AN ECONOMIC APPRAISAL OF NANDURBAR DISTRICT OF MAHARASHTRA

by

Shivade Dhiraj Mahesh
(Reg. No. 019/211)

DEPARTMENT OF AGRICULTURAL ECONOMICS

POST GRADUATE INSTITUTE
MAHATMA PHULE KRISHI VIDYAPEETH,
RAHURI- 413 722, DIST- AHMEDNAGAR
MAHARASHTRA, INDIA
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2021

CANDIDATE'S DECLARATION

I hereby declare that this thesis or part

there of has not been submitted

by me or other person to any

other University or Institute

for a Degree or

Diploma

Place : M.P.K.V., Rahuri (Shivade Dhiraj Mahesh)

Date : / / 2021

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CERTIFICATE

This is to certify that the thesis entitled **"AN ECONOMIC APPRAISAL OF NANDURBAR DISTRISCT OF MAHARASHTRA"** submitted to the Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) in the partial fulfilment of the requirement for the award of the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **AGRICULTURAL ECONOMICS,** embodies the results of a piece of bonafide research work carried out by **Mr. SHIVADE DHIRAJ MAHESH** under my guidance and supervision and that no part of the thesis has been submitted for any other degree or diploma.

The assistance and help received during the course of this investigation have been duly acknowledged.

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Place : M.P.K.V., Rahuri (P. N. RASAL)
Date : / / 2021

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Place : M.P.K.V., Rahuri *(Shivade D. M.)*
Date : / / 2021

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LIST OF ABBREVIATIONS

%	:	Per cent
ACGR	:	Annual Compound Growth Rate
Agril.	:	Agricultural
APMC	:	Agricultural Produce Market Committee
et al.	:	*`et alli / `et aliae* [And others (Co-workers)]
etc.	:	etcetera (and so on)
Fig.	:	Figure
GDP	:	Gross Domestic Product
Ha	:	Hectare
HYV's	:	High Yielding Varieties
i.e.	:	id est (that is)
KWh	:	Kilo Watt hour
Kg/ha	:	Kilogram per hectare
Km	:	Kilometer
M.Sc.	:	Master of Science
Dr.	:	Doctor
Million ha	:	Million hectare
Mm	:	millimeter
MT	:	Metric Tonnes
NH	:	National Highway
No.	:	Number
NPK	:	Nitrogen, Phosphorous and Potassium
PACS	:	Primary Agricultural Credit Society
PCO	:	Public Call Office
pp	:	Multiple Pages
Reg. No.	:	Registration Number
Rs. / ₹	:	Rupees
SC	:	Scheduled Castes
Sq. Km	:	Square Kilometer
ST	:	Scheduled Tribes
STD	:	Subscriber Trunk Dialing
SWOT	:	Strengths, Weaknesses, Opportunities and Threats
viz.	:	*videlicet* (Namely)
Vol.	:	Volume

ABSTRACT

AN ECONOMIC APPRAISAL OF NANDURBAR DISTRICT IN MAHARASHTRA

by
Mr. SHIVADE DHIRAJ MAHESH
A candidate for the degree
of
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in
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RAHURI – 413 722
2021

Research Guide	**: Dr. G. G. Joshi**
Department	**: Agricultural Economics**

In this analysis, an attempt was made to examine agricultural progress in Nandurbar district over a period of time in order to advise future policies. Estimating trends in land use and cropping patterns, growth rates of area, production and productivity of important crops, infrastructural development, major variables impacting agricultural production, challenges and recommendations are all included in this section. The analysis was based on secondary data collected from several public entities in Nandurbar and the Maharashtra Government.

The district of Nandurbar is divided into six tehsils. The data on land use and cropping patterns was collected and analyzed using a simple tabular method. The exponential function was used to examine the growth rates of area, production, and productivity of important crops. A multivariate linear regression model was used to investigate the primary factors impacting agricultural development. The district's rural population grew over the base year by 52.78 per cent. Small and marginal farmers' percentages increased by 27.26 per cent and, semi-medium and medium percentages increased by 32.65 and 15.63 while large farmers' percentage declined by 14.30. The study found that the irrigated area expanded by 124.53 per cent over the base year while the un-irrigated area decreased by 27.24 per cent. Over the base period, the net sown area increased by 7.08 per cent while the gross cropped area increased by 6.22 per cent. The amount of land that can be used for agriculture i. e. cultivable waste is dropped by 85.39 per cent. Other fallow is declining by 66.63 per cent. The amount of land used for non-agricultural purposes increased by 41.07 per cent. The cropping pattern revealed that cereals were the most common crop in the district. Cotton, a commercial crop has shown a consistent increase in area. Over the base period, the area under food grains dropped by 3.61 per cent.

During the study period, the livestock and poultry populations grew. Milk output was increased compared to the previous year. Throughout terms of agricultural inputs, the usage of HYV seeds and fertilizers has increased in the district.

The growth rates of area and production of foodgrains significantly decrease at the rate of 1.57 and 2.15 per cent per annum during the period under study whereas the growth rates of area and production of cotton are significantly increased at the rate of 7.04 and 7.38 per cent per annum in the district.

The study revealed that, the percentage of gross irrigated area to gross sown area (X_1), percentage of net sown area to gross sown area(X_3) and area under HYV's seeds (X_4) had shown a significant positive association with the increase in the value of total agricultural production in Nandurbar district.

As the district's agricultural development was not so good, there were several flaws including an increase in land used for non-agricultural purposes, a lack of reliable irrigation systems and a scarcity of high-quality seeds and fertilizers. The current analysis has substantial policy consequences including the preservation of forest land, expansion of irrigated facilities, fertilizer supply and effective credit supervision. In addition to the application of agronomical and pesticides, the area expansion of HYV's can be adequately supervised for optimal exploitation mechanical harvesting measures, rainwater and high-quality inputs for the development of agriculture is necessary.

As a result, adequate policy support for minimizing land under non-agricultural use, policy for enhancing crop productivity, priority to irrigation schemes, supplying quality inputs and policy for rapid transportation development among other things must be highlighted.

1. INTRODUTION

1.1 General

India is an agricultural country. Agriculture and its allied activities act as main source of livelihood for more than 80 per cent population of rural India. It provides employment to approximately 52 per cent of labour. Its contribution to Gross Domestic Product (GDP) is between 14 to 15 per cent. India's strengths in agriculture are numerous and assorted. We brag of one of the most grounded agricultural examination frameworks in the world. Geologically we have second biggest arable region and upwards of 127 assorted agro-climatic zones, along these lines giving India worldwide administration in a few yields. We are second around the world as far as production of rice, wheat, fish products. India is additionally the world's greatest milk producer. Indeed, even agriculture area has shown a normal development of 5.5 per cent every year throughout the last decade. In spite of this, challenges continue in Indian Horticulture. The farmers are our essential partners and remembering this administration has dispatched numerous new drives to build farm yield and twofold the farmers income by raising their financial status. The growth in itself represents a remarkable achievement in the history of world agriculture. India has achieved significant growth in agriculture, milk, fish, oilseeds, fruits and vegetables owing to green, white, blue and yellow revolutions. All these revolutions have brought prosperity for the farmers. Many factors are responsible for these achievement *viz.* conducive government policies, receptivity of the farmers and also establishment of higher agricultural education institutions.

Any developing economy that is primarily based on agriculture must go through the agricultural development process in order to accelerate economic growth. The progress of a country's economic development is largely determined by how well its agriculture sector is performing. As a result, the agricultural sector's performance is critical in the process of economic development. The performance of agricultural zone is consequently important in the manner of monetary improvement of a rustic that is particularly genuine in case of a predominantly agricultural and over-populated country like ours.

The Ministry of Agriculture and Farmers Welfare is pursuing a goal of doubling farmers' income by 2022 and farm machinery is a key component of that goal. The government is pushing farm mechanization by subsidizing equipment purchases through Sub-Mission of Agricultural Mechanization (SMAM) initiatives, which also support custom hiring models. In the last few years, Indian agriculture has made significant strides. The Indian agricultural equipment market has been heavily exposed to international trade in recent years. With Annual Compound Growth Rate (ACGR) of 6.2 per cent over the last four years, India has become a major exporter of agricultural sector (Source: http://www.hillagric.ac.in).

1.2 Agricultural Development

More than just growth is involved in development. In fact, there are several qualitative components in the development process that are obvious by their lack in economic growth or expansion. As a result, development encompasses not only economic progress but also social, cultural and institutional change. Development must be viewed as a multifaceted process. The use of high yielding varieties as well as the adoption of a package of methods for enhancing farm enterprise productivity, such as the use of required fertilizer doses, plant protection measures, irrigation and modern machinery are all part of the agricultural development process. The method tries to maximize the use of available resources such as land, labour, capital and so on. The original equilibrium position changes during the transformation process and the production function rises to a higher level occupying a new equilibrium position where profits are at their highest. As a result, the agricultural development process is critical in terms of growing agricultural productivity in the country (Source: https://en.m.wikipedia.org).

1.3 Agricultural Development in India

Agriculture is the primary occupation and economic backbone of emerging countries like India and it is a bottleneck in the country's economic progress. Although the agricultural sector's part of the national economy is declining, the number of people who rely on it is not. The land is a fixed and limited productivity component. As a result, it is vital to increase output by implementing new more advanced technology. In terms of agricultural commodities such as paddy, wheat, legumes, groundnut, rapeseed, fruits, vegetables, sugarcane, tea, jute, cotton, tobacco leaves and so on, India is among the top three producers. However, on the marketing front, Indian agriculture continues to face issues such as a lack of market integration and connectivity as well as the availability of credible information. However, on the commercial front, Indian agriculture continues to face challenges such as a lack of market integration and connection as well as the availability of trustworthy and timely information needed by farmers on a variety of concerns. In addition, the agricultural marketing industry has a fragmented supply chain. Huge postharvest losses, a plethora of market intermediaries, higher transaction costs, a lack of awareness and a slew of other socio-economic factors are just a few of the serious issues that Indian agriculture is grappling with.

Financial plan for the year 2018-19 had demonstrated that change in outlook in the horticultural approaches is expected to accomplish the target of doubling farmers' income by 2022 through more prominent accentuation on producing higher livelihoods of farmers. Giving a significant lift to the farmers' income the Cabinet Committee on Economic Affairs (CCEA) led by PM Narendra Modi supported the increment in the MSPs for all *kharif* crops for the year 2018-19 on 4th July, 2018. The choice of the CCEA is a memorable one as reclaims the guarantee of

foreordained guideline of fixing the MSPs at level of in any event 150 per cent of the expense of production declared by the association financial plan for the year 2018-19. Innovative work projects in green harvests have yielded empowering results; therefore, the production of agricultural yields has been more than foodgrains regardless of unfriendly climatic conditions. After China, India is the second biggest producer of leafy foods. Some co-ordinating focuses like National Food Security Mission (NFSM), National Horticultural Mission (NHM) and National Mission on Oilseeds and Oil-Palm (NMOOP) are being carried out to guarantee food and wholesome security in the country.

The Minister informed a Soil Health Card plan has been started so farmers can know prior to planting the strength of the soil in his homestead, the sort of harvests to be developed and the sort and amount of supplements to be utilized. At the same time with motto of 'Har Khet Ko Paani' around 100 water system projects are being finished under Pradhan Mantri Krishi Sinchayee Yojana (PMKSY). To guarantee better value revelation for farmers, the online stage e-NAM has been begun. The public authority has likewise satisfied its guarantee of giving MSP at 1.5 times and more over the cost of production for 14 *kharif* crops. It represents a test for comprehensive development. Numerous endeavors were taken in advancing the rural circumstance in India, the development in agrarian yield was nonetheless, not smooth over every one of the years just as over various states and districts in India (Source: Agricultural Statistics at a Glance, 2019).

1.4 Agricultural Development in Maharashtra

Maharashtra is state in the Western peninsular region of India occupying a substantial portion of the Deccan plateau. As the home of the Marathi people, Maharashtra is the second-most populous state in India as well as the second-most populous country subdivision. Maharashtra was formed on 1st May, 1960 by splitting the bilingual Bombay State which had existed since 1956 into majority Marathi speaking Maharashtra and Gujarati-speaking Gujarat, respectively. The state capital is Mumbai, the most populous urban area in India. The Godavari, Krishna, Bheema, Tapi-Purna basin and Narmada are the major rivers in the state. Marathi is the most widely spoken language and is also the official language of the state.

Maharashtra has the largest economy in India. Although highly industrialized, agriculture continues to be the main occupation in many regions of the state. Maharashtra ranks first nationwide in coal-based thermal electricity as well as nuclear electricity generation with national market shares of over 13 per cent and 17 per cent, respectively. In Maharashtra, all potential endeavors have been made for expanding rural production and in this manner to include in the public mission of advancement of agribusiness which commenced during post-freedom period. The improvement plot *viz.* CADA (Command Area Development Authority), DPAP (Drought Prone Area Program), SFDA (Small Farmers Development Agency) and MFAL (Marginal

Farmers and Agricultural Labours) are additionally in activity in Maharashtra. Maharashtra is front sprinter in regard of numerous new plans like SFDA (Small Farmers Development Agency), pioneer in cooperatives for example, sugar manufacturing plants, dairies, water client affiliation and so forth. All conceivable efforts have been made in Maharashtra to increase farm productivity and so participate in the national push for agricultural development that began during the post-independence period. In Maharashtra, development schemes such as NHAM, RKVY, MGNREGA, CADA, DPAP, SFDA, MFAL and others have resulted in increased food production.

The development of agriculture in Maharashtra did not prove to be much satisfactory during the plan periods. As a matter of fact, the state government was quite progressive with regard to planning and implementation of a variety of agricultural development programmes with a view to gear up natural resources conservation and development activities, supply of farm inputs including credit, development of other infrastructural facilities, strengthening of research and extension education, efforts to evolve and disseminate new agricultural technologies and expansion of adequate institutional base conducive for transformation of agriculture in the state. However, due to irrigation facility limits, regional variances in natural resource endowments and agriculture sector over dependence, little progress was made over the entire intended time. In practice, there were significant differences in the diffusion of biochemical and mechanical innovation between different regions and between individual crops within Maharashtra region (Source: Economic Survey of Maharashtra, 2019).

1.5 The Problem

The introduction of a new agricultural approach, the green revolution in 1966 aided farmers in moving away from traditional agriculture and toward modern agriculture. They now understand the need of utilizing critical inputs like as irrigation, credit, fertilizer, high yielding variety seeds, plant protection measures and so on in order to increase agricultural productivity. It appears that the aforementioned inputs in combination with new agricultural technology have had an impact on agricultural productivity and as a result, production. Since the mid-sixties, Maharashtra's agriculture has seen many changes as a result of national agricultural development programmes. It was felt that a scientific evaluation of the process of agricultural development in a well-defined area throughout time was required. Due to the arrival of the green revolution in India in the mid-sixties, farmers were able to break free from their old farming practices. They now understand the need of using critical inputs such as irrigation, finance, fertilizer, high yielding types seed, plant protection measures and so on to boost agricultural production.

A scientific study of the process of agricultural development in a well-defined area throughout time was thought to be necessary. A study of this nature could go into great detail in

evaluating the trend of changes in land usage, crop pattern and growth rates of essential crops as well as identifying major determinants influencing agricultural productivity.

It is observed that Nandurbar district in North-Western Maharashtra is one of the underdeveloped districts in agricultural development activities. In view of this it was therefore decided to undertake a study *viz.* "An Economic Appraisal of Nandurbar district of Maharashtra" during period of 1998-99 to 2018-19 in North-Western region of Maharashtra.

1.6 Objectives

The literature closely related to the present study is briefly presented under five major objectives are as below:

i) Studies on the changes in land use and cropping pattern
ii) Studies on the growth rates of area, production and productivity of major crops
iii) Studies the changes in infrastructural development in agriculture
iv) Studies on factors responsible for agricultural development
v) Studies on SWOT analysis of agricultural development

1.7 Hypotheses of the Study

The following hypotheses were offered to be investigated for meeting the requirements of the study objectives in light of the prior theoretical assertions and the review of literature supplied in the next chapter.

1) Null (H_0) : Cultivated and irrigated area remain stagnant for last several years in Nandurbar district.

   Alternative (H_1) : Cultivated and irrigated area are varying for last several years in Nandurbar district.

2) Null (H_0) : The growth rates in area, production and productivity of major crops remain stagnant during last several years.

   Alternative (H_1) : The growth rates in area, production and productivity of major crops are varying during last several years.

1.8 Scope and Utility of the Study

The study's scope is limited to the above-mentioned objectives. However, the study's findings can be extrapolated to larger areas with similar agro-climatic circumstances. The study will shed light on crucial agricultural development characteristics in a district which can then be investigated further in different conditions throughout the state to determine their significance.

The major results drawn from this research will aid in the formulation and implementation of agricultural development programmes in the district. Changes in land use, cropping patterns,

area, production and productivity of crops would show specific trends that could be changed in order to achieve balanced agricultural growth in the district.

1.9 Limitations of the Study

The current study is based on secondary data gathered from published sources and development organizations in Nandurbar district. The analysis is limited to the data that is currently available on the study's elements. The degree of reliability of secondary data determines the validity of the study's findings. The information was gathered from the Department of Agriculture, Government of India, the District Collectorate Office, the District Statistical Abstracts and Epitomes released by the Maharashtra Department of Agriculture because the data is secondary, one must proceed by considering it. The study's only limitation is its reliability. However, an attempt is made to conduct a thorough investigation. However, an attempt is made to conduct a thorough analysis of the data in order to achieve the objectives and draw significant conclusions.

2. REVIEW OF LITERATURE

2.1 General

This chapter focuses on current reviews of prior research that are similar to the current one. The main goal of this chapter is to understand the methodology used and the conclusions drawn from previous studies so that a suitable methodological framework may be developed. The literature relevant to the current investigation is summarized under four broad topics as follows. The main goal of this study was to look at the process of agriculture development in Nandurbar district in terms of changes in numerous agricultural growth and development characteristics. The reviews that have been written so far have been divided into five categories depending on the characteristics of the present study.

i) Studies on the changes in land use and cropping pattern
ii) Studies on the growth rates of area, production and productivity of major crops
iii) Studies the changes in infrastructural development in agriculture
iv) Studies on factors responsible for agricultural development
v) Studies on SWOT analysis of agricultural development

2.2 Studies on the Changes in Land Use and Cropping Pattern

Bhatt (2012) concentrated on economic improvement of agricultural advancement in Himachal Pradesh. He presumed that the land use design over years showed that a large portion of the geological space of the state was under forest and pastures. The region under forests expanded from about 21.71 per cent in the year 1975-76 to 24.67 per cent during the year 2007-08. The region under pastures declined hardly from 40.62 to 32.67 per cent during the time of 32 years.

Shaikh (2013) concentrated on economic examination of agrarian turn of events in Andhra Pradesh. He observed the land use pattern of Andhra Pradesh. The region under forest was diminished from 22.64 per cent in year 1980-81 to 22.58 per cent in year 2009-10. The complete region planted expanded from 122.82 lakh hectares to 125.61 lakh hectares during year 2009-10. Region under cereals at state level was diminished from 55.03 per cent in the year 1980-81 to 37.49 per cent in the year 2009-10. The area of pulses, vegetables, flowers and fruits expanded.

Kalaskar (2015) looked at the economic impact of agricultural development in Yavatmal. During the last 30 years, he disclosed that the area not suitable for cultivation has expanded by 20.43 per cent. The amount of fallow land fell from 78.45 thousand hectares in the year 1980-81 to 65 thousand hectares in the year 2011-12. The amount of land covered by forests has shrunk from 16.93 per cent in the year 1980-81 to 16.42 per cent in the year 2011-12. Yavatmal district's net sown area had fallen by 1.25 per cent over the base year.

Gavhane (2017) studied the agriculture development in Solapur district of Maharashtra. She concluded about the mode of agriculture in the district, the land use and cropping pattern in

respect of Solapur district for the latest year i.e. 2016-17 is explained. The total geographical area of the district is 14,87,843 hectares. The net sown area for the year 2016-17 was 9,19,700 hectares which formed 61.08 per cent of total geographical area. The area covered by forests was 35,300 hectares which formed 2.34 per cent of total geographical area. The gross cropped area was 11,22,500.04 hectares and the intensity of cropping was 122.05 per cent.

Kaur (2017) looked at the cropping patterns in Punjab and discovered that the state's agriculture economy is dominated by wheat and paddy rotation. Grains, legumes, cotton, maize and cereals other than wheat and paddy occupied a major portion of the gross cropped area prior to the green revolution. Crop combinations and rotations were replaced by monocultures of wheat and rice and crops other than these two began to vanish during the green revolution.

Waival *et al.* (2017) investigated Maharashtra's land use and farming patterns. He discovered that the variability in terrain, soil and climatic conditions had a substantial impact on crops and land use patterns. During the last 55 years, the state's gross cropped area expanded from 188.23 to 231.06 lakh hectares while the gross irrigated area increased from 12.20 lakh hectares to 49.26 (303%) lakh hectares.

Johanson (2018) tested adjustments in the cropping sample of Kerala over the last 61 years. Especially, it places collectively a district-degree database on agriculture in Kerala from the year 1956–57 when the state was formed to the year 2016–17, the maximum current year for which statistics are to be had. The to be had facts had been apportioned to 9 composite districts in step with the district obstacles of the year 1957–58 that allows you to assemble a new dataset. The special functions of this word are the creation of non-stop databases on land-use sample and place and production facts for Kerala for 61 years duration at the district level.

Changes in land use and cropping patterns studies provide an overall picture of land usage in a particular region or district as well as the crops grown there. Forest, barren and uncultivable land, land used for non-agricultural purposes, cultivable waste land, fallow land, net sown area and so on are all examples of land use. The study revealed a region's cropping pattern which provides an overview of the crops planted and their production in that location.

2.3 Studies on the Growth Rates of Area, Production and Productivity of Major Crops

Patnaik and Mohanty (2016) inspected the execution of major trim bunches within the state of Orissa for the period 1993-94 to 2011-12. It has watched an unsteady and unsustainable development in range, generation and productivity over the year within the state as well as in all physiographic zones. The moderately tall development rates of foodgrains generation in Orissa have been accomplished primarily through range impact. In spite of the fact that commitment of innovation towards a sustainable yield development has been recognized, the development within

the surrender rate is moderate. This sluggish development in zone, generation and abdicate of all trim bunches within the state is since of moderate extension of water system arrange, low level of fertilizer utilization, moderate rate of innovation selection and low level of framework advancement.

Raypure (2016) looked in an economic analysis of agricultural development, the area, production and productivity of the Gadchiroli district. Over the base period, which is 5.09 per cent, the area under oilseeds has expanded by 0.61 per cent. In addition, the area of fruits and vegetables, sugarcane and cotton was increased over the base year while the area of spices, tobacco, medicinal and aromatic plants and fodder crop were decreased.

Gondalia *et al.* (2017) affirms that the compound growth rates (CGRs) instability indices were worked out for area, production and productivity of major crops of Gujarat state for the period from 2001-02 to 2014-15. The result uncovered that under add up to cereals range was expanded non-significantly. There was profoundly critical rise in area, production and productivity of rice and wheat.

Rai and Thakur (2017) investigated the acreage, production and productivity of Uttar Pradesh's sugarcane crop. They pointed out that Uttar Pradesh is the state that produces the most sugarcane and the second most sugar. Because of the crop's importance, a study was done to determine the sugarcane compound annual growth rate in terms of area, production and productivity.

Gaikwad (2018) studied the major perspectives of growth like compound growth rates of crops and major inputs, crop enhancement, sources of yield growth as too region-wise rural and socio-economic improvement of Maharashtra. Financial examination among four districts of state (Konkan, Western Maharashtra, Marathwada and Vidarbha) was drained regard of compound growth rates of guideline crops in cereals, pulses, oilseeds and commercial crops as too N:P:K fertilizer input use. The by and large period of consider between 1960-61 to 2012-13 (over 50 a long time) separated into period I (Pre-WTO 1960-61 to 1994-95) and period II (Post-WTO 1995-96 to 2012-13). Compound development rates has shown that in Maharashtra region under *kharif* sorghum crop altogether diminished during over all period by 1.84 per cent per annum while critical increment found in yield by 1.99 per cent per annum. In every one of the locales region under sorghum crop declined altogether and usefulness expanded. *Rabi* sorghum region is diminishing essentially at 0.72 per cent per annum and usefulness expanding at 0.94 per cent per annum showing non-huge 0.21 per cent ascend underway may be for its grub inclination ruling over production reason. Efficiency of paddy is essentially expanding at 0.76 per cent per annum and region diminishing at 0.57 per cent per annum in Maharashtra over last 50 years. The area, production and productivity of red gram expanded fundamentally in Maharashtra at 1.79, 2.58 and

0.78 per cent per annum and of green gram at 1.39, 3.21 and 1.8 per cent with relating rates at 2.74, 4.5 and 1.71 per cent for gram separately. During generally period sharp expansion in area and production of sunflower seen in Vidarbha, Western Maharashtra and Marathwada area at state level. At state level critical soybean region development is seen at 14.88 per cent per annum and production ascend at 17.16 per cent. Area and production of groundnut in Maharashtra state is essentially diminishing in general period.

Singla *et al.* (2018) investigated how to achieve sustainable development in manufacturing industries by using technology push and demand pull strategies. He weighed in on the importance of various technological push (TP) and demand pull (DP) strategies for achieving long-term growth in India's manufacturing industries. The study investigates the efficacy of TP-DP methods in manufacturing companies.

Based on the aforementioned references, it can be concluded that growth rates of area and pulse production vary across the country. Crop production varies substantially across the country. Fruit and vegetable area, production, and productivity all grew at a positive rate.

2.4 Studies the Changes in Infrastructural Development in Agriculture

Shaikh (2013) announced that the utilization of hardware expanded during the investigation time frame in the state. There is higher expansion in the utilization of work vehicles which are expanded by 185.71 per cent over the base year. The all out number of sugarcane smasher and siphon sets has been expanded during the whole period. Also, number of sugar industrial facilities in the state expanded from 25 of every 1980-81 to 2009-10.

Srinivasu and Rao (2013) affirms that infrastructure is the prerequisite for the development of any economic system. Shipping, telecommunications, electricity, water, health, housing and educational facilities have emerge as element and parcel of human life, those are essential to the household lifestyles in addition to the economic hobby. Infrastructure performs a vital role in promoting financial increase and thereby contributes to the discount of economic disparity, poverty and deprivations in a rustic more get admission to of the negative to training and health offerings, water and sanitation, street community and power is wanted to bring equitable development and social empowerment. It's far a crucial pre-circumstance for sustainable economic and social improvement. Infrastructural investments in delivery (roads, railways, ports and civil aviation) power, irrigation, watersheds, hydroelectric works, medical research and schooling, markets and warehousing, communications and informatics, education, health and circle of relatives welfare play a strategic however oblique role in the improvement technique but makes enormous contribution toward growth with the aid of increasing the aspect productivity of land, labour and capital in the production procedure. This examine establishes the relationship among

infrastructure and economic boom the usage of growth theories through empirical evidences sooner or later it concludes infrastructure and poverty reduction inside the Indian context.

Bissa and Vyas (2014) contemplated the infrastructural status in farming showcasing. They inferred that India has going through a fast change in most recent 20 years. Interest in agrarian area both in broad daylight and private area has expanded. Lately in regards to the effectiveness of showcasing of farming produces in India. It is accepted that helpless linkages in showcasing channels and helpless advertising framework are prompting high and fluctuating purchaser costs. The endeavors are as of now in progress to advance area explicit advances, move them to farmers fields and guarantee input supply to Farmers in opportune time, place and over the long haul.

Chandrachud and Gajalakshmi (2015) considered the effect of foundation improvement on Indian horticultural development (possibilities and points of view). The investigation uncovers that farming is the excellent wellspring of job for in excess of 55 per cent of populace, it's offer to the public total national output has declined to 14.2 per cent. This is for the most part because of fast development of modern and administration sectors but with the supportable arrangement for the infrastructural office, we can accomplish the new pinnacles of farming production in turn higher commitment to Gross Domestic Product.

Lokesha and Mahesha (2016) reasoned that street transport plays a significant job in horticulture advancement. This is on the grounds that it is the significant methods for moving agricultural produce from the farms to the business sectors just as to different metropolitan networks. Advancement of street framework is basic for agriculture and overall economic development as likewise improving the personal satisfaction.

Prajapati (2017) examined the rural infrastructure accessibility and its effect on prosperity with exceptional reference to Uttar Pradesh. The foundation and it's anything but a significant part in the advancement of the economy and furthermore helps in the decrease of the destitution just as joblessness. The income of individuals living in the country region relies upon the foundation offices accessible to them which incorporates fundamental conveniences like wellbeing, instruction, monetary organization, streets, power, media communications and so forth. The paper connotes the connection between the foundation of the country region and the degree of expectation for everyday comforts in the provincial region. The greater amount of the offices they get, the more they procure which subsequently decreases the pay neediness just as the joblessness. In Uttar Pradesh where an enormous populace resides in rustic regions and that without the sufficient offices, they attempts to provide details regarding the relationship of the foundation, neediness and prosperity of individuals living in the country region with unique reference to Uttar Pradesh.

The above references proved that infrastructural amenities such as roads and drip irrigation projects had a beneficial and significant effect on the corresponding target. Weak links in marketing channels and poor marketing infrastructure have resulted in high and unpredictable consumer costs in recent years in India when it comes to the effectiveness of agriculture production marketing.

2.5 Studies on Factors Responsible for Agricultural Development

Birthal *et al.* (2005) examined the vertical coordination in tall esteem nourishment commodities and detailed that the tall esteem agriculture requires more capital, made strides advances, quality inputs and way better back benefit. Need of get to these may imperative little broadening. Most tall esteem commodities are perishable and require prompt transportation from generation to utilization centers and markets. Provincial markets for tall esteem commodities are lean and promoted overflow of little holders is ordinarily as well little to financially exchange in removed urban markets due to high transportation costs.

Jabir (2007) examined domesticated animals area advancement and suggestions for provincial destitution lightening in India and revealed that the animal's area in India experienced astounding development during the most recent twenty years as far as production, worth of yield from animals and exchange. It contributes almost 25 per cent to the gross worth of farming yield at the public level and more towards neediness decrease.

Bairwa *et al.* (2013) examined the cattle sector's performance, focusing on population, production and trade. In India, it has been discovered that marginal farm households keep 50 per cent of the livestock population. Women are primarily in charge of this industry. The livestock industry has provided 25 per cent of the value to agriculture and related activities, thanks to a huge increase in production of diverse products. Despite the fact that livestock exports have expanded dramatically over the last two decades, they are concentrated in a small number of countries with high levels of volatility. Buffalo meat, chicken products and dairy products all have a stronghold on the market.

Shaikh (2013) conducted research in Andhra Pradesh on agricultural development. He stated that the utilization of machines in the state grew during the study period. The utilization of tractors has increased by 185.71 per cent over the base year. Throughout the period, the total number of sugarcane crusher and pump sets has increased. In addition, the number of sugar factories in the state expanded from 25 in the year 1980-81 to 39 in the year 2009-2010.

Saleena (2017) examined contemporary trends in the Indian agricultural sector with a focus on Kerala and compares Indian agriculture to that of the rest of the globe in terms of area, production and productivity. He also looks at the productivity and production of Kerala's major agricultural crops as well as the state's cropping intensity and agricultural worker engagement. It

was determined that a paradigm shift is required to change the conventional agricultural system into a modern one through the adoption of science-based technologies, consequently improving the quality and quantity of agricultural commodities and services while also improving social conditions. In order to ensure food security and combat growing prices, self-reliance in the area of food should be prioritized.

The impact of infrastructural development on the agriculture sector is summarized from assessments of studies on changes in agricultural infrastructure development. Transportation, communication media, power, irrigation resources, financial institutions, contemporary technology, input use, health and education facilities and so on were among the infrastructural facilities available that influenced the region's agricultural development.

2.6 Studies on SWOT Analysis of Agricultural Development

Bindu *et al.* (2014) conducted a SWOT analysis of the Indian dairy industry and found that technically skilled labour and investment in the manufacturing of finished dairy products are strengths and opportunities for the industry while bad roads and insufficient transportation facilities as well as high price sensitivity of dairy products are weaknesses and threats.

Asimiea and Nuga (2015) made the SWOT analysis of the Nigerian agricultural sector. They concluded that Nigeria as a country is endowed with natural, human and capital resources will be stating the obvious. The agricultural development has been weakened by factors such as loss of focus, misplaced priority and lack of encouragement to key sector of economy provided that efforts are geared also to guide against threatening issues like religious and ethnic conflict, land degradation, inconsistent policies and ability to protect investors.

Nandanwar (2015) conducted a SWOT analysis of the Amravati district of Maharashtra and determined that the district's strengths include Nagpuri orange production, agrarian economy with cotton, soybean and red gram as important crops and relatively significant forest resources. Food and fruit processing facilities are lacking as are irrigation facilities that are substandard and inadequate. The district's key weaknesses are a lack of food and fruit processing facilities, poor and inadequate irrigation facilities and a crisis of farmer suicide. Agro-tourism, high-tech agriculture and the revitalization of milk product societies are all possibilities for the district's future development.

Pathak (2016) investigated Punjab agriculture's SWOT analysis. Punjabi agriculture is at a fork in the road today. It is hampered by a number of variables. Punjab made history by being the most productive agricultural state in the country and earning the title of India's food bowl. However, this has been accompanied by land degradation, shrinking land holdings and dwindling water supplies. While possessing the most cultivable area, record food crop output and an industrious peasantry are its strengths.

Raypure (2016) conducted a SWOT analysis of the Gadchiroli district's agricultural development. She came to the conclusion that the district has an annual running river Vainganga and an alluvial belt. Soils with a lot of nutrients such as red lateritic soil and shallow soils are very fruitful. The 75 per cent of the geographical region is covered by the yellow brown soils forest. The Naxal activity has affected the district. It is district's most serious flaw.

Sahoo *et al.* (2018) investigated the agricultural SWOT analysis in the Kandhamal area of Orissa, India. They came to the conclusion that agriculture in Kandhamal is currently hampered by a number of reasons. This study is an attempt to analyze the situation. The agriculture's strengths, weaknesses, possibilities and threats. The districts' assets are their favourable climate and potential for value addition while their weaknesses are their lack of infrastructure. The districts' strengths include their favourable environment and potential for value addition while their weaknesses are low yield, a lack of contemporary technology and post-harvest losses. Efforts must be taken to confront threats and capitalize on opportunities.

SWOT analysis was used to analyze an organization's strategic management policy, according to the above-mentioned references. As a result, the main restrictions to Indian agriculture's growth were technology, resource management and trade strategy. Our strengths included possessing the most cultivable area and producing record amounts of food grains but our weaknesses included low yields, a lack of value addition and food processing and a huge amount of post-harvest losses.

3. METHODOLOGY AND SALIENT FEATURES

3. Methodology

This chapter delves into the methods used to arrive at specific conclusions. Any research problem must be studied along certain lines and with adequate methodology in order to get significant results that are in keeping with the study's specific aims. In order to meet the requirements of the study's aims, the methodological features of the current investigation such as the selection of area, sampling, data collection and analytical approach used are briefly outlined. The following headings have been used to discuss the methodological issues.

3.1 Basic Approach of the Study

The major goal of this study is to assess the agricultural development that has occurred in Nandurbar area over the last 21 years. This is accomplished by examining key parts of the agricultural development process. It is thought that agricultural growth in a certain region causes major changes in land use and cropping patterns as a result of farmers' rational ability to invest in land development and allocate their resources to high-rewarding ventures. Crop productivity improves as a result of the adoption of new production techniques. The utilization of critical inputs that have a substantial impact on agricultural production is a feature of the modern production systems. As a result, the study aimed at evaluating agricultural development must examine changes in land use and cropping patterns, area, production and productivity of major crops grown, infrastructural development in terms of provision of critical inputs, markets and value addition systems as well as identify the factors influencing agricultural production.

In particular, the current study aims to examine changes in land use and cropping patterns in Nandurbar district during a 21 years period from 1998-99 to 2018-19 in order to determine the trend of farmers in resource allocation and product mix as a result of agricultural development. The changes are calculated by calculating proportions to the corresponding totals at the various time points.

Using multiple regression analysis, an attempt is also made to determine the elements that influence agricultural production. The total agricultural production of Nandurbar district in monetary terms is used as the dependent variable with the independent variables being the percentage of gross irrigated area to gross sown area (X_1), consumption of total fertilizer (NPK) per hectare of gross sown area (kg) (X_2), percentage of gross sown area to net sown area (X_3) and percentage of gross sown area to net sown area (X_4), percentage of area under commercial crops to gross sown area (X_5), the amount of loan (short-term and medium-term) disbursed through PACCS per year (in lakhs ₹) (X_6), average annual rainfall in the Nandurbar (mm) (X_7), area under fruit and vegetable crops (ha) (X_8), number of milch animals (No) (X_9).

In the discussion that follows, the research approach used to investigate the aforementioned issues is described.

3.2 Location of the Study

Nandurbar district is surrounded by the States of Madhya Pradesh, Gujarat and Dhule district of Maharashtra. Madhya Pradesh lies at its Eastern and Northern side and districts Surat and Baroda of Gujarat are at its Western side and Dhule district is at Southern side. The district lies between 20° 50" and 22° 17" North latitude and 73° 30" and 74° 50" East longitudes. In the year 2018, there was a total 36.29 per cent forest area of total geographical area. The district encompasses a geographical area of 5,955 sq. km. Generally the climate of the district remains hot and dry.

The Nandurbar district was chosen for this study because it appears to be agro-climatically representative of the North-Western Maharashtra. Nandurbar is located in Maharashtra's North-Western corner. The study's findings could be indicative of the broader agricultural trend in North-Western Maharashtra. As a result, the Nandurbar district has been chosen for the current investigation. Since the country's green revolution, the farmers in the district have been agriculturally conscious and have made earnest efforts for agricultural growth.

3.3 Sources of Data

The research is based on time series data gathered from a variety of sources including published statistical literature and direct contact with the Zilla Parishad, Co-operative and District Statistical Office, Post Graduate Institute, M.P.K.V., Rahuri Library. The data on land use and cropping patterns for the selected twenty-one years as well as the area, production and productivity of selected crops for the period 1998-99 to 2018-19 in Nandurbar district were obtained by consulting the Socio-Economic Review and District Statistical Abstracts of Nandurbar district published by the Directorate of Economics and Statistics, Department of Agriculture, Government of Maharashtra and Government of India.

The information gathered from diverse sources was put to good use in Nandurbar district for examining land use and cropping patterns as well as estimating area, production and productivity growth rates for the crops under study. During the period 1998-99 to 2018-19, information on credit disbursement through co-operatives, fertilizer distribution, improved seeds, average annual rainfall, agricultural production and so on was obtained by contacting co-operative banks, district co-operative sales and purchase union, Zilla Parishad and Nandurbar District Statistical Office. This information was beneficial in determining the key factors that influence production in Nandurbar district.

3.4 Method of Analysis

The data analysis was done with the study's objectives in mind. It is suggested that both tabular and statistical methods of analysis be used. The whole term of the study was divided into two sub periods as shown below with the third period serving as an overall period.

Period-I : 1998-99 to 2007-08

Period-II : 2008-09 to 2018-19

Period-III : 1998-99 to 2018-19

3.4.1 Structural Changes in the Land Use, Cropping Pattern and Input Use

The data on land use and cropping patterns in Nandurbar district were analyzed using a simple tabular method for 21 years separated into two periods: 1998-99 to 2007-08 and 2008-09 to 2018-19 and the overall period 1998-99 to 2018-19. The proportions were calculated for each of the above years to determine how the district's land usage, cropping pattern and input utilization changed over the study period. Changes in land use, cropping patterns and input use were all visually portrayed.

3.4.2 The Growth Rates of Area, Production and Productivity of Major Crops

For the estimation of compound growth rates data on area, production and productivity of major crops such as paddy, wheat, *kharif* sorghum, *rabi* sorghum, pearl millet, maize, gram, red gram, green gram, black gram, groundnut, cotton, sugarcane, chilli, fruits and vegetables from 1998-99 to 2018-19 in Nandurbar district were used. For three separate periods, namely period-I 1998-99 to 2007-08, period-II 2008-09 to 2018-19 and period-III 1998-99 to 2018-19, the data were analyzed to get compound growth rates in area, production and productivity of the above-mentioned crops. This was helpful in determining how the performance of the selected crops changed over time in Nandurbar district.

- **Compound Growth Rate (CGR)**

Fitting exponential functions of the following type to the data for the three periods described above yielded the compound growth rates.

$$\mathbf{Y = ab^t}$$

i.e. in logarithmic form

$$\mathbf{Log\ Y = log\ a + t\ log\ b}$$

Where,

Y = Total agricultural production

a = Intercept

b = Regression coefficient

t = Time period in year

Finally, the annual rates of compound growth of area, production and productivity of the crops was worked out by using the formula.

$$\mathbf{r = (Antilog\ b - 1) \times 100}$$

Where,

r = Compound Growth Rate (CGR)

The significance of the estimated compound growth rates was tested with the help of student's 't' test.

3.4.3 Factors influencing Agricultural Production in Nandurbar

The information regarding total agricultural production, percentage of gross irrigated area to gross sown area, consumption of total fertilizer (NPK) per hectare of gross sown area, percentage of net sown area to gross sown area, area under high yielding variety seeds, area under commercial crops, loan (short term and medium term) disbursed through PACS per year in crores ₹ and average annual rainfall in the district during the two periods i.e. period-I: 1998-99 to 2007-08, period-II: 2008-09 to 2018-19 and for overall period: 1998-99 to 2018-2019 were used for fitting a multiple linear regression equation.

This was done in order to identify the key variables and their impact on agricultural production in the district. The fit of numerous linear regression equations was used to evaluate them.

$$\mathbf{Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + \mu t}$$

Where,

Y = Total agricultural production of food grains + non-food grains in Nandurbar (in lakhs ₹)

a = Intercept

b_i's = Regression coefficient

X_1 = Percentage of gross irrigated area to gross sown area

X_2 = Consumption of total fertilizer (NPK) per hectare of gross sown area (kg)

X_3 = Percentage of net sown area to gross sown area.

X_4 = Area under HYV seeds ('00' ha)

X_5 = Area under commercial crops ('00' ha).

X_6 = Amount of loan (short-term and medium-term) disbursed through PACS per year (crores ₹)

X_7 = Average annual rainfall in the Nandurbar (mm)

X_8 = Area under fruit crops (‘00’ ha)

X_9 = Number of milch animals (lakhs in number)

μt = Error term

Dependent Variable

Total Agricultural Production in Nandurbar District in ₹ (Y)

The entire agricultural production acquired from food grains and non-food grain crops in Nandurbar district from 1998-99 to 2018-19 was calculated and converted into monetary form by multiplying the physical output of each crop with the farm harvest prices for that year. After then, the overall value of total agricultural production for a given year was calculated by summing the physical output values of individual crops.

Independent Variables

1. Percentage of Gross Irrigated Area to Gross Sown Area (X_1)

The variable was created by calculating the percentage of gross irrigated area to gross sown area for each of the study years. The rise in this percentage of gross irrigated area to gross sown area was predicted to strengthen the district's agricultural output. As a result, this variable was taken into account.

2. Consumption of Total Fertilizers (NPK) per hectare of Gross Sown Area (Kg) (X_2)

This variable was created to determine the impact of fertilizer use on total crop output.

3. Percentage of Net Sown Area to Gross Sown Area (X_3)

The rise in the percentage of net sown area to gross sown area was projected to have a favourable influence on the district's farm output hence this variable was studied.

4. Area under HYV Seeds (‘00’ ha) (X_4)

This variable was developed to evaluate the effects of HYV seeds on the district's overall agriculture output.

5. Area under Commercial Crops (‘00’ ha) (X_5)

The area under commercial crops such as sugarcane and cotton was developed in order to evaluate the effects of HYV seeds on the district's overall farm output.

6. Amount of Loan (Short and Medium term) Disbursed through PACS in Nandurbar District (crores ₹) (X_6)

The most essential component in agricultural development was credit. As a result, it is vital to analyze the relationship between credit particularly short and medium-term loan issued through PACS in Nandurbar district and the district's total crop output.

7. Average Annual Rainfall in mm in Nandurbar District (mm) (X_7)

This variable was developed using the data on the district's annual average rainfall. The goal was to see how average yearly rainfall affected total farm output in the district. The significance of the parameter estimations was tested using the standard statistical approach.

8. Area under Fruits and Vegetables ('00' ha) (X_8)

This variable was used to see if increasing the acreage of fruit crops would have a favourable impact on the district's total farm value.

9. Number of Milch Animals (in lakh) (X_9)

The total number of milch animals available was utilized to analyze the district's livestock and dairy development.

3.2 Salient Features of Nandurbar District

3.2.1 General

The goal of this chapter is to provide a quick overview of the Nandurbar district's history. This aids in comprehending the district's most important aspects as well as the study's findings. It is apparent that agricultural output is not solely dependent on man-made processes but also on the soil and climatic parameters of the region such as soil type, temperature, rainfall and so on. Because these circumstances are outside the farmer's control, he must change his crops and farming procedures to combat them. Aside from these elements, economic issues such as marketing agreements, transportation facilities and the availability of sufficient and timely finance at a lower rate influence the crops grown and the farmer's economics. This is especially true in the case of cash crops which demand a big amount of finance and produce perishable goods that require speedy transportation and markets. The following broad information can help you better comprehend the conditions of the tract under investigation.

Nandurbar is a district of Maharashtra state with its administrative headquarters located at Nandurbar town. The district came into existence in the year 1998. Prior to the date 1st July, 1998 it was part of the earlier Dhule district. Nandurbar, Dhule and Jalgaon districts of Maharashtra state was formed out of the previous Khandesh district. Nandurbar is also popularly known as Nandanagri, named after the King called Nandaraja. Earlier the place was known as Rasika. During the ancient period the place was bounded by Vidarbha (present day's Berar) on the East, Anupa (today's Nemad) on the North and Mulaka (present day's Aurangabad) and Asmaka (present day's Bhir) on the South. After sometime the place was named after the King Seunchandra of the early Yadava dynasty and popularly known as Seunadesa. Again the name of the place was changed to Khandesh to suit the title Khan given to the Faruqi kings by Ahmad I of Gujarat.

3.2.1.1 Location

Geographically, the district lies at 21° 38' N. latitude, 74° 24' E. longitude and 210 m altitude. In the year 2019, there was a total 36.29 per cent forest area of total geographical area. The district encompasses a geographical area of 5,955 sq. km. Nandurbar district is bounded to the South and South-East by Dhule district to the West and North is the State of Gujarat to the North and North-East is the state of Madhya Pradesh. The Northern boundary of the district is defined by the great Narmada river.

Nandurbar district is generally round and is a part of the Deccan plateau. The geography of the district is divided into three sections on the basis of elevation, climate, rainfall and type of soil land. The most part of forests is in the Satpuda hills area. First division includes Akrani, Akkalkuwa and Taloda talukas. This part of the country is densely forested and degraded. Transportation facilities are not complete. However due to tribal sub-plans and special schemes approved by the government transportation facilities have become available in Akkalkuwa and Akrani talukas to a great extent.

The second division is the foothills of the intensive Tapi valley and the entire talukas of Shahada and Nandurbar and some parts of Akkalkuwa and Taloda falls into this division having good fertility with irrigation facilities.

In the third division, in the South-West of the district, there is a rugged part of the Sahyadri mountain comprising some part of Navapur taluka.

There are many ranges of Satpuda mountain on the upper bank of Tapi river. The height of this district from mean sea level is 180 to 215 meters. However, the height of some of the peaks of Satpuda mountain is 925 meters. The South-West border of district is surrounded by Sahyadri mountain ranges.

3.2.1.2 Administrative Set-up of Nandurbar

Nandurbar district covers 1.62 per cent of the total area of the state or 5,955 km^2 and on the basis of area district ranks 31st in the state.

Table 3.1 Administrative set-up of Nandurbar

Sr. No.	Name of the sub-division	Name of the tehsil
1.	Nandurbar	Nandurbar, Navapur
2.	Shahada	Shahada, Akrani
3.	Taloda	Taloda, Akkalkuwa

(Source: District Statistics Office, Nandurbar)

The district headquarters is at Nandurbar on the Ahmedabad-Howrah highway. Administration wise, the district is divided into 6 tehsils namely Shahada, Nandurbar, Navapur,

Taloda, Akkalkuwa and Dhadgaon (Akrani). For easy governance, it is divided into three sub-divisions namely Nandurbar, Shahada and Taloda. In Nandurbar subdivision Nandurbar and Navapur talukas, Shahada and Akrani talukas in Shahada sub-division and Taloda sub-division consists of two talukas, Akkalkuwa and Taloda. Moreover, it comprises 9 towns and 930 villages. There are 01 parliamentary and 04 assembly constituencies in the district.

3.2.2 Topography

3.2.2.1 Soil

The soils of Nandurbar District can broadly be classified into three groups *viz.* (i) Light soils (ii) Medium black soils and (iii) Deep Black soils. The light soils are largely found in the South and Western parts of Navapur and Southern part of Nandurbar tehsils. These soils are alkaline in nature with light loams to clay loams in texture. They are low in fertility and needs manure and fertilizers to get good harvest.

Medium black soils are mostly found in Northern part of Shahada, Taloda and Southern part of Akkalkuwa tehsil. These soils are well suited for irrigation and needs manure and fertilizers to get good harvest.

Deep black soils are largely found on the bank of Tapi river particularly in Shahada, Southern part of Taloda, North-Eastern part of Navapur and Northern part of Nandurbar tehsils. These soils cover a width of about 15 km on each side of the Tapi river. Soils in Shahada tehsil are supposed to be extremely rich.

3.2.2.2 Rivers

The district as a whole lies in the drainage basin of the Tapi River except for a small area in the extreme North which drains into the Narmada River. Numerous small streams originate in the Satpuda ranges and meet the Tapi. Gomati and Vaki are the more important amongst them. Most of these streams dry up in the summer. Shivan, Nese rivers and their tributaries i.e. Rangavali, Rayagan, Nagan, Kordi and Amravati are the main Southern tributaries of the Tapi River. Nese and Shivan rivers meet the Tapi river in Gujarat State. Throughout the middle and upper reaches these streams have been crossed by small barriers/dams and are widely used for irrigation.

The Narmada river forms the Northern district boundary for about 70 km. The course of the river exhibits a remarkable influence of the changing strike of the Northern range of the Satpudas. The banks of the river rise very steeply and hence the river is of little value to the district. The river receives a number of small tributaries which drain the Northern slopes of the Satpuda. Some of them are Jharkhet, Udai, Khat and Devganga.

3.2.2.3 Hill Ranges

Nandurbar is a part of Satpuda Pradesh meaning Seven Hills region. Nandurbar district is under the shadow of Satpuda. There are many ranges of Satpuda mountain on the upper bank of Tapi river. Toranmal mountain is part of Satpuda. The height of the district from mean sea level is 180 to 215 meters. However, the height of some of the peaks of Satpuda mountain is 925 meters. Astambha (Akrani) of 1325 meters is the highest peak of Satpuda in the district.

There are also some branches of Sahyadri mountain range in the South-West boundry of the district comprising some part of Navapur taluka. The Satpuda mountain range divides Nandurbar district of Maharashtra and Madhya Pradesh State with its natural boundry.

3.2.2.4 Climate and Rainfall

The climate of Nandurbar district is generally hot and dry. As the rest of India Nandurbar district has three distinct seasons; Summer, Monsoon/Rainy and the Winter season. Summer is from March to mid of June. Summers are usually hot and dry. During the month of May the summer is at its peak. The temperatures can be as high as 45° Celsius during the peak of Summer. The Monsoon sets in during the mid or end of June. During this season the weather is usually humid and hot. The Northern and Western regions receive more rainfall than the rest of the region. The average rainfall is 907.6 mm through the district. Winter is from the month of November to February. Winters are mildly cold but dry.

Table 3.2 Tehsilwise rainfall of Nandurbar (2018-19)

Sr. No.	Name of the tehsil	Actual rainfall (mm)	Rainy days (in Number)
1.	Akkalkuwa	896.00	60
2.	Akrani	694.50	43
3.	Taloda	485.00	39
4.	Shahada	346.90	28
5.	Nandurbar	373.30	32
6.	Navapur	641.70	43
	Average rainfall	**572.90**	

(Source: District Statistics Office, Nandurbar)

The average maximum temperature of the district is 40° C while average minimum is 16° C, respectively. During the summer natives experience a high humidity and its average maximum temperature ranging from 30° to 40° C. The actual rainfall in the district for the year 2018-19 was 572.90 mm. Akkalkuwa taluka experienced more rainfall and rainy days of 896 mm and 60,

respectively while Shahada taluka experienced low rainfall of 346.90 mm. January is the coldest month of the year with the mean daily temperature at around 16 degree centigrade. Cold waves over Northern India affect the district and minimum temperature may drop up to 9 degrees centigrade. For most of the year the skies are clear except during the monsoon season.

3.2.3 Area and Demography

Nandurbar district with an area of 5955.00 sq. km. The population in the table is based on the 2011 census. According to the Table 3.3, the district had population of 16,48,295 persons out of which rural population was 13,72,500 and urban population was 2,75,500. Out of total population, 8,33,170 were males and 8,15,125 were females. In the year 2018-19, the district recorded 47,985 (2.91%) Scheduled Caste population and 1,141,933 (69.28%) Scheduled Tribe population. The district had sex ratio of 978 (females for every 1000 males). The density of population in the year was 277 persons per sq. km. The literacy rate of Nandurbar district was 64.38 per cent out of which 72.17 per cent males were literate and 56.47 per cent females were literate.

Table 3.3 Population of Nandurbar

(in '000' Number)

Sr. No.	**Population**	**Year**
		2018-19
A.	Total population	1648.00
1.	Rural population	1372.00
2.	Urban population	275.00
3.	Male	833.00
4.	Female	815.00
5.	SC population	47.00
6.	ST population	1141.00
B.	Sex ratio (per 1000 Male)	978.00
C.	Population density (per km^2)	277.00
D.	Literacy (%)	64.38
1.	Male literacy	72.17
2.	Female literacy	56.47

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

3.2.4 Forest

This includes all land classified as forest under any legal enactment dealing with forest or administered as forest whether state owned or private and whether wooded or simply maintained as forest land. The total area under the forest is 216100 hectares which is 36.29 per cent of the total geographical area of the district. The forest in the district covered an area of 2161.00 sq. km mostly in Akrani, Akkalkuwa, Taloda and Navapur talukas. The maximum forest area is in Akkalkuwa taluka i.e. 42.34 per cent.

3.2.5 Agriculture

Agriculture is the backbone of the economy of the district. Most of the lands in the district are use for agricultural purposes. More than half of their populations are engaged in agriculture in order to earn their livelihood. The major agricultural products in the district are sorghum, wheat, rice, pearl millet, maize, groundnut, chilli etc. every year a huge chunk of revenue comes from the agricultural products in the district helps in its economy to a great extent. The district is scantily industrialized but it has a few agro based industries.

Most of the people of this district are engaged in agricultural activities. As per 2011 census, 28.97 per cent of the total workers are engaged as cultivators and 52.79 per cent of the total workers are engaged as agricultural labours in the district. Together constitute 81.76 per cent of the total workers of the district.

3.2.5.1 Land Use

Total geographical area of the district is 595500 hectares. The land use pattern of the Nandurbar district in the year 2018-19 is presented in Table 3.4. The land use and cropping pattern in Nandurbar district for the year 2018-19 is explained to give a quick overview of the district's agricultural mode.

The area under forest was 216100 hectares and 36.29 per cent to the total geographical area. The area under non-agricultural use was 24970 hectare which occupies 4.19 per cent of gross cropped area. The area under cultivable waste, other fallow land and current fallow were 1900, 10980 and 10970 hectares, respectively during the year 2018-19. The net sown area for the year 2018-19 was 295000 hectares which formed 49.54 per cent of the total geographical area. The area under irrigation was 139880 hectares (47.42%) of the net sown area whereas un-irrigated area was 155120 hectares (52.58%) of the net sown area. The area sown more than once was 219.6 hundred hectares which contributes 3.69 per cent to the total geographical area. The gross cropped area was 316960 hectares which contributes 53.23 per cent to total geographical area.

Table 3.4 Land use pattern of Nandurbar (2018-19)

(Area in '00' ha)

Sr. No.	Particulars	Area	Percentage to the total geographical area
1.	Total geographical area	5955.00	100.00
2.	Area under the forest	2161.00	36.29
3.	Barren and Uncultivated land	313.90	5.27
4.	Land put to non-agricultural use	249.70	4.19
5.	Permanent pastures and Grazing land	0.70	0.01
6.	Area under Orchard and Miscellaneous trees	41.20	0.69
7.	Cultivable waste	19.00	0.33
8.	Other fallow land	109.80	1.84
9.	Current fallow land	109.70	1.84
10.	**Net Sown Area**	**2950.00**	**49.54**
a.	Irrigated area	1398.80	47.42
b.	Un-irrigated area	1551.20	52.58
11.	Area sown more than once	219.60	3.69
12.	**Gross Cropped Area**	**3169.60**	**53.23**
13.	**Cropping intensity (%)**	**107.44**	

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

3.2.5.2 Irrigation Resources

Irrigation is the most essential agricultural input. With the use of suitable irrigation facilities, a major modification in cropping pattern might be achieved. Irrigation is one of the most significant inputs.

Table 3.5 Area irrigated by various sources (2018-19)

(Area in '00' ha)

Sr. No.	Particulars	Area
1.	Surface irrigation other than wells	577.00 (42.86)
2.	Well irrigation	760.00 (57.14)
3.	Net Irrigated Area	1330.00 (100.00)

(Figures in Parentheses indicate percentage to the net irrigated area)

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

There were no big irrigation projects in Nandurbar district hence, the large area of the district is dry due to this there was less agricultural growth found in overall study period. It can be seen from the Table 3.5, the wells were the primary source of irrigation. Net irrigated area by various sources during the year 2018-19 was 133000 hecatre. Out of net irrigated area, 57.14 per cent i.e. 76000 ha area was well irrigated and 42.86 per cent of area was surface irrigated other than wells comprising 57700 ha.

Table 3.6 Irrigation projects in Nandurbar (2018-19)

Sr. No.	Name of Dam/Project	Location	Capacity (Million cu. Meter)	Status	River on which Dam was constructed
Major					
1.	Rangavali	Navapur	15.02	Completed in 1982	Rangavali
2.	Prakasha	Shahada	63.14	Completed in 2012	Tapi
3.	Sarangkheda	Shahada	92.19	Completed in 2015	Tapti
Minor					
1.	Koradi	Navapur	11.49	Incomplete	Koradi
2.	Naganbhardu	Navapur	26.48	Incomplete	Nagan
3.	Dehli	Akkalkuwa	19.08	Incomplete	Tapi
4.	Dara	Shahada	14.76	Incomplete	Tapi
5.	Shivan	Nandurbar	24.19	Incomplete	Tapi

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

The information related to the irrigation projects in Nandurbar is presented in Table 3.6. In the previous few years, 8 major and minor (3 completed and 5 incomplete) and 23 other irrigation projects have been built. Sarangkheda, Prakasha, Dara (Shahada), Rangavali, Nagan bhardu, Kordi (Navapur), Dehli (Akkalkuwa) and Shivan (Nandurbar) are among the district's medium irrigation projects. The three completed projects in the district were Rangavali, Prakasha and Sarangkheda with capacity of 15.02, 63.14 and 92.19 million cu. Meter. As it is seen from the table, Sarangkheda is big project among the three projects which is completed in 2015 and built on the Tapti river.

3.2.5.3 Cropping Pattern of Nandurbar

The data in Table 3.7 shows the cropping pattern of the Nandurbar district during the year 2018-19.

Table 3.7 Cropping pattern of Nandurbar (2018-19)

(Area in '00' ha)

Sr. No.	Crops	Area	Percentage to the total GCA
1.	Paddy	259.72	8.19
2.	Wheat	110.00	3.47
3.	*Kharif* Sorghum	340.79	10.75
4.	*Rabi* Sorghum	115.72	3.65
5.	Pearl Millet	83.93	2.65
6.	Maize	177.71	5.61
7.	Other cereals	599.88	18.93
8.	**Total Cereals**	**1687.75**	**53.25**
9.	Gram	72.80	2.30
10.	Red gram	117.62	3.70
11.	Green gram	64.85	2.04
12.	Black gram	99.82	3.14
13.	Other pulses	16.85	0.53
14.	**Total Pulses**	**371.94**	**11.71**
15.	**Total Food Grains**	**2059.69**	**64.96**
16.	Groundnut	29.57	0.93
17.	Sunflower	3.15	0.09
18.	Safflower	0.99	0.04
19.	Other Oilseeds	8.46	0.29
20.	**Total Oilseeds**	**42.17**	**1.35**
21.	Fruits	36.00	1.14
22.	Vegetables	18.76	0.59
23.	Sugarcane	85.83	2.71
24.	Cotton	886.54	27.97
25.	Chilli	35.92	1.13
26.	Fodder crops	0.69	0.02
27.	Medicinal and Aromatic plants	4.00	0.13
28.	**Gross Cropped Area**	**3169.60**	**100.00**

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

The gross cropped area for the year 2018-19 was 316960 hectare. The cereals are key crops accounting for 53.25 per cent of total cropped land. Among the several grains, the *kharif*

sorghum crop occupies the most area (10.75%), followed by rice (8.19%) and pulses (11.71%). Sugarcane, chilli, banana, groundnut and other vegetables are among the district's other main crops.

Fruit crops accounted for 1.14 per cent of total cultivated land out of 316960 hectare of land. Vegetables took up 0.59 per cent of the total area. Food grains constituted a major portion of the total gross cropped area as can be seen from the cropping pattern accounting for 64.96 per cent of the total gross cropped area. Total oilseeds comprised an area of 4217 ha which was 1.35 per cent of gross cropped area. Groundnut was the major oilseed crop grown during the year 2018-19 with area of 2957 ha which is 0.93 per cent of gross cropped area. Sugarcane and cotton occupied an area of 2.71 and 27.97 per cent area of gross cropped area.

3.2.5.4 Animal Husbandry

The Table 3.8 shows the livestock population in Nandurbar district based on the results of the 19th Livestock Census 2012.

Table 3.8 Livestock population of Nandurbar (2012)

Sr. No.	Particulars	Number
1.	Indigenous Cattle	340807
i.	Bullocks	176810
ii.	Cows	92495
iii.	Calf	71502
2.	Exotic/Hybrid Cattle	16531
i.	Bullocks	1271
ii.	Cows	8305
iii.	Calf	6955
3.	Buffaloes	114071
i.	He buffaloes	5181
ii.	She buffaloes	68785
iii.	Calf	40105
4.	Total Sheeps	36210
5.	Total Goats	323264
6.	**Total Livestock**	**830883**
7.	**Total Poultry**	**1093649**

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

Farmers' livestock often includes one or two bullock pairs, a few cows, one or two buffaloes and in rare occasions poultry birds and goats. The livestock situation in Nandurbar district during the year 2018-19 is depicted in Table 3.8. The total animal population in Nandurbar district was 830883. Indigenous cattle numbered 340807, Exotic/Hybrid cattle 16531 and buffaloes 114071 in the district's total livestock population. The overall population of poultry, sheeps and goats were 1093649, 36210 and 323264, respectively.

3.2.5.5 Agricultural Machineries and Implements used in Nandurbar

Farmers' production efficiency is influenced by the type of agricultural implements and technology they utilize. The use of better equipment and machines has also shed insight on technological advancements. The data in Table 3.9 shows the state of tools and machinery in the district for the 2018-19. According to the table, there were 87163 wooden ploughs, 19720 iron ploughs, 2976 oil pumps and 28012 electric pumps for irrigation, respectively. In total, there were 8592 bullock carts and 9162 tractors in the field.

Table 3.9 Use of agricultural machineries and implements (2018-19)

Sr. No.	Implements	Number
1.	Wooden ploughs	87163
2.	Iron ploughs	19720
3.	Oil pumps	2976
4.	Electric pumps	28012
5.	Bullock carts	8592
6.	Tractors	9162
7.	Sugarcane crushers	1409

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

3.3 Development of Infrastructural Facilities in Nansurbar

3.3.1 Agro-based Industries in Nandurbar

The information related to agro-based industries in Nandurbar district for the 2018-19 fiscal year is presented in Table 3.10. After examining the table, it was determined that there were fewer agro-based industries in Nandurbar district.

There were 5 sugar mills out of which 2 sugar factories were cooperatives while 3 were privately owned. 2 cotton mills, 2 rice mills and 2 dal mill industries. There were a total of 28 milk processing societies in existence. There are 31 fish processing plants. Chilli mills are well-known in Nandurbar and 400 units were present. In the district, there were 8 oil mills.

Table 3.10 Agro based industries in Nandurbar (2018-19)

Sr. No.	Particulars	Number
1.	Sugar factories	05
2.	Cotton mills	02
3.	Rice and Dal mills	04
4.	Milk processing societies	28
5.	Chilli processing units	400
6.	Fish processing units	31
7.	Weavers association	02
8.	Oil mills	08

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

3.3.2 Markets

The information about market facilities in Nandurbar district is presented in Table 3.11. It is seen that, there were 6 APMCs in Nandurbar district which were formed to improve market functioning in Nandurbar. Nandurbar, Shahada, Taloda, Navapur, Akrani and Akkalkuwa were among the APMCs. Out of these 6, Akrani and Akkalkuwa were established later in 2004. Wheat, paddy, sorghum, maize, pearl millet, soybean, chilli, fruits and vegetables were among the products they sold.

Table 3.11 Fair price shops and APMC's in Nandurbar (2018-19)

Sr. No.	Particulars	Number
1.	Fair Price Shops	1061
2.	APMC's	06

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

There were about 1061 fair price shops in district. These stores distributed food grains to those living in poverty.

3.3.3 Banking

The data related to banking sector for the fiscal year 2018-19 is presented in Table 3.12. It is seen that, there were just a few i.e. 17 primary cooperative banks and 138 Primary Agricultural Cooperative Societies (PACS). Farmers can get short and medium-term loans from them. There were also 29 District Central Cooperative Bank offices where farmers could get long-term loans for agricultural development. There were 199 non-agricultural cooperatives and 97 LAMPS (*Aadiwasi* cooperative societies).

Table 3.12 Financial institutions in Nandurbar (2018-19)

Sr. No.	Name of the Bank	Number
1.	Primary Cooperative Banks	17
2.	District Central Cooperative Banks	29
3.	Agriculture and Rural Development Banks	67
4.	Commercial Banks	47
5.	Non-agriculture Credit Societies	199
6.	Primary Agriculture Cooperative Societies	138
7.	LAMPS (*Aadiwasi* Cooperative Societies)	97
8.	Other Agriculture Societies	43

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

3.3.4 Transport and Communication Facilities in Nandurbar

Transportation and communication infrastructure are critical to any country's prosperity. The district's transportation infrastructure was well-developed. These facilities aided the development of agriculture by allowing surplus agricultural items to be easily moved from one location to another where there was a need. It is seen from the Table 3.13 that, the total road length in Nandurbar district in the year 2018-19 was 7459.29 km. The district is crossed by two national highways: NH 752G (Sendhwa-Shirdi) and NH 753B (Shevali- Netrang). The whole length of the railway route is now roughly 90 kilometres.

Table 3.13 Road and railway length in Nandurbar (2018-19)

(Length in 'km')

Year	National Highways	Main and Other State Highways	Major District Roads	Village Roads	Other Roads	Total length of Roads	Railway Length
2018-19	122.03	127.54	1088.51	4027.22	1523.66	7459.29	90.00

(Source**:** Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

The communication facilities provided through the netwok of 198 Post Offices and 50 PCO's. There were telephones and mobiles as a media of communication. There were 7090 telephone connections in the district.

3.3.5 Education and Health Facilities

As noted in the Table 3.3 that, the district's literacy rate was 64.38 per cent in 2018-19.

Table 3.14 Educational facilities in Nandurbar (2018-19)

Sr. No.	Particulars	Number
A.	**Primary Schools**	
1.	Total Schools	1901
2.	Total Students	263994
3.	Total Teachers	9377
4.	Students per teacher	28.15
B.	**Secondary Schools**	
1.	Total Schools	264
2.	Total Students	101496
3.	Total Teachers	2645
4.	Students per teacher	38.37
C.	**Colleges**	
1.	Total Schools	71
2.	Total Students	26430
3.	Total Teachers	501
4.	Students per teacher	52.75

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

There were 1901 elementary schools and 264 secondary schools. In the district, there were 71 junior and senior colleges. In the district, there were two engineering colleges, one agriculture college, one law college, one medical college, three polytechnic colleges and two pharmacy colleges. In addition, the district had few number of private colleges.

Table 3.15 Health facilities in Nandurbar (2018-19)

Sr. No.	Particulars	Number
1.	Civil Hospitals	01
2.	Rural Hospitals	11
3.	Dispensaries	183
4.	Public Health Centres	06
5.	Sub PHC's	290
6.	Primary Health Centres	59
7.	Private Hospitals	145

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

The information regarding the health facilities in Nandurbar district is depicted in Table 3.15. The district's medical facilities were rapidly developing. There are 1 district civil hospital, 183 dispensaries, 102 maternity hospitals, 59 primary health clinics and 290 sub PHC's under government control at the end of 2018-19. There were 145 hospitals in the private sector.

3.3.6 Electricity Use in Nandurbar

Electricity use for agriculture sector was more than any other sector, it indicates that there was increase in agricultural development in Nandurbar. Government charges less for per unit electricity consumption to farmers for irrigation purpose or other agricultural use. Electricity supply to every village is the key vision of Nandurbar district's Vision 2022.

Table 3.16 Electricity use in Nandurbar (2018-19)

Sr. No.	Particulars	Electricity use ('000' kWh)	Percentage (%)
1.	Household purpose	91760	14.06
2.	Business and Small Industry	27840	4.27
3.	Industrial purpose	71910	11.02
4.	Street purpose	48246	7.39
5.	Agriculture	385880	59.12
6.	Other	27024	4.14
	Total use	**652660**	**100**

(Source**:** Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

The information related to electricity use in Nandurbar district is presented in Table 3.16. It is observed from Table 3.16 that, the total electricity use in Nandurbar 652660000 kWh. Out of the total elctricity use household use was 14.06 per cent, industrial use was 11.02 per cent and agricultural use was 59.12 per cent during the year 2018-19.

3.4 Rural Development Programmes in Nandurbar

As Nandurbar is well known as *Aadiwasi* (Tribal) district so most of its population is underdeveloped, illiterate and below poverty line. Literacy is one of the prime necessity of development so government needs to improve education and healthcare facilities. For the improvement of below poverty line population, many plans had been implementing until today and continuous efforts had been made to bring welfare of rural people. Employment Guarantee Scheme provided gainful and productive employment on approved works to all unemployed persons in the rural areas.

Minor irrigation projects, percolation tanks, contour bunding and nala bunding were among the works included in the scheme. Its goal was to create jobs for individuals living in rural areas. Agricultural development has been added to the mix. Other schemes that benefited the beneficiaries included the Sampurn Gramin RojgarYojana (SGRY), Training to Rural Youth for Self Employment Program (TYRSEM), Development of Women and Children in Rural Area (DWCRA), Indira Awas Yojana (IAY), Member of Parliament Local Area Development Scheme (MPLADS), Member of Legislative Assembly Development Scheme (MLADS) and National Rural Livelihood Mission (NRLM), Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA).

3.5 Industry and Employment in Nandurbar

Despite the overall agricultural potential, Nandurbar has yet to experience the kind of industrial boom that comes with a strong social growth. The data on the agricultural workers in Nandurbar district for the 2018-19 financial year is presented in Table 3.17.

Table 3.17 Agriculture workforce in Nandurbar (2018-19)

Sr. No.	Agriculture workforce	Number
1.	Cultivators	211672 (26.72)
2.	Agriculture labours	438176 (55.32)
3.	Workers of Households, Production and Repairing	14599 (1.84)
4.	Other Workers	127618 (16.11)
	Total	**792065 (100)**

(Figures in Parentheses indicates percentage to the total agricultural workforce)
(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

From the table, it is noticed that, there were 211672 cultivators in the district accounting for 26.72 per cent of total employment. There were 438176 agricultural labours who made up 55.32 per cent of total employment, 14599 household production workers who made up 1.84 per cent and roughly 127618 other workers who made up 16.11 per cent of total employment. It signifies that agricultural labours made up the majority of the district's population accounting for more than 50 per cent followed by cultivators and other workers.

4. RESULTS AND DISCUSSION

The adoption of effective agricultural policy during the post-independence period followed by the commencement of the green revolution in the country during the mid-sixties, must have resulted in certain structural changes in farm land usage and cropping patterns. According to the report, during the post-green revolution period, a breakthrough in agricultural technology caused a shift in Indian agriculture from traditional agriculture to modern agriculture, subsistence agriculture to commercial agriculture, extensive cultivation to intensive cultivation and low income giving enterprises to high income giving enterprises. Farmers became more aware of the importance of developing basic assets such as land and diverted resources to businesses that would benefit from new technologies to boost agricultural production. It was felt that studying changes in land use and cropping patterns in the district and determining a trend of change in agriculture through time would be beneficial. As a result, the current chapter has been arranged to explain the processed data regarding structural changes in land use and cropping pattern as a result of agricultural development in Nandurbar district from 1998-99 to 2018-19. The information on the aforementioned topics was gathered over a period of time beginning in 1998-99. The data on the following aspects collected in Nandurbar district for the period 1998-99 to 2018-19 was analyzed and the results obtained are explained below.

4.1 Changes in Population of Nandurbar

The district of Nandurbar covers an area of 595500 hectares. Nandurbar accounts for 1.60 per cent of Maharashtra's land area and 1.46 per cent of its population. In 1998-99, the total population of Nandurbar district was 1062000 and in 2008-09, it was 1311000. According to the 2011 census, the district had a population of 1648000 (persons) with 833000 males and 815000 females. Over the previous 21 years, the district's population expanded by 55.17 per cent over the base year. The district's rural population increased from 898000 in 1998-99 to 1372000 in 2018-19. It means that the number of people living in rural areas has increased by 52.78 per cent from the base year. In the year 1998-99, the urban population was 163000 and it increased to 275000 in the year 2018-19. It increased by 68.71 per cent over the base year. In 1998-99, the male population was 538000 and in 2018-19, it was 833000. Over the base year, the male population had increased by 54.83 per cent. In 2018-19, the female population increased by 55.53 per cent over the base year from 524000 to 8150000.

In 1998-99, the sex ratio was 975 which increased to 978 in 2018-19. The sex ratio increased by 0.30 per cent over the base year. In 2018-19, the district's scheduled caste population was 47000 and increased by 27.02 per cent from the base year and the district's scheduled tribal

population was 1141000 and increased by 72.61 per cent from the base year. According to the 2011 census, the population density was 277 people per square kilometres. In 1998-99, the district's literacy rate was 42 per cent and in 2018-19, it was 64.38 per cent. The male literacy rate was 72.17 per cent while the female literacy rate was 56.47 per cent. Over the base year, literacy had improved by 53.28 per cent. Raypure (2016) and Gavhane (2017) also reported similar results.

The changes in the population of Nandurbar district over the study period are presented in Figure 4.1.

Table 4.1 Changes in population of Nandurbar

('000' No)

Sr. No.	Population	Year			Per cent change over the base year	
		1998-99 (Base Year)	2008-09	2018-19	2008-09	2018-19
I.	Total population	1062.00	1311.00	1648.00	23.44	55.17
1.	Rural population	898.00	1109.00	1372.00	23.49	52.78
2.	Urban population	163.00	202.00	275.00	23.92	68.71
3.	Male population	538.00	663.00	833.00	23.23	54.83
4.	Female population	524.00	648.00	815.00	23.66	55.53
5.	SC population	37.00	41.00	47.00	10.81	27.02
6.	ST population	661.00	859.00	1141.00	29.95	72.61
II.	Sex ratio (per 1000 Male)	975.00	977.00	978.00	0.20	0.30
III.	Population density (per sq. km)	215.00	261.00	277.00	21.39	28.83
IV.	Literacy (%)	42.00	55.80	64.38	32.85	53.28
1.	Male literacy	51.68	66.20	72.17	28.09	39.64
2.	Female literacy	29.15	45.20	56.47	55.06	93.72

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

4.2 Changes in Agricultural Workforce

It is seen from the Table 4.2 that, the total number of cultivators in the Nandurbar district were 191500 in 1998-99 and 211672 in 2018-19. It increased by 10.53 per cent over the base year. The number of agricultural labours increased from 180400 in 1998-99 to 438176 in 2018-19. The increase was 142.89 per cent compared to the base year. Workers involved in domestic manufacturing, processing and repair increased from 3700 in 1998-99 to 14599 in 2018-19. It

increased by 294.56 per cent over the base year. During the study period, the total population increased by 51.07 per cent. This change in agricultural workforce was mainly due to increase in cultivable area and commercialization of agriculture in the district over years. The results are in line with the findings of Bhatt (2012), Shaikh (2013) and Kalaskar (2015).

The changes in the agricultural workforce over the study period are graphically depicted in Fig. 4.2.

Table 4.2 Changes in agricultural workforce of Nandurbar

(in Number)

Sr. No.	**Population**	**Year**			**Per cent change over base year**	
		1998-99 (Base Year)	**2008-09**	**2018-19**	**2008-09**	**2018-19**
1.	Cultivators	191500.00	205567.00	211672.00	7.34	10.53
2.	Agricultural workforce	180400.00	291922.00	438176.00	61.81	142.89
3.	Workers of households production and repairing	3700.00	10245.00	14599.00	176.89	294.56
4.	Other	148700.00	214212.00	127618.00	44.05	-14.17
	Total	**524300.00**	**721946.00**	**792065.00**	**37.69**	**51.07**

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

4.3 Changes in Land Holding Pattern of Farmers in Nandurbar

The information regarding changes in farmers' land holding patterns in Nandurbar district is depicted in Table 4.3.

It seen that, the small and marginal farmers in the district contributed 41.90 per cent in 1998-99 but this has increased to 53.32 per cent in 2018-19. It was up 27.26 per cent from the base year. During the study period, the percentage of semi-medium land owners increased from 21.90 per cent to 29.05 per cent. It showed increase of 32.65 per cent over the base year. Over the base year, the percentage of medium land owners increased by 15.63 per cent. During the study period, the population of large farmers decreased from 10 per cent to 3.55 per cent. It was decreased by 64.50 per cent over the base period.

In 2018-19, the percentage of land owners held 20 and more was decreased from 15 per cent to 1.13 per cent. It decreased by a significant amount i.e. 92.47 per cent over base year and also, it decreased by 48.67 per cent in 2008-09. The results are similar with Shaikh (2013) and Nandanwar (2015).

Table 4.3 Changes in land holding pattern of Nandurbar

(%)

Sr. No.	Categories	Year			Per cent change over base year	
		1998-99 (Base Year)	2008-09	2018-19	2008-09	2018-19
1.	Small and marginal (upto 2 ha)	41.90	48.25	53.32	15.16	27.26
2.	Semi-medium (2-5 ha)	21.90	24.05	29.05	9.82	32.65
3.	Medium (5-10 ha)	11.20	11.43	12.95	2.05	15.63
4.	Large (10-20 ha)	10.00	8.57	3.55	-14.30	-64.50
5.	20 and more (ha)	15.00	7.70	1.13	-48.67	-92.47

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

In Fig. 4.3, the changes in the percentage of land owners are graphically depicted.

4.4 Changes in Land Use Pattern of Nandurbar

It is seen from the Table 4.4 that, in the year 1998-99, the area under forest was 215000 hectares or 36.10 per cent of total geographical area but this reduced to 175800 hectares in 2008-2009, a decrease of 18.23 per cent over the base year. In 2018-2019, the total area under forest was 216100 hectares. It increased by 0.51 per cent compared to the base year. During the research period, it revealed several noteworthy changes. The decrease in forest area could be related to issues such as industrialization and population increase. In Nandurbar district, there is a substantial beneficial change for sustaining ecological equilibrium. However, due to expanded tree planting programmes under government programmes, the area under forest in 2018-19 increased to 216100 hectares. During the study period, the amount of barren and uncultivable land increased from 13900 to 31390 hectares. It has risen by 125.83 per cent since the beginning of the study period. During the study period, non-agricultural land was increased to 24970 hectares. It increased by 41.07 per cent over the base period. It was raised because additional land had been taken over by homes and industry. Because the amount of land planted in high-yielding types and cash crops such as sugarcane and cotton increased during the research period. The area under cultivable waste land shrank from 1300 hectares in the base period to 1900 hectares in the third period accounting for 0.33 per cent of the total geographical area. This indicates that more land has been cultivated. With the base period, the area under permanent pastures declined by 98.51 per cent and the area under various trees decreased over time. During the research period, permanent pastures land declined from 4700 hectares to 70 hectares. Permanent meadows accounted for 0.01 per cent of

the total geographical area. The area under miscellaneous tree was increased by 17.71 per cent from the base period.

Table 4.4 Changes in land use pattern

(Area in '00' ha)

Sr. No.	Particulars	1998 to 99 (Base year)	2008 to 09	2018 to 19	Per cent change in land use pattern over base year	
					2008-09	2018-19
1.	Total Geographical area	5955.00 (100.00)	5955.00 (100.00)	5955.00 (100.00)	-	-
2.	Forest area	2150.00 (36.10)	1758.00 (29.52)	2161.00 (36.29)	-18.23	0.51
3.	Barren land and Uncultivable land	139.00 (2.33)	370.00 (6.21)	313.90 (5.27)	166.19	125.83
4.	Land under non-agricultural use	177.00 (2.97)	219.00 (3.68)	249.70 (4.19)	23.73	41.07
5.	Cultivable waste	130.00 (2.19)	40.00 (0.67)	19.00 (0.33)	-69.23	-85.39
6.	Permanent pastures	47.00 (0.79)	100.80 (1.68)	0.70 (0.01)	114.47	-98.51
7.	Area under orchard and Miscellaneous trees	35.00 (0.59)	51.00 (0.86)	41.20 (0.69)	45.71	17.71
8.	Current fallow	193.00 (3.25)	180.20 (3.03)	109.70 (1.84)	-6.63	-43.16
9.	Other fallow	329.00 (5.52)	260.00 (4.37)	109.80 (1.84)	-20.97	-66.63
10.	**Net Sown Area**	**2755.00 (46.26)**	**2976.00 (49.98)**	**2950.00 (49.54)**	**8.02**	**7.08**
a.	Irrigated area	623.00 (10.46)	915.00 (15.37)	1398.80 (23.49)	46.87	124.53
b.	Un-irrigated area	2132.00 (35.80)	2061.00 (34.61)	1551.20 (26.05)	-3.33	-27.24
11.	Area sown more than once	229.00 (3.85)	213.00 (3.57)	219.60 (3.69)	-6.99	-4.11
12.	**Gross Cropped area**	**2984.00 (50.11)**	**3189.00 (53.55)**	**3169.60 (53.23)**	**6.87**	**6.22**
13.	**Cropping intensity (%)**	**108.31**	**107.16**	**107.44**	**-1.06**	**-0.80**

(Figures in parentheses indicate percentage to the total geographical area)

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

During the research period, the un-irrigated area decreased by 27.24 per cent while the irrigated area increased by 124.53 per cent. During the II and III periods, the area sown more than

once declined. The gross cropped area was 298400 hectares (50.11 %) indicating a large increase to 318900 hectares (53.55 %) in 2008-09 and then again in 2018-19 when it reached 316960 hectares (53.23 % of GA) representing a 6.22 per cent growth over the base period. During the period 1998-99 to 2018-19, the intensity of cropping which was a measure of land use efficiency had decreased. In comparison to the base period, it declined again from 2008 to 2009. Over the base year, it has dropped from 108.31 to 107.44 per cent. Fig. 4.4 depicts the change in the major components of the land use pattern in Nandurbar district over the course of the study. To summarize over the study period, the area under forest has increased, the land under cultivable waste has decreased and the area under present fallows has declined. However, there was a 7.08 per cent rise in net sown area over the base year and a 124.53 per cent increase in irrigated area. This indicates more efforts have been taken by district to increase the area.

The similar results were reported by Nandanwar (2015) and Gavhane (2017).

Thus, the hypothesis stated, the cultivated and irrigated area are varying for last several years in Nandurbar district has been proved.

4.5 Changes in Irrigated Area in Nandurbar

It is seen form the Table 4.5 that, the net irrigated area was 51100 hectares in 1998-99 and increased to 133000 hectares in 2018-19. It increased by 160.27 per cent in the district over the last 21 years.

Table 4.5 Changes in irrigated area in Nandurbar

(Area in '00' ha)

Sr. No.	Particulars	1998-99 (Base Year)	2008-09	2018-19	Per cent change over the base year	
					2008-09	2018-19
1.	Net sown area	2755.00	2976.00	2950.00	8.02	7.08
2.	Net irrigated area	511.00	660.00	1330.00	29.16	160.27
3.	Percentage of net irrigated to net sown area	5.39	4.50	2.22	-16.51	-58.81
4.	Area sown more than once	229.00	213.00	219.60	-6.99	-4.11
5.	Gross irrigated area	623.00	915.00	1398.80	46.87	124.53
6.	Gross cropped area	2984.00	3189.00	3169.60	6.87	6.23
7.	Percentage of gross irrigated area to gross cropped area	20.88	28.69	44.13	37.40	111.35

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

The ratio of net irrigated to net sown land fell from 5.39 per cent in 1998-99 to 2.22 per cent in the year 2018-19. The gross irrigated area exhibited an upward trend. In 1998-99, the gross irrigated area was 62300 hectares which had expanded to 139880 hectares in 2018-19. It was up by 124.53 per cent over the base year. During the study period, the percentage of gross irrigated area to gross cultivated area increased from 20.88 to 44.13 per cent. This indicates that the irrigated area in Nandurbar district increased significantly over the research period. In Fig. 4.5, the growing trend in both net and gross irrigated area can be seen. The changes in irrigated area in Nandurbar district are shown in Table 4.5. It was found that the area irrigated has expanded significantly which is a positive sign for agricultural development in Nandurbar district. The government of Maharashtra has undertaken some minor irrigation projects resulting in an increase in irrigated land.

The results are in close association with Bhatt (2012), Kalaskar (2015) and Raypure (2016).

4.6 Irrigation Sources in Nandurbar

The information regarding land irrigated by various sources from 1998-99 to 2018-19 is depicted in Table 4.6.

Table 4.6 Trends in the area irrigated by various sources in Nandurbar

(Area in '00' ha)

Sr. No.	Particulars	1998-99 (Base Year)	2008-09	2018-19	Per cent change over the base year	
					2008-09	2018-19
1.	Surface irrigation other than wells	126.00 (24.66)	240.00 (36.36)	577.00 (42.86)	90.48	357.94
2.	Well irrigation	385.00 (75.34)	420.00 (63.64)	760.00 (57.14)	9.09	97.40
3.	Net area irrigated	511.00 (100.00)	660.00 (100.00)	1330.00 (100.00)	29.16	160.27

(Figures in parentheses indicate percentage to the net area irrigated)

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

In the 2018-2019 season, the well was the primary source of irrigation covering 76000 hectares of land or around 57.14 per cent of the net irrigated area. During the research period, the area under well irrigation increased from 51100 hectares to 133000 hectares. During the study period from 1998-99 to 2018-19, the share of area irrigated by wells decreased from 75.34 per cent to 57.14 per cent. In 1998-99, there were 12600 hectares (24.66%) irrigated by surface irrigation which had increased to 57700 hectares (42.86%) in 2018-19.

Over 21 years net area irrigated has showed increasing trend from 51100 ha to 133000 ha which shows more and more area brought under irrigation facilities by expanding irrigation sources like wells, irrigation projects, construction and repairing of dams.

Similar results were observed by Kalaskar (2015) and Nandanwar (2015) and Raypure (2016).

4.7 Changes in Cropping Pattern of Nandurbar

It is seen from the Table 4.7 that, the area under paddy appears to have expanded from 19715 hectares in period I to 25972 hectares in 2018-19. From 10772 hectares in period I to 11000 hectares in period III, the area under wheat has grown. In Period I, it was 3.61 per cent of gross cropped area whereas in period III it was 3.47 per cent of gross cropped area. It increased by around 2.12 per cent over the base period. The acreage planted in *rabi* sorghum has been shrinking. In period III, the area declined from 31094 hectares in the base period to 11572 hectares. Over the base period, it decreased by 38.11 per cent in period II and 62.78 per cent in period III. The decrease could be owing to the district's poor rainfall.

Table 4.7 Changes in cropping pattern of Nandurbar

(Area in '00' ha)

Sr. No.	**Particulars**	**1998 to 1999 (Base year)**	**2008 to 2009**	**2018 to 2019**	**Per cent change over the base year**	
					2008-09	**2018-19**
1.	Paddy	197.15 (6.62)	271.40 (8.51)	259.72 (8.19)	37.66	31.74
2.	Wheat	107.72 (3.61)	115.30 (3.62)	110.00 (3.47)	7.04	2.12
3.	*Kharif* sorghum	395.07 (13.24)	444.90 (13.95)	340.79 (10.75)	12.61	-13.74
4.	*Rabi* sorghum	310.94 (10.42)	192.45 (6.04)	115.72 (3.65)	-38.11	-62.78
5.	Pearl millet	174.62 (5.85)	217.72 (6.82)	83.93 (2.65)	24.68	-51.94
6.	Maize	155.19 (5.20)	205.08 (6.43)	177.71 (5.61)	32.15	14.51
7.	Other cereals	133.84 (4.49)	138.89 (4.36)	599.88 (18.93)	3.80	348.21
8.	**Total cereals**	**1474.53 (49.43)**	**1585.74 (49.73)**	**1687.75 (53.25)**	**7.54**	**14.46**
9.	Gram	68.80 (2.31)	76.77 (2.41)	72.80 (2.30)	11.58	5.81
10.	Red gram	181.82 (6.09)	186.33 (5.84)	117.62 (3.70)	2.48	-35.31

Table 4.7 Contd…

11.	Green gram	185.97 (6.23)	118.57 (3.72)	64.85 (2.04)	-36.24	-65.13
12.	Black gram	165.38 (5.54)	125.36 (3.93)	99.82 (3.14)	-24.20	-39.64
13.	Other pulses	60.41 (2.02)	39.13 (1.22)	16.85 (0.53)	-35.23	-72.11
14.	**Total pulses**	**662.38 (22.19)**	**546.16 (17.12)**	**371.94 (11.71)**	**-17.55**	**-43.85**
15.	**Total food grains**	**2136.91 (71.62)**	**2131.90 (66.85)**	**2059.69 (64.96)**	**-0.24**	**-3.61**
16.	Groundnut	257.09 (8.62)	50.75 (1.59)	29.57 (0.93)	-80.26	-88.50
17.	Sunflower	10.57 (0.35)	20.97 (0.66)	3.15 (0.09)	98.40	-70.20
18.	Safflower	12.96 (0.43)	45.51 (1.43)	0.99 (0.04)	251.16	-92.36
19.	Other oilseeds	27.71 (0.93)	23.41 (0.73)	8.46 (0.29)	-15.52	-69.47
20.	**Total oilseeds**	**308.33 (10.33)**	**140.64 (4.41)**	**42.17 (1.35)**	**-54.39**	**-86.32**
21.	Fruits	34.71 (1.16)	65.17 (2.04)	36.00 (1.14)	87.76	3.72
22.	Vegetables	40.55 (1.36)	30.08 (0.94)	18.76 (0.59)	-25.82	-53.74
23.	Sugarcane	122.93 (4.12)	85.94 (2.70)	85.83 (2.71)	-30.09	-30.18
24.	Cotton	269.05 (9.02)	646.09 (20.26)	886.54 (27.97)	140.14	229.51
25.	Chilli	47.21 (1.58)	70.16 (2.20)	35.92 (1.13)	48.61	-23.91
26.	Fodder crops	09.00 (0.30)	06.00 (0.19)	0.69 (0.02)	-33.33	-92.33
27.	Medicinal and Aromatic plants	15.31 (0.51)	13.02 (0.41)	4.00 (0.13)	-14.96	-73.87
28.	**Gross Cropped Area**	**2984.00 (100.00)**	**3189.00 (100.00)**	**3169.60 (100.00**	**6.87**	**6.22**

(Figures in parentheses indicate percentage to the total gross cropped area)

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

In period III, there was a decline in area under pearl millet, however period II saw an increase in area over the base year. Over the base year, the area planted to maize had expanded by 14.51 per cent. In period III, total cereals showed a rising tendency in area over the base year. In

the base period, the area under total cereals was 147453 hectares and it was 158574 hectares in the post-base period. In period III, the area increased to 168775 hectares. It increased from the base year by 14.46 per cent. In the base period, the area under gram was 6880 hectares and in period III, it was raised to 7280 hectares. This was a 5.81 per cent rise over the base year.

During the study period, the area under red gram reduced from 18182 hectares to 11762 hectares. It fell by 35.31 per cent compared to the base year. In comparison to the base year, the area under black gram and green gram had reduced. During the study period, the area under green gram reduced from 18597 hectares to 6485 hectares. It was down 65.13 per cent from the base year.

In the base period, the area under black gram was 16538 hectares but in the study period-III it was reduced to 9982 hectares. It was down by 39.64 per cent compared to the base year. Total pulses were applied to 37194 hectares in period III, down from 66238 hectares in the base period. It decreased by 43.85 per cent as compared to the base period. In phase III, the area under total food grains declined from 213691 hectares in the base year to 205969 hectares. It fell by 3.61 per cent compared to the base year.

During the study period, the area under total oilseeds declined from 30833 hectares to 4217 hectares. Over the base period, all oilseeds showed a decreasing trend in area. It fell by 86.32 per cent compared to the base year. In period II, the area under groundnut was reduced from 25709 hectares to 5075 hectares and in period III, it was reduced to 2957 hectares. The area under both sunflower and safflower crops was initially raised and later decreased. Sunflower had a base area of 1057 hectares which was eventually enlarged to 2097 hectares in period II. It has shrunk to 315 hectares in recent years. It was down 70.20 per cent compared to the base year. Safflower had a base area of 1296 hectares which was eventually enlarged to 4551 hectares in period II. It has shrunk to 99 hectares in recent years. It was down 92.36 per cent compared to the base year. The area under the sugarcane has shrunk slightly. Sugarcane area decreased from 12293 hectares in the base period to 8583 hectares in period III. In period II, the area under fruits increased somewhat from 3471 hectares to 6517 hectares before declining to 3600 hectares. The area under cotton has been steadily rising. The table shows that the area under sugarcane was declining while the area under cotton was expanding with a high proportion. More area was brought under commercial crop like cotton which gave maximum returns over years so district's fellow growers had tendency of shifting more towards commercial crops. Similar results were reported by Nandanwar, R. (2015).

Fig. 4.6 depicts the changes in acreages under major crops in Nandurbar from 1998-99 to 2018-19.

4.8 Changes in Crop Production in Nandurbar

The information on changes in production of major crops in the Nandurbar district is showed in Table 4.8. It is observed that, the production of cereals like paddy and wheat were increased in study period. *Kharif* sorghum, *rabi* sorghum and pearl millet all showed decreasing trend over the study period *viz.* 46.37, 46.19 and 99.17 per cent in 2018-19. In the overall study period, maize production increased from 39700 M. tonnes to 87000 M. tonnes while it increased from 39700 M. tonnes to 71700 M. tonnes in 2008-09. It was an increase of 119.14 per cent over the base year.

Table 4.8 Changes in production of major crops in Nandurbar

(Production in '00' M. tonnes)

Sr. No.	Crops	1998-99 (Base Year)	2008-09	2018-19	Per cent change over the base year	
					2008-09	2018-19
1.	Paddy	159.00	312.00	258.29	96.23	62.45
2.	Wheat	263.00	380.00	296.56	44.49	12.76
3.	*Kharif* sorghum	890.00	435.00	477.31	-51.12	-46.37
4.	*Rabi* sorghum	786.00	417.00	422.97	-46.95	-46.19
5.	Pearl millet	1848.00	211.00	15.39	-88.58	-99.17
6.	Maize	397.00	717.00	870.00	80.61	119.14
7.	Other cereals	93.00	38.00	42.48	-59.14	-54.32
8.	**Total cereals**	**4436.00**	**2510.00**	**2383.00**	**-43.42**	**-46.28**
9.	Gram	234.00	187.00	135.89	-20.09	-41.93
10.	Red gram	100.00	220.00	72.96	120.00	-27.04
11.	Green gram	196.00	95.00	38.66	-51.53	-80.28
12.	Black gram	265.00	126.00	59.36	-52.45	-77.60
13.	Other pulses	92.00	12.00	8.59	-86.96	-90.66
14.	**Total Pulses**	**887.00**	**640.00**	**315.46**	**-27.85**	**-64.44**
15.	**Total Food grains**	**5323.00**	**3150.00**	**2698.46**	**-40.82**	**-49.31**
16.	Groundnut	620.00	229.00	435.31	-63.07	-29.79
17.	Sunflower	3.00	7.00	1.00	133.33	-66.67
18.	Other oilseeds	7.00	2.00	1.00	-71.43	-85.71
19.	**Total Oilseeds**	**630.00**	**238.00**	**437.31**	**-62.22**	**-30.59**
20.	Sugarcane	7561.00	17942.00	10088.90	137.30	33.43
21.	Cotton	381.41	1076.00	1685.00	182.11	341.78

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

Total cereal production fell from 443600 M. tonnes in 2008-09 to 251000 M. tonnes in 2018-19 and then dropped again to 238300 M. tonnes in 2018-19. In the 2018-19 fiscal year, cereal production fell by 46.28 per cent. Total pulse production fell from 88700 M. tonnes in to 64000 M. tonnes in 2008-09 and then fell again to 31546 M. tonnes in 2018-19. The production of red gram has decreased by 27.04 per cent compared to the base year. During the research period, gram production fell from 23400 M. tonnes to 13589 M. tonnes. It was down 41.93 per cent from the base year. During the study period, green gram production fell by 80.28 per cent. In fact, total pulse production fell in 2008-09 then fell again in the study period from 887 M. tonnes to 315.46 M. tonnes. During the research period, overall food grain production fell from 532300 M. tonnes to 269846 M. tonnes.

During the research period, overall oilseed production fell steadily from 63000 M. tonnes to 43731 M. tonnes. It was down 30.59 per cent from the base year. Cotton production increased from 38141 to 168500 M. tonnes over the research period and also increased to 107600 M. tonnes in 2008-09. During the study period, it increased by 341.78 per cent. During the research period, sugarcane production moves from 756100 M. tonnes to 1008890 M. tonnes. It moved by 33.43 per cent compared to the base year but during 2008-09 it was hugely increased by 137.30 per cent to 1794200 M. tonnes. The production of crops like paddy, wheat, maize, sugarcane and cotton showcased increasing trend mainly due to increase in use of HYV's, technology adoption, use of fertilizers, crop improvement measures and plant protection tools.

4.9 Changes in Productivity of Major Crops in Nandurbar

According to the Table 4.9, the productivity of the some of the crops has increased since the base year. Critical observations revealed that crop productivity grew steadily during the period (1998-99 to 2018-19). The utilization of enhanced technologies and high yielding crop varieties could be the main explanation behind this. The average productivity of paddy in the district had tremendously increased from 806.49 kg to 1149.60 kg in year 2008-09 from the base year and again inclined to 994.49 kg in 2018-19. The overall change over base period was 23.31 per cent. The average productivity of wheat increased from 2441.52 kg to 2696 kg across the study period, although it was noted that productivity of wheat increased dramatically to 3295.75 kg in 2008-09. The average productivity of *kharif* sorghum decreased in period II from 2252.77 to 977.75 kg but later on it went on inclining to 1400.60 kg. The average productivity of *rabi* sorghum decreased from 2527.82 kg to 2166.80 kg in 2008-09 but then increased to 3655.12 kg in the year 2018-19. It was found to be increased by 44.60 per cent from the base year. In the case of maize, average productivity went on increasing in 2008-09 and 2018-19, rising from 2558.16 kg to 4895.62 kg over the base year.

However, overall cereal productivity declined from 3008.41 kg to 1582.86 kg in 2008-09, then again declined to 1411.94 kg in 2018-19. It decreased by 53.07 per cent over the base year. The average productivity of pulses shrunk from 1339.11 kg to 1171.82 kg in 2008-09 and again it had fallen to 848.15 kg in 2018-19. Gram, green gram and black gram productivity had decreased by 45.12, 43.44 and 62.89 per cent, respectively over the base year. During the study period, average oilseed productivity fell from 2043.27 kg to 1037.17 kg, although it also decreased to 1692.26 kg in 2008-09. The average groundnut productivity increased from 2411.60 kg to 4512.32 kg in period-II and fell to mark 1472.34 kg over the study period. It increased by 38.95 per cent compared to the base year.

Table 4.9 Changes in productivity of major crops in Nandurbar

(kg/ha)

Sr. No.	**Crops**	**1998-99 (Base Year)**	**2008-09**	**2018-19**	**Per cent change over the base year**	
					2008-09	**2018-19**
1.	Paddy	806.49	1149.60	994.49	42.54	23.31
2.	Wheat	2441.52	3295.75	2696.00	34.99	10.42
3.	*Kharif* sorghum	2252.77	977.75	1400.60	-56.60	-37.83
4.	*Rabi* sorghum	2527.82	2166.80	3655.12	-14.28	44.60
5.	Pearl millet	10582.98	969.14	183.37	-90.84	-96.27
6.	Maize	2558.16	3496.20	4895.62	36.67	91.37
7.	**Total Cereals**	**3008.41**	**1582.86**	**1411.94**	**-47.39**	**-53.07**
8.	Gram	3401.16	2435.85	1866.62	-28.38	-45.12
9.	Red gram	550.00	1180.70	620.30	114.67	12.78
10.	Green gram	1053.93	801.21	596.14	-23.98	-43.44
11.	Black gram	1602.37	1005.11	594.67	-37.27	-62.89
12.	**Total Pulses**	**1339.11**	**1171.82**	**848.15**	**-12.49**	**-36.66**
13.	**Total Food Grains**	**2490.98**	**1477.56**	**1310.13**	**-40.68**	**-47.41**
14.	Groundnut	2411.60	4512.32	1472.34	87.03	-38.95
15.	Sunflower	283.82	333.81	317.46	17.61	11.85
16.	**Total oilseeds**	**2043.27**	**1692.26**	**1037.17**	**-17.18**	**-49.24**
17.	Sugarcane	61506.55	208773.56	117545.15	239.43	91.11
18.	Cotton	1417.62	1665.40	1900.65	17.48	34.07

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

Sunflower productivity has been increasing slightly in recent years with an average productivity of 283.82 kg to 333.81 in 2008-09 and 317.46 in 2018-19. It was increased by 11.85 over the study period. Cotton's average productivity inclined from 1417.62 kg to 1665.40 kg in 2008-09 and then continued to increase to 1900.65 kg in 2018-19. During the study period, average sugarcane productivity grew significantly from 61506.55 kg to 117545.15 kg. The data in Table 4.9 shows the changes in productivity of major crops in Nandurbar district from 1998-99 to 2018-19. As mentioned earlier, increased use of HYV's, technology adoption, fertilizer use and plant protection caused sufficient increase in production which in turn increased productivity of crops like paddy, wheat, maize, sugarcane and cotton.

4.10 Annual Compound Growth Rates of Area, Production and Productivity of Major Crops in Nandurbar

4.10.A Annual Compound Growth Rates of Area, Production and Productivity of Total Foodgrains, Cereals and Pulses

In the previous section, an attempt was made to investigate agricultural development in Nandurbar district over the last 21 years in terms of changes in land use, cropping pattern and crop yield. It was concluded that agricultural growth has a significant impact on agricultural productivity resulting in higher levels of agriculture production per unit of available resources. The relative growth rates of the main crops were evaluated in order to offer an overall picture of average productivity, production and area. The yearly compound growth rates (period and total) for area, production and productivity of main crops such as paddy, sorghum, pearl millet, maize, sunflower, groundnut, cotton and sugarcane in Nandurbar district were computed for 21 years from 1998-99 to 2018-19. Compound growth rates of the aforesaid crops were individually evaluated for area, production and productivity for three different periods, namely 1998-99 to 2007-08, 2008-09 to 2018-19 and 1998-99 to 2018-2019 for the aim of scientific assessment of agricultural progress.

In period I, the growth rates of area, production and productivity of total foodgrains were negative with tunes of 0.58, 8.11 and 7.58 per cent per annum, respectively. The growth rates of area, production and productivity in period II recorded negative tunes of 4.78, 5.21 and 0.45 per cent per annum, where growth rate of area was significant at 1 per cent level and the growth rate of production was significant at 5 per cent level. In period-III, growth rates of area, production and productivity recorded tunes of 1.57, 2.15 and 0.59 per cent per annum, where the growth rates of area and production were significant at 1 and 5 per cent level, respectively.

In period I, growth rates of production and productivity of total cereals saw negative tunes of 7.58 and 8.08 per cent per annum while the growth rate of area showed positive tune of 0.55 per cent per annum. In period II, the growth rates were all negative. The growth rates of area,

production and productivity were with tunes of 4.49, 5.13 and 0.67 per cent per annum, respectively. The growth rates of area, production and productivity in period III, all recorded negative tunes of 1.13, 1.66 and 0.53 per cent per annum, where area was significant at 5 per cent. Paddy had positive growth rates of area, production and productivity for whole time period and negative in period II. In period I, the growth rates of area and production were positive with tunes of 4.25 and 3.26 per cent per annum while the growth rate of productivity negative tune of 0.95 per cent per annum. The growth rates of area, production and productivity were 1.43, 1.71 and 0.28 per cent per annum, respectively in period III. Wheat recorded positive growth rates of area and production with tunes of 1.02 and 0.25 per cent per annum while the growth rate of productivity saw negative tune of 0.75 per cent per annum. The growth rates area, production and productivity of *rabi* sorghum saw negative tunes in both period I and II. In period III, the growth rates of area and production of *rabi* sorghum recorded negative tunes of 6.68 and 0.69 per cent per annum, whereas the growth rate of productivity saw positive of 6.43 per cent per annum, significant at 5 per cent level.

Total pulses recorded negatively significant growth rates of area, production and productivity with tunes of 3.19, 9.73 and 6.76 per cent per annum, respectively in period I. In period III, total pulses also recorded negative growth rates of area, production and productivity with tunes of 2.32, 4.46 and 2.20 per cent per annum, each significant at 1, 1 and 5 per cent level, respectively. In period III, the growth rates of production and productivity of gram saw negative tune of 0.74 and 1.63 per cent per annum while the growth rate area saw positive tune of 0.91 per cent per annum. Green gram recorded negative growth rates in all three periods. In period III, the growth rates of area, production and productivity were 5.93, 8.45 and 2.68 per cent per annum in where each significant at 1, 1 and 5 per cent level, respectively.

4.10.B Annual Compound Growth Rates of Area, Production and Productivity of Total Oilseeds

According to a detailed examination of period-wise growth rates of oilseeds, all three periods recorded negatively significant growth rates. The growth rates of area, production and productivity in period I were of 13.36, 17.00 and 4.20 per cent per annum, respectively. In period II, growth rates of area, production and productivity with tunes 9.43, 28.02 and 20.52 per cent per annum, respectively were observed. The growth rates of area, production and productivity were significant at 1 per cent level in period III with tunes of 11.10, 19.36 and 9.29 per cent per annum, respectively. Groundnut experienced negative growth rates in all three periods. In period III, the growth rates of area, production and productivity saw tunes of 11.27, 13.10 and 2.07 per cent per annum, respectively. Sunflower recorded positive growth rates area, production and productivity with tunes of 12.54, 16.53 and 3.55 per cent per annum in period I while period II saw negative

growth rates. In period III, the growth rates of area and production showed negative tunes of 10.08 and 9.44 per cent per annum while the growth rate of productivity saw positive tune of 0.72 per cent per annum. The growth rates of area and production both were significant at 1 per cent level, respectively.

4.10.C Annual Compound Growth Rates of Area, Production and Productivity of Commercial Crops

Sugarcane recorded positive growth rates of production and productivity while the growth rate of area was negative in all three periods. In period III, the growth rates of area, production and productivity were 3.06, 4.25 and 7.54 per cent per annum, each significant at 1, 5 and 1 per cent level, respectively. In case of cotton, the growth rate of area, production and productivity showed positive tunes, where area and production were significant at 1 per cent level in all three periods. In period I, the growth rates of area, production and productivity were recorded tunes of 9.87, 11.58 and 1.56, respectively. In period III, the growth rates of area, production and productivity were 7.04, 7.38 and 0.32 per cent per annum, respectively.

As a result, the hypothesis stated that, the growth rates in area, production and productivity of major crops are varying during last several years has been proved.

Table 4.10 Annual compound growth rates of area, production and productivity of cereals and pulses in Nandurbar

Sr. No.	Crops	Period I 1998-99 to 2007-08			Period II 2008-09 to 2018-19			Period III 1998-99 to 2018-19		
		A	P	Y	A	P	Y	A	P	Y
1.	Paddy	4.25***	3.26	-0.95	-1.38**	-1.96	-0.59	1.43***	1.71	0.28
2.	Wheat	-5.22***	3.74**	9.45***	-1.14***	2.25	3.43	1.02	0.25	-0.75
3.	*Kharif* sorghum	1.75***	-12.85**	-14.35**	-3.73***	-9.22**	-5.7	-1.03**	-1.75	-0.72
4.	*Rabi* sorghum	-3.69***	-11.31	-7.91	-5.90***	-8.99***	-3.28	-6.68***	-0.69	6.43**
5.	Pearl millet	0.51	-1.52***	-2.02*	-15.17***	8.61*	28.03***	-3.46**	-2.08	1.43
6.	Maize	2.73**	-2.99***	-5.57***	-1.46***	-0.59	0.88	0.88**	3.96***	3.05***
7.	**Total cereals**	0.55	-7.58*	-8.08**	-4.49***	-5.13**	-0.67	-1.13**	-1.66	-0.53
8.	Gram	-0.19	-6.60***	-6.42**	-7.62**	-1.65	6.46*	0.91	-0.74	-1.63
9.	Red gram	-1.00	-1.69	-0.70	-6.18***	-6.23**	-0.05	-1.93***	-0.74	1.21
10.	Green gram	-5.39***	-14.34***	-9.46***	-8.21***	-10.05**	-2.00	-5.93***	-8.45***	-2.68**
11.	Black gram	-4.81**	-15.31***	-11.04***	-0.10	-8.56**	-8.47**	-2.80***	-7.88***	-5.23***
12.	**Total pulses**	-3.19**	-9.73***	-6.76***	-5.55***	-6.42*	-0.93	-2.32***	-4.46***	-2.20**
13.	**Total food grains**	-0.58	-8.11**	-7.58**	-4.78***	-5.21**	-0.45	-1.57***	-2.15**	-0.59

(*, **, * indicates significant at 1, 5 and 10 per cent level of significance)**

Table 4.11 Annual compound growth rates of area, production and productivity of oilseeds and commercial crops in Nandurbar

Sr. No.	Crops	Period I 1998-99 to 2007-08			Period II 2008-09 to 2018-19			Period III 1998-99 to 2018-19		
		A	P	Y	A	P	Y	A	P	Y
1.	Groundnut	-19.60***	-19.84***	-0.30	-6.35***	-15.67***	-9.95***	-11.27***	-13.10***	-2.07**
2.	Sunflower	12.54***	16.53***	3.55***	-21.43***	-23.83***	-3.05**	-10.08***	-9.44***	0.72
3.	**Total oilseeds**	-13.36***	-17.00***	-4.2***	-9.43***	-28.02***	-20.52***	-11.10***	-19.36***	-9.29***
4.	Sugarcane	-0.89	4.84	5.79**	-1.92*	11.62**	13.81**	-3.06***	4.25**	7.54***
5.	Cotton	9.87***	11.58***	1.56	3.75***	4.54***	0.76	7.04***	7.38***	0.32

(*, **, * indicates significant at 1, 5 and 10 per cent level of significance)**

4.11 Changes in Consumption of Fertilizers (NPK) in Nandurbar

The information related to N, P and K consumption per hectare of area in Nandurbar district is depicted in Table 4.12. Nandurbar district's total fertilizer usage was 36581 MT in 1998-99, 31496 MT in 2008-09 and 62785 MT in 2018-19. In the fiscal year 2008-09, it increased by 102.39 per cent. In the 2018-19 fiscal year, it increased by 198.06 per cent over the base year. Except for the year 2008-09, per hectare N, P and K consumption exhibited an increasing tendency throughout the study period, especially in the last 21 years. It was discovered that the usage of N, P and K fertilizers has increased during the last 21 years. It was mostly due to farmer understanding of the benefits of using chemical fertilizers to increase crop output as well as government incentives and subsidies for phosphatic fertilizers. Fertilizer usage per hectare was 96.15 kg in 1998-99 and marginally increased to 102.39 kg in 2008-09 and thereafter grew to 198.06 kg per hectare. Per hectare consumption showed per cent increase of 6.49 per cent in 2008-09 which later increased to 105.99 per cent in 2018-19 over the base year. As for the sake of increase in production of various crops use of fertilizers had been continuously increasing over the base period.

These results are in conformity with Shaikh (2013), Kalaskar (2015) and Gavhane (2017).

In Fig. 4.7, the changes in total fertilizer consumption (N, P and K) over time in Nandurbar districts are graphically depicted.

Table 4.12 Changes in consumption of fertilizers in Nandurbar

(Fertilizers in 'MT')

Sr. No.	Fertilizer	Year			Per cent Change over the base year	
		1998-99 (Base Year)	2008-09	2018-19	2008-09	2018-19
1.	Nitrogen (N)	17281.00	15066.00	26562.00	-12.82	53.71
2.	Phosphorus (P)	11124.00	9376.00	20509.00	-15.71	84.37
3.	Potassium (K)	8176.00	7054.00	15714.00	-13.72	92.20
4.	Total	36581.00	31496.00	62785.00	-13.90	71.63
5.	Per hectare consumption (Kg per hectare)	96.15	102.39	198.06	6.49	105.99

(Figures in parentheses indicate percentage to the gross cropped area)

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

4.12 Changes in Area under High Yielding Varieties in Nandurbar

The adoption of HYVs of paddy, wheat and maize has increased during the entire period when compared to the base year. The data in Table 4.13 shows the changes in area under high yielding varieties.

Table 4.13 Changes in area under high yielding varieties in Nandurbar

(Area in '00' ha)

Sr. No.	Crops	Year			Per cent change over the base year	
		1998-99 (Base Year)	2008-09	2018-19	2008-09	2018-19
1.	Paddy	97.15	189.20	215.01	94.75	121.32
2.	Sorghum	426.23	531.78	448.25	24.76	5.17
3.	Wheat	75.26	80.45	99.05	6.90	31.61
4.	Maize	96.72	175.69	150.90	81.65	56.02
5.	**Total area**	**695.36**	**977.12**	**913.21**	**40.52**	**31.33**

(Figures in parentheses indicates percentage change to the base year)

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

Over the base year, the total area under HYVs expanded by 31.33 per cent. Over the base year, the area under paddy HYVs expanded by 121.32 per cent. The reason for this was that the area under paddy expanded from 19715 ha in 1998-99 to 25972 ha in 2018-19. Over the base year 1998-99, the area under HYVs of wheat had expanded by 31.61 per cent. In addition, the area under HYVs of sorghum and maize grew. For period II, the area under both *kharif* and *rabi* sorghum HYVs decreased from 70601 hectares to 45651 hectares over the base year. It showed decrease in area by 13.74 and 62.78 per cent, respectively over the base year. The area of HYVs maize increased from 15519 hectares to 17771 hectares representing a 56.02 per cent increase in use of HYVs over the base year. The HYVs yields more and tolerant to the various diseases and pests which helps farmers to attend maximum production and good returns that's why there is increased use of HYV's. Changes in use of HYVs are depicted in Fig. 4.8.

Similar results were observed by Nandanwar (2015) and Gavhane (2017).

4.13 Changes in Annual Rainfall in Nandurbar

It is seen from the Table 4.14 that, Nandurbar district received less than 1000 mm of rainfall on average. The *kharif* season receives more rain than the other two. The rainfall reduced from 975.83 mm to 859.50 mm in the 2008-09 season. It rained the least during the entire study period. It indicated a decline of 11.92 per cent compared to the base year. The rainfall increased from 859.50 mm in 2008-09 to 907.60 mm in 2018-19 but it was still less than in 1998-99. It fell by 6.99 per cent from the base year. Water availability varied as a result of the variation in rainfall

throughout a 21 year period resulting in variations in agricultural production. The rainy days increased from 60 to 61 days showing 1.67 increase throughout the research period while they decreased to 38 in 2008-09, a decrease of 36.67 per cent. These results are similar with the results reported by Bhatt (2012).

Figure 4.9 depicts the variation in average annual rainfall in Nandurbar.

Table 4.14 Changes in annual rainfall in Nandurbar

Period	Rainy days (in Number)	Rainfall (mm)	Per cent change over the base year
1998-99 (Base Year)	60	975.83	-
2008-09	38	859.50	-11.92
2018-19	61	907.60	-6.99

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

4.14 Changes in the Use of Implements and Machineries in Nandurbar

The statistics on changes in the use of tools and machineries in Nandurbar district from 1998-99 to 2018-19 is presented in Table 4.15. It is seen that, the use of bullock carts has decreased over the base year while the use of wooden ploughs, iron ploughs, oil engines, electric motors, sugarcane crushers and tractors has expanded. The usage of traditional implements such as wooden ploughs and iron ploughs was replaced by modern implements such as tractors which grew over the base year. The utilization of sugarcane crushers in Nandurbar district had continually risen over a period under consideration. The most noteworthy shift was in case of iron ploughs, oil engines, electric motors, tractors and sugarcane crushers which showed an increase of *viz.* 99.82, 298.93, 83.94, 486.18 and 1158.04 per cent over the base year. It was mostly owing to an expansion in the area irrigated by wells. As a result, it is obvious that the district's usage electric motors has expanded dramatically since the base year, contributing significantly to the district's agricultural development. As adoption of new technology is today’s need, so with the use of modern implements and machineries farmers benefitted more to get good yield. This proves increasing trend of use of implements and machineries for increasing agricultural production.

The results are in line with the findings of Bhatt (2012), Kalaskar (2015) and Raypure (2016).

Table 4.15 Changes in the use of implements and machineries in Nandurbar

(in Number)

Sr. No.	Implements and Machineries	Year			Per cent change over the base year	
		1998-99 (Base Year)	2008-09	2018-19	2008-09	2018-19
1.	Wooden Plough	70989	75622	87163	6.53	22.78
2.	Iron Plough	9869	11888	19720	20.46	99.82
3.	Oil Engines	746	1705	2976	128.55	298.93
4.	Electric Motors	15229	18915	28012	24.20	83.94
5.	Bullock Carts	18020	13501	8592	-25.08	-52.32
6.	Tractors	1563	1917	9162	22.65	486.18
7.	Sugarcane Crushers	112	897	1409	700.89	1158.04

(Figures in parentheses indicates percentage change over the base year)

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

4.15 Changes in Livestock Population in Nandurbar

According to Table 4.16, the population of indigenous bullocks has increased from 176540 in 1998-99 to 176810 in 2018-19. It was up 0.15 per cent over the base year. During the study period, the population of indigenous calf declined from 82766 to 71502. It was down by 13.60 per cent from the base year. Whereas the population of indigenous cows dropped from 103581 to 92495, a 10.70 per cent drop from the base year. Over the base year, the number of exotic bullocks, cows and calves increased by 14.30, 89.44 and 45.59 per cent, respectively. During the study period, the population of he buffaloes, she buffaloes and calfs had steadily increased. The main reason for the increase in buffalo population is government-sponsored artificial insemination programmes. Farmers tried to boost their population by breeding crossbreed bullocks for drought purposes and as a result, their number grew. She buffalo populations had also expanded by 69.04 per cent from the base year. Over the baseline period, the population of he buffaloes had expanded by 123.71 per cent.

The sheep population has expanded dramatically from 10448 in 1998-99 to 36210 in 2018-19. It increased by 246.57 per cent compared to the base year. Whereas, the population of goats grew from 210474 in 1998-99 to 323264 in 2018-19 over the base year. It was up 53.59 per cent from the base year. The number of poultry in the population increased from 536086 in 1998-99 to 1093649 in 2018-19. It increased by 104.01 per cent over the base year. The overall livestock population increased from 668595 in 1998-99 to 830883 in 2018-19. It was up 24.27 per cent from the base year.

Table 4.16 Changes in livestock population in Nandurbar

(in Number)

Year	Cattle						Buffaloes		
	Indigenous			Exotic/Crossbreed			He Buffaloes	She Buffaloes	Calf
	Bullocks	Cow	Calf	Bullocks	Cow	Calf			
1998 (Base Year)	176540.00 (100.00)	103581.00 (100.00)	82766.00 (100.00)	1112.00 (100.00)	4384.00 (100.00)	4777.00 (100.00)	2316.00 (100.00)	40692.00 (100.00)	25019.00 (100.00)
2002	199673.00 (13.10)	117637.00 (13.57)	96852.00 (17.01)	3281.00 (195.05)	5660.00 (29.11)	2309.00 (-51.66)	2650.00 (14.42)	60306.00 (48.20)	50190.00 (100.67)
2007	113823.00 (-35.52)	63659.00 (-38.54)	105461.00 (27.42)	568.00 (-48.92)	17883.00 (307.92)	1963.00 (-58.91)	2721.00 (17.49)	53672.00 (31.90)	21040.00 (-15.87)
2012	180214.00 (2.08)	81730.00 (-21.09)	60460.00 (-26.95)	1445.00 (29.95)	7102.00 (62.00)	5986.00 (25.31)	2102.00 (-9.24)	72100.00 (77.19)	42731.00 (70.85)
2019	176810.00 (0.15)	92495.00 (-10.70)	71502.00 (-13.60)	1271.00 (14.30)	8305.00 (89.44)	6955.00 (45.59)	5181.00 (123.71)	68785.00 (69.04)	40105.00 (60.33)

Year	Sheeps	Goats	Total Livestock	Total Poultry
1998 (Base Year)	10448.00 (100)	210474.00 (100)	668595.00 (100)	536086.00 (100)
2002	31180.00 (198.43)	318701.00 (51.42)	925696.00 (38.45)	955259.00 (78.19)
2007	42837.00 (310.00)	331996.00 (57.73)	929132.00 (38.97)	1185012.00 (121.05)
2012	15276.00 (46.20)	272753.00 (29.59)	709076.00 (6.06)	963562.00 (79.74)
2019	36210.00 (246.57)	323264.00 (53.59)	830883.00 (24.27)	1093649.00 (104.01)

(Figures in parentheses indicate percentage change over the base year)

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

The increase in livestock proved as beneficial factor for agriculture as it provides manure and dairy products to farming community. This proves increasing trend of livestock population in the Nandurbar district. The similar results are reported by Shaikh (2012), Nandanwar (2015), Raypure (2016) and Gavhane (2017).

Figure 4.10 depicts changes in livestock population across the research period.

4.16 Changes in Milk Production in Nandurbar

According to the Table 4.17, Nandurbar district's total milk output increased from 657 lakh litres in 1998-99 to 1890 lakh litres in 2018-19. It was increased by 187.67 per cent over the base year. As we seen earlier, the number of milch animals showed increasing trend which in turn helped increase milk output of the district. Figure 4.11 depicts the changes in milk production in Nandurbar district over the base year.

Table 4.17 Changes in milk production in Nandurbar

Year	Milk Production ('000' litre)	Per cent change over the base year
1998-99 (Base Year)	65700	-
2008-09	83000	26.33
2018-19	189000	187.67

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

4.17 Development of Infrastructural Facilities in Nandurbar

Irrigation facilities, fertilizer, modern implements and other inputs such as seeds, among other things were studied during the study period in consideration of natural resources and their usage. Individual crop performance in terms of area, production and productivity was mixed. There was a significant increase in production of sugarcane, cotton, paddy, maize and wheat. The green revolution, a new agricultural strategy that imparts technological advancements for specific crops has resulted in a rise in crop production. Infrastructure facilities played a direct and indirect influence in agricultural development during this process but still the development of district was not so fair as compared to the rest of Maharashtra and eventually falls under the category of one of the least developed district of Maharashtra.

4.17.1 Changes in the Development of Roads and Railway Length in Nandurbar

Roads are a critical and fundamental piece of infrastructure. It is required for the development of any economic sector.

Table 4.18 Changes in development of road and railway length in Nandurbar

(Length in 'Km')

Sr. No.	Particulars	Year			Per cent change over the base year	
		1998-99 (Base Year)	2008-09	2018-19	2008-09	2018-19
1.	National Highways	28.00	44.00	122.03	57.14	335.82
2.	Main and other State Highways	658.00	616.00	127.54	-6.38	-80.62
3.	Major District Roads	933.00	1073.00	1088.51	15.01	16.67
4.	Village Roads	2055.00	2065.00	4027.22	0.49	95.97
5.	Other Roads	672.00	697.00	1523.66	3.72	126.74
6.	Total Road Length	4346.00	4495.00	7459.29	3.43	71.64
7.	Railway	90.00	90.00	90.00	-	-

(Figures in parentheses indicate percentage change over the base year)

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

The road length in Nandurbar district increased from 4346 kilometres in 1998-99 to 7459.29 kilometres in 2018-19, as shown in Table 4.18. Over the base year, total road length increased by 71.64 per cent. During the research period, the length of the railway remained constant at 90 kilometres. The length of National highways has increased significantly. The State Highways showed gradual decline in period III. Decrease in length of state highways was 80.62, this was due to state highways were converted into National Highways and other roads. The district roads were increased slightly over the base year. The major district roads increased from 933 km in 1998-99 to 1088.51 km in 2018-19. The village roads showed sufficient growth over the base year of 95.97 per cent. The development of national highways, railways and state highways was necessary since it aids in marketing which in turn aids in the development of agriculture as a whole.

4.17.2 Changes in Credit Disbursement through PACS in Nandurbar

From the Table 4.19, it is seen that, there were 138 Primary Agricultural Cooperative Societies and farmers can get short- and medium-term loans from them. There were also 29 District Central Cooperative Bank offices where farmers could get long-term loans for agricultural development. There were 97 LAMPS (Large Area Multi-Purpose Society/*Aadiwasi* Cooperative Bank) for the *Aadiwasi* community of the district as most of the population of the district was ST. There were 17 primary cooperative banks and 199 non-agriculture credit societiesfor credit disbursement.

Table 4.19 Financial Institutes in Nandurbar district (2018-19)

Sr. No.	Name of the Bank	Number
1.	Primary Cooperative Banks	17
2.	District Central Cooperative Banks	29
3.	Agriculture and Rural Development Banks	67
4.	Commercial Banks	47
5.	Non-agriculture Credit Societies	199
6.	Primary Agriculture Cooperative Societies	138
7.	LAMPS (*Aadiwasi* Cooperative Societies)	97
8.	Other Agriculture Societies	43

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 2018-19)

Credit is another crucial resource required by farmers for agricultural development. Because Indian farmers are poor, agriculture benefits from prompt and accurate credit.

Table 4.20 Changes in credit disbursed through PACS in Nandurbar

(in Lakhs)

Year	Credit Disbursed through PACS	Per cent change over the base year
1998-99 (Base Year)	1700.00	-
2008-09	3510.00	106.47
2018-19	6290.00	270.00

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

The credit disbursed through PACS in Nandurbar district had been steadily increasing over the time under review is depicted in the Table 4.20. Between 1998-99 and 2008-09, PACS increased its credit disbursement from 1700 lakhs to 3510 lakhs. It was increased by 106.47 per cent over the base period.

In the 2018-19 financial year, credit disbursement was increased to 6290 lakhs. It increased by 270 per cent over the base year. The significant rise in credit disbursement suggested that farmers in Nandurbar area were utilizing institutional financing to meet their financial demands. It was a dramatic shift in the district's agricultural development. Gavhane (2017) also reported similar results.

Changes in credit disbursed through PACS in Nandurbar are presented in Fig. 4.12.

4.17.3 Changes in Consumption of Electricity in Nandurbar

From the Table 4.21, it is noted that, total power usage was 554183000 Kilo Watt hour in 1998-99 declined to 268702000 Kilo Watt hour in 2008-09 and grew to 652660000 Kilo Watt in 2018-19. It increased by 17.77 per cent compared to the base year. In the years 2008-09 and 2018-19, the household power usage also grew. It increased by 15.98 and 77.97 per cent over the base year, respectively.

Table 4.21 Changes in consumption of electricity in Nandurbar

(in '000' KWh)

Sr. No.	Particulars	Year			Per cent change over the base year	
		1998-99 (Base Year)	**2008-09**	**2018-19**	**2008-09**	**2018-19**
1.	Household Consumption	51559.00 (9.30)	59798.00 (22.25)	91760.00 (14.06)	15.98	77.97
2.	Business and Small Industry	8516.00 (1.54)	7502.00 (2.79)	27840.00 (4.27)	-11.91	226.91
3.	Industrial purpose	10100.00 (1.82)	34798.00 (12.95)	71910.00 (11.02)	244.54	611.98
4.	Street Light	3382.00 (0.61)	7013.00 (2.61)	48246.00 (7.39)	107.36	1326.55
5.	Agriculture Consumption	1422.00 (0.26)	155129.00 (57.74)	385880.00 (59.12)	10809.21	27036.43
6.	Other Consumption	479204.00 (86.47)	4462.00 (1.66)	27024.00 (4.14)	-99.07	-94.36
	Total Consumption	**554183.00 (100.00)**	**268702.00 (100.00)**	**652660.00 (100.00)**	**-51.51**	**17.77**

(Figures in parentheses indicate percentage change over the base year)

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

During the study period, household electricity usage increased due to an increase in electrical connections in every village. Electricity consumption in business and small industry dropped in period II but increased dramatically in 2018-19. Electricity consumption in industry has been steadily increasing. It was down 611.98 per cent from the base year. Agriculture's electricity use increased hugely by 27036.43 per cent over the base year. The increase in power consumption in the agriculture sector was due to an increase in the usage of electric motors for irrigation as well as an increase in productivity and consistent electrical supply to farmers' fields. This increase in agricultural electricity usage indicated that the district's agricultural development had accelerated.

Bhatt (2012), Shaikh (2013), Raypure, (2016) and Gavhane (2017) also reported similar findings.

Changes in consumption of electricity are presented in Fig. 4.13.

4.17.4 Changes in Number of Agro-based Industries in Nandurbar

The number of sugar factories in Nandurbar increased somewhat during the study period is presented in Table 4.22. The number of sugar factories has increased from 03 in 1998-99 to 05 in 2018-19. It was up 33.33 per cent from the base year. Although, the area under cotton had increased, the number of cotton mills was found to be the same as during the study period. During the research period, the number of chilli processing units increased. It increased by 280.95 per cent compared to the base year. During the study period, the number of oil mills expanded from 2 to 8. It was 300 per cent higher than the base year. The increased production, technology and demand for the value added products were the main reason for increase in processing and agro-based industries in the district over base year.

Table 4.22 Changes in number of agro-based industries in Nandurbar

(in Number)

Sr. No.	Particulars	Year			Per cent change over the base year	
		1998-99 (Base Year)	2008-09	2018-19	2008-09	2018-19
1.	Sugar Factories	03	03	05	-	33.33
2.	Cotton Mills	02	02	02	-	-
3.	Chilli Processing Units	105	297	400	182.86	280.95
4.	Oil Mills	02	04	08	100.00	300.00

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

4.17.5 Changes in Number of Warehouses and their Capacity

According to the Table 4.23, it was concluded that the number of warehouses decreased over the course of the study year.

In 1998-99, there were 84 warehouses all of which 46 were government-owned. The number of warehousing facilities was reduced to 44 in 2018-19. It was 47.62 per cent down from the base year. The capacity of warehouses was 54 metric tonnes in 1998-99 but it was reduced to 50.5 metric tonnes in 2008-09 and also reduced to 49.63 metric tonnes in 2018-19. It was down 8.09 per cent from the base year. These results are similar with the results reported by Gavhane (2017).

Table 4.23 Changes in number of warehouses and their capacity

Sr. No.	Particulars	Year									Per cent change over the base year	
		1998-99 (Base Year)			2008-09			2018-19			2008-09	2018-19
		G	P	T	G	P	T	G	P	T		
1.	No. of Warehouses	46	38	84	35	26	61	32	12	44	-27.38	-47.62
2.	Capacity (MT)	40	14	54	39	11.50	50.50	43.28	6.35	49.63	-4.63	-8.09

(**G, P and T indicates Government-owned, Private-owned and Total**)

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

4.17.6 Fair Price Shops and Agricultural Produce Market Committees in Nandurbar

Agricultural produce market committees have been in charge of marketing agricultural produce. The below Table 4.24 shows information about fair price shops and APMCs in Nandurbar district. In the 1998-99 fiscal year, there were 865 fair price shops which increased to 1061 in the 2018-19 fiscal year. It was up 22.66 per cent from the base year. The number of APMCs was 4 in 1998-99 and changed in 2008-09 to 6. In the 2004-05 financial year, it was raised to 6. Akrani and Akkalkuwa were the 2 new APMC's established in the district in the year 2004. It indicates a 50 per cent rise over the base year.

Table 4.24 Number of fair price shops and APMC's in Nandurbar

(in Number)

Sr. No.	Particulars	Year			Per cent change over the base year	
		1998-99 (Base Year)	2008-09	2018-19	2008-09	2018-19
1.	Fair Price Shops	865	984	1061	13.76	22.66
2.	APMC's	04	06	06	50.00	50.00

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

4.17.7 Educational Facilities in Nandurbar

The information related to the changes in the number of primary and secondary schools and colleges in Nandurbar is shown in the Table 4.25.

The number of primary schools, high schools and junior colleges has increased by 25.97, 32.66 and 91.89 per cent over the base year. It could be owing to increased public awareness of the importance of education as well as government initiatives such as the "Sarv-Shiksha Abhiyan."

There was significant increase in number of students by 154.90 per cent and number of teachers as well over the study period and slight decline in students per teacher in primary schools due to increase in number of teachers i.e. by 3.45 per cent over the base year.

Table 4.25 Educational facilities in Nandurbar

(in Number)

Sr. No.	Particulars	Year			Per cent change over the base year	
		1998-99 (Base Year)	2008-09	2018-19	2008-09	2018-19
A.	**Primary Schools**					
1.	Total Schools	1509	1731	1901	14.72	25.97
2.	Total Students	103568	142190	263994	37.30	154.90
3.	Total Teachers	3561	5000	9377	40.41	163.33
4.	Students per teacher	29	28	28.15	-3.45	-3.45
B.	**Secondary Schools**					
1.	Total Schools	199	230	264	15.58	32.66
2.	Total Students	123396	151000	101496	22.37	-17.75
3.	Total Teachers	2382	2501	2645	5.00	11.04
4.	Students per teacher	52	38	38.37	-26.93	26.92
C.	**Colleges**					
1.	Total Schools	37	40	71	8.11	91.89
2.	Total Students	20544	24479	26430	19.16	28.65
3.	Total Teachers	475	541	501	13.90	5.47
4.	Students per teacher	43	45	52.75	4.65	23.26

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

The results are in line with the findings of Bhatt (2012), Shaikh (2013), Kalaskar (2015), Nandanwar (2015), Raypure (2016) and Gavhane (2017).

4.17.8 Health Facilities in Nandurbar

The state of health facilities in Nandurbar district during the study period was illustrated in Table 4.26. Only the number of public health centres decreased while the rest of the details, such as primary health centres and private hospitals, sub PHC's increased. The increment was 25.53, 183.31 and 11.54 per cent, respectively over base year. In the district, there was only one civil hospital. The number of public health centres dropped from 10 in 1998-99 to 06 in 2018-19, a 40 per cent fall from the base year. During the study period, the number of primary health

facilities and private hospitals also grew. It meant that the state of health facilities in Nandurbar has improved over time. The study showed slight increase in rural hospitals and tremendous increase in dispensaries. Overall the district was under somehow good healthcare facilities and showed trend on improving the status in the district.

The results are in close association with Kalaskar (2015) and Gavhane (2017).

Table 4.26 Health facilities in Nandurbar

(in Number)

Sr. No.	Particulars	Year			Per cent change over the base year	
		1998-99 (Base Year)	2008-09	2018-19	2008-09	2018-19
1.	Civil Hospitals	01	01	01	-	-
2.	Rural Hospitals	07	09	11	28.57	57.42
3.	Dispensaries	79	123	183	55.70	131.65
4.	Public Health Centres	10	09	06	-10.00	-40.00
5.	Sub PHC's	260	290	290	11.54	11.54
6.	Primary Health Centres	47	58	59	23.40	25.53
7.	Private Hospitals	51	94	145	84.31	183.31

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

4.17.9 Media and Communication Devices in Nandurbar

The change in the number of media and communication devices in Nandurbar over the study period is shown in Table 4.27.

Table 4.27 Media and Communication devices in Nandurbar

(in Number)

Sr. No.	Particulars	Year			Per cent change over the base year	
		1998-99 (Base Year)	2008-09	2018-19	2008-09	2018-19
1.	Telephone connections	10303	19000	7090	84.41	-31.19
2.	Post offices	192	196	198	2.08	3.13
3.	PCO/STD	20	16	50	-20.00	150.00

(Source: Socio-Economic Review and District Statistical Abstract of Nandurbar, 1998-99 to 2018-19)

In period II, there was a rise in the telephone connections followed by a gradual reduction in period III by 31.19 per cent due to increase in mobile phone users. The number of post offices increased somewhat while the number of PCOs and STDs decreased in period II and increased to 50 in period III by 150 per cent over the base year. It could be attributable to an increase in the number of personal mobile phones in the district. Similar observations were reported by Nandanwar (2015), Raypure (2016) and Gavhane (2017).

4.18 Factors influencing Agricultural Production in Nandurbar

We addressed changes in land use pattern, cropping pattern, input use and infrastructural facilities, yearly compound growth rates of area, production and productivity of important crops farmed in Nandurbar earlier in this chapter. The sample mean, percentage and proportion in specific items in the total of respective types were largely used in this analysis. The method of analysis used for the purpose, however, had some limitations of its own, in that it couldn't measure the relative impact of specific factors in the context of other variables driving total agricultural development in Nandurbar.

Multiple Linear Regression Analysis

The information related to the findings of an estimated multiple linear regression study of agricultural development in Nandurbar district is depicted in Table 4.28.

For the macro level time series data of agricultural development in Nandurbar district, a production function analysis was performed. The following Table 4.28 shows that the regression coefficient of the independent variable, proportion of gross irrigated area to gross sown area (X_1) was positive and significant at the 10 per cent level of significance for the overall period 1998-99 to 2018-19. This variable was found to be the cause of increased agricultural development in Nandurbar district. Also, at the 5 per cent level of significance, the percentage of net sown area to gross sown area (X_3) was positive and significant. It meant that if the district's net sown area to gross sown area ratio was increased, the district's agricultural development would improve. At the 5 per cent level of significance, the area under HYV's seeds (X_4) was found positive and significant. These variables were shown to be extremely important in enhancing the agricultural production of Nandurbar district. In the overall period 1998-99 to 2018-19, the R^2 value was 0.9243 and the F value was 28.1429.

Table 4.28 Results of multiple determinants for agricultural development in Nandurbar

Sr. No.	Particulars	Period
		Overall period 1998-99-2018-19 (N=21)
1.	Intercept	-1633.4638
2.	**Percentage of gross irrigated area to gross sown area (X_1)**	**2.0507* (1.0130)**
3.	Consumption of total Fertilizers (NPK) per hectare of gross sown area (X_2)	- 0.4964 (11.7074)
4.	**Percentage of net sown area to gross sown area (X_3)**	**15.9054** (6.059)**
5.	**Area under HYV's Seeds in '00' ha (X_4)**	**2.1195** (0.9331)**
6.	Area under commercial crops in '00' ha (X_5)	0.7594 (4.1634)
7.	Amount of loan disbursed through PACS per year in Lakhs₹ (X_6)	- 0.0494 (0.0434)
8.	Average annual rainfall in Nandurbar in mm (X_7)	- 0.0978 (0.8031)
9.	Area under fruits and vegetables in '00' ha (X_8)	6.7120 (6.4948)
10.	Number of Milch animals in lakh number (X_9)	- 33.5572 (77.3894)
11.	**R^2**	**0.9243**
12.	F value	28.1429

(*, **, * indicates 1, 5 and 10 per cent level of significance, respectively)**
(Figures in parentheses are standard errors of respective regression coefficients)

4.19 Strengths, Weaknesses, Opportunities and Threats (SWOT Analysis) of Agricultural Development

SWOT is an acronym for Strengths, Weaknesses, Opportunities and Threats. Internal factors over which you have some control are referred to as Strengths (S) and Weaknesses (W) by definition. Furthermore, by definition Opportunities (O) and Threats (T) are external factors over which you have no control. The use of a SWOT analysis in the design and selection of a strategy is critical. It's a powerful weapon but there's a lot of room for interpretation. It's preferable to use it as a recommendation rather than a prescription. Successful firms capitalize on their advantages, address their deficiencies and guard against internal and external dangers. They also keep an eye on their general business environment and are faster than their competitors in recognizing and exploiting new opportunities.

Strengths for Agricultural Development in Nandurbar

Nandurbar is a city in North-Western Maharashtra with a large share of *kharif* sorghum, cotton, sugarcane and chilli production. It is often referred to as Maharashtra's "Chilli Capital".

1. Nandurbar district is divided into two agro-ecological zones (AES). As a result, the district's rainfall and soil patterns are suitable for the cultivation of a wide range of crops, particularly food grains and horticultural crops.
2. The climate of Nandurbar taluka is ideal for growing *kharif* sorghum and chillies, while cotton thrives in Shahada, Nandurbar and Navapur taluka. These account for approximately one third of the district's domestic product primarily food grains and commercial crops such as cotton.
3. Cooperative banks support the agriculture industry by providing financial assistance to help it grow. There are 138 primary Agricultural Cooperative Societies in the district as well as 97 LAMPS (*Aadiwasi* Cooperative Societies). A significant cooperative structure is available to help and promote the livelihood and agricultural sectors by offering financial assistance.
4. The forest covers 36.29 per cent of the total geographical area, so the district has a good bio reserve with abundant biodiversity in the form of plants and wildlife.
5. The district's water resources which come from medium-scale projects like the Prakasha and Sarangkheda dams are another key assets for Shahada, Nandurbar and Taloda talukas.

Weaknesses for Agricultural Development in Nandurbar

1. The large area under rainfed farming is a weakness that is likely to stymie the district administration's efforts to develop the agricultural sector. Water scarcities are one of the most prominent agricultural hindrances.

2. Considerale proportion of barren, unculturable, culturable waste and fallows is restricting the agricultural development in the district.
3. Dominance of cereal crops in acerage under cultivation with lower production, affecting the income levels of farmers drastically.
4. The poor development of tourism distribution available in the district is restricting the stable and long term development of communities.
5. Development of agro-based as well as forest-based industries is another neglected sector in the district.

Opportunities for Agricultural Development in Nandurbar

1. The district's backward status could receive a large amount of Development Fund from the central and state governments.
2. Larger proportion of small marginal farmers in the district and rainfed nature of agriculture suggest opportunities for development of horticultural sector for sustainable income for farmers.
3. The district is home to two major dams, Sarangkheda and Prakasha, as well as 23 minor dams. Commercial crops such as cotton and sugarcane can be grown in the command areas of these dams.
4. Higher potential for agricultural as well as forest production processing industry.
5. Because the area under irrigation is restricted, all efforts must be taken to save soil and water through watershed programmes and Jalyukta Shivar Abhiyan.
6. Rainfed fruits such as dragon fruit, custard apple and ber have potential for cultivation. These crops are extremely valuable and in high demand in the market for processing and other by-products.
7. There is abundant scope for agro-tourism development in the district.
8. There is huge scope in forming cotton mills as district’s area and production continuously increasing to a great extent.

Threats of Agricultural Development in Nandurbar

1. Unprecedented natural calamities such as drought, pose a serious threat to the agricultural sector in some parts of the district.
2. The physical setting of Nandurbar district exhibits a range of landscapes impacted by relief, climate and vegetation and reveals a contrast of great dimensions.
3. With the rise in horticulture production, a lack of post-harvest infrastructure and agro-processing units may result in significant post-harvest losses.

4. There are about 2 tehsils in the district that receive low rainfall. In these tehsils, the lack of irrigation and watershed programmes will stifle agricultural development. Any delay in the construction of irrigation projects will hurt agriculture by reducing crop output.

4.20 Problems in Development of Agriculture in Nandurbar

Following barriers were identified after scanning various government texts.

1. Inadequate irrigation facilities in the districts was a major stumbling block to agricultural modernization.
2. Agricultural growth in the district was hampered by small-scale agriculture holdings.
3. A lack of marketing and transportation infrastructure.
4. Farmers were unaware of the benefits of post-harvest technology.
5. There was a lack of awareness in the district about value addition and agro-based processing industries.
6. Inadequate utilization of contemporary instruments and technologies for various farm tasks, such as sowing, ploughing and harvesting as well as a lacklustre database and market intelligence.

4.21 Suggestions to overcome the Problems

1. Increased agricultural productivity would be ensured by timely credit availability at a lower rate of interest. Monocropping should be avoided by farmers in their fields in order to maintain soil fertility and boost the output of important crops in the region.
2. Reclamation of cultivable waste lands and permanent fallows will increase net area under cultivation.
3. Water storage structures, such as nala bunding, counter bunding, bench terraces, dams, and so on may be built to store rainwater. By supplying water during dry spell and off seasons, the Nandurbar district will be able to enhance its net sown as well as gross cropped area.
4. Expansion of area under major horticulture crops such as bananas, papaya and chillies which will aid in increasing the district's agricultural production.
5. There is huge potential for growth of agro-based industries in the district. Therefore. Government and Private sector should give the top priority to increase the agro-based industries in the district.
6. To build an integrated farming system with reference to forest resources would improve the livelihood of poor tribal farmers in hilly areas by implementing low-cost integrated natural resource management technologies.

7. Use of modern irrigation techniques such as sprinklers and drip irrigation to make efficient use of available water.

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5. SUMMARY AND CONCLUSIONS

Agricultural development is an important component of a country's economic development. It has already made a considerable contribution to the advanced countries' economic growth. Because India is primarily an agricultural and overpopulated country, increasing agricultural output and productivity would contribute significantly to the country's total economic growth. Agriculture is India's most important economic activity, accounting for 14.4 per cent of GDP in 2018-19 providing employment to both literate and illiterate people and contributing to exports. Agriculture continues to play an important part in India's economic development as a food provider, an employment of around two-thirds of the workforce and a source of purchasing power for much of the economy's non-agricultural consumer products and services. As a result, high agricultural expansion is now seen as a necessary condition for India's economy to flourish and develop properly. On the other hand, during the post-independence period, the agriculture sector has had a mixed record.

Nandurbar district is one of the agriculturally disadvantaged districts in Maharashtra's North-Western area. The main focus of the research is on the trend in land use and cropping patterns, growth rates of significant crops, infrastructure development and identification of major variables impacting agricultural productivity. During the green revolution, changes in acreage, production and productivity of important crops due to the application of modern technologies were also investigated. In view of this, the present study *viz.* “An Economic Appraisal of Agricultural Development in Nandurbar District of Maharashtra” has undertaken with following specific objectives.

i) To study the changes in land use and cropping pattern
ii) To estimate the growth rates of area, production and productivity of major crops
iii) To study the changes in infrastructural development in agriculture
iv) To assess the factors responsible for agricultural development
v) To undertake SWOT analysis (strengths, weaknesses, opportunities and threats) of agricultural development

The current study is based on secondary data on various aspects of agricultural development from 1998-99 to 2018-19, a period of 21 years including land use patterns, cropping patterns, area, production and productivity of major crops, inputs such as fertilizers, HYV's seeds, implements, livestock population in district, agricultural machinery and so on, in respect. The information was gathered from the Nandurbar Socio-Economic Review and District Statistical Abstract, Economic Survey Reports, Mahatma Phule Krishi Vidyapeeth, Rahuri library and the Departmental database. Changes in land use, cropping patterns and input consumption were

investigated throughout a 21-year period, beginning in 1998-99 and ending in 2018-19 by estimating proportions to the corresponding base year for the selected points in time. The impact of agricultural development on agricultural production has been assessed by estimating annual compound growth rates of area, production and productivity of crops such as paddy, sorghum, pearl millet, maize, wheat, total cereals, gram, red gram, green gram, black gram, total pulses, total food grains, groundnut, sunflower, safflower, total oilseeds and sugarcane in cotton in Nandurbar district for the three periods *viz.* period I 1998-99 to 2007-08, period II 2008-09 to 2018-19 and also for the overall period, 1998-99 to 2018-19.

The multiple linear regression equation fitted for the data for the period 1998-99 to 2018-19 to study the functional relationship existing between the aggregate value of crop output in lakhs of rupees in Nandurbar district as the dependent variable and selected 9 independent variable *viz.* percentage of gross irrigated area to gross sown area (X_1), consumption of total fertilizers (NPK) per hectare of gross sown area (kg/ha) (X_2), percentage of net sown area to gross sown area (X_3), area of HYV seeds (‘00’ ha) (X_4), area under commercial crops (‘00’ ha) (X_5), amount of loan (short and medium-term) loan disbursed through PACS per year (in crores) (X_6), average annual rain fall in the Nandurbar (mm) (X_7), area under fruits crops (‘00’ ha) (X_8), number of milch animals (in lakh no) (X_9).

5.1 Summary of Findings

The findings of the study have briefly summarized below.

1. A thorough examination of changes in land use patterns in Nandurbar district revealed that the area under forest had increased by 0.51 per cent over the study period. Over a 21-year period, the area under barren and uncultivable land increased rising from 2.33 per cent to 5.27 per cent of the geographical area. During the study period, the area under cultivable waste land decreased from 2.19 to 0.33 per cent of the overall geographical area.
2. The net sown area of Nandurbar district has increased by 7.08 per cent over the base period of 1998 to 2007 over the last 21 years. Over the base period, the gross cropped area had expanded by 6.22 per cent. In period I, from 1998 to 2007, the district's net irrigated area was 62300 hectares which was raised to 91500 hectares in period II, a 46.87 per cent rise and 139880 hectares in period III, a 124.53 per cent growth over the base period.
3. The percentage of surface irrigation other than wells to the net irrigated area in Nandurbar district increased from 24.66 to 43.16 per cent in respective 21 years and was continuously increasing, according to the trends in area irrigated by various sources during the study period. Although the percentage of well-irrigated area to net irrigated

area declined from 75.34 per cent in 1998-99 to 56.84 per cent in 2018-19, the actual area irrigated by wells increased from 38500 to 76000 hectares over the base year.

4. In comparison to other crops in Nandurbar district, cereal crops are the most dominant in cropping patterns over the study period. The area under total cereals and total oilseeds has declined over the last 21 years. Over the base period, the region under total pulses has shrunk. Over the base year, the area under total oilseeds declined. During the research, the area under sugarcane had shrunk. It was notable that the area under gram had expanded from 6880 to 7280 hectares since the base year. Area under red gram had increased in period II and then decreased to 35.31 per cent over base year. Green gram showed big decrease over years i.e. 65.13 per cent. During the base year, 1998-99, the area under black gram was 16538 hectares but it reduced to 9982 hectares in 2018-19. The area under the food grains had slightly decreased over the period under study. Over the base year, the area under total oilseeds was reduced by 86.32 per cent. During the study, the area under sugarcane had declined but the area under cotton had expanded dramatically reaching 229.51 per cent above the base year.
5. In terms of major crop production and productivity, it was discovered that *kharif* and *rabi* sorghum and pearl millet production had decreased during the study period. During the study period, however, paddy, maize and wheat output grew. Total cereal production fell to 46.28 per cent compared to the base year. During the study period, the production of gram, red gram, green gram and black gram was reduced. Groundnut and sunflower production dropped during the study period in terms of oilseeds. Cotton and sugarcane production have increased from the base year.
6. Except for *kharif* sorghum and pearl millet, the productivity of wheat, *rabi* sorghum, maize, gram, groundnut, sugarcane and cotton, all other crops had increased over the base year 1998-99. It could be related to an increase in the respective crops HYV's. During the last 21 years, the average productivity of *kharif* sorghum, pearl millet, gram, green gram and black gram in Nandurbar district has fallen by 37.83, 96.27, 45.12, 43.44 and 62.89 per cent, respectively.
7. The period wise annual compound growth rates of area, production and productivity of major crops in Nandurbar district were calculated. Growth rates indicated that the area, production and productivity of paddy increased significantly during the period under study. The growth rates of area, production and productivity of wheat were found significant with tunes 5.22, 3.74 and 9.45 per cent per annum, respectively in period I, while in period III, the growth rates of area, production and productivity were with tunes of 1.02, 0.25 and 0.75 per cent per annum, respectively. In case of *rabi* sorghum, growth rates of negative area,

production and positive productivity showed tunes of 6.68, 0.69 and 6.43 per cent per annum, respectively. Total cereals had negative growth rates of area production and productivity experienced tunes of 1.13, 1.66 and 0.53 per cent per annum, respectively. In the case of total pulses, the growth rates of area, production and productivity were negative at 2.32, 4.46 and 2.20 per cent per annum, respectively. Over the study period, the growth rates of area, production and productivity of total oilseeds were declined by 11.10, 19.36 and 9.29 per cent per annum, respectively. During the study period, the growth rate area of sugarcane declined dramatically, while the growth rates of production and productivity improved at a pace of 4.25 and 7.54 per cent per annum, respectively. Cotton's area, production and productivity all grew at a positive rate over the research period.

8. The overall consumption of fertilizers (NPK) in Nandurbar district was 36581 MT in 1999-99 rising to 62785 MT in 2018-19 per hectare of gross sown area indicating that consumption of NPK increased during the study period.
9. Over the base year of 1998-99, the adoption of HYVs of paddy, wheat, sorghum and maize had increased by more than twofold. It was raised in the case of paddy, although this was attributable to an increase in the overall area under paddy rather than more adoption of paddy HYVs. The area under HYVs for maize has expanded significantly, from 9672 hectares in 1998-99 to 15090 hectares in 2018-19.
10. In Nandurbar district, credit distribution through PACS has steadily increased from 1700 lakhs in 1998-99 to 6290 lakhs in 2018-19. Throughout the research, PACS continued to raise the amount of money it loaned out.
11. Throughout the study period, annual rainfall exhibited only minor variations. The total annual rainfall declined dramatically in period II and then rebounded in period III, although it continued to fall steadily throughout the base year.
12. The number of indigenous bullocks, cows and calf had decreased while the number of exotic cows, bullocks, calf, he and she buffaloes, goats, sheeps and poultry had increased. Nandurbar district's population has risen over time. As a result, the total cattle population grew during the research period.
13. Throughout the study period, wooden and iron ploughs were gradually replaced by tractors and other contemporary devices but their use continued to rise. Over the base year 1998-99, there was a massive increase in the use of tractors and sugarcane crushers, with 486.18 and 1158.04 per cent increases respectively. Throughout the period, the use of tractors and sugarcane crushers increased steadily. The number of electric motors has increased by 83.94 per cent over the base year implying that irrigation in the district had expanded.

14. Over the entire period, the length of national highways, main district roads, other district roads and village roads had expanded significantly. Throughout the research period, the length of the train line remained constant. Over the base year of 1998-99, the total road length has expanded by 71.64 per cent.

15. The nine resource variables included in the model described jointly 92 per cent of the total variation in the value of aggregate crop production in Nandurbar district, according to a careful study of the multiple linear regression analysis for agricultural development in Nandurbar district. During the study period, the regression coefficients of variables such as percentage of net sown area to gross sown area (X_3) and area under HYV's (X_4) were positive and significant at a 5 per cent level of significance. The regression coefficients of percentage of gross irrigated area to gross sown area (X_1) was positive at 10 per cent level of significance in overall period.

16. Reduced current and other fallow, rainfall, total food grains, area under pulses, oilseeds, and sugarcane and an increase in barren lands and uncultivable land as well as extensive use of chemical fertilizers, electricity problems and a lack of storage facilities are some of the major roadblocks to agricultural development in Nandurbar district. While the implementation of social forestry programmes, the construction of water reservoirs, the implementation of laws prohibiting the digging of wells, the use of micro-irrigation techniques, extension programmes on improved farming, adequate electricity supply, cooperative storage and other measures are some of the solutions to agricultural development problems.

5.2 Conclusions

The following specific conclusions can be drawn from the findings of the study.

1. The land use pattern of Nandurbar has undergone several structural changes during the last 21 years. The net sown area, area under irrigation and gross sown area has slightly increased, area under forest is increased by 0.51 per cent over base year. Land under barren and uncultivable land has increased with 125.83 per cent over base year. Area under cultivable waste and current fallow has decreased over study period.

2. The area cropped under paddy, wheat, maize, gram, cotton and fruits has significantly increased whereas rest of crops like cereals, pulses and oilseeds has decreased. In Nandurbar district cereals dominated the farming pattern.

3. Production of cereals like paddy, wheat and maize increased whereas total foodgrains and oilseeds have decreased during last 21 years i.e. about 49.31 per cent and 30.59 per cent. Production of sugarcane has increased significantly by 33.43 per cent and also there is

noticeable increase in cotton production due to increase in use of high yielding varieties and fertilizers.

4. Average productivity of foodgrains has decreased by 47.71 per cent. The average productivity of groundnut decreased by 38.95 per cent during last 21 years due to use of HYVs. Average productivity of crops like paddy, wheat, pearl millet, maize, gram, cotton, sugarcane have increased to some extent over base year. Sugarcane showed significant increase in productivity by 91.11 per cent over base period.
5. Net irrigated area of district has increased by 160.27 per cent during last 21 years. Area under high yielding varieties has increased by 31.33 per cent in this 21years.
6. During study period, the population of all type of livestock showed upward trend. Number of cows and buffaloes has increased significantly which in turn helped to boost milk production in the district. Also, there is significant increase in poultry in the district.
7. Use of implements like tractors, iron plough, electric motors, sugarcane crushers and electricity for agriculture is increased to great extent during last 21 years but it is not sufficient for better agricultural development.
8. According to the multiple linear regression analysis, the factors of percentage of gross irrigated to gross sown area (X_1), percentage of net sown area to gross sown area (X_3) and area under HYV's seeds (X_4) showed a positive relationship in increasing the value of total crop production (Y).
9. During the study period, the nine resource variables included in the analysis explained 92 per cent of the overall variation in the value of total agricultural production in Nandurbar district.

5.3 Policy Implications

The policy implication had based on the conclusions of the present study could be listed as under.

1. There is huge potential for growth of agro-based industries in the district. Therefore, Government and Private sector should give the top priority to increase the agro-based industries in the district.
2. There is also huge scope in making district a agro-tourism spot by developing the with resources.
3. There is huge potential to increase the forest produce as forest area in the district went on increasing during the study period. Therefore, Government should focuse on forest policies regarding forest produce.

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7. Vitae

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MASTER OF SCIENCE (AGRICULTURE)

IN

AGRICULTURAL ECONOMICS

2021

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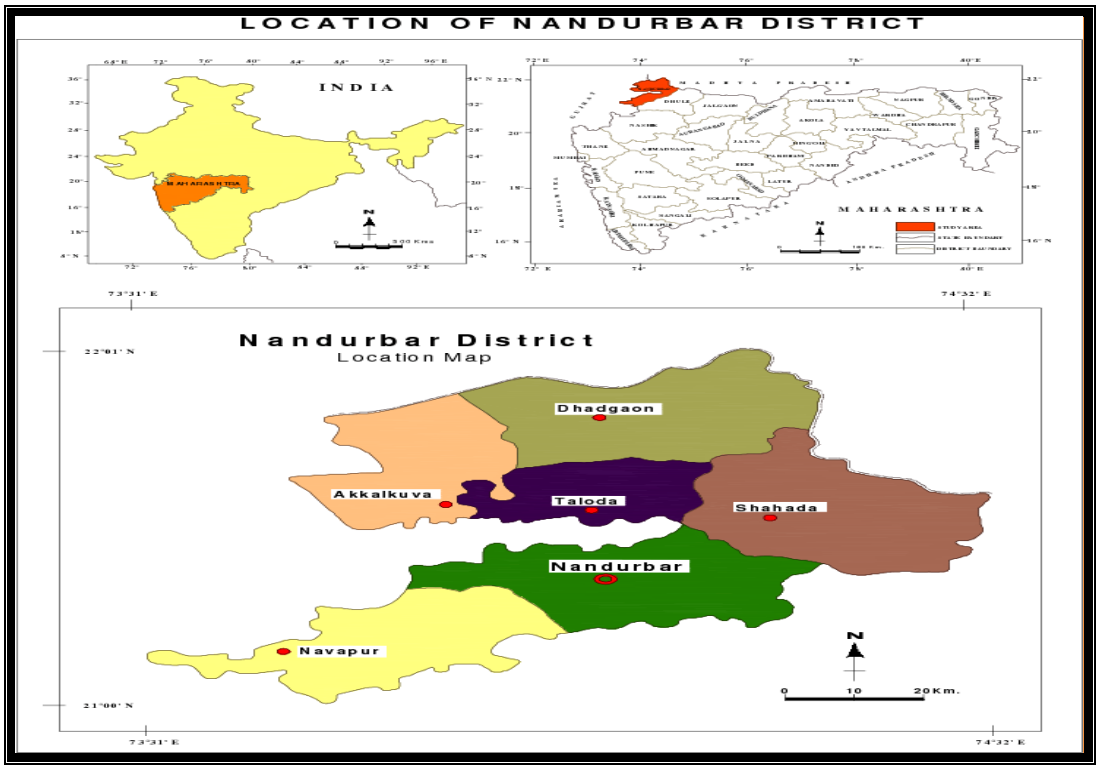

Plate.3.2 Location of Nandurbar District

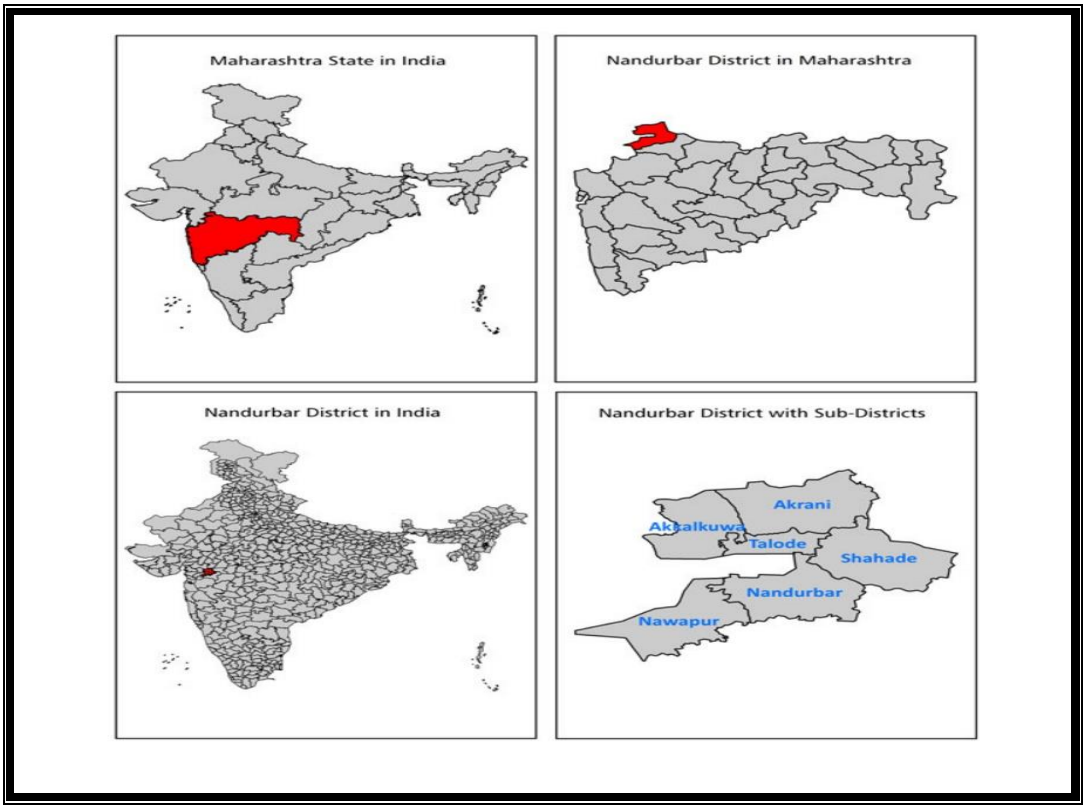

Plate.3.3 Administrative Set-Up in Nandurbar

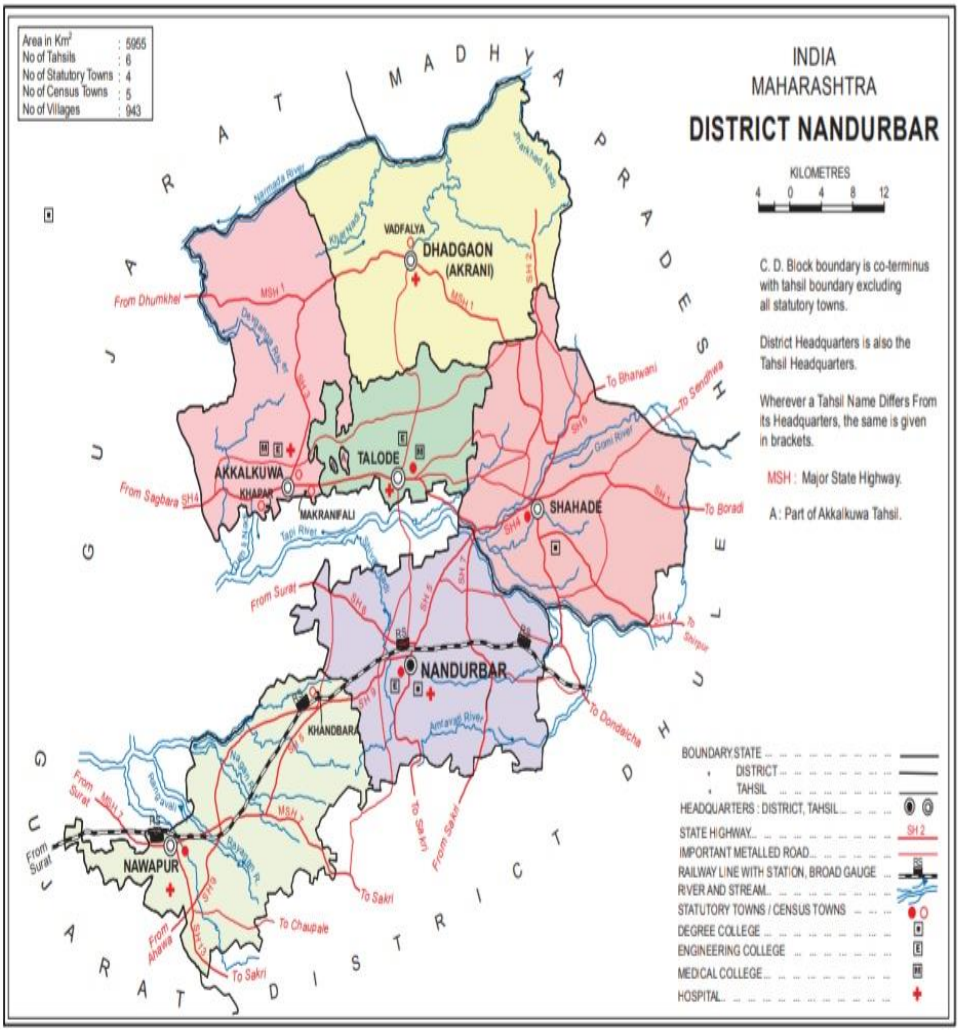

Plate.3.1 Map of Nandurbar

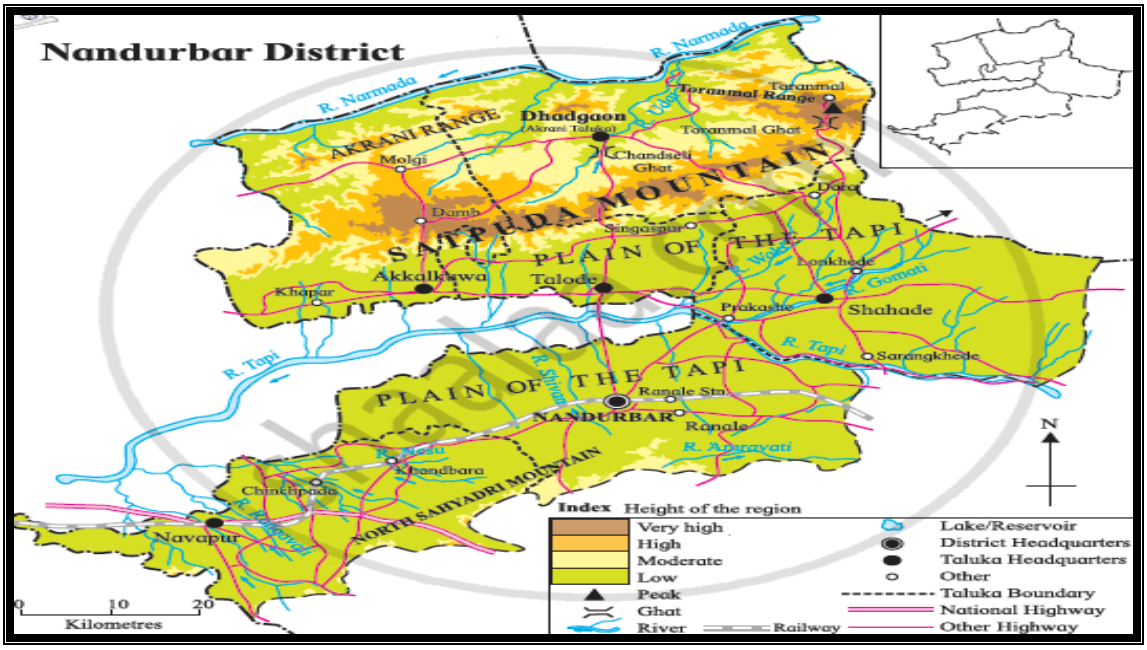

Plate.3.4 River map of Nandurbar

Plate.3.5 Astambha Peak in Nandurbar

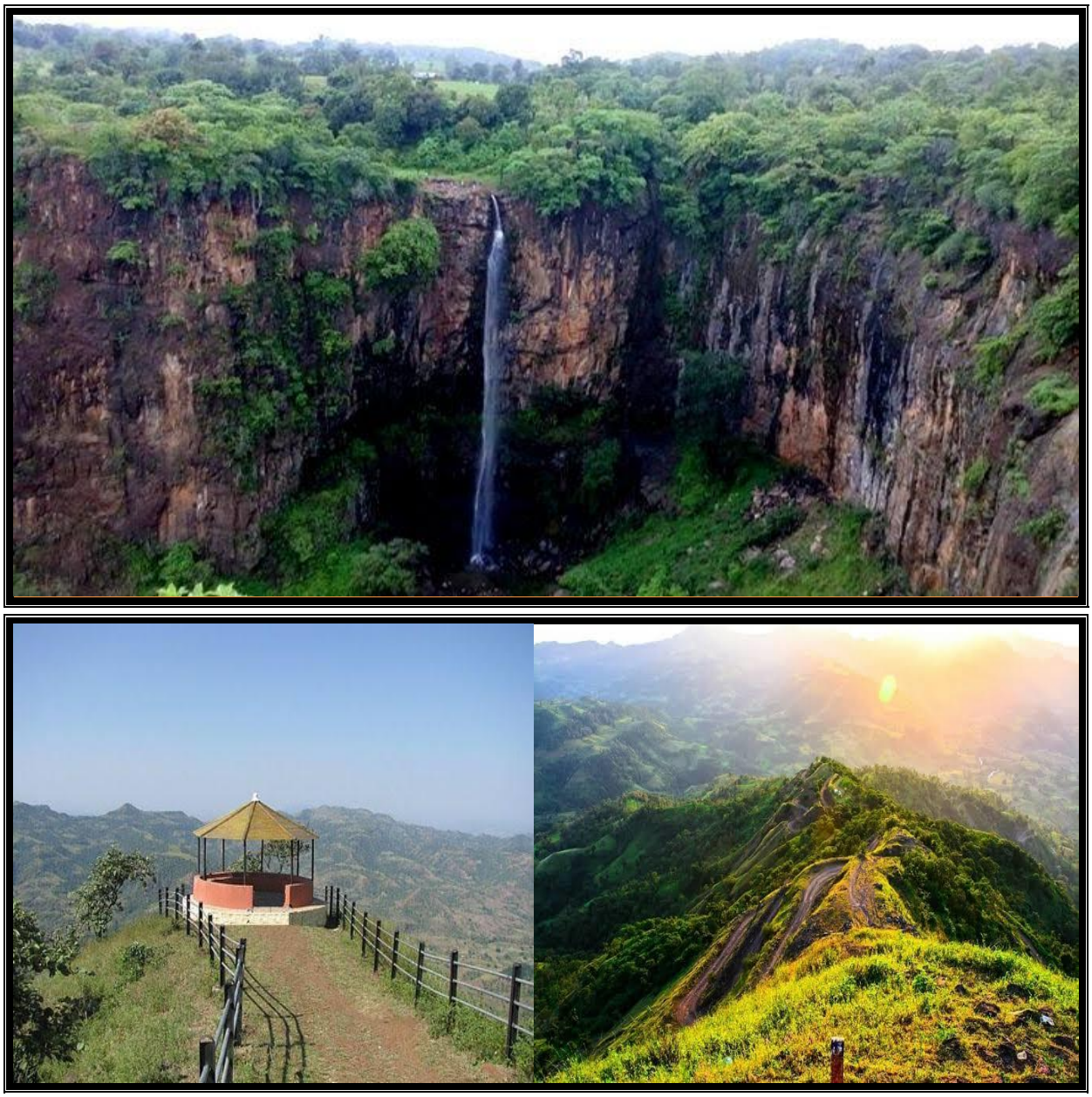

Plate.3.6 Toranmal Hill Station

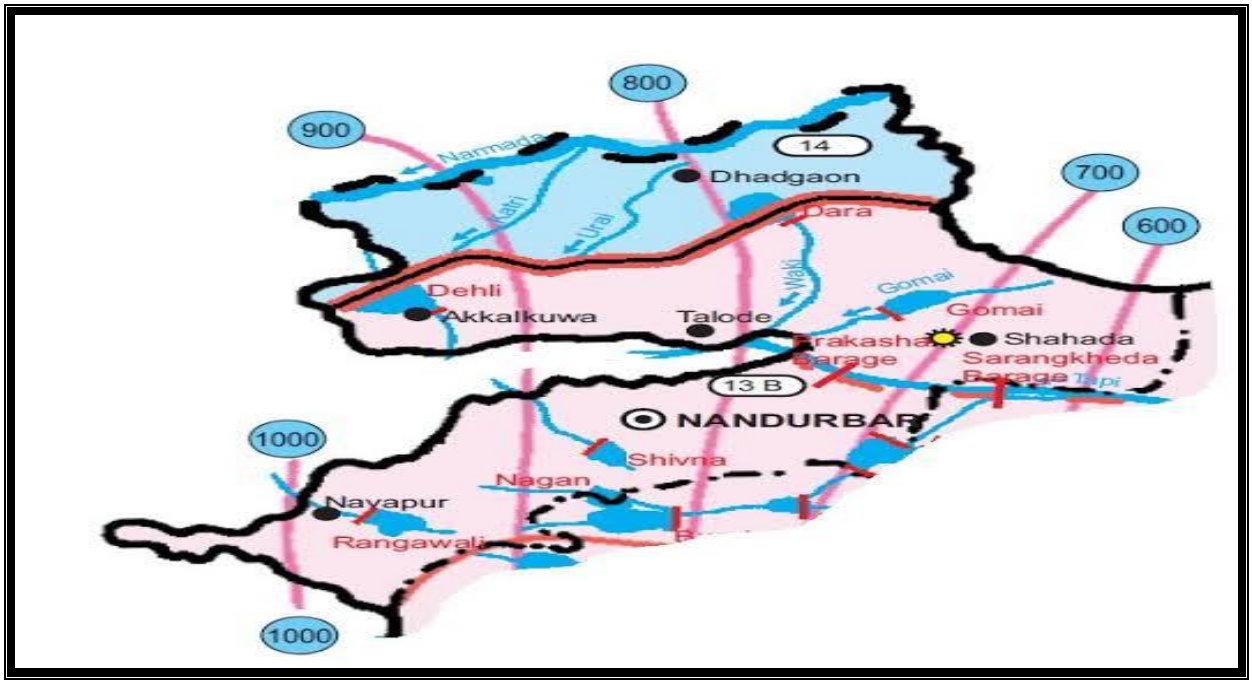

Plate.3.8 Dams in Nandurbar District

Plate.3.9 Sarangkheda Dam in Nandurbar

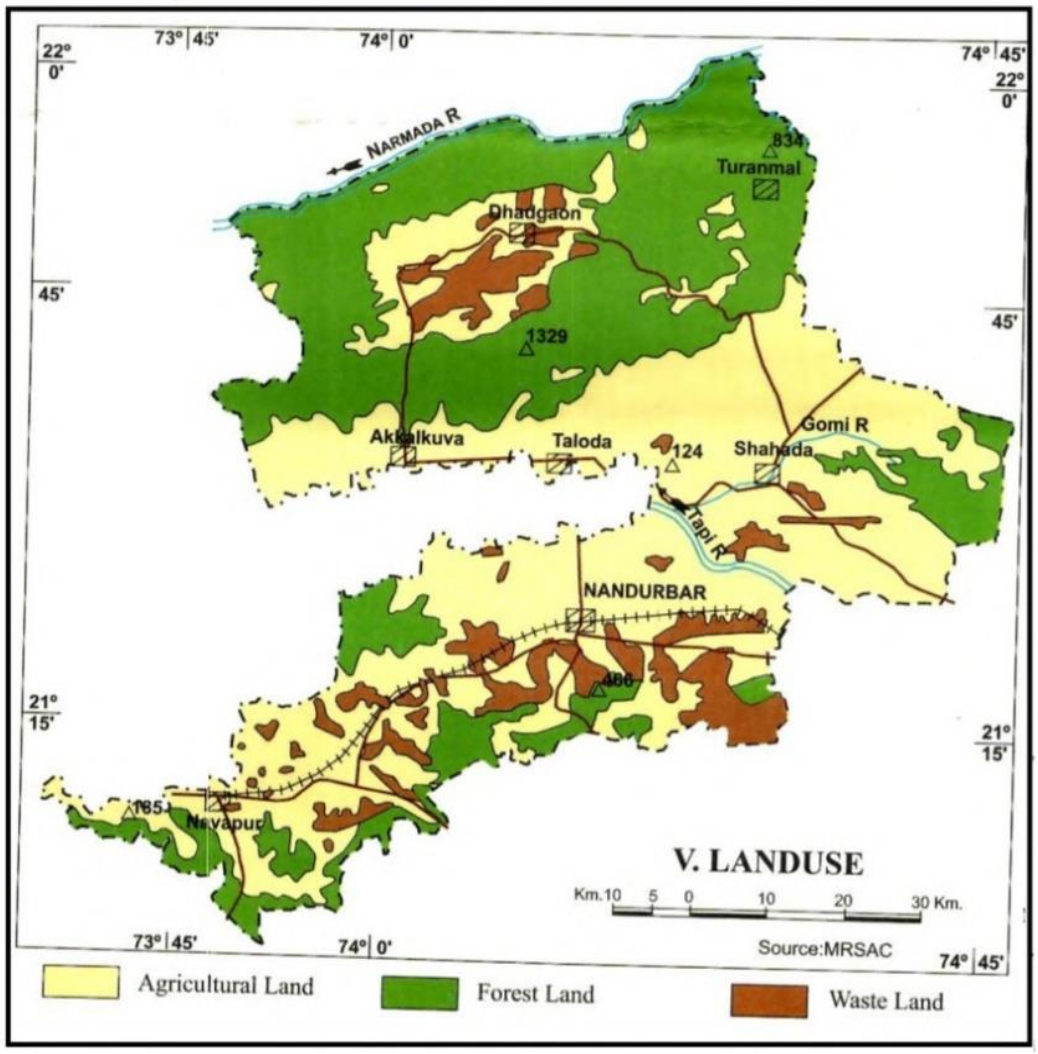

Plate.3.7 Land Use Pattern in Nandurbar

Plate.3.10 Transportation in Nandurbar

Plate.4.1 Prakasha Dakshin Kashi temple in Nandurbar

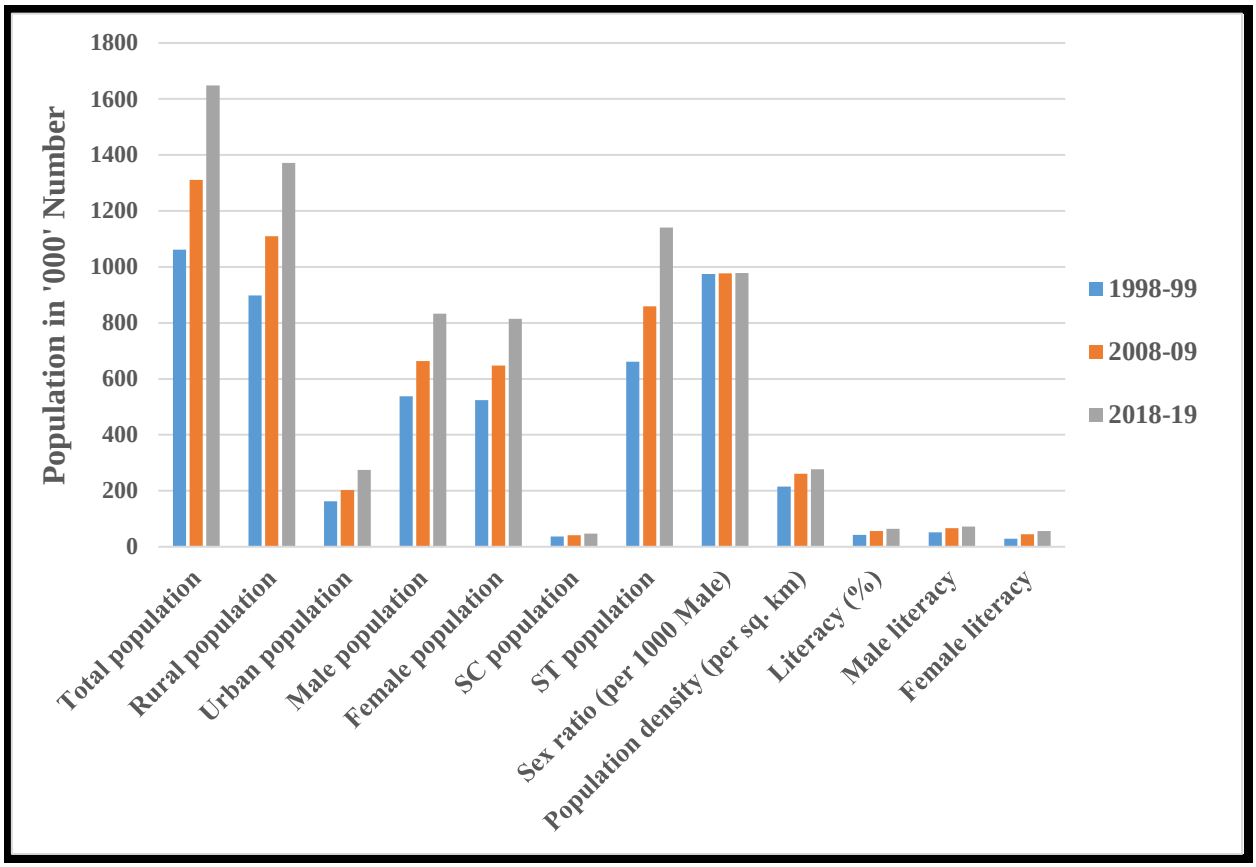

Fig 4.1 Population of Nandurbar

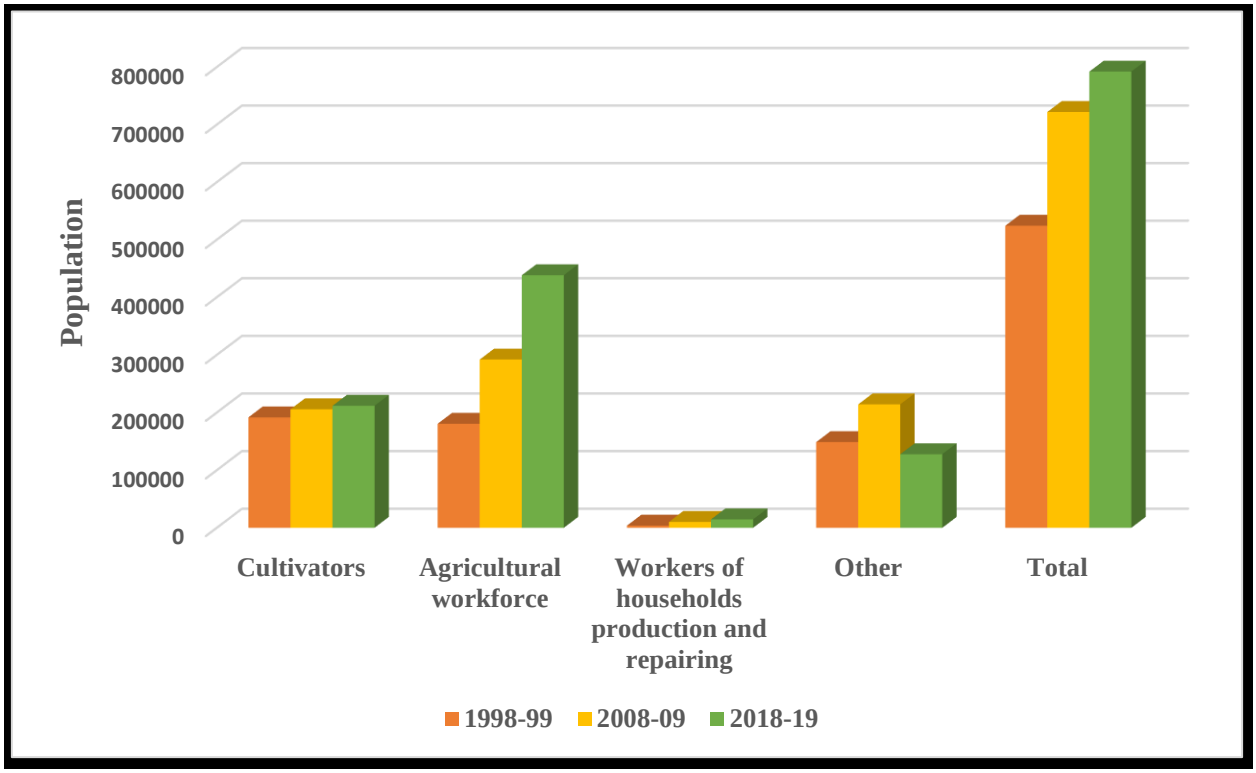

Fig. 4.2 Distribution of agricultural workforce in Nandurbar

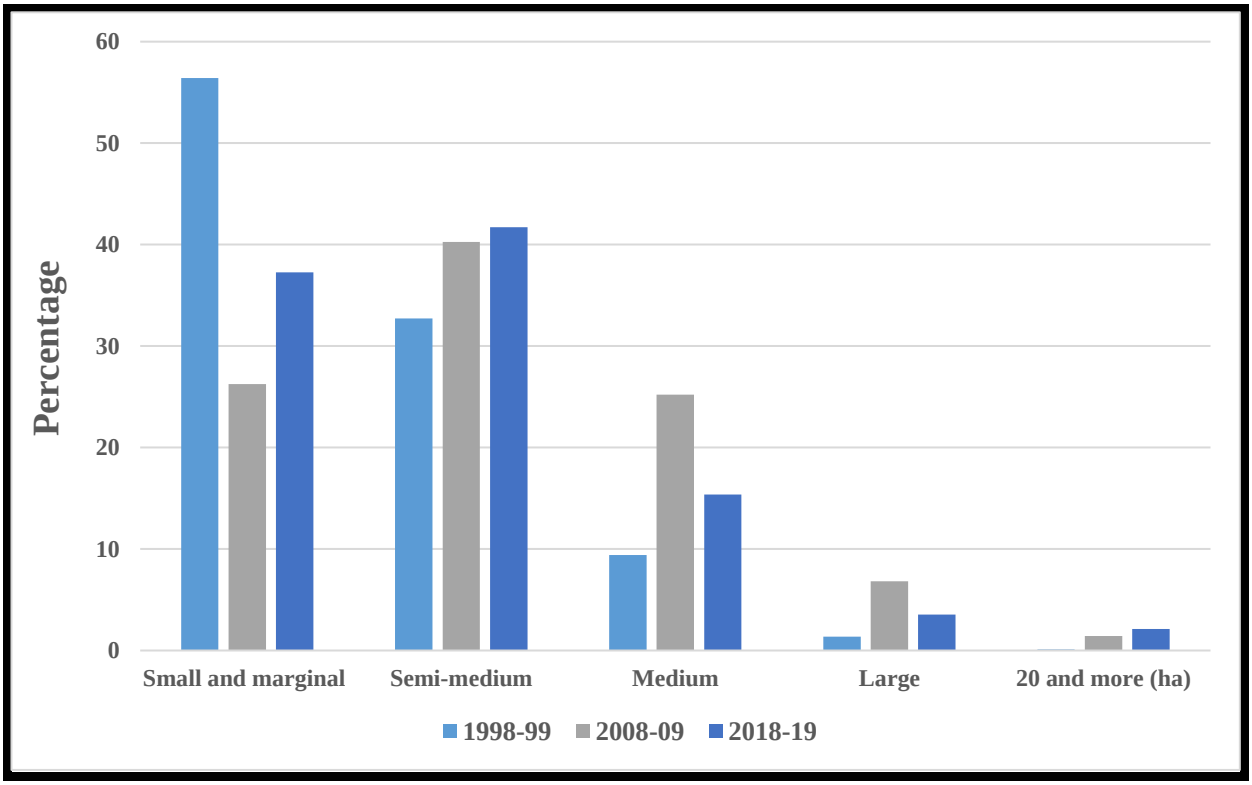

Fig. 4.3 Land holding pattern Nandurbar

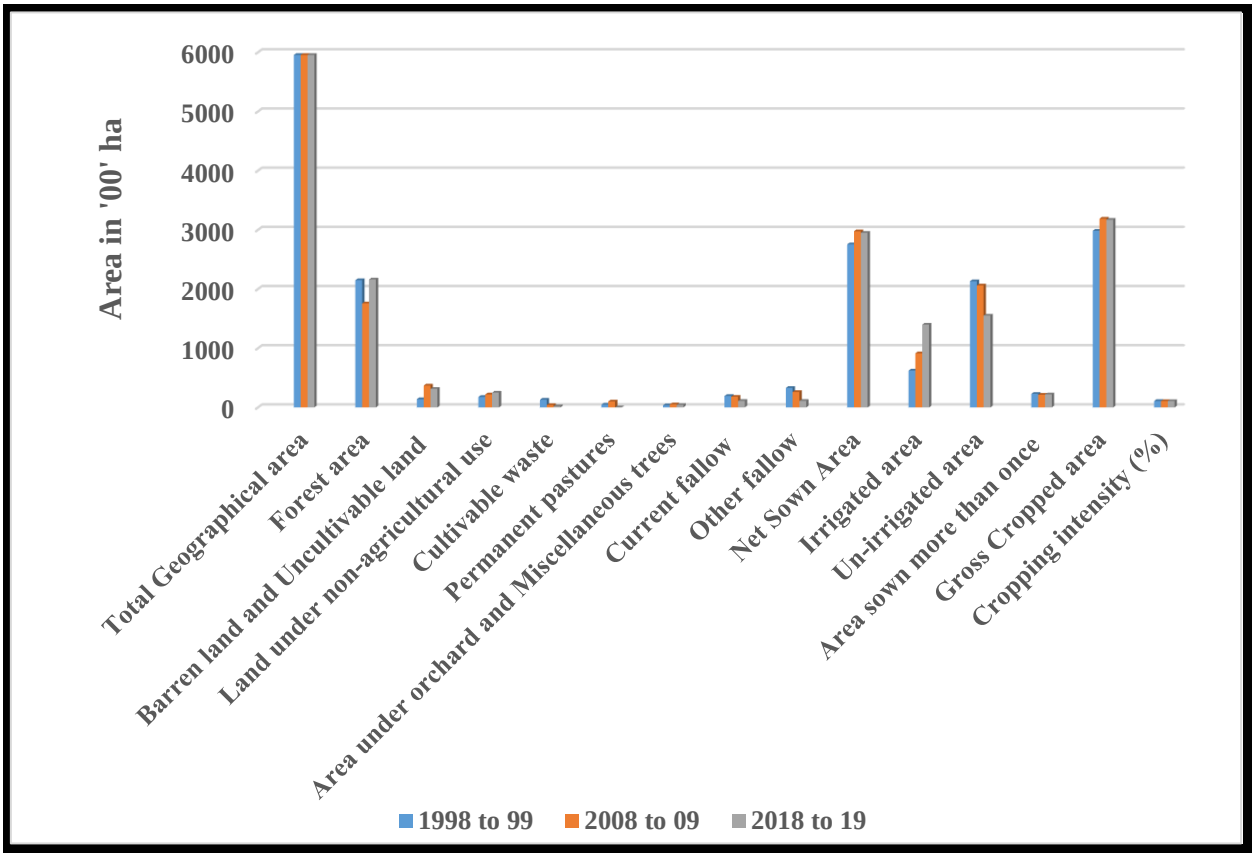

Fig. 4.4 Land use pattern of Nandurbar

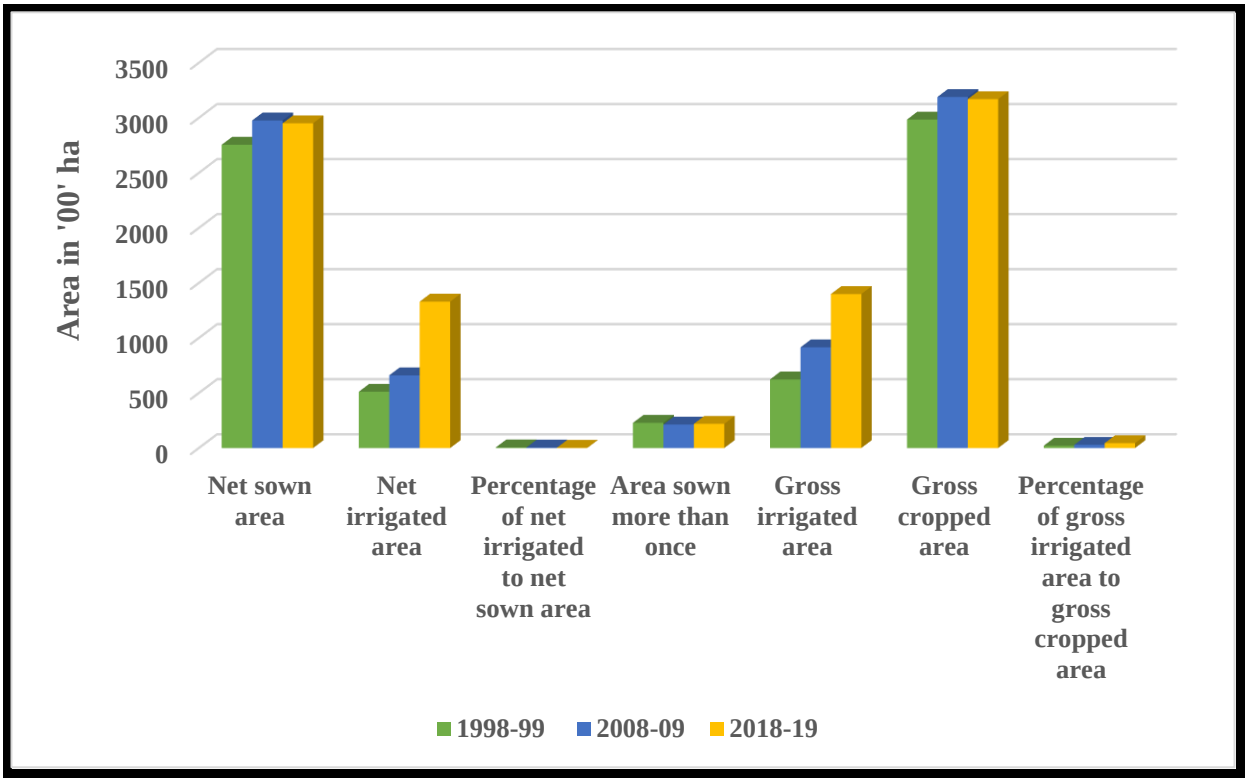

Fig. 4.5 Irrigated area in Nandurbar

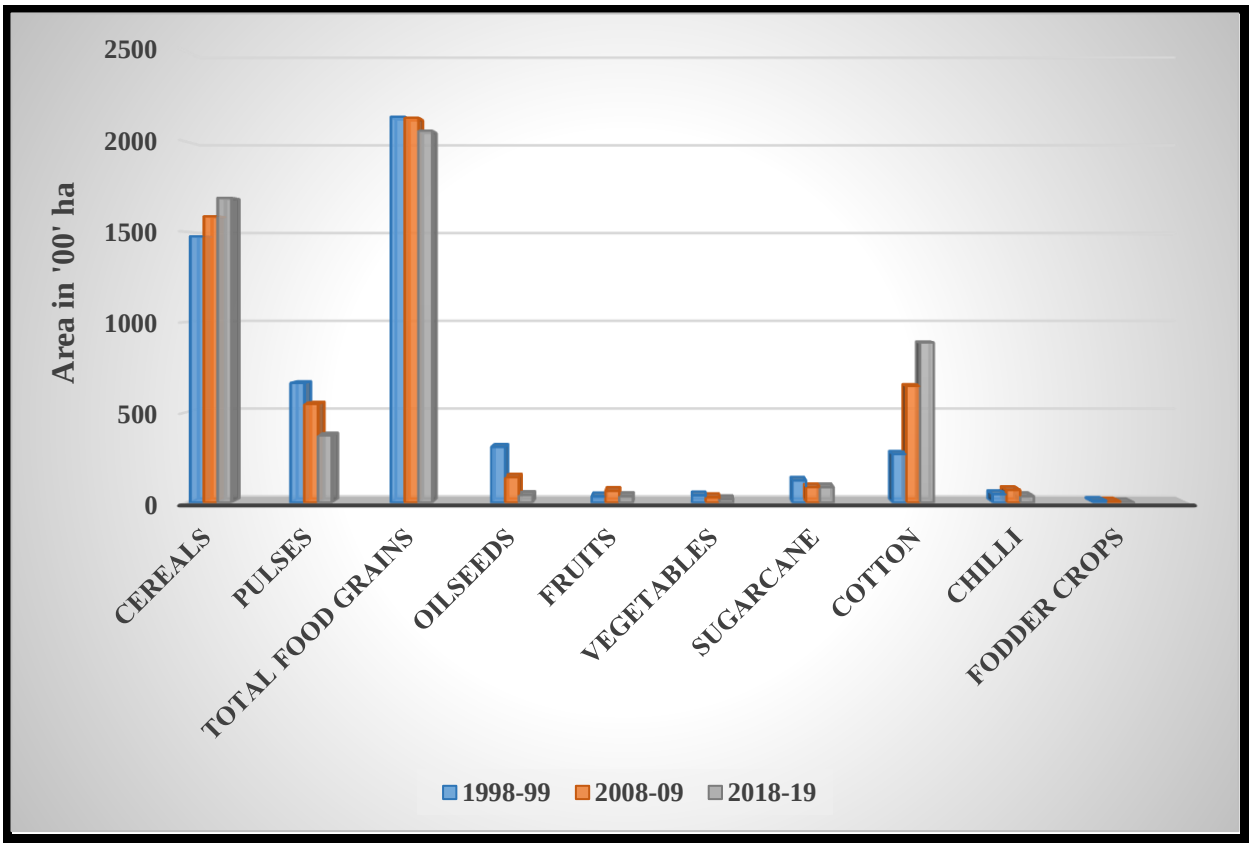

Fig. 4.6 Cropping pattern of Nandurbar

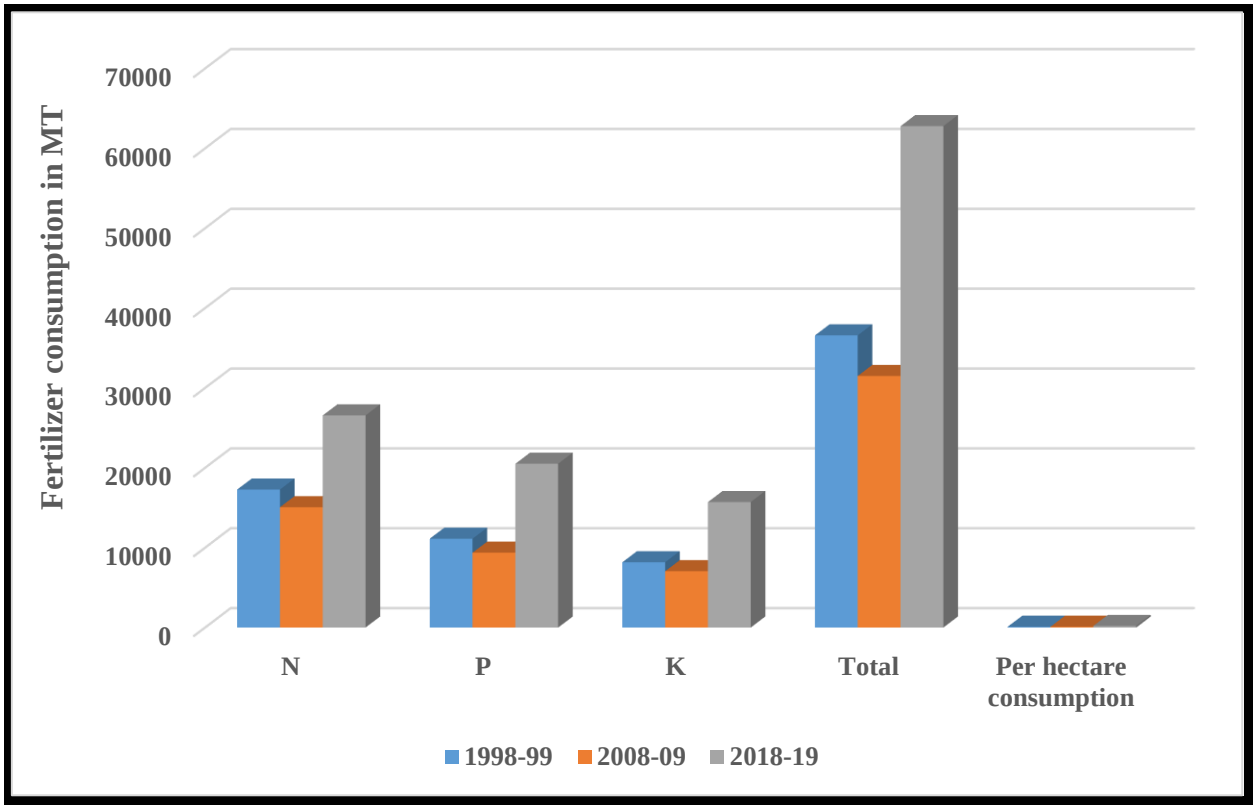

Fig. 4.7 Consumption of Fertilizers (NPK) in Nandurbar

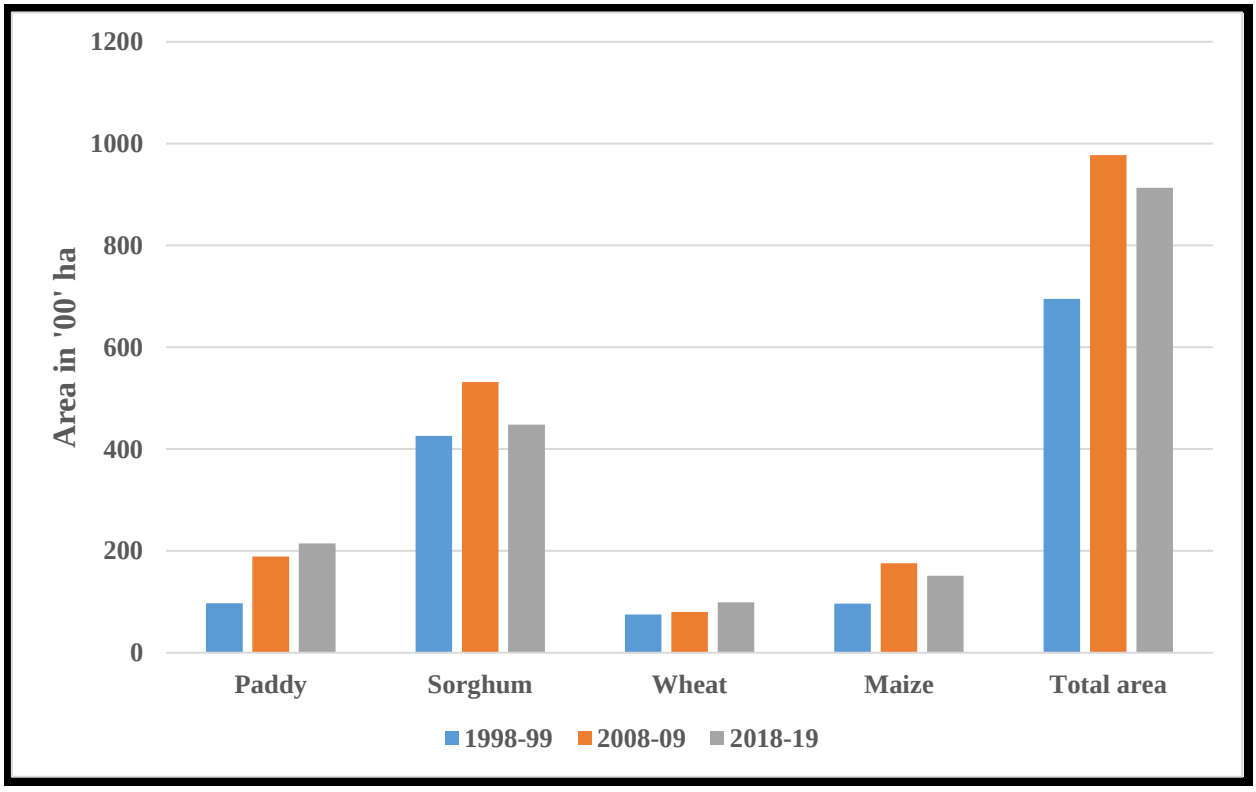

Fig. 4.8 Area under High yielding varieties in Nandurbar

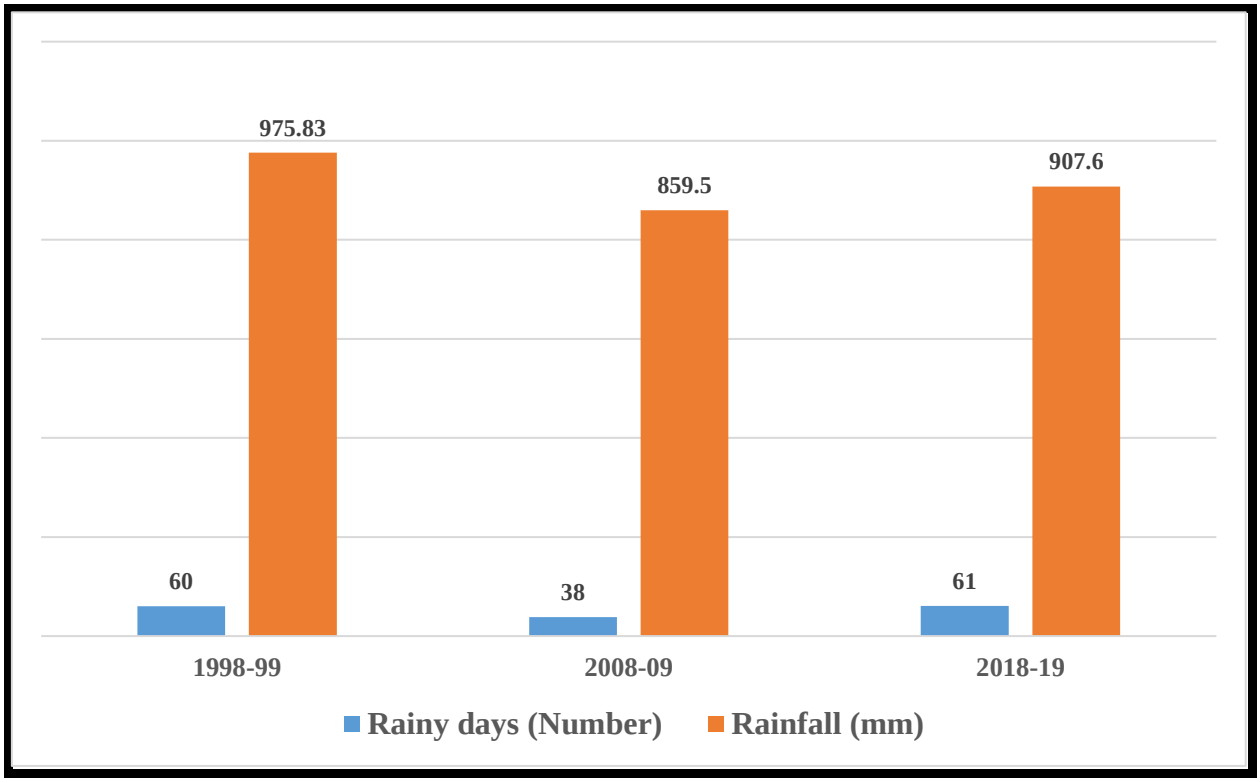

Fig. 4.9 Average annual rainfall in Nandurbar

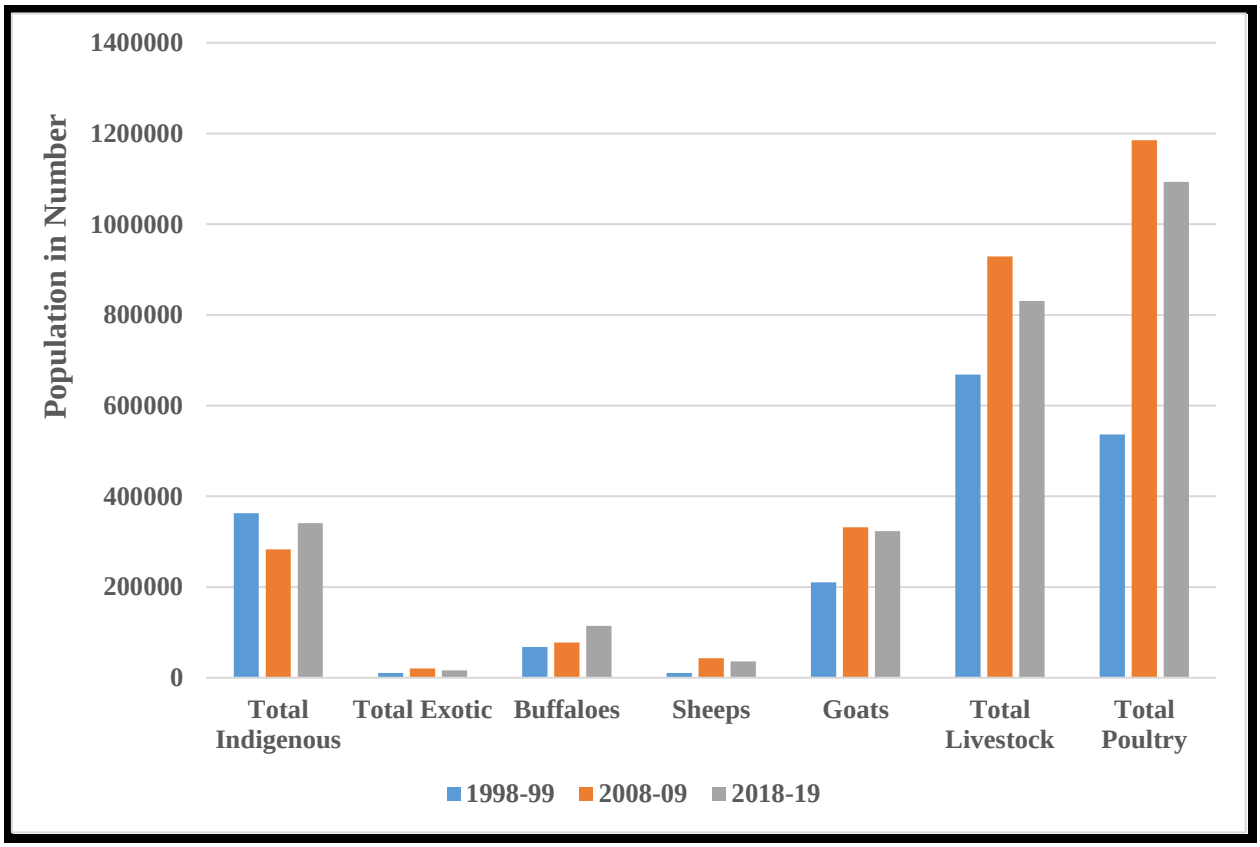

Fig. 4.10 Livestock population in Nandurbar

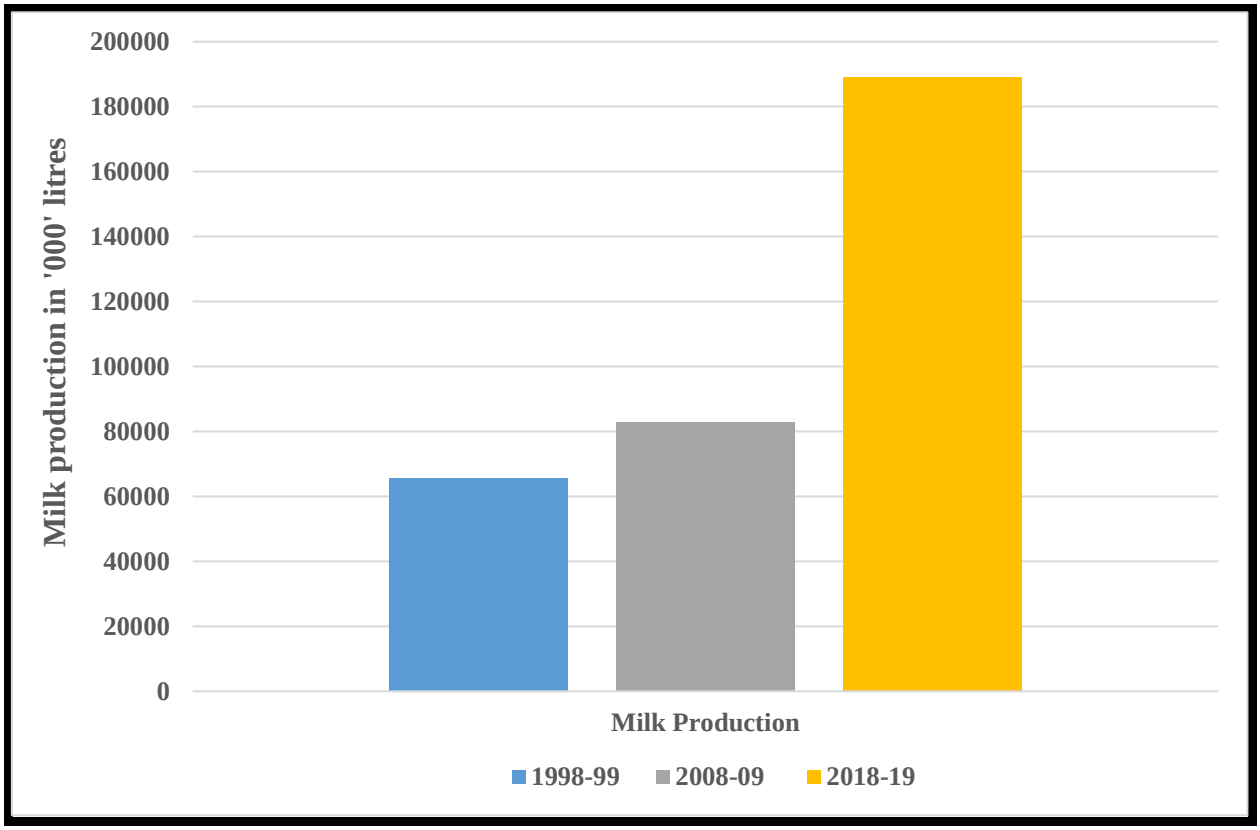

Fig. 4.11 Milk production in Nandurbar

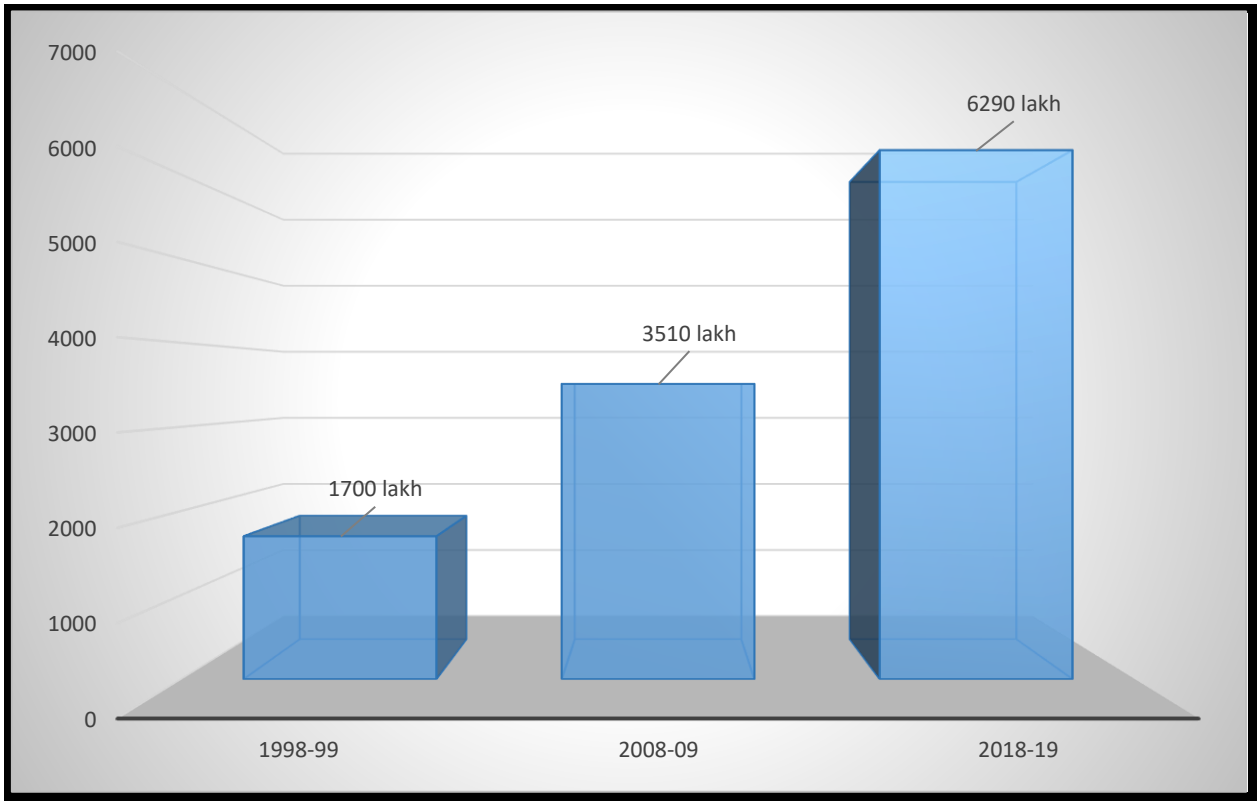

Fig. 4.12 Credit disbursed through PACS in Nandurbar

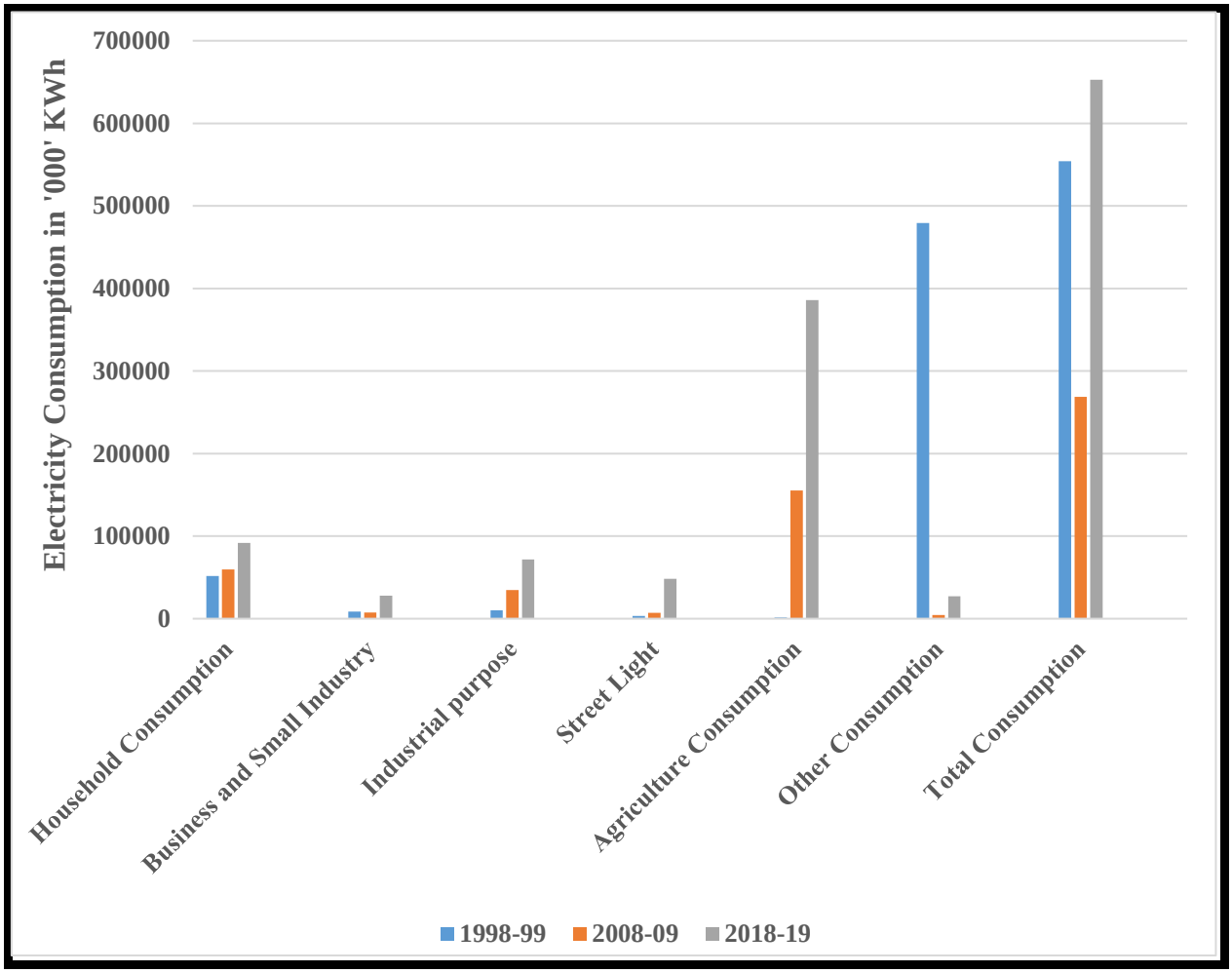

Fig. 4.13 Electricity consumption in Nandurbar