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Sustainable Implementation of Artificial Intelligence Based Decision Support System for Irrigation Projects in the Development of Rural Settlements

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Abstract: Irrigation projects may not only have a large impact on the expansion and population distribution of rural regions, but they also have the potential to have a substantial impact on a wide variety of other economic challenges. Because the primary goal of the study is to illustrate what irrigation projects achieve in rural development via the redistribution of rural human settlements in a schematic fashion that is compatible with the new irrigation reality and helps, the method that will be used will be the redistribution of rural human settlements in a way that is consistent with the new irrigation reality. This will be accomplished as a result of the method that will be used, which comprises dispersing rural human settlements in a way that is suitable with the new reality of irrigation. Utilizing the agricultural potential that is already present is one way in which issues such as the unequal distribution of development gains and the absence of public services for rural human settlements may be resolved as a result of the expansion and development of irrigation projects. There is also the possibility of revitalizing the economy of rural areas. These problems may be traced back to the expansion and further development of various irrigation projects. In addition to a rise in agricultural production, one of the most noteworthy discoveries about the significance of irrigation projects is that they result in the establishment of new communities that are able to sustain rural economies. Irrigation projects help with the urbanization of rural human settlements and the provision of both public and agricultural services because they link these communities to a network of highways so that they may be connected to one another. Another noteworthy influence is the contribution that irrigation projects provide to the urbanization of human populations who live in rural areas.

Keywords: *Irrigation Projects, Agriculture, Development of Rural Settlements, Irrigation Systems*

1. Introduction

The precarious nature of the rural settlement hierarchy combined with the widespread dispersion of communities led to an inefficient, unequal, and unfair distribution of the benefits brought about by growth [1]. The dispersed form of the communities was to blame for this circumstance. It is very necessary, in order to accomplish this aim, to make clear the purpose of irrigation projects and the assistance that these projects give for rural human settlements. It is vital, in order to achieve rural development, to distribute services in a manner that is fair and in proportion to the extent of rural human populations [2]. This will make it feasible to construct a flourishing rural community in which people may live peacefully with one another. The dispersion and expansion of rural villages has led to an unequal distribution of the advantages of development for irrigation projects, which is the primary subject of this study. As a inhabitants of rural settlements face a shortage of social and economic services, consequence, which in turn has led to an unfair allocation of development benefits. This mess got about as a result of an unfair distribution of the advantages that come with progress [3].

The concept that social relationships in rural regions and villages are more consistently social than those in urban areas is known as the "rural-village effect." This is due to the fact that agricultural labour, animal care, artisan employment, and other forms of labour associated with rural activities are more prevalent in rural areas and communities [4]. Rural neighborhoods and communities have a profound bond with the land that they inhabit. Many sociologists are of the opinion that there has been a significant shift in both the definitions and concepts of what constitutes a rural society over the past several decades. It is comprised of a diverse assortment of

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components and characteristics that come together to form the whole. The idea of geography, the concept of economics, the idea of the social and cultural way of life, and the location in relation to the primary economic activity are all concepts that have qualities that are shown [5].

The classification of rural human settlements and the technique by which they are defined are not standardized throughout the states as a result of disparities in the permissible reasons for establishing such distinctions. This is because of the differences in the admissible grounds for determining such distinctions. For instance, some countries determine what constitutes a rural village based on the number of people who live there, while others consider factors such as the primary source of income or the predominant occupation [6]. Human settlements, whether urban or rural, were classed based on the following qualities, some of which are illustrated in Figure 1: According to established criteria that were accepted by the Urban Planning Authority of the Ministry of Planning, human settlements were classified based on the following characteristics:

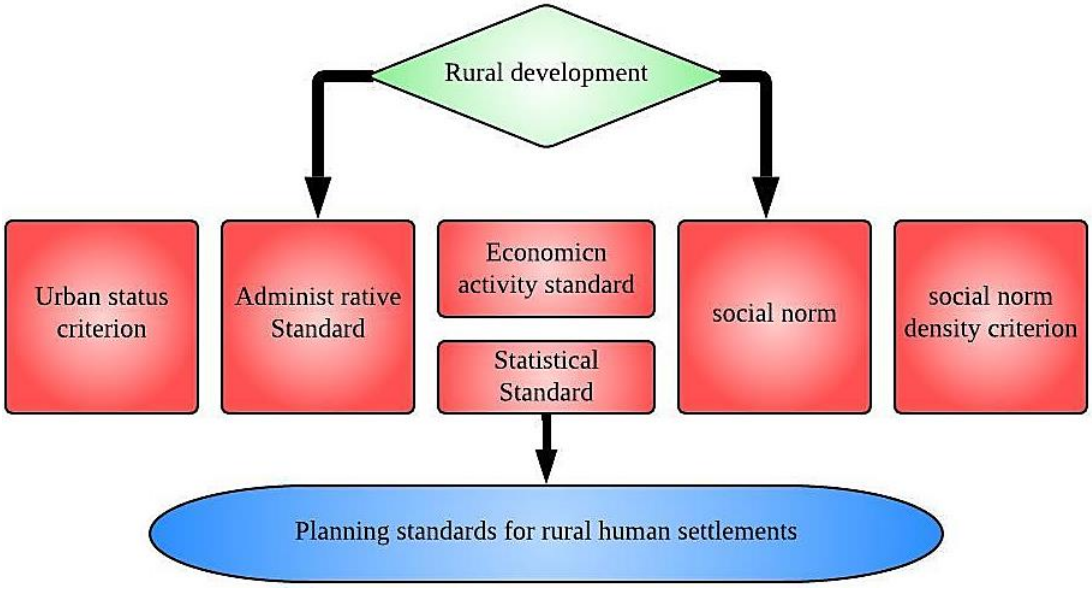

Fig 1: Planning stands for rural settlements.

2. Review of Literature

Irrigation projects have a substantial influence on a variety of other economic challenges, in addition to the patterns of population distribution and the variables that contribute to the development of rural areas. Using agricultural potential may assist with this. The key defining features of India's rural community pattern are the small size of the villages, their dispersion, and the absence of vital utilities in such communities. These are the primary characteristics that define the pattern [7]. As a direct consequence of this quality, the expansion and development of the nation are both hampered. Building new communities that help maintain rural economies is one of the most significant discoveries made about the value of irrigation projects in addition to agricultural growth. This is one of the most important conclusions. Some of the other benefits that are particularly noticeable are the contributions that irrigation projects make to the urbanization of rural human settlements and the provision of public and agricultural services via the joining of roads to a network [8].

In India, one of the most significant obstacles to the expansion of agriculture and the growth of rural areas is the country's chronic water shortage. In order to raise the amount of food that can be produced from agriculture in dry and semi-arid regions, such as Iran, it is essential to use water in the most effective way possible. This study's objective was to investigate the factors that influenced farmers' decisions to use sprinkler irrigation systems in the context of the evolution of irrigation systems [9]. The research was conducted in the form of a survey. The statistical population consisted of one hundred fifty sprinkler irrigation system using farmers from the Iranian county of India. After a pilot study had been conducted for each structure on its own, the Cronbach Alpha Coefficient, which was greater than 0.7, was used to determine the reliability of the questionnaire. This was done after the pilot study was finished [10].

According to the results of the study, the most important elements in influencing farmers' choices to build irrigation systems were engaging with other farmers who already have contemporary irrigation systems, decreasing water costs, enhancing production, and other aspects. According to the results of the factor analysis, the primary factors that influenced the expansion of sprinkler irrigation systems were economic conditions, the level of user expertise, the availability of technical infrastructure, and the provision

of extension help. These variables account for around sixty percent of the difference in the likelihood that farmers will construct irrigation systems [11].

The purpose of this research is to determine the role that project teams have in the success or failure of efforts designed to improve irrigation water management. The key subjects of the research were the project client, the project consultants, the project contractors, and the project beneficiaries of the Mwea irrigation water management improvement project, which took place in Mwea, Kenya. The problem that the study intends to address and provide a solution for is the implementation of irrigation water management improvement projects with regard to the project team. Both a descriptive and a correlational research approach were used for the purpose of this study. The significance of the data will be evaluated using a descriptive research methodology, with the metrics of mean and standard deviation serving as the measuring sticks [12].

The correlation research method was used to the task of determining the degrees of relationship between the various factors that were under investigation. Participants in the study totaling 133 were chosen at random from four different villages located within the area. In order to collect the necessary information, we employed a questionnaire that had both open-ended and likert scale question items. The descriptive analysis of the effect of the project team on the execution of irrigation projects found that the project team variable of the kind of skills that affect project time had the highest mean score. Sixty-eight point five percent of respondents agreed that it has an impact on the completion of the project on schedule [13].

The influence of project collaboration on the total amount of time needed for the project was the aspect of the project team that contributed the least, as stated by 31.5% of the respondents [14]. According to the findings of the study, the project team does have some influence on the manner in which irrigation projects are carried out. According to the findings of the study, the project team need to be assembled very early on in the process of planning rather than waiting until the project itself is being carried out to do so. Because of this, the team working on the project will be able to collaborate and become more committed to the project as a whole. Therefore, the findings of this study suggest that further research should be done in order to identify additional factors that may account for the variations in how irrigation water development projects are implemented, which amounts to 53% [15].

3. Process of Rural Development's Essential Components

❖ ***Agricultural development***

The consequences of agricultural development include a rise in agricultural output as well as an increase in individual income. Agricultural development may be thought of as the sum of several operations and changes. As a result, this ultimately leads to increases in both personal income and agricultural productivity. This is performed by the utilization of a wide variety of methods, techniques, and instruments, including those pertaining to economics and agriculture. practices that are used in contemporary agriculture to get the most out of the land and increase its output. study is conducted into all of the natural potentials, such as soil, water, and climate, as well as human capabilities, such as labor, technology, and money, in order to produce an accurate plan for investment and exploitation. This study is necessary in order to formulate a specific strategy. This is done while maintaining the labor and service agreements that are currently in place so that we can be prepared for future agricultural expansion. Agricultural extension training helps farmers improve their farming practices, increase income and production efficiency, improve their level of living, and elevate the social and academic standards of rural life. These benefits are achieved via the use of educational methods.

❖ ***Social services***

Rural regions, in especially those in countries that are still in the process of developing, are home to a number of the most important social service institutions. This is a consequence of the structure of society and the manner in which it works to progress in order to meet the requirements imposed by its components. One way to make the most of all of the tools and resources at one's disposal in order to bring about an all-encompassing development that is dependent on the self-abilities and capabilities of the people living in rural areas is to establish local development committees and centres that focus on health care, agriculture, education, traditional crafts, and productivity. This is one way to use all of the tools and resources at one's disposal to bring about an all-encompassing development. One other thing that may be done is to provide assistance to them in resolving the difficulties that they confront in all aspects of life, especially the challenges that they face in terms of health care. This is necessary in order to establish a Keep in mind that the primary objective of providing these conveniences in distant places is to persuade people to come and reside there.

❖ ***Rural road network***

Transportation is one of the most important factors in a country's development and evolution. This is because transport enables people to go from one place to another more easily. Transportation helps in expanding and improving the areas of cultivated lands, in addition to supplying the essential agricultural supplies at the appropriate moment. If a product cannot be delivered because there are no available transportation options, the value of the product is completely destroyed. Because of the critical role that they play in the growth and maintenance of rural populations, road and transport network construction is an absolute need. It was of the utmost importance to construct first-rate regional links that linked rural areas with urban ones.

❖ ***Housing***

With the extension of riverbeds or transit routes, rural dwellings adopt a rectangular shape, or so-called (strip pattern). Where curving roads in some villages meet these rural homes, they form a circle. These villages' dwelling units are spread, and there are star villages with expanded boundaries separated from one another by a big courtyard. This is a similar inference to the one that may be drawn based on the location of the contour lines. This is due to the fact that where certain towns' winding roads are situated, riverbeds or transit routes take on a circular appearance.

4. Research Methodology

The contribution that each component has made to change and development will be analyzed, and the most significant aspects from the perspectives of economics, society, and urbanism that have an impact on the growth of rural areas will be selected, discussed, and chosen, respectively. The topic of discourse will be about the improvement of rural areas. Figure 2 provides a concise description of the primary elements that have a role in the growth of rural areas.

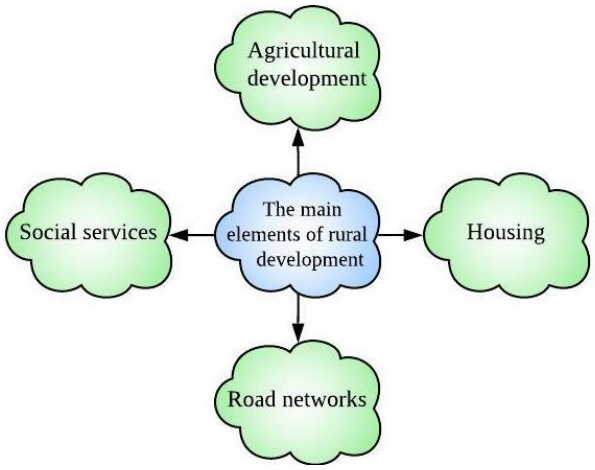

Fig 2: Main elements of rural development

The survey approach was used in the performance of this study. According to the data, the population consisted of 150 different farmers. A county located in the Mumbai Province of India. For the purpose of data collection, the questionnaire-by-interview methodology was used. In order to evaluate the reliability of the questionnaire, a pilot test population consisting of 25 farmers was used to calculate the Cronbach's Alpha coefficients for the different variables on Likert type scales. This was done in order to determine how accurate the questionnaire was. The results of the Alpha coefficients, which can be seen in Table 1, demonstrate that the scales that were used were suitable for the purpose.

Scale Name	No. Of Items	Alpha Value
Supporting And Extending Qualities	8	0.802
Financial Criterion	4	0.639
Technological And Environmental Characteristics	6	0.85
Characteristic Of Society	8	0.94

Table 1: Reliability analysis

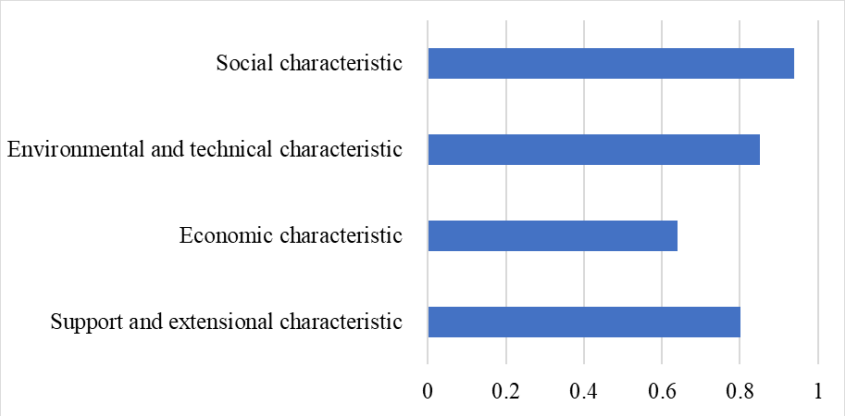

Fig 3: Reliability analysis

❖ ***Sample size and population***

The study's target population consisted of 235 individuals who participated in the survey. Using a methodology that included many stages of selection, this study's respondents were ultimately selected at random from among the four distinct clusters. The number of participants in the study was counted up. Through the use of the following computation, we were able to establish that the appropriate sample size would be 125 respondents out of a target population of 200 respondents:

$$Na = \frac{n \times 100\%}{re\%}$$

❖ ***Research Plan***

The investigator combined descriptive and correlational methods in their investigation. A descriptive research technique was used in order to learn more about how the data were clustered around a central value and to understand how to describe the sample that was picked without having any influence on the sample itself. In addition, a process known as a correlation study was used to determine whether or not the variables under investigation had any kind of link with one another. According to Porter and Carter (2000), a correlation study design is utilised when a researcher needs to determine the link between two or more important variables. In the course of this investigation, a questionnaire served as the instrument for gathering information. It is the ideal instrument for efficiently collecting descriptive data from a large pool of subjects. The structure of the questionnaire was closed-end so that analysis could be performed more easily. Additionally, it is divided into two equal halves.

The first section included of questions on the respondent's personal history, which offered information about their demographics. In the second part of the meeting, participants looked for a connection between the project team and the actual implementation of programmes to improve irrigation water management. On a scale ranging from 5 to 1, the respondents were asked to tick the box next to the relevant statement to indicate how strongly they agreed, disagreed, were neutral, or strongly disagreed with the statement. 5 represented "Strongly Agree," 4 "Agree," 3 "Neutral," 2 "Disagree," and 1 "Strongly Disagree." There were nine distinct sources of information used to compile the information on the affects.

❖ ***Rural Population distribution***

`The population distribution illustrates how persons are dispersed over the available space in terms of their geographic location. Questions pertaining to the geographical distribution of the population are an important consideration in spatial planning on all levels, including the national, regional, and district levels. The people of Chennai are spread out over the region in a number of different ways. In Table 2, the percentage contributions and total populations of the major regions illustrate how the population is not dispersed evenly throughout the country. Even at the level of the region, the subdistricts, wards, and villages all have the characteristic of unequal distribution.

Sub-district	Rural population	Percent%
Gujarat	6265	17
Chennai	11351	28
Mumbai	21955	55
Total	38567	100

Table2: Rural population Distribution by sub-district

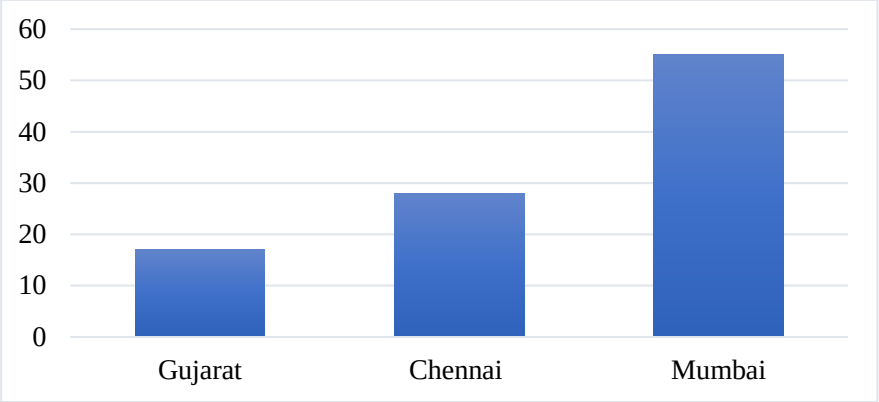

Fig 4: Rural population Distribution by sub-district

In the following table, you can see how the rural population is distributed across the Shalala district, as well as the proportion that each subdistrict contributes to the total rural population of the Shalala district. Harir continues to hold the top positions in the area in terms of population size, as seen by the rank order population distribution in the region. After this region comes Salahaddin with a percentage of 29%, and then Hiran with 16%.

5. Analysis and Interpretation

A two-factor analysis of variance with measurement repetition was carried out in order to evaluate whether or not there was a significant difference between the groups of the first component, "Rural population and Percent%" (repeated measures), with relation to the dependent variable.

a significant amount of difference in the values of the dependent variable among the several groups that make up the second factor sub-district.

There is a relationship that exists between the dependent variable and the two variables "Rural population and Percent%" and "Sub-district."

Table 3: Correlation

	Sub-district	Rural population	Percent%
Sub-district	1	0.97	0.96
Rural population	0.97	1	1
Percent%	0.96	1	1

The findings of the two-factor analysis of variance with repeated measurements showed that there is a significant difference between the groups of the first factor "Rural population and Percent%" in relation to the dependent variable, p=aN, and that there is a significant difference between the groups of the first factor "Sub-district" in relation to the dependent variable, p=aN. Additionally, the results showed that there is a significant difference between the groups of the first factor "Rural population and Percent%"

Table 4: Correlation and significance

		Sub-district	Rural population	Percent %
Sub-district	**Correlation**	1	0.97	0.96
	p (2-tailed)		.028	.036
Rural population	**Correlation**	0.97	1	1
	p (2-tailed)	.028		.001
Percent %	**Correlation**	0.96	1	1
	p (2-tailed)	.036	.001	

A Pearson correlation was carried out in order to ascertain whether or not there was a connection between the number of people living in rural areas and the percentage. The results of the Pearson correlation showed that there is a significant connection between the rural population and the percentage, with r(2) = 1 and p =.001 respectively.

Rural population and the percentage of the people living in rural areas have a very high, positive correlation (r= 1), which equals 1. As a consequence of this, the association between the Rural population and the Percentage in this sample is fairly robust and in a positive direction.

Table 5: Hypothesis

Null hypothesis	Alternative hypothesis
Regarding the factor that is being measured, there is not a statistically significant difference between the groups that make up the first factor, which is rural population, and the group that represents measurement repetition (percentage).	Regarding the dependent variable, there is a significant difference between the groups of the first factor, Rural population, and Percent% (measurement repetition).
There is not a statistically significant difference between the groups that are represented by the second factor sub-district in regard to the variable that is being studied.	There is a statistically significant gap, in terms of the dependent variable, between the groups that are differentiated by the second factor sub-district.
There is no correlation between the factors Rural population, Percentage, and Sub-district.	The variables Rural population, Percentage, and Sub-district are all connected to one another in some way.

6. Result and Discussion

In order to anticipate the value "Mumbai," a logistic regression analysis was performed, during which the influence of the variables Rural population and Percent% on the variable Sub-district was explored. According to the findings of the logistic regression analysis (Chi2(2) = 4.5, p.105, n = 4), the model does not meet the criteria for statistical significance in its whole.

The variable that represents the rural population has a positive coefficient of b = 0.1. This suggests that the probability that the dependent variable is "Mumbai" rises when the population of the rural regions grows at a faster rate than it does at any other time. The p-value for this influence is.997, which means that it is not statistically significant in any way. The odds ratio of 1.1 indicates that the chance that the dependent variable is "Mumbai" will grow by 1.1 times for every unit increase in rural population. This is because the odds ratio is expressed as a multiplier.

The value b = -36.89 represents the negative coefficient for the variable Percent%. As a result, there is a negative correlation between an increase in the value of Percent and the possibility that "Mumbai" is the dependent variable. The p-value for this influence is.997, which means that it is not statistically significant in any way. According to the odds ratio of 0, the likelihood that the dependent variable is "Mumbai" will increase by 0 times if the variable Percent% is raised by one unit. This is because the odds ratio begins at 0.

The rural population has a positive coefficient of b = 0.07, which suggests that it is a variable. This is because of the variable status of the rural population. This suggests that the probability that the dependent variable is "Chennai" rises as the number of people living in rural areas grows. However, given that the p-value for this impact is.998, we cannot say that it is statistically significant. Because the chances ratio is 1.08, it can be deduced that the probabilities of the dependent variable being "Chennai" will increase by 1.08 times for every unit increase in the variable Rural population.

The value b = -30.62 is the negative coefficient that should be applied to the variable percent. This suggests that a decrease in the chance that "Chennai" is the dependent variable is connected with an increase in the value of the "Percent%" variable. However, given that the p-value for this impact is.998, we cannot say that it is statistically significant. According to the odds ratio of 0, the likelihood that the dependent variable is "Chennai" will grow by 0 times if there is a one-unit increase in the variable "Percent%," which stands for the percentage of the total.

The rural population variable has a coefficient that is negative, and it is equal to -0.04 in value. This suggests that the probability that the dependent variable is "Gujarat" will decrease as the proportion of rural residents in the population grows. However, given that the p-value for this impact is.998, we cannot say that it is statistically significant. The odds ratio of 0.96 indicates that the chance that the dependent variable is "Gujarat" will increase by 0.96 times for every unit increase in rural

population. This is because the odds ratio is calculated relative to the rural population.

The number b = 16.23 represents a positive value for the coefficient that is associated with the variable percent. According to this, the probability that the dependent variable is "Gujarat" will grow as the percentage of that variable's value increases. However, given that the p-value for this impact is.998, we cannot say that it is statistically significant. According to the odds ratio of 11147036.02, a one-unit rise in the variable Percent% will result in an increase in the probability that the dependent variable is "Gujarat" that is 11147036.02 times greater than before.

7. Conclusion

The spread and growth patterns of India's rural villages vary from place to location. In 1981, the Indian Ministry of Planning's Urban Planning Commission approved. By doing so, they accelerated the transition to comprehensive national planning and avoided the period of fragmented processes. This technique featured a strategy that was put into action in the shape of a rural settlement plan in each governorate. At this moment, the organising, building, and growth of rural settlements in the Indian countryside started. To make them helpful to rural populations, the planning criteria were added to the development process after a full evaluation of the communities was completed. The distribution pattern matched these occurrences due to the location of rural communities being impacted by both natural and human effects. The qualities of the surface, soil, temperature, and water sources are some of the most significant environmental elements that influence the construction of the vast pattern in tiny scales. This is because these factors all interact with one another. The prevalence of rural communities throughout the country is evidence of the significance of phenomena and their effects on economic activity. The most effective use of water is made possible by the transformation of permaculture into irrigated agriculture and the application of contemporary techniques, such as tourism irrigation and sprinkler irrigation. Because of the prevalent pattern that forms the basis of the rural economy, it is challenging to adopt communal farming and the use of agricultural mechanisation. As a consequence of this, it is required to build administrative institutions, which are best represented by agricultural cooperatives, and for these organisations to play a role [16-19] in the creation of agricultural cadres who are capable of absorbing and grasping contemporary agricultural practises. This will be done because the method that will be used will be the redistribution of rural human settlements in a way that is consistent with the new irrigation reality. As part of the strategy, which also includes reorganising rural human settlements to meet the new realities of irrigation, this will be done. Rural communities in India are characterised by a number of distinguishing features, including the relatively small size of the villages, their dispersion throughout the country, and the absence of vital utilities in such settlements. Because of this, it is possible to differentiate them from one another. The characteristic makes it impossible for the country to develop and advance.

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