Impact of Irrigation Management on Income and Employment of Members of Water Users' Associations of Puri District, Odisha

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Abstract-The water users Association have emerged as a powerful instrument for agricultural development. Especially, the WUAs in Puri District have brought the disadvantaged and vulnerable groups into the realm of development through the provision of water and other inputs. The beneficiaries of these groups have been able to generate additional income and employment by utilising the water efficiently. In fact, the state Government, irrigation department and NGOs have helped in promoting WUAs with a view to making the WUA movement effective and vibrant. Unless these functionaries serve the rural farmers with strong urge and devotion, the purpose of agricultural development through WUAs will be defeated. It is therefore imperative to take a holistic approach to bring about farmer participation which will in turn foster agricultural development of the country. Thus, it is suggested that provision of adequate and timely supply of water, sufficient infrastructure, capacity building and skill up-gradation, creation of adequate marketing facilities, effective supervision and monitoring of water utilisation, strong political will and inspection of the end use of the water will not only foster agricultural development but also go a long way in attaining inclusive growth in India.

Key Words: Agricultural Development, Employment, Income, Puri District, Water Users' Association,

JEL Classification: - Q25, Q10, O12, D04

1.1 Introduction

If the process of economic growth is to begin and to be self-sustained, it must begin with the rural areas in general and agriculture in particular as stated by M.P. Todaro. India is a land of villages because 68.84 per cent of population lives in rural areas and depends mostly on agriculture for their livelihood. Rural Development can be achieved only with the uplift of the rural folk. Since agriculture is a promising sector and absorbing huge number of rural unemployed persons, the development of agriculture is very important. But due to lack of irrigation and its management, the production and productivity of agriculture is very much affected. So, irrigation management through Water Users Association is essential. Unless and until all the needy farmer population is actively engaged in the formation of WUA and irrigation management, agricultural development will not be possible. Hence, the present study emphasizes on irrigation management through WUA and examines its impact on employment and income of the WUA members through different income generating activities. The study is confined to Puri district of Odisha. The present study is unique in the sense that the findings will unfold the complex nature of the impact of WUAs on employment and income through different income generating activities.

1.2 Objectives of the Study

The present work is pursued with the following objectives.

- To find out the impact of irrigation through Water Users' Association on the employment and income generation of the beneficiaries.
- To investigate the problems of Water Users' Association in the study area and to suggest suitable policy measures for agricultural development in the study area.

1.3 Hypotheses

- Irrigation management has a positive impact on employment and income of the WUA members.
- WUAs have a positive impact on socio-economic development.

1.4 Data and Methodology

The work is based on both primary as well as secondary data. The secondary data are drawn mainly from the published and unpublished reports of the departments such as the Directorate of Economics and Statistics, Government of Odisha,

Department of Panchayati Raj, Government of Odisha, Department of Planning and Co- ordination, Government of Odisha, Irrigation department, Government of Odisha and Census publications, Government of India. The primary data are collected through canvassing a well–structured questionnaire. The primary data was collected during the period from October 2018 to March 2019. The study periods spread from April 2014 to March 2019. The Pre-WUA period data relates to information in respect of the respondents from April 2014 to March 2015 and Post-WUA period includes information from April 2018 to March 2019. Statistical tools such as ratios, percentages, annual compound growth rate, mean and standard deviation, correlation and regression analysis have been used for comparative analysis. The relationship between different variables has been examined through cross tabulation of the data. Further, Statistical inferences are drawn through the use of Paired t-test to check whether the cross-tabulated variables are significantly associated. Further, to know the impact of WUA participation on income, OLS (Ordinary Least Square) estimation is used.

In Puri district there are 11 blocks namely Astaranga, Bramhagiri, Delang, Gop, Kakatpur, Kanas, Krushnaprasad, Nimapara, Pipili, Puri Sadar and Satyabadi. Out of the above 11 blocks, the Pipili, Kanas, Gop and Brahmagiri blocks were selected on the random basis for the study. From each of the selected blocks, again 75 farmers of Water Users' Association per block were selected as given below. Besides this, 05 officials concerned with Water Users' Association were taken to collect their opinion through interview schedule. Moreover, information from twenty-five non-WUA member in each sample block is elicited for comparative study. Annexure 1.1 indicates the sampling framework of the present study which is given at the end.

Impact of WUA on Employment Generation

To examine the impact of WUA on employment generation, the following hypotheses are tested by using the primary data collected for the purpose.

Null Hypothesis – H_0: There is no difference in the average employment generation between Pre- and Post- WUA Periods.

Alternative Hypothesis - H_1: There is a difference in the average employment generation between Pre and Post- WUA Periods.

Paired t-test has been applied to test the statistical significance of the hypotheses.

$$t = \frac{\bar{d} - \mu_d}{\frac{sd}{\sqrt{n}}}$$

Where, n = Number of Paired Observations

df = n-1, degrees of freedom

$\bar{d}$ = Mean of the difference between Paired (or related) Observations.

n = Number of Pairs of differences.

Sd = Sample Standard deviation of the distribution of the difference between the Paired (or related Observations)

The Null and Alternative hypotheses are re-stated as follows.

H_0 : $\mu d=0$

H_1 : $\mu d\neq 0$

Decision Rule- If the calculated value is more than its critical value of t at a specified level of significance and known degrees of freedom, then, the Null hypothesis is rejected.

Impact of WUA on Income Generation

The following hypotheses are tested to know the impact of WUA on income of the sample respondents.

Null Hypothesis - H_0: There is no difference in generation of Average Income between Pre & Post WUA Periods.

Alternative Hypothesis - H_1: There is a difference in generation of Average Income between Pre- and Post-WUA Periods.

Paired t-test has been applied in order to verify the hypothesis under study.

1.5 Observation and Major Findings of the Study

The present study outlines the following observations from the analysis of the socio-economic profile of the study area and that of the stakeholders.

Fig 1.1 Map of Odisha Showing the location of Puri District

The economic profile of the district reflects certain peculiarities that need attention. Puri district is one of the centrally located districts in Odisha. It lies between $85^0 9'$ to $86^0 25'$ East longitude and between $19^0 28'$ to $20^0 10'$ North latitude. It is bounded by the Khurda district in North, Bay of Bengal in South, Jagatsinghpur district in the East and Ganjam district in the West. The district possesses a varied physiography. The historical background of the district along with geographical diversities contains the seeds of underdevelopment. The district is found to be an economically poor district with very low income and low per capita income compared to other districts of the state. The average density of population in the district is less than that of the state average.

Puri is agriculturally dominated but the land holding pattern is very much un-even. It is found that the average size of holding in Puri is less than that of the state average. Lack of irrigation acts as stumbling block on the path of agricultural development.

All the macroeconomic characteristics epitomize the economic backwardness of the district. From the poverty profile of the district, it is understood that the percentage of the people below poverty line is much higher than that at the state level. The poverty is mostly concentrated in the rural areas and that too among the households belonging SEBC, SC and ST. The other indicators of relative backwardness and deprivation of the state are low HDI, high death rate, high teacher taught ratio (1:51). The picture of the district in terms of some of the above characteristics is much worse and despising.

Human resource development and infrastructure penetration in the district are not satisfactory. A major percentage of villages lack all weather connectivity. The airport facility is found to be poor. The banking facility is very much urban centred. Thus, the infrastructural facility available is seen to be poor and a large number of people are unable to access the available opportunity. So WUAs are the need of the hour for widening the livelihood options among the rural people.

From the analysis of socio-economic profile of the sample respondents, it is observed that more than half of the respondents belong to socially disadvantaged groups like SEBC, SC and ST. Most of the respondents are marginal farmers and small farmers with an income below poverty line. The respondents are less educated and lack scientific temper. Among the literate respondents, most of them have only primary education which is not sufficient to understand about the WUAs functioning and record keeping. Thus, it may be pointed out that the district needs special attention for improvement of education, employment, irrigation and income so as to join the mainstream of development.

1.5.1 Employment

It is observed that in pre-WUA period, the average employment which was 170 person days increased to 235 person days in post-WUA period and registered a growth of 40.59 per cent. But the growth of employment across activities is different. In case of Horticulture crop, there is highest percentage of increase in employment i.e. 60.54 per

cent and in case of 'Plantation crop' there is lowest percentage increase in employment. So far as growth of employment is concerned, Horticulture crop is followed by Cash crop where growth of employment is more than the average growth. On the other hand, Food grain followed by Plantation crop has growth of employment less than the average growth. In case of 'Food grain' the growth of employment is 23.78 per cent. Though the growth of employment is less than the average growth yet, a large section of the population is engaged in Food grain. So, Food grain still dominates the employment absorbing sector of the agrarian economy.

Table-1 Impact of WUA on Average Employment Situation

Economic Activity	Average Employment Generated in Person days during Pre- WUA	Average Employment Generated in Person days during Post-WUA	Increase in Employment	% Increase in Employment	't' Value
Food Grains	164	203	39	23.78	3.89*
Cash Crops	193	278	85	44.04	4.56*
Plantation Crops	162	192	30	18.51	2.12
Horticulture crops	185	297	112	60.54	6.13*
Overall	170	239	69	40.59	4.574

Source- Compiled from the data collected
* Significant at 1% level.

By applying paired t-test it is found that there is significant difference in employment generation between Pre & Post WUA Periods. In other words, there is a significant Change in the generation of employment due to participation in WUA. The activity wise results of paired t-test reveal that except Plantation crop, all other crops generated a significant employment opportunity due to WUA participation. Activities like Food grain, Cash crop and Horticulture crop are found to have potential to generate additional employment opportunities in the study area.

1.5.2 Income

The average income of the respondents increased from Rs 15,097.67 in the Pre-WUA period to Rs 26,566.53 in the Post-WUA period registering a growth of 75.96 per cent.

Activity wise growth of income reveals that in Cash crop, the generation of income is highest (i.e.86.96 per cent) whereas in Plantation crop, the generation of income is found lowest (i.e 26.73per cent).

Table-2 Impact of WUA on Average Income during Pre and Post WUA Periods

Economic Activity	Average Income Generated in Rs during Pre- WUA	Average Income Generated in Rs during Post- WUA	Increase in Income	% Increase in Income	't' value
Food Grains	13,700	18,450	4,750	34.67	10.56*
Cash Crops	17,950	33,560	15,610	86.96	5.34*
Plantation Crops	19,900	25,220	5,320	26.73	4.67*
Horticulture crops	22,550	39,350	16,800	75.50	5.55*
Total Average	15,097.67	26,566.53	11,468.86	75.96	4.806

Source- Compiled from the data collected.
*Significant at 1% level.

Application of paired t-test shows that there is significant difference in income generation between Pre & Post WUA Periods. In other words, there is a significant Change in the generation of income due to participation in WUA. Activity wise results of t-tests reveal that all the activities are proved effective in generating income. The activities like Food grains, Cash crops, Plantation crops and Horticulture crops have significant potential in generating income in the study area.

To know whether the increased income in different activities is due to WUAs or due to other factors, we have to verify it through Linear Regression (OLS) Estimation.

1.5.3 Linear Regression (OLS) Estimation

In this sub-section, an attempt is made to identify the determinants that have an influence on income of the respondents. The determinants of income of the

WUA respondents have been analysed by using the following OLS multiple regression model.

$Y= \beta_1+ \beta_2 MWUA+ \beta_3 LPROP+\beta_4 EDUYS+ \beta_5 ALRUP+ \beta_6 HDASSET+ \beta_7 PNREGS + \beta_8 RDMIM+ \beta_9 RAGED+ \beta_{10} SAPLD+ \beta_{11} SGHHD+U$

Where Y = Income of the sample respondents.
MWUA =Member of WUA = 1 and Non-member = 0
LPROP =Landed Property in acres
EDUYS =Education –Years of schooling
ALRUP =Amount of loan in rupees
HDASSET =Holding of assets in rupees
PNREGS =Participation in NREGS dummy takes value 1 and 0 otherwise
RDMIM =Dependency Ratio (Ratio of dependent members to independent members)
RAGED =Age of the respondent
SAPLD =Economic Status dummy taking values 1for APL and 0 for BPL
SGHHD =Gender of the Head of the Household if male =1 and 0 for female
U =Error Term

Table -3 Factors determining Income of the Respondents: Regression Results

Dependent variable Y=Income of the respondents	Regression Co-efficient	t-value
Independent Variables		
MWUA	0.27	4.47*
LPROP	0.25	3.69*
EDUYS	0.09	1.49
ALRUP	0.17	4.82*
HDASSET	0.13	3.89*
PNREGS	0.24	5.42*
RDMIM	-0.08	3.30*
RAGED	0.06	0.58
SAPLD	0.14	5.24*
SGHHD	0.03	1.73
Constant	0.137	
R^2	0.653	

Notes- * indicates significance at 1% level

From the above table it indicates that the variables, member of WUAs, Landed property, Year of schooling, Amount of loan, Holding of Assets, Participation in NREGS, Age of the respondents, Economic status and Gender of the head of the household are showing positive regression co-efficient whereas ratio of dependent members to independent members is showing negative regression co-efficient and the t-value in case of WUA member, Landed property, Amount of Loan, holding of assets, participation in NREGS, Dependency ratio, and economic status which yields significant results. Thus, it is concluded that though other factors are contributing to the increase in income yet, its contribution is significant. The regression co-efficient of WUA participation is 0.653, which indicates that the income of the respondents has been increased by 65.3 per cent due to WUA participation.

The regression of WUA participation on income shows that there is a positive and significant impact of the former on the latter.

1.5.4 Use of Income Generated

It is interesting to note that the WUA beneficiaries productively make use of their increased income. 39.67 per cent of the respondents reinvested their income on activities in which they are engaged, 9.67 per cent of them revealed that a major part of the income generated was utilized for educating their children and 10.67 per cent of them spent it on health care. 24.33 per cent of the respondents said that income generated was spent for meeting the consumption expenditure and 15.67per cent told that income generated was used for creation of new assets. In general, the field experiences reveal that the strategy of WUAs is productive enough and had a favourable effect on employment and income generation. It is also observed that there is a quality improving effect on the families of sample respondents because majority of the beneficiaries utilized the income generated either for investing or improving the educational and health requirements. These expenditures resulted in qualitative improvement of human resources or in short it leads to human development.

1.5.5 Social Impact of WUAs

The present study reveals that 69 per cent respondents have learnt the lessons of co-operation and positive thinking after joining WUAs. 43 per cent members have developed sense of responsible citizens, 59.33 per cent have positive response to social changes, 67.33 per cent have self-respect and self-confidence and 60.67 per cent have developed leadership qualities. So, it is evident that WUAs through irrigation management are instrumental in all round development of so far under privileged and neglected sections of the society.

The WUA members are coming forward in exchanging their ideas, feeling and sharing the moments of happiness as well as sorrows with co-members. The members try to solve individual problems and extend helping hand to the needy members. The group members are found enough confident about their progress. Rural people are coming together and joining the process of their development.

It is found that WUAs are engaged in rooting out the social ills such as, alcoholism, dowry, child marriages etc. Impact of WUAs can be observed in the form of increased functional literacy. Most of the members are able to read and sign the documents of the group. Members have become aware about rules and regulations, business meetings and their rights and duties. Thus, the strategy of WUA has intervened in uplifting the socio-economic conditions of the members and helped overall development of the economy.

1.6 Problems

The problems of WUAs are varied and far flung. They differ from block to block. The farmers of WUAs face vey common problems like non-repairing and lack of supply of qualitative pipes by the Department of Water Resources, non-extension of pipeline up to the end of ayacut area, irregular payment of energy charge by farmers, non-co-operation of officials, frequent political interference, conflict among farmers, no provision of financial assistance by the department to repair machines and construction of office building for holding regular meetings.

Further, the WUAs are facing a number of problems while undertaking income generating activities. The common problems in the sample blocks which need special attention are related to marketing, timely and adequate availability of irrigation, availability of infrastructure, availability of funds and facilitators' support.

1.7 Policy Measures and Conclusion

On the basis of the above findings the following suggestions are made for successful working of the WUAs.

While preparing project reports for assistance under WUA, the emphasis should be on aspects like availability and access to training, credit, technology, infrastructure and marketing facilities. To implement the agricultural activities successfully and for sustainability of WUAs, the government needs to set up education, awareness and skill amongst the client beneficiaries. An improvement in the literacy status is also needed to maintain simple basic records of the WUAs. This is possible only if the members are imparted financial literacy and irrigation literacy through a basic orientation training followed by awareness generation programme on credit and irrigation management.

Further, crop insurance, purchase of crops by Govt., prohibition of frequent political interference, avoidance of excess irrigation and avoidance of wastage of water, judicious solution to the problem of water distribution through meetings should be made. Along with it, involvement of experts of NGOs to train farmers, sufficient distribution system of ayacut area, proper payment of taxes by farmers, co-ordination among WUAs, OLIC, Horticulture and Agriculture Department should be made. The WUAs should function as corporate agency to make them profitable with service motive. To make their organisation sustainable they should start agri-business. It is further emphasised on political will, Govt. patronage, long term land holding of farmers, timely release of grant in- aid, capacity building of WUAs, timely supply of water, conduct of election in the Association and autonomy to Pani panchayats are required for the success of WUAs. The farmers should involve themselves in the development schemes of Govt. and repair and construction of damaged canals and structures. Thus, the immediate and imminent policy implication is to identify and narrow down problem areas under the programme, target the identified regions, inspection of the end use of the water, ensure proper co-ordination amongst field level agencies to enhance the income and employment opportunities for the small and marginal farmers in the sample area.

From the analysis it is construed that the water users Association have emerged as a powerful instrument

for agricultural development. Especially, the WUAs in Puri district have brought the disadvantaged and vulnerable groups into the realm of development through the provision of water and other inputs. The beneficiaries of these groups have been able to generate additional income and employment by utilising the water efficiently. It has not only developed the saving habit of the members of the WUA but also helped them in utilising water timely. In fact, the state Government, irrigation department and NGOs have helped in promoting WUAs but these functionaries ought to act as the facilitators and promoters of WUAs rather than mere patroniser or providers of other inputs with a view to making the WUA movement effective and vibrant. Unless these functionaries serve the rural farmers with strong urge and devotion, the purpose of agricultural development through WUAs will be defeated. It is therefore imperative to take a holistic approach to bring about farmer empowerment which will in turn foster agricultural development of the country. Thus, it is suggested that provision of adequate and timely supply of water, sufficient infrastructure, capacity building and skill up-gradation, creation of adequate marketing facilities, effective supervision and monitoring of water utilisation, strong political will and inspection of the end use of the water will not only foster agricultural development but also go a long way in attaining sustainable growth in India.

Note: The major crops in India can be divided into four categories viz.
Food grains (Rice, Wheat, Maize, Millets and Pulses),
Cash Crops (Cotton, Jute, Sugarcane, Tobacco, and Oilseeds),
Plantation Crops (Tea, Coffee, Coconut, bettle nut, bettle leaf and,Cashew nut) and
Horticulture crops such as Fruits and Vegetables (Banana, Watermelon, Guava, Cucumber, Tomato, Ladys finger, Pompkin).

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ANNEXURE-1.1

Name of the Block(s) of Puri District	Members of WUA (S)	No. of Officials	Non-Member
Brahmagiri	75	01	25
Gop	75	01	25
Kanas	75	01	25
Pipili	75	01	25
Total	300	05	100