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Irrigation development in Marathwada region

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Abstract

The growth rate of number of wells was highest in Nanded district in all three periods i.e. 4.01, 4.06 and 4.64 per cent per annum, respectively and lowest in Parbhani district i.e. -0.95 per annum. The growth rate of oil engines was highest in Latur district i.e. 13.82 per cent per annum and lowest in Parbhani district i.e. -14.69 per cent per annum. The growth rate of electric engines was highest as 14.57 per cent per annum in Beed district and lowest in Latur district as -0.45 per cent per annum. The growth in the area irrigated by surface sources was highest in Beed district i.e. 15.83 per cent per annum and lowest in Latur district i.e. -10.86 per cent per annum. The area irrigated by subsurface sources has highest growth rate of 11.69 per cent per annum in Nanded district and lowest in Parbhani district with 1.55 per cent per annum. The growth rate of area under surface irrigation was highest in Beed district and lowest in growth rate in Latur district. The growth rate of area under subsurface irrigation was highest in Nanded district and lowest in growth rate in Parbhani district. The growth rate of total irrigated area was highest in Osmanabad district with 11.32 per cent per annum and lowest in Parbhani district i.e. -1.34 per cent per annum. The growth in percentage gross irrigated to gross cropped area was highest in Latur with 12.17 per cent per annum and lowest in Aurangabad with -0.20 per cent per annum. Wheat irrigated area was highest in Aurangabad district as 429.10 hundred hectares. Growth rate was highest as 18.78 per cent per annum in Osmanabad district. The mean irrigated area under rabi jowar was highest in Beed district with 522.40 hundred hectares and growth rate was highest in Hingoli district as 15.84 per cent per annum in second period. The irrigated area was highest in Aurangabad district with 220.40 hundred hectares. The growth rate was highest in Latur district with 19.65 per cent per annum. The irrigated area under summer groundnut was highest in Parbhani district with 266 hundred hectares. The growth rate was highest in Aurangabad district with 9.38 per cent per annum. The Latur district was having highest irrigated area of 350.30 hundred hectares. The growth rate was highest in Osmanabad district with 13.65 per cent per annum.

Keywords: Irrigation, Growth Rate, Surface Irrigation, Sub-surface Irrigation

Introduction

Water constitutes one of the several inputs for crop production which feeds human being. Though water is renewable, it is finite. Therefore, water needs to be conserved and use efficiency. Availability of water is not regular as it is governed by the occurrence and distribution of rainfall. Hence it is highly essential to control water use and improve water use efficiency.

“Irrigation is the artificial application of water to promote growth of crops from different sources such as rivers, springs, lakes, wells etc.” Water is the most important input for enhancing agricultural productivity. India has numerous rivers with an estimated total catchment area of 252.8 m ha. The irrigation potential of India estimated to be 139.5 m ha in 2009-10. The ground water available for irrigation is 360 km³. The annual precipitation including snowfall, the main source of water in India is estimated to 4000 be km³. The amount of rainfall in various regions in the country is variable. Hence irrigation in India has been of primary importance. Though there has been a 161per cent increase in the land under irrigation in India over the past 4 decades, it is supposed to be only 33per cent of the estimated potential. The net irrigated area in the country is about 5.5 m ha. Through tanks 3.1 m ha, Canal 17.1 m ha, through tanks 3.1 m ha, tube wells 17.9 m ha, other wells 11.9 m ha and other sources including drip and sprinkler irrigation 6.5 m ha. The country as a whole receives good rainfall in the both monsoon seasons and there is ample scope for rainwater harvesting, storage and recycling. Through rainwater harvesting more cropped area can be brought under irrigation where total rainfall exceed 700 mm. per annum India has the second largest net irrigated area in the world after China. The irrigation efficiency under canal irrigation is not more than 40 per cent and for ground water schemes, it is 69per cent. The net irrigated area in the country 53.5 m ha which is about 38per cent of total sown area.

In India 70 per cent of agriculture land is dependent on the monsoon. Irrigation can conceived as an insurance against monsoon failure. In addition to insurance today's trend is to consider a

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viral input in maximizing the production. The major irrigation sources in India today are wells, canals, tanks which irrigate about 30 per cent of net cropped area of this wells account 49 per cent, canals 38 per cent and tanks 7 per cent. The traditional source of irrigation like tanks has a declining trend. The increase in groundwater exploitation is growing at a faster rate.

Maharashtra state as of today came into existence in 1960. The increasing population was facing shortage of food grains. This has led to need of increasing agricultural production. By giving priority to agricultural development, attempt has been made to achieve irrigation development in a planned manner. Adequate, timely and reliable water supply is a paramount importance in agriculture and irrigation development plays a key role in alleviating rural poverty.

In Maharashtra, the gross and net irrigated area during 2008-09 was 39.70 lakh ha and 32.55 lakh ha respectively. The percentage of gross irrigated area to gross cropped area was 17.7 in 2008-09 out of the net irrigated area, the area irrigated under wells was 21.15 lakh ha (65 per cent). The state government has undertaken various major, medium and minor irrigation projects to create maximum irrigation potential. However, there is a wide gap between potential created and utilized in major, minor projects. The total irrigation potential utilized in the state during 2009-10 was 30.5 lakh ha of which 17.71 lakh ha was from major irrigation projects, 3.67 lakh ha was from medium irrigation projects and remaining 9.12 lakh ha was from minor irrigation projects.

At present, farmers predominantly adopt the surface irrigation methods i.e. sprinkler and drip irrigation. Farmers are using surface irrigation methods on large scale yet it's field level application efficiency is often only 40-50 per cent In Maharashtra area under drip and sprinkler irrigation was 5.41 lakh ha and 2.71 lakh ha in March 2010, respectively. In Marathwada region total gross irrigated area was 9459 ha and total net irrigated area was 7540 ha in 1999-2000. Area under well irrigation was 5982 ha in 1999-2000.

Materials and Method

Keeping the view of the objective of study all the important aspects which were compositely deemed to depict the relationship was included in the study.

The analysis based on time series data has been done by large number of the scientists and which was suppose to have reliability in the data though in aggregate manner. The farmers generally a lot the water to different crops based on existing irrigation potential not only to increase their net returns but also the consider with them marketing of commodities availability of impacts with some component present in their way of thinking. Thus their behaviour as show a pure economic behaviour as the farming problems may be varied in nature and some times over shadow the economic aspects of cultivation.

The tools used were defined and specified in their manner of understanding.

Growth analysis

The growth analysis was done compounding in all the growth computations. The formula used as,

$$Y = a + b^t$$

The growth parameter has been expressed in percentage to the mean which was easy to understand for diver at period of time.

Stability analysis

The stability of the area of the crop was measured in terms of the coefficient of variation (C.V.).

$$C.V. = S.D. / \text{mean} \times 100$$

Though it was a crude measure it was used to have some understanding about the rate of fluctuations which may be due to the season technology relative prices etc. and which may differ from period to period.

Mean

In spite of the variations or fluctuating in the figure it was also interesting to know about the average for a certain period and ultimately this has a more meaning from the point of view of the farming community.

Irrigation ratios

Irrigation ratios also are important to compare the irrigation potential which exists in the districts and how this changing over the periods. The irrigation ratio is as below:

$$\text{Gross irrigated area} / \text{gross cropped area (in percentage)}$$

Terms and concepts used:

Irrigation

Irrigation is the artificial application of water to promote growth of crops from different sources such as rivers, springs, lakes, wells etc.

Surface irrigation

Intermittent application of water to the field surface under gravity flow which results in a series of 'on' of 'off' modes of constant of variable time spans.

Subsurface irrigation

Water is applied through underground perforated pipes, through deep trenches at 15-30 m intervals water gradually wets root zone through capillary movement.

Net irrigated area

Net irrigated area is defined as the area which irrigated once during a year.

Gross irrigated area

When net irrigated area is added to the area irrigated more than once we obtained the gross irrigated area.

Gross cropped area

Sometimes two crops in two seasons are grown during a particular year on the same area. Hence such an area will be sown only once then we get gross cropped area.

Stability analysis

Stability of the crop area is measured in terms of the coefficient of variation.

Results and Discussion

Number of wells

It was revealed from the Table 4.1 that in first period i.e. 1981-1990 the growth rate of the number of wells in the Marathwada region was 1.85 per cent per annum. Amongst the district number of wells was highest in Nanded district (4.01 per cent per annum) followed by Aurangabad district (2.24 per cent per annum) and lowest in Beed district (-0.14 per cent per annum).

In case of second period i.e.1991-2000 the growth rate of the number of wells in the Marathwada region was 4.94 per cent per annum. It was increased over the first period. Within the districts the number of wells were highest in Nanded district (4.06 per cent per annum) followed by Latur district (2.48 per cent per annum) and lowest in Parbhani district (-0.95 per cent per annum).

At an overall period i.e. 1981-2000 the growth rate of the number of wells was 3.49 per cent per annum in Marathwada region and it was decreased over the second period. Amongst the districts the growth in number of wells were highest in Nanded (4.64 per cent per annum) followed by Aurangabad (2.48 per cent per annum) and lowest in Osmanabad district (-0.37per cent per annum).

Study made by earlier scientists Bastine and Palanisami (1998), Pawar *et al* (1999) is in conformity with this study that the growth in number of wells was not uniform in all districts even in different period's number of wells increased at highest rate in Nanded district in all three periods and lowest in Parbhani district.

Number of oil engines

It was revealed from the Table 4.1 that in first period i.e.1981-1990 the growth rate of the number of oil engines in the Marathwada region was 0.03 per cent per annum. Amongst the district growth in number of oil engines were highest in Beed district (9.95 per cent per annum) followed by Osmanabad district (4.69 per cent per annum) and lowest in Aurangabad district (-0.55 per cent per annum.)

The oil engines increased at highest rate in Latur whereas in Parbhani district there was negligible use of oil engines. This may be due to electrification and alternative as electric engines available which might have replaced the oil engines and this can be seen in the growth of number of electric engines in almost all district.

Number of electric engines

It was revealed from the Table 4.1 that in first period i.e.1981-1990 the growth in the number of electric engines at overall level in the Marathwada region as a whole was 1.00 per cent per annum. Amongst the district number of electric engines were highest in Jalna district (3.89 per cent per annum) followed by Parbhani district (2.05 per cent per annum) and lowest in Latur district (-0.45 per cent per annum).

In case of second period i.e.1991-2000 the growth in the number of oil engines at overall level the Marathwada region as a whole was 3.77 per cent per annum. It was increased over the first period. Within the districts the number of electric engines were highest in Beed district (14.57 per cent per annum) followed by Parbhani district (13.59 per cent) and lowest in Aurangabad district (5.14 per cent per annum).

At an overall period i.e. 1981-2000 the growth rate of the number of electric engines was 2.33 per cent per annum in Marathwada region and it was decreased over the second period. Amongst the districts the growth in number of electric engines were highest in Parbhani (9.86 per cent per annum) followed by Beed (8.71 per cent per annum) and lowest in Aurangabad district (3.01per cent per annum). The growth in the electric engines was highest in Beed district and lowest in Latur district.

4.2 Annual compound growth rates of area irrigated by surface irrigation

It was revealed from the Table 4.2 that in first period i.e.1981-1990 the growth rate of area under surface irrigation in the Marathwada region was 7.71 per cent. Amongst the districts proportionate highest growth in area under surface irrigation was in Beed district (15.83 per cent per annum) followed by Osmanabad district (7.42 per cent per annum). Lowest growth in area under surface irrigation was in Latur district (-10.86 per cent per annum).

Table 4.2: Annual compound growth rates of area irrigated by surface irrigation (Area in 00' ha)

Districts	Surface irrigation		
	Period-I 1981-1990	Period-II 1991-2000	Period-III (overall) 1981-2000
Aurangabad	6.94 (0.458) ^{NS}	-1.51 (-0.336) ^{NS}	4.17 (0.609)**
Jalna	-1.77 (-0.777) ^{NS}	-6.78 (-0.543) ^{NS}	0.77 (0.101) ^{NS}
Beed	15.83 (0.898)**	0.72 (0.143) ^{NS}	2.63 (0.427)**
Latur	-10.86 (-0.630) ^{NS}	2.54 (0.415) ^{NS}	1.95 (0.253) ^{NS}
Osmanabad	7.42 (0.397) ^{NS}	-2.07 (-0.465) ^{NS}	1.28 (0.187) ^{NS}
Nanded	2.02 (0.246) ^{NS}	-0.28 (-0.076) ^{NS}	-0.31 (-0.097) ^{NS}
Parbhani	6.39 (0.404) ^{NS}	-9.67 (-0.579) ^{NS}	-1.57 (-0.191) ^{NS}
Marathwada region	7.71 (0.802)**	-2.15 (-0.545) ^{NS}	1.13 (0.313) ^{NS}

* Significant at 5 per cent Figures in brackets indicate 'r' value

** Significant at 1 per cent

NS - Non significant

In case of second period i.e.1991-2000 the growth rate of surface irrigated area in the Marathwada region was -2.15 per cent per annum. It was decreased over the first period. Within the districts growth in surface irrigated area was highest in Latur district (2.54 per cent per annum) followed by Beed district (0.72 per cent per annum) and lowest in Parbhani district (-9.67 per cent per annum)

At an overall period i.e. 1981-2000 the growth rate of area under surface irrigation was 1.13 per cent per annum in Marathwada region and it was increased over the second period. Amongst the districts highest growth in area under surface irrigation was in Aurangabad (4.17 per cent per annum) followed by Beed (2.63 per cent per annum) and lowest in Parbhani district (-1.57 per cent per annum). Similar results were found with Anonymous (2001), Firake and Shinde (2000), Alshi and Kakade (1999).

4.3 Annual compound growth rates of area irrigated by sub-surface irrigation

It was observed from the Table 4.3 that in first period i.e.1981-1990 the growth rate of area under sub-surface irrigation in the Marathwada region was 6.68 per cent per annum. Amongst the districts highest growth in area under sub- surface irrigation was in Nanded district (11.69 per cent per annum) followed by Latur district (11.37 per cent per annum). Lowest growth in area under sub- surface irrigation was in Beed district (1.71 per cent per annum).

Table 4.3: Annual compound growth rates of area irrigated by sub-surface irrigation (Area in 00' ha)

Districts	Subsurface irrigation		
	Period-I 1981-1990	Period-II 1991-2000	Period-III (overall) 1981-2000
Aurangabad	7.65 (0.763)*	3.66 (0.143) ^{NS}	9.75 (0.705)**
Jalna	3.66 (0.541) ^{NS}	4.20 (0.825)**	3.27 (0.822)**
Beed	1.71 (0.367) ^{NS}	4.62 (0.753)*	3.21 (0.824)**
Latur	11.37 (0.608) ^{NS}	9.50 (0.866)**	1.88 (0.256) ^{NS}
Osmanabad	10.27 (0.901)**	2.55 (0.694)*	4.22 (0.822)**
Nanded	11.69 (0.857)**	5.04 (0.951)**	6.68 (0.908)**
Parbhani	8.20 (0.855)**	3.74 (0.443) ^{NS}	1.55 (0.353) ^{NS}
Marathwada region	6.68 (0.898)**	4.63 (0.326) ^{NS}	5.18 (0.725)**

* Significant at 5 per cent Figures in brackets indicate 'r' value

** Significant at 1 per cent NS - Non significant

In case of second period i.e.1991-2000 compound growth rate of the sub-surface irrigated area in Marathwada region was 4.63 per cent per annum. It was decreased over the first period. Within the districts growth in sub- surface irrigated area was highest in Latur district (9.50 per cent per annum) followed by Nanded district (5.04 per cent per annum) and lowest in Osmanabad district (2.55 per cent per annum).

At an overall period i.e. 1981-2000 the growth rate of area under sub- surface irrigation was 5.18 per cent per annum in Marathwada region and it was increased over the second period. Amongst the districts highest growth in area under sub-surface irrigation was in Aurangabad (9.75 per cent) followed by Nanded (5.04 per cent per annum) and lowest in Parbhani district (1.55 per cent per annum).

In case of area irrigated by subsurface irrigation the Nanded district was the leading district in Marathwada region. Whereas in Parbhani district there was negligible growth as observed Anonymous (2001).

4.4 Annual compound growth rates of total irrigated area (surface + subsurface irrigation)

It was noticed from the Table 4.4 that in first period i.e.1981-1990 the growth rate of total irrigated area in the Marathwada region was 7.04 per cent per annum. Amongst the district growth in total irrigated area was highest in Osmanabad district (11.32 per cent per annum) followed by Latur district (8.32 per cent per annum).Total irrigated area was lowest in Jalna district (2.58 per cent per annum).

In case of second period i.e.1991-2000 the growth in the total irrigated area the Marathwada was 2.38 per cent per annum. It was decreased over the first period. Within the districts the growth in total irrigated area was highest in Latur district (8.58 per cent per annum) followed by Beed district (3.44 per cent per annum) and lowest in Parbhani district (-1.34 per cent per annum).

Table 4.4: Annual compound growth rates of total irrigated area (surface+ subsurface irrigation) (Area in 00' ha)

Districts	Total irrigated area		
	Period-I 1981-1990	Period-II 1991-2000	Period-III (overall) 1981-2000
Aurangabad	7.47 (0.765)**	1.60 (0.662)*	6.93 (0.915)**
Jalna	2.58 (0.359) ^{NS}	1.48 (0.334) ^{NS}	2.68 (0.688)**
Beed	6.55 (0.908)**	3.44 (0.677)*	2.90 (0.800)**
Latur	8.32 (0.496) ^{NS}	8.58 (0.864)**	1.40 (0.210) ^{NS}
Osmanabad	11.32 (0.905)**	1.62 (0.508) ^{NS}	3.87 (0.752)**
Nanded	7.10 (0.836)**	3.37 (0.933)**	3.77 (0.877)**
Parbhani	7.47 (0.833)**	-1.34 (-0.175) ^{NS}	0.37 (0.090) ^{NS}
Marathwada region	7.04 (0.900)**	2.38 (0.902)**	3.32 (0.874)**

* Significant at 5 per cent Figures in brackets indicate 'r' value

** Significant at 1 per cent

NS - Non significant

At an overall period i.e. 1981-2000 the growth in total irrigated area was 3.32 per cent per annum in Marathwada region and it was increased over the second period. Amongst the districts highest growth in total irrigated area was in Aurangabad (6.93 per cent per annum) followed by Osmanabad (3.87 per cent per annum) and lowest in Parbhani district (0.37 per cent per annum).

The growth in total irrigated area among different districts it was highest in Osmanabad district in first period and lowest in Parbhani district in second period. It may be due to the development of irrigation resources as observed by Shinde (2000), Anonymous (2006).

4.5 Annual compound growth rates of district wise percentage of gross irrigated area to gross cropped area

It was revealed from the Table 4.5 that in first period i.e.1981-1990 the percentage gross irrigated to gross cropped area in the Marathwada region was 6.21 per cent per annum. Amongst the districts percentage gross irrigated to gross cropped area was highest in Latur district (12.17 per cent per annum) followed by Nanded district (9.34 per cent per annum).Percentage of gross irrigated to gross cropped area was lowest in Jalna district (1.89 per cent).

In case of second period i.e.1991-2000 the percentage of gross irrigated to gross cropped area the Marathwada region was 2.10 per cent per annum. It was decreased over the first period. Within the districts percentage of gross irrigated to gross cropped area was highest in Parbhani district (5.87 per cent per annum) followed by Nanded district (3.82 per cent per annum) and lowest in Aurangabad district (-0.20 per cent per annum.)

At an overall period i.e. 1981-2000 the percentage of gross irrigated to gross cropped area was 2.58 per cent per annum in Marathwada region and it was increased over the second period. Amongst the districts percentage of gross irrigated to gross cropped area was highest in Nanded (4.02 per cent per annum) followed by Parbhani (3.31 per cent per annum) and lowest in Latur district (0.75 per cent per annum).

Table 4.5: Annual compound growth rates of district wise percentage of Gross irrigated area to gross cropped area (Area in 00' ha)

Districts	percentage gross irrigated to gross cropped area		
	Period-I 1981-1990	Period-II 1991-2000	Period-III (overall) 1981-2000
Aurangabad	2.23 (0.301) ^{NS}	-0.20 (-0.097) ^{NS}	3.28 (0.740)**
Jalna	1.89 (0.358) ^{NS}	1.52 (0.567) ^{NS}	1.64 (0.653)**
Beed	6.00 (0.891)**	3.51 (0.677)*	2.93 (0.815)**
Latur	12.17 (0.787)**	2.02 (0.388) ^{NS}	0.75 (0.135) ^{NS}
Osmanabad	7.71 (0.940)**	-0.04 (-0.017) ^{NS}	2.21 (0.655)**
Nanded	9.34 (0.812)**	3.82 (0.872)**	4.02 (0.793)**
Parbhani	7.94 (0.885)**	5.87 (0.761)*	3.31 (0.735)**
Marathwada region	6.21 (0.870)**	2.10 (0.809)**	2.58 (0.809)**

* Significant at 5 per cent Figures in brackets indicate 'r' value

** Significant at 1 per cent

NS - Non significant

The percentage of gross irrigated area to gross cropped area was highest in Latur district and lowest in Aurangabad district. Similar results were found with Shinde *et al.* (2002), Shinde (2001) and Anonymous (2007).

Period wise comparison

The mean irrigated area was highest in Aurangabad in first period and Beed was highest in second and third period. The Hingoli has lowest irrigated area in second period. The Beed district highest C.V value i.e. 54.48 per cent and the compound growth rate i.e. 13.65 per cent per annum was highest in Osmanabad district.

The Latur district was having highest irrigated area in second period. The growth rate highest in Osmanabad district and the C.V value was highest in Beed district. Similar results were found with Shinde and Jadhav (2000).

Conclusion

1. The number of wells and irrigated area under sub-surface irrigation was highest in Nanded district.
2. The growth in the oil engines was highest in Latur district.
3. The number of electric engines and irrigated area under surface irrigation was highest in Beed district.
4. Total irrigated area was highest in Osmanabad district.
5. Irrigated area under Wheat and Gram was highest in Aurangabad district.
6. Beed district has highest irrigated area under Rabi Jowar.
7. Summer groundnut has highest irrigated area in Parbhani district.
8. The irrigated area under Sugarcane was highest in Latur district.

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