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Patterns and Processes of Agricultural Transformation in Dhule District, Maharashtra

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Abstract

Agricultural transformation reflects the cumulative impact of environmental, technological, and institutional changes over time. This study examines the patterns and processes of agricultural transformation in Dhule district over a forty-year period (1971–2011). It evaluates key indicators such as cropping intensity, irrigation development, mechanization, fertilizer consumption, and technological advancements. The study reveals significant regional disparities among tahsils and highlights the role of irrigation and modernization in shaping agricultural productivity and sustainability. The findings reveal that agricultural development in the region has been significantly influenced by the expansion of irrigation facilities, particularly canal and tube well irrigation, which has enhanced cropping intensity and land productivity. Mechanization has increased substantially, reflected in the rising number of tractors and electric pump sets, while traditional implements have gradually declined. The use of chemical fertilizers and electricity in agriculture has also grown rapidly, indicating a shift toward modern and input-intensive farming practices. However, the transformation is spatially uneven across the district. Shirpur tahsil has emerged as the most advanced region due to better irrigation infrastructure, whereas Dhule, Sakri, and Shindkheda tahsils lag behind due to drought-prone conditions and limited resource availability. Despite improvements in productivity and efficiency, challenges such as groundwater depletion, regional disparities, and sustainability concerns persist. The study highlights the need for balanced regional planning, efficient water management, and sustainable agricultural practices to ensure long-term agricultural development in the district.

Keywords: Agricultural Transformation, Cropping Intensity, Irrigation Development, Mechanization, Fertilizer Consumption, Agricultural Modernization, Regional Disparities, Sustainable Agriculture, Dhule District, Maharashtra

Introduction

Agricultural transformation is a dynamic process involving structural changes in farming practices, productivity, and resource utilization across time and space. It represents a shift from traditional subsistence farming to modern, commercial, and efficient agricultural systems. This transformation is influenced by environmental conditions, technological innovations, and institutional support systems.

The introduction of the Green Revolution marked a turning point in Indian agriculture, initiating widespread changes in cropping patterns, irrigation, and input use. Dhule district, located in Maharashtra, has experienced notable transformations since this period.

Objectives of the Study

- To analyze the temporal changes in agricultural practices in Dhule district.
- To examine spatial variations in agricultural transformation across tahsils.
- To assess the role of irrigation, mechanization, and technology in agricultural development.
- To identify regional disparities and suggest pathways for sustainable agriculture.

Study Area and Methodology

The study focuses on Dhule district, comprising four tahsils: Dhule, Sakri, Shindkheda, and Shirpur. A comparative analysis has been conducted using data from 1971 and 2011.

Key indicators analyzed include:

- Cropping intensity
- Irrigation intensity
- Area sown more than once
- Fertilizer consumption
- Mechanization (tractors, ploughs, pumps)
- Energy use in agriculture

Analysis

The study region has experienced agricultural transformation with the very beginning of the Green Revolution since 1966. Some salient features are observed in agricultural transformation of Dhule district. For this study, forty years period has been considered i.e. 1971 to 2011.

1. From 5.70% in 1971, the proportion of area sown more than once to net area sown increased upto 7.32% in 2011. Only 1.62% area sown more than once as percentage of net sown area is increased in the whole study area but its spatio-temporal variation was considerable. Overall, Dhule, Sakri and Shindkheda tahsils, this proportion was declined and only Shirpur tahsil recorded high increase in area sown more than once i.e. 15.29%. It is due to area under canal irrigation is increased in this tahsil. There are two dams namely, Karwand dam built on river Arunavati and Aner dam on river Aner and water from these dams are distributed through canals.
2. The cropping intensity in Dhule district is also slightly increased from 1971 to 2011. The cropping intensity was slightly decreased in Sakri, Dhule and Shindkheda tahsil. The major parts of these tahsils are characterized by drought-prone conditions. In Shirpur tahsil the cropping intensity in 1971 was 101.77, while it was increased upto 115.29. In this tahsil, high cropping intensity is associated with canal irrigation covering eastern piedmont plain of it.
3. Irrigation intensity is a statistical measure for expressing the gross irrigated area as proportion of net irrigated area in percent. With the introduction of short duration crops in the wake of Green Revolution, the gross cropped area has been increasing with expansion and intensification of irrigation. The growth of land productivity and output is positively associated with irrigation intensity. Recently, the irrigation intensity is more in areas of tube well and canal irrigated areas than in dug well and other sources of irrigation in the study region. The intensity of irrigation is increased from 5.67% in 1971 to 14.97% in 2011. It means there is significant increase in irrigation intensity in study region. From the table, it is also noticed that in all tahsils the irrigation intensity is increased but in Shirpur tahsil it is increased about fifteen times within forty years of period. In 1971, in Shirpur tahsil, cropping intensity was only 1.43% and it was increased upto 21.53% in 2011. It is because of canal and tube well irrigation particularly in the southern part of Shirpur tahsil.

Table 3.8: Dhule district salient features of Agricultural Transformation

Tahsil	Dhule		Sakri		Shindkheda		Shirpur	
	1971	2011	1971	2011	1971	2011	1971	2011
Area sown more than once as percentage of net sown area	4.26	3.24	10.15	5.87	6.62	4.91	1.77	15.29
Cropping Intensity	104.3	103.3	107.34	105.87	106.6	104.91	101.77	115.3
Irrigation Intensity	8.17	12.38	8.09	13.16	5.01	12.81	1.43	21.53
Consumption of fertilizers (Kgs) per hectare of cropped area		375.6		345.17		459.22		723.1
Share of agriculture in electricity consumption (percentage)	7.89	42.63	48.12	86.58	19.83	66.33	14.4	62.15
Number of tractors	29	522	55	449	17	365	17	351
Net area sown(ha per tractor)	4372	209	2372	247	5998	5388	3756	157
(Irrigated by)								
1)Wells/ Tube wells	2047	12954	20920	12549	11221	10745	2002	1189
2) River	232	74	0	1	178	2	243	0
3) Canal	428	2170	2321	2617.8	1429	876.8	0	1625
4)Others	3584	711.7	265305	178.7	0	0	0	445.9
No. of tubewells & pumpsets '000' hac of net area sown	15.61	94.72	7.44	75.18	12.65	41.77	7.63	67.01
No. of wooden ploughs	11670	7785	11943	2561	8826	5703	7393	7142
No. of iron ploughs	4241	8200	6866	11510	3148	5568	1294	3391
No. of oil engines	2111	569	1933	357	1325	253	416	172
No. of electric pumps	1980	10365	971	8366	1280	3827	487	3695

Source: Computed by researcher

4. Before the Green Revolution, organic fertilizers are predominantly, used by the Indian farmers. From the beginning of Green Revolution, the consumption of chemical fertilizers considerably increased along with organic fertilizers. Recently, the consumption of chemical fertilizers is tremendously increased. For the growth of High Yielding Varieties and availability of irrigation facilities, the use of chemical fertilizer is essential. In the study region the consumption of chemical fertilizers per hectare of gross cropped area has been increased since 1971. The consumption of chemical fertilizers, which was 209.61 kgs/hectare of gross cropped area in 1971, went upto 475.76 kg. in 2011; just increased more than doubled. In all tahsils of Dhule district, the consumption of chemical fertilizer is increased but in Shirpur tahsil, it is observed that the use of chemical fertilizer is highest in the district.

5. The electricity consumption by agricultural sector has increased 22.56 % in 1971 to 64.71 % in 2011. Recently, the electricity consumption is higher in areas of well irrigation than canal and other irrigated areas.

6. Before 1970, the bullock carts and wooden agricultural equipments are commonly used by the farmers in the study area. Initially, only farmers with large land holdings invested in tractors but now even the small and medium land holders have acquired tractors, availability of credit on easy terms from banks and co-operative institutions and the scope of enhancing income through customs hiring are some of the factors responsible for this tendency. From the table 3.9, it is noticed that the number of tractors in the district increased from 118 in 1971 to 1687 in 2011. This indicates that tractor acquisition has become more widespread over the 40 years span. It is also seen that the number of tractors is very less in all tahsils of Dhule district in 1971. Overall, in Dhule district number of tractors has been increased more than 14 times in 2011.

7. From the above table, it reveals that the use of tractors in agricultural fields has become more widespread in the last four decades. Therefore, the net area sown per tractor has tremendously declined from 4124 hectares in 1971 to 1500 hectares in 2011 in Dhule district. The net area sown per tractor ranged from 157 hectares in Shirpur tahsil to 247 hectares in Sakri tahsil in 2011 except Shindkheda tahsil.

8. Concomitant with an expansion of area under irrigation, the modes of irrigation have also been changing in favors of tube wells. Before Green Revolution period, the most of the farmers are used 'Mot' and diesel pump sets for uplifting water from dug-wells. It is due to shallow ground water table and non-availability of electricity in rural areas. Thereafter, availability of electricity for agricultural fields, electric pump sets are used by the farmers. Since last three decades. The electricity consumption by agricultural sector has increased, significantly. The depth of the ground water is increasing day by day and hence instead of dug-wells, the number of tube wells increased according to hydro- geological conditions. Accordingly, the number of electric pump sets also has been automatically increased.

In the study region, the number of tube wells and pump sets per thousand hectares of net area sown was increased tremendously in all tahsils since 1971. In Dhule district number of tube wells and pump sets per thousand hectares of net area sown increased from 10.83 in 1971 to 60.67 in 2011. The maximum number of tube wells and pump sets are noticed in Dhule tahsil i.e. 94.72 in 2011 whereas it was only 15.61 in 1971. On the other hand it was the lowest in Shindkheda tahsil i.e. 41.77 in 2011 while it was only 12.65 in 1971. It is also significantly note that in Sakri and Shirpur tahsil, the number of tube wells and pump sets per thousand hectares of net area sown was below 8 in 1971. After four decades, it was tremendously increased by ten times. It is due to the government's contribution in the form of loans for installation of tube wells and in rural electrification is beneficial for the farmers in the study region.

9. **Wooden ploughs:** Wooden ploughs are the old agricultural implements mainly used for ploughing of agricultural fields. From the table 3.9, it reveals that the most of the farmers are commonly used wooden ploughs more or less before the wake of Green Revolution. The highest number of wooden ploughs is noticed in western part of the study region, covers Dhule and Sakri tahsil. In each tahsil, about 12,000 wooden ploughs are used for the cultivation of land. On the other hand, in the central and northern part, the number of wooden ploughs ranged from 7393 in Shirpur tahsil and 8826 in Shindkheda tahsil during nineteen seventies. After forty years period of span, the number of wooden ploughs has declined tremendously in all tahsils of the study region. It was ranged from 2561 in Sakri tahsil to 7785 in Dhule tahsil. It is also seen that the maximum change is observed in Sakri tahsil. In this tahsil, the lowest (2561) number of wooden ploughs is found. Overall, in the study region the number of wooden ploughs was 39832 in 1971 which was reduced upto 23191 in 2011.

10. **Iron ploughs:** Iron ploughs are important agricultural implements mainly used for ploughing agricultural land by the farmers after green revolution. The use of iron ploughs is considerably increased by the farmers in the study region. The increasing use of iron ploughs proves the improvement in agricultural implements. In the district as a whole, the number of iron ploughs increased during the last four decades. In the study region, the number of iron ploughs increased from 15549 in 1971 to 28669 in 2011. The similar pattern is observed in all tahsils of the district. The highest number of iron ploughs is found in Sakri tahsil i.e. 11510 in 2011, while it was only 6866 in 1971. It was followed by Dhule tahsil, ranks second in the district. The lowest number of iron ploughs is found in Shirpur tahsil. In general, increasing trend in respect of use of iron ploughs is noticed.

11. **Oil engines:** Oil engines are mainly used for lifting of water from dug wells, rivers and tanks to supply water for growing of crops in the field. After electrification in rural areas, the number of oil engines declined and electric pumps are replaced by oil engines. From the table, it was found that the number of oil engines reduced in year of 2011. The same decreasing trend is found in all tahsils. It ranged from 172 in Shirpur tahsil to 569 in Dhule tahsil in 2011. On the other hand the highest number of oil engines is observed in Dhule tahsil i.e.2111 in 1971. Sakri tahsil ranked second while Shindkheda tahsil ranked third in respect of number of oil engines during 1971. It is significantly note that the maximum number of oil engines is used in drought prone area of the study region.

12. **Electric Pumps:** After electrification in rural areas, the use of electric pumps is increasing day by day. These are used to lift the water from dug wells, rivers and tanks to supply water to raise particularly winter and summer crops. Increasing use of electric pumps represents the higher level of modernization in agriculture. They save time and money as compared to the use of oil engines. Therefore, electric pumps are becoming more and more popular by the farmers in the study region. In Dhule district, the total number of electric pumps increased from 4718 in 1971 to 26253 in 2011. It means in forty years period, the electric pumps increased by about five times in Dhule district. Dhule tahsil, ranks first in respect of number of electric pumps i.e.10365 while Sakri tahsil ranks second i.e.8366, followed by Shindkheda and Shirpur tahsil, in 2011. In ninety seventies the number electric pumps was very less in

all tahsils of the district. It was due to during that period the proportion of electrification in rural areas was very low. The growing utilization of electric pumps is a good sign to agricultural modernization in the study region.

Results and Discussion

1. Cropping Pattern and Intensity

The proportion of area sown more than once increased marginally from 5.70% in 1971 to 7.32% in 2011. However, spatial variation is significant:

Decline observed in Dhule, Sakri, and Shindkheda.

Substantial increase in Shirpur (up to 15.29%), mainly due to canal irrigation.

Cropping intensity showed slight improvement overall, with Shirpur experiencing the highest growth (from 101.77 to 115.29), indicating better land utilization.

2. Irrigation Development

Irrigation intensity increased significantly from 5.67% to 14.97% over the study period. Key observations:

Expansion of tube wells and canal irrigation.

Shirpur showed remarkable growth due to irrigation infrastructure such as dams and canals.

Shift from traditional sources (dug wells) to modern irrigation methods.

This growth highlights the critical role of irrigation in enhancing agricultural productivity.

3. Fertilizer Consumption

The use of chemical fertilizers increased more than twofold:

From 209.61 kg/ha in 1971 to 475.76 kg/ha in 2011.

Highest consumption observed in Shirpur.

This trend reflects the adoption of High Yielding Variety (HYV) seeds and intensified agriculture.

4. Energy Use in Agriculture

Electricity consumption in agriculture rose from 22.56% to 64.71%, driven by:

Expansion of electric pump sets

Increased groundwater extraction

Electrification played a key role in modernization but also indicates rising pressure on groundwater resources.

5. Mechanization of Agriculture

Mechanization has significantly increased:

Number of tractors rose from 118 (1971) to 1687 (2011).

Net area per tractor decreased, indicating wider accessibility.

Shift from wooden to iron ploughs reflects technological advancement.

Mechanization improved efficiency and reduced dependence on manual labor.

6. Irrigation Technology and Equipment

Tube wells and pump sets increased drastically across all tahsils.

Electric pumps replaced oil engines due to rural electrification.

Oil engines declined sharply due to cost and inefficiency.

This transition marks a shift toward more efficient and modern irrigation systems.

7. Traditional vs Modern Implements

Wooden ploughs declined significantly (from 39,832 to 23,191).

Iron ploughs increased, indicating technological progress.

This shift highlights the gradual replacement of traditional farming tools with modern equipment.

Regional Disparities

The study reveals considerable inter-tahsil disparities:

Shirpur: Most advanced due to irrigation and infrastructure.

Sakri and Dhule: Moderate development but constrained by drought conditions.

Shindkheda: Relatively lower growth in modernization indicators.

These disparities are largely influenced by availability of water resources and infrastructural development.

Implement region-specific agricultural planning.

Conclusion

Agricultural transformation in Dhule district over four decades reflects a gradual shift toward modernization, driven by irrigation expansion, mechanization, and technological inputs. However, the transformation is uneven across regions.

While productivity and efficiency have improved, challenges such as groundwater depletion, regional inequality, and sustainability remain. The study emphasizes the need for balanced regional development and sustainable agricultural practices.

Recommendations

- Promote efficient water management and micro-irrigation techniques.
- Encourage sustainable use of fertilizers and organic farming.
- Improve access to credit and modern technology for small farmers.
- Strengthen rural infrastructure and irrigation facilities in drought-prone areas.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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