A Critical Evaluation of Economic Effects of Watershed Development Programme in Uttar Pradesh - A Case Study of Allahabad District

SUMMARY

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Submitted by: Pradeep Kumar Dwivedi
Department of Economics
University of Allahabad

Supervisor: Dr. A.K. Jain
Professor of Economics
University of Allahabad

DEPARTMENT OF ECONOMICS
FACULTY OF COMMERCE
UNIVERSITY OF ALLAHABAD

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Summary

Introduction

Land, water and vegetation are the most precious natural resources and their importance in human civilization needs no elaboration. In fact, life on earth is impossible without land, water and vegetation. However, degradation of natural resources is increasing due to fast pace of biotic pressure through anthropogenic activities. The needs of agriculture, industrial, domestic and others often result in diversion of water from one use to other. In rural areas, livelihoods and natural resources such as land water and vegetation are interlinked. Therefore, it is essential that natural resources are managed optimally for sustenance of life and development.

Sustainable and efficient management of water, land, vegetation and agriculture is an increasingly complex challenge in India. Increasing population, growing urbanization and rapid industrialization, combined with the need for raising agriculture production, generate competing claims over water. This phenomenon is further aggravated by temporal and spatial distribution of precipitation in the Indian subcontinent. This often causes floods and droughts in India. These conditions occur either due to excess or inadequacy of rainfall, lack of irrigation facility or over-exploitation of ground water.

Rain-fed agriculture in India's semi-arid tropics is characterized by low productivity, degraded natural resources and widespread poverty. The people of semi-arid tropic areas mostly depend upon agriculture and natural resources management for their livelihood.

As a result of green revolution, India achieved the objective of achieving self-reliance in food production, but, it was confined primarily to irrigated tracts. A major part of the country, which is rain-fed, was by-passed by the green revolution and experienced little or no growth in agriculture production for several decades. These regions have been victims of neglect on policy front. Now it is being realized that the development of these regions, in terms of enhancing the crop yield, hold the key to future food security of the country, because the areas where green revolution took place do not show any further improvement in agriculture productivity. Optimum and plateau productivity levels in
these regions have been achieved and their potential in meeting future demand is limited. Green revolution in Asia increased the cereal production tremendously by intensification of agriculture. This intensification has met the world’s demand for food, but, mal-distribution has not reduced hunger and poverty dramatically, while intensification has also brought environmental problems of its own. Intensive cropping, excessive and inappropriate agro-chemicals pollute, poison and alter the natural ecosystem. Wasteful irrigation has contributed to scarcity of water, unsustainable pumping of water and degradation of prime agricultural land.

Now it is being realized that optimal management of natural resources, land water and vegetation, with minimal hazard, is essential for human survival and sustainable development.

Watershed management programmes have been taken up extensively since 1995, for reclamation of nearly 147 Mha of existing degraded land in the country and development of 60% rain-fed area of country.

India has, over the past five decades, increased its annual food production from 50 million tones in 1950-51 to 255.36 million tons in 2012-13 (Department of Agriculture & Cooperation, 2013). The increase in production and productivity was the result of increased inputs, mainly nutrients, and water, high yielding varieties, and partly because of an expanded cultivated area.

In 1994, a technical committee under the chairman of C. H. Hanumantha Rao was appointed to assess Drought Prone Areas Programme (DPAP) and Desert Development Programme. The committee, after careful appraisal, opined “The degradation of environment in dry land areas is basically attributable to increase in biotic pressure on the fragile ecosystem in the absence of adequate investment and appropriate management practices to augment and conserve the land and water resources. Population growth and poverty on one hand and rising demand from affluence on the other have been exerting powerful pressure on ecosystem. The macroeconomic policies which provide inducement to the over exploitation of natural resources, that is, at a higher rate than the rate of regeneration, are also responsible for denudation of environment. For example, in the dry land areas, the pumping of water has been proceeding at faster rate than the rate at which
ground water is being recharged. The traditional community based institutions have given place so far to individualized or market driven exploitation of natural resource without any regard to adverse externalities of such action. Numerous official programmes for development of land and water resources which are dependent entirely on top-down bureaucracy have very little participation from village communities”.

Watershed programme is one of the means to address regional resource management programme for addressing the shortage of water as it will also solve temporal and spatial distribution of rainfall over the Indian subcontinent. Watershed development programme is addressing the problem of rain - fed agriculture in India. Watershed management has emerged as a new paradigm for planning development and management of land, water and biomass resources, with a focus on social and environment aspects, following a participatory approach. It aims at integration of social resource management with natural resource management. The approach is generally preventive, progressive, corrective and creative. Watershed management involves the judicious use of natural resources with active participation of institutions and organisations in harmony with the ecosystem.

The Drought Prone Area Programme (1973-74) was the first major programme aimed at soil and moisture conservation. The basic objective of the programme was to minimize the adverse effects of drought on production, crops, livestock and productivity of land. The programme also aimed at promotion of overall economic development and vulnerable sections.

The desert development programme (DDP) was introduced in 1977-78 and major objectives of the programme are to restore the ecological imbalance, conservation of soil and water and to arrest the promotion of deserts through shelter- belt plantation.

The integrated wasteland development programme (I.W.D.P), started in 1989-90, seeks to develop government wasteland and common property resource (CPRs) based on village/micro watershed plan. The I.W.D.P. is aimed at overall economic development and improving the economic condition of resource - poor population.

To involve village communities in implementation of watershed project under all the area development programmes, namely, Drought Prone Area Programme, Desert Development Programme and Integrated Waste Land Development Programme, the Government of India issued new guidelines for watershed development w.e.f. 1995 and
subsequently, it was revised in August 2001. The new guideline “Hariyali” (2003) was issued to further simplify procedures and involve Panchyati Raj Institutions more meaningfully in planning, implementation and management of economic development activities in rural areas.

The objectives of present study are to make a comprehensive assessment of economic effects of watershed Development Programme in Allahabad district to consider the change in:

1. Production of various crops-Wheat/Rice/Coarse Cereals/Oilseeds/Milk/Vegetable.
2. Consumption of various crops.
3. Sale of various crops.
4. Productivity of various crops.
5. Fodder availability and milk production.
6. Cropping intensity and cropping preferences.
7. Economic status of farmers.

Researcher evaluated the watershed impact on production of wheat, rice, and coarse cereal, pulses, vegetable, oilseed and milk production and also effect on productivity of various crops. The study also compares effect on production and productivity before and after the completion of programme. The study also covers effect of programme on irrigation facility, fodder availability, cropping intensity, crop preferences, etc.

Hypotheses

1. \( H_0 \) - Watershed development programme in Allahabad district has no impact on agricultural production.

\( H_1 \) - Watershed development programme in Allahabad district impacts agricultural production

2. \( H_0 \) - Watershed development programme in Allahabad district has no impact on agricultural productivity.

\( H_1 \) - Watershed development programme in Allahabad has positive impact on agricultural productivity.

3. \( H_0 \) - Watershed development programme in Allahabad district has no impact on cropping intensity.
H1- Watershed development programme in Allahabad district has positive impact on cropping intensity.

4- H0- Watershed development programme in Allahabad district has no impact on improvement in availability of water for livestock.

H1- Watershed development programme in Allahabad district impacts improvement in availability of water for livestock.

5- H0- Watershed development programme in Allahabad district has no impact on fodder availability for livestock.

H1- Watershed development programme in Allahabad district has impact on fodder availability for livestocks.

6- H0- Watershed development programme in Allahabad district has no impact on level of water source.

H1- Watershed development programme in Allahabad district impacts on level of water source.

7- H0- Watershed development programme in Allahabad district has no impact on economic status of farmers.

H1- Watershed development programme in Allahabad district impacts on economics status of farmers.

Methodology of Study

The present study is based on primary and secondary data. Secondary data obtained from Department of Land Resources, Ministry of Rural Development, Govt. of India, Department of Land Development and Water Resources U.P, Uttar Pradesh Statistical Abstract 2008, Uttar Pradesh Statistical Dairy 2012, Allahabad District Statistical Patrika 2012, Allahabad District Statistical Handbook (of various years), etc. Researcher prepared a structured schedule for pilot survey. The schedule was pre-tested with 80 respondents in five selected villages. Twenty respondents each were selected from Ankoria, Pagwar Bakuliha and Bhatauti villages and 10 respondents each selected from Pataidandi and Jhariyati. Pilot survey resulted in certain modifications and corrections and, after that, final schedule was prepared. The final interview schedule contained multiple choice questions on various likert scales. The final schedule was prepared to
observe the economic impact of watershed development after the programme. For impact evaluation of watershed development programme, 2006-07 was considered as before the programme and after the programme reference year.

Interviewee schedule contains 57 questions on different likert scales. Schedule was divided in 5 sections. First section contains personal information, type of house, annual agriculture income before and after the programme and size of land holding, etc. The second section is related to effect of watershed development on production of wheat, rice, coarse cereals, production of pulses, oilseed, vegetable production, etc. Section 3-A of schedule is related to the effect of watershed development programme on productivity of wheat, rice, coarse cereals, pulses and oilseed on five point likert scale. Section 3-B contains questions related to effect of watershed development programme on cropping intensity and effect of programme on crop preference.

Section-4 is related to the information of effect of watershed development programme on household items, education of children, health expenditure. Last Section -5 is related to information about water availability, level of water source, fodder for livestock, etc. Economic status of the farmer defined as annual agriculture income of the farmer which means that increase in income shows improvement in economic status of farmers.

Data were computed from Uttar Pradesh Statistical Abstract-2008 to the select top five districts, where agriculture land holdings depend upon the monsoon: Banda (63.1%), Bahraich (48.5%), Jhansi (41.1%), Jalauan (33.3%) and Allahabad (23.8%). One district was randomly selected out of these five districts and which was Allahabad where, incidentally, land holding was least dependent on the monsoon among five districts. At the same time, it had fourth rank in terms of land holdings (3,15,648). Further, regarding sampling among three districts Banda, Bahraich, Allahabad, Banda clearly should have been selected, as it had the highest percentage of rain-fed holding dependent on least actual rain fall. But Allahabad was randomly selected.

The Allahabad district is divided in 20 development blocks. Watershed development programme was operational in 6 blocks in 2006-07. Shankargarh, Meja, Karchhana, Koraon, Kaundhiyara, Jasra. Researcher selected two blocks randomly, namely,
Shankargarh and Meja. The number of households in Shankargarh and Meja are 22745 and 22590 respectively, with ratio being approximately 1:1. Sample size was kept at 400 for 5% error margin (Niles, 2006). Therefore, 200 respondents from Shankargarh and 200 from Meja were randomly selected on proportional basis.

Watershed Development Programme was operational in five villages of Shankargarh block and in 11 villages of Meja block and their ratio was approximately 1:2 in 2006-07. Therefore, researcher selected two villages through proportionate random sampling, namely, Pagwar Bakhuliha and Ankoria from Shankargarh and four villages Bhatauti 1st, Bhatauti 2nd, Jhariyati, Pataidandi from Meja block. There are 200 households in Pagwar Bakhuliha and 138 households in Ankoria in Shankargarh block. 118 respondents were randomly selected from Pagwar Bakhuliha and 82 selected from Ankoria, according to their household ratio of 1:0.7.

In Meja block, there are 563 households in Bhatauti (comprising both I & II), 134 household in Jhariyati and 156 in Pataidandi. Therefore, researcher selected 132, 31, and 37 respectively from Bhatuti, Jhariyati and Patidandi, according to their household proportion of 1:0.24:0.28.

The respondents in each village were selected through systematic random sampling. SPSS 20.0 was used and hypotheses tested by Regression, Z, t, X² and F-test, along with finite population correction factor where necessary, and interpretations were drawn accordingly.

**Secondary Data Findings**

**Wheat-**

67.9% variation in wheat productivity is explained by wheat irrigated area. In the district, enhancement in level of wheat irrigation had positively affected the wheat productivity over the years. t-test, assuming \( \beta_1 \neq 0 \), is significant for 8 degrees of freedom at 5% level of significance. Therefore, \( \beta_1 \neq 0 \) and it can be said that wheat irrigated area had positive effect on the wheat productivity.

62.6% variation in production (dependent variable) is explained by independent variable wheat irrigated area. Watershed development had positive impact on wheat production.
via enhancement in irrigation facility. t-test value, $\beta_1=0$, value, is significant for 8 degrees of freedom at 5% level of significance. Therefore $\beta_1$ is not equal to zero and it can be concluded that wheat irrigated area and wheat production are positively correlated.

**Rice**

54.8% variation in rice productivity explained by rice irrigated area. Rice productivity does not depend upon only irrigation facility. t-test applied for $\beta_1=0$ and value is significant for 8 degrees of freedom at 5% level of significance. Therefore, it can be said that rice irrigated area and rice productivity is positively correlated.

56.0% variation in rice production explained by rice irrigated area. Rice production does not depend only upon irrigation but is also depend upon other important variable. t-test applied, assuming $\beta_1=0$, and value is significant for 8 degrees of freedom at 5% level of significance. Therefore, it can be said $\beta_1 \neq 0$ and rice production and rice irrigated area are positively correlated.

**Coarse Cereals**

16.3% variation in coarse cereal productivity is explained by coarse cereal irrigated area. t-test also applied for productivity to check the significance $\beta_1=0$ value is insignificant for 8 degrees of freedom at 5% level of significance showing regression coefficient is not statistically significant and hence no correlation.

37.0% variation in coarse cereal production explained by coarse cereal irrigated area. Coarse cereals cultivation requires little irrigation facility and coarse cereal crops are rain fed crops. Therefore, irrigation facility for coarse cereal does not enhance coarse cereal production and productivity significantly. t-test shows $\beta_1=0$ is insignificant for 8 degrees of freedom at 5% level of significance. Hence no correlation is found.

**Pulses**

19.2% variances in pulses productivity is explained by pulses irrigated area. Therefore, irrigated area has very little impact on pulses production and productivity. t-test $\beta_1=0$, value is insignificant for 8 degrees of freedom at 5% level of significance, showing no correlation.
16.8% variance in pulses production is explained by pulses irrigated area. Regression test applied, taking pulses irrigated area as independent variable and pulses productivity as dependent variable. t-test $\beta_1=0$, is insignificant for 8 degree of freedom at 5% level of significance. Thus variables are not correlated.

**Oilseeds**

58.7% variation in dependent variable oilseeds productivity is explained by dependent variable. t-test $\beta_1=0$ is significant for 8 degrees of freedom at 5% level of significance. Hence regression coefficient is significant.

52.2% variation in oilseed production explained by oilseed irrigated area. Oilseed production does not only depend upon irrigation facility. There are many factors such as fertilizers, HYV seeds, soil fertility, etc. t-test $\beta_1=0$, value is significant for 8 degrees of freedom at 5% level of significance showing regression coefficient is significant.

**Potato**

20.7% variation in potato productivity is explained by potato irrigated area. Therefore, there is little variation in productivity after increase in potato irrigated area. t-test $\beta_1=0$, insignificant for 8 degrees of freedom at 5% level of significance. Thus, no significant correlation is found.

29.8% variation in potato production is explained by potato irrigated area. Therefore, increase in irrigated area had little impact on potato production. t-test $\beta_1=0$ and value is insignificant for 8 degrees of freedom at 5% level of significance, showing no correlation.

**Fertiliser Consumption in Allahabad District**

66.4% variation in variable fertilizer consumption is explained by independent variable area sown more than once. t-test $\beta_1=0$, is significant for 6 degree of freedom at 5% level of significance. This shows positive correlation.

**Fertiliser Consumption in Meja**

84.9% variation in dependent variable fertiliser consumption is explained by independent variable area sown more than once. t-test also calculated $\beta_1=0$ value is significant for 6
degrees of freedom at 5% level of significance showing regression coefficient is significant. This shows positive correlation.

Fertiliser Consumption in Shankargarh-

66.5% variation in dependent fertilizer consumption variable is explained by independent variable area sown more than once. t-test also calculated $\beta_1 = 0$ and value is significant for 6 degrees of freedom at 5% level of significance. This shows positive correlation

Primary Data Finding-

We now come to the main findings of our survey study. These are given sequentially with regard to (a) Irrigation facility (b) Production, Consumption and Sales of various crops under study, (c) Productivity of these crops (d) Cropping intensity (e) Water and Fodder availability for Live-stocks (f) Level of water source (g) Economic status of farmers.

These findings are divided in three parts (a) Some inter-village differentials for some indicators (b) Inter-block differentials (c) Overall differentials.

Some Inter-village differentials-

Wheat-

91.1% respondents who cultivated wheat positively replied that watershed development increased wheat production. There are variations in production among five villages eg. Ankoria (Shankargarh) was highly impacted by watershed development programme while least affected by the programme is Jhariyati (Meja). In Ankoria, 96.3% respondents replied that their wheat production level increased after implementation of watershed development programme. The variation in wheat production across villages is due to better implementation of programme, and good soil fertility in Ankoria. Jhariyati is least affected because of poor management of watershed resources and bad quality of soil fertility in village.

Pagwar Bakuliha’s wheat consumption increased 53.3% in comparison with other selected villages. Wheat consumption did not increase with simultaneous increase in wheat production in villages because, in some villages such as Ankoria, consumption level was already high before the programme, overall 57.1% responded that their
consumption level was same before and after the programme, while 42.8% respondent stated that their consumption level of wheat increased.

Out of 320 respondents who sold wheat, 297 (92.8%) respondents wheat sale increased after the programme. In five selected villages, wheat sale in Ankoria increased the highest in comparison with other villages. Overall, sale of wheat of all five selected villages increased but, in Jhariyati only 84% respondents reported in increased wheat sale, because watershed development in Jhariyati has not well impacted wheat production, as seen earlier.

Rice-

Watershed development programme has positive impact on rice production on across five villages. Out of 305 respondents who cultivated rice, 90.6% positively responded that there was increase in rice production. Major beneficiary of watershed development programme were Pagwar Bakuliha, Ankoria, Bhatuti. In Pagwar Bakuliha, 90.67% respondents agreed increased level of rice production due to of good irrigation facility. In Ankoria, 98.8% respondents reported increase. But in Jhariyati and Pataidandi (Meja), rice production increased comparatively less because water management in Jhariyati and Pataidandi, was not up to the mark in comparison with other selected villages.

However, rice consumption after watershed development programme did not increase in tandem with increase in production, because consumption levels might have been high before the programme. Therefore, rice consumption could not keep pace with rice production.

Out of 197 respondents who sold rice, 95.4% reported that there was increase in rice sale, because of wide impact of watershed development programme on rice production, due to increased water for irrigation.

Inter-block differentials

(A) Irrigation facility- In Shankargarh, 96% accepted that their irrigation facility increased after the program and in Meja, 88.5% said that watershed development programme had increased the irrigation facility. Thus, it is found that effect on irrigation
facility is dependent on block through Chi square test, because wider watershed area and proper management of water resources benefited Shankargarh more. At the same time, National Thermal Power Corporation had acquired watershed catchment area of Meja which badly affected water catchment area in Meja.

(B) Production, Consumption and Sale - 92.5% in Shankargarh block agreed that watershed development programme had positive impact on wheat production. In Meja, 89.5% replied that there was positive impact of watershed development programme on wheat production. Chi Square Test shows that watershed development effect on wheat production is independent of block.

In Shankargarh block, 47% positively responded in improvement of wheat production and In Meja block, 38% positively agreed that there was improvement in wheat consumption. The Chi Square test shows that wheat consumption is independent of block.

In Shankargarh block, 94.9% agreed that watershed development programme had positive impact on wheat sale while in Meja block 90.2% showed same. Chi Square test shows no significant difference between effects on wheat sale of watershed between blocks. Therefore, we can say that production, consumption and sale of wheat are independent of blocks.

94% farmers agreed that watershed development programme had positive effect on rice production in Shankargarh block, while 82.9% in Meja block said that there was positive impact of programme on rice production. Chi Square test shows that increase in rice production depends on block. It is significant to note that there were only 105 farmers in Meja that cultivated rice. Rice cultivation requires ample and timely irrigation facility, which increased less in Meja block, compared to Shankargarh block because, watershed catchment area and check dam was small and also, National Thermal Power Corporation had acquired some catchment area in Meja block.

In Shankargarh block, 51.5% replied that watershed development programme enhanced the rice consumption but in Meja block 69.5% agreed that their consumption of rice increased after the programme. Rice consumption enhancement is more significant in Meja block in comparison with Shankargarh because may be, consumption level of rice
in Shankargarh block was already high before the programme. Therefore, enhancement in rice production has little impact on rice consumption in Shankargarh block comparatively. Chi square test shows that rice consumption enhancement was dependent on block, with Meja block showing more enhancements compared to Shankargarh.

In Shankargarh block 96.4% said that their rice sale increased after the programme and, respondents in Meja block 89.7% respondents said that rice sale increased after the programme. Sales are independent of blocks.

Thus, we may conclude that rice production and sale increased in Shankargarh, while consumption increased in Meja block after the implementation of the programme. This increase in consumption of rice in Meja appears to be the result of a change in consumption pattern at the expense of wheat consumption, as seen.

Thus we can say that rice production and consumption is dependent on blocks while sale is independent of blocks.

In Shankargarh, 46.2% said that their coarse cereal production increased after the programme, but it is significant to note that out of 200 respondents in Shankargarh block, only 26 farmers were growing coarse cereal, showing that coarse cereals preference was very low in Shankargarh block. In Meja block, 56.9% said that their production increased. Coarse cereal cultivation does not require ample irrigation facility. Therefore, watershed development programme had little impact on coarse cereal production.

Out of 26 respondents in Shankargarh block, 57.5% said that their consumption level was same, before and after the programme, and 26.9% said that their consumption level increased after the programme. 15.4% said that their consumption level decreased. In Meja block, 56.9% respondents said that their consumption level decreased after the programme, as a result of increase in income via enhancement in production of wheat and rice, especially in Meja block. Chi Square test shows that effect on coarse cereal consumption is dependent on the blocks. Sales are dependent on blocks.

In Shankargarh block, 71.8% agreed that watershed development programme had positive impact on pulses production and, in Meja block, 67.7% respondents said that their pulses production increased after the programme. Pulses cultivation requires very small irrigation facility, therefore programme had positive impact in both blocks. Chi square test shows that pulses production was independent of blocks.
In Shankargarh block, 55.1% accepted that their pulses consumption increased after the programme and, in Meja block, 32.3% said that watershed development had positive impact on pulses consumption. It is significant to note that pulses consumption level did not increase in tandem with production of pulses in Meja block because consumption level was already high before the programme and in Shankargarh block enhancement in income and pulses production might have impacted on high pulses consumption. Chi Square test shows that pulses consumption was dependent with block.

In Meja block, 69.4% said that watershed development programme had positive impact on pulses sale. The total respondents in Shankargarh block is low, therefore researcher did not compare between blocks, as the analysis might be distorted.

90.6% said that programme had positive impact on oilseed production in Shankargarh block, and in Meja block, 87.3% respondents agreed that watershed development programme had positive impact on production of oilseed. Chi square test shows that effect on production of oilseed was independent of block.

In Shankargarh block, 53% said that their consumption of oilseed increased after the programme. In Meja block, 27% respondents said that watershed development programme had positive impact. Chi square test shows that oilseed is dependent on blocks. Reason behind this may be that oilseed consumption is positively related with income and, we have seen earlier that Shankargarh benefited more from the programme, because production and productivity of wheat and rice increased more in comparison with Meja and this had led to enhancement in oilseed consumption.

In Shankargarh block, 93.8% said that their oilseed sale increased after the implementation of the programme and in Meja, 89.7% respondents agreed that programme had positive impact on oilseed sale. Chi square test shows that watershed development programme impact on oilseed is independent of blocks.

(C) Productivity- Wheat productivity in mean quintal per bigah was 5.17 and 8.31 before and after the programme. In Meja, wheat productivity mean was 4.49 and 6.8 quintal per bigah before and after the programme. In Shankargarh, the wheat productivity growth before the programme increased to 60.7% after the programme and, in Meja
block, wheat productivity growth rate was 54.5%. However, Chi Square test shows mean increase was independent among blocks, while F-test shows variation between block is significant. Z-test shows that wheat productivity increased significantly after the programme in Shankargarh and Meja block both.

Mean level of rice productivity was 5.24 and 7.29 quintal per bigah before and after the programme in Shankargarh and growth rate is around 39%. In Meja block, rice productivity mean increased from 4.2 to 6.1 quintal per bigah and growth rate is around 45.23%. The rice productivity growth in Meja block increased comparatively more because rice productivity initially was very low in comparison with Shankargarh block before the programme. Z –test shows that in Shankargarh and Meja blocks, rice productivity increased significantly after the programme in Shankargarh block. F-test shows variation is significant.

Mean of coarse cereal productivity in Shankargarh block increased from 2.6 to 3.7 quintal/bigah and growth rate is around 42.3%. In Meja block, mean level of coarse cereal productivity increased from 2.25 to 3.5 quintal per bigah and growth rate is around 55%. Z-test in Meja block shows that watershed development programme increased coarse cereal productivity significantly. t-test shows that in Shankargarh block, watershed development programme increased coarse cereal productivity significantly.

Mean level of pulses productivity increased from 2.4 to 4.3 quintal per bigah in Shankargarh block and growth rate of productivity is around 79%. Mean level of wheat productivity of Meja block increased from 2.4 to 3.6 quintal per bigah and growth rate of productivity is 71.42%. Therefore, we can say that pulses cultivation productivity benefited from watershed development programme in both blocks. Z-test shows that pulses productivity in Shankargarh and Meja block increased significantly. F-test shows variation is significant.

Mean level of oilseed productivity increased from 2.4 to 5 quintal per bigah and growth rate was around 108% in Shankargarh block. In Meja block, mean oilseed productivity increased from 2.1 to 4.1 quintal per bigah and growth rate was around 95.2%. Therefore, we can conclude that oilseed productivity increased more in Shankargarh block in comparison with Meja block, because irrigation facility improved more in Shankargarh block.
Z-test shows that in Shankargarh block, programme increased the oilseed productivity significantly. Z-test also shows that in Meja block, oilseed productivity increased after the programme significantly. F-test shows that inter-block variation is significant.

**Cropping Intensity**

In Shankargarh block, respondents who grow two crops on same field increased from 50.5% to 91% from before the programme to after the programme. In Meja block, number of respondents who grow two crops increased from 36.5% to 92.5% before to after the programme. However, there was hardly any real improvement regarding three crops.

This shows the disparity between blocks reduced in number of crops grown on same field after the programme. The Chi Square test value is significant. This shows that improvement in cropping intensity depends on blocks, with Meja showing better results.

**Fodder and Water availability for Livestock**

In Shankargarh block, 83.5% said that water availability for livestock had increased. In Meja block, 75.5% said that watershed development programme had positive impact on water availability of livestock. However, Chi square value was insignificant. Therefore, it can be concluded that water availability increase was independent of block.

In Shankargarh block, 61% said that fodder availability increased due to enhanced moisture from check dam. In Meja block, 63% agreed that watershed development program had positive impact on fodder availability. Chi square test value was insignificant, showing that fodder availability was independent of block.

**Level of Water source**

In Shankargarh block, 66% said that ground water level increased after the programme. In Meja block, 48.8% said that ground water level increased. This was due to water storage in check dam after the implementation of programme in both blocks. Chi Square value was significant. Therefore, watershed level of water source is dependent on block. Wider catchment area and larger check dam in Shankargarh had increased water level of water source in comparison with Meja block.
Economic Status of Farmers-

Z-test for Meja block for mean annual agriculture income was significant. Therefore, it can be concluded that programme also affected mean level of annual agriculture income in Meja block. Z-test was significant for Shankargarh, showing that watershed development programme had increased income in Shankargarh block via enhancement in production and productivity of various crops.

Overall Differentials-

Wheat-

91.1% respondents who cultivated wheat positively replied that watershed development increased wheat production, 42.9% said that their wheat consumption increased after the programme due to high consumption base. 92.8% respondents said that wheat sales increased after the programme.

Rice-

Out of 305 respondents who cultivated rice, 275 (90.6%) positively responded that there was increase in rice production. Only 57.5% respondents reported that their rice consumption increased after the programme. This was due to higher consumption base in Shankargarh. Out of 197 respondents who sold rice, 95.4% reported that there was increase rice sale, because of wide impact of watershed development programme on rice production due to increased water for irrigation.

Coarse Cereals-

Out of 170, only 55.3% respondents positively concluded that there was positive impact of watershed development programme on coarse cereals production, however, it could not keep pace with production of rice and wheat, because coarse cereal such as Bajra and Maize do not require much irrigation. Out of 170 respondents, only 7.6% reported that there was increase in consumption level and 41.8% reported that consumption level was same. 50.6% stated that their consumption level decreased. Watershed development enhanced the production of other agriculture commodities, therefore, increase in production of wheat and rice would have reduced consumption of coarse cereal through a shift in the consumption pattern in Meja block.
Out of 152 respondents, 126 (82.8%) positively reported that coarse cereal sales increased after the programme. Watershed development programme enhanced income of respondents via increase in production and consumption of wheat, rice, oilseed, etc. and consumption was reduced so, obviously, sales increased.

**Pulses-**

Out of 211 respondents, 69.2% agreed that their pulse production had increased and 30.8% respondents concluded that there was no change. Production of pulses also could not keep pace with increase in production levels of wheat and rice, because pulses production does not require much irrigation. Out of 211 respondents, 40.8% positively responded that there was increase in pulses consumption, while 59.2% replied that there was no effect in consumption of pulses. 81 (73.0%) respondents positively agreed that watershed development programme had positive impact on pulses sale. As we have seen, there was no significant change in pulses consumption, therefore increase in production led to increase in pulses sale.

**Oilseeds-**

Out of 275 respondents, 245 (89.1%) positively replied that Watershed Development Programme had significant effect on oilseeds production. Oilseeds cultivation requires irrigation facility at crucial times, which was not available in these drought prone areas, therefore watershed development programme had significant effect on production of oilseed via enhancement in irrigation facility. 41.1% (113) agreed that watershed Development Programme had positive impact on consumption of oilseeds. It may be also conceded that oil seed production enhancement did not lead to enhancement of consumption level after the programme. 91.7% agreed that there was increase on oilseeds sale.

**It was found that first alternate hypothesis is accepted on proportional basis that Watershed Development Programme in Allahabad district positively impacts agricultural production.**
Productivity-

Wheat-

Watershed Development Programme increased wheat productively significantly. There were 226 respondents in 3-5 quintal/per bigah slab before the programme but, after the implementation of the programme, only 14 respondents remained. There were only 14 respondents in 7-9 quintal/per bigah but, after the implementation of the program, their frequency increased to 151. It is significant to find that maximum limit of 7-9 quintal/bigah increased to 11-13. It is found that alternate hypothesis is accepted at 5% level of significance that there was significant difference between wheat productivity before the programme and after the programme.

Rice-

Watershed Development Programme positivity impacted the level of rice productivity, due to enhancement in irrigation facility. There were 193 respondents in the class interval 3-5 bigah/per quintal but, after the implementation of the programme, only 14 respondents remained. There were only 15 respondents in class interval 7-9 quintal/per bigah before the implementation of programme but, after the implementation of the programme, there were 118 respondents, showing a quantum jump. Also, 68 respondents reported more than 9 quintal/bigah, which is a big achievement.

Researcher accepted alternate hypothesis at 5% level of significance that there were significant differences in mean level of rice productivity before and after the programme.

Coarse Cereals-

There are 143 respondents in class interval of 1-3 quintal/per bigah coarse cereal productivity but, after the implementation of the programme, the frequency decreased to 50. Also, higher level class interval 3-5 quintal/per bigah increased from 27 to 103 respondents. Mean level of coarse cereal productivity before the programme was 2.31 and increased to 3.61 after the implementation of the programme. Z test shows that mean level productivity of coarse cereal increased significantly.
Researcher accepted the alternate hypothesis at 5% level of significance that there were significant mean differences in coarse cereal productivity before and after the programme.

**Oilseed Productivity**-

There were 188 respondents in 1-3 quintal/per bigah class interval pulse productivity before the programme but, after the programme, only 48 respondents remained. Similarly, after implementation of the programme, the frequency of class interval 3-5 pulses productivity increased from 22 respondents to 126 respondents. Frequency in 5-7 class has also increased and 1 respondent reported productivity of 7-9 quintal/bigah. Z-test shows that oilseed productivity increased significantly.

Thus, second alternative hypothesis is accepted on basis of Z-test at 5% level of significance that Watershed Development Programme in Allahabad has positive impact on agricultural productivity.

**Cropping intensity**-

Cropping intensity before and after programme shows that frequency and percentage of respondents who grow one crop diminished dramatically from 218 (54.5%) to 8 (2.0%). The respondents who grow two crops annually increased from 174 (43.5%) to 367 (91.8%). It is significant to note that three crops were grown by 25 farmers compared to the initial 8. Thus, watershed development programme led to improvement in cropping intensity.

Thus, it was found that third alternate hypothesis is accepted on proportional basis that Watershed Development Programme in Allahabad district has positive impact on overall agricultural cropping intensity.

**Water for Live-stocks**-

79.5% respondents agreed that watershed development programme had positive impact on water availability for live-stock due to check dams, which increased storage of water.

Therefore, fourth alternate hypothesis is accepted on proportional basis that Watershed Development Programme in Allahabad district shows improvement in availability of water for livestock.
Fodder availability-

248 (62%) respondents agreed that watershed development programme has positive impact on fodder availability via enhancement of storage water in check dam. The moisture content in grazing area near check dams increased after the implantation of the programme and it resulted in increase in availability of fodder adjacent to check dams. It is found that fifth alternate hypothesis is accepted on proportional basis that Watershed Development Programme in Allahabad district has positive impact on fodder availability for livestock.

Water storage checks a further decline in ground water table. This is seen by the fact that 228(57%) respondents reported improvement in the water level. However, it cannot be concluded that effect of programme was significant because ground water level enhancement has a long gestation period.

Thus it, is found that sixth alternate hypothesis is accepted on proportional basis that Watershed Development Programme in Allahabad district positively impacts on level water sources.

Economic status of Farmers-

Analysis of annual agriculture income shows that annual agricultural income after the programme increased significantly. There are only 19(4.8%) respondents with Rs. 30000 & above of annual agriculture income before the programme but, after the programme, their frequency increased to 106(26.5%). There are only 31(7.8%) respondents in class interval of Rs. 25000-30000 of annual agriculture income before the programme but, after the programme, increased to 71(17.8%) respondents.

It further proves that Watershed Development Programme has positive impact on annual agriculture income. It was found that mean level of income before the programme was Rs. 16,870 and, after the programme, it was Rs 23,270. It was also found that value of Z was significant. Therefore, researcher accepted the alternate hypothesis that Watershed Development Programme had positive impact on annual agriculture income.
It was found that seventh alternate hypothesis is accepted through Z-test at 5% level of significance that Watershed development programme in Allahabad district impacts on economics status.

Conclusions-

Production and productivity of wheat, rice and oilseeds increased over the years in Allahabad district, but there is no significant improvement in production and productivity of the Coarse Cereals, Pules and Potato. Coarse cereals and pulses are rain-fed crops. Therefore, their production and productivity have little improvement, in spite of the improvement in irrigation intensity over the years. Government has also paid little attention in the development of high yielding varieties of coarse cereals and pulses. Improvement in the irrigation facility has also changed the cropping pattern in the district in favour of wheat and rice in over the years. Enhancement in the irrigation facility in the district and Meja, Shankargarh blocks can be corroborated by the fact that fertilizer consumption increased over the years, and without the improvement in the irrigation facility, it was not possible for the improvement in use fertilizer in the blocks and district.

Production and productivity of wheat and rice increased in both selected blocks, but there was little improvement in the consumption of wheat and rice in Shankargarh, due to high consumption level before the programme, but rice consumption in Meja increased more in comparison with the Shankargarh, due to change in consumption pattern after the programme. Coarse cereals production increased in both blocks. But coarse cereal cultivation does not require ample irrigation facility. Therefore, watershed development programme had little impact on coarse cereal production. Pulses production increased in both blocks but is also rain-fed crops and requires little amount of irrigation, therefore programme had little impact on the pulses production in comparison with cereals. Pulses consumption was initially high in Meja block compared to Shankargarh block, therefore after the programme, pulses consumption in Meja block increased less to Shankargarh block. Oilseeds production increased in both blocks and high consumption enhancement was found in the Shankargarh block due to improvement in the income level.
Wheat productivity increased in both blocks, but rice productivity growth was more in the Meja block due to low productivity levels before the programme. Coarse cereal productivity increased in both blocks, but growth rate was more pronounced in the Meja block because, there was little irrigation facility available before the programme but, after the programme, enhancement in irrigation facility increased the timely seeding of pulses in the blocks. Oilseeds productivity increased in more in Shankargarh block because of improvement in the irrigation facility after the programme. Cropping intensity increased in both blocks, but major improvement was found in the Meja block due to low base effect. In both blocks, Meja and Shankargarh, watershed development programme had positive impact on water availability of livestock, but more pronounced effect was seen in Shankargarh due large catchment area and bigger check dam in comparison with Meja block. Fodder availability increased in both blocks, and there was no major difference in enhancement in the fodder availability. Level of water sources increased in the Shankargarh in comparison with Meja block because, wider check dam led to more improvement in ground water table in Shankargarh. Annual agriculture income increased more in Shankargarh block because more commercialization wheat rice and oilseeds in the block in comparison with the Meja block.

**Suggestions**

The country’s farm sector accounts for 83% fresh water use, but excess water leads to wastage of nutrients. The Economic Survey 2012-13 admits that irrigation efficiency is low for both surface and groundwater in the country, as due to high levels of seepage and evaporation losses, the flood irrigation efficiency is at 40%, compared with micro irrigation system, where efficiency ranges between 75% to 90%. Therefore, there is need to switch over from the macro irrigation system to micro irrigation and this will reduce the water use by half. Micro irrigation system is key solution in rain-fed areas, where ground and surface water is scarce, because the micro irrigation system, backed by ideal farm practices, is answer to growing more with minimum water as weather is now prone to delivering nasty surprises.

However, micro-irrigation systems are very expensive and can cater to only small tracts of land. Thus, they are not very efficient in providing irrigation to farms. We suggest
there should be some level of integration between micro and macro irrigation system to arrive at an optimal solution.

Feasibility of larger check-dam should be explored to safeguard against the adverse effect of climate change as El Nino. Indian agriculture is chronic rain dependent and any negative variation in it has a huge impact on production. This sometimes leads to food shortages and consequent import of the same. This enhances food inflation and current account deficit. Unfortunately, Watershed Development Programmes, at present, have check-dams which can hold small quantity of water and proved inefficient in providing irrigation water in case of truant monsoon, or so called El Nino effect. We, therefore, suggest feasibility studies may be conducted to explore the possibility of larger check-dam which can hold adequate water to combat the vagaries of nature.

There should emphasis on augmenting the availability the fodder in rain-fed areas; also, attention should be paid on enhancement of natural pastures and common grazing lands for development of dairy and allied activities in these areas, because vast and ample opportunity is available for this sector and, therefore, this must be utilized for development of rain-fed areas.

Government should look in possible transfer of the water from abundant area to water scarce or rain-fed area through development small and concrete canals which also will less degrade the adjacent areas, small canal development can be feasible approach in comparison with interlinking of rivers.

It is a matter of concern with regard to special problematic land where USAR and Alkaline, Water logged and Diara & Khadar land continue to be untreated to the extent of 50-80% in Uttar Pradesh. If these lands are treated further, they can enhance production, specially cereals and food grains. Remedial measures are of paramount importance to improve the production and productivity in affected district, along with agro forestry. Further treatment of usar and reh land in eastern districts can help increase production and cultivation of cereals.

In Allahabad district, other fallow land comprises 30920 hectares (5.8%) of total rural area of 534789 hectares, while unculturable land constitutes 2.5%; thus, more than 8% of
these lands together provide an opportunity for watershed projects to make them fit for cultivation, specially the former, where cultivation is done at irregular intervals of three to five years, due to various reasons, like irrigation facility. The latter can be used through use of gypsum to treat USAR. This will have positive impact on production in Allahabad district and can be used to in Uttar Pradesh and country, wherever feasible.

**Limitations of Study**-

For DPAP and IWDP, fund utilization data were not available, hence it cannot be incorporated in the study.

Block and village level production and productivity secondary data were not available, so comparison was not possible with primary findings.

**Field observations**-

Despite the various guidelines of Government for participatory involvement of people in watershed management, it was found that government project- implementing agencies did not involve people.

Although check dams were created, but no money was provided for further maintenance of the check dam, and no specified regulation for further care of check dam was found.