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Impact of Minor Irrigation on Rural Livelihoods of Andhra Pradesh: A Study in Vizianagaram District

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Abstract: The improvement of existing irrigation systems offers the promise of increased yields and cropping intensities. This will result in employment expansion, increased food production and low food prices in the economy. In a nutshell, it leads to the development of all sectors of the economy through the growth and prosperity of the agricultural sector. It is particularly so in the agriculturally based underdeveloped countries like India. Therefore, many economists emphasize the contribution of irrigation to the agricultural sector and its importance in the economic development of underdeveloped countries.

It is concluded from observations of the study that the minor irrigation has played a major role in the upliftment of rural livelihoods. In this context the governments at all levels must encourage minor irrigation schemes, our agriculture dependent economy would further deteriorate as perennial river waters are not accessible to a significant segment of the farming community. To overcome various major irrigation-based problems (environmental and socio-economical), it is essential to strengthen the minor irrigation, especially the tank and groundwater-based schemes. These schemes can be made successful if the farmers are allowed to participate from the planning stage, as demonstrated by APFAMGS. Since the state govt. is fully aware of the importance of minor irrigation, needed steps have to be taken on a priority basis.

Keywords: Minor Irrigation, Upliftment of Rural Livelihoods and growth and prosperity of the agricultural sector.

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1. Introduction

The artificial way of supplying water to the agricultural land at the right moment in an appropriate volume for the proper growth of the plants in order

to get the maximum yields of cultivation is technically called irrigation. But irrigation also includes clearing away excess water from the agricultural land. Irrigation may be defined as "the application of water by human agency, to assist the growth of crops and grass". Irrigation plays an important role in agricultural development. It is one of the most important factors for assured crop production. It permits better utilization of all other productive factors and thus, leads not only to increased yields per unit of land and time, but also stability in economic conditions of the farmer. Adequate and timely supply of irrigation water is a prerequisite in the agricultural production process, particularly in areas where the rainfall is scanty and irregular. It is an instrument with which rural transformation and agricultural development is possible. The supply of land being inelastic, accelerated growth in production is possible only through multiple cropping and realization of higher crop yields per unit of area, both of which are heavily dependent on irrigation.

In modern times, the role of irrigation has been more than doubled. In an expanding world with its phenomenal growth of population, the havoc caused by frequent floods and droughts in different regions of the world and widespread unemployment among the rural masses and food deficiency all together highlight the importance of irrigation. It is proven that irrigation development is a more promising policy action than giving input subsidies to achieve food self-sufficiency in developing countries.

In India, due to its geographical location, tropical and semi-arid climate prevails in the major part of the country. In these tropical and semi-arid tracts, rainfall is scanty and uncertain, and often unpredictable. The rainfall in India is essentially monsoonal in character and rain occurs only in a few months in a year, the frequency of failures of rainfall being very high.

South India has a long history of rain water harvesting through tanks and weirs. Andhra Pradesh, Karnataka and Tamil Nadu account for nearly 60 percent of the tank's irrigated area. There are about 1,27,000 tanks in these states against 2,08,000 tanks in the entire country. Although several reasons like deforestation, centralization of authority, poor catchment treatment, issue of private property, increase in population, agricultural transformation, unfavorable institutional framework and its capacity to handle the tank, etc. are quite evident from the field research and the available literature that the tank systems are on declining trend in terms of performance.

2. Irrigation and Agricultural Development

Irrigation has been proved to be a decisive factor in determining the development of agriculture and the rural economy. Improved availability of irrigation brings

positive changes in the land use pattern, cropping pattern, cropping intensity and adoption of various yield-augmenting inputs, all of which one way or the other help to increase the productivity of land substantially (Dhawan, 1988; Saleth, 1996; Vaidyanathan, 1999). Besides directly benefiting the farmers, who are the primary beneficiaries of irrigation, it also helps to increase the wage rate and employment opportunities for agricultural labourers and reduce rural poverty in a sustained manner. The increased supply of food grains and other agricultural commodities which primarily takes place due to irrigation development, also helps to control prices of agricultural commodities which benefits a large section of the community in the non-agricultural sector.

The improvement of existing irrigation systems offers the promise of increased yields and cropping intensities. This will result in employment expansion, increased food production and low food prices in the economy. In a nutshell, it leads to the development of all sectors of the economy through the growth and prosperity of the agricultural sector. It is particularly so in the agriculturally based underdeveloped countries like India. Therefore, many economists emphasize the contribution of irrigation to the agricultural sector and its importance in the economic development of underdeveloped countries.

In view of the importance of irrigation, policy makers in India have been putting increased emphasis on the development of irrigation since independence. The government sector alone has invested Rs. 253301 crores (at 2006–07 prices) in the irrigation sector. As a result of increased investment, the irrigated area of the country has increased from 20.9 million hector in 1950–1951 to 96.42 million ha. in 2011–2012, an increase of more than four times. The coverage of irrigation in the cropped area has also increased from 17.4 per cent in 1950–1951 to about 60.53 per cent in 2009-2010. Today, India possesses one of the largest irrigation sectors in the world, both in terms of irrigated area and the volume of investment.

3. Irrigation Development Patterns in India

In India even after exploitation of full irrigation potential, about 60 percent of the arable land will continue to depend on rain fed farming. Both surface and ground water resources are under considerable pressure and have depleted considerably. Falling groundwater due to excessive exploitation and low recharge have led to disastrous consequences. In the most rain fed areas, water availability is not a problem but rainfall distribution and poor water management create water scarcity for crops resulting in low rainwater use efficiency (40-45 percent) and low crop productivity.

The green revolution, initiated in the mid-1960s has been the cornerstone of India's agricultural growth and has been instrumental in taking the country from food deficient to one of self-sufficiency. From a production level of 51 metric tonnes in 1950-51, the food grain production has increased to 257.44 million tonnes in 2011-12. While in the early phase expansion in production came from area expansion, for the past three decades the net cultivated area has almost remained constant but the additional production has come as result of productivity increases. This is because of the use of expansion in the irrigation facility, spread of high yielding varieties, increased use of fertilizers and other modern inputs.

Low productivity in rain fed areas, aggravated by water scarcity, degraded and poorly managed land, poor infrastructure, lack of market facility marginalizes agriculture and livelihoods of the people in rain fed areas. Globally 80 percent of the agriculture is rain fed, in South Asia it is about 60 to 65 per cent. About 66 per cent of the total arable land (142 million ha) in India is rain fed and suffers acute moisture stress. Although the green revolution helped South Asia, particularly India, to attain self-sufficiency in food production, it bypassed millions of poor livings in rain fed areas. Water is a critical constraint in increasing agricultural productivity. It is estimated that by the year 2025 one third of the population of developing countries, including 50 per cent of the population of India and China, will be facing physical scarcity of water (Molden *et al*., 2007).

It is important to recognize that the green revolution was largely confined to irrigated areas which account for about 35 percent of the total cultivated area. The rain fed area is almost double the irrigated area and contributes only 45 per cent of the total food grain production. Rain fed agriculture is characterized by low levels of productivity and low input usage. Due to the dependence on the rainfall the productivity varies from year to year depending on the volume of rainfall of that particular year. These areas show wide variation and instability in yields. The gap between yield potential and actual yields is very high as compared to the irrigated areas. The rain fed regions of eastern India have the potential to achieve higher yields. India's agriculture has now entered a post-green revolution stage of development that requires new strategies to enhance agricultural growth and reduce rural poverty. A move to an intensive diversified productivity with strong forward and backward linkages is the next evolutionary step in the country's future agricultural development.

The classification of irrigation was evolved during the British time and was linked to the quantum of resources required for executing the irrigation

works of different sizes. When the resources required for the execution of an irrigation scheme are considerable, it was categorized as major irrigation work. Similarly, if this requirement is of a smaller magnitude, the particular scheme is regarded as a minor irrigation scheme. More especially minor irrigation works include both surface water related schemes as well as groundwater related schemes. Tanks division's lift irrigation schemes are surface water related schemes which come under this category. Open or dug wells, tube wells, filter points are the groundwater related schemes included in this category.

The medium irrigation schemes come in between these two. The basis therefore, for this classification is in terms of investment norms. These investment norms have been revised from time to time to account for inflation. For example, the investment norm for minor irrigation schemes was raised from Rs.15 lakhs to Rs. 25 lakhs in 1970 (rupees 30 lakhs for hilly areas). Finally, this norm was abandoned by the Planning Commission in 1978. Nowadays irrigation schemes are categorized on the basis of cultivable command area.

Minor Irrigation: All irrigation schemes with less than 2000 hectares of cultivable command area are considered as minor irrigation works.

Medium Irrigation: Irrigation schemes with cultivable command area between 2000-10000 hectares are classified as medium works.

Major Irrigation: Irrigation schemes with cultivable command area of 10000 or above hectares are considered as major works.

4. Role of Minor Irrigation in Agricultural Development and Food Security

Small irrigation works or minor irrigation works have been the backbone of agriculture in many parts of the country. The importance of these works to Indian agriculture was highlighted by the first Irrigation Commission (1903) and the Royal Commission on Agriculture (1928). The first Irrigation Commission (1901-1903) gave considerable attention to the smaller irrigation works. The Royal Commission on agriculture (1928) was probably the first to recognize the importance of the smallest storage works and other sources of irrigation in India. The commission has rightly pointed out that construction; preservation and improvement of the minor works in the past have not received the attention from the government.

The crucial role that minor irrigation could play in augmenting food production within a short time was especially recognized in the Grow More Food Campaign launched in 1943. The committee observed that the scope for

such irrigation existed in many states and that special efforts should be made to assist them in the execution of minor works. The committee also recommended that priority should be given to new minor irrigation schemes and also repairing of existing works. The committee also suggested that substantial government funds should be earmarked for the development of minor works.

The Planning Commission, since its inception, has been stressing the importance of minor irrigation in increasing food production. Advantages of minor irrigation works are smaller capital outlays, favorable benefit cost ratio, shorter gestation period and easy mobilization of labour from local areas, early extension of irrigation facility to non-irrigated and under developed areas are some of the major advantages of minor irrigation. Primarily, in minor irrigation the local community will be involved.

The First Five Year Plan has clearly indicated that small irrigation works have an important role in developing irrigation in the country. The first plan recognized the advantages of these smaller irrigation works. "They provide a large amount of dispersal employment, involve smaller outlay and can be executed in a comparatively shorter period. Being spread over the country they confer wide spread benefits and it is therefore easier to mobilize public cooperation in their construction". Minor irrigation schemes are environment friendly and provide gainful employment opportunities to the rural population, resulting in optimum utilization of resources. This also contributes to rural economic growth and supports numerous vegetable and food processing units.

The First Plan started in 1951 with an irrigated potential of only 22.60 million hectares of which the contribution of minor irrigation was 12.90 million hectares (surface water 6.40 million hectares and ground water potential 6.50 million hectares) from then onwards in the successive plan periods, irrigation potential is getting augmented steadily. If the VI Plan is taken as the mid-level to assess the complete plan-wise development for the six decades still the end of the XI Plan, it is observed that, at the start of the VI Plan (in 1980), surface water minor irrigation potential of 8.00 million hectares and ground water potential of 22.00 million hectares had been created. There was reportedly no gap between creation and utilization till that period. The total potential creation at 30 million hectares in 1980 indicates that the growth has been modest, more so for surface water schemes. The momentum picked up after 1980 particularly for ground water schemes. The ultimate irrigation potential of the country is estimated at 140 million hectares, out of which the share of minor irrigation is 58.58 percent i.e., 81.54 million hectares. Minor irrigation schemes are expected to irrigate 51.9 million hectares by the end of IX Five- Year Plan. For the minor

irrigation scenario as a whole, the cumulative potential created by the end of the X Plan is estimated to be 60.42 million hectares.

Minor Irrigation Development Organization (MIDO) has been established in the Tenth Five Year Plan, with a clear vision, foresight and transparency to implement a minor irrigation programme. MIDO was armed with a policy formulation framework for action plan, to achieve the targets set for irrigation development and appropriate monitoring mechanism. Principal thrust in the programme is provided for modernization and improvement of existing irrigation tanks, besides taking up large numbers of Minor Irrigation Schemes (MIS). An additional area of about 0.7 million hectares is proposed to be brought under irrigation by modernization, improvement and extension of the canal system of existing tanks. Special attention is given for restoration of potential of existing minor irrigation tanks covering a large area of 1.1 million hectares.

India's population crossed 121 Crores (121.1million) and increase in per capita income assumed to create challenges of Food Security (FS). Availability of cereals and pulses in required quantities on a sustained basis is a big challenge of food security. Food security at a national and household level is the focus of policies of agriculture development. In this context also minor irrigation works with smaller capital outlays assumes significance. The approach intended to maximize food production and ensure food security need to focus on minor irrigation development along with other policy initiatives aimed to bring structural and institutional changes in Indian agricultural.

5. Minor Irrigation Development in Andhra Pradesh

Minor irrigation works taken in totality have been of great importance in Indian irrigated agriculture. This is also true in the case of Andhra Pradesh state. Indeed, there were debates in the A.P Legislative Assembly, that there were many demands to revive tanks from 1956 to 1980s. Nevertheless, State neglects seem to have continued, and tank irrigation continued to decline. Before the seventies, this neglect seems to have been accompanied by an emphasis on major irrigation in the state policy.

After the seventies, the state seems to have supported the bore well revolution through subsidies of various forms, while the neglect of tank irrigation continued. After this, even the demands for revival of tank irrigation in the state assembly seem to have weakened. The above facts raise uncomfortable questions. If large farmers exercise state power, or share substantially in it, because of the A.P. Government so neglected tank maintenance and concentrated instead on major irrigation in the initial decades,

and bore well irrigation thereafter. And this, in spite of repeated demands in the State Assembly debates. Clearly, the political influence of farmers did not translate into state policy. Further, even in debates, tanks seem to have lost their importance in the state assembly in the recent decades. And this is in spite of the fact that they provide a substantial part of irrigation water to large farmers.

In Andhra Pradesh, as many as eight districts have been declared drought-prone. Tanks were the main source of water supply in these areas for years. Many tanks were built in a series so that no wastage of water took place. Moreover, the storage tanks enriched the water table through percolation. An institutional system also evolved and enabled tanks to be the major source of irrigation. Interestingly, the region (Rayalaseema) with highest dependence on groundwater has the lowest number of tanks. A more serious problem is regarding the functioning of tanks. At the state level 69 percent of the tanks are under repair, which account for 82 percent of the area irrigated by tanks. Effectively, only 18 percent of the tank command is being irrigated (Reddy, 2003).

Minor irrigation, under which tanks are categorized, contributes to 67 percent of the state irrigation. The gamut of minor irrigation comprises minor irrigation tanks (>40 hectare command), Panchayat Raj Tanks (<40 hectare command), lift irrigation schemes and ground water-based irrigation systems. Andhra Pradesh has traditionally been a tank based rural economy and predominantly tank based irrigation system for a large part of it. Tanks have been the mainstay of irrigation and drinking water in the Deccan plateau and have a long history of more than five centuries.

6. Problem of the Study

In India even after exploitation of full irrigation potential, about 60 % of the arable land will continue to depend on rain fed farming. Both surface and ground water resources are under considerable pressure and have depleted considerably. Falling groundwater table, due to excessive exploitation and low recharge have led to disastrous consequences. In most rain fed areas, water availability is not a problem but rainfall distribution and poor water management creates water scarcity for crops resulting in low rainwater use efficiency (40-45 %) and low crop productivity.

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metric tonnes in 1950-51 the food grain production has almost quadrupled to 200 million tonnes in 1996-97. While in the early phase expansion in production came from area expansion, for the past three decades the net cultivated area has almost remained constant but the additional production has come as result of productivity increases. This is because of the use of expansion in the irrigation facility, spread of high yielding varieties, increased use of fertilizers and other modern inputs.

Low productivity in rain fed areas, aggravated by water scarcity, degraded and poorly managed land, poor infrastructure and lack of market facility marginalises agriculture and livelihoods of the people in rain fed areas. Globally 80% of the agriculture is rain fed; in South Asia it is about 60-65 %. About 66% of the total arable land (142 million ha) in India is rain fed and suffers acute moisture stress. Although the green revolution helped South Asia, particularly India, to attain self-sufficiency in food production, it bypassed millions of poor livings in rain fed areas. Water is a critical constraint in increasing agricultural productivity. It is estimated that by the year 2025 one third of the population of developing countries, including 50 % of the population of India and China, will be facing physical scarcity of water (Molden *et al*., 2007)

7. Need and Importance of the present study

Minor Irrigation deals with investigation and execution of Minor Irrigation Sources of Ayacut up to 5000 Ac. Minor Irrigation plays an important role in the development of agriculture and livelihoods particularly in drought prone areas and areas outside command of Major and Medium projects. Minor Irrigation is providing irrigation facilities to increase the agriculture production by means of creating new Ayacut, stabilizing the existing Ayacut of 25.60 lakh acres beside maintenance of these sources and also provides drinking water to villages during summer season.

In Minor Irrigation wing of Irrigation Department of Andhra Pradesh, there are nearly 6361 Nos of M.I tanks (Ayacut> 40 Ha) including other sources such as Ayacut and open head channels to serve the registered Ayacut of 17.59 Lakh Acres. In addition to this the erstwhile Panchayath Raj tanks 35,376 Nos (Ayacut< 40 Ha) having registered Ayacut 8.01 Lakh Acres were transferred to Irrigation Department from Panchayath Raj Department in 2005. As such the Minor Irrigation Department has to maintain all the above tanks of 41,737 Nos with a total registered Ayacut of 25.60 Lakh Acres. Thus, Minor Irrigation happens to be a major source of Irrigation in significant areas of the State.

The total registered Ayacut 25.60 Lakh Acres is not being irrigated every year and hence the gap of Ayacut is being increased year by year and the average gap of Ayacut is approximately 57 % of total registered Ayacut. In this connection the study is much concerned to determine the impact of minor irrigation on the rural livelihoods.

8. Objectives

The main objectives of the study are as follows

- To analyse the impact of minor irrigation on rural livelihoods.
- To suggest measures that may be useful to the policy makers both at the micro and macro levels for the overall development of rural areas.

9. Methodology and Sample Design

This Study is based on both primary and secondary data collected from various sources. The state of Andhra Pradesh is the study area, which has significant agriculture and irrigation facilities. By using multi-stage purposive sampling technique, in the first stage among all the districts of the Andhra Pradesh, Vizianagaram has been selected. In the second stage two Mandals have been selected in the district viz, Mentada mandal and Vizianagaram mandal. One Panchayats from each of the mandal have been selected viz. Andra from Mentada mandal and Dwarapudi from Vizianagaram mandal. In the final stage 50 households have been selected from each Panchayat by using simple random techniques. A pre-tested and well-designed schedule has been canvassed among the selected sample Households to elicit information on demographic characteristics, economic factors and the impact of minor irrigation on the sample households. The secondary data have been collected from various issues of Statistical Abstracts of Andhra Pradesh, District Handbook of Vizianagaram and Census reports of India. The reference period of the Study was November and December of 2022.

10. Impact of Minor Irrigation on The Rural Livelihoods

In this paper an attempt is made to know the impact of minor irrigation on the rural livelihoods here the household income is considered to be the indicator of rural livelihoods in the study area. To know the impact of minor irrigation on the rural livelihoods a multiple regression has been employed.

Multiple Regression Equation:

$$Y_i = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \mu_i$$

Where
Y_i = household income (dependent variable)
X1= sex of respondent
X2= age of respondent
X3= occupation of respondent
X4= size of family
X5= leased in land
X6= agricultural income
X7= source of irrigation
α= constant variable
β= coefficient value
μ_i= random error term.
The significance of the independent variable to the dependent variable is shown in the below equation and tables.

$$Y_i = 0.581 + 0.249x_1 + 0.179x_2 + 0.191x_3 + (-0.115x_4) + 0.060x_5 + 0.289x_7 + 0.382x_8 + \mu_i$$

Table 1: The estimated regression result of project and non-project areas

Variables	*t-values*	*Unstandardized Coefficients*	
		R^2	*Adjusted* R^2
Constant	0.581 (0.68)	37.5	31.1
Gender of respondent	0.249** (0.036)		
Age of respondent	0.179* (0.003)		
Occupation of respondent	0.191* (0.001)		
Size of family	-0.115** (0.027)		
Occupation	0.060)*** (0.074)		
Leased in land	0.289*** (0.061)		
Source of irrigation	0.382** (0.035)		

Household income (dependent variable)
Source: compiling by author.
Note: parenthesis indicates P-values.
1) * represent significant 1% level.
2) ** represent significant 5% level.
3) *** represent significant 10% level.

From the table 1, it is observed that the coefficient of the Gender of respondent is significant at 5 percent level. Which means that if the respondent is male the household income increases 24.9 percent. When compared to female respondents. The coefficient of age of respondent is significant at 1 percent level. Which indicates that if one year increases an age of respondent leads to increase the respondent income at 17.9 percent. The coefficients of variable occupation of respondents are significant at 1 percent level. Which indicates if the respondent has agriculture land under water sources like irrigation projects, tanks, canals. The household's income may increase 19.1 percent. The coefficient of the size of family is significant at 5 percent level. It indicates that one person adds to the family leads to 11.5 percent decrease in the respondent's income. This may be happening under the irrigation. The respondent has an awareness of education, so the family members may go to education rather than agricultural activities. The coefficient of variable occupation is significant at 10 percent. If the respondent family members have employment in agriculture or non-agricultural sectors. The income of the households may increase 6 percent.

Table 2: The estimated regression results of project area (Andra village)

Variables	*T-value*	*Unstandardized Coefficients*	
		R^2	*Adjusted* R^2
Constant	0.373 (0.412)	56.3	47.7
Gender of respondent	0.367** (0.036)		
Age of respondent	0.186** (0.019)		
Occupation of respondent	0.225* (0.004)		
Size of family	-0.153*** (0.070)		
Occupation	0.49 (0.307)		
Leased in land	0.268 (0.191)		
Source of irrigation	0.478 (0.148)		

Household income (dependent variable)

Source: compiling by author.

Note: parenthesis indicates P-values.

1) * represent significant 1% level. (<0.01)
2) ** represent significant 5% level. (<0.05)
3) *** represent significant 10% level. (<0.10)

The coefficient of variables leased in land is significant at 10 percent level. If the respondent takes the land for lease. The household income may increase 28.9 percent. The coefficient of variable source of irrigation is significant at 5 percent. The respondents have agriculture land under water sources like irrigation projects, tanks, canals. The respondent income may increase 38.2 percent.

Multiple Regression Equation

$$Y_i = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \mu_i$$

$$Y_i = 0.373 + 0.367x_1 + 0.186x_2 + 0.225x_3 + (-0.153x_4) + 0.49x_5 + 0.268x_6 + 0.478x_7 + \mu_i$$

From table 2, it is observed that the coefficient of the Gender of respondent is significant at 5 percent level. Which means that if the respondent is male the household income increases 36.7 percent. When compared to female

Table 3: The estimated regression result of non-project area (Dwarapudi village)
Dwarapudi regression:

Variables	*T-values*	*Unstandardized Coefficients*	
		R^2	*Adjusted* R^2
Constant	0.824 (0.096)	18.2	0.23
Gender of respondent	0.117** (0.021)		
Age of respondent	0.163** (0.46)		
Occupation of respondent	0.146*** (0.096)		
Size of family	-0.043 (0.549)		
Occupation	0.048 (0.358)		
Leased in	0.307 (0.232)		
Source of irrigation	0.362*** (0.052)		

Household income (dependent variable)
Source: compiling by author.
Note: parenthesis indicates P-values.
1) * represent significant 1% level.
2) ** represent significant 5% level.
3) *** represent significant 10% level.

respondents. The coefficient of age of respondent is significant at 5 percent level. Which indicates that if one year increases an age of respondent leads to increase the respondent income at 18.6 percent. The coefficients of variable occupation of respondents is significant at 1 percent level. Which indicates if the respondent has agriculture land under water sources like irrigation projects, tanks, canals. The household's income may increase 22.5 percent. The coefficient of the size of family is significant at 10 percent level. It indicates that one person adds to the family leads to 15.3 percent decrease in the respondent income. This may be happening under the irrigation. The respondent has an awareness of education, so the family members may go to education rather than agricultural activities.

Multiple Regression Equation

$$Y_i = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \mu_i$$

$$Y_i = 0.824 + 0.117 x_1 + 0.163 x_2 + 0.146 x_3 + (-0.043 x_4) + 0.048 x_5 + 0.307 x_6 + 0.362 x_7 + \mu_i$$

From table 3, it is observed that the coefficient of the Gender of respondent is significant at 5 percent level. Which means that if the respondent is male the household income increases 11.7 percent. When compared to female respondents. The coefficient of age of respondent is significant at 5 percent level. Which indicates that if one year increases an age of respondent leads to increase the respondent income at 16.3 percent. The coefficients of variable occupation of respondents are significant at 10 percent level. Which indicates if the respondent has agriculture land under water sources like tanks. The household's income may increase 96 percent. The coefficient of variable source of irrigation is significant at 10 percent. The respondents have agriculture land under water sources like irrigation projects, tanks, canals. The respondent income may increase 36.2 percent.

11. Conclusion

It is evident from the study in Andra (project area) among seven variables the variables like gender of respondent, age of respondent, occupation of the respondent and size of family are significant to improve the size of household income and occupation of the family members, leased-inland and source of irrigation are insignificant.

It is observed from the study in Dwarapudi (non-project area) among seven variables the variables like gender of respondent, age of respondent, occupation of the respondent and source of irrigation are significant to improve the size

of household income and size of family, leased-inland, and occupation of the family members are insignificant. It is found from the total study area that all the seven variables gender of respondent, age of respondent, occupation of the respondent, size of family occupation of the family members, leased-inland and source of irrigation are significant in improving rural livelihoods.

It is concluded from observations of the study that the minor irrigation has played a major role in the upliftment of rural livelihoods. In this context the governments at all levels must encourage minor irrigation schemes, our agriculture dependent economy would further deteriorate as perennial river waters are not accessible to a significant segment of the farming community. To overcome various major irrigation-based problems (environmental and socio-economical), it is essential to strengthen the minor irrigation, especially the tank and groundwater-based schemes. These schemes can be made successful if the farmers are allowed to participate from the planning stage, as demonstrated by APFAMGS. Since the state govt. is fully aware of the importance of Minor Irrigation, needed steps have to be taken on a priority basis.

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