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ADOPTION OF INNOVATIONS IN IRRIGATION SYSTEM IN AZAMGARH DISTRICT (Sample Study)

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"IRRIGATION IS EVERYTHING IN INDIA; WATER IS MORE VALUABLE THAN LAND, BECAUSE, WHEN WATER IS APPLIED TO LAND IT INCREASES ITS PRODUCTIVENESS AT LEAST SIX FOLD AND RENDERS GREAT EXTENTS OF LAND PRODUCTIVE, WHICH OTHERWISE WOULD PRODUCE NOTHING OR NEXT TO NOTHING."

- Sir Charles Trevelyan

Abstract:

"Irrigation in an agrarian economy assumes the same importance as blood in human body. It has played a vital role continuously in this process of agricultural development. It is most important input required for successful farming. Agricultural development and adoption of modern technology are possible only by the provision of adequate irrigation facilities. Better results from HYVs depend largely on assured and controlled irrigation as they require water at specific period of growth, development and flowering (Husain and Reddy 1996). Thus, the success of agriculture depends mainly on irrigation which works as a mother factor in the improvement of land use mechanics, cropping intensity and patterns and cropped-land productivity (Banerjee 1986). The 'New Agriculture Strategy' has also given importance to the development of modern irrigation system, which is major determinant in the adoption of HYVs and resultant agricultural productivity. Thus, it is clear that the crop productivity as well as satisfactory performance of other inputs like fertilizers, insecticides and pesticides largely depends on appropriate timing of irrigation and quantity of water supplied to crops. This paper is based on primary data analysis, and here an attempt has been made to find out the adoption pattern of irrigation innovations in time and space frame. For this Logistic curves have been drawn to assess the adoption pattern of irrigation innovations in the study area. Hagerstrand's Monte Carlo Simulation Technique has also been employed to assess the process of adoption."

Keywords: Irrigation, Agricultural Development, Adoption of Modern Technology, Hagerstrand's Monte Carlo Simulation Technique.

The term 'IRRIGATION' includes all operations or practices in the artificial supply of water to the land for growing crops. It is a means by which water is passed on to dry areas from rivers, canals, or wells to increase the fertility of the land. It is the science of harnessing and controlling water resources for the benefit of agriculture. Scientific irrigation involves the knowledge of available water supply, its conservation and application to the land, the characteristics and needs of the different types of soil, and the requirements of the various crops to be produced. For the growth of plants, water must be available in the appropriate quantities and at the right time, depending on the species of plant and climatic conditions. Crops like sugarcane and rice need larger quantities than wheat and other cereals (Rao, 1979).

Irrigation (artificial application of water to crops), is an old art in India. It began with agriculture itself. References to the practice of irrigation in India have been traced to many centuries prior to the commencement of the Christian era (Prasad, 2009). In India, nothing moves unless agriculture moves, and no input for agriculture is more important than water. Water is a basic input. Agricultural output and its efficiency, to a great extent, depend upon inputs applied and the methods adopted. However, the recent attempts for modernization in the field of agriculture in many areas have been largely restrained due to the non-availability of adequate water.

In this paper, an attempt has been made to identify the impact of these factors on the adoption of new farm practices and resultant disparities in the Azamgarh district.

Study Area

The Azamgarh district is located in the eastern part of Uttar Pradesh, lying between 25º40´ N and 26º27´ N latitudes and 82º40´ E and 83º32´ E longitudes occupying an area of 4054 sq. km. (fig 1.1) with a total population of 46,12,134 persons. The average density of the study area is 1138 persons per sq. km. (2011). The district is bounded north by Gorakhpur, Sant Kabir Nagar, and Ambedkar Nagar districts, west by Sultanpur and Jaunpur and Ghazipur district, and on the east by Mau district. Administratively, the district is divided into eight tehsils and twenty-two community development blocks.

The district slops very gentle towards the southeast. The district is a part of the Indo-Gangetic plain and formed of alluvium of the Quaternary age. The average annual rainfall is 901mm. with an average temperature of 24ºC. The district has good transportation facilities. It is well connected by north-eastern railways, state highways, and other roads. Agriculture and its allied activities are the main sources of livelihood to the majority of the people in the district. The district's physical environment is very suitable for agriculture. Crops like rice, wheat, sugarcane, pulses, vegetables, etc. are grown on a large scale. Good irrigation facility is provided by canals of the Ghaghara irrigation system. Farm size and its ownerships determine the use of new farm inputs but expensive technologies are not affordable by the majority of poor farmers. In the study area, the average size of land holdings was 0.55 hectare in 2011. There are more than 606570 operational holdings in the district, out of which about 85% have less than one hectare. Thus most of the land is concentrated with the small size of land holdings showing the disparity in its distribution.

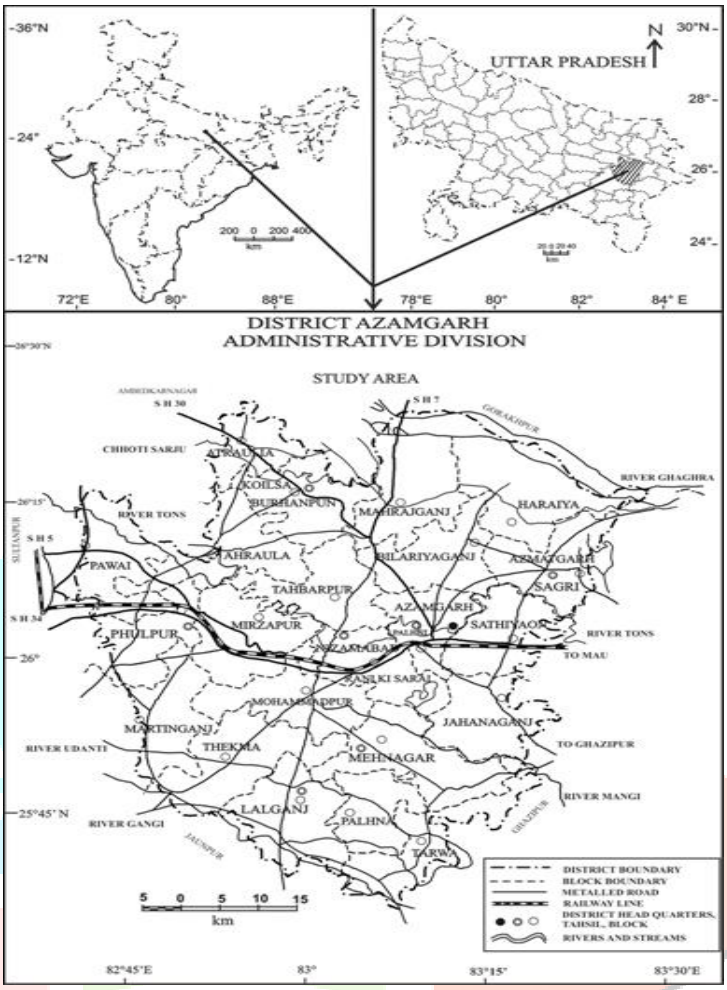

Fig. 1.1

In Azamgarh district, out of the total main workforce, about 60 percent of the working population is engaged in the primary. Due to the lack of employment opportunities in other sectors of the economy and the increase in population, the pressure on agricultural land continues to increase. Fragmentation in the family has also reduced the size of the farm landholdings thus restricting the use of new agricultural devices. Not only this, but the adoption of farm technology is also not uniform all over the area both in space and time frame. The rich farmers have become richer and the poor have not been able to keep pace with them. This requires the appropriate use of science and technology in the field of agriculture and its diffusion amongst the farmers. Actually, the adoption of innovations is a unique process over space by time depending upon the several physical and non-physical factors prevailing over an area.

Data Base and Methodology

The description of this paper is completely based on responses of 580 farmers selected through purposive sampling from different 10 villages of the study area. Based on computed Z score for each development block the Composite Index of Agricultural Development (CIAD) has been found. Further, based on CIAD the whole region has been divided into five homogeneous strata / zones and from each stratum two villages have been selected randomly.

It is known fact that several agricultural innovations have been introduced in the region till date, but only some important innovations related to irrigation have been taken into consideration to achieve the objectives. Relevant informations have been collected from three important factors as institutional, technological and socio-economic. The field work was carried out in 2011-12 in both the agricultural seasons to obtain primary data personally through interviewing farmers. Simple scoring technique was used to measure the adoption of selected innovation. Logistic curves have also been drawn to assess the adoption pattern of irrigation innovations in the present paper. Hagerstrand's Monte Carlo Simulation Technique has been employed to assess the process of adoption.

Besides above, the secondary data have been collected from published/unpublished records of government/semi-government/non-government organizations/institutions/offices of the state, district, Tehsil and Block levels.

Sample Study

For the sample study, ten villages altogether from all the development zones were selected to find out the pattern of adoption of various means of irrigation. Since pump-sets are the major source of irrigation in the study area, therefore the emphasis was laid on the detailed study of this device in practice. Firstly, using the purposive sampling method 580 respondents were selected from all the villages those were using any means of irrigation. The sample survey result shows that out of 580 respondents 60.34% have pump sets while the remaining 39.66% of respondents are using other means of irrigation. (Fig 1.2 A) shows the village-level variation in the adoption of irrigation pump-sets.

Before the adoption of pump sets at large scale water from the wells was lifted by the traditional means known as 'Dhenkuli', containing a leather bag carried by bullocks. Due to the meagre amount of water lifting by this system, irrigation was confined to small areas near the wells. But since the last four decades, farmers have started to adopt modern means of lifting the surface or groundwater. The modern techniques include the use of electric/diesel engines. The irrigation pump for the first time was introduced in the study area in 1950 in Bijarwa village. Since then gradual adoption and dissemination of irrigation pumps in the study area emphasizes its acceptability and suitability in the context of the present socio-economic environment of the peasant society.

Inception and Growth Pattern of adoption of Irrigation Pump-Sets in Sample Villages

In the study area, the inception of mechanical pumps for lifting water from wells, rivers, ponds, and nalas, etc. has been traced since the sixth decade of the 20th century. Prior to this, traditional methods like don (manually operated), Dhenkuli or rahat were prevalent. Among the sample villages, the first irrigation pump was introduced in 1950 in the village Bijarwa which lies on the roadside 25 km away from the district headquarter. This was apparently because of its nearness to Azamgarh city. The second irrigation pump was adopted in 1965 and till then this number increased to six. Onwards to this significant year adoption of modern irrigation pumps in the study area was continuous but slow. By the year 1985, altogether110 irrigation pumps were in the operational stage in ten sample villages with an average adoption of 6 irrigation pumps per year (counted from 1965). But the average adoption rate increased after 1985 and by the end of the year 2010, it reached 10 pumps per year (table 1.1). The faster adoption of irrigation pumps onwards 1986 may be attributed to the severe drought observed in 1979-80. Most of the distributaries of canals remained dry during this period due to scanty rainfall causing the lowering of water level in most of the rivers of the source region The farmers were motivated to seek alternative sources of irrigation and the Government also supported this alternative search through loans and subsidies under various rural development programmes.

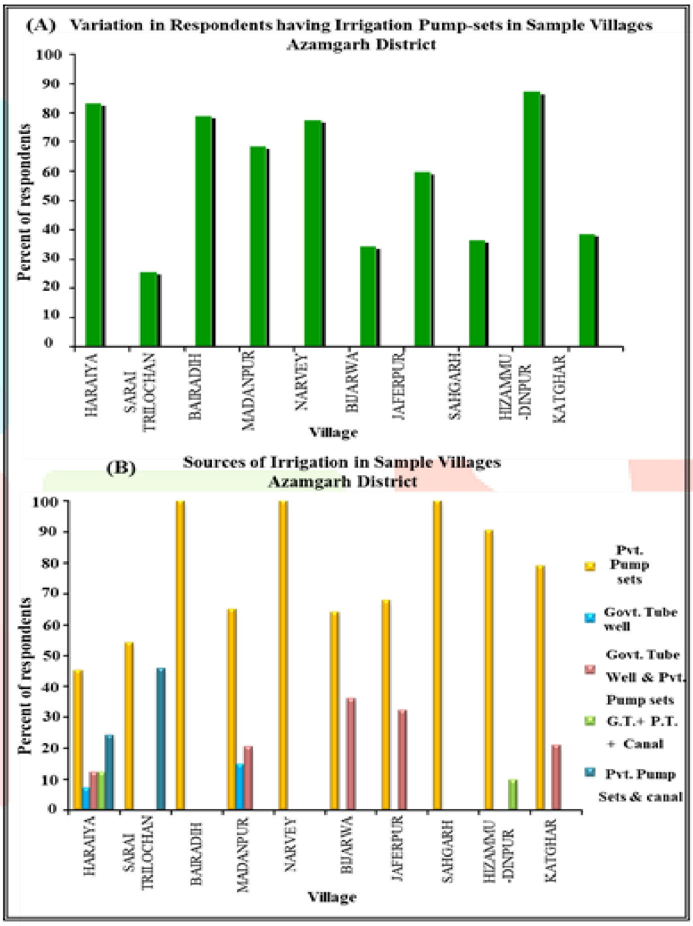

Fig. 1.2

Adoption Curve

The introduction of irrigation pump in 1950 and continuous increase in its adoption onwards 1965 in the area provides us the base for drawing the diffusion curve, which makes possible the development of the theoretical model of the diffusion process. Fig. 1.3 shows that the increase in the number of irrigation pumps up to 15 years of its inception has been rather slow followed by rapid adoption in later years. It is an observed fact that the dissemination of new ideas, practices, or innovation follows ‘S’ shaped curve which rises slowly at the initial stage of adoption followed by the middle stage when an innovation or idea proceeds at an accelerated pace and lastly a decreasing rate of adoption is obvious as the innovation approaches to the maximum (Roger, 1983). This ‘S’ shaped growth curve, suggested by Trade (1903) was extensively examined by sociologists, geographers, and economists in their respective fields in the western countries and also in India.

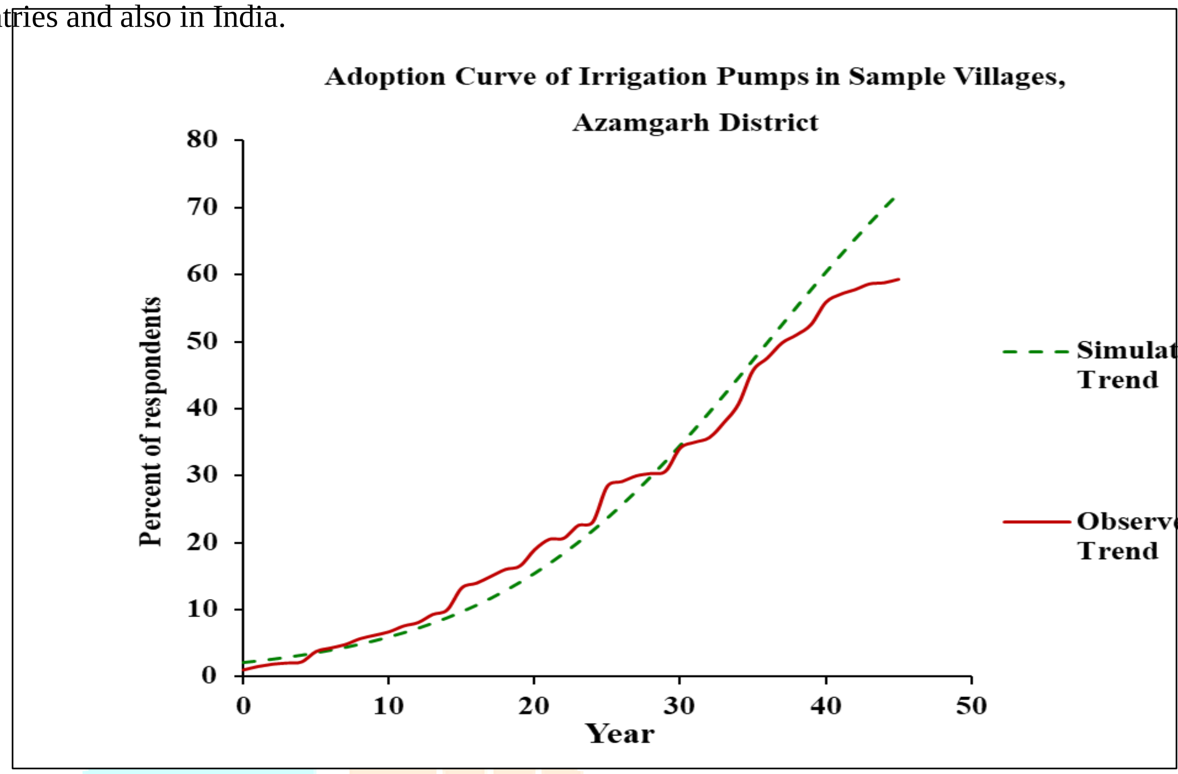

Fig. 1.3

Cumulative, normal bell-shaped curve and logistic law of growth, etc. are the different algebraic functions that are useful for charting out the 'S' shaped curve. The logistic law of growth being simple both in its application to specified observed data and in the interpretation of its theoretical implications provides a useful and satisfactory measure of diffusion path (Pearl, 1924). Therefore, logistic law of growth has been employed to examine the growth trend model to the observed case under consideration as well as to estimate the future level of adoption in the study area. The mathematical expression of this curve is:

$$P = 100/\ 1+e^{-(a+b\ t)} = e^{-(a+b\ t)} = 100\text{-}P/P$$

Where,

P = is the proportion of the farmers adopting an innovation.

t = is the time variable.

In the study area, the numerator is assumed to 100 percent since 'P' is expressed as the proportionate value. The method chosen here involves the transformation of logistic into linear equation. The linear equation is:

$$e^{-(a+b\ t)} = (100\text{-}P) / P$$

Table: 1.1: Adoption of Irrigation Pumps in Sample Villages, Azamgarh District

Year	Actual No. of Pumps	Cumulative No. of Pumps	Observed Percentage	Simulation Number	Simulation Percentage
1965	6	6	1.03	12	2.15
1966	3	9	1.55	14	2.38
1967	2	11	1.90	15	2.64
1968	1	12	2.07	17	2.93
1969	1	13	2.24	19	3.24
1970	9	22	3.79	21	3.59
1971	3	25	4.31	23	3.98
1972	3	28	4.83	26	4.40
1973	5	33	5.69	28	4.87
1974	3	36	6.21	31	5.39
1975	3	39	6.72	35	5.95
1976	5	44	7.59	38	6.57
1977	3	47	8.10	42	7.26
1978	7	54	9.31	46	8.00
1979	4	58	10.00	51	8.82
1980	19	77	13.28	56	9.71
1981	4	81	13.97	62	10.68
1982	6	87	15.00	68	11.73
1983	6	93	16.03	75	12.88
1984	3	96	16.55	82	14.11
1985	14	110	18.97	90	15.45
1986	9	119	20.52	98	16.88
1987	1	120	20.69	107	18.42
1988	11	131	22.59	116	20.07
1989	3	134	23.10	127	21.82
1990	31	165	28.45	137	23.69
1991	4	169	29.14	149	25.65
1992	5	174	30.00	161	27.73
1993	2	176	30.34	173	29.90
1994	2	178	30.69	187	32.17
1995	20	198	34.14	200	34.52
1996	5	203	35.00	214	36.96
1997	4	207	35.69	229	39.46
1998	13	220	37.93	244	42.02
1999	16	236	40.69	259	44.62
2000	29	265	45.69	274	47.25
2001	11	276	47.59	289	49.90
2002	13	289	49.83	305	52.55
2003	7	296	51.03	320	55.18
2004	9	305	52.59	335	57.79
2005	19	324	55.86	350	60.35
2006	7	331	57.07	365	62.85
2007	4	335	57.76	379	65.29
2008	5	340	58.62	392	67.66
2009	1	341	58.79	406	69.93
2010	3	344	59.31	418	72.11

Source: Based on survey results (2009-10) &Computed by author.

After getting the values of ‘P’ and ‘t’ we can estimate the parameters ‘a’ and ‘b’. The obtained value also represents the simulated value of ‘P’ from logistic curve in the time frame and gives an idea to measure the excellency in the fitting of the data. The obtained results have been presented in table-1.1.

Result

The above procedure gives the values of a and b as -3.819 and 0.106 respectively. Thus results obtained for adoption of irrigation pumps have been shown for simulation as well as observed growth percentage (fig.-1.3).The word simulation used here refers to a variety of techniques in which various empirically derived or arbitrary parameters are applied sequentially to a multi stage set of rules (a model) for a complex situation, in order to develop sets of artificial data. Ultimately the values of the logistic curve are found by the following equation:

$$P = 100/1+ e^{-(-3.819 + 0.106\ t)}$$

Where P is the percent of adopters and t the year of adoption measured from 1965 which has been considered as the base year. The correlation coefficient between observed and simulated values is 0.99 which is significant at 1 percent level of significance. This highly positive correlation between empirical and simulated data shows very close correspondence between them.

According to general notion an innovation or new idea into a social system is adopted by few progressive farmers in the beginning. It has been observed that with growing awareness, the farmers gradually tend to adopt more irrigation pumps. Simulation trend for adoption of pumps from the logistic law of growth indicates about 95 percent adoption by the end of 2029. It is worthy to mention that there are various complex mostly unpredictable factors which determine the growth in adoption of irrigation pumps. Therefore certain limitations are inherent in the used data hence it is difficult to predict the proportion of potential and interested farmers who will adopt the innovation in future.

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