				1.000	
<u>Maize</u>	x	1.000	0.442	-0.001	-0.350	
	Ir		1.000	-0.362	0.282	
	P			1.000	-0.775	
	Po				1.000	
<u>Wheat</u>	x	1.000	0.164	0.259	-0.290	
	Ir		1.000	-0.628	0.825	
	P			1.000	-0.811	
	Po				1.000	
<u>Above Cereals</u>	x	1.000	0.739	-0.088	0.230 (annual)	
	Ir		1.000	-0.234	0.214	
	P			1.000	-0.696	
	Po				1.000	

Appendix III

Multiple Regression Equations with Percentage of Area under HYV in Various States as Dependent Variable

$$x_{HYV} = a + b_1 y_{Ir} + b_2 y_p + b_3 y_{po} + u$$

where:

$x_{HYV}$  = Percentage of area under high-yielding variety in states

$y_{Ir}$  = Percentage of irrigated area (of the crop)

$y_p$  = Annual precipitation (mm)

$y_{po}$  = Potential evapo-transpiration (mm)

$a$  = Constant

$b_1$  to  $b_3$  = Regression coefficients

$u$  = Residuals

Paddy

$$\begin{aligned} 1) x_{HYV} &= 29.25 + 0.63y_{Ir} + 0.001y_p - 0.03y_{po} \\ (t) &= (3.63)^x (0.14) (0.30) \\ \underline{R^2} &= 0.61; \bar{R}^2 = 0.51 \end{aligned}$$

$$\begin{aligned} 2) x_{HYV} &= 11.42 + 0.60y_{Ir} + 0.003y_p \\ (t) &= (4.30)^x (0.63) \\ \underline{R^2} &= 0.61; \bar{R}^2 = 0.55 \end{aligned}$$

$$\begin{aligned} 3) x_{HYV} &= 36.68 + 0.64y_{Ir} - 0.03y_{po} \\ (t) &= (3.97)^x (0.69) \\ \underline{R^2} &= 0.61; \bar{R}^2 = 0.55 \end{aligned}$$

Jowar

$$\begin{aligned} 4) x_{HYV} &= 75.02 - 0.05y_{Ir} - 0.003y_p - 0.09y_{po} \\ (t) &= (0.51) (0.19) (2.23)^{xx} \\ \underline{R^2} &= 0.66; \bar{R}^2 = 0.49 \end{aligned}$$



## Appendix III Contd....

Jowar

$$5) x_{HYV} = -9.82 - 0.06y_{Ir} + 0.02y_p$$

$$(t) \quad \quad \quad (0.52) \quad (1.69)$$

$$\underline{R^2} = 0.38; \bar{R}^2 = 0.21$$

$$6) x_{HYV} = 68.50 - 0.05y_{Ir} - 0.08y_{po}$$

$$(t) \quad \quad \quad (0.51) \quad (3.31)^x$$

$$\underline{R^2} = 0.66; \bar{R}^2 = 0.56$$

Bajra

$$7) x_{HYV} = 107.48 + 0.19y_{Ir} - 0.04y_p - 0.07y_{po}$$

$$(t) \quad \quad \quad (0.50) \quad (0.83) \quad (0.59)$$

$$\underline{R^2} = 0.16; \bar{R}^2 = -0.21$$

$$8) x_{HYV} = 36.79 + 0.18y_{Ir} - 0.02y_p$$

$$(t) \quad \quad \quad (0.45) \quad (0.61)$$

$$\underline{R^2} = 0.11; \bar{R}^2 = 0.11$$

$$9) x_{HYV} = 16.85 + 0.26y_{Ir} - 0.01y_{po}$$

$$(t) \quad \quad \quad (0.71) \quad (0.07)$$

$$\underline{R^2} = 0.07; \bar{R}^2 = -0.16$$

Maize

$$10) x_{HYV} = 226.26 + 0.69y_{Ir} - 0.02y_p - 0.28y_{po}$$

$$(t) \quad \quad \quad (1.97) \quad (1.27) \quad (2.31)$$

$$\underline{R^2} = 0.53; \bar{R}^2 = 0.36$$

$$11) x_{HYV} = 5.90 + 0.69y_{Ir} + 0.01y_p$$

$$(t) \quad \quad \quad (1.61) \quad (0.58)$$

$$\underline{R^2} = 0.22; \bar{R}^2 = 0.05$$

## Appendix III Contd....

Maize

$$12) \begin{array}{l} x_{HYV} \\ (t) \end{array} = 122.04 + 0.79y_{Ir} - 0.16y_{po}$$

$$(2.26)^{xx} \quad (1.98)^{xx}$$

$$\underline{R^2} = 0.44; \bar{R}^2 = 0.32$$

Wheat

$$13) \begin{array}{l} x_{HYV} \\ (t) \end{array} = 89.01 + 0.62y_{Ir} + 0.13y_p - 0.09y_{po}$$

$$(1.43) \quad (0.85) \quad (0.54)$$

$$\underline{R^2} = 0.27; \bar{R}^2 = 0.02$$

$$14) \begin{array}{l} x_{HYV} \\ (t) \end{array} = 30.30 + 0.45y_{Ir} + 0.02y_p$$

$$(1.53) \quad (1.69)$$

$$\underline{R^2} = 0.24; \bar{R}^2 = 0.09$$

$$15) \begin{array}{l} x_{HYV} \\ (t) \end{array} = 165.41 + 0.66y_{Ir} - 0.18y_{po}$$

$$(1.58) \quad (1.51)$$

$$\underline{R^2} = 0.21; \bar{R}^2 = 0.05$$

Above Cereals

$$16) \begin{array}{l} x_{HYV} \\ (t) \end{array} = 70.24 + 0.60y_{Ir} - 0.004y_p - 0.03y_{po}$$

$$(4.20)^x \quad (0.75) \quad (1.63)$$

$$\underline{R^2} = 0.64; \bar{R}^2 = 0.54$$

$$17) \begin{array}{l} x_{HYV} \\ (t) \end{array} = 18.26 + 0.58y_{Ir} + 0.002y_p$$

$$(3.83)^x \quad (0.45)$$

$$\underline{R^2} = 0.55; \bar{R}^2 = 0.48$$

$$18) \begin{array}{l} x_{HYV} \\ (t) \end{array} = 50.43 + 0.61y_{Ir} - 0.02y_{po}$$

$$(4.40)^x \quad (1.56)$$

$$\underline{R^2} = 0.62; \bar{R}^2 = 0.56$$

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x Significant at 1 per cent

xx Significant at 5 per cent

## CHAPTER IV

### REVIEW OF LITERATURE

4.1 In an all India perspective, bajra crop is not of great significance. It is considered as one of the inferior cereals. It constitutes only nine per cent out of the total area under foodgrains (average 1974-75 and 1976-77) and the yield is as low as 443 kg/ha. Its share in production of foodgrain is therefore low (4.8 per cent). Yields of all other cereals except small millets are more than bajra. The crop has however high regional importance in Western India.

4.2 The principal states growing bajra are Rajasthan, Gujarat, and Maharashtra (Table 4.1). Rajasthan constitutes 43.0 per cent of the total bajra growing area in the country and has 22.4 per cent of the gross sown area (GSA) (Table 4.2). Bajra constitutes about 14.5 per cent of the total foodgrain production of the state. It is the most important kharif cereal, and in western arid Rajasthan it is the staple food of the rural people. Gujarat constitutes 14 per cent of the country's area growing the crop. In this state about 15.5 per cent of GSA is under bajra cultivation. The share of this crop in total foodgrain production in the state is as high as 28.7 per cent.

#### Review of Literature on Bajra

4.3 The problems and prospects of bajra production in the country has been studied earlier.<sup>1</sup> The core districts i.e. those with

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<sup>1</sup> S.L. Bapna, 1976, "Slow Increase in Production of Coarse Cereals The case of Bajra", Bajra Production: Problems and Prospects. Indian Council of Social Science Research, (Bombay Allied Publishers).

proportionately larger area under bajra, face the problem of instability in production. Nearly a third of these 45 districts have coefficient of 50 per cent and more variation (1960-61 to 1972-73). Ten of the core districts have been negative growth two districts have less than five per cent growth in production and in 24 districts' production has increased at a rate of more than five per cent per annum. All the core districts (12) of Gujarat have over five per cent growth rate but in Rajasthan, only in five of the 16 core districts, production increased at the rate of over five per cent per annum. Six of the core districts' production has increased <sup>at the rate of</sup> over five per cent. Six of the core districts of Rajasthan have negative growth rate. The districts which have low or negative growth rates have very high percentage of cropped area under bajra.

4.4 Rajasthan and Gujarat show contrasting development. While in the former, yield per ha has declined @ -1.24 per cent, in Gujarat it has increased @ 12.16 per cent. In Rajasthan area under bajra has increased @ 1.16 per cent, but it does not show a similar increase in production, which in fact has declined @ -0.54 per cent. In Gujarat, however, as a result of area increase (3.16 per cent) the production has increased at a phenomenal rate of 17.09 per cent.<sup>2</sup>

4.5 In spite of the fact that in three districts of Gujarat, the infrastructural facilities like roads etc., used in indexing

<sup>2</sup> Growth rates for the country for the same time span, are area 0.86 per cent, productivity 3.99 per cent and production 4.83 per cent, in Guhvant Patel Gujarat's Agriculture, Appendix I (Ahmedabad: Overseas Book Traders) 1977.

developments (Reserve Bank of India Development Index)<sup>3</sup> has been poor, the production rate of bajra has been high. In Rajasthan, on the other hand districts with low developmental index has also been those with negative growth of bajra production. Further, even out of five districts with low growth rate of bajra production, two have been agriculturally developed districts as per RBI index. Bapna has concluded that in Gujarat, the terms of trade as judged from changes in price of bajra in relation to competing crops, are highly favourable for bajra farmers, but this is not so in Rajasthan and therefore factors "other than terms of trade might have played an important role in shaping the production trends observed in different areas."<sup>4</sup>

4.6 The relative spread of hybrid variety in Gujarat and Rajasthan is widely different, even though in both states micro level studies indicate good performance of the variety. According to the same author, "the causes of overall poor performance need to be explored."<sup>5</sup> He has opined, "hybrid varieties evolved and adopted so far were dependent on irrigations or moisture availability except in Gujarat."<sup>6</sup> Also there are enough indications that there is "a close positive association between the size of the farm and the proportion of farmers adopting and the proportion of area covered by hybrid bajra."<sup>7</sup> Inadequate availability of credit, seed, and knowledge of HYV are the other possible constraints in the adoption of HYV.

<sup>3</sup> "Inter District Comparison of Agricultural Development and Spread of Banking Facilities in Rural Areas", RBI Monthly Bulletin, (October 1969)

<sup>4</sup> Bapna, Op. cit, pg. 21

<sup>5</sup> Ibid, 1976 pg. 25

<sup>6</sup> Ibid, 1976 pg. 27

<sup>7</sup> Ibid, 1976 pg. 28

4.7 In Nagaur district in the arid zone of Rajasthan, it is reported that awareness for HYV bajra varies from 92 to 100 per cent in the various land farm units, but only seven to seventy six per cent have tried the variety and only eight to twenty eight per cent have accepted it. In two groups, there is no adoption at all. These are regions with hilly regions and buried pediments, and saline flat aggraded older alluvial plain. Adoption has been reported in graded river bed and younger plains, sand dune and inter-dunal plain, as also saline depressions<sup>8</sup>. The average yield of hybrid bajra under dry land single cropping system, has been as high as 23.9 q/ha (1975-78)<sup>9</sup>.

4.8 An outbreak of disease of the crop, around time when the programme of HYV was picking up, has been cited as a reason for slow spread of bajra hybrids. An absence of strong seed production programme and infrastructure for distribution and weak extension programme may have contributed to the slow spread of hybrids in Rajasthan.<sup>10</sup> "The improvement of the varietal efficiency particularly under adverse moisture" is yet another aspect heading attention.<sup>11</sup> Organization of parents seed production programme, and coordination between extension

<sup>8</sup> ICAR, Annual Report 1978, Table 57, Central Arid Zone Research Institute, 1978, Jodhpur:

<sup>9</sup> Ibid p.177

<sup>10</sup> B.R. Murthy, Technological Aspects of Increasing Bajra Production in Bajra Production: Problems and Prospects, (Indian Council of Social Science Research Studies in Agriculture, Bombay: Allied Publishers, 1976).

<sup>11</sup> Bapna, Op cit p.56

and research wings are the other organizational aspects which need attention. Investment in bajra research by the states, in addition to the effort of ICAR, is also required and a system of extensive testing in different parts need to be introduced for developing suitable varieties.<sup>12</sup>

4.9 The effect of change in 12 independent factors on the acreage of bajra crop as a dependable variable has been studied for Rajasthan for the post hybrid period (1965-66 to 1977-78).<sup>13</sup> Though six different prediction model equations were tried for bajra, "none of the regression coefficients was statistically different from zero".<sup>14</sup> The best  $R^2$  value obtained was only 0.44 and coefficients of none of independent variables were significant. The authors havenot indicated reasons for such totally neutral phenomenon for bajra. (Amongst the five major cereal crops studied, input prices have not adversely affected the area except under jowar). Secondly, technology (irrigation, HYV, fertilizers and tractors) had significant effect on acreage expansion under paddy and wheat and thirdly support price policy had adverse effect on wheat and paddy area but had positive effect on jowar area.<sup>15</sup> It is possible that such behaviour is a reflection of lack of alternative crops available as substitutes for bajra and the absolute and unavoidable necessity to grow this crop in arid regions.

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<sup>12</sup> Bapna, Op cit p.60

<sup>13</sup> S.S. Acharya, and N.L. Agarwal, Agricultural Prices Analysis and Prices Policy in Rajasthan, University of Udaipur, Jobner Campus, 1979, p.76.

<sup>14</sup> Ibid, p.63

<sup>15</sup> Ibid, p.66

4.10 In the districts of Rajasthan (1974-75) aggregate crop output has been significantly correlated with productivity of land, total irrigated area, number of agricultural workers and tractors, and quantity of fertilizers. The  $r$  values have been respectively 0.78, 0.77, 0.54, 0.58, 0.43. The aggregate production function for the same year has been:

$$Q = 1.48 x_1^{.08} x_2^{.79} x_3^{.57}$$

Q = Output (thousand rupees)

where

$x_1$  = irrigated area (thousand ha)

$x_2$  = agricultural workers (thousand)

$x_3$  = fertilizer use (tonnes)



Table 4.1  
State-wise Area under Bajra and Maize, and Percentage Shares  
of States (Average 1972-73, 1973-74)<sup>1</sup>

State	(Thousand Ha)			
	Bajra		Maize <sup>2</sup>	
	Area	Percentage share	Area	Percentage share
Andhra Pradesh	533.6	4.2	280.0	4.8
Assam	-	-	12.0	0.3
Bihar	16.2	0.1	915.4	15.5
Gujarat	1771.0	13.9	254.7	4.4
Haryana	927.5	7.3	115.0	1.4
Himachal Pradesh	-	-	250.0	4.3
Jammu Kashmir	16.3	0.1	271.7	4.8
Karnataka	357.5	2.8	135.3	2.4
Kerala	-	-	-	-
Madhya Pradesh	260.3	2.1	622.9	10.6
Maharashtra	1756.1	13.8	33.6	0.6
Orissa	4.1	0.03	77.9	1.3
Punjab	131.1	1.0	555.4	9.4
Rajasthan	5473.9	43.0	819.5	13.9
Tamil Nadu	428.5	3.4	15.3	0.3
Uttar Pradesh	1074.4	8.4	1483.4	25.1
West Bengal	-	-	46.9	0.9
India	12728.6	100.0	5929.2	100.0

Source: 1 Agricultural Statistics Madhya Pradesh 1974, Page 187.

2 Information for maize is included as the completed monograph will include a study of case on hybrid maize.

Table 4.2

## Comparative Status of Bajra Crop in Rajasthan and Gujarat

Year	Bajra			Foodgrain production	Gross sown area
	Area	Production	Yield Kg/ha		
<u>Rajasthan</u> <sup>1</sup>					
1975-76	37.2	11.3	304	77.4	171.6
1976-77	36.1	13.2	366	74.9	169.0
1977-78	40.7	8.0	197	71.6	169.2
Average	38.0	10.8	289	74.6	169.9
<u>Gujarat</u> <sup>2</sup>					
1975-76	19.1	13.9	728	45.2	105.0
1976-77	15.6	12.6	808	40.3	103.5
1977-78	13.7	9.1	664	38.7	103.9
Average	16.1	11.9	733	41.4	104.1

Sources: 1. Pages 3 and 5, Agriculture Statistics and Plan Progress (1968-69 to 1979-80) Part 1, Jaipur, Directorate of Agriculture, Planning Coll).

2. Department of Agriculture, Ahmedabad.

## CHAPTER V

### COMPARISON OF RAJASTHAN AND GUJARAT

5.1 Geographically, Rajasthan is a much larger state than Gujarat. The former has an area of 3,42,214 sq.km. while Gujarat's area is only 1,95,984 sq.km. This state has also a much larger gross sown area (GSA) of 17 m ha as compared to only 10 m ha of Gujarat. The population density in Rajasthan is less (75/sq km) when compared to Gujarat (136/sq km). However, the proportion of rural population is higher (82 per cent) in Rajasthan than in Gujarat (72 per cent). The number of villages in Rajasthan is also more than in Gujarat.<sup>1</sup> Relatively, Gujarat is a more industrialized state than Rajasthan. It also has greater extent of literacy (Table 5.1).

5.2 Both these states are mainly in the arid and semi-arid zones. A few of the districts of both are stated to be in sub-humid zone. Based on natural factors, Gujarat state is divisible in these three zones.<sup>2</sup> The distribution of talukas and districts in these zones is given in Appendix VA. Ordinarily no significant area of Gujarat is recognized to be in humid zone. However, in Rajasthan, four districts (Appendix V ) are included in humid zone. Major parts of both the states are in arid and semi-arid zones.

5.3 In defining the zones of Rajasthan and Gujarat, we have followed the commonly recognized basis of climate. However, it is observed that

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<sup>1</sup> Indian Agriculture in Brief, (17th ed.), (New Delhi: Ministry of Agriculture).

<sup>2</sup> Gunvant Patel, Gujarat's Agriculture, (Ahmedabad: Overseas Book Traders, 1977), p.363.

for the bajra research coordinated programme of ICAR, different basis has been used in the past.<sup>3</sup> It recognized three major regions of the country specifically for bajra "based generally on growing conditions, seasons and latitudes"<sup>4</sup>. Mainly however, they have a latitudinal bases of demarcation. The Northern Zone extends north of 24th north parallel, the central one between 24th and 14th parallel (in some parts only upto 17th parallel) and the Southern one, south of 14-17th parallel). It also further recognizes three ecological sub-regions for bajra. These were:

- i) Desert or semi-arid zone with less than 30 cms. of annual rainfall
- ii) Limited rainfall -- 30 to 50 cms of annual rainfall
- iii) Adequate rainfall-- above 50 cms of annual rainfall

5.4 Rajasthan has been considered to be in the northern region and Gujarat is in the central zone. However, even the basis of latitudinal zoning puts northern parts of Gujarat in the Northern zone. These would include most of the area consisting of Banaskantha District but none of Mehsana and little of Kutch Districts. In contrast to this, it needs to be pointed out that standard economic, climate and vegetation maps of the regions of Gujarat and Rajasthan indicate that the northern border of Saurashtra and western parts of Banaskantha and Mehsana

<sup>3</sup> Progress Report of the Coordinated Millet Improvement Programme 1964-65, Fig. 3, (New Delhi: Indian Council of Agricultural Research).

<sup>4</sup> Ibid, Fig. 8.

and the whole of Kutch are in the "millet zone". This corresponds to what has been known as "arid climatic zone" which includes the said areas of Gujarat and parts of Rajasthan. The climatic classification of these regions and comparison, by and large described by us, have followed this more widely accepted basis of climatic zones.

5.5 The Ministry of Agriculture, Government of India, however has divided Rajasthan into nine zones based on agro-climate and cropping pattern for their comprehensive scheme on cost of cultivation of important crops. These are: Zone I, Ganganagar District; Zone II, Barmar, Bikaner and Jaisalmer; Zone III, Churu, Jhunjhunu, Jodhpur, Nagaur, and Sikar; Zone IV Jalore, and Sirchi; Zone V, Ajmer, and Pali; Zone VI, Bhilwara, Chittorgarh, and Udaipur; Zone VII, Banswara, and Dungarpur; Zone VIII Alwar, Bharatpur, Jaipur and Sawai Madhopur; and Zone IX, Bundi, Jhalwar, Kota, and Tonk.<sup>5</sup>

#### 5.6 Comparison of Rajasthan and Gujarat

A comparison of the factors closely related to agricultural development in Rajasthan and Gujarat has been attempted. Land and animal resources are compared in Table 5.1. The data of two important climatic factors, potential evapo-transpiration and rainfall, are given in Table 5.2. Comparative land use pattern in the different climatic zones of the two states are in Table 5.3, and a similar comparison of crop pattern is presented in Table 5.4. The performance of bajra crop in the comparable climatic zones of Rajasthan and Gujarat is stated in Table 5.5.

<sup>5</sup> S.S. Acharya, and N.L. Agarwal (1979) Dynamics of Rajasthan Agriculture (Regional Analysis), University of Udaipur, p.2

Table 5.1

## Comparison of Land and other Resources of Gujarat and Rajasthan

Region/State	Average size of land holding ha (1976-77)	Percentage of rural literacy 1981 census	Livestock Number (1978)	
			Per ha of geographical area	Per ha of GSA <sup>2</sup>
Arid Gujarat	6.4	32.6	0.04	1.36
Arid Rajasthan	8.9	15.7	0.91	1.92
Semi-Arid Gujarat	5.2	38.0	1.04	1.57
Semi-Arid Rajasthan	2.5	19.3	1.76	2.83
Sub-humid Gujarat	2.6	39.7	1.00	2.50
Sub-humid Rajasthan	2.4	15.3	1.66	4.74
Humid Rajasthan	2.7	22.0	1.39	2.53
Gujarat State	3.71	36.31	0.8	1.4
Rajasthan State	4.65	17.73	1.2	2.4

<sup>1</sup> Total reported area according to village papers

<sup>2</sup> Five years' average 1973-74 to 1977-78.

Table 5.2

Comparison of Climatic Factors of Climatic Zones  
of Gujarat and Rajasthan

	Potential Evapo-transpiration (mm)			Normal rainfall (mm)	Number of rainy days
	June- October	November- May	Annual		
Arid Gujarat	811.5	972.4	1783.9	631 <sup>2</sup>	30 <sup>2</sup>
Arid Rajasthan	945.4	875.0	1820.4	347 <sup>3</sup>	-
Semi-Arid Gujarat	735.7	1035.8	1771.5	726	34
Semi-Arid Rajasthan	791.7	864.1	1655.8	623	-
Sub-humid Gujarat	665.5	1001.6	1667.1	1251	51
Sub-humid Rajasthan	125.6	1255.6	1381.2	720	-
Humid Rajasthan	145.3	1395.0	1540.3	894	-

Source: 1. K.N. Rao, C.D. George, K.S. Ramasastri, "19 Potential Evapo-transpiration (PE) over India", Table 1. India Meteorological Department Scientific Report 136.

2. Department of Agriculture, Ahmedabad

3. Based on: Basic Statistics, (Jaipur: Directorate Economic and Statistics), p.53.

Table 5.3

Comparison of Land Use Pattern in Arid and Semi-Arid Regions of Gujarat and Rajasthan (Five Year Average 1973-74 - 77-78)

	Percentage of total reported area according to village papers				Percentage of GSA irrigated
	NSA	Gross land	Waste land	Forest	
Arid Zone Gujarat	64.9	5.5	2.8	3.8	11.8
Arid Zone Rajasthan	45.1	3.9	23.6	1.0	10.3
Semi-Arid Zone Gujarat	65.1	5.4	2.7	8.5	18.4
Semi-Arid Zone Rajasthan	51.4	7.3	8.4	6.1	23.0
Sub-humid Zone Gujarat	52.2	2.4	3.8	19.6	15.4
Sub-humid Zone Rajasthan	26.5	7.7	13.3	15.9	28.2
Humid Rajasthan	46.3	7.4	9.0	20.2	15.5
Gujarat State	49.6	4.5	10.7	9.8	16.9
Rajasthan State	44.0	5.3	18.2	5.2	7.6



Table 5.4

Comparison of Crop Pattern of Climatic Zones of Gujarat and Rajasthan  
(Five Years' Average, 73-74 to 77-78)

(Percentages)

	Per cent of GSA under Crop (Percentage of crop area irrigated in bracket)							Area double cropped
	Foodgrains	Bajra	Jowar	Pulses	G. Nut	Cotton	All crops	
Arid Gujarat	42.1 (6.9)	23.2 (2.6)	11.4 (4.9)	5.0 (1.6)	1.5 (8.7)	14.6 (7.5)	100 (11.8)	7.7
Arid Rajasthan	66.5 (10.9)	35.8 (0.8)	1.0 (1.6)	25.9 (6.9)	0.1 (3.7)	1.9 (99.8)	100 (10.3)	5.7
Semi-Arid Gujarat	42.6 (17.8)	15.9 (7.4)	7.8 (2.9)	2.6 (2.6)	22.5 (0.6)	16.6 (31.6)	100 (18.0)	9.0
Semi-Arid Rajasthan	78.5 (26.3)	16.7 (2.2)	11.8 (0.1)	22.4 (8.6)	4.0 (1.4)	1.0 (79.5)	100 (20.2)	20.9
Sub-Humid Gujarat	45.4 (12.7)	1.0 (6.5)	15.9 (5.0)	7.6 (2.0)	4.6 (8.6)	22.6 (21.1)	100 (16.4)	5.0
Sub-Humid Rajasthan	77.2 (32.8)	2.0 (1.2)	7.2 (0.3)	15.7 (9.8)	4.0 (3.4)	1.8 (54.9)	100 (28.2)	32.5
Humid Rajasthan	80.2 (16.2)	-	21.0 (0.1)	19.0 (11.5)	1.5 (3.8)	3.4 (0.8)	100 (15.6)	18.8
Gujarat State	44.9 (15.0)	16.0 (6.5)	8.6 (4.0)	4.0 (1.8)	16.9 (2.0)	17.4 (26.4)	100 (16.9)	7.7
Rajasthan State	71.3 (17.5)	25.3 (1.0)	5.8 (0.3)	23.3 (7.7)	1.5 (2.2)	1.8 (77.4)	100 (15.3)	5.4

- 5.7 The zone-wise comparison of land holding size indicates that in arid Rajasthan, holdings are larger than in the similar zone of Gujarat. However, in the case of semi-arid zone the land holdings are larger in Gujarat than in Rajasthan (Table 5.1). One other difference is in respect of density of livestock population. In each of the zones, Rajasthan has larger livestock resource per unit area (Table 5.1). This is related to the larger availability of wasteland and grassland (Table 5.3) and the greater extent of area under foodgrains in Rajasthan, which also provides fodder (Table 5.4).
- 5.8 Bajra is the principal foodgrain crop in both the states, but it has a larger share of GSA in Rajasthan than Gujarat (Table 5.4). This crop is important not only as a foodgrain, but also as a fodder crop, and its larger area in Rajasthan provides yet another explanation for the higher livestock population in Rajasthan.
- 5.9 The cultivation of bajra is mainly in the arid and semi-arid zones with which are associated dry climatic conditions. The sub-humid zone is the outer limit of the naturally adapted area for bajra cultivation. The potential evapo-transpiration (PE) for the kharif and winter seasons, as also its annual value indicate the relative dryness of the three climatic zones of these states (Table 5.2). Small differences exist between PE of Gujarat and Rajasthan. In arid Rajasthan PE is slightly more than in similar zones of Gujarat. However, semi-arid zone of Gujarat is slightly drier than the similar zone of Rajasthan state. Both the states are dependent on south-west monsoon for bajra

cultivation as also for other kharif crop cultivation. The total annual precipitation (Table 5.2) in the respective zones, as well as in the state as a whole, is generally higher in Gujarat than in Rajasthan; this difference is particularly more between the arid zone of the two states.

5.10 Bajra area is predominantly in the arid zone in Rajasthan but due to lower productivity its share in production is much less than the share of area (Table 5.5). Its semi-arid region has the highest productivity in the state, and though its share in area is only 18 per cent, it contributes 32 per cent to the state's bajra production. The sub-humid and humid zones are unimportant for bajra production. More recent data do not indicate substantial qualitative changes in the relative share of the zones in bajra area. In 1980-81, arid zone had a share of 82 per cent of bajra area, but its share in production dropped to 41 per cent due to lower productivity (115 kg/ha). In 1975-76 to 1976-77 it was 68 per cent even though HYV coverage in that year (1980-81) increased to 10.5 per cent from 4.8 per cent. The semi-arid zone however had an improved productivity (767 kg/ha) in 1980-81 as compared to (595 kg/ha) 1976-77. Further, without any change in its share of bajra area in the state its contribution to production jumped to 59 per cent in 1980-81, as compared to only 32 per cent earlier. This is possibly due to a higher yield resulting from a greater coverage by hybrid in 1980-81 than (39 per cent as compared to only 19 per cent) in 1975-77. (The comparison with 1980-81 is only

given to indicate the progress of coverage of hybrid in recent years. Its crop area data are not final).

Table 5.5.

Performance of Bajra in the Climatic Zones of Rajasthan and Gujarat (Average 1975-76, 1976-77)

	A. Rajasthan				State
	Arid	Semi-Arid	Sub-Humid	Humid	
Bajra Area	29.8	6.6	0.3	0.05	36.75
Percentage of share of zones in bajra area	(81.1)	(18.0)	(0.8)	(0.1)	(100)
Production	8.28	3.90	0.07	0.02	12.27
Percentage of share of zones in bajra production	(67.5)	(31.7)	(0.6)	(0.2)	(100)
Yield kg/ha	278	595	272	400	335
Yield index	(83)	(178)	(81)	(119)	(100)
Area under hybrid lakh ha	1.4	1.3	0.10	—	2.8
Percentage area under hybrid in each zone	(4.8)	(19.1)	(38.8)	—	(7.6)

Contd.....

Table 5.5 Contd.....

## B. Gujarat (Kharif and Summer)

	Arid talukas & Kutch District	Semi-arid talukas & other Districts	Sub humid	Humid	Total
Area under Bajra Kharif	5.3	10.1	0.1	-	15.5
Percentage share of zones in kharif	(34.2)	(65.2)	(0.6)	-	(100)
Area in summer	0.07	0.78	0.01	-	0.855
Percentage share of zones in summer	8.0	(91.0)	(1.0)	-	(100)
Total bajra area	5.38	10.85	0.1	-	16.33
Percentage share of zones in bajra area	(32.9)	(66.5)	(0.6)	-	(100)
Total area under hybrid bajra lakh ha	1.95	9.0	0.10	-	11.05
Percentage area under hybrid in each zone	(36.2)	(83.0)	(100)	-	(67.6)
Kharif area under hybrid	1.37	8.12	0.09	-8	9.58
Percentage of kharif area under hybrid in each zone	(25.8)	(80.4)	(90.0)	-	(61.8)

5.11 Rajasthan has reported steady but slow increase in coverage by hybrid bajra in recent years. The percentage of bajra area covered by hybrids are: 1977-78, 10.4 per cent; 1978-79, 11.5; 1979-80, 14.3; and 1980-81, 15.6. Similar rates of increase in coverage existed in arid and semi-arid zones, but in the sub-humid (in which bajra area is relatively less) the coverage has declined. In these later years the productivity has been: 1977-78, 198 kg/ha; 1978-79, 253; 1979-80, 89; and 1980-81, 231. This does not reflect parallelism with increasing percentage coverage by hybrid bajra. The productivity of the arid zone also has not shown improvement. Actually in all the subsequent years, yields have been less than in 1975-76 and 1976-77. In the semi-arid zone, the yields have been in 1975-77, 595 kg/ha; 1977-78, 319; 1978-79, 654; 1979-80, 246; 1980-81, 767. It indicates higher peaks, which provides a signal of the effect of increased coverage by hybrid bajra in this zone. (From 19.1 per cent in 1975-76 to 39.0 per cent in 1980-81). In a state with the most widely fluctuating rainfall, (as affecting yield), possible indicator of impact may be the achieved peaks, rather than the growth rate.

5.12 Unlike in Rajasthan, Gujarat has much less proportion of area under bajra cultivation in the arid zone. Nevertheless, it constitutes a one-third of bajra area in the state (Table 5.5). The coverage by hybrid bajra is 36 per cent (though much less than in its semi-arid zone) which is <sup>much</sup> more than in the comparable area of Rajasthan (4.8 per cent). The spread of hybrid in semi-arid zone of

Gujarat is far more (83 per cent) than in its arid zone - also far more than in the similar zone of Rajasthan. The data of humid zone (though area in this zone is small in both states), of Gujarat also showed a higher coverage than in Rajasthan. The percentage area of bajra crop covered by hybrid is 67.6 per cent in Gujarat as compared to only 7.6 per cent in Rajasthan.

- 5.13 In Gujarat, the crop is grown both in kharif and summer. In Rajasthan it is only grown in kharif. (The winter season in both states is not suited to bajra cultivation). This is so in spite of the higher PE from November to May in Gujarat. In Gujarat bajra is cultivated in summer in the eastern **part** and the coastal belt of the state where the humidity at flowering time is not so low as to dehydrate pollens and prevent seed setting. The other parts of the arid and semi-arid zone particularly in the central parts of Saurashtra peninsula have dry winds at flowering time of summer bajra crop, thus preventing its economic cultivation as a grain crop. Secondly, unavailability of irrigation in summer is a limitation for summer cultivation. Out of the total area of bajra in Gujarat, as much as in one lakh hectare (7.0 per cent) is grown in summer (February to May) and its yield is 1.7 t/ha nearly three times that of kharif crop. Its annual production is about 1.8 lakh tonnes. The performance of the hybrid varieties is also different in both seasons; almost the entire summer bajra crop is covered by hybrid variety, unlike in kharif. The yield of this summer crop has further improved to 2.1 t/ha (average 1977-78 to 1979-80) and the annual production has exceeded 2.5 lakh

tonnes in recent years. The high productivity of the summer crop is also an advantage for the hybrid seed production programme in the state. The share of seed produced in summer season has increased over the years.

- 5.14 In Gujarat, except for the district of Kutch, no district in totality falls in arid zone. For a satisfactory zone-wise comparison of the two states, it would be appropriate to have separate data for all the talukas falling in arid zone of Gujarat (Appendix V/A). Such data could be obtained only for area (Table 5.5). But as yield estimation (and production) are for district as a unit, such statistics for the arid talukas could not be had.
- 5.15 The productivity of bajra crop in Rajasthan is only 335 kg/ha (Average 1975-76, 1976-77) (Table 5.5), which is less than half of Gujarat (756 kg/ha), excluding the summer crop of high productivity (1642 kg/ha). Therefore in spite of the fact that the actual area in Rajasthan (37 lakh ha) is more than double that of Gujarat (16.3 lakh ha), the production in both the states was almost same (12 lakh t). The contrasting data of the spread of HYV and its impact in the two (Table 5.5) is partly reflected in the large differences in the productivity of the crop in the two states.
- 5.16 For a more accurate comparison of the spread of hybrid bajra in the two states, we have attempted to separate area under hybrid bajra in summer in Gujarat. In this season, almost entire area is under hybrid. Coverage by hybrid bajra in kharif season has been 9.6 lakh ha



(ave. 1975-76, 1976-77),

which is 62 per cent of kharif bajra crop, which is also much higher than the coverage in Rajasthan. Even though the hybrid coverage has been relatively less in kharif than in summer (in Gujarat) the yield of kharif crop has been much more than of Rajasthan.

5.17 The comparative climatic conditions prevailing in the two states as also the average yield of bajra crop obtained in each, have been described earlier. An additional comparison is that of the yields obtained on university research farms under All India Coordinated Research (Millet) Project. The average of yields obtained at various location in the two states in a number of experiments are presented in Table 5.6. The productivity levels in these two states on their research farms are also widely different. As compared to an average yield level of 13.5 q/ha for the variety BJ 104 in Rajasthan, in Gujarat the yield of the same variety has been twice as much. The grain fodder ratio has been slightly narrower in Gujarat, but on an average the difference between the two states has not been large.

5.18 The practice of exclusion of local variety in experimental trials does not enable us to determine the comparative superiority of the same variety over local types of the respective states. In minikit trials on farmers' fields in Rajasthan in 1978-79 the hybrid gave 32 to 53 per cent higher yield than the local variety. The average

of 45 per cent higher yield of BJ 104 than local on research farms in Rajasthan is much less than the reported 69 per cent higher yield for local on research farms in Gujarat.

Table 5.6

Comparison of Yields of Bajra Hybrid BJ 104 in Rajasthan and Gujarat

Year	Average yield on research farm Q/ha		By Agricultural Department Minikit Trials on Farmers' Fields	
	Rajasthan <sup>1</sup>	Gujarat	Rajasthan	Gujarat
1979-80	14.52	26.03	1978-79 Q/ha	
	Grain:Fodder	Grain:Fodder	Ajmer	16.08
	1:3.4	1:2.4	Jodhpur	10.61
			Bikaner	9.45
			Kota	12.58
		State	12.96	N.A.
1980-81	11.78	29.64	(Number of	
	(Local 12.0)	(Local N.A.)	demonstrations 559)	
	Grain:Fodder	Grain:Fodder	Ajmer	12.59
	1:2.28	1:2.03	Jodhpur	8.57
	(Local N.A.)	(Local N.A.)	Bikaner	-
			Tonk (Kota)	19.88
		State	11.96	
BJ 104				
Average	{ 1979-80 13.5 Q/ha	27.8 Q/ha (Number of		
	{ 1980-81 G:F	G:F	demonstrations 44)	
	1:2.34	1:2.21	12.50 Q/ha	N.A.

N.A. - Not Available

1. Based on Annual Report 1979-80. (All India Coordinated Millet Improvement Project sponsored by ICAR)
2. Based on Annual Research Report, 1979-80, 1980-81, (Bajra Crop Millet Research Station, Jamnagar)
3. The average yields are for both irrigated and unirrigated plots. However, when averaged separately, average yield of irrigated plots was less than unirrigated ones.

even the outdated variety Mb 3 over local one in Gujarat.

Surprisingly, in 1980-81 in Rajasthan, on experimental station in a few comparative trial, the hybrid gave less yield than local (BJ 104: 11.8 Q/ha. local: 12.0 Q/ha). The latter had a grain:fodder ratio of 1:4.1 and hence its fodder yields were higher than BJ 104, even at the lower level of its grain productivity.

5.19 The rates of growth of area, productivity and production varied for the time periods studied depending on the selection of base year. This is also true for bajra crop in Gujarat. The published data for this state are given in Table 5.7. The hybrid bajra was introduced in mid-sixties. It spread rapidly. By 1975-76, 71 per cent of bajra area was under hybrid. Irrespective of the sources of growth rates, the impact on the productivity has been clearly noticed for the periods in which hybrid bajra spread. But even more important was its influence on area, as the competitiveness of the crop improved by the high yield and higher profitability of HYV, resulting in greater preference for the crop and an increase in bajra area.

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<sup>6</sup> Gurnvant A. Patel, R.L. Shah and B.K. Patel, "Performance of Hybrid Bajra in Gujarat State" Fertilizer News 19(6), 1974, pp.17-20.

<sup>7</sup> An analysis of crop cutting experiments for the years 1969-70 to 1973-74 (including a few years of mildew epidemic) in Gujarat have however revealed that yield of hybrid in unirrigated plots was only 42 per cent more than local. The superiority of hybrid in irrigated plots was much less (8 per cent than local).

Table 5.7

Rate of Growth of Area, Production and Productivity of Bajra  
in Gujarat

Time Span	Area	Production	Productivity	Reference
1952-53 to 1963-64	-4.0	-4.0	6.0	Growth rates in agriculture min. of Agr. GOI, (1964) <sup>1</sup>
1953-54 to 1961-62	-5.8	-2.9	3.1	George PS and Krishna Kumar (1982) <sup>2</sup>
1961-62 to 1970-71	5.0	11.7	6.5	-do-
1960-61 to 1971-72	3.8	17.8	9.8	Gunvant Patel <sup>3</sup> (1977)
1970-71 to 1977-78	-4.8	-5.4	-1.1	George PS and Krishna Kumar (1982)

<sup>1</sup> Mimeograph

<sup>2</sup> P.S. George and Krishna Kumar, "Growth and Instability in Gujarat Agriculture", Working Paper 412, Indian Institute of Management, Ahmedabad 1982).

<sup>3</sup> Gunvant Patel, Gujarat's Agriculture (Ahmedabad: Overseas Book Traders, 1977).

5.20 The yield growth rate of bajra in Gujarat between 1960 and 1972 has been 9.8 per cent, which has been accompanied by rapid increase of coverage by hybrid. However, this growth rate has not been sustained beyond this period. Recent data of Gujarat show relative stagnation in spread of hybrid bajra, as also the yield levels. The year-wise area (in lakhs ha) under hybrid has been: 1977-78, 10.5; 1978-79, 11.6; 1979-80, 10.5; 1980-81, 10.6. The yields (kg/ha) of these years has been 1977-78, 598; 1978-79, 954; 1979-80, 929, 1980-81, 779, 1981-82, 934 - for the kharif crop.

5.21 In Gujarat, agricultural productivity is shown to be highly variable due to an almost total dependence of the cropping system on a highly variable rainfall pattern. The number of rain gauge station with different coefficients of variability (CV) of annual average precipitation in Gujarat state is given below:<sup>8</sup>

Coefficient of variables	21-30	31-40	41-50	51-60	60-70	70-80	81-90	91-100
Number of Stations	2	40	37	12	3	3		2

5.22 Most of the stations in Gujarat with relatively small variability in annual precipitation are in its sub-humid zone, where bajra is not cultivated. This crop is essentially rainfed, grown in arid and semi-arid zones, and has high variability in productivity and consequently in production. It also influence area. The coefficients of variability of bajra crop for Gujarat are given below for the different periods.<sup>9</sup>

Time Span	Area	Production	Productivity
1953-54 to 1960-61	7.0	25.2	22.3
1961-62 to 1970-71	3.4	21.2	18.1
1971-72 to 1977-78	10.4	29.0	26.6

5.23 From the above <sup>statement</sup> it appears that in the period 1961-1970 in Gujarat, the hybrid technology (not only increased productivity but also) helped to reduce variability in productivity (and

<sup>8</sup> Gunvant Patel, Gujarat's Agriculture, (Ahmedabad: Overseas Book Traders, 1977) p.33.

<sup>9</sup> P.S. George, and Krishna Kumar "Growth and Instability in Gujarat Agriculture", (Working Paper 412, Indian Institute of Management, Ahmedabad, 1982).

consequently that of production also). However, this relative stability of the period was not sustained in the next decade. This is possibly attributed to widespread epidemics of diseases of the crop. Out of the two major diseases, technological improvement in the varieties has now provided protection against one (downy mildew). This also seems to be short lived. The control of the other disease (ergot disease) is not yet achieved as was the case for mildew. Gujarat is now in a worse situation regarding variability in productivity than was the case in the period prior to the introduction of hybrids (1953-54 to 1960-61).

5.24 The statistics of variabilities of bajra crops in Rajasthan are not available in detail. However, in 1956-57 to 1974-75 period, average fluctuation per year in the various years has been area 8.8 to 40.7 per cent; production 31.9 to 78.9 per cent; productivity 33.7 to 79.1 per cent.<sup>10</sup> These seem higher than in Gujarat. The highest fluctuations in productivity and production have been in the Bikaner agro-climatic zone of the arid climatic zone. It is however, also true, that the minimum variability in productivity and production for in bajra has been/Jodhpur zone which is also in arid part of Rajasthan.

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<sup>10</sup> S.S. Acharya and N.L. Agarwal, "Dynamics of Rajasthan Agriculture", (University of Udaipur, Jodhpur Campus, 1979).

## Appendix V

## List of Districts in Different Climatic Zones of Gujarat and Rajasthan

	Arid Zone	Semi-Arid Zone	Sub-Humid Zone	Humid Zone
<u>Gujarat State</u>				
Identified Talukas of		Talukas of		
1. Banaskantha district	1. Deesa 2. Deodar 3. Dhanera 4. Kakraj 5. Radhapur 6. Santhalpur 7. Thard 8. Wav	following districts, not in arid zone: 1. Banaskantha 2. Jamnagar 3. Mehsana 4. Surendranagar 5. Rajkot Other districts 6. Ahmedabad 7. Amreli 8. Bhavnagar 9. Gandhinagar 10. Junagadh 11. Kaira 12. Panchmahals 13. Sabarkantha 14. Vadodara	1. Bharuch* 2. Dangs 3. Surat 4. Valsad	
2. Mehsana	1. Sami 2. Harij			
3. Jamnagar	1. Jodia			
4. Surendranagar	1. Dasada 2. Dhragdhara 3. Holvad			
5. Rajkot	1. Malie			
6. Kutch	Whole District			
<u>Rajasthan State</u>				
	1. Barmar 2. Bikaner 3. Churu 4. Jaisalmer 5. Jalore 6. Jhunjhunu 7. Jodhpur 8. Nagaur 9. Pali 10. Sikar 11. Sriganganagar	1. Ajmer 2. Alwar 3. Bharatpur 4. Bhilwara 5. Jaipur 6. Sawai-Madhapur 7. Tonk	1. Bundi 2. Chittorgarh 3. Sirohi 4. Udaipur	1. Banswara 2. Dungargarh 3. Jholawar 4. Kota

\* Ordinarily in semi-arid but as a district with very low bajra area; considered as sub-humid.

## CHAPTER VI

### ORGANIZATIONAL SYSTEMS AND ASSIGNMENT OF FUNCTIONS

6.1.1 The entry of the state in establishing organizations for agricultural development had commenced in the early part of the present century. The objective had been transfer, at times even transplant of technology. The creation of state departments of agriculture was a result of this. It was also accompanied by transfer of inputs associated with the technology. The development of organizations was in the initial period directed more towards the fulfilment of the needs of export oriented crops. Unavoidably these organizations had many different functions. These were agricultural extension, supply of inputs, and when need arose even marketing of output. Agricultural colleges were the centres of developmental activities which administratively linked extension with sources of technology. The four functions of research, education, extension, and supply got disconnected as the demand for specialized organizations grew. While governments' direct role in this regard has been necessarily large, for certain commercial and export oriented crops, different organizational units were developed.

6.1.2 The dependence of planters of export-oriented plantation crops, on government for research, extension and supply has been minimal. These self supporting systems, integrated with marketing organizations which are now exceptions, point to a future possibility wherein agricultural marketing organization could develop systems to operate these functions, which are now-a-days, as also traditionally, confined to non-enterprise organizational



systems. An analysis of these integrated and closed single organization for all functions would be fruitful; however, the scope of our present work is limited to a few field crops grown by millions of farmers in situations where several independent systems operate for development. Therefore, the distinguishing features of organizations for development of these field crops are only in our compass.

6.1.3 In recent times, attempts are being made to develop and supply econometric models to ascertain the benefit derived from public investment in the non-enterprise systems. Research articles have appeared which analyse growth in agriculture and cost of such interventions in research and extension.<sup>1</sup> However, decisions of government in regard to new areas of investment for agricultural development continue to be results of the felt needs of development by the executives who are in close touch with the problems. Pinpointing critical areas which limit growth in agriculture has been an important duty of these personnel. They also take decisions on whether to invest in the existing institutions or create new ones.

6.1.4 Even without the needed support of econometric models for investment decisions, organizations have grown in size, and new units created, with some of the functions originally performed by departments and transferred to them. System specializations have been evolving and

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<sup>1</sup> For example, see R.E. Evanson, and D. Jha, "The Contribution of Agricultural Research Systems to Agricultural Production in India", Indian Journal of Agricultural Economics, XXVIII(4), pp.212 - 230.

will further evolve, as the size of an organization becomes large and unwieldy under the prevailing communication system and operative limits of efficiency. The organizations for agricultural development have multiplied. Many of them as part of government, some are autonomous but financed by government, others are fully self-dependent and autonomous, and still others financed by government in the initial period in the hope of their being self-supporting in later periods, and thus fully autonomous. In countries like India, farming is a 'free enterprise' and based on an accepted capitalist system of land ownership involving decisions of millions of individual farmers. For catering to the developmental needs of farmers scattered over diverse agro-climatic conditions in such an economic system, the nature of organizations and their autonomy are relevant.

6.1.5 Our study has been concentrated only on the organizational systems helping agricultural development. The primary emphasis is on its structural aspect and historical cleavages that have occurred giving births to new organizations in the total organizational system in the two states which can be possibly considered comparable for a single crop development - bajra. Originally, the intention was only to compare the existing organizations, but it was felt that results of bajra development as observed currently have much to do with the time frame in which the systems have developed and new organizations have been added. The difference to be noted are therefore not only in the structure of the organizations as now existent but also when they were

started and their sequence. It would have been of advantage, if the corresponding investments in the time frame could have been brought out. However, within the time available this was not feasible.

6.1.6 The organizations and their goals, relevant to our study are the departments of agriculture of a state, with their close association in many cases with panchayats and/or community development departments, the agricultural universities, and the supply organizations which in most cases are independent of the former two. The institutions at the national level are the Indian Council of Agricultural Research and the Ministry of Agriculture of Government of India. Amongst these are apportioned the basic functions of research, education, extension and supply related to agriculture which varies with states. One can possibly identify the changes in the organizations in relation to the growth of agriculture. The prevailing assumption is that separate organizations are necessary for a) agricultural extension, b) research and education and c) supply of inputs, and d) marketing of outputs. It is however important to understand that such identifiable and separate organizations may be unnecessary and prove uneconomical in early stages of growth in agriculture in a country. What these stages are and, at what point of time and how growth would be inhibited without diversification of organization can be a useful study for developing countries. This would be also of importance in the present period where organizational changes, often transplants have become the order of the day especially when they are associated with

credit from international lending agencies or from other governments.

6.1.7 Even within India, it cannot be said that all states, and all areas within a state are at similar stages of growth and therefore, it is quite likely that uniformity in organizational pattern if introduced without relevance to growth stages can prove counter productive. Certain differences in combinations of functions noticeable between departments of agriculture, department of animal husbandry, fishery, or forestry, even within the same state, also point to the same fact the organizational structures and functions are related to stages of growth of the industry which is intended to be developed by their efforts. In a country with diversity of climate, culture, religion, and socio-economic conditions (particularly literacy and communication) this is likely to be even more so.

6.1.8 Though a countrywide perspective would be desirable, the state departments of agriculture provide the primary focus for the study. This is so, because in recent past these departments carried on numerous functions which later got allocated to other organizations. The functions included, extension, research, education, input supply, enforcements of regulations, output marketing and processing. The introduction of community development and later Panchayat Raj and creation of corresponding departments was a major development. Separation of supply function was yet another. Creation of autonomous bodies for research and education, seed and other input supply system, were the other creations in the historical and total framework of

organizations. Their coordination, linkages and interphases also became important and necessary as a consequence. The history of the development of organizations for agricultural development, in its essence, in the states and the country usually involved the same participating institutions.

6.1.9 These are:

1. Department of Agriculture (and that of animal husbandry) with multifarious functions
2. Panchayat
3. Agricultural university
4. Cooperative credit institutions
5. Commercial banks as credit institution
6. Seed corporation
7. Seed certification agency
8. Output marketing and processing institutions

However, the structure of some of them and the period of induction of these institutions, are different in different states.

## 6.2 Department of Agriculture

6.2.1 "Extension and extension education"<sup>2</sup> relate to the process of conveying the technology of scientific agriculture to the farmer

<sup>2</sup> In the system of agricultural extension, training of extension workers has been of importance, due to a moderate academic base of recruitment for this service. Oftentimes, the work connected with this aspect has been restrictively termed 'extension education', though it is synonymous, with agricultural extension.

in order to enable him to utilize the knowledge for better agriculture and a better economy.<sup>3</sup> Extension programmes however not only aim at transfer of knowledge but also impart skills for its adoption.<sup>4</sup> It "aims at improving the efficiency of the human capital in an effort to rapidly increase the rate of agricultural production."<sup>5</sup> An additional objective is of "changing the attitude and outlook of the farming community."<sup>6</sup>

6.2.2 However, the area of management of agricultural extension has been given different boundaries in respect of its scope. At one extreme, it has included purely a non-formal and non-institutional training of farmers in all aspects of their life (though, mainly for farming vocation). At the other extreme it has encompassed in its scope, not only non-institutional training but supply<sup>7</sup> (and in still extreme cases, though rarely, also welfare aspects of farm families). In India, the scope has not included land reforms, cooperative development, and social welfare. Traditionally, extension work related to development of cattle, and welfare of cattle-owning non-farming communities have been the responsibility of institutions dealing with animal husbandry

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<sup>3</sup> National Commission on Agriculture Report Part XI Research Education and Extension, p.232

<sup>4,5,6</sup> Ibid, p.233

<sup>7</sup> Gunvant Patel, "Extension Services for Farmers," Commerce Annual Number, 1970.

and dairy development; and similarly work related to soil, crop and water for production by the target group of farm families has been the responsibility of agricultural department. Extension work related to grassland development would be that of agricultural department; however their development has suffered due to divided responsibilities between departments. Extension work extends to homes of farming families, and such work particularly related to farm women has been also considered generally as a part of agricultural extension work. Similar type of extension work can also be for fishermen folks as target group.

6.2.3 It has been well recognized, and mostly accepted that "the state departments of agriculture/animal husbandry/fisheries, should be responsible for performing extension work, developmental tasks, regulatory functions, and ensuring supplies and services.<sup>8</sup> The Commission has observed that extension work is carried out by different agencies and programmes at the district level, such as agricultural department, panchayats, farmers' training centres, national demonstration programme and by the agricultural universities in selected areas.<sup>9</sup> Coordination therefore is of importance "so that farmer is able to take full advantage of them and multiplicity of agencies is not created."<sup>10</sup> It also recommended that "extension

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<sup>8</sup> National Commission on Agriculture Report of XI 1976 p.263

<sup>9</sup> Ibid p.262

<sup>10</sup> Ibid p.261

machinery should form an integral part of the agency responsible for agricultural development.<sup>11</sup>

6.2.4 The more specific functions of the agriculture department in respect of agricultural extension have been stated to be 1) establishment of a state information cell acting in cooperation with the agricultural university, 2) processing and converting the research findings into simple sets of practical guidelines and direction for use in different media, and 3) organizing training programmes of farmers and field functionaries. For establishing coordination with agricultural universities, "selected extension officers under this department should act as a link between the university and the department" and thus provide the means of transmission of technical information<sup>12</sup> to the various levels. The agriculture department will share along with the agricultural university the responsibility of conducting field trials and demonstrations. It will "formulate new farm technology through a process of deliberation with university,<sup>13</sup> and will "suggest field problems"<sup>14</sup> and thus provide a feedback mechanism.

6.2.5 In its original form, the departments of agriculture in Rajasthan and Gujarat had same functions. These included administration of agricultural colleges (affiliated to traditional universities),

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<sup>11</sup> Ibid

<sup>12</sup> Ibid p.264

<sup>13</sup> Ibid

<sup>14</sup> Ibid



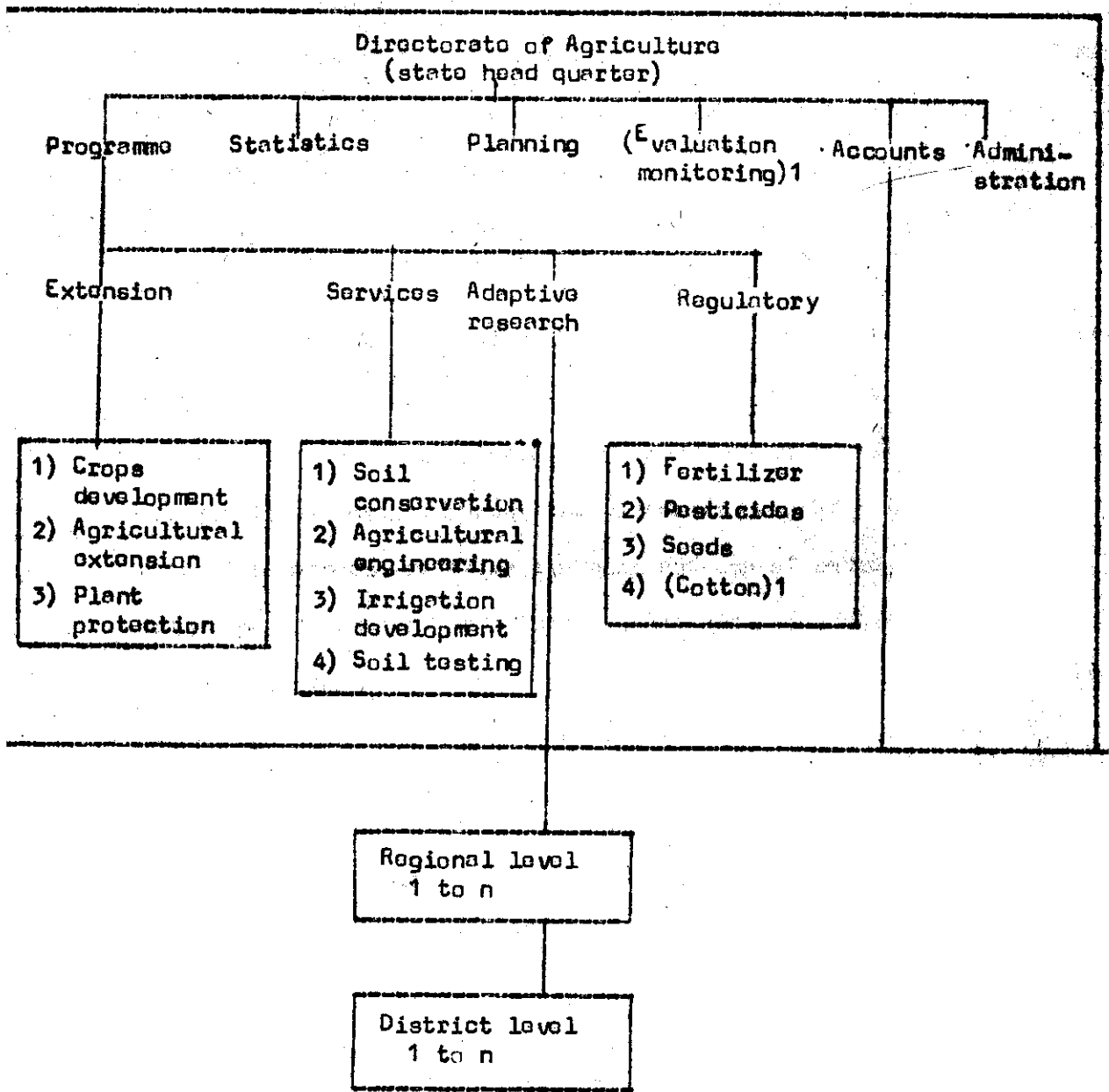
extension, research, regulatory functions and supply of inputs.

The division of responsibilities with other institutions such as agricultural university, seed corporation etc. was gradual and spread over many years.

- 6.2.6 The main functions of the Department of Agriculture are shown in Chart VI/1. The organization in Gujarat and Rajasthan are presented in charts VI/2 and Charts VI/3 A and B. They have certain basic similarities, but there are also differences in certain important aspects.
- 6.2.7 The line functions are organized around programme units at head quarter. They fall in four categories 1) extension, which includes extension programmes for individual selected crops and others like plant protection, 2) service functions of soil conservation, agricultural engineering, irrigation development, and soil testing 3) adaptive research, and 4) regulatory function. For comprehensive development, the agricultural development programmes have to be adequately supported by statistics. This is provided. The evaluation and monitoring (currently for T&V programme) have been distinctly provided for in Gujarat State Department of Agriculture. Accounts and administration, are the two staff functions identified at the headquarter in both the states.

Chart VI/1

Main Functions of a State Department of Agriculture



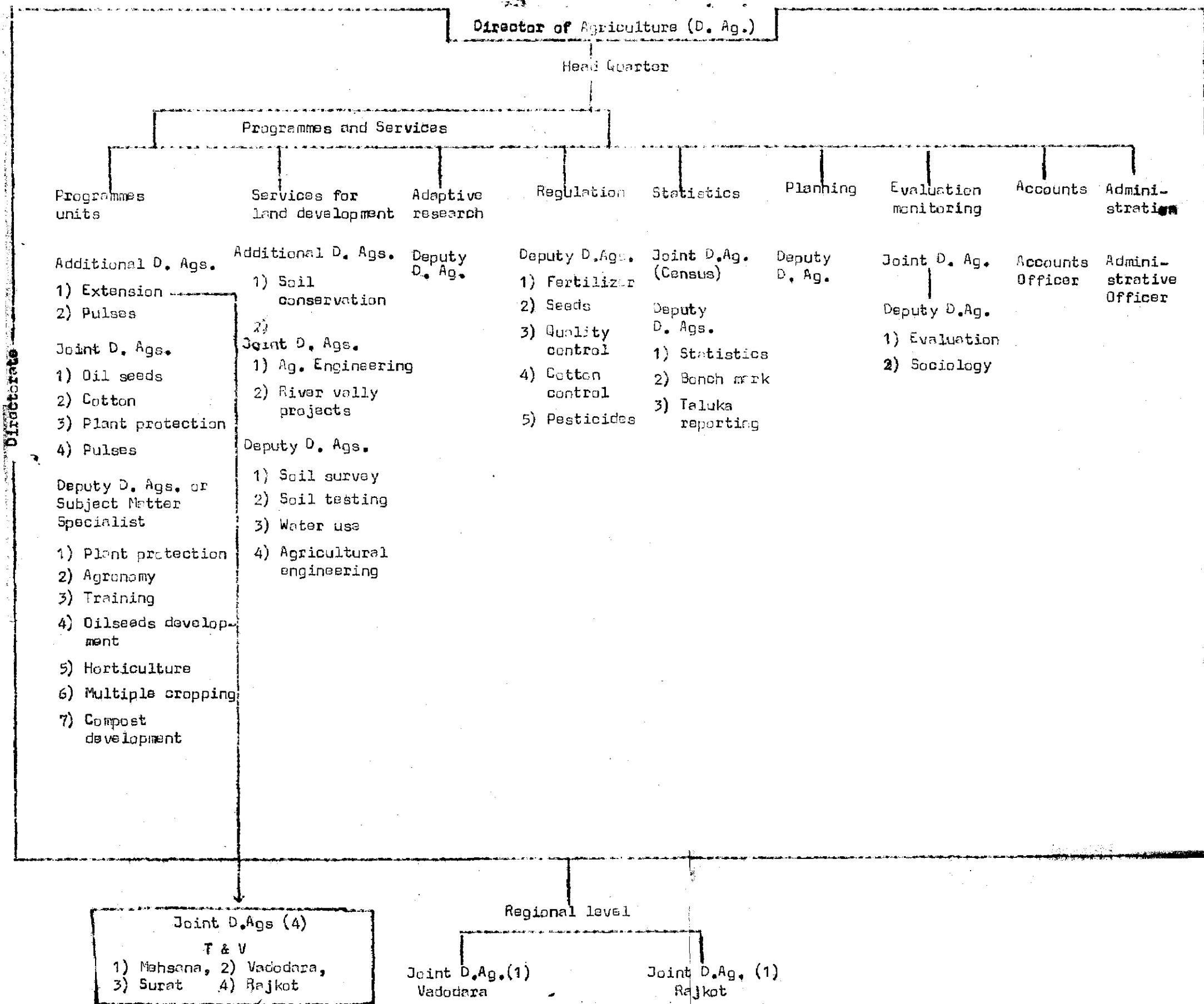
<sup>1</sup>Not identified in Rajasthan Department of Agriculture

6.2.8 The organization of the directorate has certain broad common features. One is the arrangement for the line functions, each one, either headed by a joint director of agriculture or an additional director of agriculture (Charts VI/2 and VI/3). The other is the location of subject matter specialists (at different levels). The former attend to programme planning and implementation, while the subject matter specialists provide a strong base to technical contents of the programmes. Whether the programmes are for crop development, or say plant protection there are certain common needs as all these really pertain to extension. Under the circumstances, adoption of suitable extension methods, relative emphasis and use of media, defining target population and area become important. The development in these directions, is easily possible under the existing organizational framework, provided relative expertise is added.

6.2.9 Though the organizational set up (Charts VI/2 and VI/3) of the departments of agriculture of the two states have many common features there are some important differences as well. In Rajasthan, the separation of staff for extension and regulatory functions are not distinct at various levels in the hierarchy. Consequently staff functions along with other programmes like cotton development are under an additional director of agriculture. Further, quality control is not separated at a high level, and it falls in the same line as other development programmes. However, seed programme has an important place in the state directorate of Rajasthan. The other significant feature in Rajasthan is the support<sup>in</sup>/planning is

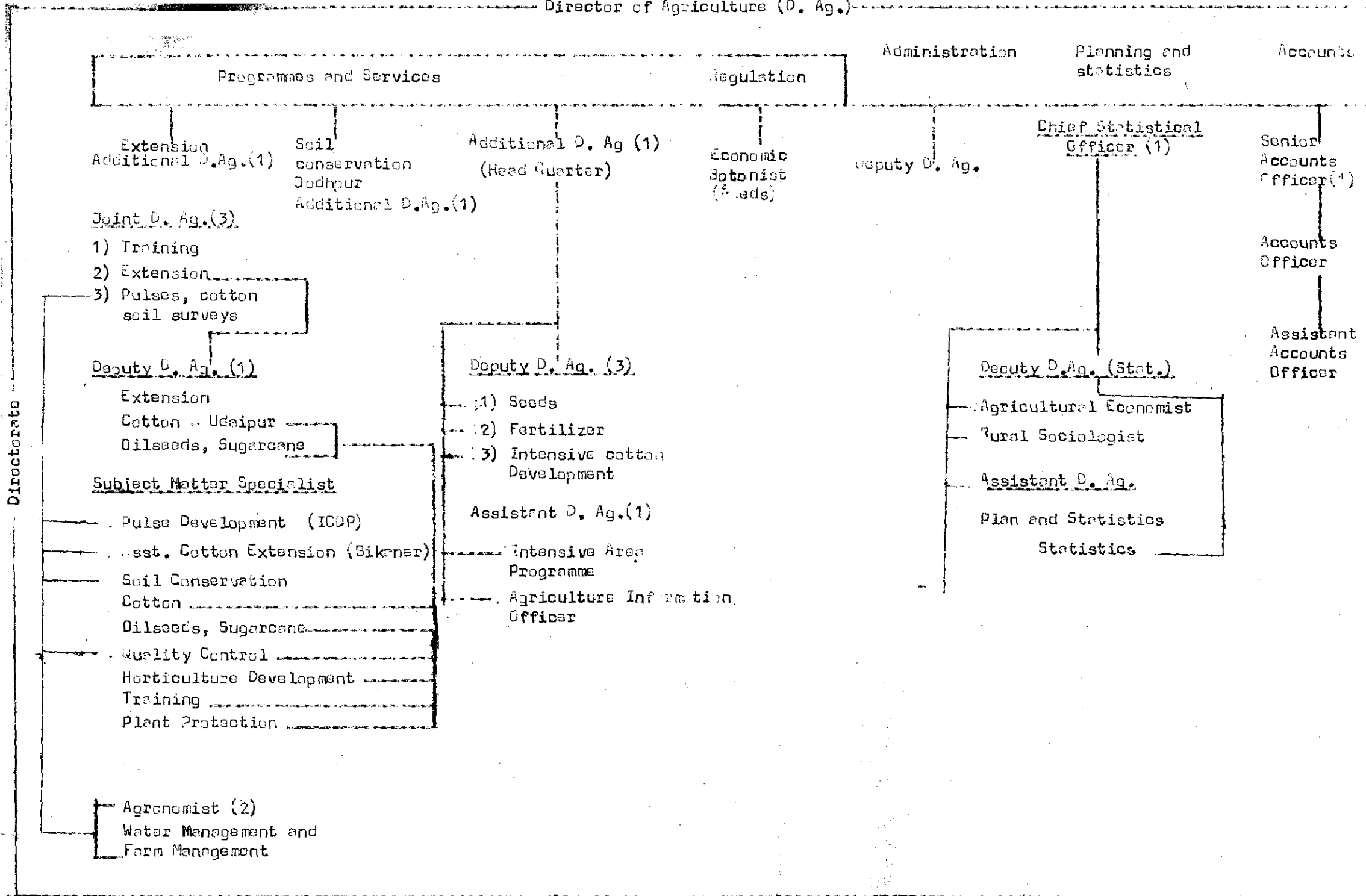
Chart VI/2

Department of Agriculture  
Gujarat



Department of Agriculture  
Rajasthan

Director of Agriculture (D. Ag.)



Subject matter Specialist (with each Joint D. Ag.)

Jaipur

- Agronomist
- Asst. Plant Protection Officer
- Asst. Fruit Development Officer
- Asst. Entomologist
- Asst. Plant Pathologist
- Asst. Agri. Economist
- Asst. Research Officer

Regional Level (Joint Director of Agriculture (5))

Udaipur

Ganganagar

Kota

Jodhpur

Similar to Jaipur

## Director of Agriculture

## Special Projects

Chambal command  
Kota

Rajasthan canal

Extension  
Project DirectorResearch  
Joint D. Ag.

Extension

Joint D. Ag.  
InputJoint D. Ag.  
ResearchSubject Matter  
SpecialistsSubject Matter  
Specialists

S.M. Ss

Asst.  
Plant  
Protection  
Officer

S.M.Ss.

Training

Agronomy

Training

S.D.O

Agronomy

Plant protection

Ag. Chemistry

Plant  
protectionDistrict  
Agriculture  
Officer

Ag. Chemist

Soil & water  
management

Entomology

Soil & water  
managementAssistant  
Agri. Officer

Antomology

Rabi crops

P. Pathology

Rabi crops

Assistant  
Agri. Officer

Pathology

Kharif crops

Soil and water  
management

Kharif crops

Agri.  
SupervisorSoil & water  
management

Statistics

Botany

Statistics

Horticulture

Inputs

D E O

Subject Matter  
SpecialistsAssistant Agr.  
Officer

V E W

received from economist and sociologist.

- 6.2.10 In the past, the two states had similar organizations for agricultural extension. It provided for a single line organization in which agricultural development activities were the line function. The supporting staff functions were also a part of the same department. A change occurred in both the states with the introduction of community development (CD) programme and Block Development Officer, Extension Officers and multipurpose Village Level Workers (VLW). The line function at and below the tahesil level (in addition to staff functions) shifted to this organization. The responsibility of management of agriculture programmes continued to be with the agricultural department but without the powers to administer both line and staff functions. The transformation of the CD into Panchayats at Block level (as also the village and the district levels) also worked on the same principle. With the creation of Panchayats, the extension function even at the district level was statutorily made a part of another organization - the Panchayats. With this development, the organizational line of the Department of Agriculture was further cut short at the district level.
- 6.2.11 The general structure at the district level is then of two types (Chart VI/4 A and B). One prevalent in Gujarat (A) wherein the District Agricultural Officer and below, are part of the larger and different organization of the Panchayats of three tiers. The District staff function within the district Panchayat, and tahesil

Chart VI/A

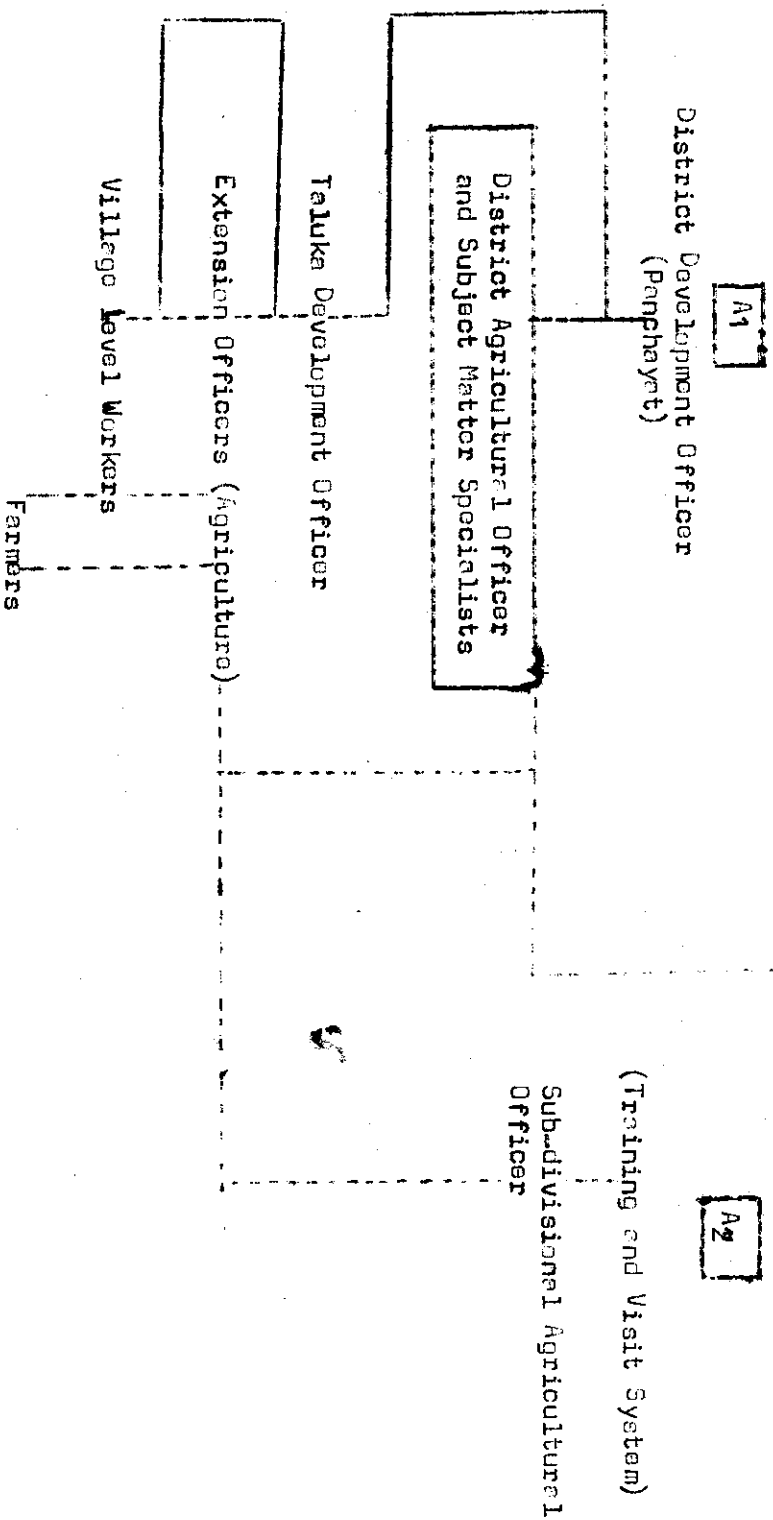
District Agricultural Organization

(State Department of Agriculture)

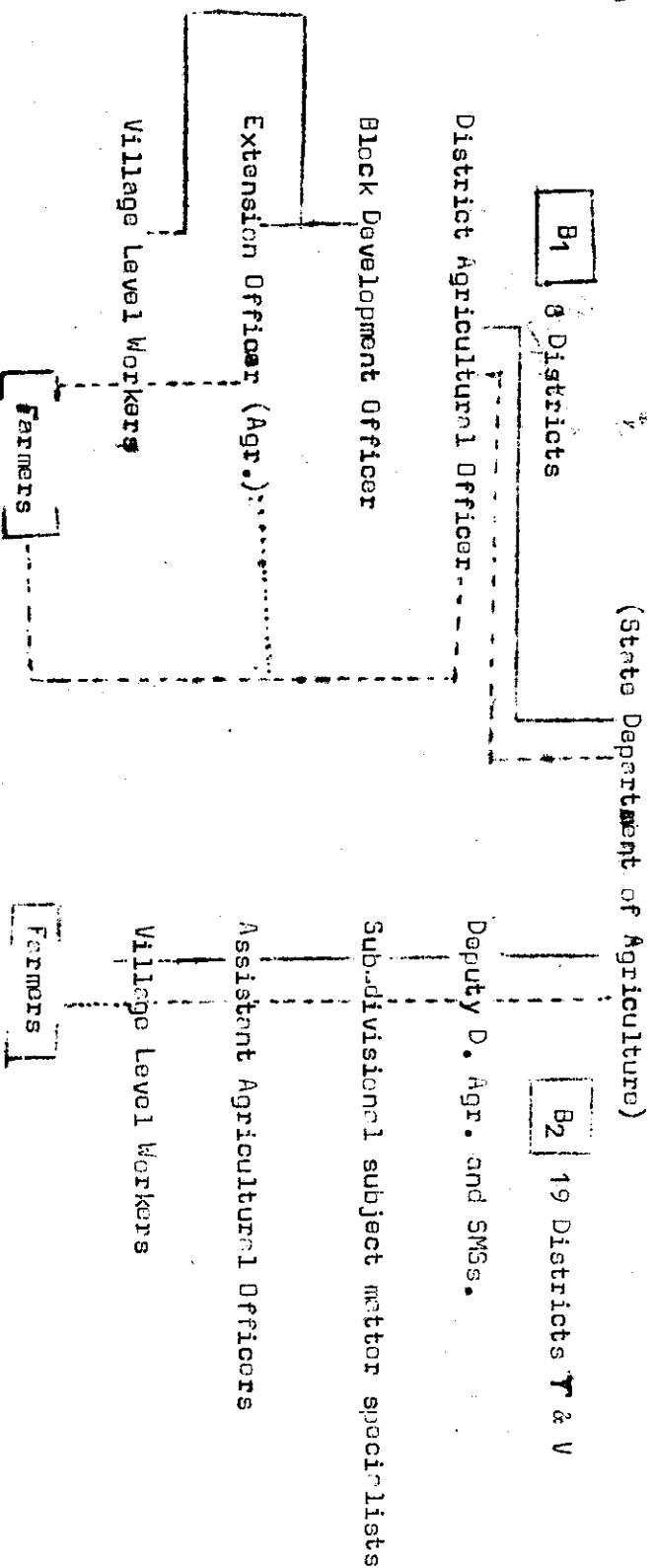
Joint D. Ag.

————— Solid line: Administrative  
 ..... Dotted line: Technical programmes

A. Gujarat



B. Rajasthan





staff including Extension Officers and Gramsevak (VLWs) in the Taluka (Tahesil) Panchayats. Most of the programmes are formulated and supported by the agricultural department, but the participation of local people is ensured by the production committees (consisting of elected members) as a part of the Panchayat System at the district and tahesil levels. The officers and others from district level and below are also administratively under the Panchayats. (The staff of the rank of District Agricultural Officer and so called gazetted officers however belong to state government cadres and the rest to the Panchayat). Thus the line of administration of the state's agricultural department do not include the district level and below. However, this mainly implies that the staff functions are carried out by the Panchayat executives. But the responsibility for extension programme function, though statutorily transferred to it, continue to be the function of the State Agricultural Department at all levels. The Panchayat system provides for generating local resources; however, most of the agricultural extension programmes are initiated and financed by the state government, through the Department of Agriculture. At the district level generally, and sometimes even below, subject matter specialists are provided. Their number and subjects vary as per the importance of the programme in the district (Chart VI/A).

6.2.12 In the second type, in the districts where the Training and Visit (T&V) system has been introduced, (in Gujarat) certain changes have been brought about not only at the regional level but within the

district. The district agricultural officer (under the Panchayat) is now supported by subdivisional district agricultural officers (two to four in each district), who are assisted by subject matter specialists (two in each subdivision one for agronomy and another for plant protection). These along with agricultural extension officers (about eight with each subdivision) and eight village level workers with each extension officer form a single line for both administration and execution of extension programmes within a district but not above.

#### 6.2.13 Rajasthan

In Rajasthan, the state is divided into two administrative units:

1) in this unit of 18 districts National Extension and Research Project is in operation, and 2) the remaining nine districts where this programme is not operating. These districts fall in the arid zone and are the main bajra growing area. Until the introduction of National Extension and Research Project, the system of Community Development/Panchayat Samitis prevailed all over the state (Chart VI/4B1). A Panchayat Samiti was for 20-30 villages. They were administrative units with necessary powers and the extension work, distribution of inputs (and also loans). There was a Zilla Parishad which had only advisory function (unlike in Gujarat where it is the main administrative and executive organization).

6.2.14 The departments of agriculture works through their own regional heads and district agricultural offices; but at the tahesil level and below, the block staff (extension officer and village level workers), take

care of the extension programme. However, in addition, the agricultural department has some agricultural extension personnel; fieldmen at the tahasil and village level for specific programmes which are organized by them. (This is also the case in Gujarat for few programmes). The latter system more or less exists in the remaining districts of Rajasthan.

- 6.2.15 The other districts which are covered by the National Extension and Research Project in Rajasthan receive special attention. In these, the agricultural department has direct responsibility for administration and execution of agricultural development programmes. The organization is built by providing personnel for all functions of the agricultural department with additions where required.
- 6.2.16 The districts selected for T&V Programme are organized into 20 agricultural districts. Out of these, 16 are headed by a deputy director of agriculture each of whom is assisted by a district agriculture officer for inputs and there are two subject specialists. For their 50 sub-districts, subject specialists (training, crops, plant protection) are provided. Each sub-district is organized into 10 units headed by assistants district agricultural officers each with about eight village level workers.
- 6.2.17 One characteristic of the regional and also district level organizational set up is the introduction of support of the subject matter specialists. This area of the organization is rapidly expanding both in its size and diversity and need a comment. Their main

function is to provide technical content, and teaching aids and organize respective training programmes. The specialists themselves also carry out extension function for their subject and also assist the general extension staff in this matter. Those at the state level, establish links with counterpart research units in the agricultural universities and elsewhere so as to obtain recent information on the subject which may prove useful to farmers. This can also occur at the regional and district levels of the organization. The line function of the agricultural extension, is therefore not in a single line, but several parallel lines (corresponding to each subject specialist) whose number depends on the representation each subject receives. The increasing number of subject matter specialists in the extension organization is a positive indication of the enlarging volume of work as well as the diversification needed in the extension system. This development is necessary for conveying the correct messages right upto the farmers' level. The sales pressure mounted by input marketing companies (particularly for seeds and pesticides for their own brands/products) actually necessitate a great effort on the part of the extension organization so as to enable the farmers to take the most economic and advantageous decision in regard to the type and quantity of inputs to be used. Signs of stress and even conflicts - in this regard are already visible in this area, which further enhances the need and importance of coordination with the organization and between organizations.

- 6.2.18 Agricultural extension is the main line function of agricultural departments. Others, as indicated earlier, are the service function like agricultural engineering, and the regulatory function. Subject-wise specializations seem to be rapidly developing resulting in an increased need for unifying basic aspects of extension such as programme planning, training, use of media, target groups, etc.
- 6.2.19 Recently a new dimension has been added in both the states, by the introduction of T&V for which comments are necessary. There is a need to clearly understand whether T&V introduces administrative and/or organizational reforms, or is it a new concept of agricultural extension or is it an intensification of a few of the aspects of agricultural extension or their combinations.
- In Rajasthan, this has not yet covered the whole state and there has been a significant preference in selecting better endowed areas. Most of the arid zone growing bajra crop is not under this programme. In Gujarat all areas excluding the district of Kutch of the arid zone are included. Introduction of new posts of joint directors (and additional director) in both states have created a new line of administration. It was also envisaged to increase the number of Subject Matter Specialists (SMSs) at three levels in the hierarchy. The system attempts to strengthen coordination of extension department and the agricultural university.

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<sup>15</sup> Improving Training and Visit System in Gujarat. Report by I.C. Patel, Gujarat Agricultural University.

At the district level (in Gujarat), a separate line is created, in addition to the existing one of the district agricultural officer under the respective Panchayats. The latter organization, it is said, is not under the administration, of the department of agriculture, however, the programmes implemented are mostly of that department.

The other feature of the T&V is the introduction of regular and frequent (at shorter intervals) training of extension workers and with emphasis on selected farmers and others of selected villages, on specified days by rotation. Thus the basic concept of training seems to remain unaltered. What is emphasized is its increased frequency within a season and a month. A discounted capacity and knowledge of village level workers (even earlier believed to exist) or less efficient communication system are probably the reasons for its justification. The training of farmers was emphasized earlier around demonstrations of improved practices. However, the tools of training of farmers (and also extension workers) do not seem to have received needed time and attention. The concept of mass participation by campaigns have been set aside.

There are two aspects of improving educational systems. One is the changes to be brought about in the institutions and organizations and their management, and second, the improvement in education per se, including contents, pedagogy etc. Likewise, improvement in agricultural extension can be effected on two broad fronts.

One is the changes to be brought in the organization of agricultural extension and its management so as to improve its effectiveness, and second, to improve extension education per se, by improving its contents and how they can be quickly accepted by the beneficiaries - by improving pedagogy. In this context it is significant that the Operational Notes<sup>16</sup> circulated by the Government of India for T&V includes 12 points, out of which extension as an educational process is possibly in two of them, the rest are for the organization and its management.

The tools of training of farmers, e.g. demonstrations have not been emphasized, and converted into administrative chores occupying much time in distribution of free inputs (to be used for demonstration) and consequential reporting. A review of T&V in Gujarat<sup>17</sup> having come to this conclusion has even advocated dropping demonstration from T&V altogether. This would be a high price to pay for the administrative tilt given to demonstrations which are otherwise a powerful tool for extension education in a semi-literate or illiterate society. The extension programmes require greater attention to the training part, its form, content and communication.

<sup>16</sup> Agricultural Extension: The Training and Visit System. Operational Notes. Mimeograph by Director of Agricultural Extension, Ministry of Agriculture and Cooperation, Government of India, New Delhi.

<sup>17</sup> Factors Affecting the Development of Self-Sustained Professional Agricultural Extension in Gujarat. Report by V. Venkatesan (1982).

Under the T&V the administration of the department of agriculture was intended to be reintroduced at all levels. The National Commission on Agriculture had also recommended a technocrat oriented agricultural administration in which there would be a single line of control from the state to village level.<sup>18</sup> The reorganization by which the District Agricultural Officer (of the Panchayat) has direct administrative responsibility upto the village, or the Director of Agriculture having similar responsibility in a district has not been so far carried out (in Gujarat).

The advantages of participation of the local organizations in development programmes has been recognized for long. Accordingly, extension and development have been entrusted to the Panchayats (in Gujarat). This has been done by a statute. This provides for the potential advantages of democratic decentralization and generation of local resources for the programmes.

The advantage is greater in programmes requiring community action. The T&V however, envisages direct line of control of all extension staff. The role of Panchayats is (intended) to be reduced or bypassed.

In the past, agricultural development financed from resources outside the country, many times, forms of organizations have not been of indigenous origin. T&V is not an exception. Panchayats which provide for people's participation and a source and channel of

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<sup>18</sup> National Commission on Agriculture. Report Vol. II, Para 7.3.61.



funding and administration, were financed from the resources of the country. T&V does not provide for the activation of the concept of organized people's participation in agricultural development but envisages its replacement or bypassing it. In a society with low literacy level, written communication is likely to be less effective, but the cohesion in rural groups can help the diffusion process. In as much as the latter can be helped by the Panchayat system, deemphasizing it does not seem to be an ideal approach.

6.2.20 Decentralization, particularly regionalizations are the common needs of a large organization like the Department of Agriculture. The extent of decentralization varies. Reasons for these may be different. They can be purely political, organizational or based on soil and agro-climate. The compelling reason is organizational, and partly political and related to historical development. In Rajasthan, the headquarters of the regional organizations fall in each of the four climatic zones: Kota in humid zone, Udaipur in sub-humid zone, Jaipur in semi-arid, and Jodhpur in the arid zones. To handle the problem of Rajasthan canal water utilization, a regional headquarter is in Bikaner, (which is actually in the arid zone). Chambal command area development has also been given this importance. The regional arrangement in Rajasthan thus offers considerable advantages in programme planning execution and evaluation. In Gujarat, two administrative regions are reorganized: 1) Vadodara is in the eastern alluvial soil region and 2) Rajkot is in the soil type formed in situ from trap rock.

Both are in the semi-arid zone. The arid zone in the extreme north and the small sub-humid zone in the extreme south did not have this organizational facility. (Recently however, as a part of Training and Visit Programme, Surat in sub-humid zone, and Mehsana in semi-arid have been identified as a headquarters for the sub-regions). The regionalization in Gujarat appears to have historical/political base, and can be improved in relation to soil and agro-climate. In the states with identified agro-climates and the corresponding regions, for efficient functioning and the required responsiveness to farmers' needs, decentralization is required at many levels. At these levels coordination is to be established with other agricultural development organizations such as agricultural universities. This is being attempted in T&V system.

### 6.3 Command Area Development Authority (CADA)

- 6.3.1 A specialization within and outside the Department of Agriculture, is for irrigation development. In many states separate agency, the Command Area Development Agency (CADA) has been created. Its organizational structure and objectives vary. The two main objective are, 1) to provide services to farmers for efficient use of irrigation water, and prevent underutilization so as to lead to complete utilization of canal water in the shortest possible time and thus prevent locking up of heavy investments, and 2) to create facilities for the use of financial resources available with the commercial banks. These funds are not ordinarily available to state governments (for development purposes in government

departments). Several departments execute their respective programmes which are: revenue department for land and revenue matters, Panchayats for extension (and other functions for which responsibility is transferred), animal husbandry department for livestock and veterinary development, agricultural university for research and education, agricultural department for land development, soil conservation, extension, irrigation water use, and construction and maintenance of irrigation systems by the Public Works Department. Some years ago, the idea of a unified Command Area Development Agency was mooted. Accordingly, in Gujarat, such agencies were created for individual commands and their scope of work was limited to 1) canal maintenance, 2) land development such as levelling in irrigated areas and construction of field channels. All the rest of the agricultural development functions continue with the respective departments. This authority, in Gujarat, was independent of the Agricultural Department, but was under the Secretary of Agriculture until recently. (It is now looked after by irrigation department in the State Secretariat). The other objective of increasing capability to tap institutional financial resources is not served by the type of organization created. In Rajasthan, it is mentioned as a part of the State Department of Agriculture: Chart VI/3 B indicates its structure. In that state, all activities pertaining to agriculture (other than maintenance of canal per se and distribution of water) in the command area are attended by that organization. The organizational capacity mainly for agricultural extension (and research) is in-built in the organization. In Gujarat, on the other hand, its function is

essentially that of structural work of field channel construction and land levelling in the respective commands. Rest of the agricultural development functions are attended to by other agencies as in the rest of the State. The function of coordination is said to have been entrusted to CADA.

#### 6.4 Agricultural University

- 6.4.1 The basic common features of the agricultural universities are as follows: 1) the definition of agriculture is to be wide, and the responsibilities of the university shall be in respect of agriculture per se, as also for animal husbandry, dairying, and forestry, fishery and home economics; 2) the university has to integrate research and education, and also extension therewith, so as to create an effective flow of knowledge for recipient system of which farmers are a part.
- 6.4.2 The responsibility for agricultural research and education has been clearly put on the agricultural universities. In regard to different types of research, the fundamental or basic research is to be a function of Central research organization (ICAR and its institutes) and the agricultural universities. The former has also, in addition, a coordinating role. The Council maintains crop research institutes in different parts of the country as also similar institutions for animal husbandry and dairying. Most of these are non-teaching organizations. A few educational institutions are however under the Council. At these institutions, both research and teaching are

carried out. The Council partly finances coordinated research projects of national importance in state institutions, mostly the agricultural universities.

6.4.3 The applied research ~~is to be~~ conducted by the agricultural universities and the adaptive trials by the state department of agriculture.<sup>19</sup> Some attempts are made to translate this suggested organizational division of responsibility in both the states. In both states, research is entrusted to the agricultural university. The Gujarat Agricultural University Act in addition to the entrusting this function states, "the University through its Agricultural Research Organization shall be the principal agency of control over agricultural research activities of the state of Gujarat."<sup>20</sup>

6.4.4 The Council also partly finances agricultural universities, for educational activities. The primary sources of funds for both research and education are however that of state governments. In particular, Gujarat Agricultural University Act provides that the State Government shall make financial provision for grants to the university of an amount not less than the estimated net expenditure on pay and allowances of the staff contingencies and services of the university,<sup>21</sup> as also for "such additional items of expenditure,

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<sup>19</sup> Ibid p.81

<sup>20</sup> Gujarat Agricultural University Act (Gujarat Act No.13 of 1969) 1969 Section 33 (2).

<sup>21</sup> Gujarat Agricultural University Act (No.13 1969) Section 39(b).

recurring and non-recurring as the state government may deem it."<sup>22</sup>

This financial responsibility of the state, which is consequential to the transfer of responsibility regarding research and education to the university as prescribed in Gujarat Agricultural University Act, is not stated in the Act creating University of Udaipur in Rajasthan.

- 6.4.5 In regard to integrating research, education and extension education, "advantage in having teachers engaged in research is by way of what he does in his class"<sup>23</sup>. Besides bringing realism, the students benefit from the knowledge developed recently. In the university system, "the staff concerned with the teaching of the subject, those dealing with research in the area of the subject and those dealing with extension of the knowledge of the subject matter to the field extension workers and farmers have all to be recognized as academic staff members."<sup>24</sup> "The organization and working of the department(s) (of the university) should be such that the capabilities of its staff are employed to the best advantage by its head, for teaching, research, and in extending the technical information to those who have to put it into practice. This is what is meant by integration of teaching, research and extension education."<sup>25</sup>

<sup>22</sup> Ibid, Section 39(c)

<sup>23</sup> National Commission on Agriculture Report PX I, p.142, 1976

<sup>24</sup> Ibid p.142

<sup>25</sup> Ibid

- 6.4.6 One of the other suggested principles of organization is that of developing constituent units, in preference to affiliated colleges common in traditional universities in the country.
- 6.4.7 The organization of Gujarat Agricultural University is shown in Chart VI/5 and that of Udaipur University, in Chart VI/6.
- 6.4.8 The structure of the university is usually made up of three units: 1) the Board of Management (and control), 2) the Academic Council, and 3) the Board of Studies. The Gujarat Agricultural University Act provides for these three. University of Udaipur, has one additional unit, 4) the Council of Deans. Usually there is also a committee of courses, either provided by the Act itself or under the statutes made later by the University. The Vice-Chancellor is a full time person and is the Chief Executive.
- 6.4.9 The authorities of the agricultural university in regard to educational matters falls into the pattern of traditional universities. The academic matters pertaining to teaching function are assigned to the faculty, while the Registrar is in charge of the aspects related to all organizational concerns; he is also the secretary of Board of Management and the Academic Council, in addition to the staff functions.
- 6.4.10 The management of the university rests in a Board. The composition of the latter in Rajasthan is on the pattern of traditional universities, with significant number of members elected from different constituencies. In Gujarat, on the other hand, no

Gujarat Agricultural University  
(Sardar Krshinagar, Dantiwade)

Chancellor

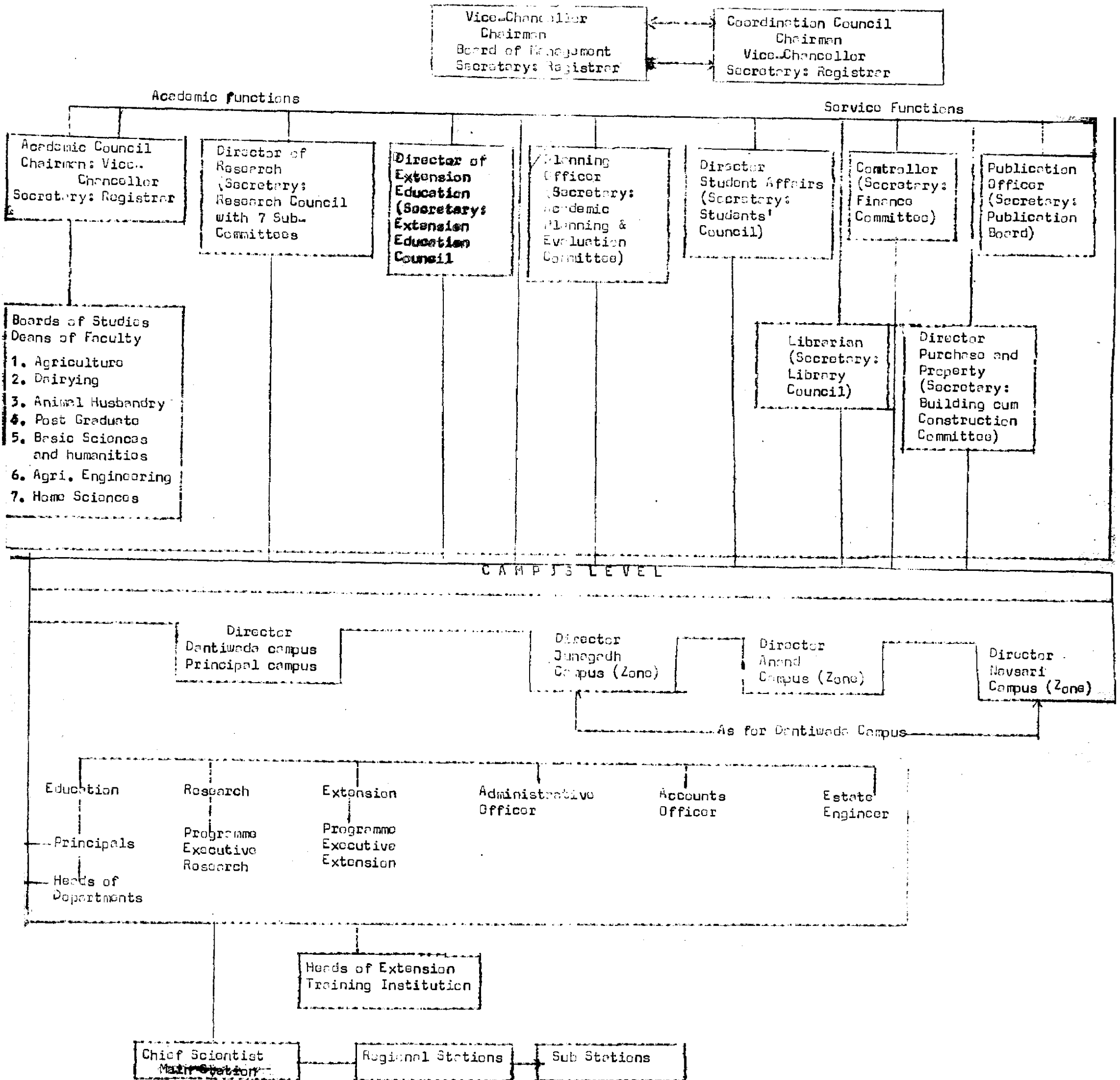




Chart VI/6

University of Udaipur  
Udaipur

Chancellor

Board of Control  
Chairman Vice-Chancellor

Executive Committee

Academic Functions

Services Functions

Academic Council  
Secretary-Registrar  
Chairman  
Vice-Chancellor

Council of Deans  
Chairman  
Vice-Chancellor

Director  
Agr. Experiments  
Stations

Director  
Extension  
Education

Controller

Estate  
Officers

Dean  
Students  
Affairs

Heads of Institution  
for Extension Training

Officers 1/C  
Regional  
Research  
Stations

- i) Dungenpur
- ii) Vallabh nagar
- iii) Kutch

Officers 1/C  
Agr Research  
Stations

- i) Sumarpur
- ii) Banswara

Officer 1/C  
Research Sub Stations

- i) Navagam (Alwar)
- ii) Hanumangarh
- iii) Diggi
- iv) Aklur
- v) Arjia
- vi) Mandor
- vii) Tebiji

Private  
administrative  
organizations

Associated  
colleges  
(seven)

Dean  
(Board of Study)  
Agricultural  
College  
Udaipur

Heads of  
Department

Associate Dean  
(Board of Study)  
College of Home  
Science

Heads of  
Departments

Dean  
(Board of Study)  
College of Technology  
and Engineering  
Udaipur

Heads of  
Departments

Dean  
(Board of Study)  
Basic Sciences

Heads of  
Department

Dean  
(Board of Study)  
College of  
Agriculture  
Jahner

Heads of  
Department

Director  
(Board of Study)  
College of  
Veterinary  
Sciences  
Bikaner

Heads of  
Department

member is an elected one. The other difference is its size. In Rajasthan it consists of over 70 members, but there are only 21 members in Gujarat. In the former state, the Board of Studies and Dean is for each educational college, while in Gujarat they are for each faculty of agriculture, animal husbandry, etc. Each faculty, in Rajasthan, has a Chairman who exercises the powers and the functions of the Board of Studies. In Gujarat he is designated as Dean, who is also Chairman of the Board of Studies.

6.4.11 The more specialized features of the agricultural universities relate to the organization for research and extension. In both the states, Directors for Research, and Extension are also office bearers of the university, in addition to Vice-Chancellor, Registrar, Comptroller Director of Purchase and Property, Librarian, Directors of Student Affairs and Director of Studies in Basic Sciences and Humanities. A special feature of Gujarat Act is formation of the post of Director for each campus (who is neither an employee of the university nor a government servant). He is appointed by the Government like the Vice-Chancellor. Other officers are appointed by the University.

6.4.12 One of the problems that the agricultural universities face is to find the type of organization best suited to the twin problem of multi-faculty and varied locations of colleges and the research farms. In Department of Agriculture, from where the functions have devolved to the universities, the regionalization of research units, in a line organization of administration. Several faculties also

exist in traditional universities. But the colleges outside the campus of the universities are affiliated ones and their staff functions are vested in bodies other than the University. In agricultural university, affiliated college pattern is not encouraged, and therefore, these functions also have to be managed in a suitable manner by the university itself. Besides, the management of large number of research farms scattered over the length and breadth of a state also require special attention. The states of Rajasthan and Gujarat have attended to these problems in different manners. In Gujarat, academic functions are centralized in authorities and officers (either prescribed by the Act or created by resolutions of the Board of the University) at the university headquarter. At the campus level, however, the staff functions have been entrusted to Directors of campuses of four zones. Thus the academic function and staff functions do not exist on the same line. The operational consequence of this organizational arrangement, is the separation of programming and programme execution, from the development of supporting services. Thus, the research programmes are formulated by the officer and authority designated for the purpose, and information flows through Director of Research, to Research Scientists of the main stations, and through them to regional and sub stations. All supporting services of funds, staff, physical facilities have to be arranged by another line of staff with its distinct hierarchy.

6.4.13 A general feature of the Gujarat Agricultural University Act, is the statutory provision of 12 executives (officers) of the universities, each one with the stated powers and duties. The original act provided for only four authorities: 1) Board of Management, 2) Academic Council, 3) Faculties, 4) Board of Studies. However, the later decisions of the Management have added five councils, one Board and three committees at headquarter with corresponding units at each of the four campuses. Each officer of the University (with possibly one exception) is the secretary of a committee, or council or a board. Substitution of powers and duty of the executive officers, by committees seems to be a characteristic pattern of growth of this organization. For example, the Act provides that the Vice-Chancellor, "shall be responsible for the proper administration and for close coordination and integration of teaching, research and extension education.<sup>26</sup>" However, the University has created a Coordination Council with Registrar as Secretary and Vice-Chancellor as Chairman for coordinating the efforts of various officers of the university.

#### 6.5 Allocation of Resources for Research in Gujarat and Rajasthan

6.5.1 The total investments in the agricultural universities, since inception are shown in Table 6.1. In the agricultural university system, it is difficult to separate the investment for education

<sup>26</sup> Gujarat Agricultural University Act, 1969 (Gujarat Act No.13 1969) Section 12(1).

and research, as the very concept of creation of agricultural university requires an integration of these two as also of extension education. Financial allocations only for research are however, reported, but this may not reveal the exact situation. Comparable data on expenditure (average 1974-75 to 1976-77) on research and education are given in Table 6.2. The total expenditure on agriculture (excluding allied areas like animal husbandry, soil conservation, etc.) is also shown therein. In Table 6.3, comparison is made the number of research farms, their area, and number of faculty members in the universities of the states under comparison. Comparison of other university institutions and deployment of personnel is shown in Table 6.4.

6.5.2 The agricultural university system had an early start in Rajasthan (Table 6.1). (The Gujarat Agricultural University has only 5 years standing, in the year of comparison, as compared to 15 years for a similar University of Rajasthan). The annual expenditure on these as assessed by ICAR for the states, reveals a larger dependence on ICAR funds in Rajasthan than in Gujarat. Besides, the per annum total investment on this system has been much less in Rajasthan than in Gujarat. Likewise per annum expenditure for the agricultural university system for each ha GSA is much less in Rajasthan than in Gujarat.

6.5.3 The total expenditure on agriculture (excluding allied subjects) <sup>is</sup> however/only slightly more in Gujarat than in Rajasthan. However, when the state expenditure on agriculture per farmer or per ha GSA is compared, Gujarat state has spent over 50 per cent more than Rajasthan (Table 6.2).

Table 6.1  
Total Investments in Agricultural Universities (Up to 31.3.1977)<sup>1</sup>

University	No. of years of existence	Total Investments			Annual Investment		
		ICAR	State govt.	Own Total	Lakh Rs./p.a	Rs.p.a/ha. GSA	
							Rs. Lakhs <sup>1</sup>
Gujarat Agricultural University (Dantiwada (Gujarat))	5	271	1506	492	2269	454	4.55
University of Udaipur (Rajasthan)	15	532	1511	402	2445	163	0.95
University of Agricultural Sciences Habbal (Karnataka) <sup>2</sup>	13	1333	1974	488	3795	292	2.61
Rajendranagar Agricultural University (Bihar) <sup>2</sup>	6	276	1256	119	1651	275	2.44
(Uttar Pradesh) <sup>2</sup>							
GBPUAT Pantnagar	17	484	774	1254	2512		
CSAUAT	2	109	303	54	466		
NDUAT Faridabad	2	85	88	3	176		
(231 Lakhs ha GSA) Total		678	1165	1311	3154	186	0.80

Source: 1. Annexure XIX Report of the Review Committee on Agricultural Universities, ICAR 1978.

GSA ha: Gujarat 102 Lakh; Rajasthan 172 Lakh; Karnataka 112 Lakh; Bihar 113 Lakh; Uttar Pradesh 231 Lakh.

2. Information for these states included as these will be used for the case of hybrid maize.

Table 6.2

Annual Average Expenditure on Agricultural Research and Education  
Average 1974-75 to 1976-77

	Rs. in lakhs (Percentages in brackets)				
	Gujarat	Rajasthan	U.P. <sup>4</sup>	Bihar <sup>4</sup>	Karnataka <sup>4</sup>
Agricultural <sup>1</sup> Research	86.5 (7.49)	83.3 (7.46)	148.1 (5.7)	13.4 (1.1)	31.7 (2.3)
Agricultural <sup>1</sup> Education	242.6	104.2	166.3	216.9	293.8
Total above	329.1 (28.5)	187.5 (16.8)	314.4 (12.08)	230.3 (19.0)	325.5 (23.5)
GSA Lakh ha <sup>2</sup>	102.0	171.6	231.0	112.8	111.6
<u>Rs./ha. GSA</u>	3.23	1.09	1.36	2.04	2.92
Agriculture Total	1155.2 (100)	1117.1 (100)	2603.1 (100)	1212.0 (100)	1382.6 (100)
<u>Rs./ha. GSA</u>	11.33	6.51	11.26	10.75	12.39
Number of 3 farmers (Land holders)	24.3	37.3	156.4	75.8	35.5
<u>Expenditure per farmer</u>					
Agriculture	47.54	29.95	16.64	15.99	38.95
Ag. Research	3.56	2.23	0.95	0.18	0.89
Ag. Research + Education	13.54	5.03	2.01	3.04	9.17

Sources: 1. Table 78-A Combined Finance and Revenue Accounts of the Union and State Governments in India for the years 1974-75, 1975-76 and 1976-77

2. Indian Agriculture in Brief, (17 Edition) Table 2.10.

3. Ibid Table 4.4

4. See note 2 under Table 6.1.

Table 6.3

Comparison of Some Features of Agricultural Universities<sup>1</sup>

University	Number of Research Stations	Area of Research Stations Ha	Number of Faculty members in position		Vacant	Total
			Post Graduates	Graduates		
Gujarat Agricultural University Dantiwala (Gujarat)	56	5789	151	102	170	423
University of Udaipur Udaipur (Rajasthan)	13	354	305	Nil	60	365
University of <sup>2</sup> Agricultural Sciences Habbal (Karnatak)	38	2690	395	59	207	661
Rajendranagar <sup>2</sup> Agricultural University Dholi (Bihar)	6	1350	138	Nil	39	177
(Uttar Pradesh) <sup>2</sup> GBPUAT Pantnagar	7	5495	295	---	74	369
CSAUAT Kanpur	23	3413	188	---	64	252
NDUAT Faridabad	5	3104	---	N.A.	---	---
Uttar Pradesh	35	12012	483	---	138	621

Sources: 1. Annexure XII and VII,  
Report of Review Committee on Agricultural Universities  
ICAR 1978.

2. See note 2 under Table 6.1.



Table 6.4

Number of Academic Institutions in Various Climatic Zones of Rajasthan and Gujarat

Climatic Zone	Rajasthan			Gujarat		
	Research Farms	Educational Institutions	Extension <sup>1</sup> Institutions	Research Farm Locations	Education Institutions	Extension <sup>1</sup> Institutions
Arid	5	(1) <sup>2</sup>	1	9	1+(1)	4
Semi-arid	6	1	3	31	2+(2)	29
Sub-humid	2	3	4	11	1	5
Humid	3	-	2	-	-	-
Total	16 <sup>3</sup>	4 + (1)	(Add Fatchpur Shekhavati in above)	52 <sup>4</sup> (Two are for seeds production)	4+(3)	38

1 Not including processing centres of National Demonstration Project and Farm Advisory Service

2 Pertain to animal husbandry

3 and 4 Their number was found to be different from the Report of ICAR transferred in Table VI/3.

- 6.5.4 The per cent share of expenditure on research alone out of total expenditure on agriculture is nearly equal (7.4 per cent) in Gujarat and Rajasthan, (Table 6.2) but the share of agricultural education and research taken together is much higher in the former state. Further, when this expenditure is converted on a more comparable basis of investment per ha GSA, the investment in Gujarat is almost three times as large as compared to Rajasthan. The expenditure for research and education per farmer in Gujarat is 65 per cent higher than in Rajasthan.
- 6.5.5 The research effort in the state can also be judged from the number of research stations, their total area, and faculty strength. (Table 6.3 and 6.4). On all these counts the effort in Rajasthan is less than in Gujarat. It must be further added that broadly, the two states fall in arid, semi-arid and sub-humid zones; and Rajasthan is a much larger state than Gujarat in terms of geographical area, gross sown area, or number of farmers. If these facts are taken into account, research efforts in Rajasthan would amount to be still less than Gujarat.
- 6.5.6 An additional point for comparison of the two states is the use to which funds are applied. According to a published report<sup>27</sup> in Rajasthan share of administrative cost in total of agricultural university budget (1975-76), is 18.4 per cent, as against only 7.4 per cent in Gujarat. Correspondingly the number of technical

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<sup>27</sup>

Report of the Review Committee on Agricultural Universities,  
ICAR 1978 - Annexure XX.

personnel in Rajasthan is not as high as in Gujarat. (Table 6.3).

The pattern of investment in the agricultural university in Rajasthan is not as much oriented towards development of infrastructural facilities and provision of scientific manpower, as in Gujarat.

## 6.6 Bajra Research

6.6.1 The organization for bajra research in both the states falls in two parts related to the sources of funding: 1) All India Coordinated Crop Research Project (Millet Project) (AICRP), and 2) the state organization. The former is financed by the ICAR. It utilizes the infrastructural facilities of the state organization.

6.6.2 The allocation of funds by ICAR to the two states for millet research is shown in Table 6.5 along with the allocation made by the respective agricultural universities from state resources, as a part of their total efforts for bajra research. The higher allocation for bajra research in Gujarat than in Rajasthan is conspicuous. A further significant observation is that the share of state resource in bajra research is less in Rajasthan than Gujarat. The sources of funding and relative strengths also cast their shadows on manpower and other resources allocation, for bajra research (Table 6.5). The total number of scientific personnel working on bajra research in Gujarat is almost 50 per cent more than in Rajasthan. Further, in Gujarat, almost 60 per cent of the personnel are funded from the state resources, but in Rajasthan, ICAR's resources support 77 per cent of bajra research personnel. Considering the much larger area under bajra in Rajasthan, its research organization for the crop

can be considered to be of relatively smaller size. The infrastructural facility of research farms for bajra is also larger in Gujarat. In this state besides the main station, there are four sub-stations for the crop and an additional five farms cooperate in testing the varieties in advanced stages of development. As many as six of these locations are in arid zone, or in its close proximity and the remaining are in semi-arid zone.

6.6.3 In both the states, the organization for bajra research is multidisciplinary. The important disciplines, plant breeding, agronomy, entomology and plant pathology are represented in the team of research workers. In Rajasthan, a plant physiologist and in Gujarat statistician are the other supports. The total number of trials in each of the state is not much different. However, an important difference is in respect of the greater scatter of the trials in Gujarat over the climatic zones with diversities of soil (Table 6.5). The better infrastructural facilities and organization of research in Gujarat enables experimentation over a larger number of locations at the same time.

Table 6.5

Comparison of Efforts for Bajra Research in Gujarat and Rajasthan

	Gujarat*		Rajasthan	
	ICAR-Coordinated Project	State Project	ICAR Coordinated Project	State Project
Expenditure Rs. lakhs	2.19 (1980-81)	5.75 (1980-81)	2.79 (1980-81)	1.87 (1980-81)
Research Staff (sanctioned) number	9	15	10	3
Number of locations for research trials (actual)	1 to 5 Average 3	2 to 10 Average 5	1 to 4 Average 1.6	1 to 4
Number of entries in varietal trials	16 to 27 Average 20	8 to 22 Average 16	8 to 31 Average 18	16 to 36 Average 24
Number of trials in varietal research	4	6	6	5
Number of stations cooperating for bajra research	10 (4 sub-stations for bajra + 5 others)			5 (Out of 7)
Perceived main handicap				<ol style="list-style-type: none"> <li>1 Lack of isolation facility for developing new varieties and seed production</li> <li>2 Inadequate funds</li> <li>3 Inadequate physical facility like glass house, laboratory etc.</li> <li>4. Absence of a station in arid zone.</li> </ol>

\* Source: Director of Research, Gujarat Agricultural University.

## CHAPTER VII

### STAGES IN REDISTRIBUTION OF FUNCTIONS

7.1 The support farming enterprise receives has been traditionally of diverse types. Depending on the stage of development and political forms of the country, the extent of state's participation varies. In India, the early stage of organizational development was marked by state's support on all fronts. These were not only the non-commercial type of activities like research, education, and extension, but also several others which could be classified as services with cost recoverable from the beneficiaries like soil conservation, and supply of inputs. Production of seed of field crops had been traditionally a state function. In official language, these were classified as quasi-commercial activities. Several of these were put under separate organizations, e.g. seed corporation and land development corporation. Some of the non-commercial activities like research and education, seed certification, were also entrusted to separate organizations. The supply of inputs like pesticides, fertilizers, machinery, were taken up by private agencies, cooperatives, or government corporations.

7.1.1 These organizations were either created by special enactments, or under existing laws. One created by special act was the agricultural university. The certification agency was under the Seeds Act. Special enactments provided for creation of cooperatives.

All government corporations (like any other private corporations) were registered under the Company Law.

7.1.2 The reason for founding these bodies was because it gave an autonomy to the said agency, i.e. freedom to manage their affairs unrestricted by the traditional restraints inherent in government administration. However, as all the members of the Board including the chairman and its chief executive, of these organizations (Corporations, Boards, Universities, Agencies) are nominated by government (i.e. Minister in charge), the so called autonomy is not effective. Further, in a situation of total financing (of share capital and others) by government, operations get circumscribed both at policy and operational levels. As against the advantage of freedom from the traditional administrative restraints of government, there is total absence of direct responsiveness to the public (beneficiaries) and the legislature, which can result in potentially serious disadvantageous situation for purposive growth and satisfaction of related needs.

7.1.3 All these organizations (with the exception of cooperatives which have equally autonomous constituent units in a federal structure) are unitary. Even the large national corporation like the Food Corporation of India, is of this type. The details of their organizational structure would entail going into areas of corporate structure which can be pursued by those interested in the numerous work on the subject. Several reviews have also appeared on the subject of government corporations which are useful for the

understanding of their structure, function and management practices. We therefore content ourselves by a general paragraph in this chapter on the laws under which they are constituted and the issue of coordination in a subsequent chapter.

- 7.1.4 An observation in respect to enactments under which agricultural development organizations got instituted has relevance to a large country with a federal constitution with division of responsibilities between the centre and the states (and as in some, within states, the Panchayats). More often, the laws for non-enterprise system are of the states. These include, i) Panchayats, ii) agricultural universities. Amongst the enterprise systems, the laws concerning cooperatives are of the states. The corporations, private or of the state are registered under a central law.
- 7.1.5 The transfer of trading function from departments of agriculture to cooperatives and government corporations has been a significant trend in the development of agriculture. A further extension of the same trend, is also the entrustment of service functions formerly managed by department of agriculture, to the corporations. In particular, the Land Development Corporation, (in Gujarat) has been given the responsibility of land reclamation and soil conservation. It is expected that reclamation of saline land under the existing Khar Land Board constituted by a State Act, will be ultimately also entrusted to the Land Development Corporation, an agency created by the State and registered under a Central Act. Services like ploughing and levelling, besides being available from private



entrepreneurs can be also provided by state Agro-Industries Corporations.

## 7.2 Redistribution in Gujarat

7.2.1 The last decade and a half have witnessed many major changes in the organizational systems associated with technology transfer in agriculture. Gujarat state as a political entity was created in 1960, though its linguistic and cultural identity has been known for centuries. At the time of its creation (Stage I), all the functions of agricultural development, were vested in the state's department of agriculture (Chart VII) (It even included animal husbandry department). The distribution of inputs was also a part of its responsibility. Most of the research projects were then financed by the state government with little support from Indian Council of Agricultural Research and the then existing Commodity Committee. The research on bajra in particular was initiated and solely supported by the State Government.

7.2.2 The Department looked after the administration of most of the agricultural (and veterinary) colleges in spite of the fact that they were affiliated to the traditional universities, whose concurrence was necessary for changes in academic aspects of courses. (One agricultural college was however managed by a trust, and financed by state government). These universities also served as an examining body. The faculty of agriculture mostly consisting of government servants was however, least disturbed in the trends it set for itself; or influenced by trends in other faculties. The teaching staff in the agricultural and veterinary colleges were also supported

for applied research and thus research and teaching were integrated. The research staff outside the colleges, however, did not teach, (as is the case even after the creation of agricultural universities, where teaching and research are to be integrated) except by special arrangement for post graduate courses.

7.2.3 The agricultural extension and soil conservation were the other major activities of the state department of agriculture. In formulating the package of practices or varietal recommendations, coordination existed in the form of conference of research and extension workers prior to the two seasons of kharif and rabi each year. Conduct of the adaptive research and district trials on the farmers field of new varieties evolved by research workers was jointly organized by the research and extension staff; the former had the leading role and the latter executed the programme. The research specialists played the role of communicating the findings to the extension personnel, and also seeing for themselves the performance of new varieties on farmers' fields organized by the extension workers as per jointly approved plan for adaptive trials. The conferences for planning these, besides serving as training ground, provided the feedback channel. Training sessions for farmers at the district level organized by the extension staff were also assisted by the local research staff; their participation depended on the crop or subject matter to be discussed. Participation ~~was~~ of research personnel in district training programme was, however, limited due to shortage of manpower and time, rather than by any hindrance of policy of the organizational system in this regard. Overall shortages of trained

personnel was a direct consequence of a dearth of suitable training institutions and a rapid expansion of both research and extension programmes.

7.2.4 The agricultural extension system at the tehsil and village level was a part of the Community Development Department. The District Agricultural Officer and his other staff formed the boundary of the organization of the State Department of Agriculture. This arrangement continued until 1963, when the 'Panchayat Act' came in existence. In Gujarat, a three tier Panchayat System was introduced with elected Pramukhs for the district, taluka (tehsil) and the village panchayats. At each level, the chief executive was from Development Department the District Development Officer for the district and Taluka Development Officer at the tehsil level. The constitution provided - in addition to other functional committees - a (Agriculture) production committee at the district level and tehsil level, the secretaries of which were respectively the District Agricultural Officer and the Extension Officer (Agr.). The line of administration was as in Community Development Department. (The Agricultural Department's line of control did not extend to the district level). Nevertheless the responsibility and initiative for agricultural development rested with the District Agricultural Officer, with the back up and technical support of the State Department of Agriculture.

7.2.5 The coordination between research and extension wings of the department of agriculture existed in respect to training programmes and the district trials of hybrid bajra varieties. There was

coordination between the research scientists and the seed production and supply system to assure timely and reasonably priced pedigree parents' seed supply. This was achieved in meetings. These were accompanied by an extension programme for making the farmers aware of hybrid bajra and its acceptance. The major instrument was that of field demonstrations (in every VLW's circle) all over the state through use of ready kits. Farmers' meeting, printed literature and radio talks were other follow-up efforts.

7.2.6 The commencement of hybrid bajra research and its first fruit, was a result of informal but direct link of the state research with the scientists of Rockefeller foundation in India. The male sterile lines absolutely necessary for hybrid bajra development was made available by them to the state's Millet Scientist who with the infrastructural facilities of the research farms of the state, developed the variety-Hybrid-3 which at one time, covered most of the hybrid bajra area not only in Gujarat but in most other states. The development of this new technology adaptable to Gujarat was possible because of the informal link across international boundary of a state organization. It is also significant to note that the National Commission on Agriculture (in 1976) had stated<sup>1</sup> that the more rapid growth rates of production of ~~xxx~~ crops (bajra was one) in India were for those crops where there were no central institutes of research either of Government of India or the Indian Council of Agricultural Research. The concept of All India Coordinated Crop Research Project of ICAR, was initiated

<sup>1</sup> National Commission on Agriculture, 1976 Report Part XI, p.44

for millets (bajra) about the time hybrid bajra programme was already evolved and the variety was widely accepted.

- 7.2.7 One of the other feature of early part of this Stage I was only a partial separation of the functions of supply of inputs from extension agency. Long term credit for farmers in most parts of the state was however already separate and entrusted to the Land Development Cooperative Bank. Likewise, disbursement of short term crop loans was a function entrusted to the cooperatives. The short term credit only in selected circumstances was however, disbursed through the channel of the Revenue Department. For the disbursement of subsidy at the farmers' end and funding was from development department(s) particularly agriculture. In respect of disbursement of subsidy for wells and pumpsets, or other inputs, the extension personnel of agriculture department were made responsible. The amount (mostly) was paid (or adjusted) to individuals generally through the cooperative and marketing agencies.

#### Stage II

- 7.2.8 The function of supply of inputs which was fully with the extension personnel was slowly channelized through the cooperatives. Fertilizer distribution was the first to be entrusted to the cooperatives (Gujarat State Cooperative Marketing Federation and its constituent bodies at the district, taluka, and village levels). Then, the department of agriculture at the state level acted only as intermediary of Government of India who were then

the sole suppliers of nitrogenous fertilizers. Likewise, the distribution of pesticides, almost all of which was subsidized, was arranged through cooperatives at the retail level. This arrangement had made the district level extension system free from the work of distribution and marketing of inputs; they were however, no doubt, concerned with planning their procurement and distribution.

### Stage III

7.2.9 The production, supply and marketing of improved seed was for many years carried out by the extension personnel. The infrastructure for production were the seed farms (over a hundred) - one for each tahsil. The exception (of considerable significance and of a large size) to this system was the improved cotton seed programme in Gujarat. Their certification and marketing had developed in the past two to three decades. The function of certification was by the department of agriculture and the marketing was by the cotton cooperatives. The distinguishing feature was also its financially self supporting nature. When the hybrid bajra and HYV programmes were initiated there was a major shift in policy - the function of their seed production and marketing was entrusted to the cooperative.

7.2.10 Production of parents' seed and certification, the two important links in the seed marketing chain, was carried out by the department of agriculture. All other activities related to production and marketing of hybrid bajra and other HYV seed was entrusted to a state level cooperative - the Gujarat State Cooperative Marketing Federation. In this arrangement, this organization was used for

all the related purposes, but with goals, detailed outlines and rules, defined by the state government for all important steps in the programme. These rules also provided for selection of seed growers, pricing, targets for seed production, distribution, and a departmental certification. The management of the programme and finances were however from the cooperative sector. In view of the large government intervention in the policy and programme and target oriented production, the Federation was insured by state government against financial losses if any, on condition that the programme was carried out as per directions given by the government from time to time. This insurance provided to the cooperative in the HYV seed business was instrumental in making available the large quantities of quality seed needed to fulfil coverage of targetted area. The primary responsibility of state department of agriculture in respect of hybrid bajra programme pertained to 1) planning production and supply of all stages of seed as per targets, 2) certification and 3) an extension programme for acceptance of hybrid bajra by farmers and 4) planned production of parents seed in quantities to match the need as per targetted production of certified seed for the targetted coverage of the variety. Obviously, the production distribution and marketing was based only on developmental goals, rather than on a market assessment and forecast for seed. In absence of any past cases and experience of 'marketing' of such seed, the marketing goals were to be reached as per needs of the targetted coverage.

7.2.11 At about this stage of development, the National Seeds Corporation was created in the country as a support for the national programme of HYV. Its creation further emphasizes the need for a production and supply line for seeds in a HYV programme. Without such an organizational arrangement, a longer time would have elapsed to build up a privately owned system not tuned and experienced to attend to the seed business of high risk, undefined areas for seed production and costly transport over long distance to lakhs of villages of a bulky commodity like seeds. (It is possible to argue that the country could have then followed the easier course of import and transplant of management expertise for seed programmes - as indeed it was thought of - from developed countries, by availing of services of private foreign seed companies. Pros and cons of such a policy was not an aspect of our review). The centralization of seed business in a central Corporation, in a country with poor transport and communication system, needs a comment. Earlier observation on seed supply to farmers (arranged by even state governments) had indicated frequent late arrival of seed after the optimum sowing time, which is critical in rainfed farming. This is more so if attempts are made to produce seed in distant locations and transport planned to consuming centres over long distances. As an economic principle, growing seed in more favourable areas cannot be questioned, but if it results in delayed supply, the advantage gets altered to high risk and a disadvantageous situation. Complaints about delayed supply of HYV seed was therefore not a new phenomenon in the Indian



context with the then existing level of development of infrastructure. In spite of this, due to inadequate organizational capacity for seed supply at the local level, dependence on NSC was an accepted system for HYV programmes by most states. The experience in regard to supply of both foundation and certified stage seed by the central Corporation was and continues to be same.

7.2.12 In the Indian context, independence from a central agency (and foreign country) is likely to be branded as parochial. However, the issue should not be disposed of in this pre-emptory manner, without weighing pros and cons and capabilities existing all over the country. Prior to creation of NSC, the entire business of improved seeds of grains and cotton was carried out by state departments of agriculture. The concept (of Central Government) of taluka seed farms in the early sixties, was also a recognition of the need for decentralization in seed production and trade, due to the limitations of infrastructure in the country for a centralized system. Added to this were some new problems of non-legal state barriers for movement of seed (as for grain) created by states themselves so that HYV seed produced in the state remained in the state. Even a specific declaration by Government of India - which had to be got issued - that certified seed movement is not restricted by movement control order for foodgrains, did not have the desired effect. This incapacity further endorses the need for a policy in favour of organizations for decentralized seed production.

- 7.2.13 Yet another issue is the relative ease of marketing non-hybrid HYV seed (e.g. wheat and rice), as compared to hybrids. The annual reports of NSC reveal a predominance of the former (60 per cent and more and a relatively smaller volume of business has been for hybrids. In this regard, one of the factors favouring centrally organized wheat and rice seed trade, is the difference in price of grain between the surplus producing states and deficit states (resulting from movement restriction and zonal system then prevailing). For other grains this was not that important and the price difference would not support a large central organization with its usual accompaniment of high cost of overheads and long distance transportation cost. The result was a larger interest of the central organization in HYV of wheat than of bajra, maize, and jowar. The supply of the latter three got limited on this account. The other reasons were the inherent technological problems of hybrid seed production and maintenance of seeds of parents of pure hereditary lines involving male sterile lines.
- 6.2.14 Gujarat has been traditionally a food deficit state. The major reason for food deficit in the state is its focus on the highly commercialized agriculture such as of cotton, groundnut, tobacco and other non-foodgrain crops. In each of these, <sup>the state</sup> is self-sufficient for seeds. For cotton, even prior to the advent of hybrids, a seed production and marketing programme existed for a million hectares. There was also a seed supply system for tobacco,

The former managed by cooperatives was supported by the technical assistance from department of agriculture, in the form of supply of breeders' seed, and a certification service. The state, therefore, opted for a hybrid bajra seed programme through local cooperatives. The purpose of dealing with the changes in seed supply system at length is to emphasize that a hybrid promotion programme is more likely to succeed if it is suitably backed by a sound seed production and marketing programme suited to the available level of local infrastructure.

#### Stage IV

7.2.15 The establishment of the Gujarat Agricultural University was the next important change in the agricultural development organization of the state. The statute enabling creation of the University was passed in 1969 and the University was established in 1972. This resulted in delinking of the academic functions of the agricultural colleges (and others) from the traditional universities to the new university and also transfer of responsibility of research to the Agricultural University from the State Department of Agriculture. One of the important objective of this type of university was integration of research, education and extension. The Agricultural University by its statutes considered all the research - and also extension staff as teachers. However, many of them were located on research farms, scattered out of necessity in different crop zones, and therefore entrusting them teaching tasks was not (and has not been yet) achieved. Acceptance of a policy of total integration of research

and education would be easy in states with less agro-climatic diversity and crop pattern and with corresponding need of few locations of research stations. (In Gujarat as many as 14 crop zones have been identified.<sup>2</sup> Regarding tasks of agricultural extension most of the functions of training of trainers was entrusted to the University. When the organization of research was transferred to the agricultural university and the department of agriculture continued to be the primary extension agency, need of coordination became important between these two separate organizations. This is discussed separately. The university however, was entrusted with almost all the responsibility for training which is sometimes, erroneously called extension education.<sup>3</sup>

7.2.16 The organizational situation which prevailed prior to delinking of extension and research and creation of a university, the activity of adaptive trials - formerly called district trials - had firm administrative mechanism. This link having been severed after the creation of the University had to be reformed and given a new shape, which does not seem to have been achieved, thus resulting in a weak link with possible far-reaching consequences. In order that research workers continue to have contact with farming situation, their participation in National Demonstration Programme (an ICAR Project), and training, as also farmers' training (more by way of participation in such programmes organized by the district extension staff) are being arranged. This again becomes an important area of coordination, needing organized linkages.

<sup>2</sup>Gunwant A. Patel, G.B. Kasad and R.L. Shah, "Crop Zones of Gujarat Department of Agriculture", Technical Bulletin No.36, pp.26

<sup>3</sup>(Agricultural) extension is synonymous with extension education but sometimes training of trainers alone is termed as extension education.

- 7.2.17 The creation of agricultural university has disassociated its researchers from the proximity and possible direct communication with teachers and researchers in basic sciences in the traditional universities with which the agricultural colleges were formerly affiliated. It is true, however, that when the agricultural colleges with its teachers-cum-researchers were affiliated to the traditional universities, this possible linkages were only beginning to be developed. The separate legal and physical identity given to applied sciences in agricultural universities and a similar set up for basic sciences in traditional university will be a handicap for development of research in its comprehensive sense. As to whether this will prove to be a disadvantage on a national scale, only future will reveal. Nevertheless some remedial measures to bring both these types of institutions on the same platform will increase their potential and output and improve agricultural growth rates by serving both science and technology for the good of the country.
- 7.2.18 The creation of the agricultural university with the combined functions of research and education and also extension did not clearly define its responsibility in the seed supply system. (No mention is made thereof in the Act creating the university). Prior to the stage of its creation, there was integrated functioning of supply of breeders' seed, production of foundation seed, and the certified seed, which gave way in the next stage without committed and organized linkages. In the bajra development programme wherein supply of hybrid seed is the base, the seed (of all stages) supply

system has to be properly organized, with clear responsibility and linkages so that the complex seed production system would function. In this Stage IV, the original links were not only severed, but the insurance against losses to the cooperative (para 7.2.10) was withdrawn. At the same time government committed to finance (and also bear all the risk - instead of only an insurance) a seed programme through a State Seed Corporation. Originally created to develop the foundation stage seed programme, which was not (and is not yet) satisfactorily organized, the seed corporation, also entered into a business of certified seed production and marketing. The weakened link of supply of foundation stage seed which it was to rehabilitate remained stagnant; as a result, the inadequacy of availability led to import of foundation stage seed from other states (1982). An estimate recently made has revealed that 68 per cent of such seed (value terms) used in the state was from sources other than the Gujarat Agricultural University and the State Seed Corporation (in contrast in the beginning of the programme total supply was from state research stations). The Corporation depends for marketing and distribution of its production on cooperatives, which are affiliated to a Cooperative Federation also in the same seed business for the past 15 years. Seed supply function of the Corporation, instead of following its own channel crosses over to cooperative organization thus not necessarily expanding the availability of HYV seeds in villages. Apart from any ideological overtones, such a system can create

consequences of serious types to both the corporation and the cooperatives, besides affecting the development of seed trade. One of the important (resultant) change is in regard to shares of institutions and private seed supply agencies. There has been an expansion of the latter, and as many as 70 private agencies are now in this business, mostly depending on foundation stage seed from sources outside Gujarat State.

7.2.19 Seed Certification Agency: Since the beginning of the department of agriculture, seed certification on a voluntary basis (particularly cotton and also hybrid bajra) was being carried out for a few crops. After the enactment of the Seed Act, an agency was set up within the department of agriculture. The standards for certification were developed for a few crops including that of hybrid bajra, cotton etc. In this important area of work, the state crop research specialists had a major role in prescribing standards of purity of variety - (rather than physical purity) which under our conditions was the most important criterion. The standards for germination were arrived at on the basis of actual experiences and were high due to relatively dry weather at harvest time. The agency as a part of departmental organization continued up to 1980, when an 'autonomous' body was created. Its policy-making body consists of a Board consisting of 14 members all appointed by state government. They include a seed producer, a farmer and a seed trader, five government servants and three representatives of Agricultural University, and one each of State Seed Corporation, and Cooperative Marketing Federation. Most

of its staff including; the managing director and other executive staff are loaned from state department of agriculture. The funds are fully provided by the state government, and the chairman appointed by government holds the office until (in practice) the party in power which appointed him continues to be in ~~the~~ power. In view of this, it can hardly be called autonomous.

### 7.3 Comparison of Rajasthan and Gujarat

7.3.1 We have dealt with the divisions and redistribution of function in Gujarat in some detail. As the basic structure of the organization, would be similar in the two states, we have tried to emphasize the differences in this section, at the same time salient points are not missed. A sequential examination of events in Rajasthan reveal changes of the same kind as in Gujarat, and therefore need attention in respect of the time frame only. The Chart VII/1 depicts a comparison of changes in respect of periods of occurrence in the two states. Creation of these organizations can be considered as necessities for growth, and the later creation of many institutions including the one for seed marketing in Rajasthan parallels the slow growth of hybrid bajra in that state. (Elsewhere we have already referred to the RBI index of infrastructural development in Rajasthan of a lower order than Gujarat).

7.3.2 One can look at this not only from the number of multiplicity of organization, but whether in early stages, specially when new technology is introduced, the importance of all related functions is recognized and satisfactory organizational arrangements are made



to fulfil these tasks, however small or big they may be. Some of them like research have long gestation periods and therefore the earlier these arrangements are made, their development and growth are likely to be quicker. However, when a technology is available (as accepted in case of Rajasthan for HYV bajra) the two systems 1) agricultural extension and 2) seed supply are vital.

7.3.3 Importance of extension system and the need for seed supply system for agricultural development have been accepted for long. In regard to the latter, the chain of seed farms set up earlier than the advent of HYV is a proof thereof. However, the seed production system set up for non-hybrid varieties of cereals and cotton as then organized, does not seem to have responded to the new types of demands thereon by the technological peculiarities of hybrid seed production programme. The essential needs of this programme, was large blocks under seed plots (to allieviate the problem of required isolation to prevent pollination from neighbouring crop fields, and thus ensure purity) and specialized guidance to seed growers and supervision during growth period, harvest and processing of seed crop and the difficulties associated in producing and providing parent seed. The additional problems are the high risks for both seed producer and the marketer in the early stages of introduction, when risks are not quantifiable for the local agro-climate.

7.3.4 India is a vast country with varying agro-climate and soil types. Fulfilment of research needs of each area cannot be met from centralized institutions (Their role, as well stated by the National

Commission on Agriculture, is for basic research). The observed dependence of the departments of agriculture of states on central institutions, is a consequence of inadequate allocations of resources by the states (See Tables 6.1, 6.5, and para 6.6.2) from their own resources. Building a research organization, usually would (and should) begin with development of research personnel. Their training would be the primary need. This aspect is often taken for granted but a planned approach is necessary in assuring availability of the type of personnel and their ~~pla~~ training. The physical facilities have to be timed in accordance with personnel plan and the need assessed on soil and agro-climatic consideration. In regard to a federal state with agriculture as a state subject this has to be for each state and financially supported by them and only if necessary supplemented by other sources such as the Central Government or institutions abroad. Allocations of resources would not only pertain to personnel, physical facilities and financial resources but foreign exchange would also be an important element for equipment and training of personnel abroad, as indigenous facilities in early stages of development are usually inadequate.

7.3.5 One of the principle of good organizational system is the absence of overlapping responsibilities. This principle needs to be analysed in respect of a few aspects of agricultural development organizations. One of this is the research responsibilities of the central and state institutions. The problem is more complex, when viewed in the context of the Constitution. It has included

'agriculture' in the state's responsibility, while 'research' in general is in the Union's schedule of responsibilities. Visualizing the possibility of overlapping development that may take place in agricultural research, the National Commission on Agriculture identified the respective responsibilities for basic/fundamental research, applied research and adaptive research. The centre--according to the Commission--was to look after basic research and play a coordinating role. The applied research was recognized as the responsibility of state institutions--particularly the agricultural universities. The adaptive research was to be conducted by the state.. department of agriculture.

Chart VII

Comparison of Gujarat and Rajasthan in Respect of Years of  
Creation and Involvement of New Organizations for Agricultural  
Development

Year	G U J A R A T		R A J A S T H A N	
	Area under HYV bajra	Organization	Area under HYV bajra	Organization
Prior to 1960		Department of Agriculture Cooperative Bank Land Development Bank		Department of Agriculture Cooperative Bank Land Development Bank
1961				
1962				
1963				
1964		Cooperative for input marketing		Rajasthan Agri- cultural University (University of Udaipur)
1965				
1966				
1967		Cooperative for HYV seed marketing		
1968				
1969				
1970				
1971				
1972		Gujarat Agricultural University		
1973		Land Development Corporation, State Seed Corporation		
1974				
1975				
1976				State Seed Corporation
1977				Autonomous Seed Certification Agency
1978				
1979				
1980		Autonomous Seed Certification Agency		

## CHAPTER VIII

### CONCLUSIONS AND COORDINATION

8.1.1 The comparison of the systems participating in the hybrid bajra programme in the two states of Rajasthan and Gujarat reveal differences pertaining to structures of the organizations, investment policy and time of their creation and coordination between them. The first three have been described in earlier chapters and coordination will be described in the latter part of this chapter. Before undertaking this, some of the major findings in respect of structure and time of creation are summarized below:

8.1.2 The development of agriculture is a state subject in the Indian constitution. It is expected that the states apply their resources to this area of development.

8.1.3 Gujarat in the past had invested in a large number of research stations some of them specifically for bajra in its large semi-arid part. This seems to have led to development of varieties more suited to this zone, and has been easily accepted. An analysis of success of hybrid bajra in the state reveals, that it is in this very region - semi-arid - the hybrid has flourished the most. The arid zone which suffers from inadequate infrastructure for this purpose has lagged behind. Like most of Rajasthan, and in arid part of Gujarat, the spread of hybrid is not adequate. There is also a dearth of data from testing stations in this region; consequently, the states averages in all respects over shadows the slow spread of hybrid

bajra in arid part of the state. The prevailing climatic condition with larger risk of failures of sowings, necessitates, more steps towards seed distribution than the insurance cover provided to the state nominated seed marketing organization. Insurance cover for farmers in respect of full cost of seed can be one alternative solution.

8.1.4 In regard to bajra research in the beginning Gujarat had applied its own resources for the programme and continues to do so. In both states the crop has a large share of GSA, but Rajasthan's share in bajra research has been much lower than Gujarat. The relative efforts of the states, had a corresponding differential impact in both the states. This raises important issues in regard to the place ICAR's coordinated programme should have in the total effort. The crop is spread over two climatic zones in Gujarat and over three zones in Rajasthan, covering a total of 7.2 million ha. Question arises whether centrally directed single point effort can prove adequate without corresponding efforts in the zones and sub-zones relative to the size of zones.

8.1.5 Indications are that new parameters are to be drawn for selections of varieties suitable for these areas in both the states. This however does not seem possible under the current dependence of bajra research system on only ICAR's coordinated scheme in both the states. For Gujarat State desirable tilt can be achieved with less cost as some basic facilities are already available for other purposes in the arid part of the state, and can be utilized for bajra research. Rajasthan however will need a major policy decision to provide the required infrastructure for its vast arid part.

- 8.1.6 It is also observed that Rajasthan has been using their own resources to a lesser extent than Gujarat for agricultural development in general and for Bajra in particular. This has resulted in an inadequate infrastructure for research, particularly, appropriately located research farms and trained manpower in that state. The inadequacy extends further to the support for extension education by the University to the extension department.
- 8.1.7 The past and present policy of Rajasthan State and current policy in Gujarat to depend on ICAR for its research effort on bajra crops, has its inevitable fall out. The coordinated trials of the ICAR project, which have national perspective, cannot cater to the varied agro-climatic requirements within each of the participating state. It can emphasize the common denominator expecting the constitution of an integer suitable to each state to the enterprise of the latter. States complementary effort is therefore essential, specially in the identified agro-climatic zones with its own technological needs. This is specially so where the crop's area is large, though the principle applies equally and forcefully to even small identifiable pockets where the crop is grown and has nevertheless different requirements.
- 9.1.8 The arid zone of Rajasthan has received little attention in respect to arrangement for research, extension services, and seed supply. They are practically absent. Question therefore arises whether suitable variety will develop which can satisfy the quantitatively (and to some extent qualitatively) different needs

of the arid zone, from the existing research organization. (For example arid zone has few other cultivated fodder resources other than bajra, which therefore necessitates emphasis on both yield and quality of its fodder). It is felt that such aspects left to chances of spotting of adaptable cultivation for arid area, in other better endowed areas, will take longer than if a major organizational reorientation is made so as to respond to the local needs of the particular zone. This will be in the nature of not only changing the objective of the breeding programme, but also creating facilities within the region for not only breeding them but testing them at many locations in the zone with large geographical area. Likewise, the extension approach will have to be built to cater to the distinct needs of an area where economy is integrated between farming and cattle rearing. It cannot be denied that this area of agricultural development work needs particular attention in the arid zone.

8.1.9 Within the existing organization for research, suitable changes to cater to the distinct needs of different agro-climates, and socio-economic situation are required, so that feed-back from farmers are correlated to the distinct situation, and the research is oriented to these needs.

8.1.10 A temporary expedient would be the development of capacity to summarize state's varietal trial results obtained from sub-station, after weighing them for crop area of the region to which the station caters to. The performance of varieties which appear outstanding on research stations in semi-arid regions when so



weighed down (due to its relatively smaller area than arid) will help in arriving at more equitable decision for the state as a whole. There is however no substitute for trials within the zone itself.

8.1.11 The extension organization in Gujarat provided for organized public participation in the programmes in the form of Panchayats with statutory responsibility. In Rajasthan, the dependence is essentially on the public servants. For regions with long channels of communication, without adequate infrastructure public participation at village level is a valuable asset for extension programmes. As for research, the semi-arid region is attended better by the extension personnel. Indeed the Training and Visit System, has demarcated area of activity which excludes the arid part of Rajasthan state. The attention which is planned for the semi-arid part and better areas for agricultural extension is reminiscent of the policy for selecting districts for Intensive Agricultural District Programme (IADP) in the country. The lessons learned from the latter do not seem to have been used for determining the policy of T&V setups. The institutional framework for extension work in the arid region (which has usually the same pattern as in other parts), needs special attention as even longer distances are involved because of thinly distributed population, and large uncultivated lands interspersed over the region.

8.1.12 The seed supply system is crucial for a hybrid variety extension programme. This is not so for non-hybrids such as HYV wheat and rice. Resowing of crops - particularly in arid zone - due to frequent failures of rains at sowing time adds to the strain on the

supply system, which is already stretched beyond the economic level in a situation of long distances, with poor transportation.

- 8.1.13 The reliance of the state authorities on outside seed supply agencies (for production and supply of parents seed as well as certified seed) has been different in the two states. The GOI established the National Seed Corporation (NSC) with a concept that it was essential for the HYV programme. However, the share of hybrid seeds in its total sale has been always less. Much of it has been for non-hybrid HYV wheat and other crops, where the ease of production and the zonal system with movement restriction of foodgrains distribution then prevailing, resulted in a price spread pattern which conferred organizational advantages to a central organization with easy access to permits, and transportation. The hybrid bajra programme was constrained for many years due to short supply of both parent and certified seed.
- 8.1.14 In Rajasthan, the inadequate spread is attributable - amongst other causes - to a total dependence on such outside sources like the NSC, and a late development of local seed agency who would be authorized to take reasonable risk in programming seed supply.
- 8.1.15 Rajasthan, until lately, depended totally on centralized sources of seed while Gujarat built its own production and marketing system, with a state insurance for risks in HYV seed marketing. The problem of timely availabilities of quality seed, was eased in the latter state, while Rajasthan had to remain a co-sharer of shortages which is possibly one of the causes of the slow growth of hybrid bajra in the state.

8.1.16 Early success of hybrid bajra programme in Gujarat is attributable - in addition to other causes - to an organized local seed supply by a non-government cooperative with extensive marketing channel extending to interior rural areas. The uncertainties of marketing hybrid seed and concomitant financial risk necessitated, as was done in Gujarat - an insurance to the marketing agency for losses if any, in an otherwise tightly controlled production, marketing, and certification programme. Avoidance of dependence on distant sources of seed supply is absolutely necessary in a situation where communication systems are poor. Creation of state seed corporation in essence indirectly provides the former by the state's investment in the share capital of the organization as also a proximate source of supply.

8.1.17 Risk and investment for seed supply has to be understood and planned if a programme of HYV is to have a rapid thrust. (Dependence on market intelligence for rationalization needed in a commercial undertaking, will follow such initial thrusts achieved at some risk and cost by public exchequer). Public intervention in a seed supply system, with distinct possibilities of unforeseen heavy losses is imperative if a rapid spread is aimed at. Leaving it to only commercial operations (even in case of agencies like cooperatives or government corporation) without state's specific support to safeguard losses will result in slow growth. This principle shall apply equally to parents' seed related to certified seed programmes.

- 8.1.18 The extension system in India is particularly prone to result in creation of demand of inputs - including hybrid bajra seed - in scattered thinly dispersed locations. If such a demand is to be fulfilled cost of marketing will be higher than what is usually planned as a profitable marketing strategy. It is also accompanied by risks incidental to entry in areas relatively unknown in respect of demand. In such situations public support to seed agencies should be to such units which have their market channel extended to interior rural areas. It will not serve any purpose if such a support is given to units catering to only favoured locations from marketing point of view. Even disincentives for such locations would stimulate extension of channel to less favoured area (particularly in situations where supply is inadequate) without endangering achievement of targets in such areas. Uniform subsidy to farmers is also not conducive to achievement of regional or intra-regional targets, as subsidy would also be absorbed more readily (and with greater advantage) in favoured locations.
- 8.1.19 We have emphasized a few aspects of working of hybrid seed marketing programme, in case of bajra, as it is predominantly an unirrigated crop fertilized *only* to a small extent. However, for other crops and production programmes, supply of fertilizers, credit and pesticides will be vital and therefore there will be need to support their distribution on the same principle. (it may be recalled that in early stages of fertilizer and pesticides growth, the entire transport cost and risks were borne by government).

The type of agency to be supported can be decided on the basis of least cost to public exchequer.

8.1.20 In developing situations, decision to organize local institutions for research, extension, and also supply appears to be vital for rapid growth. Further, suitable demarcations of areas with distinctive climate, soil, and socio-economic needs are necessary and orientation of research objectives and programmes should be tuned to their needs. Even in states of the sizes studied, over centralization, is likely to create impediments resulting in longer time span for development of new suitable varieties and their acceptance. A more thorough agro-climatic cum economic divisions of the state, along with definition of their crucial needs, seem necessary for locating research centres and fixing research objectives than has been the case in both the states. The cursory manner in which these aspects have been handled in the past and its inadequate application seem to be at the root of differential spread of hybrid bajra, between the two states and within the states.

8.1.21 Our study extended to technological details to the extent certain major policy issues were involved. One other such factor was rainfall. We have used average annual rainfall in comparing the climatic regions of the two states. This cannot be considered adequate, as commencement and withdrawal of south-west monsoon provides important parameters for plant breeding in Western India. In this context during discussion with many research and extension personnel, we were informed that International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).

is to them an important source of technological output in crop breeding and planning. The possible advantages flowing from such sources are many and recognized. However, we would like to point the special care needed in such process, when the potential evapotranspiration and rainfall pattern of Hyderabad and locations in Gujarat and Rajasthan are different as shown in Appendix VIII.

### 3.2.0 Coordination

- 8.2.1 In the hybrid bajra programme, the national perspective requires participation and coordination of many agencies. These are: 1) research organization, of the State Agricultural Universities and ICAR, 2) Millet Breeders of the Universities for ensuring supply of parents' seeds of the released varieties, and in Gujarat the State Seed Corporation which was specifically created to ensure supply of foundation stage seeds, 3) the seed supply and distribution (where they are separate) agencies (including those nominated by the state government and the centre) and private seed companies, 4) extension agencies of the State Department of Agriculture, the Agricultural University, the Panchayats and corresponding authority in the Ministry of Agriculture GOI and 5) credit institutions.
- 8.2.2 In other agricultural programmes, usually the manufacturers and supply agencies of fertilizers, pesticides, and irrigation department need an equal emphasis as the rest: but in case of hybrid bajra programme, due to the crop being a low income crop in dry farming region, their importance is not crucial. (However, when any common coordination system for agricultural development is being considered, all these will have to be integrated at a prominent place).

- 8.2.3 Coordination is an oft spoken word in India's agricultural administration. The constructive philosophy in smoothening progress implied in the process is however rarely emphasized. The participating agencies often consider the process as only a hindrance to their actions, rather than an arrangement to anticipate and solve the emerging problems of programmes with large and national objectives involving many, otherwise independent, agencies.
- 8.2.4 Such programmes have to have numerous organized systems to back the programmes' objectives. These systems have an identity and each one of them is managed by separate authority, often only administratively, but also sometimes statutorily. The administration or its objective, and the statutes where they exist for the purpose, do not prescribe coordination as an objective nor identify and define an organizational system by which coordination is to be achieved. The identity of individual agencies has however grown over decades of their existence. There is little inter-agency mobility of personnel, and hence the thinking of the latter gets oriented and fixed at the objectives of the institutional agencies in which they work, which are necessarily narrow and fall short of the large national objectives of the same programme. In a country, where organizations have these characteristics, it will not be surprising if programmes stagnate due to inadequate coordination or its total absence. The tendency to entrust the work of coordination to personnel not familiar with any of the coordinate organizations is another form of avoidable impediment in implementing the programmes requiring multiple agencies.

- 8.2.5 Coordination is usually considered when programmes begin to be implemented. However, it is equally if not more important to ensure it, at the planning stage of the programme. It is at present not unusual to plan research and extension programmes on assumptions of coordinate systems responding automatically to the set course and targets. Besides negating the planning process, the result is throwing up of problems which may appear new, but could have been anticipated and steps to remedy could have been a part of the plan of the project itself.
- 8.2.6 The plan for a project, besides defining the responsibilities of different agencies and extent thereof, should not leave the input supply system to decide their role purely on market forces. In developing agriculture, where inputs enter new areas, the knowledge of marketing is usually inadequate and risks appear large. To back up the extension programme, wherein the government invests huge sums, adequate financial and insurance support to marketing agencies is vital if success is to be achieved. Entry of government corporations and assistance and insurance to cooperatives, and subsidy to farmers, have been the main approaches to the solution of the problems. Less expensive alternatives are possible and should be also considered. Such assistance should be a part of the project plan.
- 6.2.7 The importance of coordination is far more in supply of seeds where advance planning and timeliness of supply are crucial to the success of the programme. Change over of varieties without a notice of



several seasons would lead to unsold inventory of outgoing types, creating serious problems of cash flow for the supplier and financial risk and indeed endanger the stability of a seed company. Under Indian conditions this situation is frequent where producers are heavily and almost totally dependent to public non-enterprise systems for forecasting demand. These systems with the aim of achieving targets at "any cost", not realizing that the supply system trying to work on supply and demand economics, would land themselves in financial breakdown if targets alone were the consideration. The experiences of marketing agencies in India suggest that this is an important fall out of the system and entrepreneurs, either in seeds (more particularly), pesticides or fertilizers should not get fully guided by the grandiose plans.

8.2.8 The coordination committee for seeds existed in Gujarat, but later on, this function was shifted to a statutory committee meant for issues like seed quality required under the Seeds Act (GUI). Its membership include institutional representatives of seed certification agency, the agricultural university, department of agriculture, cooperatives, and persons in the vocation of farming and seed business. The comprehensive composition is commendable, however, the capacity to act by each of them after the discussions are taken are greatly limited by the powers each representative enjoy in their respective organization.

8.2.9 The role of coordinating committee for seeds, in addition to the normal function of coordination of the annual programme, has to

provide a forum for a discussion on results of trials of oncoming varieties. The validity of the results for a marketing programme will be greatly dependent on adequacy of geographical spread of these trials (on institutional farms and farmers' field) so as to give accurate results of varietal responses in various agro-climatic zones.

8.2.10 According to our study of hybrid bajra in Gujarat inadequate attention to this aspect seems to have been one of the reason why the hybrids have not spread satisfactorily (been accepted so well) in the arid zone. Reorientation of these trials is called for in this regard. Arranging such trials is the function of the agricultural university and the Department of Agriculture and the Panchayats. A coordinating committee with all the powers to coordinate these trials is urgently needed. The trials can be more effectively laid out by the Department of Agriculture and the Panchayat, due to their widespread contact in rural areas. Secretary of the committee should be from this Department and adequate financial support (which cannot be high) for these trials should be provided to him. These trials should serve both the purposes of comparison of new varieties with the existing ones, as also serve as demonstrations to farmers and to seed marketing agencies.

8.2.11 After the creation of agricultural universities, the problem of coordinating research, particularly the issues of broad objectives and determining priorities have remained unattended. The Legislative Act under which the universities are created do not specifically provide for this important function. It is sometimes stated, that

representation of the extension department of agriculture, on various bodies of the universities, should be adequate for the purpose. Keeping in view the large geographical area which each of the agency caters, there is greater need of such coordination at various levels. Rajasthan State has attempted such a course. By a government resolution, state and regional level committees which include representation of the agricultural university and the State Department of Agriculture, have been constituted. They can provide the required forum for coordination between research and extension organization. It will be of interest to watch this experiment as a way of achieving coordination. In the meantime, it would be worthwhile to also entrust the function of coordinating the trials of new varieties and other recommendations on farmers' fields to this committee. Indeed, this should be considered as its most important function as it is an important link between the research and the extension systems.

8.2.12 On the other hand, in Gujarat attempt at coordination for the institutional training of farmers (and trainers) is made by the University. This is provided for by committees at various levels in which the three concerned agencies - viz., the agricultural university, the Department of Agriculture, and the Panchayat - are represented. At the state level, there is an extension council, and at regional and district levels, committees attend to planning of this type of extension work. They can and do perform coordinating role. Between the agricultural university and the Department of Agriculture, however, there is no arrangement for coordination for the extension programme of the latter, particularly on the farm programmes which are not institutional.

- 8.2.13 After discussion some important aspects of coordination in the hybrid bajra programme, we have felt it appropriate to list the salient features of each part of agricultural programmes cutting across many agencies, needing coordination. For each item like fertilizers and seeds etc., these are given in Table 8.1. For similar reasons, we have also discussed though briefly the broad issues as generally applicable to all these and a few suggestions are offered at the end. By no means, we have covered the entire ground.
- 8.2.14 The main form of coordination is a committee, with representations of agencies concerned. The level by which each agency is represented determines whether the decisions of the coordinating committees prove to be recommendatory or will be acted upon straight away. Obviously the process is linked with devolution of powers in regard to policy making in each participating agency/department. It is characteristic of Indian administration that delegation of powers usually only relate to execution and not to policy making. It is also true, that the administrative line dividing the policy making function and execution has become massively irregular with inroads on either side. The extent of inroads, varies with such factors like individual's capacity and interest in the topic under reference; the organizational frame has less influence.
- 8.2.15 More often, the committees attending to the finalization of programmes achieve a status of coordinating body. This is so as far as determination of targets and corresponding manufacturer/production, supply and transportation capacity is concerned. Besides reduction

or increase in targets few operational issues are considered by these committees. They usually meet prior to season and only on rare occasion assemble and decide the emergent problems during the working season. The other reason for ineffectiveness of committees for coordination is the absence of efforts for coordination during planning of the programme and implementation.

8.2.16 The whole process of so called coordination more often becomes an educational process to know the others' point of view. This knowledge helps to arrive at a view on the topic. As to whether the decision is an accepted fact by all participants remain an altogether different matter. The participants then take stand on the topic in their organization. It is not uncommon for the participant to arrive and/or agree to one conclusion in the coordinating committee but take a different stand in his capacity as a member in his own organization which he represented in the coordinating committee. The process of arriving at a decision is again gone through within a department in absence of other coordinate agencies. This not only adds to the total time for arriving at often the same decision again, thus delaying the execution of the programme itself, in addition to negating the principle of coordination itself.

8.2.17 In view of these observations some of the steps which can make the present system more effective are the following:

- i) Introduction of element of coordination at the inception of the plan for research or extension for agricultural programmes

ii) Strengthening the coordinating committees by entrusting specific powers either administratively or statutorily so that decisions are binding to all participants.

iii) Representation on the committees should be only by those who have powers to take decisions in their own departments/agencies.

A similar report on hybrid maize will be included in the <sup>final</sup> monograph.

Table 8.1

## Main Features of Coordination in Agricultural Development System

Area needing Coordination	Levels concerned	Organizations/agencies concerned	Mode of coordination
(1)	(2)	(3)	(4)
<b>Fertilizers</b>			
Import Policy Farming	Government of India (GOI)	Ministry of Chemicals and Fertilizers Ministry of Agriculture Ministry of Finance and Economic affairs	Committee and sub-committee
Imports Execution	Government of India Ministry of Agriculture	Food Corporation of India, Department of Agriculture (GOI)	Government of India, Ministry of Agriculture
Allocation to States (Policy and execution)	Government of India Ministry of Agriculture	Ministry of Agriculture, Railway Board, States' Department of Agriculture, industry	Annual or biennial conferences
Allocation within a State: Policy framing	State	Secretariat	?
Allocation within a State: State Execution	State	Secretariat, Department of Agriculture, industry, state sponsored marketing institutions	?
Allocation within a district policy	District	Agricultural wing of Panchayat	Production Committee
Execution	District	Marketing agencies industry	

Table 8.1 contd...

(1)	(2)	(3)	(4)
<u>Seeds</u>			
Release of varieties	GOI	ICAR, Ministry of Agriculture, (Seed industry)	Statutory Seed Committee
	State level	Agricultural University, Department of Agriculture, State sponsored marketing Organizations, (Seed industry)	Statutory Seed Committee
Production and distribution programming:		National Seeds Corporation, Ministry of Agriculture, ICAR (Seed industry)	? (Annual conference)
i) Breeders' Seeds,		State sponsored marketing organization, Department of Agriculture, Agricultural University	Meeting ?
ii) GOI Foundation stage seeds,			
iii) Certified Seeds	State level		
<u>Farm Production Credit</u>			
Determination of norms for crop loans	State level	Lending agencies, Cooperative Department, Agricultural Department	Committee
<u>Pesticides</u>			
Imports Policy	GOI	Ministry of Chemicals and Fertilizers, Ministry of Agriculture, Ministry of Industry, Ministry of Finance, Economic Affairs.	Discussion and meeting
Imports Execution	GOI	Ministry of Chemicals and Fertilizers, Industry	Discussion and meeting
Production policy	GOI	-do-	-do-
Production execution	GOI	-do-	-do-
Distribution policy	GOI	Ministry of Agriculture, Industry, State Governments	Annual meeting
Distribution execution	GOI	-do-	-do-



Appendix VIII

## Comparison of Ahmedabad, Jodhpur and Hyderabad

Month	Potential Evapo-transpiration mm.			Average Monthly Rainfall mm		
	Ahmedabad	Jodhpur	Hyderabad	Ahmedabad	Jodhpur	Hyderabad
June	190.8	260.3	196.4	72.3	25.1	103.0
July	131.0	184.0	140.4	378.2	105.0	173.4
August	116.7	145.2	135.5	179.5	118.4	92.7
September	133.7	156.1	119.3	82.2	71.2	177.2
October	139.6	134.3	123.6			