CHAPTER 1

INTRODUCTION
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The term innovation usually is meant to refer to something new in technology, method, idea or invention. Innovation is change over of new ideas, objects or practices from existing one by or constituents of social system. Innovation may show either slight modification significant replacement of ideas in vague. The 'idea' is the central element of an innovation, either in material form or behavioural form. For ideal result the innovation should be adopted both in terms of idea and form i.e., material or behavioural which ultimately felt by attaining intended consequences of an innovation.

Innovation refers to some new idea, method, or technology, and its diffusion means not only the spreading of the information over the entire area but also the adoption of the innovation. Nevertheless, the process of the spread of information is vital to the process of adoption, thus the entire diffusion process itself. The diffusion is the process in the course of which an innovation is adopted by those who had not adopted it earlier. In other words, diffusion is the process by which an innovation spreads within a social system. Innovation diffuses within a social system at group level and to individuals through its "adoption". Diffusion and adoption are complement to each other, thus they are closely interrelated Inspite of being distinct conceptually.

In agriculture the term "innovation" manifests a material form which include improved implements, high-yielding and disease-resistant seeds, chemical fertilizers and plant protection chemicals such as pesticides, fungicides, and herbicides.

Diffusion of Agricultural Innovations refers to the spread and implementation of new and improved agricultural practices over the existing one by the farmers in terms of use of HYV, pesticides,
fungicides, herbicides, mechanisation agricultural farming etc. The reflection of some innovation may be seen in behavioural form e.g., improved cultural practices. In other words we can say that diffusion of agricultural innovations means spread of adoption of improved agricultural practices.

Innovations do vary in their diffusion rate; some diffuses at higher rate, while others at slight rate. An innovation which show only a slight modification of an existing idea or practice will obviously diffuse at a faster rate than the one which represents a significant modification over existing one. It is due to the fact that, in slight modification the society need not worry about the changing of whole existing setup or the major part of it. In case of significant modification there are problems for society to adopt new practices in which major part of existing practices is to be reinstalled.

Some of the important traits of an innovation, which influence its rate of adoption, are: utility, compatibility, complexity, communicability and divisibility.

Utility of an innovation refers to the degree to which it is perceived as useful and advantageous by farmers. Compatibility is the degree to which an innovation is perceived to be in conformity with the ideas, values and practices of a social system. Complexity refers to the relative difficulty to understand the nature and use of an innovation. Communicability is the degree to which the use and result of an innovation can be observed communicated to others. Divisibility refers to the degree to which an innovation can be tried out in a small scale before making the decision to adopt it.

Most of these traits are a matter of perception to farmers rather than being inherent qualities of an innovation. Although the communicability or divisibility appears to be an inherent trait of an innovation, the utility, compatibility or complexity of an innovation
depends on the of perception by farmers. The perceived qualities of
an innovation vary for individual farmers and social systems.

Diffusion of agricultural innovations has a very strong
bearing upon the agricultural efficiency and productivity in any
region or area. Diffusion of agricultural innovations vary from one
social system to another and also within the social system itself
because of the way in which it is perceived is more important. At
present all new ideas, practices and technology are geared to the
improvement in agricultural efficiency (which is directly
proportional to diffusion of innovation) more so in less developed
countries of the world such as India. It has been proved beyond
doubt by now that the technology of even the late 19th century
would not have been able to provide sustenance to the present large
population of the world. There have been a number of innovations,
which have brought about revolutionary changes in the agricultural
productivity and efficiency all over the world. In this connection we
can cite the example of India, where the diffusion has been rather
slow, but at numerous instances, it has shown positive results.

Taking the case of mechanisation of farming operations, a
tractor makes possible cultivation of wide spread areas more
effectively in a much shorter period. In India major part of
cultivable land left fallow in the form of culturable waste because
of in efficiency of animal driven plough, however with the
introduction of tractor, it has been brought under cultivation. Use of
machinery for sowing, irrigation, harvesting, and separating grain
from husk, has made commerce to the cropping of cereals like
wheat. Use of power (mechanical or electrical) has made irrigation
possible in many unirrigated areas.

More or equally important has been the result of diffusion of
practices of using HYV, chemical fertilizers. This has been a major
factor in solving India's food problem to a greater extent. Many new varieties are better suited to the environmental conditions in various regions. Being adverse environmental suited varieties, the chances of its failures is reduced significantly. Chemical fertilizers have proven a boon, as our agriculture suffered a lot due to exhaustion of fertility under repeated and long continuous use. Fertilizers and irrigation facilities have made possible the practices of double and sometimes even multiple cropping in the areas where even a single crop would be at the mercy of weather elements. ^

Practices like contour bunding have made cultivation possible on slope. Innovations in the field of agricultural infra-structure have gone a long way in ensuring returns to the farmers and now a days there are arrangements for timely lifting of perishable commodities. ^

Thus a lot of loss, which used to be there as a result of non-lifting of products in time, has been made available due to diffusion of agricultural innovations. We thus, can say that diffusion of innovation has a direct positive bearing upon agricultural efficiency. As regards our own country, a lot has been done and we are reaping the benefits in the form of better efficiency and consequently increased production. However, Indian farmers are still very much tradition bound and need a lot of effort encouraging and coaxing them to adopt the new, may be equipment, a farming technique, a new seed or a new chemical fertilizer. ^

It takes time for an innovation to diffuse throughout a social system because all farmers in a community never adopt an innovation just after its introduction. There is always a variation among the members of a social system in the way they respond to an innovation i.e., idea or practice due to variation in nature and behaviour of different members within the society and among the societies. ^
(The concept of diffusion of innovation forms an important aspect in geography, which is a model of time-space relationship. Not only Geographers are involved but sociologists, psychologists and economists are also paying much attention towards diffusion studies because it is having inter-disciplinary approach. The term “diffusion” generally refers to dispersion, spreading out or intermingling whereas scientifically it has more precise meaning (Hagget 1975). Diffusion of innovation is not a quick process, it has two important elements the time and the space. The spatial diffusion help in innovation, emigration, alteration, change or spread of ideas occurring in human society. The transfer may be economic, social or psychological. The diffusion also implies the spatial redistribution of some components or activities, more often than not, emanating from one or more centres. There may also be some population growth in addition (Wilson and Kirkby, 1975).

Development is an innovative process leading to the structural transformation of social system (Friedmann, 1969), however, development is a state of mind which emphasize an individual to use natural resources for the benefit of the society (Misra, 1985). Innovation according to Friedmann (1969) is the successful introduction of ideas perceived as new, into a given social system. The diffusion of innovation involves directly the acceptance over time of some specific idea or practice by individuals, groups or other adopting units (Berry, 1972).

The diffusion studies in the very beginning were conducted by anthropologists, however, both sociologists and anthropologists have been interested for a long time. The later part of 19th century witnessed the establishment of the “diffusionist school” of thought in anthropology, opposing the “evolutionists” argument that each culture grew independently of others following identical evolutionary stages. The evolutionists were believers of “psychic
unity" of man contributed to this process of evolution of each culture followed by number of stages through independent inventions, discoveries of ideas, materials, and practices. 'diffusionists' countered the argument by stating that man was too uninventive to come up with same ideas and practices repeatedly. They were opined that once an idea or practice invented in one culture, it spread from there to other cultures. Most of the innovations both in ideas and practices of culture are borrowed from other cultures rather than being invented by itself. Various diffusionists considered in different meanings, British diffusionists in early 20th century argued that most of the constituents of human civilizations were first invented in Egypt and later on diffused to other parts of the world. While German diffusionists stressed to the fact that all cultural elements of human society were not invented in only one part of world, but in different parts of world in different stages. German diffusionist its seem to be more systematic and objective than their British counterpart, but they could not provide empirical evidence to prove the given fact. The diffusionist view point of cultural development was rejected by latter day anthropologists but notion 'diffusion' continued to play an important role in anthropological theories of social and cultural change.

Anthropologists study both the inter-societal diffusion of cultural traits and complexes and process by which such traits and complexes diffuse within a social system. Ralph Linton, for example, observed that new items, cultural or material, are adopted on the basis of evaluation of their three characteristics; (i) utility, (ii) compatibility and (iii) prestige. Utility determines rate of diffusion. The next to which an idea or practice is simply a modification of existing one or totally foreign to the knowledge and experience of the adopter will also determine whether or not it will
be accepted. An idea or practice is also sometimes accepted and adopted because it enhances the status of the adopter within his social system.

Barnet identified eight traits, which influence the acceptance of a novelty within a social system: compatibility, efficiency, advantage, prestige, pleasure, wastery, penalty and cost.

Till 1950s diffusion studies could not get serious attention from Sociologists, Albeit Gabriel Trade and F. Stuart Chapin were first to show that the adoption of a new idea within a social system follows an S-shaped growth curve and a number of other scholars attempted to trace the diffusion of single innovation like postage stamps, city manager plan government, and political attitudes, over a geographic area in the late 1920s and 1930s by using the secondary sources of data. Their interest in such case was to observe the "change within social system as well as to different social systems" in the adoption process by which an "individual decides to adopt or reject" or upon the process by which "an individual decides to adopt".

In the last four decades principal research activities of rural sociologists have been 'diffusion studies'. Rural sociology is said to be produced largest number of diffusion studies and is continued to contribute to diffusion studies. In 1920s U.S. Department of Agriculture decided to evaluate the process of their programme of improved farming practices among farmers i.e., diffusion of agricultural innovations. Bryce Ryan and Neal Gross were the first scientists to get the greatest attention from social scientists regarding their research on the diffusion of hybrid seed corn in two Iowa communities. The findings of this study showed for the first time that adoption of innovations by farmers involved a combination of several processes. The process of individual
decision making by a farmer to adopt or reject a practice, and of
diffusion of an innovation over time through a social system are
closely interrelated. Since 1950s most of the diffusion studies have
been inspired by the study of Ryan and Gross. The number of rural
sociological researches on diffusion of innovation grew rapidly in
U.S. during 1950s and 1960s, which pave the way for other similar
studies in USA.

A review of 468 studies on the diffusion of agricultural
conducted until 1967 have shown that the majority of these studies
were conducted in North America, especially in United States,
followed by Europe and Asia. Of the 46 studies conducted in Asia
until 1967, almost 70 percent were made in India.

Early 1960s witnessed the appearance of diffusion studies in
India for the first time. Most of these studies were conducted either
by rural sociologists or specialists in agricultural extension, many
of whom received their training in the U.S. Their studies dealt
primarily with the diffusion of innovations and adoption of
agricultural innovations. With humble beginning in the early 1960s,
the diffusion studies grew rapidly between 1965 and 1974. There
was however, a significant decline in the number of such studies in
between 1975 and 1979, and they came down almost to a trickle in
1985 to 1990.

The diffusion studies in India have been mostly in
agricultural colleges and universities, state departments of
agriculture, and research institutes. The findings of these studies
are expected to assist extension agencies in encouraging farmers to
adopt improved farming practices.

Another interesting feature of tradition of diffusion research
in India is that a great majority of diffusion studies have been
conducted by agricultural extension educationists rather than by
rural sociologists. Indeed, most ‘rural sociologists’ in India are principally extension educationists with some background in sociology or rural sociology. The traditions of rural sociology and agricultural extension education are intimately related in India that it is often difficult to distinguish one from the other. Indeed, the Indian Journal of Extension Education is the single most important outlet for the publication of articles on research on diffusion of agricultural innovations in India.

Torsten Hagerstrand (1952) was the first to demonstrate the idea of diffusion of agricultural innovations. He figured six components in the process of diffusion i.e., (i) area, (ii) time, (iii) item, (iv) origin, (v) destination and (vi) path.

Area according to him, the environment or space in which the process takes place may be uniform or highly marked off. Time is expositive of the stages by which innovation proceeds. Item is the component to be dispersed. Other three components are absolutely spatial elements. Origin refers to the source from where innovations begin and destinations are the points, which are the recipients in the process. Eventually, path is the footmark or route followed in the diffusion process. Hence, the path is of great value which apprises the diffusion waves.

An assured innovation can have more acknowledgements from human being in the comparison of others. So, the process of acceptors depends upon the significance of an innovation. They may be marked out five vital components of communication (i) information source, (ii) transmitter, (iii) channel, (iv) receiver and (v) destination (Shanon and Weaver, 1949).

Any institution or agent may act as information source. Transmitter is the one who transmits the message to the receiver. It should be efficient enough so that the message does not vary in its
vital components, design and thoughts. Channel is the medium used to transmit a message to the receiver whereas the receiver is the individual who attains delivery of the message or concept of innovation and works as mediator. At times, transmitter acts as a receiver also. Destination means the individual or clusters in an area who accept a special innovation.

Another important element related to diffusion of innovation is social system, as the process of adoption depends much on social system prevailing in a society. In a conservative and accustomed society, innovation takes place gradually, while in an advanced society, which has fair amount of literate, and economically sound population, the faster will be the rate of diffusion of innovations as compared to other.

The two significant elements of spatial systems are physical distance and functional distance. It is perceived that interaction among individuals as well as the diffusion of innovation are spatially hampered. Hence, the presumption: contact or diffusion goes on decreasing with increasing distances. True, the information extends out from originating source in such a way that the adoption of item of information is more likely to occur in the immediate vicinity as compared to others having the same information at a distance (Lloyd and Dicken, 1972).\(^\text{12}\)

The time is also a significant element concerning the process of innovation. Researchers have observed that in an initial stage there are only few adopters and their number goes on argumenting through time. It, however, decreases after achieving a level of saturation, the innovation or information so assumes spatial logistic curve. Contextually, Hagerstrand(1952) has diagnosed three classes of the population i.e., (i) non knowers, (ii) knowers but not adopters and (iii) adopters with respect to an item of information.
Resistance acts as a significant agent of checking the adoption. A few variables which effect resistance are age, social status, financial position, mental ability or cosmopolitan attitude and group norms (Brown 1968)\(^\text{13}\) Figure. 1.1.

Map showing diffusion of innovation marked with two kinds of locational patterns (Cox 1972)\(^\text{14}\). These are spatial trend and inversion. The dates of innovation on the one hand develop with distance from some site or sites and on the other, these do not develop with distance from site or sites at a point or line. Very absolute differentiation is there, between the two, because in most cases spatial diffusion maps explain links with the elements. Similarly, a composite or ambiguous pattern on maps appears to be confusing and ill defined. Thus necessitates filters to break off signals from noise (Gould, 1969)\(^\text{15}\). Diffusion may be of mononuclear or polynuclear type depending whether the originating source diffusion is single or multiple.

Hagerstrand (1952) Figure 1.2 derived a four-stage model to explain the passage of what he named innovation waves more popularly called diffusion waves. From maps of the diffusion of several innovation ranging from bus routes to agricultural techniques in Sweden he drew a series of cross-sections to present the wave profile at different points of time \((t_1, t_2, t_3, \ldots, t_n)\). He identified diffusion profiles characterised with four stages in the course of an innovation through an area;

A. **The Primary Stage:** This stage marks the beginning of the diffusion process, which is apparent by the system of the centres of the adoption.

B. **The Diffusion Stage:** It signals the start of the actual spread process in which diffusion being transmitted and a network of centres of innovation being raised up even in the remote areas.
Expansion Diffusion (Adapted from Brown, 1968)

**Fig. 1.1**
HIERARCHIC DIFFUSION

(A) HYPOTHETICAL PROFILES FOR DIFFUSION WAVES

(B) RAPID DOWNWARD SPREAD FROM MIDDLE LEVEL

(C) SLOW UPWARD SPREAD TO UPPER LEVEL

(D) RAPID DOWNWARD SPREAD FROM UPPER LEVEL

Source: After P. Hagget

DIFFUSION WAVES IN TIME & SPACE

Source: After R. L. Morrill

Fig. 1.2
C. The Condensing Stage: In this stage the relative increase in the numbers of accepting an item is equal in all locations, regardless of their distance from the original innovation centre.

D. The Saturation Stage: The final (saturation) stage is marked by slowing and eventual cessation of the diffusion process, which produces a further flattening of the acceptance curve. In this final stage, the item being diffused is accepted throughout the region or country so that there is very little regional variation (Cliff and Hagget, 1981).

The shape of diffusion is said to presumed wave like from when drawn through time and space. The transforming character of innovation waves is simply remarkable with distance from the time and point of origin. The slow weakening of waves counts on both space and time. The process of adoption of an innovation is not free from harshness. There are several kinds of adopters of innovations, e.g., early adopters, early majority, late majority and laggards. This concept originates from the fact that for any innovation there will be a few pioneers, a large number of early adopters and then the bulk of population leaving only a small number of laggards who will adopt much latter. This is because of different levels of resistance exercised by population while adopting an innovation. Hagerstrand (1968) has observed that if population of adopters is accumulated and mapped through time the curve will be logistic or S-shaped Figure 1.3.

Curve shows the slow taking-off stage of varying length, an intermediate stage of more rapid development and a final stage of declining growth, which asymptotically seems to approach a ceiling.
Innovators
Early
Majority
Late
Majority
Laggards

TIME

DISTRIBUTION OF INNOVATION ACCEPTORS

Innovators Early Late Laggards
Majority Majority

The Logistic Curve of Innovation Adoption

Upper limit

Rate of rising and falling determined by (b)

Height of O determined by (a)

Time Periods (T)

Curves of Innovation Adoption Controlled by Different Parameters

Fig. 1.3
**Work Review Done So Far**

Thompson (1926) analysed the relative productivity of British and Danish farming and expressed it in terms of gross output of crops and livestock. Ganguly (1938) for computing productivity in agriculture of the Ganga valley presented a theoretical discussion. Kendall (1939) expressed the productivity measurement as a mathematical problem and initiated a system of farm coefficients of productivity, ranking, money value and starch equivalent or energy. Hirsch (1943) used 'Crop Yield Index' to measure productivity. Ryan Bryce (1948) analysed the diffusion of hybrid seed cord as technological development in terms of time sequence in cultural change. Hagerstrand (1952) explained the idea of diffusion of innovation in agriculture by enlisting six components in this process (i) area, (ii) time, (iii) item, (iv) origin, (v) destination and (vi) path. Bennet (1953) examined the speedy development of agricultural innovations by considering the socio-economic conditions of the farmers. Thirumalai (1954) pointed out the ways to gain immediate and in long term with the use of modern techniques and implements further he discussed the problems in agricultural development in India. Lindstrom (1958) emphasised the rapid diffusion of innovation like Japan and Netherland without neglecting the will of farmers. Stamp (1958) applied calorific value of farm production in measuring the agricultural productivity. Ramsey et al. (1959) examined the problems that arise during acceptance of new innovation and its diffusion. Shafi (1960) used Kendall's "ranking coefficient" in calculating the agricultural efficiency in Uttar Pradesh. Bose (1961) explained the characteristics of farmers who adopt the improved practices earlier. Commen (1962) measured the productivity on the basis of yield per acre while working out the
trends of agricultural productivity in Kerala. Fliegel (1962) examined the relationship between traditionalism and technical change among the farmers’ families. Mechenzie (1962) evaluated the agricultural production in Canada by using the coefficient of output relative to input. Dasgupta (1963) explained three types of adopters of innovation, viz., innovators, early adopters and late adopters with certain variables. Bose (1964) examined whether the adoption of innovation follows any definite pattern. Chatterji and Maitreya (1964) expressed the levels of agricultural development and productivity during given point of time in West Bengal. Garg (1964) explained the trends in agricultural development with respect to total cropped area, gross cropped area and food grain production in the different districts of Uttar Pradesh. Singh and Misra (1964) suggested certain changes for increasing the area under cultivation including current fallow by more than eight percent. Bose and Saxena (1965) examined the impact of socio-economic factors on diffusion of innovations. Khusro (1965) correlated assessment of productivity with the output unit of a single input and output per unit of cost of all inputs in the agricultural production. Bose and Saxena (1966) explained that the larger livestock, higher education and greater participation in community activities tended to promote adoption of innovations in agriculture. Desai and Misra (1966) analysed the causes of growth in food production to make almost self sufficient in food grain and concluded that technological advancement and adoption of innovations are the main causes. Oammen (1966) discussed the term technological change means all kinds of innovations and inventions, which are aimed at increasing the efficiency of agricultural productivity. Jain (1966) emphasised that mechanisation is highly responsible for raising the agricultural productivity. Panse and Singh (1966) analysed that the
technological change is one of the critical factors in the development of Indian agriculture, which consists of adoption of farming techniques. Savale* (1966) expressed the diffusion of innovation as a process in the course of which those who have not adopted it earlier adopt an innovation. Frank* (1967) explained that there is no association between adoption and new farm practices and net farm practices. Misra* (1968) emphasised that there is an overwhelming need of innovation, diffusion and adoption of improved ideas and practices in almost all the fields of human activity for agricultural development. Kanwar* (1969) explained that for a minimum output from land it is necessary to bring more land under irrigation, fertilizers, high yielding varieties and better agronomic technology. Kumaraswamy* (1969) discussed the importance of cooperation in the development of agriculture providing loans and other important inputs.

Bardhan* (1970) concluded on intensive study of the effects of the green revolution on agricultural labourers. Chaudhari* (1970) examined that farmers, in order to produce more, need to spend more on improved inputs, which must be financed without saving, or borrowing. Nath* (1970) suggested that the development of cooperatives and expansion of infrastructure would help in the development of Indian agriculture. Jain* (1970) analysed that agriculture is now paying well on account of the availability of a wide array of HYV and hybrid seeds. Hayami and Ruttan* (1970) explained technological change as "any change in production coefficient resulting from purposeful resource. Using activity directed to the development to new knowledge embodied in design, materials or organisation. Shafi* (1972) used formula for both to determine the productivity of a particular crop with reference to yield per hectare and the area of that crop in the district in relation to the national level. Sachchidananda* (1972) examined several
objectives for the survey; (i) to identify the social correlates of adoption in improved agricultural practices, (ii) to categorise the adopters into first adopters, early adopters, later adopters and laggards, (iii) to identify the barriers to adoption and (iv) to discover the important elements of communication for the agricultural innovations. Parthasarthy and Prasad\(^5\) (1974) explained that it is the larger farmers who make up the largest component of those adopting the new technology. Mohammad\(^5\) (1974) emphasised that the non linear regression to forms of exponential are used and tested. They are Second Degree Curve and Logistic Curve. A straight line indicates a constant amount of increase or decrease, a Second Degree Curve involves increasing or decreasing amount of increase and decrease.

Bhati\(^6\) (1975) concluded that those farmers who continue using green revolution technology usually operate farms, which are on an average larger than whose operators do not adopt the techniques. Hagerstrand\(^6\) (1975) explained the concept of diffusion as an inimitable model of time-space relationship, which forms an important aspect in geography. Mohammad\(^6\) (1976) pointed out that, for increasing production and bringing about a remarkable result immediately after the introduction of an innovation. Sharma\(^6\) (1976) expressed that the development of agriculture should be assessed not only by productivity levels but also with reference to input such as improved varieties of seeds and irrigation. Bhalla\(^6\) (1977) examined that the variation in the agricultural productivity is important mainly by the nature of various inputs of technology. Roy\(^6\) (1979) emphasised that the irrigation development and improved water management are crucial to agricultural development of India. Arora and Sharma\(^6\) (1981) suggested to increase area under pulses or other non-fertilizer using crops, where as HYV of wheat and paddy may be raised under irrigated conditions. Shafi\(^6\)
(1981) pointed out that the irrigation is indeed the surest way in which agricultural production could be increased. Shafi (1981) pointed out that agricultural development depends on a larger extent to the level of technology and the system of farming. Mohammad (1981) emphasised that the use of modern technology for bringing about a change in agricultural output. Mohammad (1981) examined that India can increase its agricultural production to a larger extent, if adequate and assured irrigation facilities are made available. Sharma (1984) suggested that all agricultural productive activities require for their sustenance to some degree of credit. Singh (1984) emphasised that the use of irrigation, HYV and fertilizers can not increase agricultural productivity unless the farmers are educated for the judicious use of the implements. Quizon (1985) examined the role of fertilizer in the development of agriculture. Arshad (1986) explained that the introduction of HYV along with new technology and fertilizers alone couldn't balance agricultural production. Goud (1987) revealed that the extending proper financial assistance to the farmers so frees them from clutch of moneylenders and they help in rapid agricultural development. Vasant (1987) emphasised that the supply and application of all other inputs needed for irrigated agriculture can produce sufficient food-grain for over increasing population of India. Ghosh (1997) examined that there are different types and forms of diffusion. Some experiences regarding spread and adoption of ideas and practices seemed to be necessary in order to test the validity of the theories of diffusion.

Data Base

The study is based on the analysis of statistical data covering the period from 1970-71 to 1993-94 collected from both primary and secondary sources at districts and tehsils level. The primary
data were collected through well prepared questionnaires, taking into account of all the variables related to agricultural development and diffusion of innovations. The village level information was collected from the selected respondents and Gram Pradhans, Sarpanchs and the Gram Vikas Adhikaris of the sample households and villages located in varied physical setting of different districts.

Sources of Secondary Data

In the present study, the secondary data has been obtained from the published literature, government reports and district statistical bulletins, daily and weekly newspapers and unpublished records of the public administration and semi-government agencies. The sources of secondary data utilised in the present study are enlisted in the following succession:

(i) Survey of India Toposheets.
(ii) Census of India Statistics.
(iii) District Gazetteers of Saharanpur, Bulandshahr, Meerut, Muzaffarnagar and Ghaziabad.
(iv) State Administration Statistical Bulletin.
(v) Village and Town Directories of Saharanpur, Bulandshahr, Meerut, Muzaffarnagar and Ghaziabad.
(vi) District Census Handbooks of Saharanpur, Bulandshahr, Meerut, Muzaffarnagar and Ghaziabad.
(vii) Conference Proceedings.
(viii) Newspapers and other Periodicals.
(ix) Uttar Pradesh, Agricultural Statistical Bulletin.
(x) Departmental District Head Office Records.

Methodology

The qualitative and quantitative techniques have been used for the analysis of the present study are as under:

(i) Descriptive approach has been adopted to put down the account of physico-cultural account of study area.

(ii) Interpolation method has been followed to represent relief of the region by taking spot heights as the base.

(iii) For determining the development of agriculture by technoinstitutional factors, per thousand hectare of land has been chosen as unit of mechanization, by knowing the number of electric pumps, tractors, threshers, fertilizer drillers, seed drillers, diesel pumps, ploughs per thousand hectare. Besides, size of holding and consumption of fertilizer kg per hectare.

(iv) Second degree and logistic curves have been used to analyse the trend of diffusion of innovations. Logistic curves are Pearl-Reed curve which is merely a modified by exponential curve i.e.,

\[
Y_c = \frac{K}{1 + 10^{a+bx}}
\]

Where K, a and b are constant and x is time variable

Second degree curve is represented by \( Y_c = a + bx + cx^2 \)

(v) Coefficient of correlation has been used to examine the efficiency of the second degree curve and logistic curve in between observed and calculated values.

(vi) Weaver's minimum deviation method has been used to find out different crop combination regions. Formula is given as

\[
d = \frac{d^2}{n}
\]

by calculating deviation from the real percentages of crops for all possible combinations in the compound aerial units against theoretical standard.

(vii) Kendall's Ranking method has been used to analyse the various crops under different scale of preference over a period of time.
(viii) For the determination of productivity the value is represented in terms of Rs. per hectare by per unit of area converting the volume of products of all the crops into Rs. at current price.

(ix) To work out the trend of agricultural development, trend line has been fitted the regression line of the form \( Y_c = a + bx \). Regression line make it possible to predict the exact change in the production level in various time points. Further, coefficient of correlation is worked out between area and production; and between area and yield for selected crops and it is tested for significance by 't test'.

(x) Techniques of composite Z score has been employed to determine the levels of diffusion of innovations and the correlation between agricultural productivity and diffusion of innovations. Standard score (Z score), is represented by.

\[
Z = \frac{x - \bar{x}}{SD}
\]

\( Z \) = Standard score

\( x \) = Original value of the observation.

\( \bar{x} \) = Mean for all the values of \( x \).

\( SD \) = Standard Deviation of \( x \).

Hypothesis

(1) The farmers of large size of holdings tend to adopt improved agricultural practices more than the farmers of other size of holdings.

(2) The rate of adoption among owner farmers is high as compared to owner share-cropper or share-cropper.

(3) The farmers having adequate and assured irrigation facilities are more adoptive of agricultural innovations as compared to others.
The rate of adoption among owner farmers is high as compared to owner share-cropper or share-cropper.

The farmers having adequate and assured irrigation facilities are more adoptive of agricultural innovations as compared to others.

Adequate and timely availability of power tends to promote speedy adoption of agricultural innovations among farmers.

Availability of adequate and timely credit facilities promotes quick adoption of agricultural innovations.

Availability of incentives in the form of subsidies tends to promote speedy adoption of improved agricultural practices.

Timely and adequate availability of inputs promotes adoption of agricultural innovations.

The rate of adoption of an innovation is positively related to its ultimate returns.

Availability of incentives in the form of assured fair prices for agricultural produce tends to promote speedy adoption of agricultural innovations.

The high adoption diffusion of innovations is directly proportional to high productivity.

Objective

The objective of the present study is:

To assess the advancement in agriculture and to analyse the contribution of different techno-institutional factors i.e., number of electric pumps per thousand hectares, number of threshers, number of seed drillers, number of diesel pumps, number of ploughs, number of tractors per thousand hectare, different sources of irrigation and size of land holdings.
(2) To identify the inter district variations in agricultural development and trend of diffusion of innovations.

(3) To establish relationship between area and yield and area and production.

(4) To identify the factors causing variations in yield in different districts and tehsils of the region, including specific technological inputs irrigation, fertilizers, HYV and use of implements.

(5) To trace out the association of various crops i.e., crop combination regions and intern tehsil variations in crop combination.

(6) To represent the ranks of various crops.

(7) To identify the factors of diffusion of agricultural innovations i.e., size of holding, tenure status, income and economic status, availability of irrigation, commercial orientation, caste status, social participation, urban and outside contact, extension contact, socio-economic status and mass-media.

(8) To identify different productivity region based on per hectare productivity in terms of Rs. per hectare.

(9) To establish relationship between irrigation facilities, consumption of fertilizers, use of implements and level of diffusion of agricultural innovations.

(10) To establish correlation between agricultural productivity and diffusion of innovations.
Plan of the work

The present study on "Diffusion of Agricultural Innovations in Upper Ganga-Yamuna Doab" has been organised into seven chapters, which are as follows:

Chapter I deals with the introduction comprises of conceptual framework of diffusion of agricultural innovations, a brief outlook of work review done so far, sources of data, consisting of primary and secondary, principles of methodology including qualitative and quantitative both, hypothesis, objectives of the study and plan of the work.

Chapter II examines the various physico-cultural and demographic factors of the study area to understand the casual relationship of all the factors with the diffusion of innovations as well as the productivity of the selected crops.

Chapter III presents the discussion of agricultural development comprises of (i) Technological and institutional advancement in agriculture with reference to time and space, patterns of modern agricultural technology consisting of tractors, electric pump sets, diesel pump sets, iron plough, wooden plough and other improved tools. Besides, these two major advancing techno-institutional factors agricultural labourers, agricultural credit, pattern of land ownership, pattern of irrigation and consumption of fertilizers has also been taken into consideration; (ii) The sub chapter of development of agriculture includes the trend of agricultural development encompassing with the study of area, production and yield through time and space, changing landuse pattern, cropping pattern, intensity of cropping, production variability, yield variability; (iii) Moreover, it has also been focussed towards the study of agricultural productivity comprises of
regionalisation of agricultural productivity, crop combination and ranking of crops.

Chapter IV studies the trend of diffusion of agricultural innovations including the factors of diffusion of agricultural innovations and various physio-cultural and socio-economic variables. It further examines the trend of diffusion of agricultural innovations; consumption of fertilizers and use of irrigation of the different districts of Upper Ganga-Yamuna Doab and the region as a whole.

Chapter V deals with the level of diffusion of Innovations comprises of irrigation, fertilizer and implements. Besides the composite scores of different sources of irrigation, consumption of fertilizer and various forms of tools and implements of diffusion of agricultural innovations have been taken into account. Moreover, the correlation between agricultural productivity and diffusion of agricultural innovations has been analysed.

Chapter VI presents a comprehensive study of the first hand information regarding the impact of techno-institutional and socio-economic factors on diffusion of agricultural innovations. The present chapter also examines the various hypotheses of the adoption of agricultural innovations vs. various factors such as size of land holding, tenurial status, irrigation, electric and diesel power, credit, subsidy, inputs, yield, fair prices, level of exposure to mass media, level of education and social position.

Chapter VII the last chapter presents epitomize work of the study area and it has incorporated many more suggestions regarding the diffusion of agricultural innovations and also generated various interests of further research on diffusion of agricultural innovations at micro-level.
References


32. Fliegel, F.C., Traditionalism in the Farm Family and Technological Change, 1962, pp. 70-76.


