A MULTI-DIMENSIONAL STUDY OF ADOPTION OF *JOWAR* WITH REFERENCE TO THE TECHNOLOGICAL GAP

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CERTIFICATE

This is to certify that the thesis entitled, " A MULTI-DIMENSIONAL STUDY OF ADOPTION OF JOWAR WITH REFERENCE TO TECHNOLOGICAL GAP " submitted to the Faculty of Agriculture, Mahatma Phule Agricultural University, Rahuri, District : Ahmadnagar (Maharashtra), in fulfilment of the requirement for the degree of DOCTOR OF PHILOSOPHY (Agriculture) in AGRICULTURAL EXTENSION, embodies the results of a piece of bonafide research work carried out by Shri H.S. Bhoite under my guidance and supervision and is of a sufficiently high standard to warrant its submission for examination and award of the said degree. No part of the thesis has been submitted for any other degree or diploma or published in any other form.

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Date : February , 1983.

CANDIDATE'S DECLARATION

I, hereby, declare that the thesis entitled " A MULTI-DIMENSIONAL STUDY OF ADOPTION OF JOWAR WITH REFERENCE TO THE TECHNOLOGICAL GAP " , submitted for the degree of DOCTOR OF PHILOSOPHY (Agriculture) in AGRICULTURAL EXTENSION, of the Mahatma Phule Agricultural University, Rahuri-413 722, District : Ahmadnagar, Maharashtra, India, has not been previously submitted by me for a degree of any other University.

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CHAPTER I

INTRODUCTION

CHAPTER I

THE PROBLEM

" Unapplied scientific knowledge remains
an unrealised public investment ".

- Rogers and Jain (1969)

INTRODUCTION

In the present era of science and technology, transfer of technological innovations in traditional agriculture is one of the basic elements of all rural development programmes in India. The need for directed efforts to persuade farmers to adopt new ideas and practices has been realised by those concerned with modernisation of Indian agriculture for a long time. Several attempts have been made in this direction. On the basis of experience and continuous research, there has been a shift in the strategy from one Five Year Plan to another.

1.1 AGRICULTURAL DEVELOPMENT ; A COMPLEX PROBLEM

During the First Plan, the strategy for raising agricultural production was mainly designed towards bringing in more area under the plough and extension of irrigation facilities. During the Second Plan, while this approach continued, stress was laid on the use of

agricultural inputs, viz., fertilizers, seeds, pesticides, fungicides and like. In the Third Five Year Plan period, the concept of Intensive Agricultural Development Programme emerged with a view to developing the package approach for selected areas and crops. Then came the High Yielding Varieties Programme and greater stress was laid upon increased use of high yielding seeds, fertilizers and plant protection measures along with efficient water utilisation for irrigation purposes. This approach continued in the Fourth Plan period. The Fifth Plan laid special emphasis on integrated area approach. As a result of these efforts, there is a substantial increase in the overall food production in the country i.e. from 50 million tonnes in 1949-50 to 131.5 million tonnes in 1978-79.

Though there is an increase in food production, there exists a great gulf between the potential of agricultural technology to increase production and its adoption by the farmers. Even though enough technical information is generated at the agricultural universities and various other institutions, there exists a wide gap between the research findings available for the farmers and their acceptance and integration in the farming system. Guba (1968) observed, " There is a tremendous gap between knowledge production and knowledge utilisation ". Scientific research results are not put into

practice or at least not as rapidly as we might wish them to be.

Singh (1976) has stated that adoption of new technology is multidimensional, involving as many as 71 factors, which have been grouped into four categories - client orientation, environment, technology and communication variables.

Several factors act as barriers to adoption of improved technology. Research has shown, why farmers accept a certain form of technology and not another. The major acceptance motives are economic profitability, relative advantage in respect of yield, time, labour etc., attainment of goal, security, problem solving, while the reasons for non-adoption are lack of information, lack of facilities for marketing of output, financial limitation, labour scarcity, lack of assured irrigation and the risk and uncertainty involved in the use of innovations. The difference between these two situations creates a technological gap. The fundamental objective of extension strategy is to promote adoption of technology by farmers so that the existing technological gap is bridged. The latest effort in this direction is the introduction of the Training and Visit System popularly known as Benor Pattern. The main thrust of the system is to have a systematic time-bound programme of training and visits of field level extension workers combined with clearly

specified schedules of work and duties, with regular and close supervision. The village level extension workers are given regular training in production methods, which they disseminate among the farmers through selected contact farmers by visiting them at their fields. The methodology provides for a management system which can assure delivery of expert know-how in time for the operation.

1.2 ADOPTION BEHAVIOUR

Research on adoption of a new idea or practice by an individual or groups of people has shown that adoption of a new idea is not a snap decision, but a mental process on the part of an individual over a period of time. According to Rogers (1965) " Adoption process is the mental process through which an individual passes from hearing about an innovation to final adoption ". Adoption of a farm practice has been conceptualised as a process involving a number of successive stages by rural sociologists.

One of the important contributions made by adoption researchers is the development of a concept of sequential nature of adoption. Adoption behaviour of an individual farmer has been conceptualised by Ryan and Gross, the North Central Rural Sociologist Sub-Committee, Neal,

Rogers and Bohlen, and Wilkening as a process composed of a number of successive stages. Several research studies have been conducted by Indian scientists at various Agricultural Universities, the Indian Agricultural Research Institute, New Delhi and the studies undertaken at the National Institute of Rural Development, Hyderabad, and Diffusion project of Michigan State University undertaken at the same Institute on diffusion and adoption process.

The above referred studies on adoption brought out patterns of adoption behaviour, factors responsible for adoption and major constraints in adoption. Nevertheless, what has not been explored and realised is the extent of technological gap in adoption of packages of practices of crops. Very few have touched this area. Tripathy (1977) studied technological gap in rice, while Sadamate (1978) studied the tribal farming system and the technological gaps.

1.3 CONCEPT OF TECHNOLOGICAL GAP

India's agricultural technology is far from being adequately transferred, despite the fairly impressive production in preceeding years. Not more than one fifth of the available technology is estimated to have been absorbed in India's villages, benefitting only about one tenth of the farm families. Studies have revealed wide disparities in adoption of various components of technology

among different crops, different regions and different sections of the farming community. Drawing attention to the big technological gap existing in India's agriculture, M.S. Swaminathan (1977), former Director General of the Indian Council of Agricultural Research said " To produce 100 million tonnes of food grains, the country ought to need only 10 million hectares of land, if all the results of scientific work can be applied on such area ". According to him a ninefold increase in productivity can be achieved even in an advanced place like Delhi in a high yielding crop like wheat. He has identified three types of gaps which account for the untapped yield reservoir in Indian agriculture, the research gap, the research cum-management gap, and the extension gap. According to him, the gap between the yield possible on theoretical consideration and the best yield achieved so far can be referred to as gap 1, 'The research gap'. The gap between the best yield obtained in research farms and by progressive farmer or a National Demonstrator farmer can be referred to as gap 2, 'The research-cum-management gap'. The gap between the best yield realised by progressive farmers in the State and the State average can be referred to as gap 3, 'The extension gap'. The term Extension gap can be used inter-changeably as to mean the yield gap or communication gap. The magnitude of the yield gap or extension gap in jowar in India is presented in Table 1.

Table 1.1: Average yield of the country and National Demonstration of jowar *

Sr. No.	Year	Av.yield of National Demonstration	Av.yield of the country	Yield gap between National Demonstration and Av.yield of the country
1.	1965-66	31.76	4.29	27.47
2.	1966-67	27.15	5.11	22.04
3.	1967-68	35.53	5.45	30.08
4.	1968-69	46.69	5.23	41.46
5.	1969-70	35.90	5.22	30.68
6.	1970-71	35.98	4.70	31.28
7.	1971-72	42.61	4.61	38.00
8.	1972-73	30.74	4.49	26.25
9.	1973-74	32.17	5.30	26.87
10.	1974-75	38.73	6.45	32.28
	Av.mean	35.726	5.185	30.641

*Source : Annual Report of the All India Coordinated Project, National Demonstration (1975-76).

National Demonstrations were conducted on farmers' fields by subject matter specialists, where 100 per cent technology is utilised. On the average farmers' fields, utilisation of technology is according to his social and economic environment in which he lives and operates and hence there is a variation in yield which is to be considered as yield gap or extension gap.

It will be seen from Table 1 that there is a variation in National Demonstration mean yield and National average yield. The corresponding yield variation of jowar is the highest i.e. 1:7 which indicates a big technological gap.

Today, one hectare of arable land in India supports two adults and three children, two heads of cattle and three or four poultry birds. By 2000 A.D., our population is likely to touch one billion and each hectare of land will have to support about eight persons, four heads of cattle, and a dozen birds. The nation will then need to produce three times the quantity of dietary energy and protein from the land and water to feed the animal and human population.

The current production potential and actual production are the highest in the country in the last several decades, and the gap between the two has never been as wide as it is today. This gap is reflected in the production imbalances between crops and areas. During the 13 years period commencing 1964-65, jowar production is seen to have risen only by 36 per cent in sharp contrast to that of wheat which is 154 per cent. It clearly indicates, though jowar is an important crop grown, the yield gap is the highest. The yearly production of about 16 million tonnes of grains does not match this vast area.

This could be attributed to the cultivation of jowar mainly under rainfed conditions. About 80 per cent of jowar in India is rainfed.

1.4 STUDY : ITS IMPORTANCE

According to the report of the Irrigation Commission (1973) only about 23 per cent of the cultivated area in the country receives assured irrigation. However, development in the next two to three decades is expected to increase this to about 50 per cent by the turn of this century. In case of Maharashtra, the State Irrigation Commission had estimated a decade ago that, when all the resources of irrigation both surface and undergroun. are tapped, it may be possible to bring about 30 per cent of the total area under irrigation in the State and the remaining 70 per cent will have to depend upon the vagaries of monsoon, leaving only a part blessed with assured rainfall. This fact shows that 92 per cent of the total cultivated area in Maharashtra will have to depend on rains to grow crops.

Agricultural development of Maharashtra, therefore, depends upon the crops which are grown on the residual moisture and drought prone conditions. Moreover, there is no suitable alternative crop to jowar for its adoption under dry farming agriculture.

Thus, jowar has an important place in the development of agriculture in Maharashtra. It occupies a total area of 66 lakh hectares which is about 41 per cent of India's total area under this crop. It occupies 46 per cent of the area among the different food grains in Maharashtra and its contribution to the total food grain production is to the tune of 49 per cent. The per hectare yield of kharif and rabi jowar are 10.8 and 4.7 q/ha as against the national average of 8.4 and 5.3 q/ha while comparing the yield which might be due to the technological gap in various components of the high yielding jowar technology as practised on the fields of the farmers.

The grain production of rabi jowar is almost constant during the last decade, though research system has generated enough technology for high production and has also been proved on the national level under National Demonstration. Per hectare yield of jowar in 1973-74 was 460 kg, in 1976-77 660 kg, 1977-78 473 kg and in 1978-79 502 kg.. This indicates an almost stagnant level of production of jowar. Then the question arises as to why grain production of jowar has remained stagnant. The reasons for this could be that the technology generated may not be suitable to the ecological conditions or it requires additional support of infrastructure, perhaps farmers themselves are lagging due to personal, social

and economic conditions and there may be other reasons as well.

For understanding the reasons for such a big gap in yield and developing strategies for overcoming the gap, we need to identify and analyse critically the constraints responsible for this.

The methodology and content of such a study should necessarily be interdisciplinary in character which has been attempted in this study to a certain extent.

1.5 STUDY : ITS OBJECTIVES

In the light of the above factors, the following specific objectives for the study were selected.

1. To study the system of jowar farming prevalent in Maharashtra.
2. To determine the extent of technological gap in relation to various components of recommended production technology.
3. To identify the factors responsible for technological gap.
4. To study the differential characteristics of technological gap categories.

5. To study the relationship and the relative contribution of techno-economic, socio-psychological stimulus and communication variables towards technological gap.

6. To study the reflection of technological gap over yield gap in cultivation of high yielding varieties of jowar in rabi season.

7. To suggest, based on the findings, an appropriate jowar development strategy for Maharashtra to bridge the technological gap and in consequence reduce the yield gap.

1.6 STUDY : ITS LIMITATIONS

This study has the following limitations.

1. The study has been conducted in Solapur district. The recommendations and strategy developed in the study may not totally apply to the whole State.

2. The findings of this study are based on the ability of the respondents to recall and on the verbal opinions expressed by them. Hence, the objectivity of this study is limited to their ability to recall and also to their frankness and fairness in furnishing the required information.

1.7 ORGANISATION OF THE THESIS

The study has been presented in five chapters. The current chapter deals with introduction which highlights the problem, the objectives and limitations of the study.

Chapter second gives the relevant review on earlier findings on the subject. The research methodology, setting which describes the locale of the study, its physiography, the demography, the socio-economic infrastructure and other resources of the research area have been described in the third chapter. Further, it comprises sampling procedure, tools and techniques of data collection, statistical analyses, operationalisation of various terms and concepts used in the dissertation and their measurement procedures. Findings and discussion are presented in the fourth chapter. This chapter is divided into six sections each devoted to one important objective of study. The last chapter deals with the summary of the findings, implications and suggestions for further research.

CHAPTER II

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

The review of literature has been integrated into following parts.

1. Theoretical orientation regarding the adoption behaviour.
2. Factors associated with adoption of high yielding varieties of jowar.
3. Technological gap in the adoption of package of practices.
4. Various factors involved in the adoption of high yielding varieties of jowar technology.

2.1 THEORETICAL ORIENTATION REGARDING ADOPTION BEHAVIOUR

Simon (1957) pointed out that action of an individual was a function of his exposure to the source of his socio-economic condition and the source of information. He further defined exposure as the willingness of a farmer to react to a particular information media; thus communication sources are important stimuli to the individual in the adoption process. It provides a link between the diffusion of an innovation and its final adoption. This is also

supported by a number of research findings. Past research studies (Beal, 1956; Copp, 1956; Lionberger, 1960; Wilkening, 1962; Beal, Rogers and Bohlen, 1956; Rao and Reddia, 1966; Singh and Jha, 1964; and Misra and Prasad, 1966) have pointed out that the adoption of innovation is a function of contact with the information sources. The adoption behaviour of a farmer is a special kind of action and is the function of the situation in which he lives, his socio-psychological system and his exposure to the different sources of information through which diffusion of an innovation is taking place.

Diffusion of an innovations is necessary for adoption, but the end product is not always adoption. Rogers (1962), defines diffusion of an innovation as "the spread over time of a new idea through a social system via communication channels". The crucial elements in the diffusion of an innovation are (1) the new idea (2) which is communicated via certain channels (3) among the members of a social system (4) over time.

A close analysis of the literature on diffusion adoption process will support the contention that when stripped of its basic elements, this process consists of (1) actors who are potential acceptors of change, (2) actors who are advocates of change, (3) a social system in which those actors operate, (4) communication between the actors and (5) an innovation. In terms of a social-

psychological model, the scheme may include (1) the innovation being diffused, (2) the person or source of information about the innovation, (3) the person who receives information and adopts the innovation, (4) the media, channel or structure through which information is transmitted, (5) the situation in which information is transmitted and adoption occurs and (6) the time span during which the diffusion of information and its adoption occur.

An innovation is an idea or object perceived as new by the adopting unit. Many studies have shown that the attributes of innovation are very important for their diffusion and subsequent adoption. To mention a few, relative advantage, complexity, compatibility, divisibility, visibility and communicability are important factors in subsequent adoption or rejection.

In the general framework of the theory of action, we can view the diffusion adoption process either from macro or micro levels of social systems. Diffusion in this sense is "the primary social process involved in institutionalisation per se". Theories regarding diffusion adoption are dealing with an aspect of modernisation theory i.e. the acceptance or rejection of new ideas. Modernisation theories make implicit assumptions about how new ideas are diffused and accepted to bring about modernism. Diffusion theorists

imply or conjecture that the new ideas which are generally of more valued social goals will, if they are accepted, create changes in people. This change is generally in the desired direction which leads to modernisation of the society, particularly in the field of agriculture. Axinn and Thorat (1972) stated that agricultural development in the broader sense depends upon a system of related functions. They further stated that as components of the system, agricultural producers, suppliers, marketers, researchers, those who govern and those involved in education and extension all are related. Thus, the effectiveness of the extension education function is crucial to the modernisation of a traditional agricultural system.

Modernisation and modernity have been defined by a number of social scientists in different ways of which a few are discussed here. Smith and Inkeles (1966) define individual modernity as "a set of attitudes, values, and ways of feeling and acting presumably of the sort either generated by or required for effective participation in modern society". Inkeles indicates that a modern man is characterised by (1) innovativeness, (2) democratic orientation, (3) present-future orientation, (4) orientation and involvement in planning, (5) efficacy, (6) calculability, (7) dignity, (8) faith in science and technology and (9) faith in distributive justice.

For Lerner (1963), the concept of empathy at the individual level is of paramount importance for modernity. He contends that presence or absence of empathy determines how an individual will "operate in changing world". He refers to it as "the capacity to see oneself in the other fellow's situation". A modern man is urbanised, literate and participant, while a non-modern man is less educational and non-participant. Lerner further defined the process of modernisation as " Everywhere, for example, increasing urbanisation has tended to raise literacy, rising literacy has tended to increase media exposure; increasing media exposure has gone with wider economic participation (per capita income) and political participation". Thus, according to lerner's model, a traditional society is characterised by low education, low per capita income, low media exposure and low political participation.

McClelland (1963) attributes need for achievement to modernism. High need for achievement makes a man modern, low need for achievement makes a man non-modern.

Black (1967) presents a view of traditional and modern man reflective of the attributes of the societies they belong to. A modern man possesses the qualities of adaptability, initiative and empathy and is individualistic.

A traditional man is involved in relationships primary with his family, his community and the functional

group he belongs to. He is tradition bound, less individualistic, dogmatic and has the least propensity for change. Hagen (1962) is more specific in describing personalities in traditional societies. He classifies the participating members of societies on a continuum of problem avoiders, problem seekers. Any problem for a traditional man is a source of anxiety which can be avoided by reliance on tradition and the decisions have to be made by some kind of an ascriptive authority.

In one of his recent work, Hagen (1966) reemphasised that home environment perpetuates personality types. For him, a personality change is a prerequisite for modernisation. He further asserts that the transition from a traditional state to a modern state takes place because of technological creativity, innovations, and a new types of personality.

Horowitz (1966) indicates that a traditional society "is characterised by little change from generation to generation; a behavioural pattern governed almost exclusively by custom; status determined almost entirely by inheritance (ascription); low economic productivity; and a social organisation and life styles grounded in the principles of hierarchical command". He uses the term underdeveloped to mean, "a measure of technical and technological inferiority vis-a-vis the developed societies". This society exhibits rapid

social change; behaviour governed by law as well as custom; status based on achievement as well as inherited patterns; low economic productivity in other sector; and a life style geared to rapid social mobility despite intensive stratification though not defined by it. Developed societies, on the other hand, are those "in which change is first and foremost a social fact".

Levy (1966) is essentially interested in distinguishing between modern and non-modern societies. He makes these distinctions in terms of (1) aspect of social system, and (2) the organisational nature of societies, and common elements, variation and problem focuses to differentiate between universal and particular element of societies. Following essentially the same type of framework, Black (1967) discusses five major areas of modernisation : (1) intellectual, (2) political, (3) economic, (4) social and (5) psychological.

The point which needs reemphasis, however, is that in order to do evaluative or planning research for development change, such a model is useful in at least three ways. First, it gives a more accurate structural identification of the social system under study. Second, it will give a better explanation of changes created by development. Third, it can ascertain the changes in the modernised or modernising structure.

Further, it is essential to study various elements of society reacting in the modernisation and adoption behavioural process.

Adoption behaviour

Wilkening (1952) was one of the first authors to conceive adoption as a process that involved decision. The term adoption has been applied to signify the acceptance and use of improved practices or products. Ramsay et al (1959) have postulated that adoption behaviour involves two components, behaviourial and cognitive. The latter (covert) involves acquiring knowledge, critical evaluation of the practice in terms of the individual's situation and arriving at complex decisions. Behavioural adoption refers to the actual use of a practice. Emery and Oeser (1958) viewed adoption of a farm practice as a consequence of communication.

In determining the adoption behaviour, a number of elements play their roles. These important elements in any theory of human action are the circumstances under which the individual receives a stimulus. Recognising this element Parsons and Shils (1951) stated that behaviour of any living organism is called action, only when it is analysed in term of a situation in which it occurs. Many workers suggested that individual

characteristics and situational factors account for most of the variability in human behaviour.

Sherif and Sherif (1963) have conceptualised four more categories of factors as (i) factors related to individuals, (ii) factors related to problem task or activity, (iii) factors related to site and facilities and (iv) inter-relationships among the preceeding three sets of factors.

Several research studies regarding adoption have been conducted in India and abroad such as those of Beal and Bohlen (1957), Copp, Gill and Broun (1958), Lionberger (1960), Jaiswal (1965), Mahudkar (1967), Nair (1969),Fliegel et al (1968), Thorat (1968), Choubey(1972), Jha (1974), Ernest (1973), Ramachandran (1974), and Singh (1975), Sadamate (1976), Tripathy (1977) have shown that certain socio-personal and socio-psychological characteristics of farmers are associated with adoption of improved agricultural practices.

Singh (1978) has reviewed most of the studies made till 1979 and has found that in all 71 factors were associated with adoption. These factors were grouped into four clusters i.e. (i) client centered - 38, (ii) client environment - 17, (iii) technology - 7, (iv) communication variables - 9. Of these 71 factors, 24 are related to village adoption behaviour i.e. when

village is taken as a unit instead of an individual. This dimension was included in the National Institute of Rural Development based Michigan State University Project.

On the basis of the above review, it may be stated that adoption is an individual's action and it required suitable subject matter for its effective communication to potential adopters. In addition to this, there are several factors reported to have been associated with adoption behaviour. These factors not only affect the adoption behaviour, but also affect the perception of farmers about technology. Hence, multi-dimensional factors involved in adoption need further discussion. Some of the important factors are delineated here.

Age : There is inconsistent evidence in the literature as regards the influence of age on adoption behaviour. Hoffer (1942), Ryan and Gross (1950), Shelke (1971), Ernest (1973) found age to be negatively associated with the adoption of improved practices. Coleman (1951) did not find any statistically significant correlation between age and adoption. Mane (1971), Narayanappa (1975), Sundershan (1979), Lukmarji (1970), Somasundaram (1976), Chattopadnya (1976) did not report significant relationship between age and adoption.

Education : Education helps in developing mental faculty of individuals whereby one could know the world better and hence, he becomes prone to change. Wilkening (1952), Ramamurthy (1961), Reddy (1962), Singh (1966), Reddy and Reddy (1966), Rao (1966), Muthayya (1971), Ranelke (1971) found that education was positively and significantly related to adoption of high yielding varieties. Narender Singh (1979), Majafi (1979) and Lakshminarayan (1970) reported that education is correlated with the adoption of improved practices. Desai and Desai (1971) in their study of high yielding varieties programme in Surat district of Gujarat found that 75 per cent of the participants had formal education. Among non-participants only 55 per cent had formal education.

Rao and Rao, Singh, Tuley and Majumdar (1980) had reported that education has positive association with the transfer of technology.

On the contrary, Gupta (1966), Parthasarathi (1976) and Sundaram (1973) did not find any significant relationship between farmers' literacy level and their participation in high yielding varieties programme.

Pal (1975) in his study of high yielding varieties programme in Cuttack district has reported no statistically significant difference between adopter and non-adopters of high yielding rice so far as their level of education was concerned.

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Occupation : Income is related to the occupation of an individual. Patel (1965) reported that small farmers depend upon secondary occupation. A farmer engaged in such an occupation which would either fetch him more income or provide him with an opportunity to gain knowledge would adopt new agricultural technology.

Das and Das, Singh, Huley and Mujumdar (1980) reported that occupation is correlated with the transfer of technology.

Farm size : Singh and Sohal (1967) reported that size of holding was significantly related to the acceptance of agricultural practices.

Singh, Aulakh, Saini (1977), Majafi (1979), Raghubar Singh (1979) and Narayanappa (1977) have reported that size of farm was statistically significantly related with the adoption of improved agricultural practices. Singh (1963), Motilkar (1967), Choudhary and Ghosh (1968) and many other studies including the study of Pandey (1974) conducted among marginal farmers showed significant association of farm size with participation in the development activities. Shelke (1971) reported, while studying adoption of hybrid jowar, that there is a significant relationship between farm size and adoption. Pathak (1976), Sundarshan (1979) observed that the size of farm had no significant relation with the adoption behaviour. However, there were a few

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studies indicating contradictary results.

Social participation : Social participation according to Ray (1961) refers to the voluntary sharing in person to person and group to group relationships, beyond the immediate household. It shows the degree to which the farmers were involved in formal organisations as members or office bearers.

Studies conducted by Reddy (1962), Nicuberger (1960), Jaiswal (1966), Reddy and Alvila (1966), Phelke (1971), Ernest (1973), Singh (1979) and Nagnubar Singh (1979) revealed a positive association between farmers' social participation and the level of adoption of innovations.

Social-economic status : As per Rogers (1962), social status is an indication of one's position of command. Social status may either inhibit or enhance a person's adoption behaviour. It refers to the position a farmer occupies in comparison to others with respect to possession of land, type of house, material possession, farm power and social participation. Studies of Ahlawat (1966), Aiken and Coleman (1966), Ziegel (1966), Supe et al (1966), Jaisani (1966), Bose (1966), Phelke (1971), Phatake (1971) reported that there is a significant association between adoption of fertiliser and socio-economic status. Ernest (1973), Kripathy (1977),

Sadamate (1978), Pathak (1978) and Singh (1979) have shown that the socio-economic status has direct bearing on adoption behaviour.

Urban contact : Based on empirical studies, Frey as cited by Loomis (1971) advanced a communication hypothesis: he believes that "certain adoptions (such as the plough for example) are brought about, so much by a man's change in receptiveness or by an increase in his psychological motivation, as by seeing that the tool exists, is available, and is used by others with whom he has a chance to interact". According to this hypothesis, travel to a city might make people adopters of many things seen there. Patel (1971) and Rajmohan Singh (1979) reported that adoption of improved practices conceived that urban contact i.e., number of contacts made with the neighbouring city, would be positively associated with the adoption behaviour of a farmer.

Contact with extension agency : By contacting extension agencies, individuals may gain knowledge and motivation for adoption. Many studies like those of Moulik (1965), and Khaliwal and Sohal (1966), Budhani, Sethuraman and Veerbhadraiah (1973), Somasundaram(1976), Sadamate (1978), Waghmare Singh (1979) and Najafi (1979) indicated that contacts with institutional agencies is associated positively with adoption.

It is hypothesised that farmers' contact with the extension agency would be positively associated with their adoption behaviour.

Infrastructure : ube (1967) and Lokhande (1973) reported the procedural complexities in obtaining credit by farmers. Radhakrishna Menon (1970) also expressed about a concern about small farmers in availing inputs and subsidies due to procedural difficulties. Ernest (1973) found out positive relationships of timely supply and adequate supply of input with adoption.

The study conducted by the Department of Agriculture Economics, Coimbatore (1974) brought out the problems of providing adequate and timely credit and the input supply system. In the workshop on small farmers and agricultural labourers (1970) and in the subsequent regional seminars, the different aspects of providing infrastructures were highlighted, besides stressing the importance of infrastructures for the development of small farmers. Singh (1970) reported that the lack of infrastructural agencies to provide the timely inputs to farmers, is associated with the adoption of farm technology.

Level of Knowledge : Jaiswal (1966), Poulik (1966), Sinha (1966), Choubey (1973), Chattopadhyaya (1970),

Somasundaram (1976), Saumate (1976), Sinha and Lanjewar (1978), Das, Singh, Pandey (1980) have reported positive correlation between knowledge and adoption of improved farm practices.

Attitude : Many studies have been conducted to find out the association between the attitude of farmers and adoption of improved farm practices. Important among them are the studies conducted by Fliegel (1965), Webb (1960), Jaiswal (1965), Moulik (1965), Nair (1969), Choubey (1973), Singh (1975), Chattopadhyaya (1976), and Singh and Singh (1975). They all have reported positive attitude towards high yielding varieties of wheat and fertilizers. However, in general, there is a paucity of studies on relationship between attitudes of farmers towards high yielding varieties of jowar and the adoption of recommended packages of practices.

Socio-psychological and communication variables : Wilkening and Johnson (1958) held the view that "decisions may be viewed as a social or psychological process" and suggested that in order to have a thorough knowledge of the concrete decision, both social and psychological factors should be taken into account. Sinha (1969) after reviewing a number of reports and studies stated that the central problem to awaken the enthusiasm among people for growth is psychological, not technological. The variation caused

by the socio-psychological and communication factors were studied by a number of researchers. Of these, Singh and Singh (1970) reported that 70.34 per cent of variation was due to socio-psychological variables and 27.57 per cent variation was due to communication variables in wheat growing farmers. Tripathy (1977) observed 67.06 per cent variation because of the socio-psychological variables and 39.32 per cent variation by communication variables, while studying the rice growers of Orissa. Pathak and Muzumdar (1978) reported that the socio-psychological variables explained 49.67 per cent of variation while the communication variables explained 38.49 per cent of variation in the adoption behaviour of jute farmers.

Market perception : Any farmer whether he is small or big, would be marketing his produce, though may not be because of its surplus nature but at least for repaying his debts and to meet other needs. Therefore, perception about the prevalence of ready and remunerative market would motivate him to go in for more adoption. Hence, it is presumed that market perception would be positively associated with the adoption of improved farm practices.

Localite - cosmopolite value orientations : Reddy (1962) reported that the adoption of improved practices is a function of sources of information and socio-economic

condition of the receiver. Rogers (1962) after reviewing many studies on sources of information by stages, made a generalisation that impersonal information sources were most important at awareness stage and personal sources were most important at the evaluation stage in the adoption process.

In the study on the "Influence of source credibility on communication effectiveness", Hovland and Weiss (1967) found that the effectiveness of communication was the function of the attitude of the audience towards the communicators. Singh (1970) in his paper on "Studies in Agricultural Communications in India" has also mentioned that the greater the number of information sources sought, the greater the adoption; and higher the contact of farmer with communication sources greater was his adoption.

Merton (1964) describes that "the localite largely confines his interest to his own community". He is preoccupied with local problems and almost ignores the national and international scenes. Such individuals are parochial in outlook. Cosmopolite individuals on the other hand, though having some interest and influence in the community they live in, are oriented more to the outside world and consider themselves as an integral part of that world. The cosmopolite is thus ecumenical. Indian studies by Rose (1962), Singh (1967), Rane (1971), Rajagura and Ratnapathy (1971), Arthy and Singh (1974),

Ramchandran (1974), Somasundaram (1976), Singh (1979) and Jay (1981) have clearly demonstrated the influence of localite-cosmopolite value orientations with the adoption behaviour of farmers.

Economic motivation : A farmers' economic motivation may be regarded as an indication of the degree of his willingness for investment of available potential resources in adopting farm innovations. The concept of economic motivation is used in this study in a restricted sense, indicating those value systems which emphasize monetary gains more than such traditional rural values as freedom from debt, self-sufficiency and expected risk of monetary loss involved in experimentation with new farming techniques. It is felt that individuals passess different degrees of economic motivation. In the studies of Rao and Moulik (1966), Singh (1969), Nair (1969), Supe (1971), Singh (1975), Somasundaram (1976) and Singh (1979), Vijayraghavan and Subramanyan (1981) economic motivation was found to be positively and statistically significantly associated with the adoption behaviour.

Risk orientation : Risk orientation may be stated as the degree to which a farmer is oriented towards encountering risks and uncertainty in adopting any new idea in farming. Farming is regulated directly or indirectly by many unforeseen elements like inclement

weather, pests and diseases and price fluctuations. Studies of Beal and Bibeley (1967) and Lalit Sen (1970) conducted in the developed countries have shown that individuals vary in their willingness to take risk. Ernest (1973), Sandhu and Gupta (1973) and Ramchandran (1974) have shown that risk orientation was positively related to farmers' adoption behaviour. Similar association with reference to adoption behaviour has been reported by Singh (1975), Somasundaram (1976), Singh (1979), Mochin (1970), Singh, Das and Luley (1980). Findings of Vijayraghavan and Subramanyan (1961, were along the same lines.

Knowledge about cultivation practices : Kaplan and Kaplan (1961) defined knowledge as a body of understood information possessed by an individual or by a culture. Knowledge is one of the important components of behaviour and hence, it plays a vital role in the adoption behaviour of farmers. Wilkening and Morrison (1963) had observed that all types of decisions required technical knowledge of farming as well as of the farms and its operation. Rogers and Shoemaker (1971) recognised knowledge function as one of the four functions in the innovation decision process. Shelke (1971) reported that knowledge of hybrid jowar helps in adoption of jowar practices. Knowledge as a factor affecting adoption behaviour has been studied by Hess and Miller (1964),

Williams (1958), Stangland (1958), Hobbs (1960), Reddy (1968), Koulik (1969), Nair (1969), Alexandran (1974), Singh (1975), Somasundaram (1976), Kadamate (1976), Singh and Pulay and Das (1980). They reported a positive and statistically significant association between knowledge and adoption.

Ernest (1973) and Jha (1974) reported a positive and statistically significant relationship of knowledge about the package of practices possessed by small farmers with their adoption behaviour.

Scientific orientation : Any farmer who is oriented towards science would be better placed in accepting the scientific findings. Studies conducted by Supe (1969) and Sinnarkar (1973) revealed positive association between scientific orientation of farmers and their rationality in decision making and adoption behaviour. Findings of Singh (1979), Lakhminarayan (1979) and Vijayraghavan and Subramanyan (1981) are also consistent with the above findings.

Techno-economic factors Studies conducted by Roonin (1979) with the conception that the well-being of small farmers can be improved by the adoption of new technology found that there were some constraints in the diffusion and adoption process and the adoption of new technology

is a very uneven process, varying geographically from farmer to farmer, region to region and country to country as well as among crops and number of factors like cultural and environmental conditions. He reported that there were five general types of factors affecting the adoption of new technology. These are identified as (1) attributes of the adopter (technical skill, attitudes towards change and risk, level of income, aspirations, and confidence, (2) aspects of the technology, economic profitability, divisibility, complexity, communicability and technical appropriateness, (3) character of the economy (infrastructure demand for agricultural products, off farm employment and government policy), (4) features of the environment, at the farm level (socio-cultural factors, farm resource constraints), (5) risk and uncertainty.

Thones (1979) reported that appropriate technology for basic needs, rather than for high yielding profitable agricultural modernisation was gaining ground. He also studied technology strategies, focussing on ways in which both traditional and modern modes of investment and resources were used. He found that in India, the period between informing a small farmer of an innovation and its adoption is 7.2, years for improved seed, 5.2 years for fertilisers and 4 years for a new system of cultivation.

Veerabhadraiah, Sethurao and Dwarakanath have studied the influence of different characteristics of hybrid jowar in relation to the perceived influence upon its adoption and reported that the characteristics, profitability and relative advantage of hybrid jowar as an innovation have exerted considerable influence on their adoption, while the compatibility factor like taste, keeping quality and resistence to pests and diseases had influence to a very limited extent. Krishina Murthy (1975) while studying the adoption pattern of high yielding varieties with reference to farm size in Simoga district of Karnataka has stated that adoption of modern varieties decrease with a corresponding decrease in farm size in the wet season. The variation in the adoption behaviour due to the techno-economic factors as reported by Singh and Singh (1971) was 40.44 per cent in adoption behaviour in case of high yielding wheat varieties technology. Tripathy (1977) reported 62.05 per cent variation in high yielding varieties of rice technology. Pathak and Mujumdar (1978) reported variation due to techno-economic factors to the extent of 69.70 per cent in jute farmers.

Cropping intensity : It denotes the way in which a farm is run. Those farmers who follow intensive cultivation try to exploit all factors of production for achieving the aim of maximising farm profits. Such farmers have

greater skill and management abilities and knowledge about farming. Mukherjee (1966) and Wolte (1967) reported that adopters have higher intensity of cropping than non-adopters.

High yielding varieties of crops are mostly shorter in duration. Hence, the adopters of these varieties will be in a better position to put more crops in their cropping pattern as a result of which their intensity of cropping will be more than the non-adopters. This was reported by Vyas et al (1969) in their studies on the new strategy for agricultural production in Gujarat state. According to them the intensity of cropping (expressed as the percentage of the total cropped area to the operational area) was substantially higher for adopters than the non-adopters. Singh (1969) reported in his study on the adoption of high yielding varieties and investment pattern of additional income in the Delhi territory observed that the participating and non-participating farmers differed significantly in their intensity of cropping. The extent of adoption of recommended practices by the participating farmers was also positively and significantly related to their intensity of cropping. The findings of Pathan (1976) are consistent with these findings.

Sinha and Wolte (1974) also reported findings in line with those of Singh (1969). Singh and Choubey

(1974) reported that the farm size and cropping intensity had positive relationship with the adoption of new technology. They also reported that farm size and relative gain had an association with the adoption of technology at high level. Findings of Das, Singh, Kulay and Mujumdar (1980) were not consistent with the above findings. Tripathy and Sadamate also reported similar findings.

The review of available researches of High Yielding Varieties Programme shows that adequate attention has not been paid on cropping intensity as a factor affecting adoption behaviour of farmers.

Tenure status : Singh and Choubey(1974), while studying operational farm size and differential adoption of high yielding wheat varieties technology, reported that operational holding and tenure status had an association with adoption of technology. Mohammad (1978) studied the impact of six economic variables and reported that the tenure status had a positive association with adoption of technology. Karim and Mahboob (1974) reported that there was a statistically significant relationship between adoption of fertilisers and tenure status. Das, Singh, Kuley and Mujumdar (1980) reported significant relationship between adoption and tenure status. Reddy and Kivlin (1968) reported that adoption

of high yielding varieties was not influenced by the tenure status of the farmers. Pal (1975), while studying the relation between tenure status and adoption of high yielding varieties of rice in Cuttack district of Orissa, stated that tenure had no effect on the timing and extent of adoption of modern varieties in the two villages studied. With regard to fertiliser use he has marked sharp differences between owner and tenants. On an average, the owner cultivators used chemical fertiliser at the rate of 54 kg/ha in case of modern varieties, whereas tenants used 42 kg/ha during the wet season.

The research regarding tenure status and adoption is not consistent and nothing can be said conclusively.

Irrigation : Irrigation and assured rainfall are the requirements for growing high yielding varieties. However, there is no guarantee that a farmer with assured irrigation facility will adopt high yielding varieties. This was reported by Mohammad (1978) in his study of impact of economic factors on diffusion of agricultural innovations in Tran - Ghaghare plain. Sharma and Nair (1974), while studying multivariables of adoption of high yielding varieties of paddy, reported that irrigation was positively and statistically significantly related with the adoption of improved technology.

Irrigation has a significant role in adoption of fertiliser technology. When a mode of irrigation is available to a client he will adopt not only fertiliser technology but also a package technology of crop. Raghubar Singh (1979) and Phatake (1971) reported that there was a statistically significant association between irrigation facilities available and adoption of fertiliser technology as well as adoption of new technology. The Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India (1973) in its studies on High Yielding Varieties Programme for kharif 1971-72 reported that the proportion of holdings under irrigation was not a discriminating feature of participating cultivators. The difference in the proportions of holdings irrigated among the participants and the non-participants was only marginal.

The Agro-Economic Research Centre, Viswa Bharti, Shantiniketan (1972) and (1973) reported that the farmers participating in High Yielding Varieties Programme for paddy in Cuttack district had better irrigation facilities. But their study in Birbhum district for High Yielding Varieties Programme of I.R.8 Paddy (1973) did not show any difference between participants and non-participants. Parthasarthi (1975) in his study of high yielding varieties of rice in West Godavari district of Andhra Pradesh reported that the adoption of modern varieties was associated with the irrigation potential.

The Agro-economic Research Centre, Gwalpur (1975) in its study of high fielding varieties programme for wheat found that the participants had greater percentage of area irrigated than non-participants.

2.2 COMMUNICATION TECHNOLOGY

Hovland et al (1953) viewed communication as the process by which an individual, the communicator transmits stimuli to modify the behaviour of other individual communicatees.

Infield (1957) explains communication as the movement of knowledge to people in such ways that they act on that knowledge to acnieve some useful results. According to Rogers and Yost (1968) "Communication is flow of research findings from agricultural scientists to farmers".

Communication as described by Newman and Summer (1962) "is a process of exchanging facts, ideas, opinions or emotions by two or more persons. The change is successful only when mutual understanding results. Merely saying is not enough, a receiver and sender may not agree, but communication has occurred when one at least understands what the other means to convey". Leagans (1971) proposed another dimension which might also contribute to the desired interpretation of the stimuli. He stated that effective use of sophisticated

production technology, however, requires a parallel availability and proper use of numerous purchaseable inputs, including fertilisers, insecticides, fungicides and new methods, planting seeds with germplasm superior to indigenous varieties. Rogers (1968) also points out that it is not the actual characteristics of the stimuli that decides the behaviour, but it is the perception of an individual about the attributes of the stimuli that are important.

Based upon the above discussion, the concept of interpretation of stimuli as controlled by different factors is considered as the perception of suitability of the agricultural technology; the farmers might consider several factors to perceive it as suitable or otherwise. Bauer and Melvin (1966) pointed out that "some kind of communication, some kinds of issues brought to the attention of some kind of communication, some of kind of issues brought to the attention of some kind of people under some kinds of conditions have some kind of effects".

Rogers (1974) proposing a concept of "communication effect gap" gave the following reasons for such gaps. (1) The 'ups' perhaps as an artifact of gaining their original superior status, possess greater receptivity to the change oriented communication and hence show greater response to it than the 'down' ... (2) The sources or

producers of the change - oriented message are usually more homophilous with the 'ups' than with the 'downs' and hence, their messages have relatively greater effects on the 'ups'. (3) The lack of integration of marginals with inter-personal communication network".

Tichenor et al (1970) have explained the "knowledge gap". (1) 'ups' refers to the well to do big farmers, (2) 'downs' are marginal population, consisting of villagers and urban poor who have relatively limited communication with the power elites who manage their society.

Evaluation studies made by the Planning Commission (1968) also reported that the extension personnel knocked at the doors of big farmers whenever there was pressure on them from top to achieve the fixed and rigid target. The average farmers are, by and large, neglected. On the basis of above discussion, it may be stated that the difference in the communication of agricultural information to farmers of different strata would result in the "communication gap" which in turn would affect effective communication and also the adoption behaviour.

Communication factors :

The Indian Institute of Mass Communication (1968) in its study of the flow of agro-economic information

reported that interpersonal sources especially village level workers were the first agents of agro-information at the village level for about 80 per cent of the farmers. Mass media were seldom mentioned as the source for dissemination of information pertaining to high yielding varieties. Among the mass media, radio was the most desired source to get information on high yielding varieties. Vries (1976) reported that personal contact had an impact on the adoption of improved practices.

Majafi (1979) studied relationship of independent variables such as communication channels on neighbours, extension agents, radio, demonstration, printed material, films and found that these were related to the adoption of innovations. Narayanappa (1979) studied the various communication media used at different stages involved in the decision making process. He reported that in the knowledge, persuasion, decision stages, neighbours and relatives, radio, higher level extension staff and village level workers, were the sources of information. The programme evaluation organisation (1968) in the study of high yielding varieties programme for kharif reported that, of the total participants adopting high yielding varieties, 58.2 per cent were approached by village level workers, 13.2 per cent received information from progressive farmers and less than 3 per cent of the participants mentioned demonstration as a source of

information. Kane (1971) reported a statistically significant association between the extent of use of mass media and adoption.

2.3 TECHNOLOGICAL GAP IN ADOPTION OF RECOMMENDED PRACTICES

Varietal recommendations :

The Directorate of Evaluation, Uttar Pradesh (1967) in its report on High Yielding Varieties Programme for rabi (1966-67) pointed out that only 40 per cent of the respondents adopted 50 to 70 per cent of the total package of practices; 20 per cent of them adopted below 50 per cent and only 3 per cent of the respondents adopted above 90 per cent of the recommended package of practices.

The Agricultural Research Sub-Committee of Economics Section of the Mahatma Phule Agricultural University, Rahuri (1976), in its study of adoption of recommended practices reported that 38 per cent of the farmers used K-35-1 variety of rabi jowar whereas, the remaining 62 per cent of the farmers used local varieties like Dagadi, Chitapuri and Lakadi. The area under these varieties was 30.76 per cent of the total area under jowar. Narayanappa (1979) reported that a majority of the respondents had knowledge about improved varieties of peas, but only 39.40 per cent had grown them. Krisnna and Jalihal (1976), while studying the adoption of improved practices of hybrid maize, reported that 22 per cent of the trained maize cultivators had low adoption.

Nagabandalam and Chand Pasha (1981) studied the extent of adoption of improved varieties of groundnut and paddy and reported that none of the groundnut and paddy farmers used high yielding varieties.

Tripathy (1977) observed that the gap in seed treatment in rice was 10 per cent in low-gap-category farmers and 32.50 per cent in the high-gap-categories.

The Department of Agricultural Economics, Mahatma Phule Agricultural University, Pahuri (1976) reported that 36 per cent of the farmers used the recommended variety of jowar i.e. M-35-1, the area covered under this crop in All India Integrated Development Project Mandrup, district Solapur, was 60 per cent. Studies on adoption and diffusion of the new technology by the Agro-Economic Research Centre, Hyderabad (1976) reported that the highest percentage of adoption of improved varieties was observed in case of rabi jowar (66 per cent) followed by bajara (64 per cent). Groundnut (76 per cent) and area covered under improved varieties in case of rabi jowar, bajara and groundnut was to the extent of 57, 68 and 62 per cent respectively.

The All India Coordinated Research Project for Dry Land Agriculture, Solapur (1976) for the development of dry land agricultural technology and its diffusion, reported that 93 per cent of the farmers used the

recommended variety and the area covered under this variety was 60 per cent of the total area in integrated dry land project.

Chaudhari and Kushwaha (1968) while studying yield variation in Indore (. .) area, reported that only 45 per cent of the area was under recommended seed variety. Most of the recommended crop varieties which had high yield potential under rainfed conditions, had found the least priority in farmers' cropping pattern mainly due to the vagaries of nature and low risk bearing capacity of farmers. A significant point observed during the course of study was that the smaller farmers planted proportionately more area under recommended kharif crop varieties compared with the larger farmers. Jagannusham and Chand-Basha (1961) reported that none of the groundnut farmers used any high yielding varieties of improved seed.

Seed treatment -

Singh (1969) in his study of high yielding wheat varieties programme in Delhi territory reported that 43.33 per cent of the farmers used treated seeds and the rest i.e. 56.67 per cent did not adopt this technique.

The Department of Agricultural Economics, Shivaji Krishi Agricultural University, Akhuri in its Agriculture

Sub-Committee Report (1971) pointed out that almost all farmers i.e. 97 per cent treated jowar seed with sulphur for preventing smut and no one used carbofuran for seed treatment.

Seed rate :

The Agricultural Research Sub-Committee report of the Department of Agricultural Economics, Mahatma Phule Agricultural University, Rahuri (1977) indicated that the average seed rate worked out to 8.35 kg/ha for rabi jowar and found out that most of the farmers adopted higher seed rate than the recommended. Gupta (1968) in his report on high yielding varieties programme for Mexican wheat in Saharanpur district of Uttar Pradesh pointed out, that against the recommended seed rate of 100 kg/ha, only 77 kg/ha was used by the participating farmers.

Nair (1969) in his study of high yielding varieties programme in Kerala State observed that 40 per cent of the farmers adopted the recommended seed rate in rice. Pal (1975) in his study of High Yielding Varieties Programme of rice in Cuttack district of Orissa, reported that most of the farmers did not use the correct seed rate. In almost all the cases, he observed a higher seed rate than the recommended rate. Parthasarathi (1975) in his study of High Yielding Varieties Programme in West Godavari district has made similar observations.

.e reported that farmers used higher seed rate in kharif whereas for rabi, it was more or less as per the recommendations.

Sowing time :

Studies on adoption and diffusion of the new technology, presented in the second Workshop on Agro-Economic Research, Hyderabad (1976), have shown that the recommended sowing date for rabi jowar i.e. 10th September was observed by a majority of farmers i.e. more than 90 per cent. The Department of Agricultural Economics, Mahatma Phule Agricultural University Rahuri in its study on adoption of dry land agricultural technology (1976) reported that almost all farmers sow rabi jowar in the first fortnight of September.

Spacing :

The Agricultural Research Sub-Committee report of the Mahatma Phule Agricultural University, Rahuri (1976) on the adoption of dry land technology has revealed that only 3 farmers i.e. 1.50 per cent followed the practice of sowing rabi jowar at the recommended spacing 45 cm. The spacings of 22.50 cm and 30 cm were adopted by 48 and 51 per cent of farmers respectively.

Fertiliser :

Nair (1969) in his study conducted in Kerala State pointed out that 90 per cent of the farmers applied nitrogenous fertilisers, but the majority applied only less than half the recommended doses. Phatake (1971) studied the factors associated with the adoption of chemical fertilisers and reported that the extent of adoption of fertilisers was 40 per cent only in case of kharif jowar.

Jati and Tripathy (1978) reported the extent of fertiliser consumption in terms of some common crops and in terms of percentage of farmers using them in the package programme.

It was revealed by the authors that farmers had the maximum response (73.3 per cent) for calcium nitrate whereas it was minimum (32.2 per cent) in case of urea.

Karim and Mehboob (1974), while analysing the adoption of fertilisers in Bangla Desh, reported that 50 per cent of the growers applied urea. About one sixth of the growers adopted phosphate and only 5 per cent of them adopted potash.

Parthasarathi (1976) observed that farmers were using more fertiliser on modern varieties than local varieties.

A large majority of the farmers exceeded the recommendations for local varieties in the wet seasons and they also reported unfavourable results. Rajagopalan (1975) in his study of the High Yielding Varieties Programme of Rice in North Arcot district of Tamil Nadu, reported that the use of straight fertilizers viz. as ammonium sulphate, superphosphate and muriate of potash declined after 1966, partially due to their shortage and there was a switch over to the use of complete fertiliser as a basal dose before transplanting and to urea for top dressing at tillering and initiation stage of growth. He further stated that about twice as much fertiliser was applied to the modern varieties as to the improved local varieties. In contrast to most rice growing areas, North Arcot applied more nitrogen per hectare in the wet season than in the dry season.

Thilagamkar (1976) in his study of fertiliser utilization behaviour of Maharashtra farmers has observed that the extent of use of total nutrients (N+P+K) in kg/ha was 41.40, 40.00 and 36.40 for big, medium and small farmers respectively in the year 1974-75.

Kripathy (1977) observed that the gap of nitrogen application was 10 per cent in low category, whereas it was 61.00 and 71 per cent in moderate and high categories. The Agricultural Research Sub-Committee report of the

Mahatma Phule Agricultural University, Rahuri on adoption of recommended practices for dry land (1976) revealed that 20 per cent of the farmers used fertilizer for rabi jowar covering 7.24 per cent of the area under rabi jowar. The farmers applied nitrogen fertilizers at the rate of 20.20 Kg/ha.

In the All India Co-ordinated Research Project for Dry Land Agriculture, Solapur (1971) adoption of dry land agricultural technology and its adoption were studied. This study indicated that 15 per cent of the farmers have applied nitrogen fertilizer to the extent of 20 Kg/ha for rabi jowar and the small farmer belonging to the group of less than one hectare holding has not used fertilizer at all. However, the percentage of nitrogen users has generally increased as the size of the holding increased. As regards P_2O_5 the application was very poor and only 12 per cent of the adopters applied the same.

In the Second Workshop on Agro-economic Research, Hyderabad (1976), papers presented on studies on adoption and diffusion of the new technology, stated that 53 per cent of the farmers had used fertilizer for jowar crop. However, the area covered was about 9.64 per cent. The quantity of nitrogen used was 19 Kg/ha. This is low considering the recommended dose of 50 Kg/ha.

The Department of Agricultural Economics, Mahatma Phule Agricultural University, Rahuri, in its report on adoption of dry land agriculture technology (1978) reported that only 21 per cent of the farmers had used fertilizer for jowar crop. The quantity of nitrogen used was 22.23 kg/ha, the maximum being in the group of farmers owning more than 8 hectares of area. It is also observed that 53 per cent of the farmers applied 25 to 50 per cent of the recommended dose of nitrogen to rabi jowar; 22 per cent of the adopters applied 50 to 75 per cent of the recommended dose of N, 14 per cent of the farmers applied less than 25 per cent of the recommended dose. Only one farmer i.e. three per cent of the farmers, had applied the recommended dose i.e. 50 kg/ha.

The Agricultural Research Sub-Committee Report of the Department of Agricultural Economics, Mahatma Phule Agricultural University, Rahuri (1976) indicated, while studying economics of hybrid jowar, that out of the total cost of Rs.2315/-, the most expensive item was fertilizer i.e. 27.10 per cent.

Interculturing / weed control :

The Department of Agricultural Economics, Mahatma Phule Agricultural University, Rahuri (1977) reported in its study on economics of jowar cultivation in Pilot Project of Shirur taluka of Pune district, that one

interculturing was carried out by almost all farmers, while 26 per cent had carried out two interculturings. No farmer carried out the three recommended interculturings. Only 11.50 per cent of the farmers opined that it should be done three times.

The scientists of the Department of Agricultural Economics, Mahatma Phule Agricultural University, Rahuri (1978) reported in their study of adoption of dry land agricultural technology that 97 per cent of the farmers had carried out interculturing operations. The frequency as per recommendation was three. However, 26 per cent of the adopters had adopted this fully. Forty eight per cent of the adopters did interculturing twice and 23 per cent intercultured only once.

A report on studies on adoption and diffusion of the new technology, presented to the Second Workshop on Agro-Economic Research Centre, Hyderabad (1978) indicated that 80 per cent of the farmers had carried out interculturing operations. The frequency of interculturing recommended was three. However, only 30 per cent of the adopters had adopted this. Fifty one per cent intercultured twice and 19 per cent adopters only once.

The scientists at the All India Coordinated Research Project for Dry land Farming, Solapur of the Mahatma Phule Agricultural University, Rahuri (1979),

while studying adoption of dry land agricultural technology and its diffusion, reported that 43 per cent of the adopters carried out three interculturings, 50 per cent two, and 7 per cent only one.

While studying the gap in weed control in rice technology, Kripathy (1977) reported that 35 per cent of the farmers were in low technological gap category, whereas a majority of them i.e. 63 per cent were in the moderate gap category and only 3.0 per cent were found in the high gap category.

Plant Protection Measures :

The Department of Agricultural Economics, Mahatma Phule Agricultural University, Rahuri (1976) in its report on adoption of dry land agricultural technology stated that 10 per cent BHC was recommended against aphids and sugary disease on rabi jowar. Though the incidence of sugary disease was reported by 53 per cent of the farmers, the plant protection measures were adopted by only five per cent of the farmers.

A report presented by the Coordinated Dry Land Agro-Economic Research Scheme to the Second Workshop on Agro-Economics Research, Hyderabad (1978) on studies on adoption and diffusion of the new technology, stated that only ten per cent of the farmers had used plant protection

measures in jowar crop. The All India Coordinated Research Project for Dry Land Agriculture, Solapur (1978) reported under the study of adoption of dry land agricultural technology and its diffusion that only four per cent of the farmers adopted plant protection practices for rabi jowar and the area covered was only two per cent. This clearly shows that adoption of plant protection practices was very poor. Prasad (1977), in his study reported that two per cent of the farmers were in the low gap category, thirteen per cent of them were in the moderate gap category and a majority of them i.e. 85.0 per cent were in the high gap category as regards the adoption of plant protection measures. Jagbhusnoor and Dhara-Biswas (1981) in their study reported that none of the groundnut growers had used plant protection measures.

2.4 [illegible]

The Programme Evaluation Organisation (1968), in its report on High Yielding Varieties Programme for Kharif 1967 pointed out that adoption in combination of any three of the four practices was reported by 60 per cent of the participants in jowar, maize and bajra and 30.40 per cent for paddy. Those who followed any two of the practices were only 20 per cent. The remaining one tenth of the participants adopted only one of the

four practices. They also found that the proportion adopting the combination of practices increased with the increase in the size of the holding and concluded that a sizeable proportion of cultivators, particularly the smaller ones, were yet to realise the value of the entire package of practices as a unit. The Agro-economic Research Project in Drought Prone Areas, Solapur, while studying adoption and diffusion of new technology (1976), reported that in case of rabi jowar, 60 per cent of the farmers have adopted a combination of improved seed and interculturing, or improved seed, early sowing and interculturing. Due to these two packages, the average yield increased by 20 per cent.

The Agro-economic Research Centre, Hyderabad (1976) reported the relationship of adoption of practices and yields of rabi jowar and observed that four practices viz., improved seed, early sowing, intercultivation and fertilizer use were adopted by only six per cent of the farmers and barely three per cent of the farmers adopted five recommended practices and the area covered was 2.5 per cent of the total area under rabi jowar.

Shanmugasundaram and Perumal (1982) studied the technological gap in adoption of dry land technology and reported that the maximum gap was found in formation of compartmental bunds and raised beds and furrows (80 and 65 per cent respectively). The gap was minimum in weeding (seven per cent).

The report of the Department of Agricultural Economics, Mahatma Phule Agricultural University, Rahuri on adoption of Dry Land Agriculture Technology (1977-78) stated that 72 per cent of the farmers have adopted a combination of three improved practices and only 4.41 per cent of farmers have adopted all the five recommended practices for rabi jowar.

The International Crops Research Institute for Semi-arid Tropics, Hyderabad (A.P.) on working group meeting of yield gap analysis (1980) stated that the recommended package of practices has its direct impact on crop yield. It is observed from the practicewise yield data analysis that as the adoption of number of practices increases, the yield of the crop also increases gradually. Rangaswamy (1980) reported in his paper presented to the meeting organised by the All India Coordinated Research Project for Dry land Agriculture and the International Crops Research Institute for Semi-arid Tropics, that farmers, in general, have not adopted the total package of practices, nor the recommended dosages of inputs for rainfed crops i.e. rabi jowar. They have been rather selective in their use of modern inputs, preferring relatively less risky or risk-reducing inputs like fertilizers and pesticides than the more risky disease prone hybrids and high yielding varieties. They seem to prefer varieties

which they know from their experience to be more resistant to disease and drought than others. Sharma and Nair (1974) reported that the extent of adoption of package of practices was also far below the expected level. Only nine per cent of the participating farmers adopted three practices.

2.5 CONSTRAINTS IN THE ADOPTION OF HIGH YIELDING VARIETIES OF JOWAR

Though the technology of jowar production is not so intricate and involves simple practices, its adoption has been partial because of certain constraints. The major constraints reported by the farmers are delineated here.

Choukidar and George (1972) pointed out that lack of knowledge, characteristics of varieties themselves like taste, keeping quality, cooking quality were the major constraints in the adoption of high yielding varieties.

The Agricultural Research Sub-Committee Report of the Department of Agricultural Economics, Mahatma Phule Agricultural University, Rahuri (1977), while studying adoption of recommended practices for dry land area, reported that the constraints in adoption jowar technology were (i) non-availability of seed of high yielding varieties of rabi jowar and costly seed as

reported by 32 per cent of the farmers and (ii) unsuitability of the variety to their soil was opined by 27.50 per cent of the farmers.

Rajagopalan (1975) reported that the most serious bottleneck in rice technology was the inadequate supply of modern inputs such as fertilizers, plant protection chemicals and seeds. Mishra (1974) in his study of "Rice yield in Orissa" reported following major constraints :

(i) Physical - soil type, backward areas, climate.

(ii) Technological - seed, fertilizer, irrigation.

(iii) Economic - Incentives, disincentives, prices, taxes, subsidies.

(iv) Institutional and organisational - Land tenure, credit, marketing, extension education.

The Second Workshop on Agro-Economic Research, Hyderabad (1976), while reporting the studies made on adoption of new technology, expressed following constraints. (i) In case of rabi jowar, 75 per cent of the farmers had reported that seed was costly; (ii) Small farmers had opined lack of conviction as reason for

non-adoption. (iii) A high percentage of farmers opined unsuitability of the seed for local condition. (iv) High susceptibility for the pests and diseases. (v) As regards the intercultivation of rabi jowar, 40 to 60 per cent of farmers having different sizes of holdings stated shortage of labour and high cost of operation. 40 per cent of the farmers opined that it was not profitable to interculture rabi jowar. Eighteen per cent of the farmers did not take up interculturing because of poor crop stand.

The major constraints which have been reported in case of plant protection were lack of knowledge and high cost of plant protection measures. The scientists at the All India Coordinated Research Project for dry land agriculture, Solapur, conducted studies on adoption of dry land agriculture technology and its diffusion (1979) and found that 70 per cent of farmers reported following constraints. (i) Costly seed and (ii) shortage of capital. Out of the 70 per cent farmers, 60 per cent reported shortage of labour and 40 per cent, shortage of funds. In case of rabi jowar crop and 40 per cent of the farmers reported high cost of insecticides.

The All India Coordinated Research Project for Dry Land Agriculture and the International Crop Research Institute for Semi-Arid Tropics in a working group meeting of yield gap analysis discussed the report

regarding research gap and constraints in the drought prone Areas of Rajkot district (1980) and reported that the major constraints in yield gap were (1) inadequate and erratic rainfall, (2) unknown topography of the soil, (3) shallow nature of the soil, (4) greater risk involved under dry farming conditions; the farmers were reluctant to use optimum quantity of fertilizers, plant protection, fungicides and pesticides. Choudhari and Kushwaha (1980) in their report on "A study of yield variation in Indore (M.P.) Area" stated that constraints in adoption of high yielding varieties and fertilizer were the costly nature of these inputs, availability, knowledge, risk bearing capacity of farmer and shortage of capital.

The Department of Agricultural Economics, Mahatma Phule Agricultural University, Rahuri in its study of "Adoption of Dry Land Agricultural Technology" (1976) stated the constraints in adoption of rabi jowar technology in the Rainfed Project of Solapur district as below. (i) Most of the farmers opined that M-35-1 variety was not suitable for their local condition on account of shallow soils and hence, the farmers sow jogadi variety. (ii) Forty per cent of the non-adopters reported that inadequate hoeings were carried out as the cost of the operation was not commensurate with the profits gained. The shortage of labour at the time of this operation was also reported by 60 per cent of farmers.

shortage of funds for carrying out this operation was further reported by 46 per cent. (iii) The reasons for non-adoption of plant protection measures were lack of knowledge (60 per cent) and high cost of insecticides (40 per cent).

Tripathy (1977), while studying technological gap in rice cultivation, reported that (i) 90 per cent farmers perceived that government supplied seeds were of low germination percentage, complete immunity was not ensured by seed treatment, low purity of seed, high varietal mixture and (ii) difficulty in use of plant protection measures because of adulteration of insecticides. Sixty six per cent of the farmers reported that placement of fertilizer is very expensive and does not give proportionate increase in yield. The constraints pertaining to institutional infrastructure were (i) credit - cost involved in running to the nearest urban centre several times for credit was very high, 75.0 per cent reported straight recovery procedure during harvest time were a hardship; 62.5 per cent expressed complicated procedure for obtaining credit and 40 per cent reported high rate of interest. (ii) Sixty six per cent of farmers reported that stocks of inputs were neither received well before the season, nor in adequate quantities; 65 per cent reported exploitation of farmers by private agencies and unfair treatment to the farmers

in the urban markets; 37.5 per cent reported faulty weighment. Singh (1976) reported that the major constraints in adoption new technology were lack of information and lack of easy, timely and adequately available inputs. Beside this, small holding was one of constraints in adopting high yielding varieties and fertilizers. Rana and Sinha (1966) reported the constraints in adoption of high yielding varieties of maize to be unavailability of credit, untimely supply of inputs and lack of knowledge of package of practices. Nagabhushanam and Chand Basha (1961) reported the major constraints regarding adoption of improved agricultural technology as follows :

1. Farmers' misconception that improved varieties were more susceptible to pests and diseases.
2. Farmers faced difficulties in marketing of produce.
3. Eighteen per cent of the farmers felt that the content of improved variety was low.
4. Due to lack of local demand, the improved variety was not adopted by the farmers.
5. Risk retarded the application of fertilizer in dry land agriculture.
6. Farmers feared the failure of crops owing to the failure of rains.

7. Exorbitant and high price of fertilizer besides shortage of capital which was beyond the reach of the farmers.

8. Lack of knowledge of identification of pests and diseases, ignorance as to when to apply, how to apply and what chemicals to apply for controlling the pests and diseases, on the part of the farmers.

9. Non-availability of sprayers and dusters in time; high cost of chemicals was one among the other reasons.

10. Hand weeding practice was not adopted twice as it reduced the margin of profit, since it did not affect the production appreciably.

Narayanappa (1970) reported that the constraints in adoption of recommended varieties were high susceptibility to diseases and requirement of more manure and fertilizers. Lack of knowledge was the main reason for not adopting the spacing and plant protection measures.

Sharma and Nair (1974) reported non-availability of chemicals for seed treatment as one of the constraints. He also reported high cost of fertilizers and their untimely and inadequate supply. Nagabhushanam and Ghani Basha (1981) reported that besides the factors discussed

earlier, psychological factors also served as constraints in the adoption of farm technology. These were misconceptions and superstition. Attitudes and beliefs of farm also play a major role in the application of science and technology.

Waghmare and Pandit (1982) reported the constraints in adoption in high yielding wheat varieties technology as follows - (a) constraints related to improved seeds were the lack of knowledge and lack of technical guidance about new varieties of wheat, (b) constraints related to seed treatment, method of sowing, use of chemical fertilizers and plant protection and educational constraints were the main constraints, followed by socio-cultural, practical and economic constraints.

Dhankumar and Perumal (1982) reported constraints in adoption of dry farming technology such as non-availability of labour as well as high labour cost, poor price for the produce, non-availability of credit at the required time and high cost of fertilizers.

CHAPTER III

METHODOLOGY

CHAPTER III

METHODOLOGY

In this chapter, the methods and procedures used in the study are discussed. The chapter consists of three parts. The first part describes the sampling techniques used. The second part deals with the empirical measures of different variables and the third part deals with the details of the field procedures and statistical analyses used for collection and analysis of data.

Locale :

The study was conducted in twelve villages from Karmala, Sangola, Mangalwedha and South Solapur Community Development Blocks of Solapur district. The focus of the study was on the cultivation of high yielding varieties of jowar in rabi season.

3.1 [illegible]

The study envisages to probe into the gaps and constraints in the adoption of high yielding varieties of jowar in the drought prone areas of Maharashtra. Solapur district has the maximum acreage under rabi jowar and is a representative tract of drought prone areas. Moreover a dry land agricultural research station is situated in

the district to cater to the needs of farmers by generating suitable technology.

Selection of blocks :

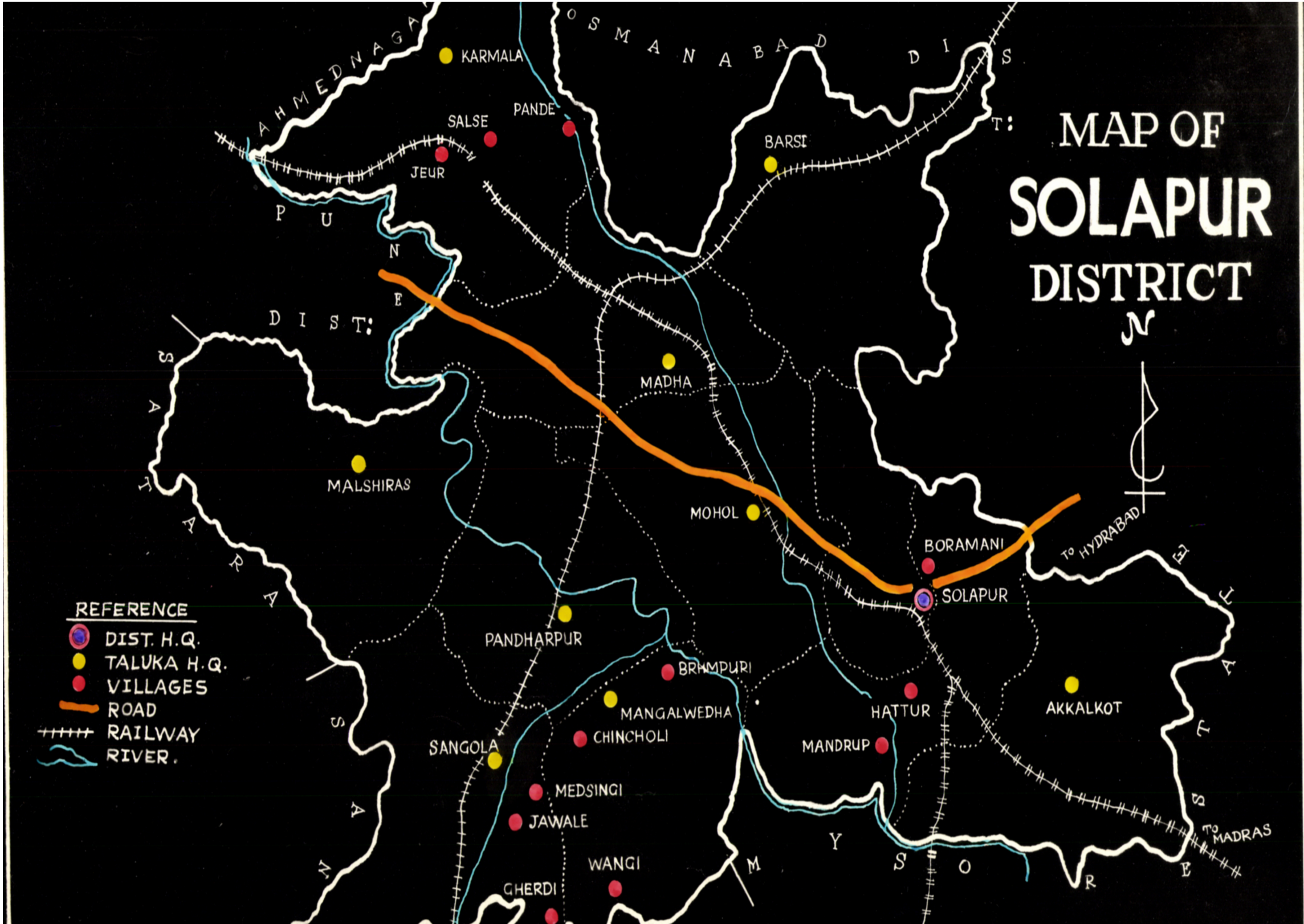
Random sampling technique was used to select four blocks from the Solapur district. This district has eleven blocks. Nearly thirty seven per cent of the total area is included in the study.

Selection of villages :

A list of the villages from the four community development blocks was obtained from the Block Development Officers of the respective blocks. By random sampling three villages from each block were selected for the study.

List of the villages selected :

Sr. No.	Name of the block	Name of the villages selected
1.	Sangola	1. Javale 2. Medsingi 3. Gheradi
2.	Mangalwedha	1. Brhampuri 2. Chincholi 3. Mangi
3.	Karmala	1. Jeur 2. Pande 3. Salse
4.	South Solapur	1. Hattur 2. Mandrup 3. Boramani


MAP OF
SOLAPUR
DISTRICT
AHMEDNAGAR DIST:
OSMANABAD DIST:
PUNE DIST:
SATARA DIST:
KARMALA
PANDE
SALSE
JEUR
BARSI
MADHA
MALSHIRAS
MOHOL
BORAMANI
SOLAPUR
TO HYDRABAD
PANDHARPUR
BRHMPURI
MANGALWEDHA
CHINCHOLI
SANGOLA
HATTUR
MANDRUP
AKKALKOT
MEDSINGI
JAWALE
WANGI
GHERDI
TO MADRAS
MYSORE STATE
REFERENCE
DIST. H.Q.
TALUKA H.Q.
VILLAGES
ROAD
RAILWAY
RIVER.

Selection of respondents :

A list of khatedars (land-holders) was obtained from the talathis (village revenue official) and verified with the village level workers for finding out those who actually cultivated the land. Absentee land-holders were deleted from the list and a final list of rabi jowar growers having an area of 20 acres under jowar was prepared. With the help of the list, 25 farmers were selected on a random basis from each of the selected villages, thus, making the total number of respondents 300. Of these, 286 were interviewed as the remaining were not available for interview inspite of repeated efforts.

Selection of variables :

The independent variables included in the study were selected on the basis of an extensive review of literature, discussion with experts and a preliminary study conducted in the area of investigation. Only those variables which were found to be having some relevance to the adoption of high yielding varieties of jowar were selected for detailed investigation.

The list of variables studied along with the instruments used for measuring them is given below :

Variables studied and their measurements

Variables	Measures
1. Technological gap (Techno-economic variables)	Index developed for the study.
2. Farm size	Number of hectares cultivated.
3. Cropping intensity	Schedule developed for the study.
4. Irrigation potential	Schedule developed for the study.

Stimulus variables
(perceptional)

5. Profitability	Schedule developed for the study.
6. Physical compatibility	Schedule developed for the study.
7. Rate of innovation	Schedule developed for the study.
8. Simplicity complexity	Schedule developed for the study.
9. Infrastructure efficiency	Scale developed by Ramaswamy (1976).

Personal and socio-psychological variables

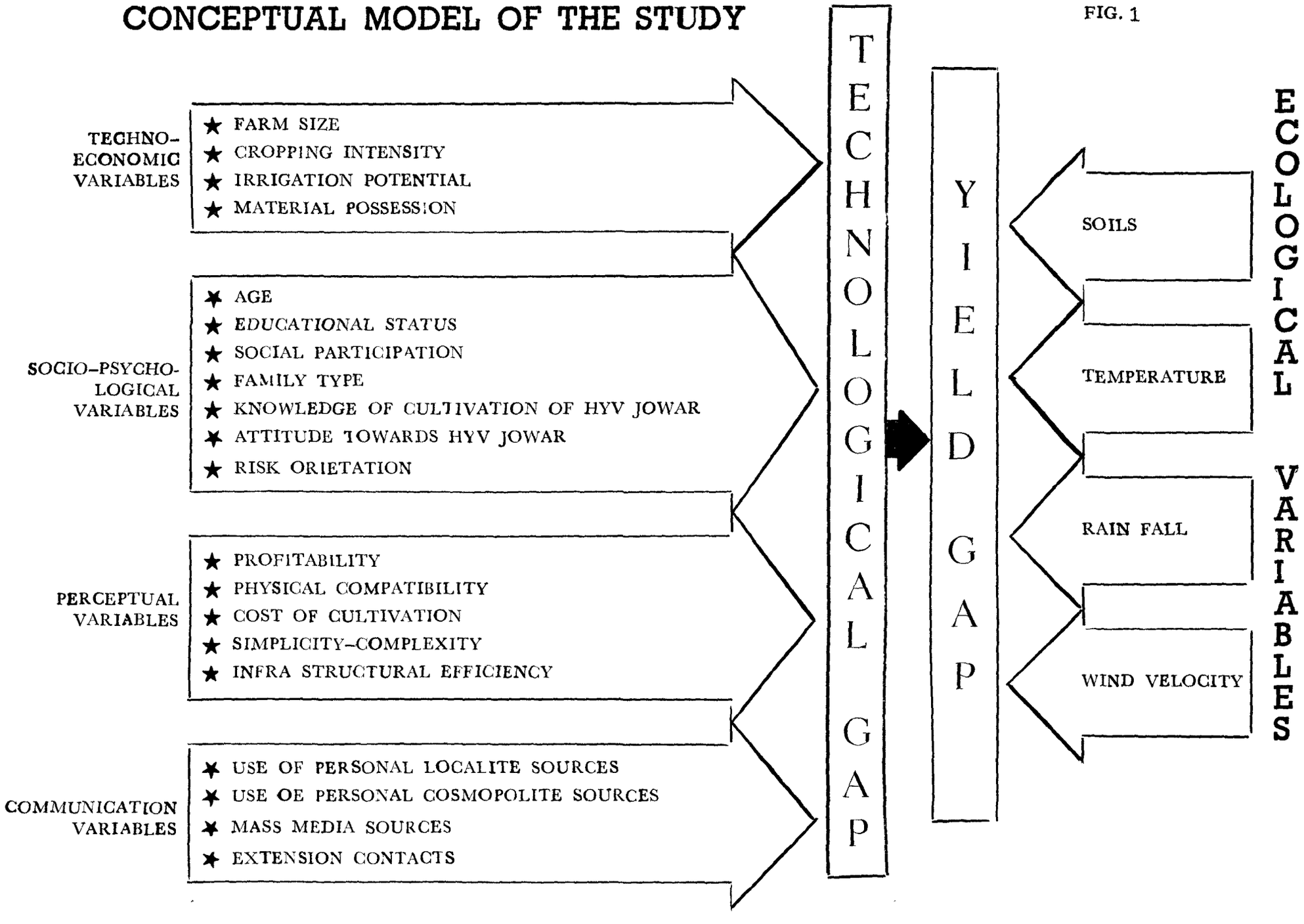
10.	Age	Chronological age in years.
11.	Educational status	Scores as per S.E.S. Scale of Trivedi and Pareekh (1963).
12.	Social participation	Scores as per S.P.S. Scale of Trivedi and Pareekh (1963). (with accessary modifications).
13.	Family type	Schedule developed for the study.
14.	Knowledge of cultivation of HYV jowar	Test developed by Choubey(1972) with necessary modification.
15.	Attitudes towards HYV jowar	Test developed by Nair (1969) with necessary modifications.
16.	Risk orientation	Risk preference scale developed by Suse (1969).

Communication variables

19.	Mass media use	Schedule developed for the study.
20.	Personal - cosmopolite-source use	Schedule developed for the study.
21.	Personal - localite source use	Schedule developed for the study.
22.	Extension contact	Schedule developed for the study.

CONCEPTUAL MODEL OF THE STUDY

FIG. 1



3.2 EMPIRICAL MEASUREMENT OF VARIABLES

Measurement of technological gap

Technological gap is the dependent variable of the study. This could be determined when adoption is computed. Therefore, technological gap and adoption are considered to be the two sides of the same coin. If we know one, we can know the other. The recommended practices selected for calculating the technological gap were :

i) Seed and its treatment
ii) Care after germination
iii) Nutrient management
iv) Water harvest and water management
v) Cultivation and methods of cropping
vi) Weed control
vii) Disease and pest management
viii) Harvest and post-harvest technology.

Measurement of dependent variables
(Technological gap)

This variable was measured against the gap index for major package of jowar technology.

Gap against varietal recommendation :

A bulletin published by the Department of Agriculture on jowar and recommendations made therein,

were considered for the extent of adoption of package of practices. These practices were grouped into five categories and were given scores as below :

Correct adoption	...	4
Almost correct	...	3
Somewhat deviation	...	2
Deviation(almost)	...	1
Complete deviation	...	0

The gap index in varietal - recommendation was calculated by the following formula expressed in percentage.

$$\text{Gap Index} = \frac{\text{R} - \text{A}}{\text{R}} \times 100$$

Where -

R = Recommended package with score four

A = Score obtained out of four

Average gap for each respondent :

Gap index for a particular practice was calculated by the following formula.

$$\text{Average Gap Index} = \frac{\text{R} - \text{A}}{\text{R}} \times 100$$

Where -

R = Recommended package

A = Adopted package

The average gap for each respondent was calculated as -

$$\text{Average gap} = \frac{\sum \text{Gap index } i}{n}$$

where,

i = Gap index in particular major package

n = Total number of major packages

Over all gap : Over all gap was calculated as

$$\text{Over all gap} = \frac{\sum \text{Average gap } j}{j}$$

where,

j = Average gap for j th respondent

j = Total number of respondents

Farm size :

Almost all the researchers have shown a significantly positive correlation between farm size and adoption behaviour of farmers. Different researchers have tried to measure this variable in different ways.

Trivedi (1963), while constructing socio-economic status scale, used item analysis and determined weightage for different sizes of holding groups. In his scale, farmers with no land score '0', upto one acre 1, upto 5 acres 2, upto 10 acres 3, upto 15 acres 4, upto 20 acres 5, and above 20 acres 6.

Irrigation potentiality

This has been operationally defined in this study as the fraction of the total area irrigated and was calculated by using the following formula.

$$\text{Irrigation potentiality} = \frac{\text{Total area under irrigation}}{\text{Size of holding}} \times 100$$

3.3 SELECTION OF THE ATTRIBUTES OF HIGH YIELDING JOWAR VARIETIES (Stimulus variables)

In this study, only four attributes viz., profitability, physical compatibility, cost of innovation and simplicity complexity of the innovation were included. All these attributes were quantified in terms of farmers perception of the attributes with respect to high yielding varieties of jowar in the rabi season of 1981-82.

Cultivation of high yielding varieties of jowar requires adoption of many practices like seed, seed treatment, care after germination, accurate dose, time and method of manuring, recommended spacing, inter-culturing, weed control, water management, recommended plant protection practices, harvest and post harvest technology. Each of the practices may vary in its degree of possession of the above mentioned attributes. The measurement of each attribute was done as follows.

Profitability :

Profitability of high yielding varieties of jowar was operationalised as the additional gain in terms of economic yield and/or money which one gets by using the recommended practices over the local one in a unit of land.

To quantify the farmers' profit perception, the respondents were asked to state as to how profitable they considered was the cultivation of high yielding variety of jowar during the rabi season of 1961-62. The responses were recorded on a five point rating scale as follows.

Scores	5	4	3	2	1
Response categories	Very profitable	Profitable	Somewhat profitable	Least profitable	Not profitable

The responses on the scale range from the most profitable to the least profitable in relation to profit perception.

Physical compatibility :

Physical compatibility of high yielding varieties of jowar was operationalised as the farmer's perception of the farming resources available at his disposal such as type of soil, human and bullock labour, source of

irrigation and the existing cropping pattern. Their responses were obtained on a five point scale as follows.

Scores	5	4	3	2	1
Response categories	Most compatible	Compatible	Some what compatible	least compatible	not compatible

Cost of innovation :

The cost was operationalised as the initial purchases or other expenditures involved to put the pacakge of practices into operation. To quantify their perception of cost with regard to cultivation of high yielding varieties of jowar in the rabi season of 1981-82, respondents were asked to indicate as to how costly they think are the package of practices. The responses were obtained on a five point continuum as follows.

Scores	5	4	3	2	1
Response categories	Very low cost	low cost	Neither low nor high	High cost	Very high cost

Simplicity - complexity of the innovation :

The simplicity - complexity of cultivation of high yielding varieties of jowar was operationalised as the farmer's perception of difficulty in cultivating high yielding varieties of jowar in the rabi season of 1981-82.

To identify the perception of difficulty, the respondents were asked to state as to how difficult they think is the package of practices to adopt in rabi season. Their responses were obtained on a five point continuum as follows.

Scores	5	4	3	2	1
Response categories	Very easy to use	Easy to use	Neither easy nor difficult	Difficult	Very difficult to use

3.4 [illegible] of the Infrastructural facilities

It was operationalised as the total perception of a farmer respondent based of his actual experience with respect to the following eight aspects of organisation meant for infrastructural support.

i) Complexity of organisational procedures.
ii) Incentives provided by the organisations.
iii) Degree of distance of the organisations.
iv) Adequacy of inputs provided by the organisations.
v) Supply efficiency of the organisations.
vi) Time efficiency of the organisations.
vii) Dealing efficiency (customer treatment).

Keeping the above objectives in view and also based on the definition of infrastructure, the organisations which were responsible for providing finance,

seeds, fertilizers and plant protection chemicals and marketing facilities were selected for the study.

A scale developed by Somasundram for measuring infrastructure efficiency was used with certain modifications for selecting aspects of infrastructural support.

i) Complexity of organisational procedures :

This aspect was measured with a five point scale, the points being 'very complicated', 'complicated', 'some what complicated', 'simple' and 'very simple'. A score of '1' was allowed to the 'very complicated' procedure, while a score of '5' was allowed to the 'very simple' point. The remaining points viz., 'complicated', 'some what complicated' and 'simple' were allotted 2, 3 and 4 scores respectively.

This scoring method states that the higher the score, the simpler is the procedure. At the end of each proforma, a column was provided to get the nature of constraints a farmer core across; for example in this case not only the farmer's perception of complexity of the organisational procedure was recorded, but also the nature of complexity was revealed.

ii) Incentives provided by the organisation :

Since the study was conducted in the drought prone area programme area where organisational incentives figured very importantly it was found necessary to examine this aspect.

The incentives studies were different with reference to different inputs. The incentive for credit was the low interest charged, whereas the incentives for fertilizers, seeds and plant protection chemicals were the subsidies given. Considering the type of incentives under study, scores were allotted differently as below.

Types of incentive		Degree of incentive				
1.	Rate of interest	1	2	3	4	5
2.	Subsidy	Very high	High	Moderate	Low	Very low
		5	4	3	2	1

More score would mean low rate of interest for credit and more subsidy for fertilizers, seed and plant protection chemicals.

iii) Degree of distance from home :

Degree of distance of the organisations dealing in inputs and credits was measured against a three point

scale based on the approximate distance in kilometres from their homes.

Scale	Very near	near	at a distance
Scores	3	2	1

The more the score, the nearer would be the organisations.

iv) Adequacy of inputs provided by the organisations :

The adequacy of supply was quantified by assigning scores of 3, 2 and 1 for responses obtained over a three point scale viz., 'very adequate', 'adequate' and 'inadequate'.

v) Supply efficiency of the organisations :

The variable was measured by using a three point scale viz., 'well before the season', 'during the season', and 'after the season' with a scoring system of 3, 2 and 1 for respective points. More score means more timely supply.

vi) Time efficiency of the organisations :

This aspect refers to the time taken in rendering services and supplies to farmers. How long one has to wait for getting loan or getting his produce marketed or getting an implement repaired or getting the quota of seeds, fertilizers and insecticides, were studied under

this; 'very quick', 'quick' and 'late' were the three points in the scale. If a farmer gets his service and supply rendered on the same day, it is termed 'very quick', if it is available in a week, it is termed 'quick' and if it is delayed over a fortnight, it is 'late'. The response on this scale were quantified by assigning a score of 3 for 'very quick', 2 for 'quick' and 1 for 'late'. The more the score, the lesser was the time taken in service and supply.

vii) Dealing efficiency (customer - treatment) :

How the farmers were treated at the time of their visits to input organisations, by the persons attending to them was measured using a four point scale. The scale and the scoring procedure used were as follows.

Scale	Very fair	Fair	Bad	Very bad
Score	4	3	2	1

(Higher score indicates fair treatment)

The instrument developed by Somasundaram to quantify the various aspects of the organisation providing infrastructural support was used. The scale as perceived by farmers had face validity. As it was selected on the basis of the observations of the experts, field workers and farmers, it could be stated that the instrument also had content validity. The reliability of the instrument

was determined by test - retest procedure. The test-retest conducted at an interval of 10 days gave a co-relation co-efficient of 0.81 for the eight aspects administered as a lot each time.

3.8 [illegible]

All the respondents who had personal experiences in dealing with the co-operatives, agricultural depots, banks, input-agents were requested to record their experiences with respect to each of the above aspects separately for each infrastructure. For easy comparison of the responses on different aspects measured, using different points or scales, the score of each aspect of was first converted into an index by multiplying the proportion of actual score to maximum score with 100. This enables the data to be in the same level so that they can be added together to arrive at a single score for each infrastructure. This also gave the pooled scores for a single farmer.

Age :

The number of years completed by the respondent at the time of enquiry was considered as his age for this study.

Educational status :

Educational status of the respondent was operationalised as the number of years of formal

education obtained by the respondent. The scoring system followed by Trivedi (1963) in his socio-economic status scale for the respondents was used. The scores were as follows.

Illiterate	...	0
Can read only	...	1
Can read & write	...	2
Primary	...	3
Middle School	...	4
High School	...	5
College	...	6

Family type :

'Family type' was operationalised on the basis of whether the members were staying jointly with a common kitchen or they had a nucleated type of family with separate kitchens. The score assigned for joint family was 1, whereas the score for nucleated type of family was 2.

Social participation :

Social participation in this study refers to the degree of involvement of the respondent in a formal organisation either as member or its office-bearer. The variable was quantified on the basis of the scoring system followed in the socio-economic status scale of Trivedi (1963).

Membership in one organisation	1
Membership in more than one organisation	2
Office-bearer	3
Distinctive features ([illegible] or [illegible] etc.)	0

Knowledge about cultivation of high yielding varieties of jowar :

This variable refers to the extent of knowledge the respondent possessed at the time of interview as evidenced by 'correct', 'near correct', or 'wrong' responses to a set of questions purposively designed, covering all aspects of cultivation of high yielding jowar in the rabi season. The base for comparison was the official recommendations of the Directorate of Agriculture, Maharashtra State.

The device developed by Choubey (1972) for testing the technological knowledge of respondents in regard to cultivation of high yielding wheat was adopted with necessary modifications and was used in case of jowar in Solapur district for the rabi season. On the basis of various knowledge scales and by reviewing scores assigned by Rupe (1960), Tripathy (1977), Singh (1969), weightage

was assigned as '2' for 'correct' answer, '1' for 'near correct' and '0' for 'wrong' answer. All the scores obtained by the respondents were summed up, and the aggregate score was considered as the respondent's technological knowledge score for cultivation of high yielding jowar.

Attitudes towards high yielding jowar varieties

Attitude was operationalised as individual's degree of favourableness or unfavourableness towards phenomena. This variable was measured by an attitude scale developed by Nair (1969). The scale consisted of 10 items, of which 5 were negative and the other 5 positive. The scale followed the Likert scaling pattern, and the reliability of the scale was 0.77 by test-retest method and 0.87 by 'split half' method as reported by Nair. The scale had both construct and content validity. The response patterns were 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree'.

The scoring procedure followed was 5, 4, 3, 2 and 1 respectively for positive statements and 1, 2, 3, 4, 5 for negative statements.

Risk orientation :

'Risk Preference Scale' developed by Suhe (1969) was used to measure the risk orientation of the respondent

This scale consisted of six items. The responses were on a five point continuum with 4 positive and 2 negative items in it.

The scoring procedure was as below.

Response	Strongly agree	Agree	Neutral	Is-agree	Strongly disagree
Score for positive items	7	6	4	3	1
Score for negative items	1	3	4	6	7

The maximum score an individual could obtain on this scale was 42.

Use of communication channels :

The communication channel used by the farmer was measured by taking into consideration two aspects.

(a) Information source use :

For quantifying the information sources used, all possible sources of information available in agricultural technology were listed in consultation with the extension staff of the Mahatma Phule Agricultural University, Pahuri, All India Radio and the Deputy Director of Agriculture of the concerned area of investigation. These channels were classified into three categories viz., mass media, personal

cosmopolite and personal localite. Each respondent was asked to indicate as to how often he gets information regarding high yielding varieties of jowar from each of the above listed sources. The possible range of responses and the scoring procedure are given below.

Response	Score
Most often	3
Often	2
Some times	1
Never	0

The total score for each of the above stated three groups was calculated by adding the score of an individual over different sources in each category. Thus, the maximum score an individual may get would be 30, 21 and 27 for the use of mass media, personal cosmopolite and personal localite sources respectively.

(b) Contact with extension agency

This was measured with the help of a schedule. Contact with extension agency was measured in terms of degree of contact. Each farmer was asked how often he comes in contact with the extension workers. The possible responses and their scoring were as follows.

Response	Score
Most frequently (every week)	6
Frequently (fortnightly)	5
Most often (once a month)	4
Often (once in two months)	3
Some time (once in three months)	2
Barely (once in six months)	1
Never	0

The total score of a farmer was obtained by adding the scores obtained by him as per the above scaling procedure.

3.6 MEASUREMENT OF THE SUITABILITY OF HIGH YIELDING JOWAR TECHNOLOGY IN RAPI STAGE

The suitability of the high yielding jowar technology was studied in relation to the agro-economic environment of the area of investigation.

It is conceptualised in this study that the constraints are not only in the set of human factors, but also in government operated economic and policy factors and they are also inbuilt in agro-ecological environment of the area of investigation.

The agro-ecological parameters studied to isolate the inbuilt constraints in the technology were as below.

(a) Climatic factors :

i) Rainfall ... distribution, intensity, periodicity, lag period.

ii) Temperature ... Maximum - minimum - average, monthly temperatures, heat unit requirement.

iii) Sun shine ... Average daily sun shine in rabi season.

iv) Relative humidity at different stages of crop growth and its correlation with disease and pest build up.

(b) Soil factors :

v) Topographical pattern, classification of land types, specific land type - requirement of high yielding varieties.

vi) Nutrient management under different land types.

vii) Soils : textural classification and their suitability for high yielding varieties.

viii) Soil drainage - water holding capacity and drainage potential.

(c) Agronomic factors :

ix) Crop competition

x) Cropping pattern.

The methodology to study the suitability of high yielding jowar technology with the above agro-ecological parameters was to compile data from the secondary sources. The difference between the 'ideal' or what is recommended through research and the actual condition existing in the area, explained the gap. In other words, the suitability of the technology was judged on the basis of its compatibility or otherwise with the existing ecological parameters during the rabi season.

3.7 PROCEDURE INVOLVED IN FINAL DATA COLLECTION

The final data were collected with the help of a common schedule incorporating all the items on which information was required. The schedule consisted of three parts.

The first part was concerned with the characteristics of variables. The second part consisted of the actual adoption and the constraints as perceived by the respondents. The third part of the questionnaire dealt with the measurement of communication variables.

Apart from this, data from secondary sources like

research papers, annual reports and other published documents were collected.

The entire schedule before its use was pre-tested in the field on a separate sample of farmers. On the basis of pre-testing, necessary modifications were made in the final schedule.

The data collection was carried out from December 1981 to March, 1982. The respondents were individually contacted in person mostly at their residences. Rapport was built to get unbiased information. The assistance of the local village level workers and the Agricultural Extension Officers was availed of to locate the respondents. The duration of each interview was, on an average, one to one and half hours. The schedule was translated into Marathi, the local language, and read out to the respondents to obtain their responses.

Statistical methods used

Based on the nature of data and the types of information required, following non-parametric and parametric statistical methods were used in this study.

1) Percentage :

Percentages were used in descriptive analysis for making simple comparisons. For calculating percentages,

the frequency of a particular cell was multiplied by 100 and divided by the total number of respondents in that particular category to which cell they belonged.

ii) 't' test :

The test applied in this study was the 't' test, the significance of the difference of mean values of any two category of respondents. The formula used for calculating 't' value was as follows.

$$t = \frac{\text{difference between means}}{\text{standard error of differences}}$$

The significance of 't' was tested by referring to the 't' table. If the observed value of 't' was equal to or greater than the table value of 't' under 0.05 level of probability, it was considered as significant.

iii) Pearson's co-efficient of correlation :

This test was used to find out the zero order correlation between technological gap of farmers participating in high yielding varieties programme and selected techno-economic socio-psychological and communication variables.

The formula used for calculating the co-efficient of correlation is as follows.

$$r = \frac{n \sum xy - (\sum x)(\sum y)}{\sqrt{n \sum x^2 - (\sum x)^2}\sqrt{n \sum y^2 - (\sum y)^2}}$$

where,

n = Number of pairs being correlated.

x and y = the variable being correlated.

r = Co-efficient of correlation between x and y.

The details of multiple correlation and multiple regression are discussed in the relevant chapter on analysis of data and discussion.

3.8 BLOCK PROFILE

Agricultural production in the monsoon countries like India fluctuates from season to season depending on the quantum and distribution of rainfall. Most of the area of our country is characterised as semi-arid with low rainfall, high evaporation demands and low productivity. It extends from Punjab in the north, cutting across the length of the country to the down upto the east coast of Tamil Nadu and Andhra Pradesh.

It covers one third of the total area of the country and two thirds of the area of Maharashtra State, where ninety per cent of farming is rainfed, of which 40 per cent area is drought prone comprising of tehsils spread over 12 districts. In this zone, the total annual rainfall is low (less than 750 mm) and its distribution is uneven and erratic. Rainfall is an important limiting factor for crop production in this area. The cropping pattern includes crops like jowar, bajara and safflower which are grown in moisture deficit conditions. Therefore, Solapur district was selected for the study and it is a representative district for the predominantly rainfed farming system prevailing in Maharashtra. It occupies an area of 35 lakh hectares out of 60 lakhs which is under the jowar crop in the State (out of this, 56 per cent is under rabi jowar). Four tehsils from this district were randomly selected for the study. The details regarding geographical area, agro-climatic conditions, cropping pattern and resource inventory are delineated in this chapter. These factors generally determine the way of life, behavioural patterns, socio-economic conditions and the nature of infrastructure evolved. Moreover, they also play an important role in the adoption of innovations and cultural pattern of life. It is, therefore, necessary to study the profile of the area.

Geographical features of the Solapur district :

This district is situated on the South-east fringe of Maharashtra State and lies between 17°-10' and 18°-32' North latitude and 74°-42' and 76°-10' East longitude. The district is surrounded by Ahmednagar and Osmanabad districts in the North, Osmanabad district and Andhra Pradesh in the East, Sangli district and the Karnataka State to the South and Satara and Pune districts towards the West.

Solapur district comprises eleven tehsils of which four viz., Karmala, Sangola, Mangalwedha and South Solapur were selected for the study.

The total geographical area of the Solapur district is 15,01,000 hectares. Out of this, 32,700 hectares are under forest and the net sown area is 1,07,400. The situation of each tehsil is shown in the map of Solapur district (Fig.1) from which the boundaries can be identified in respect of other tehsils and district headquarters.

The total geographical area of the tehsils under study is as follows.

Sr. No.	Name of the tensil	Total geographical area in Sq km.	Area under forest in Sq km.	Net sown area in Sq km.
1.	South Solapur	1150	10	100.2
2.	Karmala	1036	62	106.4
3.	Malsiras	1094	35	106.7
4.	Mangalwedha	1142	0	107.4
	Total	4527	107	420.7

The total geographical area of four tehsils is 36.75 per cent of the Solapur district; area under forest is 43 per cent and the net sown area is 35.57 per cent.

Population :

The total population of Solapur district is 22,34,000 out of which 1,16,000 are males and 1,06,000 are females. This population comprises 2,70,200 cultivators and 2,40,600 agricultural workers. The data regarding population, cultivators and agricultural labourers of the tensils under study are as follows.

Table 3.2: Total population of tehsils under study

Sr. No.	Tehsils	Total population	Male	Female	Cultivators	Agricultural workers
1.	South Kolapur	1,38,000	69,000	64,000	17,600	32,600
2.	Karmala	1,01,000	76,000	73,000	27,000	15,000
3.	Sangola	1,50,000	79,000	76,000	29,400	14,000
4.	Mangalwedha	1,00,000	50,000	52,000	21,200	12,400

The population of the four tehsils is 5,47,000 which is about 25 per cent of the district. Cultivators are 95,000 in number which is 36.00 per cent of the total number of cultivators in the district.

The density of population of district is 150/sq.km and as compared to the State, it is less (164/sq.km) and the average size of house hold members is 5.6.

Birth and Death rate :

The birth and death rates of the district are less than that of the State (24.00 and 8.7 respectively). The birth rate of the district is 20.0 and the death rate is 7.3 which is also less than the average in the country.

Education :

Literacy percentage of the district is 38.90, while in case of the tensils included in the study, it is 25.77 per cent in South Solapur, 24.05 per cent in Mangalwedha, 20 per cent in Mangoli and 29 per cent in Karmala. The total educational institutions in the district are : Primary education - 1875, Secondary education - 223 and Higher education - 22.

Research Institute :

The area of investigation is predominantly a drought prone area which constitutes the rabi zone and where rainfed farming is the extensive practice adopted.

Dry farming research in the country was initiated in 1933 at Solapur. Subsequently, the then Imperical Council of Agricultural Research extended the work in 1935 to the sub-centres located at Bijapur, Raichur and Bellary (near Bellary) in the State of Karnataka. One centre was also located in Punjab at Lontar. These centres continued the work till 1945.

After 1945, the work in dry farming was continued as a part of the regular departmental work in the then Bombay Province at Solapur and Bijapur. After the reorganisation of States in 1956, the work in dry farming

in Maharashtra continued at Solapur supported by sub-centres at Jeur (Solapur) and Vhas (Ahmednagar).

With the introduction of high yielding varieties of jowar, bajara, wheat and rice a green revolution came about in irrigated farming. This created a wide yield gap between the irrigated and dry land farmers. To bridge this gap, the Indian Council of Agricultural Research launched a nationwide project on dry land farming during 1970 at sixteen main centres and eight sub-centres with the project headquarters at Hyderabad. One of the main centres is located at Solapur in the jurisdiction of Mahatma Phule Agricultural University.

The present research organisation is linked with the All India Integrated Development Project to verify the techniques evolved on the farmers' fields at Mandrup (Taluka South Solapur) in 1970. Thus, it provides first hand information on suitability or otherwise of the methodology and modification required, if any. This has helped to reduce the time lag of the transfer of technology from research farms to the cultivators' fields. The process is further accelerated with the initiation of the Drought Prone Area Programme (DPAP) with the World Bank assistance in Solapur and Ahmednagar districts in Maharashtra State.

Infrastructure facilities :

In the district, there are 94 branches of district central co-operative bank, nine District Industrial Banks and 29 Urban Banks. There are 668 Primary Agricultural Credit Societies in the district. Out of these, 66 are in South Solapur, 66 in Mangalwedha, 70 in Sangola and 92 in Karmala. Besides these, there are some private organisations/agencies dealing with credit, supply and services like Agro-Service Centres.

Climate :

Weather plays an important role in crop production. Out of the several elements of weather, rainfall has a key position in the success of farming, particularly where rainfed agriculture is practised.

The climate of the area of study is usually hot and the potential - evaporation (PE) is far in excess of the precipitation. The annual precipitation is of about 722 mm and the potential - evaporation is about 1000 mm annually, resulting in a deficit of 60 per cent. This high rate of demand for the evaporation puts strain on the crop growth and thus the production. The climatological details are as follows :

Rainfall features :

Generally, the rainfall is scanty, erratic and ill-distributed. Some times, the quantity of rainfall may

not be a limiting factor, but its distribution and uncertainty are the other two qualities which make the rainfed farming very difficult. Thus, rainfall is the single most important factor in the farming system of this area. Detailed studies have been made by the Dry Farming Research Centre, Solapur for 110 years with the help of available records. The lowest precipitation of about 270 mm was recorded in 1876 and 1972. The maximum precipitation received was 1,727 mm during 1978. Year to year fluctuations are so much that there is no guarantee of a fixed quantity of rainfall.

Another climatic feature is the dry spells. Breaking in of the monsoon is normally experienced during late July and August. They may extend by the 2 weeks to about 13 weeks at a stretch. A break is a period receiving less than fifteen mm rainfall in the consecutive weeks, the normal rainfall during the week being more than five mm.

Water availability periods :

Water availability period gives a rough idea about the extent of suitable periods for crop growth. Water availability depends on the rainfall and the potentio - evaporation (PE). Humid and moist periods taken together, provide congenial weather for active crop growth. During moderate dry period, moisture stress is observed. Crop planning in such a fashion that the maturity period would fall during moderately dry period is a key to the

successful farming in this area.

Wind velocity :

Wind velocity in this district is usually high during July and August and it exceeds, 16-20 km/hr during this period. Usually such period coincides with dry spell. Wind velocity is usually minimum i.e. about 4 to 5 km/hr during November and December.

Bright sunshine hours :

Bright sunshine is usually experienced during January and February. It is for about eight to nine hours. During April and May, the sky is usually hazy with more dust particles. The lowest bright sunshine is noticed during August (about 4 to 5 hours). This indicates the cloudy weather, but no rainfall.

Humidity :

Humidity is high during July and September. From February to May, it is low. During dry spell, relatively less humidity is noticed. Evaporation demands are also accelerated with high temperatures and low humidity.

Temperatures .

The temperature exceeds 41^{0}C during late April and early May. Temperature drops down during July and August and then there is a slight increase during late September and early October. The minimum temperature is noticed during December and from January onwards, it starts rising.

from June to early October, the difference between the mean maximum and mean minimum temperatures is narrow. Thereafter the difference gradually widens, the maximum being during December. The lowest weekly minimum temperature is about 14° to 15°C.

On the whole the climate of this area is semi-arid with mild winters and hot summers. In prolonged cold weather jowar suffers considerably.

Soils :

The soils of Solapur district, particularly of the tehsils under study, are derived from the basic igneous rock viz., basalt, commonly known as Deccan trap. The colour of the soil varies from reddish brown to dark grey black. The soils exhibit very shallow depth. Half of the soils of Karmala are black and the remaining, red and light. The soils of Mangolu are mainly light brown or greyish black and are shallow. The soils of South Solapur and Mangalwedha are medium to deep black.

As regards the fertility status of the soils, they are generally low in organic carbon (0.35 to 0.5 per cent) and total nitrogen (0.035 to 0.05 per cent), low to medium in available phosphate (10 to 30 kg P_2O_5/ha) and high in available potash (300 to 750 kg K_2O/ha). The cereal crops when supplied with nitrogenous fertilizers give fairly good response (10 to 15 kg grain/kg of N).

Crops and cropping pattern :

The cropping pattern of the area under study is dependent on the quantity and distribution of rainfall, soil type and its depth. In addition to this, home requirements play an important role. The cropping during kharif is less than 20 per cent. This is because the dependability of the rains is very low. On the contrary, the rains in September are more assured and as such farmers prefer to take rabi crops even in medium deep soils with about 25 to 30 cm depth. Farmers have, however, a tendency to adopt low cost and minimum risk technology.

In general, about 25 to 30 per cent area is cropped during kharif, leaving the rest for rabi season. Even as much as 90 to 95 per cent of area is diverted to rabi crops in the event of failure of kharif rains. The principal crops grown in this region during kharif are bajara, groundnut, red gram, horse gram, moth, beam, green gram and black gram, and during rabi, jowar, gram safflower and to a certain extent wheat are grown.

Kharif season :

Bajara :

It is a principal crop grown during kharif and constitutes about 15 to 20 per cent of the total area. This is the only cereal cultivated on shallow soils.

Usually the early maturing local variety sojjuri is grown. Beside this, improved varieties like K-1-8, MD-3, K-560, K-120 are introduced for adoption.

Groundnut :

This is the only cash crop of the region. The cultivation of groundnut has been mainly confined to drought prone areas. The crop is very sensitive to moisture fluctuations. The varieties grown are K - 1, TMV-7, K-13, VRI-1 and Kadiri Pragati (Dry).

Sesamum :

Mostly grown on textured soil and is usually taken in newly opened soils after ploughing. It is also cultivated as a mixed crop.

Red gram :

This is cultivated as a mixed crop with groundnut and some times as a sole crop.

Green gram :

It is a short duration pulse mostly grown in assured rainfall areas. In dry farms, it was a place to increase the cropping intensity by introducing it as the first crop to rabi jowar. Moreover, Black-gram and horse-gram are also grown.

Rabi season :

Jowar :

Rabi jowar is the major cereal of this area. Out of 60 lakhs under jowar in the State, it occupies an area of 35 lakh hectares. The crop is generally grown on receding soil moisture. The two major types grown by cultivators are Maldandi and Nagadi. Maldandi is taken as a dry land crop. A selection from composite variety viz., M-35-1 is an improved strain being recommended for the last 30 years. A large number of strains for rabi are available; out of these CSH-1, CSH-9, CSH-7R, M-35-1 and SPV-86 are the important ones.

Safflower :

Next to jowar, safflower is the important crop during rabi. It is mostly cultivated as a mixed row crop in jowar. However, it is uneconomic to mix this crop with jowar and as such sole cultivation is recommended. A-62-8, No.7, Kusa are the important strains popularised in this area.

Irrigation potential

Though the district comes under semi-arid area, there are some irrigation resources; the major ones

being (1) Bhima Irrigation Project, (2) Ashti Tank - Pimpol, (3) Mundial Tank - Sangola, (4) Ekruk tank - North Solapur, (5) Chandni Mangalwedha Tank - Karmshi, (6) Padwalkarwadi tank - Mangalwedha. Beside these wells are another source of irrigation. The total number of wells in the district is 69,600 out of which 5,347 are in South Solapur, 4,603 in Karmala, 3,166 in Sangola and 2,042 in Mangalwedha. Some of the parts of the area viz., Malshiras and Madhapur tehsils receive water from the right bank canal, where sugarcane crop is predominantly grown.

Table 3.3: Area under major crops in Solapur district and the tehsils under study in hectares

Sr. No.	Name of the district and tehsils	Rabi Jowar	Kharif Jowar	Bajara	Total pulses	Wheat	Oilseeds	Total food grains
1.	Solapur	6,61,893	18,135	72,687	2,10,700	62,899	90,313	10,62,235
2.	South Solapur	52,730	312	3,723	24,665	6,282	9,500	90,595
3.	Mangalwedha	39,782	1,525	15,693	17,550	3,989	54,483	79,703
4.	Sangola	50,663	1,216	23,657	10,063	3,705	5,882	95,556
5.	Karmala	95,024	25	5,406	11,532	7,740	10,856	1,20,504

Present system of jowar farming prevalent in Maharashtra :

Jowar contributes the largest share to the agricultural economy of the State. However, its yield depends on the vagaries of the monsoon. In the years of adverse rainfall conditions, the production of food-grains considerably dips down.

Cultivation practices :

Soils : Jowar is cultivated on all types of soils, viz., from light soils to very fertile heavy soils. This is the main reason why there is a wide range in the yields of jowar crop in various parts of Maharashtra State. The lowest average yield is two to three quintals per hectare in scarcity zone to the highest average yield of 18 quintals per hectare in Kolhapur district.

Season : Jowar is grown both in kharif as well as in the rabi seasons. In the Deccan, it is mainly grown as a rabi crop, especially in Solapur, Pune, Ahmednagar, Satara, Aurangabad, Nanded, Bhir and Osmanabad districts. In the Vidarbha region, jowar is mostly grown as a kharif crop. The kharif and the rabi seasons correspond with the South West and the North East monsoon periods respectively. Failure of normal rainfall in these seasons invariably results in low production of jowar

bringing in its wake near famine conditions in some or the other parts of the State. This is the most important factor in the agro-climatic complex which is directly related to the production of jowar.

Preparatory tillage : Since jowar is cultivated in rotation with a large variety of crops, the nature of preparatory tillage varies widely when it is cultivated after crops like sugarcane, cotton, or other irrigated crops. The land is ploughed and harrowed in the summer. When jowar is cultivated after groundnut or other cereal crops, no ploughing is given but only three to four harrowings are carried out. In the scarcity tract rabi jowar is cultivated on the lands which are kept harrowed in the kharif. These fallow lands are ploughed twice or thrice in the kharif so as to conserve moisture in the soil.

Varieties : There are good local improved varieties like Aispuri and Satpani in Jalgaon and Dhule area. Nagpur jowar varieties Davaner and Sankal are grown in Vidarbha region and PJ-4 and PJ-16 are grown in Marathwada region during the kharif. In rabi, Maldandi is the most popular variety; PJ-4 is also grown in the rabi. The grain quality of these varieties is very good and liked by the farmers. These varieties are not

very responsive to the fertilizer use and are of a long duration; but these have acclimatized themselves to the soil-climate complex of various regions. Kharif varieties are generally sown in the first fortnight of July. Rabi sowings are undertaken from early September to middle of October.

Manuring : Manuring practices also vary in different regions since jowar is almost wholly grown as a rainfed crop. Farmers do not use chemical fertilizers for cultivation of conventional varieties. Farm yard manure of about 5 cart-loads is used for jowar crop.

Most of the conventional varieties of jowar are largely resistant to pests and diseases. Before the introduction of hybrid varieties, the only problem was that of sugary disease in the rabi season which could be easily controlled by dusting BHC.

What has been known as the Bombay dry farming method for jowar cultivation was popularised after 1940. The various dry farming methods recommended for different regions vary on the basis of soil, climate and slope of land. The recommendations of Solapur dry farming research station are suited for Deccan trap regions of Maharashtra. Some of the salient features of the recommendations of the Agricultural Research Station, Solapur are as follows.

1) Prevention of run off and erosion :

Construction of a series of small embankments or bunds made of soil, murum, stones or combinations of these and thus dividing the area of the holding into several compartments is considered as the first step in the dry farming method. For the usual slope, it is recommended that at a fall of every 60 cm, a bund of 45-60 cm height should be constructed. Provision for allowing excess storm-water must be made by constructing outlets called waste-weirs.

2) Deep preparatory tillage :

The next operation is to cultivate the soil so as to make it suitable for the maximum absorption of rain water, to destroy weeds, to bury all stubbles into the soil and to expose the lower layer to the sun and air. This is best done by a suitable iron plough which inverts the soil and opens it efficiently and thoroughly. In the case of deep and medium deep types of soil, systematic ploughing of 1/3 of the area every year is the most suitable economic and desirable practice.

3) Surface tillage during monsoon :

The clods brought out by ploughing when exposed to the hot sun before the monsoon, begin to crumble gradually. Harrowing given with the local blade harrow

helps such crumbling which is later completed by monsoon rains. However, for the proper pulverisation of the soil and for greater absorption of rain water, the operation of harrowing has to be repeated four times.

4) Addition of organic manures :

Bulky manures like the farm yard manure, compost and the green manures, have been found to be effective in improving the physical and chemical characteristics of the soil and have resulted in giving increased yields even under low rainfall conditions, provided the applications are made at proper time and in moderate doses. Twelve cart-loads of farm yard manure or compost/ha are added once in three years and 50 kg N/ha per year is used.

5) Sowing and seed rate :

It is advantageous to sow as early as possible in the second fortnight of September. The seed-drill to be used should have its coulters 45 cm apart. This facilitates interculturing operations to be carried out even when the crop has advanced. The seedrate should be eight to ten kg/ha, previously treated with sulphur against smut disease. The seeds should be covered with a light harrow which also serves as a mulch. M-35-1

evolved at Nonol has been found to give higher yields as compared to the local variety which is not a pure type.

6) Interculturing :

It is necessary to stir the surface layer as early as possible without disturbing the young seedlings. The first interculturing with a slit hoe or an entire blade hoe should be given three weeks after germination. The second and the third interculturings should be given at an interval of every three to four weeks.

7) Crop rotations and mixtures :

In tracts where soils are deep and seasons favourable, cotton should be rotated with jowar.

The practice of raising some less important crop in a mixture with the main crop is found. The two important oilseeds viz., safflower and linseed, are usually found mixed with jowar. Sowing one drill width of the subordinate crop coming after several drills of the main crop of jowar is quite a good practice instead of mixing the two seeds together. Gram is the only legume which is definitely known to succeed in this tract in the rabi season. The following rotations may be adopted.

Jowar - Jowar - Jowar - Jowar

Jowar - Jowar - Jowar - Groundnut

The second jowar crop can be replaced by other crops such as wheat, cotton, tobacco.

6) Fallowing :

This method involves the loss of a crop in one year and loss of dry matter. The loss of a crop in the year of fallow is, however, compensated to a great extent by very much increased yield in the year of cropping. During the year of fallow, the expenditure on cultivation is very small. The land is worked with a fine cultivator followed by occasional harrowing of the surface soil to keep the land free from weeds and to maintain a mulch of loose earth on the surface for conserving moisture. Lands which have less than 40 cm depth are unsuited for fallowing as the moisture of one year cannot be carried over to the next in such soils.

It is recommended that a part of the deep soil, say about 1/6 of the total area, should be kept fallow to provide for the carrying over of the soil moisture to the next year as an insurance against complete failure of the crop due to a bad season.

9) Use of surface mulch :

Surface mulch of farm waste material has been found to be very useful for conserving moisture. It has

been proved that it is the longer moisture retention that helps to boost production rather than the quantum of moisture due to surface mulch. Dead waste like jowar stubble, dried stalks, grass or straw which have no fodder value should be used as surface mulch. Normally 5 tonnes/ha is the requirement of the material. It is necessary that the mulch is applied immediately after the emergence of the crop. On an average mulch increases rabi jowar production by 25-50 per cent depending on the rainfall. No effect of mulch was noticed when rainfall is in far excess the normal. Once the mulch is applied, interculturing operations can be dispensed with. Otherwise three interculturings during third, fifth and eighth week of the crop growth are required.

10) Protective irrigation

One protective irrigation to the extent of 5 cm of water helps to boost the production by nearly 50 per cent. Normally, dry jowar requires about 100 cm moisture for successful production. An additional 50 cm helps to better production when applied during pre-boot stage (55-60 days after sowing) of M-35-1 variety. Use of fertilizer, protective irrigation and mulch together are known to boost production to about 150 per cent.

The further details regarding innovations in the field of jowar development and improved package of practices which needs to be transferred for their adoption are discussed under the jowar development strategy.

CHAPTER IV

RESULTS AND DISCUSSION

CHAPTER IV

RESULTS AND DISCUSSION

The findings of the present study are presented in this chapter under six sections as detailed below in accordance with the objectives set forth for the study.

The discussion on the findings are given at the end of each section.

SECTION I — The extent of technological gap in relation to the components of high yielding jowar technology.

SECTION II — Constraints responsible for technological gap as perceived by farmers.

SECTION III — (a) Differential characteristics of low and high technological gap categories.

(b) Relation between the selected independent variables and the technological gap.

(c) Multiple regression analysis to find out the contribution of the selected independent variables towards technological gap of farmers.

SECTION IV Relationship between technological gap and yield gap.

SECTION V Towards formulation of a suitable jowar development strategy in Maharashtra.

1) Jowar development strategy.

2) Communication strategy for transfer of high yielding jowar technology.

SECTION I

4.1 EXTENT OF TECHNOLOGICAL GAP IN RELATION TO THE COMPONENTS OF THE HIGH YIELDING JOWAR TECHNOLOGY IN THE RABI SEASON

In this section the main focus is on finding out the extent of technological gap existing in various components of the high yielding jowar technology in rabi season. This has been worked out by the frequency distribution of the respondents according to the technological gap in percentage.

Table 4.1 : Distribution of average technological gap in the various components of jowar technology.

Sr. No.	Components of technology	Average gap in percentage (N = 290)	Rank
1.	Seed and seed treatment	30.83	VIII
2.	Care after germination	45.96	VII
3.	Nutrient management	65.62	II
4.	Water management	62.46	III
5.	Cultivation practices	50.46	VI
6.	Weed control	59.67	IV
7.	Disease and pests management	72.87	I
8.	Harvest and post-harvest technology	57.15	V

The above table reveals that the highest gap (72.87) is observed in case of disease and pests management. It means, that there is about 27 per cent of adoption of rabi jowar technology in case of disease and pests management. At the second rank nutrient management stands, and shows 65.62 per cent gap. In case of water management, there is 62.46 per cent gap. Weed control occupies the fourth position in the rank order with 59.67 per cent, while the fifth position goes to harvest and post harvest technology. The sixth and seventh, position are occupied by the cultivation practices and care after germination respectively. The least technological gap is observed in seed and seed treatment (30.65 per cent). The over all technological gap observed in respect of all the components of the rabi jowar technology is 56.41 per cent.

Technological gap score :

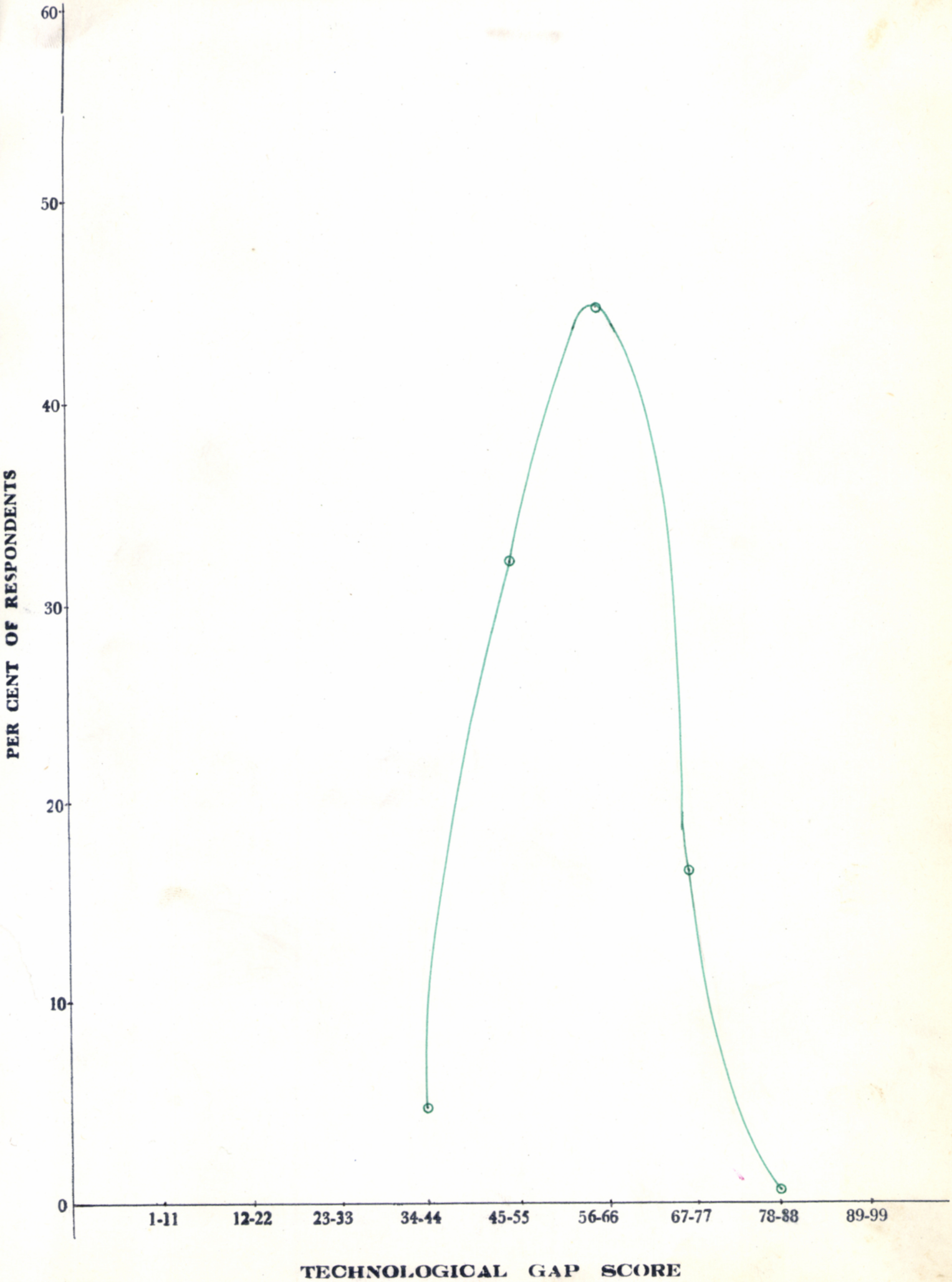
Individual technological gap was worked out and the same was treated as a score for analysing the distribution of farmers to know the extent of technological gap existing in various components of high yielding jowar technology in the rabi season. For this, the frequency distribution of the respondents along with the technological gap score was worked out and is presented in Table 4.2.

Table 4.2 : Frequency distribution of average technological gap score.

Sr. No.	Av. technological gap	Frequency (N = 290)	Per cent	Rank
1.	1 - 11	-	-	-
2.	11 - 22	-	-	-
3.	23 - 33	-	-	-
4.	34 - 44	14	4.83	V
5.	45 - 55	100	34.48	II
6.	56 - 66	129	44.49	I
7.	67 - 77	46	15.87	III
8.	78 - 88	1	0.34	VI
9.	89 and above	-	-	-

The average technological score was worked out and distributed in the various categories. It is observed that none of the farmers had the average score of less than 33, while almost all the farmers had scores ranging from 34 to 77. Nearly 80 per cent of the farmers are in the category ranging from 45 to 66. Sixteen per cent had scores of 67 to 77 and 4.83 per cent had a score of 34 to 44. It seems that the average rabi jowar technology has been adopted to the extent of technological gap score of 33. At the same time only one farmer had an average technological gap score of 77.

FIG. 2 : AVERAGE TECHNOLOGICAL GAP



The respondents are categorised in low, moderate and high gap categories on the basis of their total average technological gap score; those between one to 33 were termed as 'low', those between 34 to 66 were 'moderate' and those between 67 to 100 were taken to be high technological gap categories. The extent of technological gap was calculated on the basis of the adoption of technology during the rabi season of 1980-81.

Seed and seed treatment :

In the improved farm technology, seed is the basic innovation which occupies an important place, in deriving the results of technology. In the present study, this aspect was studied by considering various improved varieties and their treatment by various chemicals. The technological gap in respect of seed and seed treatment is presented in Table 4.3.

Care after germination :

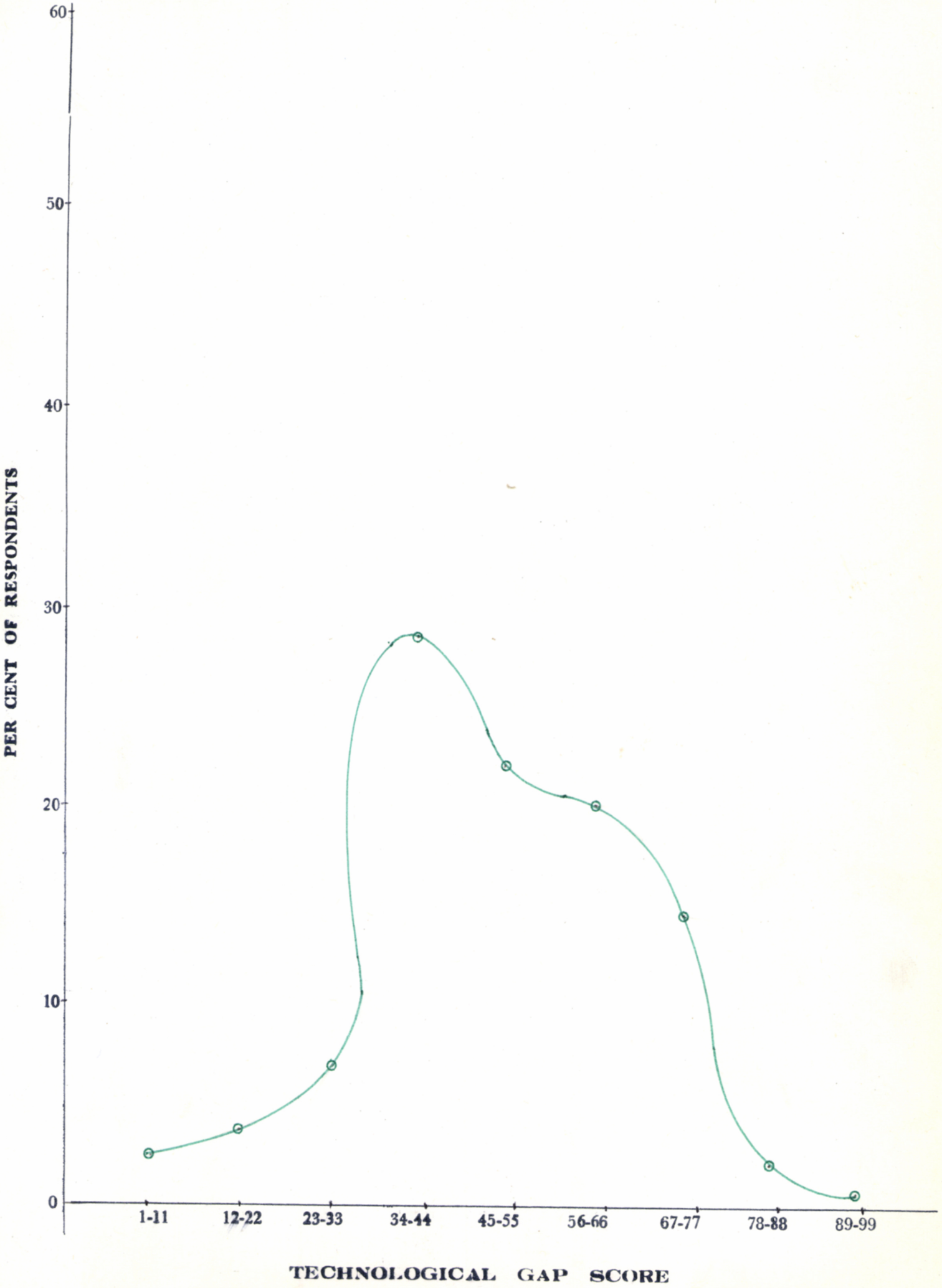
This component was studied by considering various aspects of care after germination for maintaining required plant population. The gap in this component is presented in Table 4.4.

Table 4.4 : Distribution of farmers according to the technological gap in care after germination.

Sr. No.	Technological gap	Frequency	Per cent		C.F.	C.P.
1.	1 - 11	7	2.41		7	2.41
2.	12 - 22	11	3.79	13.10	18	6.21
3.	23 - 33	20	6.90		38	13.10
4.	34 - 44	82	28.28		120	41.38
5.	45 - 55	64	22.07	70.35	184	63.45
6.	56 - 66	58	20.00		242	83.45
7.	67 - 77	42	14.49		284	97.93
8.	78 - 88	5	1.72	16.55	289	99.66
9.	89 and above	1	0.34		290	100.00
	Total	290	100.00			

The highest percentage (70.35) of the farmers belonged to the moderate gap category i.e. score ranging

FIG. 4 : TECHNOLOGICAL GAP IN CARE AFTER GERMINATION



from 34 to 66, while 16.55 per cent were in the high gap category whose score ranged from 67 to 89 and above. Only one farmer from this category belonged to the technological gap score of 89 and above. There was marginal difference between farmers belonging to low gap category and high gap category.

Nutrient management :

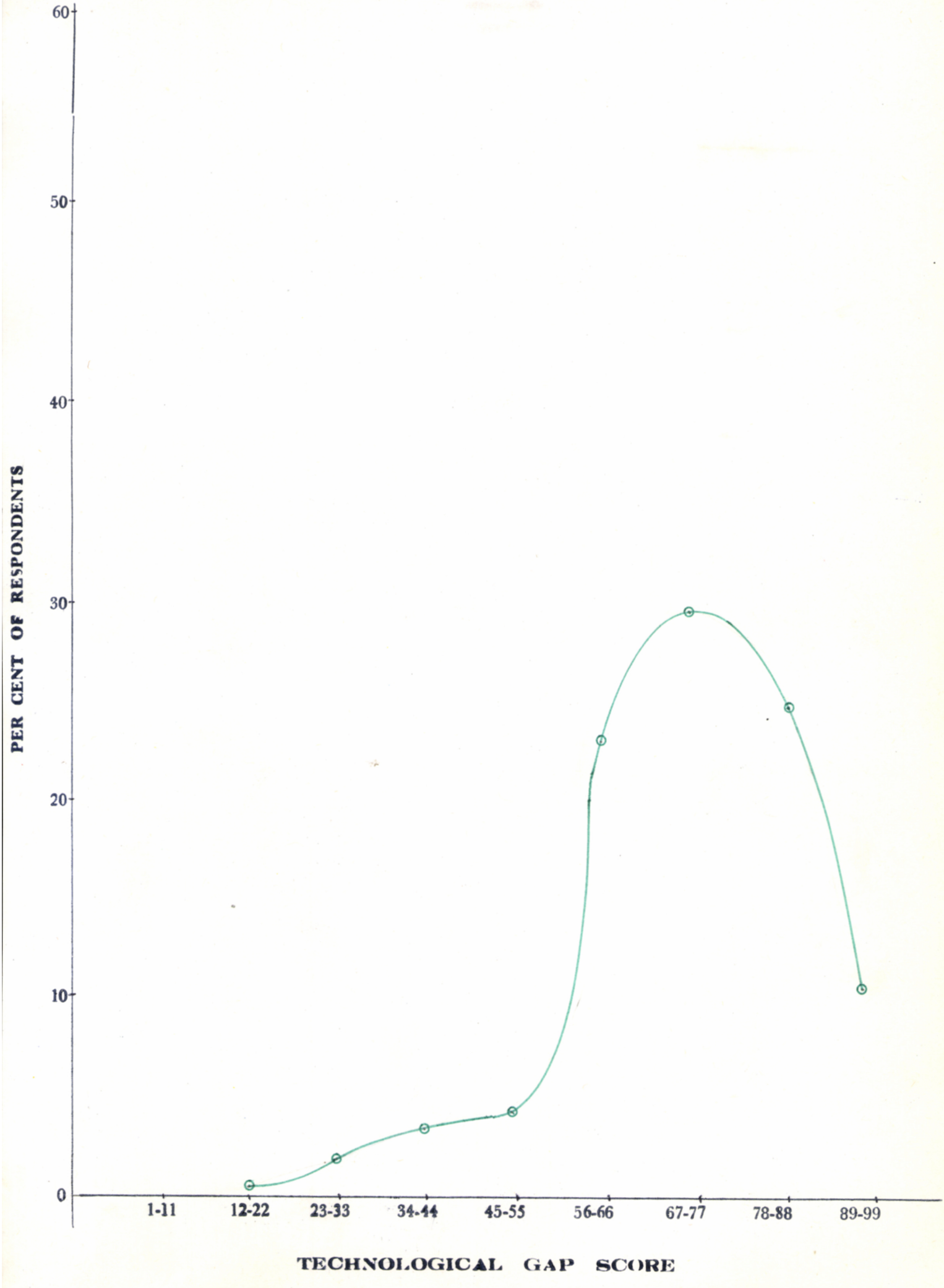
For rabi jowar, fertilizer doses have been recommended under dry farming conditions. Efforts are being made to persue the farmer to adopt the recommended doses. Application of compost and fertilizer according to the recommendations has been studied and presented in Table 4.5.

Table 4.5 : Distribution of farmers according to the technological gap in nutrient management.

Sr. No.	Technological gap	Frequency	Per cent		C.P.	C.P.
1.	1 - 11	-	-		-	-
2.	12 - 22	1	0.34	2.41	1	0.34
3.	23 - 33	6	2.07		7	2.41
4.	34 - 44	9	3.10		16	5.52
5.	45 - 55	12	4.14	31.38	28	9.66
6.	56 - 66	70	24.14		98	33.79
7.	67 - 77	85	29.31		183	63.10
8.	78 - 88	77	26.55	66.21	260	89.66
9.	89 and above	30	10.35		290	100.00
	Total	290	100.00			

From an examination of Table 4.5, it is revealed that there was not a single farmer in the technological gap ranging from one to 11 in nutrient management. However, there was only one farmer (0.34 per cent) in the technological gap ranging from 12 to 22. Only 2.41 per cent of the farmers belonged to the low technological gap and 31.38 per cent belonged to the moderate technological gap; as against this, 66.21 per cent showed the high gap. The maximum number of farmers (29.31) were found in the technological gap category of scores ranging from 67 to 77.

FIG. 5 : TECHNOLOGICAL GAP IN NUTRIENT MANAGEMENT



Water management :

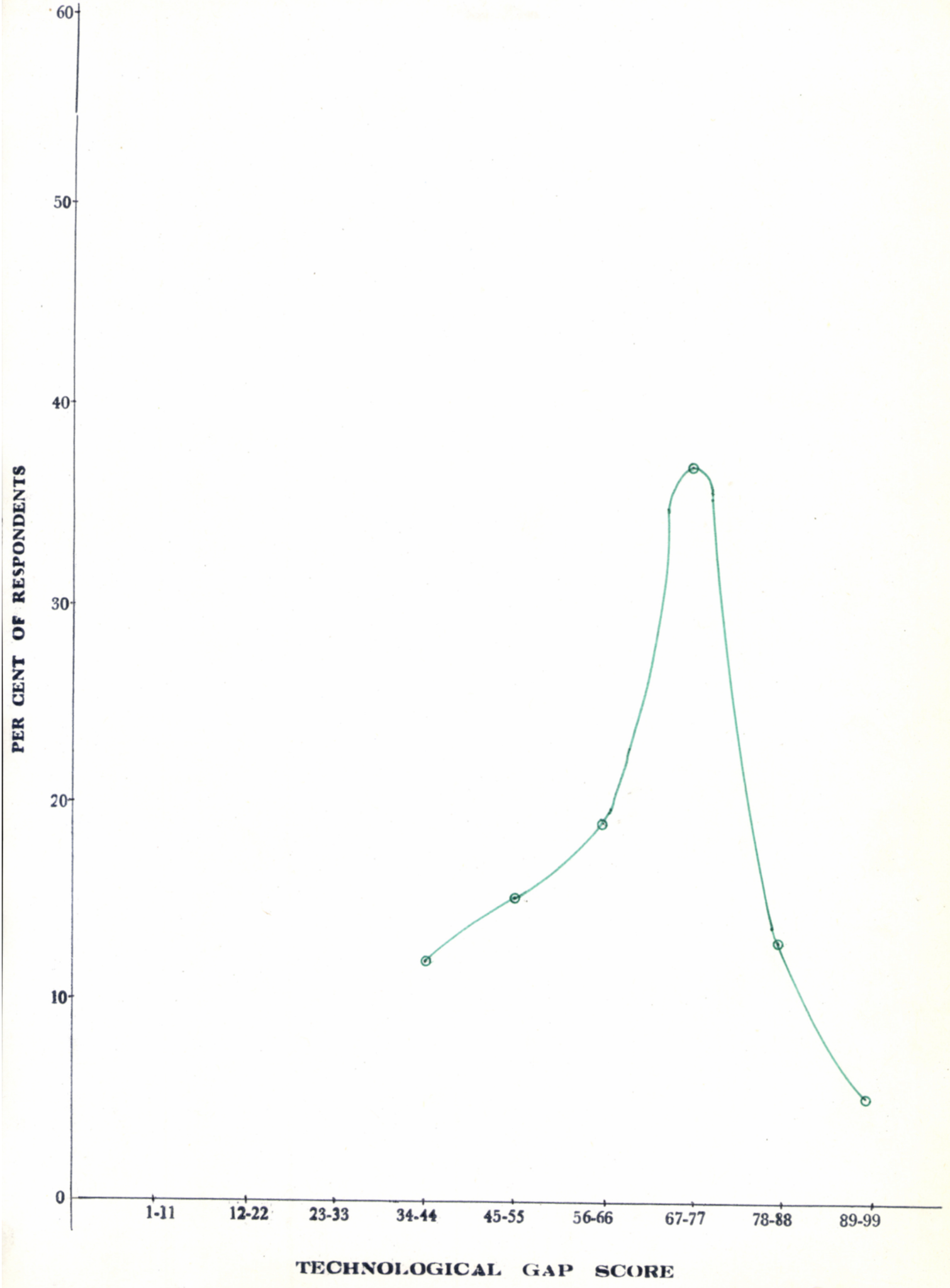
Moisture is the limiting factor in cultivation of the rabi jowar. Therefore, various improved practices have been developed to retain moisture; these were studied and the relevant information is presented in Table 4.6.

Table 4.6 : Distribution of farmers according to the technological gap in water management.

Sr. No.	Technological gap	Frequency	Per cent		C.F.	C.P.
1.	1 - 11	-	-		-	-
2.	12 - 22	-	-	0.00	-	-
3.	23 - 33	-	-		-	-
4.	34 - 44	35	12.07		35	12.07
5.	45 - 55	44	15.17	46.21	79	27.24
6.	56 - 66	55	18.97		134	46.21
7.	67 - 77	107	36.90		241	83.10
8.	78 - 88	34	11.72	53.79	275	94.83
9.	89 and above	15	5.17		290	100.00
	Total	290	100.00			

It is revealed from Table 4.6 that the highest percentage of farmers i.e. 37 per cent were in the

FIG. 6 : TECHNOLOGICAL GAP IN WATER MANAGEMENT



technological gap ranging from 67 to 77. When taken in a group, it could be observed from Table 4.6 that no one belonged to the low technological gap category, in respect of water management, whereas 46.21 per cent belonged to the moderate and 53.79 per cent to the high gap category in the use of recommended water management practices.

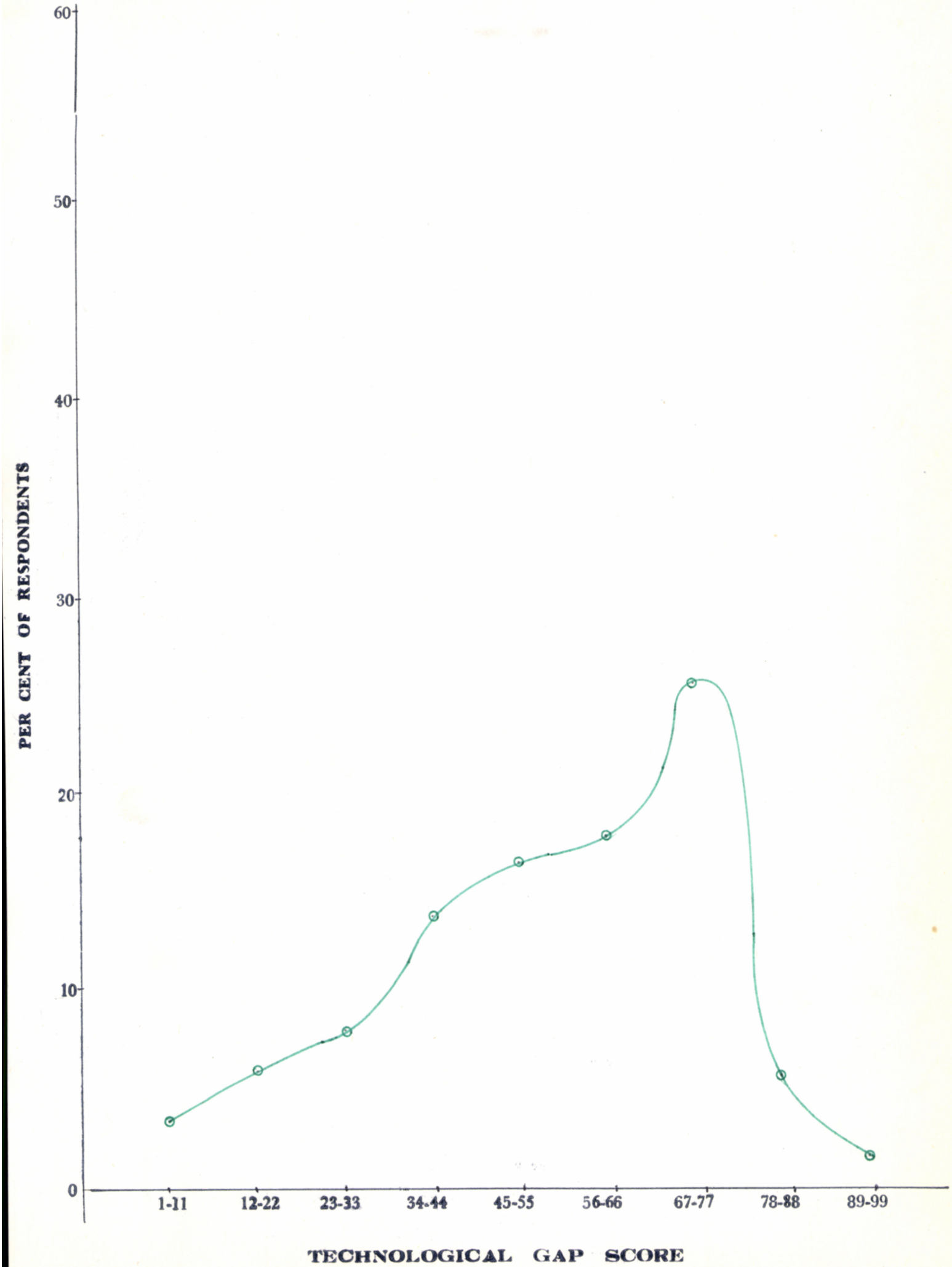
Cultivation practices :

A certain set of package of practices of cultivation such as preparing seed bed, intercropping, mulching, preparing ridges have been studied under this component and the information is presented in Table 4.7.

Table 4.7 : Distribution of farmers according to the technological gap in cultivation practices.

Sr. No.	Technological gap	Frequency	Per cent		C.F.	C.P.
1.	1 - 11	10	3.45		10	3.45
2.	12 - 22	17	5.86	17.24	27	9.31
3.	23 - 33	23	7.93		50	17.24
4.	34 - 44	40	13.79		90	31.03
5.	45 - 55	47	16.21	47.93	137	47.24
6.	56 - 66	52	17.93		189	65.17
7.	67 - 77	81	27.93		270	93.10
8.	78 - 88	16	5.52	34.83	286	98.62
9	89 and above	4	1.38		290	100.00
	Total	290	100.00			

FIG. 7 : TECHNOLOGICAL GAP IN CULTIVATION PRACTICES



It is observed from Table 4.7 that in case of the package of practices of jowar cultivation, a majority (48 per cent) of the farmers belonged to the moderate technological gap category, when the entire group was considered, and 35 per cent of the farmers showed the high technological gap, while only 17 per cent had low technological gap scores of 1 to 33 for package of practices. Only a few (4 farmers) belonged to the technological gap score of 89 and above for the package of practices of cultivation.

Weed control :

Weeds are the competitors to the main crop for uptake of the soil nutrients. Various practices have been developed for controlling weeds and the adoption of the same has been studied and presented in Table 4.8.

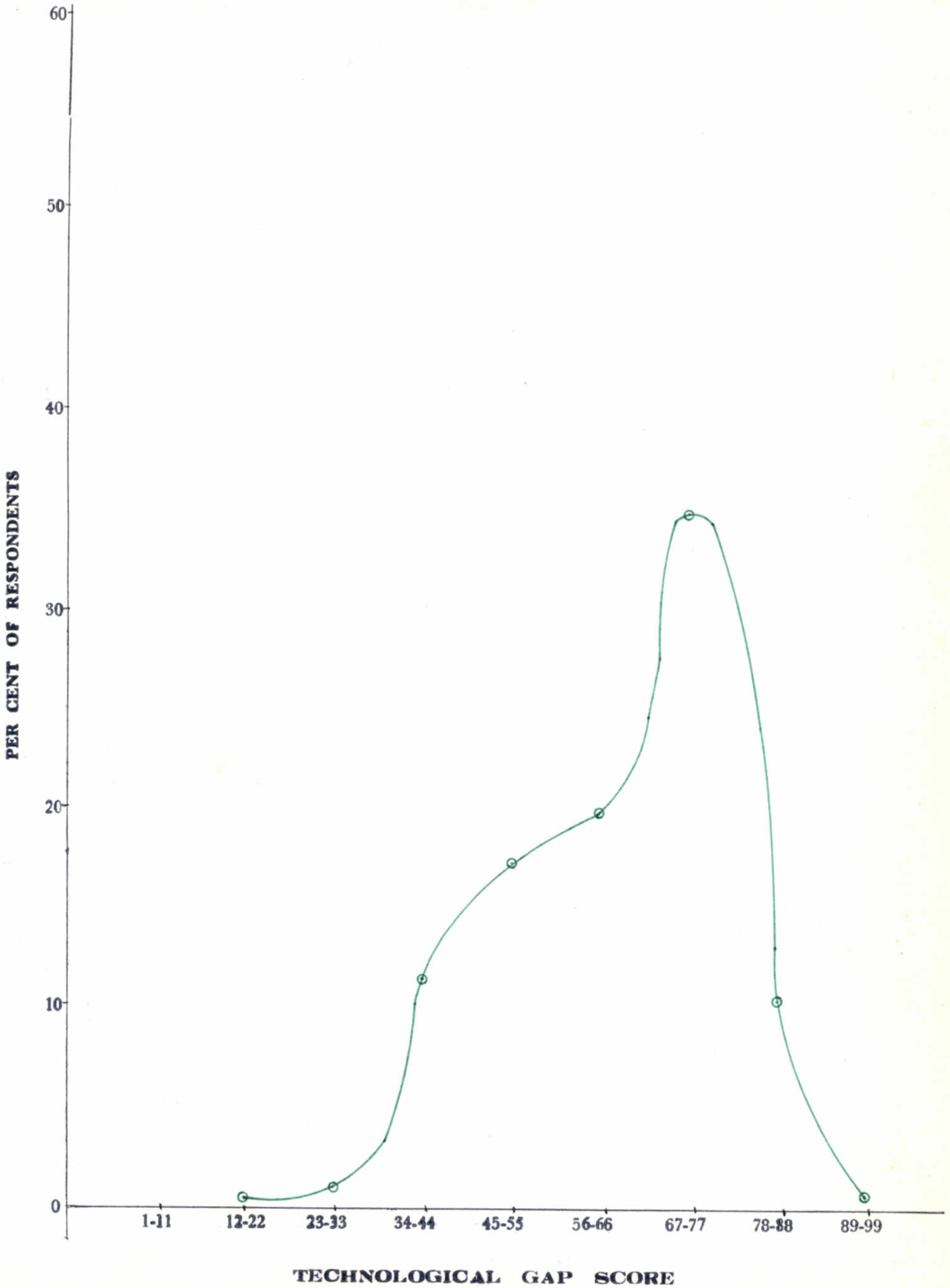
Table 4.6 : Distribution of farmers according to the technological gap in weed control

Sr. No.	Technological gap	Frequency	Per cent		C.F.	C.P.
1.	1 - 11	-	-		-	-
2.	12 - 22	1	0.34	1.04	1	0.34
3.	23 - 33	2	0.70		3	1.03
4.	34 - 44	40	13.79		43	14.83
5.	45 - 55	50	17.24	53.44	93	32.07
6.	56 - 66	65	22.41		158	54.48
7.	67 - 77	101	34.83		259	89.31
8.	78 - 88	30	10.35	45.52	289	99.66
9.	89 and above	1	0.34		290	100.00
	Total	290	100.00			

From the above table, it is observed that there is no farmer in the sample whose technological gap in weed control was in the range of one to 11 and there is only one farmer in the sample whose technological gap was in the range of 89 and above.

It is, however, observed that the maximum percentage of farmers was found in the technological gap ranging from 67 to 77.

FIG. 7 : TECHNOLOGICAL GAP IN WEED CONTROL



Taken as a group, it could be seen that about one per cent of the farmers were in the low gap category, whereas 53.44 per cent were in the moderate and 45.52 per cent in the high gap categories in respect of technological gap in recommended weed control practices.

Disease and pests management :

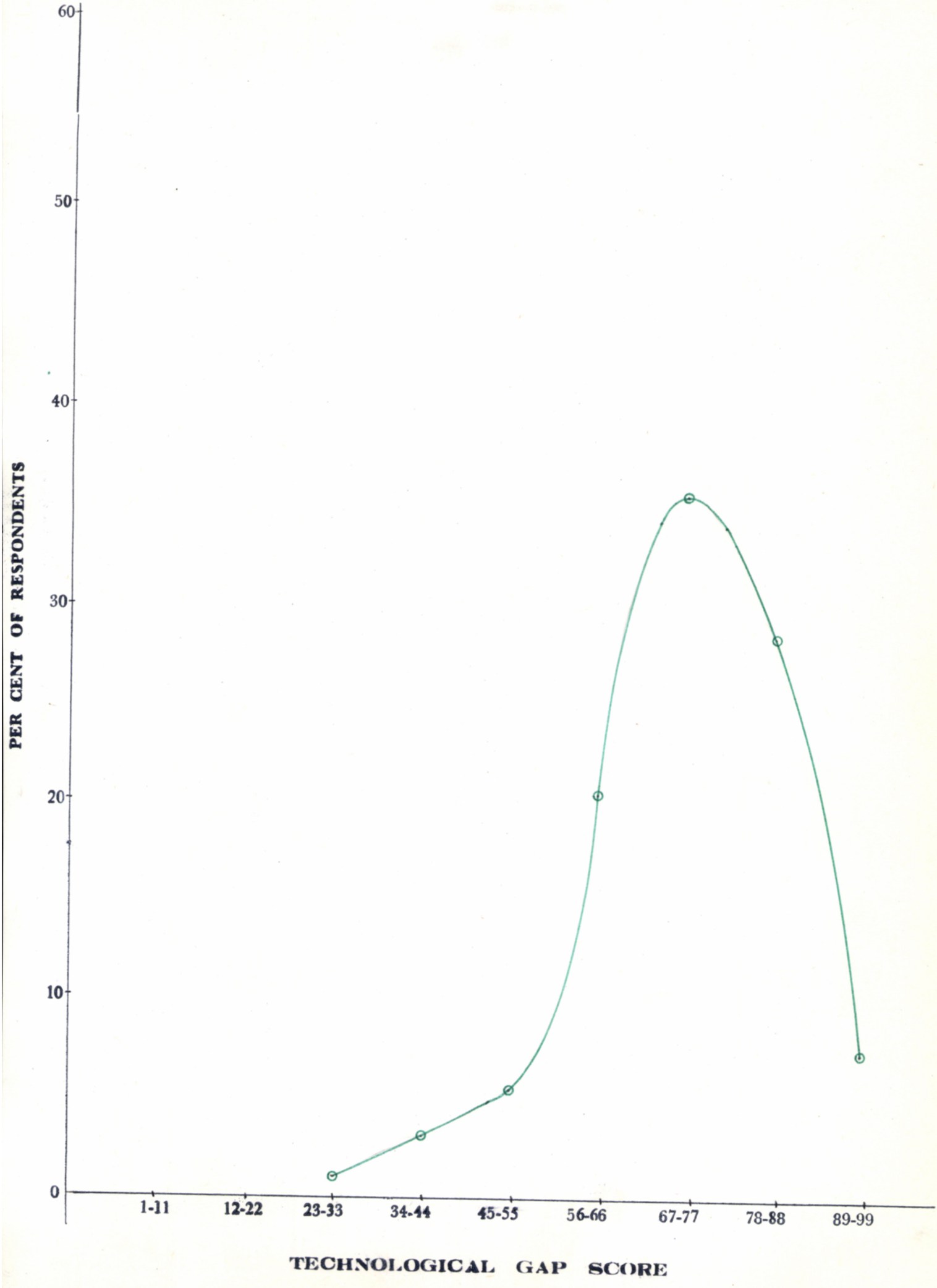
Plant protection measures against disease and pests can control losses in crop yields. To what extent the farmers use these measures, has been studied taking into consideration the use of various fungicides and insecticides. The information in this regard is tabulated in Table 4.9.

Table 4.9 : Distribution of farmers according to the technological gap in disease and pests management.

Sr. No.	Technological gap	Frequency	Per cent		C.F.	C.P.
1.	1 - 11	-	-		-	-
2.	12 - 22	-	-	1.03	-	-
3.	23 - 33	3	1.03		-	1.03
4.	34 - 44	8	2.76		11	3.79
5.	45 - 55	15	5.17	28.28	26	8.97
6.	56 - 66	59	20.35		85	29.31
7.	67 - 77	102	35.17		187	64.48
8.	78 - 88	82	28.28	70.69	269	92.76
9.	89 and above	21	7.24		290	100.00
	Total	290	100.00			

It is revealed from Table 4.9 that there was not a single farmer in the technological gap ranging from one to 22 in disease and pests management. However, there were only one per cent of the farmers in the technological gap range of 22 to 33. Similarly, only seven per cent of the farmers were found in the gap ranging from 89 and above. The maximum number of farmers i.e. 35.17 per cent were observed in the range of 67 to 77. Taking the sample as whole, it is seen from the table, that only one per cent farmers belonged

FIG. 9 : TECHNOLOGICAL GAP IN DISEASE AND PESTS MANAGEMENT



to the low gap category. About 28 per cent of the farmers belonged to the moderate and 71 per cent of them in the high gap categories in matters of disease and pests management.

Harvest and post-harvest technology :

Harvesting at proper time, and storing the grains is an important aspect which was studied considering various methods of storing, proper time of harvesting and use of chemicals while storing.

The information in this regard is presented in Table 4.10.

Table 4.10 : Distribution of the farmers according to the technological gap in harvest and post-harvest practices.

Sr. No.	Technological gap	Frequency	Per cent		C.F.	C.P.
1.	1 - 11	-	-		-	-
2.	12 - 22	-	-	3.10	-	-
3.	23 - 33	9	3.10		9	3.10
4.	34 - 44	23	7.93		32	11.03
5.	45 - 55	99	34.14	75.17	131	45.17
6.	56 - 66	96	33.10		227	78.28
7.	67 - 77	51	17.59		278	95.86
8.	78 - 88	12	4.14	21.73	290	100.00
9.	89 and above	-	-		-	-
	Total	290	100.00			

Table 4.10 indicates that there is no farmer in the sample whose technological gap in harvest and post-harvest technology ranges from one to 22. Only three per cent of the farmers were found in the technological gap score ranging from 23 to 33. The table further reveals that the maximum (34.14) percentage of farmers were found in the technological gap score range of 45 to 55.

On further examination on the basis of the group, it is found that only three per cent of the farmers were in the range of one to 33 i.e. the low gap category and 75.17 per cent in the moderate gap category and 21.73 per cent in the high gap category in respect of recommended practices in harvest and post-harvest technology.

II. Extent of technological gap in relation to different components of high yielding jowar technology and the technological gap categories

The analysed data regarding the three technological categories viz., low, medium and high regarding the various components of the technology are presented in Table 4.11. The mean of the technological gap score in each of the three categories with respect to the components are calculated and ranked for each category.

Table 4.11 : Extent of technological gap in relation to different components of high yielding jowar technology in the rabi season.

Sr. No.	Technological gap categories/components of high yielding jowar technology	Low gap category N = 290		Moderate gap category N = 290		High gap category N = 290	
		Mean gap in per cent	Rank	Mean gap in per cent	Rank	Mean gap in per cent	Rank
1.	Seed and seed treatment	18.62	I	14.37	VI	1.03	VIII
2.	Care after germination	4.37	III	23.45	II	5.52	VII
3.	Nutrient management	1.72	V	11.15	VII	21.04	II
4.	Water management	-	VIII	15.40	V	17.93	III
5.	Cultivation practices	5.75	II	15.98	IV	11.61	V
6.	Weed control	0.52	VII	17.81	III	15.17	IV
7.	Disease and pests management	1.03	VI	9.43	VIII	23.56	I
8.	Harvest and post-harvest technology	3.10	IV	25.06	I	10.87	VI

Discussion

The objective of the present investigation was to find out the extent of technological gap existing in the various components of the high yielding jowar technology in the rabi season. The sample was 290 randomly selected farmers from the Solapur district of Maharashtra, a predominently jowar growing area. Solapur district is mainly a jowar sowing area as it receives only 270 mm to 1727 mm rainfall. Year to year fluctuations are so much that there is no guarantee of a fixed quantity of rainfall. Jowar is a drought resistant crop.

The analysis of data has revealed an overall gap of 56.41 per cent when all the eight components of the high yielding jowar technology were considered. The maximum gap of 72.87 per cent was observed in case of disease and pests management. It was found that only 27 per cent of the technology in respect of disease and pests management has been adopted by the farmers. The practices included in this component are easy to adopt and do not necessarily require modern tools for their adoption e.g. dusting of B.H.C., this activity has been adopted on a large scale in case of irrigated jowar. Majority of the farmers used seed treated with sulphur. The technological gap in case of disease and

pests management is the highest. This might be due to the high cost of insecticides, and lack of knowledge regarding identification of pests. Besides this, the expenditure on spraying is probably not commensurate with the yield in grains and fodder.

Application of fertilizer and compost has been adopted by about 34 per cent of the farmers which indicates that there existed a 65.62 per cent technological gap in nutrient management.

At the same time, about equal proportion (64.05 per cent) of technological gap was observed in case of water management. Moreover, it seems that these two components are interrelated i.e. one has a bearing on the other. Therefore, it is necessary that transfer of technology of these two components should go hand in hand. For both these components, the farmers had pre-conceived ideas which serve as major constraints in the adoption of water and nutrient management technology.

The high percentage of the technological gap observed in water management might be due to the reason that the practices recommended may not be suitable to local conditions and also practicable, i.e. protective irrigation practice is difficult to adopt because stored

water percolation rate is very high in the deep black soil and water can not stagnate for more than 8 to 10 days. Moreover, the rate of evaporation is also high which leaves very small quantity of water for protective irrigation.

Weed control (59.67 per cent) gap was observed to be the next in order of technological gap magnitude. None of the farmers used chemical weedicides and none of them had any knowledge of them. Further, weed control practices are neglected because of lack of knowledge of their effect on yield and the farmers think that the practice is non-remunerative.

Fifty seven per cent of the technological gap was observed in case of harvest and post-harvest technology. This is due to the non-availability of labour in time for harvesting and inadequate space for storing produce. Moreover, other main reason for the gap is lack of knowledge about the chemicals to be used in storing the produce. Majority of the farmers followed traditional practices viz., use of neem leaves, storing in the bags and dusting of B.H.C. on bags which cover the major part of the post-harvest technology.

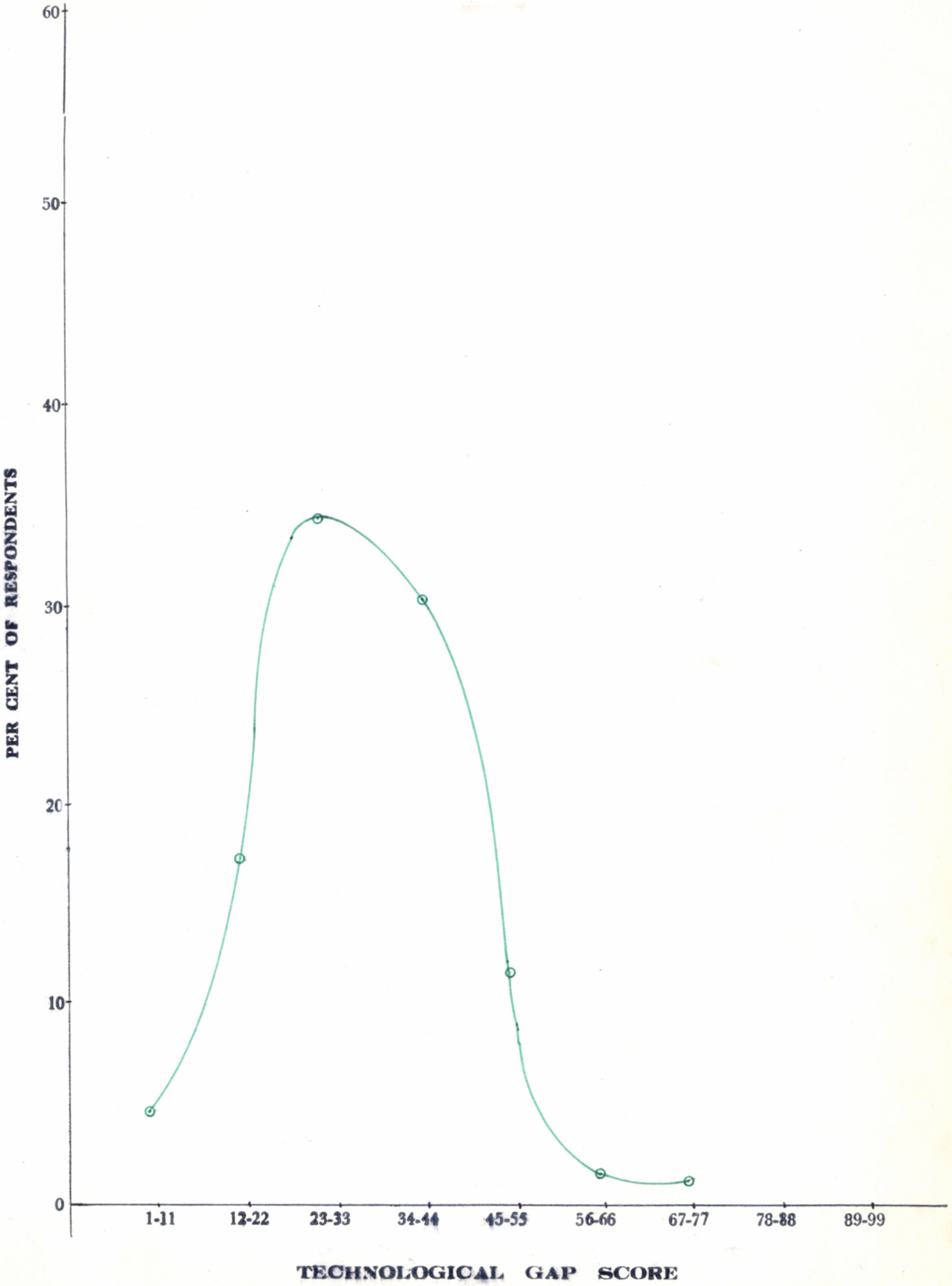
The set of package of practices of cultivation recommended under jowar technology were simple and most

of them were non-cash input practices. Even then 50.46 per cent gap was observed in case of the cultivation practices. These aspects need more attention from the extension education point of view.

Care after germination is a very important component as far as yield is concerned for maintaining proper plant population and ultimately getting good yield, after care is essential. In this study, 55 per cent of the farmers adopted technology regarding care after germination.

The technology regarding seed and seed treatment has been adopted by 70 per cent of farmers which indicates the least gap in this component. A high degree of adoption was observed because the variety and seed treatment aspects of the technology have been popularised for the last 30 years i.e. recommendation of Maldandi 35-1 and seed treatment with sulphur against smut disease. Moreover, the high yielding varieties programme has been under operation since 1964 onwards. The varieties have been adopted by majority of the farmers, because of the special incentives. When the over all gap was considered in each practice, it was seen that there was no single person in the low gap category (the score ranging from one to 33). The maximum number of farmers (84.48 per cent) belonged to the

FIG. 3 : TECHNOLOGICAL GAP IN SEED AND SEED TREATMENT



moderate gap category and only 15.52 per cent belonged to the high technological gap category (score ranging from 67 to 100). The main reason for moderate gap in jowar technology was that the practices included in the various components have been popularised for years together i.e. for more than 30 years particularly in case of variety Maldandi-35-1, the adoption is more than 95 per cent. Also a special programme has been implemented for kharif high yielding jowar varieties and to some extent for rabi jowar. This has created an awareness regarding the general technology of jowar and also its adoption to a considerable extent. Beside this, jowar technology is simple and within the reach of the average small farmer as it is mainly non-cash input technology which reduces the risk in the adoption of the technology. Inspite of all the technological attributes and efforts made, there still existed a gap of 57.26 per cent because of the gap in the components like disease and pests management, nutrient and water management was considerably high.

Distribution of farmers according to the technological gap in each of the components of high yielding rabi jowar technology :

In order to obtain the maximum yield from high yielding jowar varieties in rabi season, it is essential that the recommended package of practices of cultivation

are adopted fully by the farmers. In other words, the technological gap should be the least. However, the findings of this investigation reveal that the extent of technological gap is moderate, inclined to a high gap category. It was observed that there were very few farmers in this sample whose technological gap ranged from one to eleven in the components like seed and seed treatment, after care and practices of cultivation of high yielding jowar technology.

With regard to seed and seed treatment, it was observed that 55.86 per cent of the farmers were in the low gap category whereas 43.11 per cent were in moderate technological gap category and about one per cent in the high category. A sizeable number of farmers (30.35 per cent) had the technological gap score between 34 to 44. When low and moderate categories were considered together, it constituted 98.97 per cent of the respondents. The constraints responsible for moderate technological gap category have been discussed in the subsequent section.

In the component care after germination, it was observed that a maximum of 70.35 per cent of farmers were in the moderate gap category whereas 13.10 and 16.55 per cent were in the low and high categories respectively. Both moderate and high categories taken together constitute 87 per cent. This obviously indicated that the farmers in general did not take

recourse to recommended practices after germination, though this component is mostly related to the non-cash input practices.

The importance of nutrient management in case of dry farming was not fully realised by the farmers because of some pre-conceived ideas. Only 2.41 per cent of the farmers had low gap, while 31.38 per cent had moderate gap and 66.21 per cent had high gap. Moderate and high gap together constitute about 97.59 per cent. This is alarmingly high and since nutrient application is very significantly related to yield in rabi jowar, it can be inferred that low nutrient application in rabi season was a potent cause of low yield.

A high percentage (63.11) of the farmers were observed to be in the high technological gap category. This might be due to the vagaries of nature. Under such conditions, farmers were reluctant to adopt nutrient management technology as they felt that most of the times it was non-remunerative.

Under irrigated conditions, the adoption of nutrient technology was high. The nutrient management and water management technology were related to each other. Where water was available or adoption of water management technology was high, the adoption of nutrient management was also high. However, in this study, there

was a large technological gap in both the components. In the matter of water management, there was no single farmer who belonged to the low gap category. Forty six per cent of the farmers had moderate gap, whereas about 54 per cent had high gap. Interestingly enough, no farmer was observed in the low category, when the moderate and high categories were considered together. One of the reasons might be the inherent constraints in the water management technology itself as stated by the respondents. They were of the opinion that a practice like protective irrigation was not suitable to the area and a practice like mulching was not profitable and feasible to the local conditions. Therefore, adoption of such practices was very low which led to the high technological gap in water management technology.

In the cultivation practices component, it was seen that mainly there existed a moderate and high gap. Seventeen per cent of the farmers had low gap, while 47.93 per cent had moderate gap and 34.83 had high gap.

The cultivation practices recommended under the improved technology have been covered in what has been popularly known as the Bombay Dry Farming Method which has been popularised in <u>rabi jowar</u> growing area. The time lag is big for different cultivation techniques. As a result, there were 18 per cent of the farmers who had low gap and 48 per cent who had moderate gap.

About 35 per cent had high gap in the cultivation of rabi jowar. Moreover, the gap was observed due to unrealisation of the importance and utility of the practices.

In the matter of weed control, only about one per cent belonged to the low gap category whereas 53.44 per cent farmers had moderate gap and 45.52 per cent had high gap. The moderate and high gap categories together constitute about 99 per cent of the gap which is considerably high. Though disease and pests management is an important component for better yield in rabi jowar, a high gap is observed in case of 70.69 per cent of the farmers, whereas 28.28 per cent of the farmers had moderate gap and only one per cent had low gap. This obviously shows the indifferent attitude of the farmers towards disease and pests management. It was also observed that there was no single person in the score ranging from one to 22. Of the few farmers who had adopted the technology regarding disease and pests management, they had irrigation potential. An alarming gap in this component is observed on account of lack of identification of disease and pests, pesticides and their spraying techniques, as well as high cost of insecticides and pesticides.

It also seemed that the extension worker lacked in the technique of motivating farmers to adopt practices

regarding disease and pests management. The majority of the farmers had adopted very few practices regarding harvest and post-harvest technology. The study indicated that 75 per cent of the farmers had moderate gap and only 3.10 per cent and 21.73 per cent had low and high gap. It seemed that majority of the farmers were lacking in knowledge of chemicals used in storing. Moreover, there was limited space in the house for proper storing. Most of them were unaware of the losses occurring in the storage due to store pests and lack of knowledge about the control measures. The labour shortage for harvesting the crop in proper time was one of the reasons for poor adoption of technology. This shortage of labour was due to the employment guarantee scheme. The farmers have adopted the old methods of harvest and post-harvest technologies combined with the new ones which has resulted in a moderate gap.

SECTION II

4.2 CONSTRAINT ANALYSIS IN RELATION TO DIFFERENT COMPONENTS OF HIGH YIELDING JOWAR TECHNOLOGY IN THE RABI SEASON

In this section, an attempt is made to identify and analyse the constraints responsible for technological gap in the rabi season of high yielding jowar cultivation as perceived by the farmers. A large number of constraints are operating in creating an adoption gap which is ultimately responsible for the low yield particularly in case of high yielding rabi jowar. The constraints have been divided into two major areas.

A) Constraints pertaining to the technology of high yielding jowar.

B) Constraints pertaining to the institutional infrastructure.

   1) Constraints pertaining to credit.
   2) Constraints pertaining to service and supply.
   3) Constraints pertaining to information transfer.
   4) Constraints pertaining to organisation.

A) Constraints in relation to different components of the technology of high yielding jowar :

The farmers were requested to give five most important technological constraints as they perceived to be responsible for the technological gap in the

adoption of the package of recommended practices of jowar. The constraints were ranked on the basis of frequency of farmers expressing the same. Thus, the most important and the least important constraints were found out in respect of each component of the technology as below.

1. Seed and seed treatment :

Three important varieties of rabi jowar were taken into consideration under the technology for adoption by farmers and the constraints reported by them were as follows.

Table 4.12 : Constraints pertaining to technology of seed and seed treatment as expressed by the farmers.

Sr. No.	Constraints	Frequency (N = 290)	Per cent	Rank
1.	Expenditure on seed treatment is not commensurate with production and high cost chemicals (carbofuran)	155	60.34	I
2.	Non-availability of seed in time	163	56.21	II
3.	Lack of conviction	157	54.14	III
4.	Complexity in seed treatment	131	45.17	IV
5.	Unsuitability to local conditions	87	30.00	V

Table 4.12 indicates that the major constraints in the adoption of seed and seed treatment were non-availability of required seed (56.21 per cent) and high cost of carbofuran (60 per cent). Moreover, there was lack of conviction among farmers regarding seed treatment (54.14 per cent). Only 30 per cent of the farmers reported that jowar varieties SPV-86, CSH-8R were not suitable to local conditions.

2. Care after germination :

To maintain the required plant population, care after germination is necessary. Certain improved practices are involved and their adoption results in maintaining the required plant population. The information in this regard is presented in Table 4.13.

Table 4.13 : Constraints pertaining to technology of care after germination.

Sr. No.	Constraints	Frequency (N = 290)	Per cent	Rank
1.	Moisture is the limiting factor; hence no operation is undertaken	203	70.00	I
2.	Lack of conviction	190	65.52	II
3.	Shortage of labour and expenditure was not remunerative	183	63.10	III
4.	Gap filling does not match the crop and transplanting is not possible	164	56.55	IV
5.	Shortage of capital	159	54.83	V

It is seen from Table 4.13 that 70 per cent of the farmers reported that moisture is the limiting factor and hence no operation could be undertaken. Sixty six per cent of the farmers reported that they were not convinced about the technology, 63.10 per cent said that they could not adopt the technology because of shortage of labour and the expenditure is not commensurate with production and 54.63 per cent reported that there was lack of capital for adoption of technology of care after germination.

3. Nutrient management :

Adoption of technology regarding nutrient management is a crucial factor in jowar production. Its non-adoption lowers down the yield considerably. Most of the farmers perceived various constraints in adoption which are presented in Table 4.14.

Table 4.14 : Constraints pertaining to the technology of nutrient management (compost/fertilizers).

Sr. No.	Constraints	Frequency (N = 290)	Per cent	Rank
1.	Fear of heavy losses in case of failure due to lack of rains	260	89.65	I
2.	High prices of fertilizers	205	70.69	II
3.	Shortage of capital	197	67.93	III
4.	Placement of fertilizers perceived as complicated and and returns non-remunerative	185	63.79	IV
5.	Diversion of fertilizers/compost to irrigation crops	123	42.41	V

It would be seen from Table 4.14 that about 90 per cent of the farmers expressed fear of heavy losses in case of failure of rains as the major constraint in the adoption of the nutrient technology. Seventy one per cent reported high prices of fertilizers as constraints, 67.93 per cent reported shortage of capital and 63.79 per cent reported placement is difficult and return is non-remunerative, while 42.41 reported diversion of fertilizer to irrigated crops.

4. Water management :

Moisture and its retention in the soil has a significant relevance to yield of jowar in the rabi season. Retention of moisture is important and through improved technology, moisture is conserved to some extent for the survival of the crop.

Table 4.15 : Constraints pertaining to the technology of water management.

Sr. No.	Constraints	Frequency (N = 290)	Per cent	Rank
1.	Mulching is not economical and is a labour consuming process	228	78.62	I
2.	Weeding and crack filling is non-remunerative	211	72.76	II
3.	Lack of conviction	206	71.03	III
4.	Not suitable to the local conditions (farm ponds)	177	61.03	IV
5.	Lack of capital	155	53.45	V

An examination of the data presented in Table 4.15 indicates that 78.62 per cent of the farmers reported mulching is not economical and is a labour consuming process and hence a major constraint in the adoption of water management technology. The second constraint reported was that weeding and crack filling is

non-remunerative, while the third constraint was lack of conviction as reported by 71.03 per cent farmers followed by unsuitability to the local conditions and lack of capital i.e. (61.63 and 53.45 per cent) respectively.

5. Cultivation practices :

Cultivation practices for preparing seed bed and mixed cropping and crop rotation were considered. Constraints felt by the farmers in the case of adoption of cultivation practices are presented in Table 4.16.

Table 4.16 : Constraints pertaining to the technology of cultivation practices.

Sr. No.	Constraints	Frequency (N = 290)	Per cent	Rank
1.	Heavy investments in ploughing which is not remunerative	209	72.07	I
2.	Lack of conviction	199	68.62	II
3.	Lack of knowledge	197	67.93	III
4.	Varieties of the mixed crops for intercropping are not suitable to local conditions.	122	42.07	IV
5.	Mixed cropping reduces the yield of main crop	97	33.45	V

Table 4.16 reveals that 72.09 per cent of the farmers reported that ploughing requires more money and it did not prove to be remunerative. About 69.00 per cent reported that there was lack of conviction about the cultivation practices, while 67.93 per cent reported that they did not have knowledge of cultivation practices. Only 33.45 per cent reported that they felt that mixed cropping/intercropping reduces the yield of the main crop. These were the important constraints in cultivation practices.

6. Weed control :

Unwanted growth of plants other than the main crop, generally competes for moisture and nutrient uptake. Retention of moisture in the soil for better growth is essential. The main constraints in the adoption of technology regarding weed control are presented in Table 4.17.

Table 4.17 : Constraints pertaining to the technology of weed control.

Sr. No.	Constraints	Frequency (N = 290)	Per cent	Rank
1.	Shortage of labour for hand weeding and return is non-remunerative	235	81.03	I
2.	Lack of conviction	200	68.96	II
3.	It disturbs upper layer of soil and reduces the moisture	199	68.62	III
4.	High cost of chemicals and use of chemical weed control is not as effective as hand weeding	188	64.83	IV
5.	Total area can not be covered due to lack of capital	107	36.90	V

It could be seen from Table 4.17 that the majority (81.03 per cent) of the farmers reported that shortage of labour for hand weeding is the major constraint. Besides, they reported that the return from weeding was non-remunerative; 73.00 per cent reported lack of conviction as a constraint; while 68.62 per cent reported that it disturbed the upper layer of the soil and reduced the moisture. Forty per cent of the farmers reported that larger area under jowar required more capital to adopt the practices.

7. Disease and pests management :

Major diseases and pests of rabi jowar were taken into consideration and constraints in respect of adoption of control measures were studied with various dimensions of seed treatment and spraying with insecticides and pesticides at different stages and the same is presented in Table 4.18.

Table 4.18 : Constraints pertaining to technology of disease and pests control.

Sr. No.	Constraints	Frequency (N = 290)	Per cent	Rank
1.	Lack of knowledge	210	72.42	I
2.	Lack of technical help	198	68.27	II
3.	High cost of insecticides and it is also non-remunerative	174	60.00	III
4.	Lack of conviction about their effectiveness	163	56.21	IV
5.	Adulteration of insecticides and hence they are not effective in controlling the pests	97	33.45	V

It is revealed from Table 4.18 that 72.42 per cent of the farmers reported lack of knowledge about disease and pests and their control measures as the constraints. Similarly, 68.27 per cent of the farmers reported lack of technical help as the constraint in the adoption of control measures, while 60.00 per cent reported high cost and spraying to be non-remunerative. Fifty six per cent reported lack of conviction about the effectiveness of insecticides as the constraint. About 34.00 per cent of the farmers reported that adulteration and ineffectiveness to control the disease and pests were some of the constraints.

8. Harvest and post-harvest technology :

In the process of harvesting and storing the produce, losses occur. To minimise the losses, adoption of improved practices has been recommended, the major constraints in the adoption of these practices were studied and are presented in Table 4.19.

Table 4.19 : Constraints pertaining to the technology of harvest and post-harvest.

Sr. No.	Constraints	Frequency (N = 290)	Per cent	Rank
1.	Delay in harvest due to lack of labour	208	71.72	I
2.	Produce is limited and consumed for house hold purposes	168	57.93	II
3.	Produce required to be sold out immediately after harvest	127	43.79	III
4.	Harvest is limited hence it is carried out by manual labour	110	37.93	IV
5.	Lack of knowledge of use of chemicals in storing	93	32.07	V

From an examination of Table 4.19, it is observed that 71.72 per cent of the farmers reported delay in harvest due to lack of labour as a constraint for adoption of harvest and post-harvest technology. Fifty eight per cent reported that most of the produce is consumed for house hold purposes. About 44 per cent reported that the produce is required to be sold immediately after the harvest for economic reasons. While 37.93 per cent farmers reported that the meagre produce did not allow them to adopt the technology, 32.07 per cent reported lack of knowledge of use of chemicals in storing.

B) Constraints pertaining to the institutional infrastructure :

The infrastructural constraints have been categorised under broad areas like credit, supply and services, information transfer and organisation. These institutions play an important role in providing the inputs for better results of improved technology. With this view, some of the infrastructural institutions were studied and farmers' perception of the constraints responsible for high technological gap in respect of institutions were studied.

1. Credit :

Credit constitutes an important support which enables farmers to minimise his financial difficulties and strengthen his financial potential for purchasing inputs and other investments necessary for the adoption of improved technology. Constraints involved in securing credit from various institutions are presented in Table 4.20.

Table 4.20 : Constraints pertaining to credit.

Sr. No.	Constraints	Frequency (N = 290)	Per cent	Rank
1.	Recovery procedure is stringent and recovery demanded during the threshing period when the price of produce is the lowest	227	78.28	I
2.	Various fees charged (authorised and unauthorised) and cost involved in running several times to the credit agencies is high	211	72.76	II
3.	Complicated procedures and hence delay in getting credit (should be available on the same day)	196	67.59	III
4.	The rate of interest is not only high but also varies from agency to agency	122	42.07	IV
5.	Short, medium, long term credits are not available with one agency	92	31.72	V

It will be seen from Table 4.20 that 78.28 per cent of the farmers expressed that the recovery procedure is a major constraint in getting loan; similarly 72.76 per cent of the farmers reported that fees charged and

expenditure on account of visiting and running several times to credit agencies is high. About 70 per cent expressed complicated procedure and delay as a constraint, while 42 per cent reported that the rate of interest was high and it varied from agency to agency. Thirty two per cent of the farmers reported that short, medium and long term loans were not available with one agency.

2. Services and supplies :

Though a number of agro-service centres are opened at village level, their number is limited and they are not able to fully cater to the needs of the farmers. The co-operative societies and other private agencies are not adequately fulfilling the needs of rural peasants and as such a number of constraints need to be over come in the process of securing services and supplies. The constraints in this regard are presented in Table 4.21.

Table 4.21 : Constraints pertaining to the services and supplies.

Sr. No.	Constraints	Frequency (N = 290)	Per cent	Rank
1.	Supply agencies are linked with co-operative and government institutions and political leaders take the maximum benefit and others are deprived of the same	251	86.55	I
2.	No agency to buy jowar produce from the growers at the government fixed rate during the harvesting season. Hence, compelled to sell the produce at the lower price	217	74.83	II
3.	Stocks are neither received in time nor in adequate quantities in the market	204	70.34	III
4.	Monopoly in the market, artificial shortage of product and sold the same in black market	189	65.17	IV
5.	Fair treatment is not given to the farmer in the market and at the whole sale market. Harassment in collecting unauthorised charges and faulty weighment	145	50.00	V

It would be revealed from Table 4.21 that 86.55 per cent of the farmers reported that one of the major constraints, supply agencies were linked with co-operative and government agencies and the maximum benefit was taken by local leaders and practically nothing is left for others, while 74.83 per cent reported the lack of agency for buying jowar produce at government fixed rate and hence they had to sell it immediately after harvest, in the local markets. Seventy per cent reported that the stocks are neither received in time nor in adequate quantities in the market; 65.15 per cent reported that monopoly and artificial shortage of goods were the constraints faced by them. Fifty per cent reported unfair treatment and harassment and faulty weighment.

3. Information transfer :

Information to a large extent is generated at the research institutions of which even 40 per cent is not transferred to the clients or adopters, which results in a big technological gap. As such, there is an yield gap between demonstration fields and average farmers' fields. The constraints pertaining to transfer of information are presented in Table 4.22.

Table 4.22 : Constraints pertaining to the information transfer.

Sr. No.	Constraints	Frequency (N = 290)	Per cent	Rank
1.	Intensity of contact with Block officials and village level workers is very low	213	73.45	I
2.	Lack of interest and dedication for work on the part of extension worker	207	71.38	II
3.	Improved technologies are not demonstrated in near by area/or in our village fields	199	68.62	III
4.	Inadequacy of mass media used	183	63.10	IV
5.	Failure on the part of the formal and informal leaders in diffusing the information to others	169	58.28	V

It would be observed from Table 4.22 that 73.45 per cent of farmers reported that they had less contacts with block extension staff and village level workers, while 71.38 per cent reported there was a lack of interest and dedication for work on the part of extension workers; sixty nine per cent said that the technologies are not demonstrated in the near by area

or in their villages. Besides this, 58.25 per cent reported that there was a failure on the part of formal and informal leaders in diffusing the information.

4. Organisations :

Organisations are means to satisfy the needs of the farmers by guiding and providing inputs, and making available the technical know how. Various organisations are functioning in this area. However, they lack in one or other activity and can not contribute to the fullest extent to satisfy the needs of the farmers. The perception of constraints regarding organisations were studied and the information is presented in Table 4.23.

Table 4.23 : Constraints pertaining to the organisation.

Sr. No.	Constraints	Frequency (N = 290)	Per cent	Rank
1.	Untimely and inadequate of supply of inputs (seed, fertilizer, insecticide)	210	72.41	I
2.	Working of the organisations is influenced by local leaders	199	68.62	II
3.	Lack of coordination amongst organisation (Zilla Parishad, University, Co-operative department)	185	63.79	III
4.	Maximum benefit of the organisations is taken by big land-lords	183	63.10	IV
5.	Inputs sold by the organisations are low in quality	169	58.28	V

From the examination of Table 4.23, it is observed that 72 per cent of the farmers reported untimely and inadequate of supply of inputs (seed, fertilizer, insecticides), while 68.62 expressed that working of the organisation was influenced by local leaders, sixty four per cent reported that there was

lack of coordination among the organisations like Zilla Parishad, Agricultural University and Research Institutions. About sixty three per cent expressed that the maximum benefit of organisations was taken by big landlords, while 58.28 per cent said that the inputs sold by these organisations were low in quality.

Discussion

In this section, an attempt has been made to study the most and the least important constraints expressed by the farmers for the technological gap in the adoption of the package of recommended practices of *rabi jowar* cultivation. The constraints are ranked according to the importance.

Use of the seed and seed treatment had some constraints. The cost of treating seed with chemical (carbofuran) was felt to be high and was one of the constraints reported by 60 per cent of the farmers. Moreover, the expenditure on seed treatment was felt to be not commensurate with the increase in production. This constraint ranked first.

The constraint of non-availability of seed in time was reported by 56.21 per cent of the farmers. Most of the time, seed was available after the sowing season. The other constraints *viz.*, lack of conviction, complexity in seed treatment, unsuitability to local condition were in accordance with their importance reported by the farmers.

In case of care after sowing, there were some limiting factors which acted as constraints. In dry farming areas, moisture is a limiting factor. The

cultural operations carried out to pulverise the soil and cause loss of moisture which ultimately affects the crop growth and total grain production. Hence, moisture as the limiting factor is one of the most important constraints which is reported by 70 per cent the farmers. Other constraints were lack of conviction, shortage of labour, gap filling does not match the crop and shortage of capital according to their importance expressed by the farmers.

The nutrient management component was felt to be a constraint by a high percentage of farmers (i.e. the highest 90 per cent and the lowest 43 per cent). The application of nutrients (fertilizers) requires adequate amount of moisture in the soil for its absorption by the crop. Considering the uncertainty of the rain or the water facilities available, farmers are reluctant to apply fertilizer. Therefore, fear of heavy losses in case of crop failure due to lack of rains is the first constraint reported by 90 per cent of the farmers. The second constraint reported was the high prices of fertilizers by 70 per cent of the farmers. The third constraint reported by 63.79 per cent of the farmers was placement of fertilizers perceived as complicated. Returns non-remunerative, shortage of capital and diversion of fertilizers/compost

to irrigated crops were the two other constraints respectively. Availability of credit and subsidies has come about with the exploitation of irrigation potential to bring the area under irrigation. Naturally, the farmers tend to use the fertilizer more for the irrigated crops on account of surety of high returns.

Jowar is the main crop in the drought prone area where moisture/water conservation is an important aspect. The most important constraint ranked first was the practices of mulching; 78.62 per cent of the farmers reported that it was not economical and was a labour consuming process. Moreover, the material required for mulching was not available locally. The other constraints were weeding and crack filling felt to be non-remunerative, lack of conviction about the suitability to local conditions (i.e. the farm ponds for protective irrigation) and lack of capital. The soils of this area are black and heavy deep and as such rain water percolates through the soil. This affects the shortage of water in the farm ponds. Therefore, it does not appear to be suitable to the local conditions.

The preparation of seed bed was an important component for rabi jowar where moisture is a limiting factor. The various cultivation practices are

essential for good production. In respect of cultivation practices, 70 per cent of the farmers reported that the major constraint was heavy and non-remunerative investment in ploughing. The other constraints, according to their rank were lack of conviction, lack of knowledge, varieties for mixed cropping are not suitable, mixed cropping reduces the yield of main crop and the lack of sincere efforts on the part of extension workers in communicating the technology.

Regarding weed control, labour shortage was the first constraint reported by 81.82 per cent of the farmers. The labour shortage is due to the fact that the major labour force is engaged in the employment guarantee scheme. Lack of conviction regarding importance of weed control was the second constraint. Disturbance of the upper layer of the soil which reduces the moisture, high cost of chemical and difficulty in covering the total area were the other constraints.

Disease and pests management has a significant role in grain production of rabi jowar. Seventy three per cent of the farmers lacked in knowledge of disease and pests management practices which appears to be the foremost constraint as it ranked the first. Use of

pesticides and insecticides involves certain techniques *viz.*, the specific quantity of water to be used in the pesticide, different concentrations of solutions, operating spraying machine etc. In this regard, they lacked technical help and guidance which was a constraint reported by 68.27 per cent of the farmers. Sixty per cent reported high cost of insecticides as the constraint and lack of conviction and adulteration of insecticides were other constraints.

Harvest and post-harvest technology involves timely operation and as such harvesting of *jowar* crop in time was an important aspect which can not be performed if labour is short. The shortage of labour in rural area is due to the employment guarantee scheme, where labour is paid more amount for a piece of work than the amount paid by farmers for agricultural operations. The employment guarantee scheme has pulled out the labour force from farms. Therefore, there is delay in harvesting of *rabi jowar* which is the main constraint in harvest and post-harvest technology. The other constraints are limited quantity of produce and lack of knowledge regarding use of chemicals in storing.

B) Constraints pertaining to the institutional infrastructure

As far as credit is concerned the major constraints reported by 70 per cent of the farmers were recovery procedure being stringent and recovery was demanded during threshing period when the price is low. The next constraint reported was the various fees charged and cost involved in going several times to credit agencies being high. The other constraints were complicated procedures, high rates of interest and short, medium and long term credit were not available with one agency.

Eighty seven per cent of the farmers expressed that supply agencies were linked with co-operatives and the government and as such political leaders took the benefit which was the first constraint. The second constraint reported by 75 per cent of the farmers was that there was no agency to buy jowar produced. The third constraint that most the time stocks were neither received in time nor in adequate quantity in the market and the other two were monopoly in the market and unfair treatment.

Though the extension agency is working for the last 30 years, very few came in contact with it. Most of the farmers were lacking in knowledge of rabi jowar technology. The major constraints reported by 73.45 per cent of the farmers were less frequency of contacts

with block officials and village level workers. The next constraint was less interest and dedication for work on the part of extension workers. The other constraints were less demonstrations, inadequate use of mass media and less involvement of formal and informal leaders.

In the organisational constraints 72.41 per cent of the farmers reported untimely and inadequate supply of inputs followed by the constraint that working of organisation is influenced by the local leaders. The other constraints found were lack of co-ordination, more benefits received by the larger cultivators and quantity of inputs being very low.

SECTION III

4.3 A) DIFFERENTIAL CHARACTERISTICS OF TECHNOLOGICAL GAP CATEGORIES

A comparative study of low and high technological gap categories of farmers with respect to techno-economic, socio-psychological stimulus and communication variables was undertaken. These categories were formulated on the basis of technological gap scores. The scores ranging from one to 50 are considered as low technological gap and scores ranging from 51 to 100 are considered as high technological gap.

The mean score of the two categories of farmers was worked out for each variable. The significance of difference between means was tested by the 't' test. The mean score for all the variables and the 't' test value for difference in the means are presented in Table 4.24. The findings are as follows.

Table 4.24 : Differential characteristics of low and high technological gap categories.

Techno-economic variable	Mean score		't' value of difference of low and high mean score
	Low category	High category	
1	2	3	4
Techno-economic characteristics			
1. Farm size ...	04.84	4.19	1.823
2. Irrigation potential	37.50	14.08	8.391 *
3. Agricultural material possession	32.38	15.30	6.426 **
Socio-psychological variable			
1. Age	46.07	47.26	1.972 **
2. Caste	04.61	04.25	1.487
3. Educational status	04.64	02.32	9.553 **
4. Family size ...	01.54	01.80	1.326
5. Knowledge about cultivation of high yielding varieties of jowar	34.11	26.78	6.11 **
6. Social participation	03.43	2.24	4.987 **
7. Attitude towards high yielding varieties of jowar	37.43	25.48	4.597 **
8. Risk orientation	34.25	27.83	5.633 **

Table 4.24 (contd.)

1	2	3	4
Stimulus variables			
1. Profitability ...	40.25	37.95	4.582 **
2. Physical compatibility	39.73	32.59	6.357 **
3. Cost of cultivation	36.80	34.77	1.913
4. Simplicity-complexity	31.21	28.80	1.877
5. Infrastructure efficiency	78.91	70.50	7.852 **
Communication variables			
1. Use of personal localite sources	16.48	11.40	4.351 **
2. Use of personal cosmopolite sources	6.00	5.40	1.456
3. Use of mass media source	9.84	4.24	4.80 **
4. Extension contact	25.98	20.65	5.17 **

* Significant at 0.05 level

** Significant at 0.01 level

Techno-economic characteristics :

It would be seen from the data presented in Table 4.24 that out of the three techno-economic characteristics viz., farm size, irrigation potential and agricultural implements and tools possessed, a statistically significant difference was observed in irrigation potential and material/tools possessed by the farmers. The data revealed that there was no statistically significant difference between the farmers of low gap category and high technological gap categories in case of farm size.

Personal and socio-psychological characteristics :

In case of personal and socio-psychological characteristics, the data presented in Table 4.24 revealed that there were differences between the low and high technological gap categories with regard to six variables out of eight. These variables were age, educational status, social participation, knowledge about cultivation of high yielding varieties of jowar, attitude towards the varieties and risk-orientation. With regard to the two variables viz., caste and family size, no statistically significant difference was observed between the low and high technological gap categories.

Stimulus characteristics :

There were five stimulus variables selected for study and of these, profitability, physical compatibility and infrastructural efficiency showed statistically significant differences between low and high technological gap categories.

Communication variables :

The data revealed that there was difference between high and low technological gap categories with regard to three variables out of the four viz., personal localite sources, personal cosmopolite sources, mass media sources of information and extension contacts. The variable, use of personal cosmopolite source did not differ from low and high technological gap categories.

B) RELATIONSHIP OF SELECTED TECHNO-ECONOMIC SOCIO-PSYCHOLOGICAL, STIMULUS AND COMMUNICATION VARIABLES WITH TECHNOLOGICAL GAP OF FARMERS

In this section, relationship between the technological gap of farmers participating in the high yielding jowar programme in the rabi season with the twenty independent variables will be tested with the help of zero order correlation as shown in Table 4.25. The order of presentation is as follows. First, the

general hypothesis No.1 is stated followed by its sub-general hypothesis and the corresponding sub and empirical hypothesis are stated in their order.

Table 4.25 : Relationship of selected techno-economic, socio-psychological, stimulus and communication variables with technological gap of the farmers.

Variables	Zero order correlation
A) Techno-economic variables	
1. Farm size ...	0.0539
2. Irrigation potential...	-0.4556 **
3. Agricultural material possession	-0.3728 **
B) Socio-psychological variables	
1. Age ...	0.3671 **
2. Caste ...	0.0492
3. Educational status ...	-0.4137 **
4. Family size ...	0.0639
5. Social participation...	-0.5871 **
6. Knowledge about cultivation of high yielding varieties of jowar	-0.4757 **
7. Attitude towards high yielding varieties of jowar	-0.4047 **
8. Risk-orientation ...	-0.3942 **

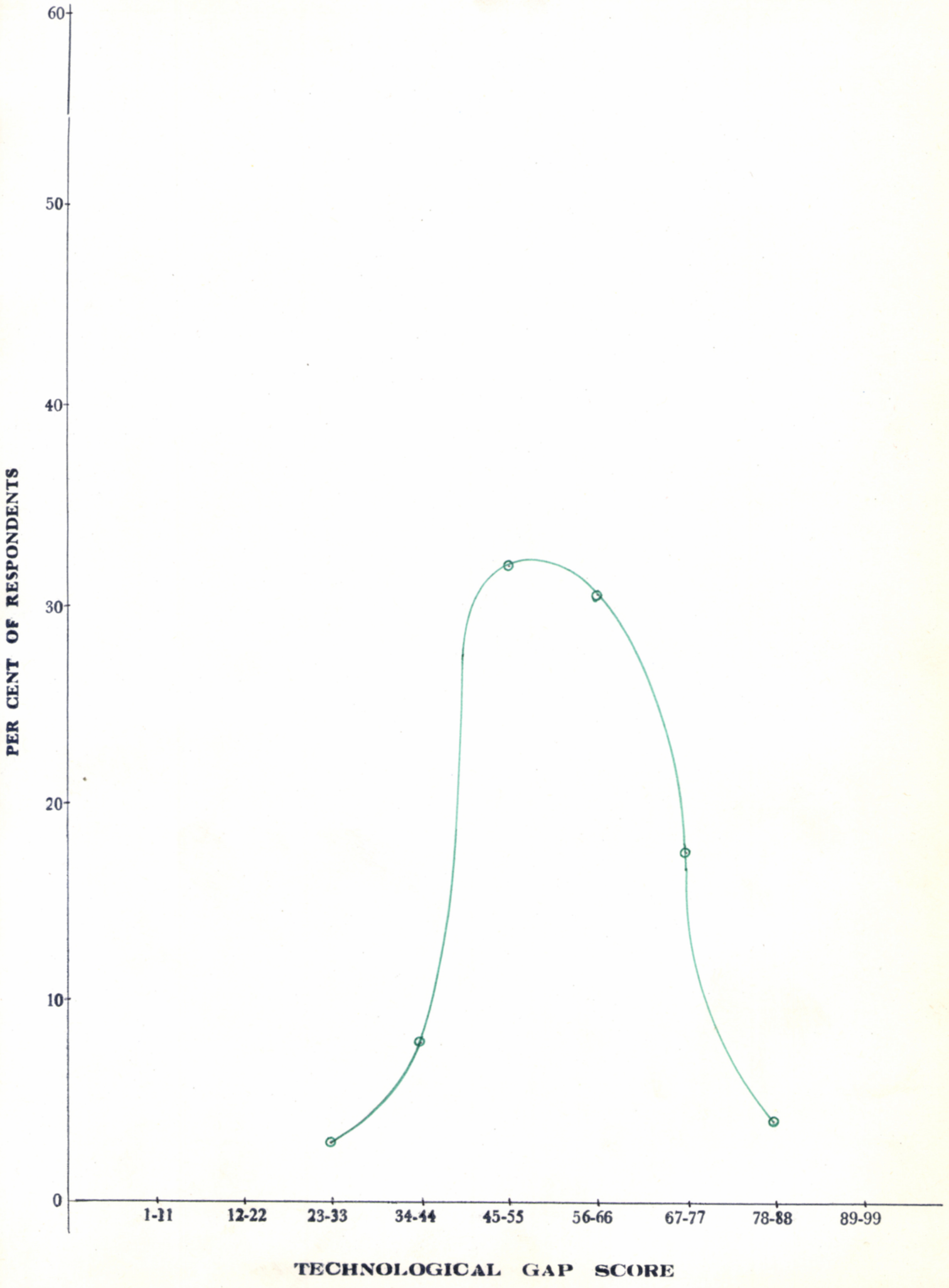
Table 4.25 (contd.)

Variables	Zero order correlation
C) Stimulus variables	
1. Profitability ...	-0.3748 **
2. Physical compatibility	-0.2324 *
3. Cost of cultivation ...	-0.1176 *
4. Simplicity-complexity..	-0.0963
5. Infrastructure efficiency	-0.5192 **
D) Communication variables	
1. Use of personal localite sources ...	-0.3189 **
2. Use of personal cosmopolite sources ...	-0.0676
3. Use of mass media sources ...	-0.2319 **
4. Extension contacts ...	-0.4127 **

* Significant at 0.05 level

** Significant at 0.01 level

FIG. 10 : TECHNOLOGICAL GAP IN HARVEST AND POST-HARVEST TECHNOLOGY



General hypothesis : 1

The technological gap of farmers participating in the high yielding jowar programme in the rabi season, will vary with their techno-economic socio-psychological, stimulus and communication behaviour.

Sub-general hypothesis 1 : 1

The technological gap of farmers participating in the high yielding jowar programme in rabi season will vary with the variation in their techno-economic characteristics.

Sub-hypothesis 1 : 1 : 1

There will be a negative relationship between farm size and technological gap of farmers.

E.H. 1 : The technological gap index score will vary inversely with the number of hectares cultivated.

N.H. 1 : There is no inverse relationship between technological gap index score and the number of hectares cultivated.

The computed correlation coefficient is 0.0539 which is not significant at 0.05 level of probability. Therefore, the null hypothesis is accepted. The data do not support the original proposition.

Sub-hypothesis 1 : 1 : 2

There will be a negative relationship between irrigation potential and technological gap index score.

E.H. 2 : The irrigation potentiality score will vary inversely with the technological gap index score of the farmers.

N.H. 2 : There is no inverse relationship between the irrigation potentiality score and the technological gap index score of farmers. The computed correlation coefficient is -0.4556 which is significant at 0.1 level of probability.

The null hypothesis, therefore, is rejected and the original proposition accepted.

Sub-hypothesis 1 : 1 : 3

There will be a negative relationship between the agricultural implements possessed and the technological gap index score of farmers.

E.H. 3 : The extent of agricultural implements possessed by the farmers will vary inversely with the technological gap index score.

N.H. 3 : There is no inverse relationship between the extent of possession of agricultural implements and the technological gap index score of farmers.

The computed correlation coefficient is -0.3728 significant at 0.01 level of probability. The null hypothesis is, therefore, rejected and the original proposition accepted.

Sub-general hypothesis 1 : 2

The technological gap of farmers adopting the package of practices of cultivation of high yielding jowar in rabi will vary with the variation in their socio-psychological characteristics.

Sub-hypothesis 1 : 2 : 1

There will be a positive relationship between 'age' and the technological gap of farmers.

N.H. 4 : The score on age will vary directly with the technological gap index score.

N.H. 4 : There is no direct relationship between the score on age and the technological gap index score. The computed correlation coefficient is 0.0539 which is significant at 0.01 level of probability. Therefore, the null hypothesis is rejected. The data support the original proposition.

Sub-hypothesis 1 : 2 : 2

There will be a positive relationship between caste and technological gap of farmers.

E.H. 5 : The score on caste will vary directly with the technological gap index score.

N.H. 5 : There is no direct relationship between the score on caste and the technological gap index score.

The computed correlation coefficient is 0.0492 which is not significant at 0.05 level of probability. The null hypothesis is, therefore, accepted. The data do not support the original proposition.

Sub-hypothesis 1 : 2 : 3

There will be a negative relationship between the educational level of a farmer and his technological gap.

E.H. 6 : The educational score of the farmers will vary inversely with the technological gap index score.

N.H. 6 : There is no inverse relationship between the educational level score and the technological gap index score of the farmers.

The computed correlation coefficient is -0.4137 which is significant at 0.01 level of probability. The null hypothesis is, therefore, rejected. The data support the original proposition.

Sub-hypothesis 1 : 2 : 4

There will be a negative relationship between the

family size and the technological gap index score of the farmers.

E.H. 7 : The score on family size will vary inversely with the technological gap index score of the farmers.

N.H. 7 : There is no inverse relationship between the score on family size and the technological gap index score of the farmers.

The computed correlation coefficient is 0.0639 which is not significant at 0.05 level of probability. The null hypothesis is, therefore, accepted. The data do not support the original proposition.

Sub-hypothesis 1 : 2 : 5

There will be a negative relationship between the social participation of the farmers and the technological gap of the farmers.

E.H. 8 : The score on family size will vary inversely with the technological gap index score of the farmers.

N.H. 8 : There is no inverse relationship between the score on social participation and the technological gap index score of the farmers.

The computed correlation coefficient is 0.5871 which is significant at 0.01 level of probability.

The null hypothesis is, therefore, rejected. The data support the original proposition.

Sub-hypothesis 1 : 2 : 6

There will be a negative relationship between the level of technological knowledge about cultivation of high yielding jowar in rabi season and the technological gap.

E.H. 9 : The score on knowledge of high yielding jowar cultivation in rabi season will vary inversely with the technological gap index score of the farmers.

N.H. 9 : There is no inverse relationship between the knowledge score and the technological gap index score of the farmers.

The computed correlation coefficient is -0.4757 which is significant at 0.01, level of probability. The null hypothesis is, therefore, rejected and the data support the original proposition.

Sub-hypothesis 1 : 2 : 7

There will be a negative relationship between the farmers' attitude towards high yielding varieties of jowar and the technological gap.

E.H. 10 : The attitude score will vary inversely with the technological gap index score.

N.H. 10 : There is no inverse relationship between the attitude score of the farmers and their technological gap index score.

The computed coefficient of correlation is -0.4047 which is significant at 0.01 level of probability. The null hypothesis, therefore, is rejected. The data support the original proposition.

Sub-hypothesis 1 : 2 : 8

There will be a negative relationship between risk-orientation of the farmers and their technological gap.

E.H. 11 : The risk orientation score will vary inversely with the technological gap index score.

N.H. 11 : There is no inverse relationship between the risk-orientation score and the technological gap index score of the farmers.

The computed value of correlation coefficient is -0.3942 which is significant at 0.01 level of probability. The null hypothesis is, therefore, rejected. The data support the original proposition.

Sub-general hypothesis 1 : 3

The technological gap of farmers cultivating high yielding varieties of jowar will vary with the perception of the attributes of innovation.

The sub-hypothesis pertaining to the sub-general hypothesis 1:3 are stated below.

Sub-hypothesis 1 : 3 : 1

There will be a negative relationship between the farmers' perception of profitability and the technological gap.

E.H. 12 : The score on the profitability of the cultivation of high yielding varieties of jowar will vary inversely with the technological gap index score.

N.H. 12 : There is no inverse relationship between the profitability score and the technological gap index score. The computed correlation coefficient value is -0.3748 which is significant at 0.01 level of probability. The null hypothesis is, therefore, rejected. The data support the original proposition.

Sub-hypothesis 1 : 3 : 2

There will be a negative relationship between the farmers perception of physical compatibility of the package of practices recommended for the cultivation of high yielding varieties of jowar in rabi and the technological gap.

E.H. 13 : The score of physical compatibility of the package of practices will vary inversely with the technological gap index score.

N.H. 13 : There is no inverse relationship between the score on physical compatibility and the technological gap index score. The computed value of correlation coefficient is -0.1324 which is significant at 0.05 level of probability. The null hypothesis is, therefore, rejected. The data support the original proposition.

Sub-hypothesis 1 : 3 : 3

There will be a negative relationship between the farmers' perception of cost involved in the technology and the technological gap.

E.H. 14 : The score on cost perception will inversely vary with the technological gap index.

N.H. 14 : There is no inverse relationship between the score on cost perception and the technological gap index score.

The computed correlation coefficient is -0.117 which is not significant at the 0.05 level of probability. The null hypothesis is, therefore, accepted. The data do not support the original proposition.

Sub-hypothesis 1 : 3 : 4

There will be a negative relationship between the farmers' perception of simplicity-complexity of the innovation and the technological gap.

E.H. 15 : The score on the simplicity-complexity of the cultivation of high yielding varieties in rabi will vary inversely with the technological gap index score.

N.H. 15 : There is no inverse relationship between the score on the simplicity-complexity of the innovation and the technological gap index score.

The computed correlation coefficient value is -0.096 which is not significant at the 0.05 level of probability. The null hypothesis is, therefore, accepted. The data do not support the original proposition.

Sub-hypothesis 1 : 3 : 5

There will be a negative relationship between the farmers' perception of infrastructural efficiency and the technological gap.

E.H. 16 : The score on the farmers' perception of the infrastructural efficiency will vary inversely with their technological gap score.

N.H. 16 : There is no inverse relationship between the score on the farmers' perception of infrastructural efficiency and the technological gap index score. The computed correlation coefficient value is -0.519 which

is significant at the 0.01 level of probability. The null hypothesis is, therefore, rejected. The data support the original proposition.

Sub-general hypothesis :

The technological gap of the farmers' participating in cultivation of the high yielding jowar varieties in rabi season will vary with the variation in their communication behaviour.

Sub-hypothesis 1 : 4

There will be a positive relationship between the farmers' use of personal localite sources of information and the technological gap.

E.H. 17 : The score on use of personal localite sources of information will vary directly with the technological gap index score of the farmers.

N.H. 17 : There is no direct relationship between the score on personal localite sources of information and the technological gap index score of the farmers.

The computed correlation coefficient value is -0.318 which is significant at the 0.01 level probability. The null hypothesis, therefore, rejected. The data support the original proposition.

Sub-hypothesis 1 : 4 : 2

There will be negative relationship between the farmers' use of personal cosmopolite sources of information and the technological gap.

E.H. 18 : The score on use of personal cosmopolite sources of information will vary inversely with the technological gap index score.

N.H. 18 : There is no inverse relationship between the score on use of personal cosmopolite sources of information of the farmers and their technological gap. The computed correlation coefficient value is -0.0679 which is not significant at the 0.05 level of probability. The null hypothesis is, therefore, accepted. The data do not support the original proposition.

Sub-hypothesis 1 : 4 : 3

There will be a negative relationship between the farmers' use of mass media sources of information and the technological gap.

E.H. 19 : The score on the use of mass media sources will vary inversely with the technological gap index score of the farmers.

N.H. 19 : There is no inverse relationship between the score on the use of mass media sources of information and the technological gap index source.

The computed correlation coefficient value is -0.2319 which is significant at the 0.01 level of probability. The null hypothesis is, therefore, rejected. The data support the original proposition.

Sub-hypothesis 1 : 4 : 4

There will be a negative relationship between the extension contacts of the farmers and the technological gap.

E.H. 20 : The score on extension contacts will vary inversely with the technological gap index score.

N.H. 20 : There is no inverse relationship between the score on extension contacts of the farmers and their technological gap index score.

The computed value of correlation coefficient is -0.4127 which is significant at 0.01 level of probability. The null hypothesis is, therefore, rejected. The data support the original proposition.

C) THE RELATIONSHIP OF DIFFERENT GROUP OF INDEPENDENT VARIABLES WITH TECHNOLOGICAL GAP

In the previous chapter the zero-order correlation between technological gap and the twenty independent variables has been discussed. However, as pointed out by Guilford (1955) the actual relationship between the

variables is not so simple. It may so happen that a single variable is associated with more than one variable at a time. This point has been discussed in the theoretical orientation. It has been mentioned there that the technological gap of the farmers is a function of techno-economic, socio-psychological, stimulus and communication variables. The technological gap is not entirely due to any one of these variables but of all these as a part of variables of an inter-dependent system.

With this concept in view, the main orientation in this section is to determine the degree or the extent to which the technological gap of the farmers be explained in part, through a group of independent variables.

The prediction analysis :

The statistical techniques of multiple regression and multiple correlation were used to determine the combined effect of selected variables in predicting the technological gap of the farmers cultivating high yielding varieties of jowar in rabi.

Multiple regression :

The following prediction equation was used in this dissertation to determine the multiple regression.

$$Y = a + b_1x_1 + b_2x_2 + \dots b_nx_n$$

Where,

Y is the dependent variable (in case of technological gap).

a = constant, n = the total number of independent variables and each 'b' co-efficient which appears in the equation represents the amount of change in Y (technological gap) that can be associated with the a given change in any one of the x's with remaining independent variables held fixed. The b's obtained in the multiple regression equations will be referred to as partial coefficient or partial b's since they express scopes obtained by holding constant, each of the remaining independent variables considered in multiple regression equation.

Multiple correlation :

The predictive power of each multiple regression equation was evaluated with the help of multiple correlation coefficient (R) and sequare of multiple correlation coefficient (R^2).

The multiple correlation coefficient (R) represents the zero-order correlation between actual technological gap index score obtained from the farmers and the technological gap score predicted from the independent variables used in the multiple regression. If the predicted technological gap score for each farmer would correspond exactly to his actual technological gap score, the multiple regression would be unit or one.

The prediction power of each of the regression models was evaluated with the help of the multiple correlation (R^2) which represents the proportion of the total variation explained by the independent variables in the regression equation acting together.

The findings will be presented in terms of per cent (p.c.) variation in technological gap of farmers, the multiple R^2 multiplied by 100 can be interpreted as the proportion of the total variation in technological gap explained by the set of independent variables.

In this study, only those variables which were found to be significantly related to technological gap of the farmers were considered for preparing the sets.

In all six following sets of regression models were used to determine the technological gap.

Set I : Regression model with fifteen independent variables significantly related to technological gap of the farmers.

Set II : Regression model with situational variables which includes two variables which are significantly related to the technological gap of the farmers.

Set III : Regression model with six socio-psychological variables significantly related to the technological gap of the farmers.

Set IV : Regression model with three stimulus variables significantly related to the technological gap of the farmers.

Set V : Regression model with three communication variables significantly related to the technological gap.

Set VI : Multiple regression analysis with six finally selected independent variables.

Set I : Multiple regression equation with fifteen significant variables :

Fifteen out of the twenty independent variables were related to the technological gap of the farmers at 0.05 level or higher. In the first set these variables were fitted in the multiple regression equation. The findings are presented in Table 4.26.

Table 4.26 : Multiple regression analysis with fifteen significant independent variables

Independent variables		Partial 'b'	't' value for partial 'b'	Correlation with dependent variables	R^2	F
1		2	3	4	5	6
x_2	Age	0.014	0.985	0.367		
x_3	Education	0.287	2.479 *	0.413		
x_6	Irrigation potential	0.113	2.174 **	0.455		
x_7	Material possession	0.040	1.766	0.372		
x_8	Social participation	0.031	1.912	0.587		
x_9	Contact with extension agencies.	0.074	2.124 *	0.412		
x_{10}	Knowledge of HYV jowar	0.113	3.126 **	0.475	0.8467	45.06 **
x_{11}	Attitude towards HYV jowar	0.095	2.679 *	0.404		

Table 4.26 (contd.)

1	2	3	4	5	6
x_{12} Risk-orientation	0.114	2.076	0.394		
x_{13} Profitability	0.037	1.150	0.374		
x_{14} Physical compatibility	0.106	3.030 **	0.232		
x_{15} Cost of cultivation	0.088	2.098	0.117		
x_{17} Infrastructural efficiency	0.200	8.045 **	0.519		
x_{18} Personal localite source of information	0.072	1.551	0.318		
x_{20} Mass media source	0.092	1.978	0.2319		

* Significant at 0.05 level

** Significant at 0.01 level

F = 45.06 **

It will be seen from Table 4.26 that out of fifteen independent variables fitted in the set I of the multiple regression equation only seven contributed significantly to the prediction of technological gap of the farmers. These were -

1. x_3 Educational status
2. x_6 Irrigation potential

3. x_9 Contact with extension agency
4. x_{10} Knowledge of HYV jowar
5. x_{11} Attitude towards HYV jowar
6. x_{14} Physical compatibility
7. x_{17} Infrastructural efficiency.

The independent variables fitted in Set I explain 84.67 per cent variation in technological gap.

Set II : Multiple regression equation with two techno-economic variables :

Out of the three techno-economic variables two were related to the technological gap of the farmers, at 0.05 or high level of probability. These variables were fitted to the multiple regression equation in Set II. The results of the analysis are presented in Table 4.27.

Table 4.27 : Multiple regression analysis with two significant techno-economic variables

Independent techno-economic variables		Partial 'b'	't' value for partial 'b'	R^2	F
x_{16}	Irrigation potential	0.192	8.231 *	0.2968	42.32 **
x_7	Material possession	0.110	3.112		

* Significant at 0.05 level of probability

** Significant at 0.01 level of probability

It will be seen from Table 4.27 that two techno-economic variables were found to explain 29.65 per cent of the variation in the technological gap out of the two variables fitted in Set II of multiple regression equation, the x_6 (irrigation potential) is significant to the technological gap.

Set III : Multiple regression equation with six socio-psychological variables :

Of all the seven socio-psychological variables, six were related to the technological gap of the farmers at 0.05 or higher level of probability. These six variables were fitted together in the multiple regression analysis set III.

Table 4.28 : Multiple regression analysis with six socio-psychological variables

Independent socio-psychological variables		Partial 'b'	't' value for partial 'b'	R^2	F
x_2	Age	0.016	1.040		
x_3	Educational status	0.329	3.614 *		
				0.7086	28.67 **
x_8	Social participation	0.198	2.320		
x_{10}	Knowledge about cultivation of HYV jowar	0.118	3.330 *		
x_{11}	Attitude towards HYV jowar	0.101	2.407		
x_{12}	Risk-orientation	0.093	3.002 *		

* Significant at 0.05 level of probability

** Significant at 0.01 level of probability

It would be seen from Table 4.28 that when six socio-psychological variables were fitted in Set III of the multiple regression, they explain 70.86 per cent of variation in the technological gap of farmers. Out of six variables only three variables viz.,

1. x_3 Educational status
2. x_7 Knowledge about cultivation of HYV jowar
3. x_{12} Risk orientation

were statistically significant.

Set IV : Multiple regression equation with four stimulus variables :

Out of the five stimulus variables four were significantly related to the technological gap. Therefore, all these were fitted in the multiple regression analysis.

Table 4.29 : Multiple regression analysis with four stimulus variables

Independent stimulus variables		Partial 'b'	't' value for partial 'b'		R^2	F	
x_{13}	Profitability	0.122	2.715				
x_{14}	Physical compatibility	0.123	3.591		0.5868	45.87	**
x_{15}	Cost of cultivation	0.104	2.723				
x_{17}	Infrastructural efficiency	0.215	9.945	*			

* Significant at 0.05 level of probability

** Significant at 0.01 level of probability

It would be observed from Table 4.29 that the four stimulus variables when fitted together in the multiple regression analysis of Set IV, explain 58.68 per cent of the variation in the technological gap of the farmers. Out of these four variables, only one i.e. x_{17} (infrastructural efficiency) was statistically significant.

Set V : Multiple regression equation with three communication variables

Out of the four communication variables studied, three were significantly related to the technological gap of the farmers. Hence, these were fitted in Set V of regression model and the findings are presented in Table 4.30.

Table 4.30 : Multiple regression analysis with three communication variables

Independent communication variables		Partial 'b'	't' value for partial 'b'	R^2	F
x_{18}	Personal localite use	0.103	2.376	0.5265	35.63 **
x_{20}	Mass media use	0.215	4.328		
x_9	Extension contact	0.162	2.836		

* Significant at 0.05 level of probability

** Significant at 0.01 level of probability

It will be observed from Table 4.30 that three communication variables when fitted together in the regression model of Set IV explained 52.65 per cent of variation in the technological gap of the farmers. Out of these, three communication variables only one i.e. x_{20} (use of mass media source of information) was significant.

Set VI : Multiple regression analysis with six finally selected independent variables

The objective of this study was to select best predictor from each of the theoretical configurations presented in the theoretical orientation section of this paper. Hence, multiple regressions were fitted separately with each configurational group of factors and from these groups only those variables were selected for inclusion in the final multiple regression equation whose partial b's were significant. Following the above method, the independent variables selected for x_6 (Irrigation potential), x_3 (Educational status), x_{10} (Knowledge about cultivation of HYV jowar), x_{12} (Risk-orientation), x_{17} (Infrastructural efficiency), x_{20} (Mass media use).

The multiple regression equation with the finally six selected independent variables which explained 81.65 per cent of the variations in the adoption behaviour of the farmers are presented in Table 4.31.

Table 4.31 : Multiple regression analysis with six selected variables

Independent variables		Partial 'b'	't' value for partial 'b'	R^2	F
x_6	Irrigation potential	0.242	5.326 *		
x_3	Educational status	0.294	3.417		
x_{10}	Knowledge about cultivation of HYV jowar	0.132	3.762 *		
				0.8165	78.36 **
x_{12}	Risk orientation	0.102	2.937		
x_{17}	Infrastructural efficiency	0.258	7.892 *		
x_{20}	Mass media use	0.147	2.913		

* Significant at 0.05 level of probability

** Significant at 0.01 level of probability

On further analysis, it was revealed that from the techno-economic group, one variable viz., irrigation potential, from the socio-psychological group, three variables viz., educational status, knowledge of cultivation of HYV jowar and risk orientation, from the stimulus variable group, one viz., infrastructural efficiency and from the communication variable group, one viz., mass media use were significantly related to the technological gap. When these six variables were

fitted together they accounted for 81.65 per cent of technological gap of farmers.

General hypothesis :

The technological gap of the farmers cultivating high yielding varieties of jowar in rabi, can be in part, predicted from their techno-economic, socio-psychological, stimulus and communication behaviour.

Sub-general hypothesis 2 : 1

All the twenty variables which were statistically significantly correlated with the technological gap of the farmers can explain a significant amount of variation in the technological gap.

S.H. 1 : The score on fifteen independent variables will explain a significant amount of variation in technological gap of the farmers. The statistical hypothesis stated in the null form is : The additional sum of squares for regression added by the variables x_1 to x_{15} would be zero.

The computed F value is 45.06 which is significant at 0.01 level of probability. The null hypothesis is, therefore, rejected. The data support the original hypothesis. Thus, the above test indicates that the fifteen variables taken together

explain a highly significant amount of variation (84.67) in the technological gap of the farmers.

Sub-general hypothesis 2 : 2

The techno-economic variables would explain a significant amount of variation in the technological gap of the farmers.

S.H. 1 : The score on two selected techno-economic variables will explain a significant amount of variation in the technological gap of the farmers. The statistical hypothesis stated in the null form is : The additional sum of squares for regression added by two techno-economic variables (x_6, x_7) is zero.

The computed multiple R^2 is 0.2968 and the computed value of 'F' is 42.32 which is significant at the 0.01 level of probability. The null hypothesis is, therefore, rejected and the data support the original proposition.

The above test indicates that the two selected techno-economic variables taken together explain a significant amount of variation (29.68 per cent) in the technological gap of the farmers.

Sub-general hypothesis 2 : 3

The six socio-psychological characteristics of the farmers would explain a significant amount of variation in the technological gap.

S.H. 3 : The score on six selected independent socio-psychological variables would explain a significant amount of variation in the technological gap of the farmers. The statistical hypothesis stated in the null form is : The additional sum of square for regression added by six socio-psychological variables

(x_2, x_3, x_8, x_{10}, x_{11}, x_{12}) is zero.

The multiple R^2 is 0.7086 and the 'F' value is 28.67 which is significant of 0.01 level of probability. The null hypothesis is, therefore, rejected. The data support the original proposition. The above test indicates that the six socio-psychological variables taken together explain a significant amount of variation (70.86 per cent) in the technological gap of the farmers.

Sub-general hypothesis 2 : 4

The four stimulus variables would explain a significant amount of variation in the technological gap of the farmers.

E.H. 4 : The score on the four selected independent stimulus variables would explain a significant amount of variation in the technological gap of the farmers. The statistical hypothesis stated in the null form is : The additional sum of squares for regression added by four stimulus variables (x_{13}, x_{14}, x_{15}, x_{17}) is zero.

The multiple R^2 is 0.5868 and the F value is 45.87 which is significant at 0.01 level of probability. The null hypothesis is, therefore, rejected. The data support the original proposition. The above test indicates that the four stimulus variables taken together explain a significant amount of variation (58.68 per cent) in the technological gap of the farmers.

Sub-general hypothesis 2 : 5

The three communication variables would explain a significant amount of variation in the technological gap of the farmers.

E.H. 5 : The score on the three selected independent communication variables would explain a significant

amount of variation in the technological gap. The statistical hypothesis stated in the null form is : The additional sum of square of regression added by the three communication variables (x_{18}, x_{20}, x_9) is zero.

The multiple R^2 is 0.5265 and the F value is 38.63 of 0.01 level of probability which is significant. The null hypothesis is, therefore, rejected. The data support the original proposition. The above test indicates that three communication variables taken together explain significant amount of variation (52.65 per cent) in the technological gap.

Discussion

In this section discussion and interpretation of results regarding differential characteristics of the two technological gap categories and the relationship of the selected independent variables with the technological gap are presented.

Out of the 20 independent variables, 15 were found to be statistically significantly related to the technological gap. The variables which were not statistically significant were farm size, caste, family size, simplicity-complexity and use of cosmopolite sources of information. Out of the 15 significant variables, irrigation potential, agricultural material possession, age, educational status, social participation, knowledge about high yielding jowar varieties, attitude towards high yielding varieties of jowar, risk orientation, profitability, infrastructural efficiency, use of personal localite sources of information, use of mass media sources and extension contacts were significant at 0.01 level of probability and the remaining two i.e. physical compatibility and cultivation were significant at 0.05 level of probability.

I. Techno-economic variables : Three techno-economic-variables were studied and the findings are presented below :

Farm size : It was observed from the data that the 't' value for the differential mean between low and high technological gap categories did not significantly differ from each other. The data revealed that irrespective of the number of hectares cultivated, there was no statistically significant difference in the technological gap between the smaller and the bigger farms. The high yielding jowar technology appears to be size neutral. This finding is also in line with the previous investigations and tends to show the notion of size neutrality of the high yielding jowar technology.

Irrigation potential : It was revealed from the data that a sharp statistically significant difference with regard to irrigation potential was found between low and high categories. The zero-order correlation analysis further revealed that irrigation potential had statistically significant negative correlation with technological gap. With the increase in irrigation potential technological gap decreased. For the cultivation of high yielding jowar, moisture is an essential factor and to maintain the moisture requirement irrigation potential is needed in one form or another. Similar findings have been reported by Nair (1969),

Singh (1969), Singh and Singh (1970), Pal (1974), Krishna Murthy (1974), Tripathy (1977), Sachhidanan (1972), Muthiah et al (1978) and Singh (1981).

Agricultural Material possession : It was observed that there was a statistically significant difference between the low gap category and high gap category as far as agricultural material possession was concerned. The agricultural material possession helps farmers to undertake new activities or use the technology immediately. When the farmer is fully convinced about the technology, he may purchase the required implements and as such there is a considerable difference between the low and high technological gap categories. It was revealed by the zero order correlation that the relationship between the independent variable, agricultural material possession and technological gap was significant at 0.01 level of probability.

II. Personal and socio-psychological variables :

It was noticed that out of the eight personal and socio-psychological variables studied caste and family size were observed to be statistically non-significant with the technological gap. The findings are discussed below.

Age : A statistically significant difference was observed between age and the low and high technological gap. The mean age of the two technological gap categories was 46.07 and 47.26 respectively. This age seems to be probably the most matured and productive period of a person's life span. The youngers have a tendency to take more risks and learn new things and put them into practice and are inclined to accept challenging situations. Therefore, there was a statistically significant difference between the low and high categories. This finding was further confirmed by zero-order correlation coefficient between the two variables (-0.3671) which was significant at 0.01 level of probability. Therefore, it appears that age has a negative relationship with the technological gap in the adoption of high yielding jowar technology.

Caste : There was no statistically significant difference between the low and high technological gap categories as far as caste was concerned. The mean score calculated was 4.61 and 4.25 respectively. It seems that caste has no bearing on adoption. Whatever technology that was communicated to the farmers, seems to have been transferred irrespective of caste and creed. This finding was confirmed by zero-order correlation.

Educational status : The data indicated a statistically significant difference in educational status between low and high technological gap categories. Education helps to expose the individual to a varied type of situations which influence the attitude to try and learn. A marked difference was, therefore, observed. Further, the zero-order correlation analysis indicated a significant negative correlation between educational status of the farmers and technological gap. Education opens the mental faculties of an individual which in turn help him in taking correct decisions. The above finding is in confirmity with the findings of Gupta (1968), Rao (1968), Reddy and Kivilin (1968), Nair (1969), Singh (1969), Singh and Singh (1972), Gaikwad (1973), Mishra (1975), Chattopadhya (1976), Tripathy (1977), Sadamate (1978) and Pathak (1981).

Family size : No statistically significant difference was found among the low and high technological gap categories regarding their family size. Further, the correlation study indicated a zero-order correlation of 0.0639 between the two variables which was not significant at the 0.05 level of probability indicating thereby that the family size had no statistically significant association with the technological gap. Family members provide additional labour required for the new technology. However, if necessary the labour

can be hired for a particular job and as such there appears to be no bearing of the size of the family on the adoption of technology.

Social participation : Participation in social activities by farmers of the low and high technological gap categories showed a statistically significant difference. The correlation analysis indicated a negative correlation (-0.5871) between the social participation and technological gap. This may be, because of through participation in various activities of social, economic and political institutions in a community, individual interacts and communicates effectively with others. His learning gets reinforced and thus he is motivated for the adoption of innovations. The above findings are in line with the findings of Singh (1970), Shelke (1971), Raghubar Singh (1979) and Pathak (1981).

Knowledge about cultivation of high yielding varieties of jowar :

It was observed from the analysis of the data that there was statistically significant difference in the knowledge of cultivation of high yielding varieties of jowar among the low and high technological gap categories. A strong negative correlation was observed between these two categories. An accurate

knowledge of the package of practices like nutrient management, water management and pest management were the pre-requisites for successful cultivation of the crop, the lacking in any one of the areas would lead to the failure of the crop and thus, would develop a prejudice towards the package of practices.

Therefore, it can be inferred that knowledge of cultivation of the crop can be a good source of re-inforcement for adoption of recommended practices. The findings of this study are supported by earlier findings of Nair (1960), Jaiswal (1965), Moulik (1965), Chattopadhya (1970), Singh and Singh (1972), Tripathy (1977) and Sadamate (1978).

Attitude towards HYV jowar : Low and high gap categories did differ statistically significantly in their attitude towards cultivation of high yielding varieties of jowar. The mean scores of low and high categories were 37.43 and 26.48, respectively. The attitude scores of the farmers were statistically significantly correlated with the technological gap score meaning thereby that, with an increase in attitude score the technological gap score would come down. This phenomenon is explained by the fact that favourable or unfavourable pre-disposition is necessary for the adoption or rejection of an innovation. This finding

is in line with Fliegel (1965), Moulik (1965), Singh and Singh (1970), Choukidar and George (1972). Somasundaram(1976), Tripathy (1977) and Pathak (1981).

Risk-orientation :

It was revealed from the study that the two categories (low and high) of technological gap were distinctly different from each other in regard to their capacity of risk taking. The low technological gap categories exhibited more risk bearing capacity.

The correlation study reveals a statistically significant negative relationship between the risk orientation and technological gap indicating thereby that as the risk bearing capacity of a farmer goes up, his technological gap comes down. Jowar is exposed more to the vagaries of ecology like rainfall, disease and pests. This finding is supported by Singh (1969), Naik (1969), Singh and Singh (1970), Mishra (1975), Somasundaram(1976), Chattopadhya (1976), Tripathy (1977), Singh, Das and Muley (1980).

III. Stimulus variables :

It had been postulated that the decision making of an individual at a point in time is not only a function of situational factors or socio-psychological make-up of the individual but it was also influenced by

the perception of farmers with regard to attributes of high yielding jowar technology as well as their perception of the infrastructural efficiency. These are studied as under.

Profitability : Profitability of a practice influenced statistically significantly, the low and high technological gap categories. The correlation analysis revealed a strong negative relationship (-0.3748) between perception of profitability and the technological gap. Economic motivation appeared to be an important incentive to move the farmer to adopt the innovation in a poor country like India. Because of the low perception of profitability, the high gap categories were not tempted to adopt the recommended package of practices and hence, more technological gap was found with them. Similar findings have been reported by Singh and Singh (1970), Chattopadhya (1970), Nair (1976), Somasundaram(1976), Tripathy (1977), Raj and Knight (1977), Pathak (1981), Waghmare and Pandit (1982).

Physical compatibility :

It was clearly indicated that the low technological gap category significantly differs from the high technological gap category in respect to their consideration of the physical compatibility. The zero-order correlation between the independent and the dependent

variables was found to be -0.2324 which was significant at the 0.05 level of probability. It could, therefore, be said that physical compatibility and technological gap were negatively correlated.

Physical compatibility generally refers to the feasibility of package of practices. Some times even if there was a possibility of getting suitable conditions in terms of soil, irrigation, power, technical skill and marginal capacity for adopting practice, a farmer may not adopt a practice which leads to a high technological gap. In order to reduce the technological gap, the high yielding jowar technology has to be made more compatible with the existing physical situation of the farmer. This finding is consistent with the finding of Singh and Singh (1970), Raj and Knight (1977), Tripathy (1977), Pathak (1981), Waghmare and Pandit (1982).

Cost of cultivation :

The analysis of data revealed that there was a statistically significant difference between the low and high technological gap categories with regard to their perception of cost of cultivation. The correlation coefficient between perception of cost of cultivation and technological gap of farmer was -0.1176 which is statistically significant at 0.05 level of probability.

The farmers suffer chronically from credit constraints and poverty and to overcome these constraints the farmer should be provided with a low cost technology. It is quite logical to expect that less costly a practice perceived by them the more likely would be its adoption.

Simplicity-complexity :

The attribute simplicity and complexity was not seen to be statistically significantly different in the low and high technological gap categories.

The correlation analysis has not established any statistically significant relationship between the perception of simplicity-complexity and technological gap. It is possible that the farmers under study had no clear perception of whether the practices were simple or complex.

Infrastructural efficiency :

A significant difference was observed between low and high technological gap categories with respect to the perception of the infrastructural efficiency. The mean score for low and high gap categories worked out to be 78.91 and 70.50 respectively. A highly negative correlation was observed between the farmers perception of infrastructural efficiency and technological gap which means that with efficient infrastructure the

technological gap will be reduced. Non-availability of inputs required for adoption was one of the major constraints in high technological gap. Similar findings were reported by Tripathy (1977), Raj and Knight (1977) and Sadamate (1978).

IV. Communication variables :

It had also been postulated here that the adoption behaviour of the farmers can, in part, be predicted by their information seeking habits. The information seeking habit has been studied by taking into consideration the degree of extension contact and use of different information sources, viz., personal localite, cosmopolite and mass media.

Use of personal localite source of information :

The farmers of the low and high technological gap categories differ statistically significantly in respect of personal localite sources of information. The mean score of low technological gap category was 11.40. This finding was further confirmed by the correlation analysis indicating a statistically strong negative relationship (-0.3189) between the personal localite sources and technological gap. The technological information percolates to localite agencies through several channels and by the time it

reaches this agency, not only there is a loss of information but distoration occurs. Beside this, there are a number of personal localite sources playing a role in disseminating the technical know-how to the cultivators. The findings confirm those of Singh and Singh (1970), Singh and Sahay (1970), Tripathy (1977) and Day (1981).

Use of personal cosmopolite sources of information :

Low and high technological gap categories were not signaificantly different from each other in respect of use of personal cosmopolite sources of information.

The computed correlation coefficient between personal cosmopolite source use and technological gap was -0.0676 which is not significant at 0.05 level of probability, though it indicates a trend of negative correlation. Similar findings have been reported by Singh and Singh (1970), Singh and Sahay (1970), Jha (1974), Tripathy (1977) and Day (1981).

Use of mass media sources :

A highly statistically significant difference was observed between the two (low and high) technological categories with regard to their mass media use. The mean score of the low gap category was two times as high as the mean score of the high gap category.

The high gap category was found to have much less use of the mass media sources of information. The correlation gap was computed to be -0.2319 which was significant at the 0.01 level of probability.

This finding indicated that, with more mass media use, the technological gap in adoption would be bridged. This finding is in line with the findings of a large number of scientists like Lionberger (1960), Rogers (1962), Jaiswal (1965), Nair (1969), Singh (1969), Singh and Singh (1970), Supe and Singh (1972), Choukidar and George (1972), Apparao (1974), Tripathy (1977), Somasundaram,Reddy and Singh (1977), Pathak (1981), Waghmare and Pandit (1982).

Extension contacts :

It was observed from the data that the two technological gap categories viz., low and high differed significantly with each other in respect of extension contacts. The mean extension contact score was found to be 25.98 in case of low gap category and 20.65 in high gap category.

The correlation analysis revealed a strong negative correlation between extension contacts and technological gap. It was, therefore, concluded that with more and intensive contacts of the farmers with the extension agency, their technological gap can be

bridged. The present finding confirms the earlier findings of Sinha (1966), Nair (1969), Singh and Singh (1970), Ernest (1973), Bhilegaonkar (1975), Reddy (1976), Tripathy (1977), Sadamate (1978), Raghubar Singh (1979) and Pathak (1981).

From the analysis of data, it was observed that, out of the 20 independent variables studied only 15 were significantly related to the technological gap of the farmers (Table 4.26). These variables when fitted in the regression equation, explained 64.67 per cent of the total variation in the technological gap. However, when the two techno-economic or situational variables were taken together, they accounted for 42.32 per cent of the variation (Table 4.27). Similarly, six socio-psychological variables, 4 stimulus variables and 3 communication variables when fitted in separately in the multiple regression equation accounted for 70.86 per cent, 58.68 per cent and 52.65 per cent respectively of the total variation in the technological gap. The high percentage of variation explained by each group of variables might be due to the 'multicolinearity' effect because variables belonging to the same group are highly intercorrelated.

SECTION IV

4.4 INFLUENCE OF TECHNOLOGICAL GAP OVER YIELD GAP

In this section, the relationship between technological gap in each of the components of the high yielding jowar technology with the yield gap will be tested with zero-order correlation. Further, the contribution of each independent variable towards the dependent variable would also be determined by the multiple regression analysis which has been described in the earlier section.

The square of the multiple correlation (R^2) represent the proportion of the variation explained by the independent variable in the regression equation. The findings will be presented in terms of percentage of variation in the yield gap of the farmers, the multiple of R^2 multiplied by 100 can be interpreted as the proportion of the variation in yield gap explained by the respective independent variables (as shown in Table 4.32). The order of presentation is as follows.

The general hypothesis 3, is stated first, followed by its sub-hypothesis and the corresponding empirical hypothesis.

Table 4.32 : Relationship between technological gap and yield gap

	Independent variables	Zero-order correlation with dependent variables
*	Gap in seed and seed treatment	0.396 **
*	Gap in care after germination	0.340 **
*	Gap in nutrient management	0.596 **
*	Gap in water management	0.582 **
*	Gap in cultivation practices	0.332 **
*	Gap in weed control	0.518 **
*	Gap in disease and pests management	0.447 **
*	Gap in harvest and post-harvest	0.157

* Significant at 0.05 level of probability

** Significant at 0.01 level of probability

General hypothesis 3 :

The yield gap of the farmers will vary with the technological gap in the adoption of each of the components of the high yielding varieties of jowar technology in rabi season.

Sub-hypothesis 3 : 1

There will be a positive relationship between technological gap in seed and seed treatment and the yield gap of the farmers.

E.H. 1 : The yield gap score will vary directly with the technological gap index score of seed and seed treatment. The hypothesis stated in the null form is : There is no direct relation between technological gap index score in seed and seed treatment and the yield gap score.

The computed correlation coefficient is 0.396 which is significant at 0.01 level of probability and hence, the null hypothesis is rejected. The data support the original proposition.

Sub-hypothesis 3 : 2

There will be a positive relationship between the technological gap index score in care after germination and yield gap score.

E.H. 2 : The yield gap score of the farmers will vary directly with the technological gap score in care after germination. The hypothesis is stated in the null form : There is no direct relationship between technological gap index score in care after germination and yield gap score.

The computed correlation coefficient is 0.340 which is significant at 0.01 level of probability. The null hypothesis is, therefore, rejected. The data support the original proposition.

Sub-hypothesis 3 : 3

There will be a positive relationship between technological gap score in nutrient management and yield gap score.

E.H. 3 : The yield gap score of the farmers will vary directly with the technological gap score in nutrient management. The hypothesis is stated in null form : There is no direct relationship between technological gap index score in nutrient management and yield gap score.

The computed correlation coefficient is 0.596 which is significant at 0.01 level of probability. The null hypothesis is, therefore, rejected. The data support the original proposition.

Sub-hypothesis 3 : 4

There will be a positive relationship between technological gap index score in water management and yield gap.

N.H. 4 : The yield gap score of the farmers will vary directly with technological gap score in water management. The hypothesis is, thus, stated in the null form : There is no direct relationship between technological gap index score in water management and yield gap score.

The computed correlation coefficient is 0.582 which is significant at 0.01 level of probability. The null hypothesis is, therefore, rejected. The data support the original proposition.

Sub-hypothesis 3 : 5

There will be a positive relationship between technological gap index score in cultivation practices and the yield gap score.

N.H. 5 : The yield gap score of the farmers will vary directly with the technological gap score in cultivation practices. The hypothesis is stated in null form : There is no direct relationship between technological gap index score in cultivation practices and yield gap score.

The computed correlation coefficient is 0.332 which is statistically significant at 0.01 level of probability. The null hypothesis is, therefore, rejected. The data support the original proposition.

Sub-hypothesis 3 : 6

There will be a positive relationship between the technological gap index score in weed control and yield gap score.

E.H. 6 : The yield gap score of the farmers will vary directly with the technological gap score in weed control. The hypothesis is stated in null form : There is no direct relationship between technological gap index score in weed control with the yield gap score.

The computed value of correlation coefficient is 0.518 which is significant at 0.01 level of probability. The null hypothesis is, therefore, rejected. The data support the original proposition.

Sub-hypothesis 3 : 7

There will be a positive relationship between the technological gap index score in disease and pests management and yield gap score.

E.H. 7 : The yield gap score of the farmers will vary directly with the technological gap score in disease and pests management. The hypothesis is stated in null form : There is no direct relationship between technological gap index score in disease and

pests management with the yield gap score of the farmers.

The computed value of correlation coefficient is 0.447 which is significant at 0.01 level of probability. The null hypothesis is, therefore, rejected. The data support the original proposition.

Sub-hypothesis 3 : 8

There will be a positive relationship between the technological gap index score in harvest and post-harvest technology and the yield gap score.

F.H. 8 : The yield gap score of the farmers will vary directly with the technological gap score in harvest and post-harvest technology. The hypothesis is stated in the null form : There is no direct relationship between the technological gap index score in harvest and post-harvest technology with the yield gap score of the farmers.

The computed value of correlation coefficient is 0.157 which is not significant at 0.05 level of probability. The null hypothesis is, therefore, accepted. The data do not support the original proposition.

The multiple regression analysis of the significant seven variables is presented in Table 4.33.

Table 4.33 : Multiple regression analysis with seven significant variables

Independent variables	Partial 'b'	't' value for partial 'b'	Correlation with dependent variables	R^2	F
1. Gap in seed and seed treatment	0.0430	6.2929 **	0.3964		
2. Gap in care after germination	0.0429	5.0158 *	0.3405		
3. Gap in nutrient management	0.0514	7.8297 **	0.5967		
				.8022	85.00**
4. Gap in water management	0.549	12.1763 **	0.5825		
5. Gap in cultivation practices	0.0384	4.8752 *	0.3325		
6. Gap in weed control	0.0365	4.8627 *	0.5184		
7. Gap in disease and pests management	0.0407	7.4440 **	0.4472		

** Significant at 0.01 level of probability

* Significant at 0.05 level of probability

It would be seen from Table 4.33 that all the seven significant variables fitted in the multiple regression equation contributed statistically significantly to the prediction of the yield gap.

The relative contribution of each of the above seven variables were worked out by successively dropping independent variables from the multiple regression analysis in reverse order of their contribution in predicting the yield gap (the procedure has been described in the earlier section).

Table 4.34 : Loss in multiple correlation coefficient (R^2) associated with the least square delete regression

	Variables	R^2	'F' value
* 1.	Gap in seed and seed treatment	0.1168	20.35 **
* 2.	Gap in care after germination	0.0417	7.85 **
* 3.	Gap in nutrient management	0.1792	27.10 **
* 4.	Gap in water management	0.2034	33.74 **
* 5.	Gap in cultivation practices	0.0502	8.24 *
* 6.	Gap in weed control	0.0872	14.36 **
* 7.	Gap in disease and pests management	0.1237	21.23 **
	Total	0.8022	

* Significant at 0.01 level of probability

** Significant at 0.05 level of probability

The findings of the multiple regression analysis with seven significant independent variables, indicate

that together they accounted for 80.22 per cent of the yield gap. The factors responsible for the rest of the 19.78 per cent of the yield gap would be discussed later. When this was partitioned between each variable by the least square delete technique (Table 4.34) it could be seen that gap in water management contributed to the extent of 20.34 per cent of the yield gap. Similarly, the gap in nutrient management contributed to the extent of 17.92 per cent, gap in disease and pests management 12.37 per cent, gap in seed and seed treatment 11.68 per cent; gap in weed control 8.72 per cent; gap in the cultivation practices 5.02 per cent; gap in care after germination 4.17 per cent.

The data further revealed that the three crucial factors viz., water management, nutrient management and disease and pests management were together responsible for 50.63 per cent of the yield gap.

Discussion

It is a well known fact that the crop yields obtained by the farmers are not as high as those obtained in research plots. Further, there is a difference between the research station yield and the National Demonstration yields. Since National Demonstrations are conducted on farmers' fields, it would be desirable to consider the demonstration yield (instead of experimental station yield) as potential yield that can be obtained under farmers' field situations. The difference between National Demonstration yield and State average yield is the yield gap.

One of the objectives of this study was to find out whether the technological gap was related to yield gap and if so, to what extent it contributes to the yield gap.

In this section, the relationship between the technological gap in each of the components of the high yielding jowar technology and their contribution to the yield gap will be discussed.

The concept of yield gap has been developed in three stages.

Gap I (Research gap)	There is a gap between the yield possible on theoretical consideration and the best yield so far achieved on research station farm. This may be called research gap. The bridging of this gap mainly depends on the efforts of research scientists.
Gap II (Management gap)	There is a gap between the best yield obtained on research farm and that of the best farmer in his own situation. This gap may be called management gap. The bridging of this gap depends on the joint efforts of research and extension scientists.
Gap III (Extension gap)	This is the gap between the best average yield obtained in farmers' situation and the average yield of farmers. This may be termed extension gap, and can be bridged by the joint efforts of developmental, extension and research agencies. It is the gap III i.e. the extension gap with which we are concerned.

In this study, it has been conceptualised that the technological gap is a function of techno-economic,

personal and socio-psychological, stimulus and communication factors. In turn, yield gap is a function of both technological and ecological factors.

It will be seen from figure (eleven) that average National Demonstration yield of jowar in farmers' situation was 35 q/ha whereas the average yield of the farmers was 5 q/ha. The gap was found to be 30 q/ha. The present study revealed that 80.22 per cent of the gap in yield was caused by the technological gap in the various components of the high yielding jowar technology. Their individual contributions towards yield gap, given in Table 4.34 shows that water management is the most important casual factor, followed by nutrient management and disease and pests control. These three crucial factors together are responsible for 50.63 per cent of the yield gap.

The ecological factors like temperature, soil and rainfall together contribute to the extent of 19.78 per cent of the yield gap as revealed by the study. It can be said that the above ecological factors are non-manipulative whereas the technological factors could be manipulated to increase the yields.

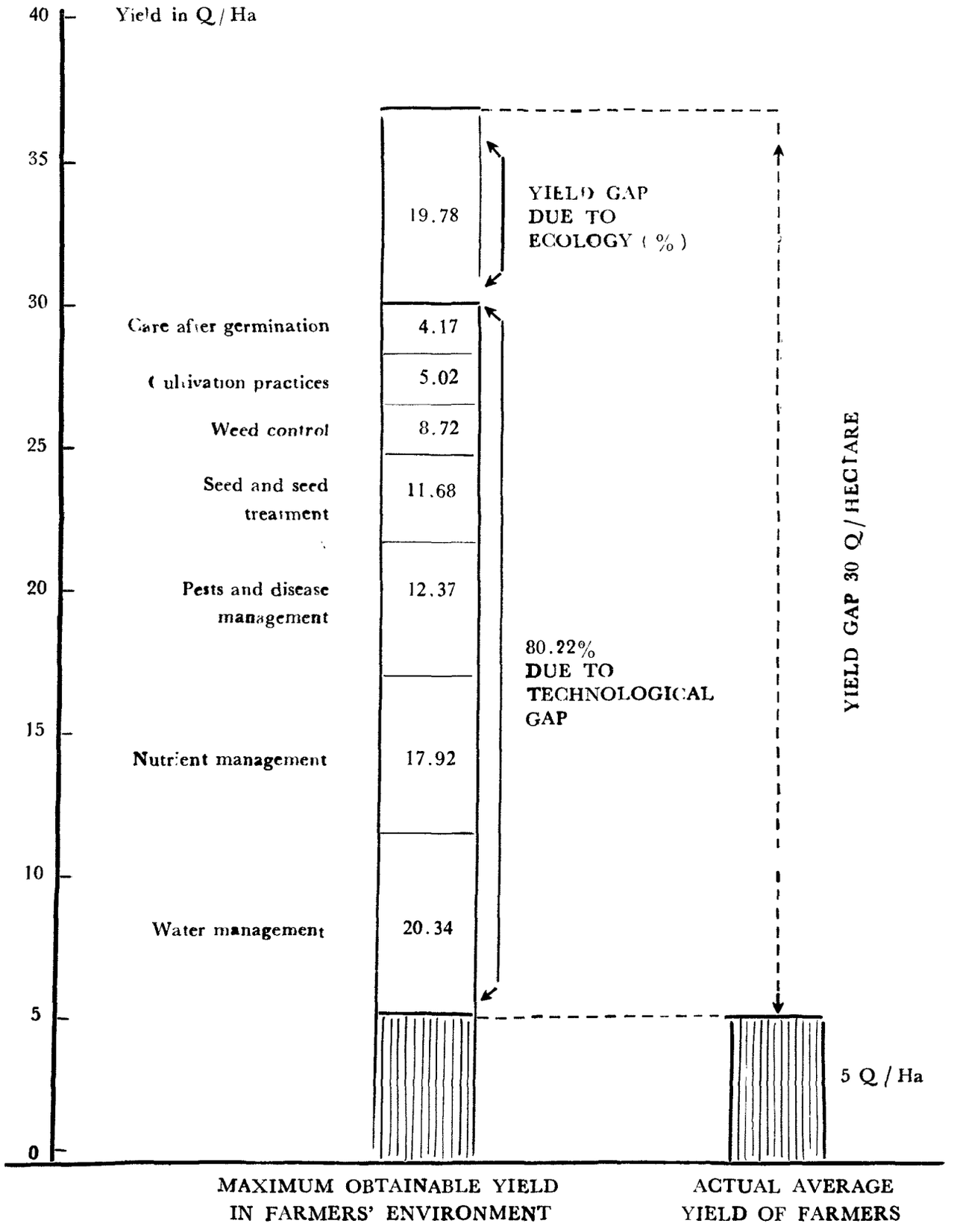


Fig. 11: Contribution to technological gap & ecology to yield gap in *rabi jowar* in Maharashtra

4.5 JOWAR DEVELOPMENT STRATEGY

Although jowar occupies the largest area under cereals next only to rice, there was no clear statement of national policy on jowar production till 1975, when in the Indian Science Congress (1976) it was announced that rice and jowar production programme in the country should receive emphasis.

Jowar is considered as a coarse grain implying that it is inferior to rice and wheat. This statement ignores the fact that jowar is the preferred and staple food of a considerable proportion of the population and that jowar straw is by far the most important source of fodder in the dry lands.

In spite of its importance as food grain for the poor, during the last five years, none of the States has attempted a coverage larger than 20 per cent and the coverage is not large enough to have visible impact on the jowar production, according to a report of the Indian Council of Agricultural Research, New Delhi(1981). In fact, in extreme cases as in Maharashtra, the total production of jowar may rather go down on account of the build up of pests which devastate the local jowar. The approach, therefore, should be an attempt to saturate the jowar growing areas within the coming years with a suitable development strategy.

Jowar research strategy

Based on the experience of a number of jowar scientists and extension workers, in this study, a jowar research and jowar extension strategy which together constitute jowar development strategy, has been outlined for Maharashtra State.

Jowar is the number one crop of the State in terms of area, production, number of people engaged in its cultivation, and it also contributes the largest share to the agricultural economy of the State. Although jowar is an important crop, there is no agency specially meant for improving production either in the States or at the Centre. Though there exists a Directorate of Millets, this organisation is concerned with many crops besides jowar and as such it rather falls short in paying undivided attention to the jowar crop.

Needed areas of research

1. Varietal change over, on an area basis in preference to the prevalent diffused spread, could improve as well as stabilise dry land jowar production. It is, therefore, necessary to give the right variety for the area both for hybrid as well as high yielding varieties for the rabi season.

2. Maldandi jowar is a formidable factor against the spread of other varieties in so far as the excellent grain and fodder qualities are concerned. In case of rabi jowar, R-16 is much nearer to Maldandi, but has the draw-back of charcoal rot disease and needs to be improved. Hybrids or composite varieties yielding high and maturing within 110 to 120 days need to be evolved for the rabi season. Hybrid CSH-1, is also grown in rabi and is an accepted variety for high yields. But its grain is small and the consumer preference is rather less. It is also susceptible to shoot fly. Its fodder is relatively low in tonnage. A variety which does not have these draw-backs will have to be developed.

3. The resource allocation of personnel, credit and fertilizers is limited for the jowar production programme. This needs to be intensified with a view to evolving desired types of varieties. Since jowar is a rainfed crop, it suffers from all the uncertainties and risks associated with the dry land agriculture, adequate attention was not paid to develop varieties suitable for rabi jowar and no programme or a definite strategy was developed till 1975, for overcoming the above constraints.

Only after 1975 i.e., during the last five to six years rabi trials were conducted at Parbhani, Mohol and Solapur, under rainfed conditions and at Kopargaon under irrigated conditions. These trials have clearly brought out the superiority of hybrids over the locals. At Parbhani, CSH-1 and CSH-3 have yielded 38.44 and 31.509 q/ha respectively, whereas the check M-35-1 yielded 27.98 q/ha. At Mohol, the yields of CSH-1, CSH-4 and M-35-1 were 22.70, 22.14 and 15.21 q/ha respectively. Though an area of three lakh of hectares is under irrigated jowar, there is no suitable variety for this area; moreover, less attention has been paid to this problem.

Varietal improvement

It is pertinent to note that the earlier breeding programme (prior to 1960) was mostly restricted to selection from the locally adopted populations. The work of transference of male sterility from CK-60-A to indigenous varieties of jowar was started in 1964-65 by 'direct' as well as by 'indirect' method. At Parbhani, PMS-1036-A (from PI-7-R), PMS-648, PMS (from Shenoli) PMS-418 (from PJIR) PMS-36 (from PJ 16-K), MPS-1587-A (Shalu type), PMS-750-A, PMS-1258 and PMS-1202 (from

Maldandi) male sterile lines have been developed by 'indirect' and 'direct' method. Some of the male steriles like PMS-1036-A, 36-A, 1258-A and 1202-A have provided female base for the hybrids like CSH-4, CSH-7-R, CSH-8-R and Maldandi hybrids which have given 10 to 28 per cent more yield.

The extension strategy should be based on diffusing the following key points.

1) Advancing date of planting by at least 20-30 days in all single cropped areas.

2) Choice of CSH-1, CSH-4, CSH-7-R, CSH-8-R and SPV-86, under advanced date of sowing and choice of CSH-2 or CSH-3 when profile moistures are low at the time of planting.

Seed and Seed treatment

The constraints as perceived by the farmers with regard to seed and seed treatment were 'expenditure on treatment of seed is high', non-availability of seed in time, high cost of chemicals and complexity in seed treatment.

In order to overcome these constraints, the following programme needs to be undertaken.

a) Certified seed after being properly treated with fungicides and testing the germination percentage, should only be released to service co-operatives.

b) For those who use the local seeds, seed treatment should be organised on a mass scale in each community before sowing.

c) Non-availability of seed in time is the second important constraint. The seeds of hybrid varieties such as CSH-7-R, CSH-8-R have given about 20-28 per cent higher grain which could serve the need of supplying seeds timely. The present varieties possess bold grain, mature in 110 to 115 days, do not lodge under soil cracked conditions and are tolerant to shoot-fly, and charcoal rot and hence can contribute to higher yield.

Similarly, SPV-86 and some of the PR cultures have shown promise and could serve the immediate needs. In addition to these two hybrids, four new hybrid combinations with Maldandi (MS-1258 and MS-1202) male sterile are showing promise. Two of the hybrid combinations of these male steriles with S-285 mature in just 95 days and the rest of the two in 100 days, while the local i.e., M-35-1 matures in 125 to 130 days. These early maturing hybrids possess tolerance to shoot fly, their grains are pearly and lustrous and since they have a height of 180 cm, the fodder yields are equal to those

of locals. These hybrids are under trial. Considering these factors, the proposed strategy with regard to the choice of variety is given below.

Jowar is a rainfed crop and grown on receding moisture and as such short duration varieties are required to be popularised. SPV-86 has proved its superiority over M-35-1. The seeds of these varieties should be provided well in advance i.e., prior to the commencement of the rabi season with other inputs as well.

Hybrid seed is one of the limiting factors in jowar production. A jowar production programme based on hybrids, implies production, distribution and supply of the seed to all the hybrid crop growing farmers well in advance of the season. This is difficult to fulfil as the area under hybrids continues to be relatively in extensive. A time has, therefore, come to switch on to high yielding straight varieties. Although the varieties may yield about 20 per cent less than the hybrids, the greatest advantage will be the rapid coverage.

The major advantage of a variety based production programme of jowar would be lost, if the seed is not produced by the farmer himself. This poses to the fore-front problems of seed production. A good illustration of the problem is in Western Vidarbha and

the Marathwada regions. Planting early, ratooning the planted crop when it is about 40-45 days old (Boot-leaf) and managing the ratoon crop for seed production is the simplest and the most convenient way for a dry land farmer to produce his own seed.

Nutrient management :

The response of rabi jowar to nutrient, specially N depends upon the soil moisture reserve. Therefore, the major constraints expressed by the farmers were fear of heavy losses in case of crop failure due to lack of rains, high prices of fertilizers, placement of fertilizers is complicated and returns less remunerative. Therefore, the technological gap observed was to the extent of 65 per cent in the area of investigation.

In fact, farmers who were applying fertilizers, hardly do so as per the recommendation because of the high prices of fertilizers and non-availability of moisture. Further, in dry land area farmers had certain preconceived notions that application of fertilizers is not at all economical and it hampers the yield and as such they divert the fertilizers to cash crops or irrigated crops viz., sugarcane, vegetables.

The subsidized distribution of fertilizers is done mostly through the co-operative and private

agencies. There are persistent complaints that a substantial part is netted in by big farmers. Therefore, corrective measures regarding distribution of fertilizers need to be taken.

The Drought Prone Area Development Programme should be implemented with proper emphasis by involving small and marginal farmers to encourage obtaining subsidy upto 25 per cent and 33 per cent.

a) Distribution process needs to be streamlined through the chain of private agencies and co-operatives in every village.

b) A massive programme of fertilizer promotion and education about it has to be undertaken in the State.

IV. Water management :

Jowar is grown on rainfed conditions; only three lakhs of hectares are under irrigation either of the wells or canals. Moisture is the most limiting factor in dry land farming. It is, therefore, essential that each drop of moisture is used very carefully. It is revealed from the past studies that 60-70 per cent of moisture stored in soil profile is lost due to evaporation. The process of evaporation starts immediately after the soil surface gets moisturized.

The technological gap observed in this component is 62 per cent and the major constraints reported were, mulching was not economical and not suitable to local conditions. To obtain a good harvest, the practices such as use of mulch, inter plot water harvesting, water harvesting in farm ponds developed by the Dry land Research Station, Solapur should be popularised.

b) The farmer should be educated in water management for crop production keeping in mind, the two considerations. The first is the method of water application and the second, the stage of crop growth. If the appropriate method of water application is used, it would result in the maximum production per cm of water applied. The same is the case with the stage of application. In case of rabi jowar, emergence of earhead to flowering is the critical period of moisture requirement.

c) Water harvesting in farm ponds. The water in the pond is not expected to last to a late stage although critical irrigation should be applied at the early stage. Here, we have to compromise between the theory and practice. At a later stage, water may not available or would be available to a less extent to cover the expected area.

Plant protection :

Plant protection measures followed are very meagre in dry land agriculture, as can be seen from the fact that the maximum 72.41 per cent gap is observed in case of plant protection measures. The major constraints observed were lack of knowledge, lack of technical help, high cost of chemicals etc.

a) The strategy envisaged should be to educate the farmers about effectiveness of plant protection measures. Insecticides and pesticides should be made available through co-operatives at subsidised rates.

b) Seed treatment should be organised on community basis and plant protection appliances should be supplied through co-operative societies or gram panchayats on minimum hire charges.

c) Early sowing should be encouraged to avoid the incidence of pests and the zonal system of pest control should be organised on village basis.

Care after germination :

Optimum plant population per hectare is not maintained. In some areas, it is very low and elsewhere it is very high. Thinning is required to be carried out in case of over plant population. The constraint expressed in this regard was the shortage of labour.

The spacing between and within rows is not maintained. To help; solve this problem, a seed drill of 45 cm distance between rows should be popularised. The Maharashtra Agro-industries Development Corporation has fabricated such type of seed drills. This activity should be strengthened by providing financial support to the farmers to purchase the seed drills. Plant geometry is an important aspect for rabi jowar i.e. population of 1,30,000 is the most optimum for higher production. This aspect should be demonstrated by conducting the demonstrations to drive home the advantage of the practice.

Weed control

Estimates from the jowar producing areas indicate that jowar yield losses to the extent of 20 to 40 per cent occur due to weeds which exceeds those in any other crop. Losses upto 50 per cent are not uncommon. Yield losses ranging upto 75 per cent have been reported due to severe infestation of striga. The major constraints were shortage of labour and that the practice is not commensurate with the profits gained. To overcome this difficulty, the practice of hoeing two to three times should be encouraged. Moreover, chemical weed control is required to be introduced on a large scale. The farm women need to be trained in identifying the weeds and their control measures.

Harvest and post-harvest Technology :

The losses to crops immediately prior to and after harvest due to soil pests, plant pests living on grains, birds, rodents, delay in harvesting, premature harvesting, inadequate drying after harvesting and use of traditional storage containers were observed.

Educating farmers and farm women in harvest and post-harvest technology is necessary. Emphasis should be given to post-harvest technology in farmers' rallies. These rallies should be conducted on a large scale. (1) The farmers should be trained to harvest the crop as soon as the crop is matured, i.e. when the moisture content is still 18-20 per cent (2) Immediate drying either before or after threshing (3) Storage of cleaned grain at safe moisture content in closed containers with effective insect control measures.

The problem is to provide cheap / low cost and suitable equipment to farmers whose land holdings are of 1 to 2 hectares for drying, threshing, cleaning and storing. An alternative is the joint use of equipments by number of farmers.

Economic infrastructure :

Land holdings in drought prone area are comparatively large. A separate definition of small

and marginal farmer has been adopted for this area, i.e., those having less than five hectares land are defined as small and marginal farmers. Therefore, a majority of farmers came under small farmers category. As they have to depend upon the vagaries of nature and monocultural cropping pattern, their economic condition is poor which affects use of the inputs resulting in low production. To break the vicious circle, input capacity should be improved by the following method.

The farmers' service co-operatives are the ideal agencies for distribution of essential inputs to the farmers. The areas where service co-operatives do not exist, agro-service centres should be given this responsibility. The Shetkari Sangh of Kolhapur district is the best example of a service co-operative embracing a wide range of activities.

Credit :

The constraints reported by the farmers were that the long term loan was not available with one agency, recovery procedure is stringent and high rate of interest is charged. The strategy would consist of changing the policies of Nationalised Banks for advancing crop loans. They should not adhere to the terms and conditions of irrigated and cash crop in dry farming. The dry land agriculture should be given

priority and they should charge a very low rate of interest on loans advanced.

Marketing :

The major constraints reported were the middle man took the maximum benefit in settling transactions, remunerative price should be given to the produce. The price assurance should be given at the beginning of the season which will induce the farmers to incur expenditure on account of adoption of improved technology.

In brief, the jowar development strategy should be based on the following points :

1) High yielding varieties for early sowing :

Early sowing of rabi jowar widens the grain to fodder ratio (1:6-8), especially in the case of M-35-1, CSH-8 and SPV-86. These promising hybrids and high yielding varieties are better suited for early sowing.

2) Carbofuran seed treatment :

Early sowing poses the problem of increased shoot-fly incidence, especially in high yielding varieties. This problem can be overcome by seed treatment with carbofuran (10 per cent proportion) and also by

adopting high plant population in M-35-1, for traditional variety (M-35-1), seed rate can be increased to compensate the losses caused due to shoot-fly damage.

3) Early sowing of rabi jowar :

Rabi jowar is usually grown under receding soil moisture conditions in a considerably large area in rabi Deccan tract. Limited soil depth puts limitations on soil moisture storage capacity which ultimately affects the production. It has been observed that by advancing the date of sowing of rabi jowar to early September, accumulating and receding soil moisture conditions are created which increases the production by about 100 per cent, probably due to efficient utilization of fertilizer and native nutrients from the soil.

4) Fertilizer use for rabi jowar :

Fifty kg N/ha can be safely recommended for rabi jowar at the time of sowing between the seed rows.

5) Mulch application for rabi jowar :

Application of any organic mulch at the rate of five tonnes per hectares immediately after the emergence of the crop is useful for increasing production to the

extent of 50 to 100 per cent depending on the rainfall situation.

6) Protective irrigation

One protective irrigation at pre-boot stage (60-65 days after sowing for K-35-1) has been found to increase the production to the extent of 60-70 per cent.

7) Water harvesting :

A technique of run off collection in dug out farm ponds by providing grassed water ways and using the stored water for giving life saving irrigation is being developed. It is a promising technique.

8) Weed control :

Weeds compete with the main crop for soil moisture and nutrients. Losses may vary from 37 to 95 per cent depending on the intensity of weeds. Mechanical weed control by hand weeding or hoeing as well as use of atrazine at the rate of 0.5 kg a.i./ha as pre-emergence spray have been found to be effective.

9) Package of practices for rabi crops :

A definite package of practices for rabi crops has been evolved. The package includes improved

variety, optimum plant population, seed treatment, fertilizer use, optimum time of sowing and plant protection.

While preparing a development strategy, extension workers must bear in mind the above points. They must clearly know what they wish to communicate and therefore, a through knowledge of these factors is essential, if a sound development strategy is to be executed.

4.6 COMMUNICATION STRATEGY FOR TRANSFER OF HIGH YIELDING JOWAR TECHNOLOGY

Strategy refers to the art of planning an operation skilfully, to achieve the desired goal. The following points stated by Axinn and Thorat (1972) should be borne in mind, while preparing a massive communication strategy.

1) The success of any training programme tends to be directly related to the extent to which its participants carry out with their own hands all of the significant activities about which they are being taught "What a man sees, he can doubt, what a man hears, he can doubt, but what a man does himself, with his own hands, he can not doubt".

2) The more the communication channels in parallel between a communicator (agricultural extension staff) and his audience (farmers), the greater the chance that any particular message sent by the communicator will be received by the audience.

3) The impact of agricultural writing or broadcasting directed at farmers, tends to be directly related to the extent to which it employs the same words those farmers typically use (with similar meaning), in the same type of phrases, with the same kind of feelings.

4) The effectiveness of communication between any sender and receiver tends to vary directly with the degree to which treatments are constructed with symbols that have the same meaning for both the sender and the receiver.

5) The effectiveness of communication between any sender and receiver tends to vary directly with the fidelity of the channels employed.

6) The effectiveness of communication between any sender and receiver tends to vary directly with the extent to which that receiver (audience) attends to the channel(s) being utilised.

7) The effectiveness of communication between any sender and receiver tends to vary with the capacity of

channels employed as well as with the receiving skill of the receiver (audience) in regard to the particular channel(s) utilised and with the number of other receivers who also constitute the audience for particular communication.

8) The effectiveness of communication between any sender and an audience tends to vary inversely with the amount of time that lapses between origination of the treatment by the communicator and the reception of the treatment by the audience.

9) The effectiveness of communication between any sender and an audience tends to vary directly with the extent to which that audience associates the channel(s) used as channel(s) typically used by persons of status equal to or higher than its own.

Communication need :

Effective communication of farm information to the farmers is the key to socio-economic transformation of a nation. An understanding of communication behaviour of farmers is essential in formulating effective communication strategy for agricultural development.

Considering the profiles of the farmers from the drought prone area and the major constraints expressed

by them and the urgency of the situation, the present communication strategy is not only inadequate, but also old and obsolete. Research studies have indicated that the farmer depends largely on localite sources of information i.e., progressive farmers, neighbours, friends and relatives. Demonstrations, field trips, village level workers, etc. are other sources of information for them. The next source of information is mass media, viz., exhibition, film shows, training meetings, posters, etc. Hence, it is desirable to combine these sources and make the information available to the farmers. In order to achieve an effective transfer of technology, the following suggestions may be implemented.

a) Recently, the training and visit system of extension education is introduced in all the districts of Maharashtra. The village extension workers should establish a proper rapport with the farmers. This needs to be corrected by repetitive visits in leisure time to the homes and farms.

b) The messages prepared for the contact farmers must not be restricted to them only. The messages should be displayed in the common places on boards which will facilitate to rebrush the knowledge of the educated. This will help other innovators and early adopters to diffuse the messages.

c) Provision of visual aids kits for each group should be made.

d) Young farmers of each group should be given encouragement by according special attention to recognition and status.

e) The farmers should be exposed to the varied situations by using the mass media.

f) The benefits of various schemes / programmes undertaken by government, semi-government, voluntary organisations or private agricultural trusts be given. The programme like Lab to Land may be utilised for conducting the demonstrations.

g) Make use of multi-dimensional channels in logical combination for information transfer. The impact of field trips can be maximised with the following combinations.

<u>Pre-inforcement of field trip</u>

Radio + Slide Show + Field trip.

Posters + Slide show + Field trip

<u>Post-inforcement of field trip</u>

Field trip + Slide show + Group discussion

Field trip + Group discussion (meeting) + Folder

The impact of demonstrations can be maximised by combining the following media.

Pre-inforcement of demonstration

Radio + Group discussion + Demonstrations

Film show + Group discussion + Demonstration

Slide show + Group discussion + Demonstration

Post-inforcement to demonstration

Demonstration + Group discussion + Slide show

Demonstration + Slide show + Review meeting

h) At least two field trips, one in kharif and one in rabi and two demonstrations or a maximum of four field trips and four demonstrations be organised at the various stages per village on variety, fertilizer, water management and disease and pests control on the high yielding varieties of jowar.

i) Considering the sequential nature of adoption process, a campaign may be organised to motivate the farmers at each stage, well before the crop season by use of poster exhibitions, mobile vans, film shows, television programmes, success stories, mass meetings and radio announcements.

j) The Agricultural Universities and Information Unit of the Department of Agriculture should prepare

audio-visual materials for distribution through the existing infrastructure of the State Department of Agriculture.

k) The master training programme or trainers' training programme should place emphasise on philosophy of extension education, use of teaching aids and socio-psychological aspects of the clientele.

II. Training :

a) Farm Man :

Selection of farmers for training is very important. Only those who are actually engaged in jowar cultivation should be selected. The groups should be homogeneous in respect of age, special interest, and knowledge level. The progressive farmers who would act as trainers, should be given priority in training.

b) Farm women :

Involving farm women in agricultural development in general, and the training aspect in particular, is neglected since independence and also after the lauching of development programmes in 1952.

The largest number of working women are engaged in farming operations. According to the 1971 census,

28 per cent of the total number of women workers were engaged as cultivators and another 46 per cent as agricultural labourers. Hence, they formed 74 per cent of the total working population of women. These farm women should be trained in agricultural technology.

c) There should be follow-up programmes after training. It has been proved that arranging field trips is most beneficial to motivate the farmers and farm women to adopt new technology.

d) Visits of village level workers and progressive farmers to the Agricultural Universities and Research Centres and farms of the progressive farmers should be arranged.

e) Wide publicity should be given to the success stories of the farmers who adopt the package of practices.

f) Village level workers should be trained in performing and operating the practices which will increase the credibility of the grass root workers.

g) A feed back mechanism should be encouraged by providing incentives such as rewards and praise.

CHAPTER V

SUMMARY AND RECOMMENDATIONS

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Agriculture has always occupied a pride of place in our national economy. The significance of agriculture in our life and national economy is well borne out by the fact that it is by far the largest single industry in the country. Even in the present situation when the per hectare yields of almost all the crops in our country are probably the lowest in the world, it could not be overlooked that agriculture still contributes more than 50 per cent to our national income.

It is not that we lack in technical know-how in the field of agriculture. In fact, we have enough of it. But the fact remains even today, that when we have gone far ahead in agricultural research, the findings available are adopted by only a small section of our farmers. Majority of them still follow the traditional methods of farming which unfortunately leads to a tremendous gap in the utilisation of modern farm technology.

The first hybrid variety of jowar CSH-1 was introduced in 1965 for kharif season and subsequently in 1976 for the rabi the hybrid strains like CSH-7R, CSH-8R were released. Though a number of efforts were

made for the last one and half decades, the production of jowar has not yet stabilised. Surprisingly enough, the area under jowar is a little reduced during the last half decade.

Jowar is the number one crop in Maharashtra in terms of area, production and the number of people engaged in its cultivation. The productivity of jowar has remained static over the past one and half decade, in spite of various Government efforts.

Though there has been a satisfactory increase in the production of kharif jowar, there has not been any break through in the productivity of rabi jowar, which constitutes 52 per cent of the total jowar production of the State.

National Demonstrations have amply shown that an average of 3.5 tonnes (35 quintals) per hectare with high yielding or hybrid varieties could be obtained in the rabi season whereas the average yields obtained by the farmers has been worked out to be 0.48 tonnes (4.8 quintals) per hectare with the same varieties. This shows an yield gap of 7:1 tonnes per hectare (30 quintals) which is primarily due to a high technological gap existing in the various components of the high yielding jowar technology.

It was, therefore, conceptualised in this study that constraints of bio-physical and socio-psychological nature are responsible for the technological gap in adoption. The present study is an attempt to identify and analyse these factors and suggest a suitable jowar development strategy for the State. The specific objectives of the study were :

1) To study the system of jowar farming prevalent in Maharashtra.

2) To determine the extent of technological gap in relation to various components of recommended production technology.

3) To identify the factors responsible for the technological gap.

4) To study the differential characteristics of the technological gap categories.

5) To study the relationship and the relative contribution of techno-economic, socio-psychological, stimulus and communication variables towards technological gap.

6) To study the influence of technological gap over yield gap in cultivation of high yielding varieties of jowar in the rabi season.

7) To suggest, based on the findings, an appropriate jowar development strategy for Maharashtra to bridge the technological gap and in consequence reduce the yield gap.

On the basis of extensive review of literature, discussion with experts, and studies conducted by the All India Co-ordinated Research Project for Dry land Agriculture in the area of investigation, some important variables were selected and a conceptual frame work of the study was developed. The variables were classified into four groups, techno-economic socio-psychological, stimulus and communication variables.

The field investigation was carried out during 1980-81 in 12 randomly selected villages from four randomly selected tehsils of Solapur district. The sample consisted of 300 respondents of 25 cultivators of high yielding varieties of jowar was randomly selected from each village. Out of these, 290 were interviewed with the help of a structured schedule prepared for the investigation. The remaining ten respondents could not be contacted in spite of repeated visits.

The empirical measures were developed to quantify all the variables included in the conceptual frame work.

The technological gap which was the dependent variable of the study was measured by the Technological gap Index developed by Sadamate (1978). The area in hectares under cultivation was taken as a measure of farm size. Irrigation potentiality was measured by the fraction of the total area irrigated. For quantification of the variables like educational level of the farmers, and social participation, the scoring system as used by Trivedi (1963) in his socio-economic status scale was used. Care was taken, while developing the schedule, to record the perception of the farmers with regard to certain characteristics of the high yielding jowar technology such as profitability, physical compatibility, cost of innovation and simplicity-complexity etc.

The scale developed by Somasundaram (1976) was used to measure the farmers' perception of infrastructural efficiency. Knowledge of the farmers in cultivation of high yielding jowar was measured by means of knowledge test developed by Choubey(1972) with necessary modifications. Attitude of farmers towards high yielding varieties of jowar was measured by the test developed by Nair (1969) with necessary modifications. Risk-orientation was measured by the risk preference scale developed by Supe (1969) with certain modifications. For measuring use of information

sources and extension contacts a schedule was developed considering the nature and frequency of use.

The statistical tools used to test the hypotheses include 't' test, and zero-order correlation. The minimum level of probability fixed for the acceptance or rejection of the hypotheses was 0.05. The important findings of the study are summarised below.

5.1 EXTENT OF TECHNOLOGICAL GAP IN THE VARIOUS COMPONENTS OF THE HIGH YIELDING JOWAR TECHNOLOGY

a) When the technological gap in the individual component of high yielding jowar technology was studied, it was seen that the maximum gap was found in case of disease and pests management (72.15) which was followed by nutrient management (65.62) and water management (62.46); subsequently weed control, harvest and post-harvest technology, cultivation practices, care after germination and seed and seed treatment were in the order of rank.

b) When the total sample of 290 farmers was categorised on the basis of their over all technological gap, it was found that almost all, except one, respondent belonged to the moderate category.

c) About 56 per cent of the farmers belonged to the low technological gap category in case of seed and seed treatment. Seventy one per cent belonged to moderate gap (34-66 score) in case of care after germination, 66 per cent respondents to high gap category in nutrient management and 53 per cent in case of water management. Forty eight per cent of the farmers belonged to moderate gap category in cultivation practices and 54 per cent in case of weed control. A high percentage (71 per cent) of farmers were found in the high gap category in case of disease and pests management, while 76 per cent had moderate gap as regards harvest and post harvest technology.

d) The highest mean (23.56) technological gap was found in disease and pests management in high gap category and the highest mean (25.06) in moderate category was found in harvest and post harvest technology. The highest (18.62) mean in low gap category was found in seed and seed treatment.

5.2 CONSTRAINT ANALYSIS IN RELATION TO DIFFERENT COMPONENTS OF HIGH YIELDING JOWAR TECHNOLOGY IN RABI SEASON

A large number of constraints were found to be operating in creating an adoption gap which is ultimately responsible for the low yield in rabi jowar. The farmers

perceived the following constraints with regard to the technology of cultivation of high yielding varieties of rabi jowar.

a) Seed and seed treatment :

Non-availability of seed in time, expenditure on seed treatment is not commensurate with production and high cost of chemical (carbofuran) and lack of conviction were the major constraints reported by the respondents.

b) Care after germination :

Moisture was felt to be the limiting factor and hence no operation was undertaken by the farmer after sowing. There was lack of conviction about the utility of the practice and shortage of labour and expenditure reported to be non-remunerative. These were the major constraints in this area.

c) Nutrient management :

In case of nutrient management, fear of heavy losses in case of failure of rains, high prices of fertilizers and placement of fertilizers were perceived as complicated and returns were reported to be non-remunerative. In addition, shortage of capital was the major constraint perceived by the respondents.

d) Water management :

The constraints in water management and water conservation were perceived to be mulching was not economic and is a labour consuming process, weeding and crack filling is non-remunerative, and farmers' ignorance of moisture conservation methods and efficient use of water.

e) Cultivation practices :

Heavy investment in ploughing is not remunerative, lack of conviction and knowledge regarding preparation of seed bed and unsuitability of varieties for intercropping were the constraints expressed by the respondents.

f) Weed control :

The constraints reported were shortage of labour for hand weeding and returns were non-remunerative, lack of conviction, weeding disturbs the upper layer of soil and reduces the moisture and the high cost of chemical, weedicides.

g) Disease and pests management :

Lack of knowledge regarding appropriate use of pesticides, lack of technical help and high costs of insecticides were some of the constraints reported by the respondents.

h) Harvest and post-harvest technology :

Delay in harvest due to non-availability of labour, the produce was limited and consumed for household purposes, produce required to be sold out immediately after harvest and lack of knowledge of use of chemicals in storing, were the constraints reported.

II. Constraints pertaining to the institutional infrastructure

a) Credit :

Recovery procedure was stringent and recovery was demanded during the threshing period when the price of produce was the lowest, various fees were charged, cost involved in running several times to the credit agencies was high and complicated and hence, there was delay in getting credit were the constraints reported in getting credit for inputs.

b) Service and supply :

The constraints perceived by the respondents were the supply agencies were linked with the co-operative and government institutions and mainly dominant leaders were benefitted and others were deprived of the benefits, no agency to buy jowar produced from the growers at the Government fixed rate during harvesting season, hence the compulsion to sell

the produce at lower price, supplies were neither received in time nor were in adequate quantities in the market.

c) Information transfer :

The constraints as perceived by the respondents were, low intensity of contact, less interest and dedication for work on the part of extension workers, inadequate demonstrations and training programmes of improved techniques right in the villages, inadequacy of mass media use in disseminating agricultural information with the help of informal leaders in an understandable manner for an average rural person.

d) Organisation :

The organisational constraints brought out by the respondents were untimely and inadequate supply of inputs, working of the organisations were influenced by local leaders, lack of co-ordination among organisations involved in input and credit supply and maximum benefit of the organisation was taken by larger land holders.

5.3 DIFFERENTIAL CHARACTERISTICS OF LOW AND HIGH TECHNOLOGICAL GAP CATEGORIES :

To what extent the low and high technological gap categories differed was studied by applying 't'

statistics. In all 20 variables were studied to find out the differential characteristics of low and high technological gap categories. The three categories, low, moderate and high were grouped into two categories as low and high.

a) Techno-economic characteristics - situational factors :

Out of the three techno-economic factors, two variables viz., irrigation potential and agricultural material possession had shown significant difference between the low and high technological gap categories, while the variable farm size did not show any difference.

b) Socio-psychological characteristics :

i) A significant difference was observed between low and high technological gap categories with regard to age, educational status, social participation, knowledge about cultivation of high yielding varieties of jowar, attitude towards high yielding varieties of jowar and risk to adopt the technology.

ii) The variables, caste and family size did not differ significantly in the low and high technological gap categories. It means that the number of members in the family and the caste of the respondents did not have any influence over the adoption of high yielding varieties technology of jowar.

c) Stimulus variables :

i) A significant difference was observed between low and high technological gap categories with regard to their perception of profitability, physical compatibility and infrastructural efficiency.

ii) Cost of cultivation and simplicity-complexity variables were not perceived by the respondents in a differed manner. The cost and nature of technology (simplicity - complexity) had no influence on adoption.

Communication variables :

i) Out of the four communication variables studied, three were distinctly different from each other with regard to their communication behaviour in use of personal localite sources, mass media and extension contacts.

ii) The variable use of cosmopolite sources did not differ significantly in low and high technological gap categories. The cosmopolite sources of communication were used frequently and as such they may not have created a significant impact on the mind of the respondents.

5.4 RELATIONSHIP OF SELECTED TECHNO-ECONOMIC SOCIO-PSYCHOLOGICAL, STIMULUS AND COMMUNICATION VARIABLES WITH TECHNOLOGICAL GAP

Correlation co-efficient statistics were used to find out the relationship between the independent and the dependent variables. Out of the twenty variables studied, five variables viz., farm size, caste, family size, simplicity - complexity and use of personal cosmopolite sources were not statistically significantly related to the technological gap. The variables viz., irrigation potential, educational status, social participation, knowledge about high yielding varieties of jowar, attitude regarding high yielding varieties of jowar, profitability, infrastructural efficiency, use of personal localite sources, use of mass media sources and extension contacts were statistically significantly related to the technological gap of the farmers at 0.01 level of probability, while physical compatibility and perception of the cost of cultivation were related significantly at 0.05 level of probability.

b) Prediction of technological gap :

1) All the 15 independent variables which were significantly related to the technological gap of farmers, when taken together, explained 84.67 per cent variation of technological gap.

ii) The two techno-economic variables viz., irrigation potential and agricultural material possession explained 29.68 per cent of variation in the technological gap. However, irrigation potential contributed significantly.

iii) The six socio-psychological variables, viz., age, educational status, social participation, knowledge about cultivation of high yielding varieties of jowar, attitude towards high yielding varieties of jowar and risk-orientation when fitted in set III of the multiple regression, explained 70.66 per cent of variation in the technological gap of the farmers.

iv) The four stimulus variables viz., profitability, physical compatibility, cost of cultivation and infrastructural efficiency when fitted together in multiple regression analysis, explained 58.68 per cent of the variation in the technological gap of the farmers.

v) The three communication variables explained 52.65 per cent of the technological gap when they were fitted in multiple regression analysis set V.

The variables included in this set were personal localite use, mass media use of information and extension contacts.

5.5 REFLECTION OF TECHNOLOGICAL GAP OVER YIELD GAP

a) Eight independent variables which constituted the components of the high yielding jowar technology were tested with the zero-order correlation statistics to find out their relationship with the dependent variable, i.e. the yield gap. Seven variables viz., gap in seed and seed treatment, care after germination, nutrient management, water management, cultivation practices, weed control, disease and pests management were found to be significantly related to yield gap with the exception of harvest and post harvest technology which was not significantly related to the yield gap.

b) Out of eight variables, seven were significantly related to yield gap. These seven significantly related independent variables when fitted in multiple regression analysis, were found to contribute 80.22 per cent of the variability in yield gap. The rest (19.78 per cent) of the gap was due to ecological constraints.

c) The seven significantly related variables were further analysed by successively dropping independent variables from the multiple regression analysis in reverse order of their contribution in predicting yield gap. Their individual contribution

towards yield gap was calculated.

Gap in water management accounted for 20.34 per cent; gap in nutrient management accounted for 17.92 per cent and gap in disease and pests management accounted for 12.37 per cent. These three variables accounted for 50.63 per cent of technological gap. The remaining variables viz., gap in seed and seed treatment accounted for 11.68 per cent, gap in weed control accounted for 8.72 per cent, gap in cultivation 5.02 per cent. The least (4.17 per cent) technological gap was accounted for by gap in care after germination.

5.6 RECOMMENDATIONS OF THE STUDY

The findings of this study may be of practical utility to extension agencies and personnel, particularly for those working in the Training and Visit System, Drought Prone Area Programme, Integrated Rural Development and Lab to Land Programme, and the research workers engaged in jowar development programme in the country, in general, and Maharashtra, in particular.

a) The findings with regard to the technological gap indicated that nearly 60 to 75 per cent of the farmers were having technological gap between 66 to 99 per cent in the key components of the high yielding jowar technology such as disease and pests management,

nutrient management and water management etc. It is for the scientists to find out better, easier and cheaper methods for adoption of these components. The extension agencies should establish a rapport with the farmers and convince them the advantages of the key components through effective communication media to bridge the technological gap.

b) In this study a large number of constraints have been observed which are responsible for high technological gap in the adoption of high yielding rabi jowar technology. The constraints have been arranged in their order of importance. However, due order of priority in solving them may be attempted by the extension agencies.

c) The most pressing problem which needs immediate attention of the research scientists is evolving of high yielding varieties better than M-35-1, which could perform better under drought conditions and also a variety which would yield maximum under irrigation.

d) It is revealed that lack of knowledge of the package of practices of jowar technology is the major constraint observed. It is, therefore, necessary to organise mass education for judicious application and management of fertilizers, water, and disease and pests management to increase the yield of rabi jowar.

e) Besides the technological constraints, a number of socio-psychological, economic and communication constraints were found to be related to technological gap. These are irrigation potential, educational status, knowledge about cultivation of high yielding varieties, risk-orientation, infrastructural efficiency and mass media sources of information. These six variables together accounted for 79.67 per cent of the technological gap. The extension agencies may concentrate on these factors by way of better education, creation of efficient infrastructure for input supply and effective information transfer through various media.

f) The environmental constraints which have been brought out in this study are hardly controllable, and therefore, the study has an implication for the scientists to evolve a suitable technology that would rather be compatible with the environment.

5.7 SUGGESTED AREAS OF FUTURE RESEARCH :

a) One of the limitations of this study was that, only the rabi jowar cultivation was taken into account; therefore, a more comprehensive study could be taken up in future to compare the extent of technological gap and yield gap in kharif and rabi jowar cultivation.

b) The present study was conducted in a drought prone area of Maharashtra. Hence, its scope and content

should be widened to the different agricultural and climatic regions of Maharashtra State.

c) Revalidation of the findings may be undertaken in the similar agro-climatic conditions of Maharashtra State for establishing a sound jowar communication strategy.

5.8 IMPLICATIONS :

The findings of the study were analysed and the constraints in adoption of jowar technology were identified. The relative roles of ecological, techno-economic, socio-psychological and communication factors in causing a specific gap between actual and potential jowar yields were studied. With the knowledge about the constraints, it should be possible to initiate appropriate corrective steps to eliminate them.

Three major steps are involved in the transfer of new jowar technology. These are :

1) Availability of economically viable technology.

2) Organisation of extension and other services including supply of credit and other inputs, that will enable all the farmers irrespective of their

innate potential for mobilising inputs and their willingness to take risks to adopt new technology.

3) Public policies in the areas of pricing, storage, marketing and distribution.

The constraints identified for low yield of jowar, would be useful if seminars and workshops are organised for planners, field extension workers and input supply organisations and agencies to reveal to the participants the size of the yield gap and the nature of the constraints responsible for it. To undertake this task successfully, it is essential that social scientists and agricultural scientists work together as a team. At the field level, social and biological engineering will have to be integrated. Diffusion of rabi jowar technology and its adoption in the 87 tehsils of the drought prone area of Maharashtra will be possible, only if all the farmers in drought prone area co-operate with the agencies working for them. Integrated individual and community action will be necessary under conditions of dry farming area to obtain good yields and reduce the technological gap.

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APPENDIX

APPENDIX - I

Schedule

1. Name of the respondent :

2. Village :

3. Age :

4. Education :

5. Caste :

6. Number of members in the family : and information about them :

Sr. No.	Name of the family member	Age	Education	Occupation	Income in Rs.

7. Farm Size :

i) Land under irrigation -------- Ha

ii) Land without irrigation --------Ha

iii) Cultivable waste Land -------- Ha

iv) Waste land -------- Ha

v) Total land -------- Ha

8. Crops grown during the year 1981-82.

Sr. No.	Crop	Area	Season	Variety	Remarks
1.	Jowar (Other than HYV)				
2.	HYV Jowar				
3.	Bajra				
4.	Ground nut				
5.	Vegetables				
6.	Sugarcane				
7.	Any other				
	a)				
	b)				
	c)				
	d)				

9. Farm power and Agricultural implements possessed by the respondent :

Sr. No.	Items	No.	Sr. No.	Items	No.
1.	Seed drills		6.	Levellers	
	a) Improved		7.	Hand sprayers	
	1. Shivaji seed drill		8.	Power Sprayers	
	2. Two bowl. seed drill		9.	Dusters	
	3. Three couter seed drill		10.	Winnowing fan	
	b) Local seed drill		11.	Ploughs (Wooden) (iron)	
2.	Harrows		12.	Tractors	
3.	Hoes		13.	Oil Engine	
	1. improved with slit blade		14.	Electric motor	
	2. entire blade		15.	Threshing machines	
4.	Bullock cart		16.	Crushers	
5.	Mhot		17.	Any other (Please specify)	

10. Participation in social institutions and organisations

Sr. No.	Institution/ Organisation	Member	Office bears	Meetings conducted	Meeting attended	REMARKS
1.	Grampanchayat					
2.	Co-operative Society					
3.	Panchayat Samiti					
4.	Zilla Parishad					
5.	Marketing Committee					
6.	Legislative Council					
7.	Legislative Assembly					
8.	Any other (Please specify)					

11. Knowledge about cultivation of HYV jowar

Kindly furnish details about the practices recommended for cultivation of HYV rabi jowar as below :

a) What are the different varieties of HYV and hybrid jowar for kharif and rabi seasons recommended ?

Kharif season	Rabi season
i)	i)
ii)	ii)
iii)	iii)
iv)	iv)
v)	v)

b) What is the recommended seed rate per hectare of jowar ?

i) High yielding varieties

ii) Hybrid

c) Which are the chemicals that is used for the treatment of jowar seed before sowing ?

1) 2) 3)

d) What are the fertilizers applied to rabi jowar ?

1) 2) 3)

Please state the recommended doses of fertilizer/hectare

e) What are the diseases of jowar ?

i) upto the flowering stage ----

ii) After flowering stages ----

f) What are the major pests of jowar ?

i)

ii)

iii)

g) Which is the pest that causes the maximum damage to jowar ?

h) What are the fungicides and insecticides used to control pests and disease ?

i) Fungicide ii) Pesticide

i) What is the quantity of compost and fertilizers used in preparatory tillage ?

Compost	Nitrogen (N)	Phospharic acid (P)	Potash (K)

j) Can you tell the different methods of sowing ? If yes please indicate which ?

k) Do you irrigate jowar crop ? if yes, how many times ?

l) What are the critical stages of irrigating jowar crop ?

m) Do you use mulching for moisture conservation ? Yes No

n) Which is the pest that causes the maximum damage to jowar crop ?

o) What is the duration of jowar crop ?

p) What happens when the harvesting is delayed ?

q) How do you store the jowar grain produced ?

r) What are the chemicals used in storing the jowar grain produced ?

Attitude towards HYV jowar (Rabi)

People have different opinions about high yielding varieties of jowar. You too must have some opinion. Given below are some of statements which show the opinion. Kindly indicate whether you strongly agree, agree, undecided, disagree, strongly disagree with these statements.

Statements	SA	A	UD	DA	SAD
a) Cultivation of HYV jowar will solve the food problem of our State.					
b) Cultivation of HYV jowar is very complicated for an average farmer to practise					
c) High doses of fertilizers recommended for cultivation of HYV jowar will reduce the fertility and damage the structure of the soil.					
d) High yielding varieties are better than local varieties.					
e) It is not profitable to cultivate HYV of jowar.					
f) After the introduction of HYV jowar, there has been remarkable improvement in the economic condition of the farmers.					
g) If we want to produce enough jowar, the best way is to cultivate HYV jowar.					
h) HYV jowar should be intensively cultivated by all farmers.					
i) All types of farmers will be equally benefitted by HYV jowar cultivation.					
j) It is very easy to cultivate HYV jowar for an average farmer.					

14. Adoption of HYV jowar technology and constraints

Kindly give details with reference to your adoption of the following practices in respect of HYV jowar grown in the rabi season during 1981-82 and also state as to why you could not adopt the complete package of practices, if so :

Sr. No.	Items	Area	Extent of adoption		Technological constraints
			Extent %	from year	
A)	Seed and seed treatment				
	i) What variety of HYV jowar did you cultivate ?				
	1) M-35-1				
	2) SPV-86				
	3) CSH-8R				
	ii) What seed rate/ hectare you used ?				
	iii) Did you treat the seed with chemicals ? Yes/No if yes, please name the chemicals you used.				
	a) Sulpher				
	b) Corbofuran				
	iv) How did you treat the seed ?				
	i) By using drum ?				
	ii) By manipulating with hands ?				

Sr. No.	Items	Area	Extent of adoption		Technological constraints
			Extent %	from year	
	v) When did you sow the rabi jowar ?				
	i) 15th September				
	ii) After 15th September				
	vi) What was the distance you kept between the rows ?				
	(90 cm x 45 cm)				
	(45 cm x 30 cm)				
B)	Care after germination				
	1) What did you do when germination was not proper ?				
	a) Transplanted the seedlings ?				
	b) Sown the seed again ?				
	c) Sown the seed, which has high vegetative growth				
	2) How many days, after germination hoeing operation has done and by what method ?				
	i) With the help of bullock				
	ii) With the help of men				
	iii) How many times and after how many days weeding operation was done ?				

Sr. No.	Items	Area	Extent of adoption		Technological constraints
			Extent %	from year	
C)	**Nutrient management**				
	i) How much manures(FYM) and composite did you apply to the rabi jowar crop ?				
	ii) How much fertilizer/ hectare did you apply				
	a) N				
	b) P				
	c) K				
	iii) When did you apply the fertilizers ?				
	a) Before sowing				
	b) At the time of sowing				
	iv) Did you use bacterial fertiliser ? If yes, state the name				
	Water management				
	i) How many times did you irrigate the jowar crop ?				
	ii) What did you do for conservation of soil moisture ?				
	i) Mulching ?				
	ii) Weeding ?				
	iii) Crack filling ?				
	iv) Do you have farm ponds/wells				

Sr. No.	Items	Area	Extent of adoption		Technological constraints
			Extent %	from year	
	v) Do you have facilities like to farm ponds/bunds to give protective irrigation. If yes how much do you irrigate ?				
	Cultivation practices				
	1) After how many years do you plough the land				
	1) Every year ?				
	2) After every two years ?				
	3) After every three years ?				
	ii) What crop rotation did you follow ?				
	Weed Control				
	How did you control the weeds ?				
	1) Used entire blade hoe ?				
	a) How many times did you hoe the crop ?				
	2) By weeding ?				
	a) How many weedings were done ?				
	3) By using weedicides ?				
	Which were the weedicides you used ?				

Sr. No.	Items	Area	Extent of adoption		Technological constraints
			Extent %	from year	
	Disease and pest management				
	1) What were the diseases you observed on HYV ?				
	rabi jowar				
	i) Smut				
	ii) Charcoal rot				
	2) What were the pesticides you used ?				
	i) BHC				
	ii) Endosalfon				
	iii) Carbaryl				
	iv) Sulphur				
	ii) How many times did you use them ?				
B)	What are the pests you observed on rabi jowar ?				
	Midge fly				
	Aphid				
	Shoot fly				
	Harvest and post harvest				
	When did you harvest your crop ?				
	1. In time				
	2. Early				
	3. Late				
	If the crop is harvested late, what is the percentage of loss ?				

Sr. No.	Items	Area	Extent of adoption		Technological constraints
			Extent %	from year	
	How did you thresh the crop ?				
	1. By bullock power ?				
	2. By man power ?				
	3. Mechanical power ?				
	How did you clean the produce ?				
	1. Winowed				
	2. Used winowing fan				
	3. Used threshing machine				
	How did you store the produce ?				
	1. By local method ?				
	2. Tin containers/Barrels?				
	3. Gunny bags ?				
	4. In store house ?				

15. Risk orientation

Please state whether you agree, disagree or are undecided about each of the following statements.

Sr. No.	Statement	SA	A	UD	DA	SDA
a.	A farmer should grow a larger number of crops to avoid greater risks involved in growing one or two crops					
b.	A farmer should take more of a chance in making a big profit than to be content with a smaller but less risky profit.					
c.	A farmer who is willing to take greater risk than the average farmer usually does better financially					
d.	It is good for a farmer to take risk when he knows his chance of success is fairly high.					
e.	It is better for a farmer not to try new farming methods unless most others in the locality have used it with success.					
f.	Trying entirely a new method in farming by a farmer involves risk but it is worth.					

16. Perception of the attributes of HYV rabi jowar technology

By profitability we mean the additional gain in terms of yield and/or money which one gets by using the recommended practice over local one in 20 are of land. Considering, from this point of view, to what extent you consider the following practices are profitable in your farming situation ?

Sr. No.		Most profitable	Profitable	Some what profitable	Least profitable	Not profitable
1.	Use of HYV jowar seed					
2.	Seed treatment					
3.	Use of improved method of sowing					
4.	Recommended doses and method of manuring					
5.	Recommended spacing between the rows					
6.	Recommended number of hoeings					
7.	Recommended water management practices					
8.	Recommended plant protection measures					
9.	Recommended water moisture conservation measures					
10.	Recommended grain storing practices					

B) Physical compatibility

Keeping in view the farming resources available at your disposal such as the type of soil, human and bullock labour, source of irrigation, existing cropping pattern etc. to what extent do you consider the following practices are compatible to your situation ?

Sr. No.	Practice	Most compatible	Compatible	Some what compatible	Least compatible	Not compatible
1.	Use of HYV jowar seed					
2.	Seed treatment					
3.	Use of improved method of sowing					
4.	Recommended doses and method of manuring					
5.	Recommended spacing between the rows					
6.	Recommended number of hoeing					
7.	Recommended water management practices					
8.	Recommended plant protection measures					
9.	Recommended water/ moisture conservation measures					
10.	Recommended grain storing practices					

C) Cost of Innovation (Capital)

By cost we mean the initial purchase or other expenditure involved to put innovation into operation. What do you think about the following practices in this respect ? Please give your opinion on each practice against appropriate column.

Sr. No.	Practice	Very low cost	Low cost	Neither low nor high	High cost	Very high cost
1.	Use of HYV jowar seed					
2.	Seed treatment					
3.	Use of improved method of sowing					
4.	Recommended doses and methods of manuring					
5.	Recommended spacing between rows					
6.	Recommended number of hoeings					
7.	Recommended water management practices					
8.	Recommended plant protection measures					
9.	Recommended water/ moisture conservation measures					
10.	Recommended grain storing practices					

D) Simplicity-complexity

A number of practices are recommended to grow HYV jowar. Some of them may be easy to use, but others may be difficult. Taking this into consideration please give your opinion about each of the following practices regarding the extent to which they can be practiced with ease or with difficulty.

Sr. No.	Practice	Very easy to use	Easy to use	Neither easy nor difficult to use	Difficult to use	Very difficult to use
1.	Use of HYV jowar seed					
2.	Seed treatment					
3.	Use of improved method of sowing					
4.	Recommended doses and methods of manuring					
5.	Recommended spacing between rows					
6.	Recommended number of hoeings					
7.	Recommended water management practices					
8.	Recommended plant protection measures					
9.	Recommended water/ moisture conservation measures					
10.	Recommended grain storing practices					

Information source use

Please indicate from which of the following sources did you obtain technical information about the cultivation of HYV jowar and how often ?

Sr. No.	Source	Most often	Often	Some times	Never
a)	Mass media sources				
	1. News paper (News items)				
	2. Radio				
	3. Printed publications				
	4. Films				
	5. Posters				
	6. Demonstrations				
	7. Farm magazine				
	8. Television				
	9. Leaflets				
	10. News paper articles or features				
b)	Interpersonal cosmopolite sources				
	1. Field Demonstrations				
	2. Gram sevaks				
	3. Agricultural Assistan--ts.				
	4. Agricultural Officers				
	5. Block Development Officers				
	6. Co-operative Officers				
	7. Agricultural University personnel				

Sr. No.	Source	Most often	Often	Some time	Never
c)	Interpersonnel localite sources				
	1. Neighboures				
	2. Agricultural shows				
	3. Private agencies				
	4. Agents of private insecticide / pesticide companies				
	5. Sarpanch				
	6. Member of Panchayat				
	7. Progressive farmers				
	8. Members of welfare organisation				
	9. Visit to urban areas				

Infrastructure

Please indicate which of the production inputs you needed for your farm, last year (1980-81) in connection with cultivation of HYV rabi jowar and which source you get them from :

Sr.No.	Particulars		Source	Remarks
1.	Finance	a)		
		b)		
		c)		
2.	Seed	a)		
		b)		
		c)		
3.	Fertilizer	a)		
		b)		
		c)		

Sr.No.	Particulars		Source	Remarks
4.	Plant protection measures	a)		
		b)		
		c)		

a) If you have used the co-operatives, banks, block organisation, village money lenders or University organisations for crop loan, fertilizers, seed and plant protection chemicals etc. Please give your frank opinion on the following aspects of the organisation meant for infrastructural support (how complicated or easy is the procedure). Please also mention the constraints in getting these inputs.

Sr. No.	Items	Very compli-cated	Compli-cated	Some what compli-cated	Simple	Very sim-ple	Con-stra-ints
1.	Crop loan						
2.	Seed						
3.	Fertilisers						
4.	Plant protection chemicals						
5.	Marketing						

b) What do you think about the incentives given for the following ? (The incentives for crop loan is the low rate of interest charged, while incentives for the remaining may be subsidies or (varying from 25% to 50%) remunerative price etc.

Sr. No.	Items	Very high	High	Moderate	Low	Very low	Constraints
1.	Crop loan						
2.	Seed						
3.	Fertilizers						
4.	Plant protection chemicals						
5.	Marketing						

c) How far are the organisations dealing in the following inputs situated from your place of residence ?

Sr. No.	Institutions dealing with	Distance in km.	Degree of distance		
			Very near	Near	Distant
1.	Crop loan				
2.	Seed				
3.	Fertilizers				
4.	Plant protection chemicals				
5.	Marketing				

d) Do you think that the following inputs are adequate to meet your needs ?

Sr. No.	Items	Very adequate	Adequate	Inadequate	Remarks
1.	Crop loan				
2.	Seed				
3.	Fertilisers				
4.	Plant protection chemicals				
5.	Marketing				

e) When did you get the following inputs ?

Sr. No.	Items	Well before season	During season	After season	Don't get at all
1.	Crop loan				
2.	Seeds				
3.	Fertilizers				
4.	Plant protection chemicals				
5.	Marketing				

f) Do you think that you are fairly treated by the persons in charge of organisations during your visit to the organisation for getting inputs or selling agricultural commodities.

Sr. No.	Items	Very fair	Fair	Bad	Very bad	Remarks
1.	Crop loan					
2.	Seeds					
3.	Fertilizers					
4.	Plant protection measures					
5.	Marketing					

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