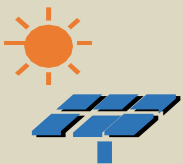


ENABLING STATE LEVEL STRATEGIC ACTIONS FOR INDIA'S NDC

STATE SELECTION REPORT

MARCH 31, 2019



Submitted to:

*MacArthur Foundation India
India Habitat Centre
Zone VA, First Floor
Lodhi Road
New Delhi 110 003
India*

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Authors : **Dr. Ashutosh Sharma, Area Conveyor**

Dr Chandrashekhar Singh, Senior Research Analyst , IRADe

Mr. Mohit Kumar Gupta, Project Analyst

Mr. Ankur Malyan, RA, IRADe

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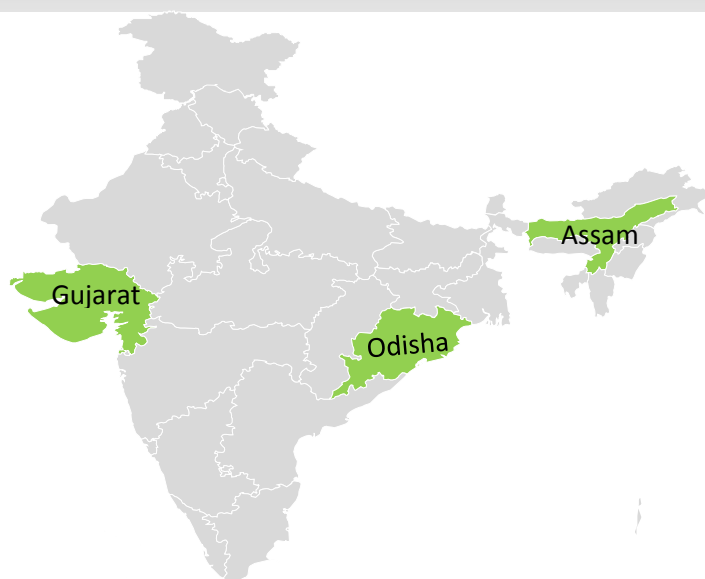
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Report: Background of Selected States



Enabling State Level Climate Mitigation



Submitted to:

MacArthur Foundation,
India Habitat Centre (IHC),
Zone VA, First Floor, Lodhi Road,
New Delhi 110 003 India

Project Team

Dr Ashutosh Sharma

Dr. Chandrashekhar Singh

Mr. Mohit Gupta

Mr. Ankur Malyan

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Abbreviations

AE	Advanced Estimates
ASEB	Assam State Electricity Board
ASTC	Assam State Transport Corporation
BEE	Bureau of Energy Efficiency
BPL	Below Poverty Line
CEA	Central Electricity Authority
CEA	Central Electricity Authority
CNG	Compressed Natural Gas
CSO	Central Statistics Office
DISCOMs	Distribution Companies
FY	Fiscal Year
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEC	Green Energy Corridor
GHG	Greenhouse Gas
GoI	Government of India
GSVA	Gross State Value Added
LDO	Light Diesel Oil
LPG	Liquefied Petroleum Gas
MNRE	Ministry of New and Renewable Energy
MoP	Ministry of Power
MU	Mega Units
MW	Megawatt
NDC	Nationally Determined Contribution
RPO	Renewable Purchase Obligation
SGDP	State Gross Domestic Product
SERC	State Electricity Regulatory Commissions
SEZ	Special Economic Zone
T&D	Transmission and Distribution
TFR	Total Fertility Rate
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WTE	Waste-to-Energy

Chapter 1. – Introduction

1. Introduction

India faces the challenge of sustaining a rapid economic growth to elevate a large section of poor people above poverty in the era of rapidly changing climate. The problem emanated from accumulated greenhouse gas emissions in the atmosphere and further aggravated due to constant addition to those stocks because of increasing consumption of fossil fuel based energy sources. India as a responsible and enlightened member of the international community has pledged to reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level under NDC's Goal- 3 and achieve about 40 percent cumulative electric power installed capacity from non-fossil fuel based energy resources by 2030 under NDC's Goal-4 submitted to UNFCCC. To achieve these objectives India need to have a comprehensive strategy.

India follows a federal structure of governance where central government primarily focuses on the national level plans implemented by State governments. There are a number of policy objectives of the central government which require state specific actions. Each state has their own limitations and due to which many states in the past were not able to attain the goals set by the central government. Therefore, it is important that states should design policies that are compatible with their resources. Moreover, the policy should address the collective concerns of the all the stakeholders in the state. This study has identified three states for intensive case study to come up with the state level strategy and solutions, which could be followed by other Indian states. The selection of three states are done keeping in view that these states should be representative of other states of India. We first divided states in three groups and one state from each groups is selected. From the group of developing states we have selected Odisha, from northeast and Himalayan states we have selected Assam and from the group of relatively developed states, we have selected Gujarat¹.

¹ For detailed methodology and information's regarding selection of state, please refer to State Selection Report.

The economic structure as well as the emission contribution of different sectors in the country is changing. To explore strategic options to reduce emission intensity of the economy, we analysed quantities and trends of GHG emissions from different sectors. By analysing state level sectoral emission time series data, we found that energy, transport and agriculture sectors are the three main emitters across the states. Share of these three sectors in state's total emissions has been increasing over years. Therefore, we have considered only these three major sectors of the economy in each state for intensive analysis.

This report elaborate on the background of demographic, economic and GHG emissions of three selected states of India especially in context of three sectors namely Energy, Transport and Agriculture. These three sectors account for major share of GHG emission in the states. The rest of the report is organised as: In Section 2, we elaborate on the demographic and brief economic profile of Odisha with focus on the nature of industry followed by a snapshot of three major economic sectors responsible for CO₂ emissions and a state specific GHG emission profile. Similarly, Section 3 and Section 4 provides details about Assam and Gujarat respectively.

Chapter 2. – Profile of Odisha

2. Profile of Odisha

Odisha is located in the eastern region of India. The state shares its borders with West Bengal on the northeast, Jharkhand on the north, Andhra Pradesh on the south, Chhattisgarh on the west, and the Bay of Bengal on the east. It has a long coastline of 480 km along the Bay of Bengal. Odisha by area is the ninth largest state of India with a total area of 155,707 square kilometres. Odisha has abundant natural resources. It contains a fifth of India's coal, a quarter of its iron ore, a third of its bauxite reserves and significant reserves of chromite. The carbon footprint analysis for the Odisha indicates that total GHG emissions was 66 million tonnes² in 2017-18. The share of coal and petroleum products in total emissions were 73% and 27% respectively. This section briefly presents the population, economic and major economic sectors responsible for emission in the state.

2.1 Demographics

Odisha with a population of approximately 45 million in 2017-18 is eleventh largest state of India. The growth rate of population in Odisha is fluctuating from decade to decade, population increased with a CAGR of 1.02 % from 2011 to 2017 (Figure 1). With the improvement in medical facilities, the crude birth rate and death rate are gradually decreasing over the years. Similar to other northern states of India, Odisha has a major population in the working age group of 16-64 years. Odisha has made rapid improvements in literacy rates in the past few decades. As per Census 2011, Odisha's literacy rate was 72.9%, registering a decadal increase of 9.8 percentage points. The state has a population density of 288 person per square Km's. Ganjam, Cuttak and Mayurbhanj are the most populated districts for almost three decades. Majority of population

² The emission estimates consider emission due to consumption of fossil fuel (Petroleum, Coal and Natural gas in the state only. For coal, we have considered consumption only from the power sector. In 2017-18 coal, consumption in the power sector was 66 % of total coal consumption in India.

resides in rural areas i.e. 84% and merely 16 % of the population resides in urban areas. It has a sex ratio of 979 females per 1000 males.

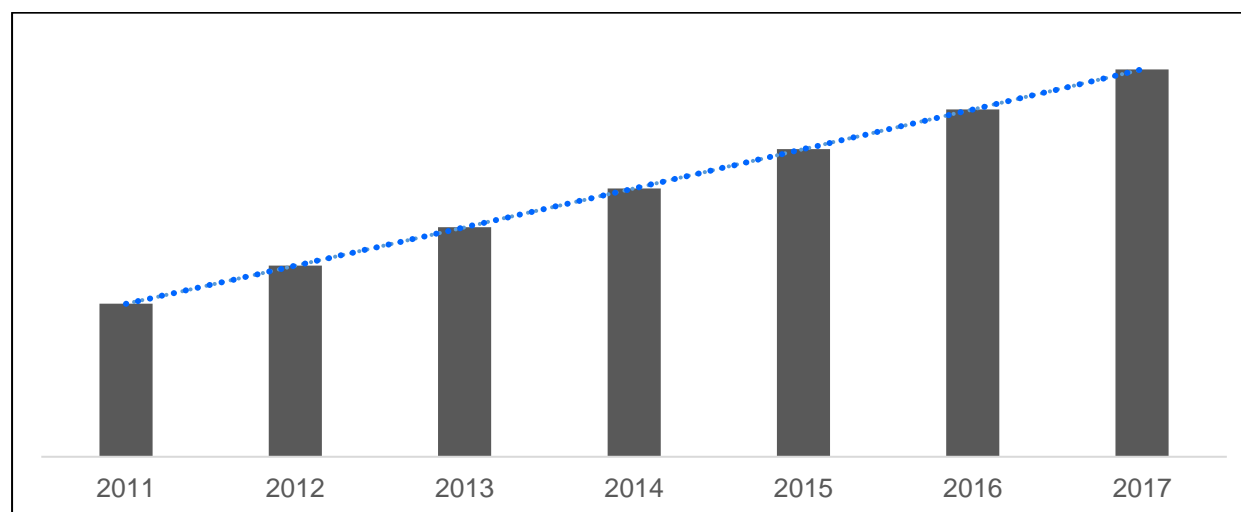


Figure 1: Population of Odisha

Data Source - Ministry of Statistics and Programme Implementation

2.2 Economy

Odisha is the largest mineral producing state and with a SGDP of INR 3,463 billion in 2017-18 and contributes 2% to India's GDP. The economic growth in the year 2018-19 increased to 8.4% from 7.4% in previous financial year. Because of sustained strong economic growth, Odisha has managed to improve its state ranking measured on per-capita income from 25th in 1996-97 to 16th in 2016-17. During the fiscal period 2011-12 to 2017-18, the state economy expanded by 53 percent and real per capita income increased by 42 percent (Figure 2). In 2017-18, services account for 45% of the SGDP, industry 35% and agriculture sector at 20% (Figure 3). Agriculture sector with 48% of workers is the largest employment sector in the state. Whereas nearly 24.8% of workforce is dependent on services sector (2017-18).

The industrial sector has played a critical role in State's economic growth. Industrial sector comprised nearly 39.5% of Gross State Value Added in 2018-19 AE (Advanced Estimates) in the state as compared to 29.8% at all India level (2018-19 AE). Odisha is a leading State in the country for aluminium, both in terms of production and reserve capacity. Odisha produces more than 50% of the aluminium and 20% of the stainless steel produced in India. The State has improved its share in total manufacturing output at all India level from 1.4% in 2004-05 to 2.1% in 2016-17. In

registered manufacturing sector, wages and emoluments has improved considerably and constitute 40% of total gross value added in 2016-17 as compared to 24.7% in 2006-07.

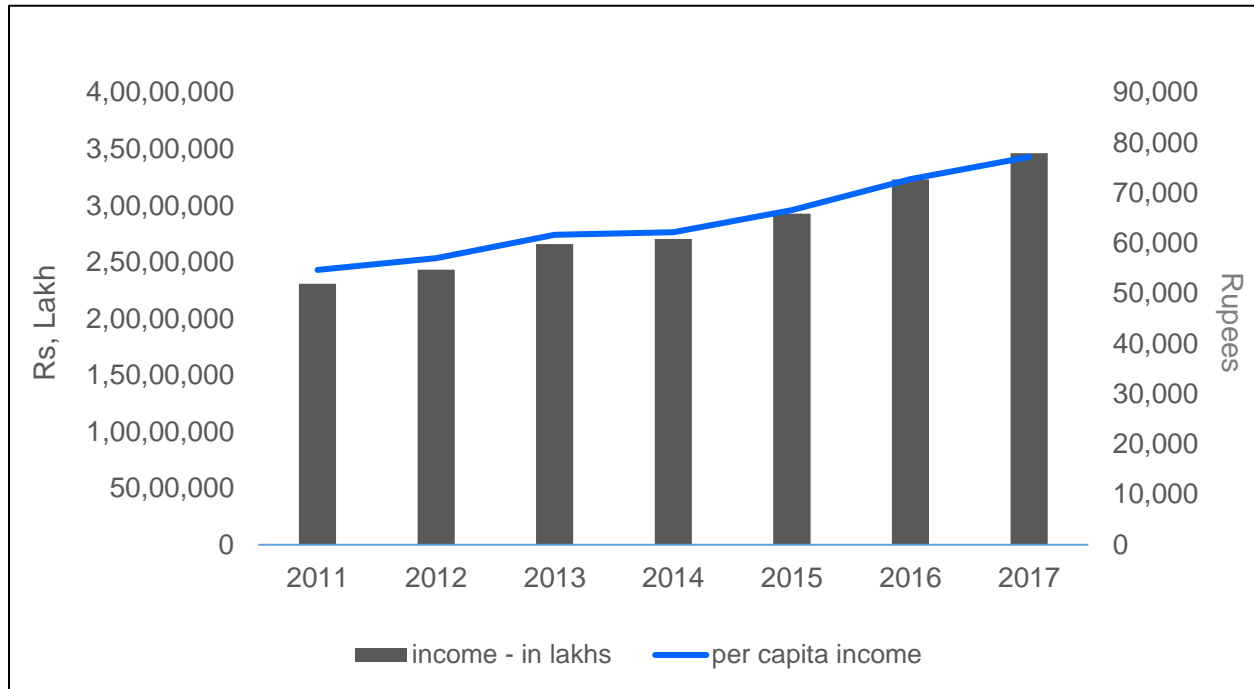


Figure 2: State Gross Domestic Product of Odisha (in lakhs) and Per Capita Income
Source - Directorate of Economics & Statistics, Odisha

The state has significant reserves of iron ore, bauxite, nickel, coal, etc. It produced 579 million dollars' worth of natural resources in 2016-17. It has 99% of India's chromite deposits, 51% of iron ore and 39% of bauxite deposits. Hence, it is an attractive destination for mineral-based industries. Since 2013-14, mineral production has increased substantially in the state.

2.3 Energy/ Power Sector

The total installed capacity of all power projects (share of power from central & other sources) in Odisha was 5509.37 MW (Megawatt) in 2016-17 and the estimated demand for power was 3090 MW. The availability of power is well above estimated demand therefore Odisha has had a consistent surplus every year except few years. In 2016-17, Odisha sold 156 MW power to other states.

Odisha has good potential for generation of electricity from renewable energy sources such as solar, wind, small hydro, biomass etc. Currently, thermal power plants (coal) contribute 68% to the total energy production followed by hydro power plants, which provides 29% of power. The Renewable Energy policy of 2016 aims at augmenting the generation of renewable energy with more emphasis on solar energy. By the year 2022, Odisha envisages generation of 2200 MW

of solar power, 200 MW of wind power, 180 MW of biomass power, 150 MW of small hydropower and 20 MW of Waste-to-Energy (WTE) power. As on 2016-17, the State had 10 hydropower and 9 thermal power projects (both State & Central sectors), one biomass project, two small hydroelectric projects, 14 Solar Photo Voltaic (SPV) projects and 32 captive power plants to supply power.

Access to electricity has improved considerably in the recent past and Odisha achieved 100% electrification on March 2019. However, there is a huge gap in rural and urban household electricity consumption. The estimated daily consumption of electricity for rural household was 2.67 units/day while for urban household was 5.60 units/day in FY 2018-19.

2.4 Transport Sector

Odisha has a total length of 3593 KMs of National Highways. The total length of railway line is around 2287 km, which includes 91km of narrow gauge. Railway density in the State is still low with 16 km per thousand square km of area, which is less than the national average of 20 km per thousand square km of area. The East Coast Railway in Odisha has the largest load in both freight as well as passenger traffic in the country.

Odisha State Road Transport Corporation looks after the roadways transportation in the state. During 2016-17, the Corporation had 379 on road buses with an average fleet strength of 455. There were total 5833,000 registered vehicles in Odisha in 2016-17, a rise of 11% from the previous year (figure 3). The road density of Odisha has improved to 165 km per 100 sq. km of area in 2016-17. Public interventions through Pradhan Mantri Gram Sadak Yojana and Bharat Nirman Yojana are expected to further improve the coverage of all-weather surface roads and the road density in the State.

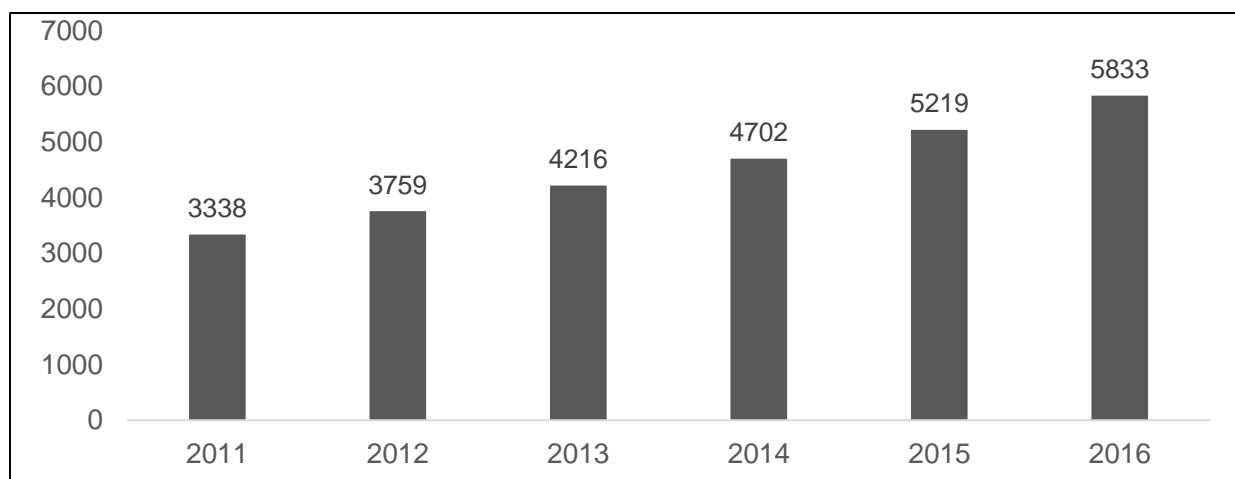


Figure 3: Number of Registered Vehicles (In Thousands)

2.5 Agriculture Sector

Odisha falls under 10 agro-climatic zones and has 8 major soil types favourable for a variety of crops. The year 2016-17 saw an unprecedented growth of nearly 20 percent in agriculture sector. This unprecedented growth may be attributed to a low base because of a severe contraction of over (-) 13% in 2015-16. The contraction in agriculture sector was largely because of vagaries of weather.

Odisha has total cropped area of about 88 lakh hectares, out of which merely 19 lakh hectares is irrigated. The principal crop rice constitutes more than 90% of the total agriculture production. Other major crops grown using high quality seeds include jute, oil seeds, pulses. Intensive cultivation and expansion in the coverage of irrigated land has led to an increase in the area under cultivation of rice.

Power consumption by agriculture sector mainly for irrigation was at 311 MU (Mega Units) in 2016-17, indicating a rising trend over last 5 years in the State.

2.6 GHG Emissions

Odisha contributes 6% to the total GHG emissions in the country. As per CII report, the carbon footprint of energy and industry sector have increased substantially in the recent years due to increasing dependence on thermal power plants. The main source of emissions is energy (62%), of which a majority comes from power generation and transport. The emissions per capita were at 1.54 (tonnes CO₂ per capita) and emissions per GDP were at 18.96 (tonnes CO₂ per GDP). Electricity emissions are the major source of emissions in the state due to heavy dependence on coal for generation of electricity.

As shown in Figure 4, the total emissions from the energy sector were 65.66 Million tons CO₂ of which 47% were due to coal and 17% were due to petroleum production. It also includes emissions from the transport sector from road, rail and aviation. In 2011-12, the emissions from the transport sector (10% of total energy sector emissions) were estimated to be 6 million tons of CO₂ Eq. The road sector contributed almost 97% of transport emissions with 5.9 million tons of CO₂ Eq., aviation contributed 0.1 million tons of CO₂ Eq.

and railways contributed 0.06 million tons of CO₂ Eq. accounting for 2% and 1% of emission from transport respectively. At present emissions from the transport sector in 2017-18 were at 17.85 (Million tons CO₂).

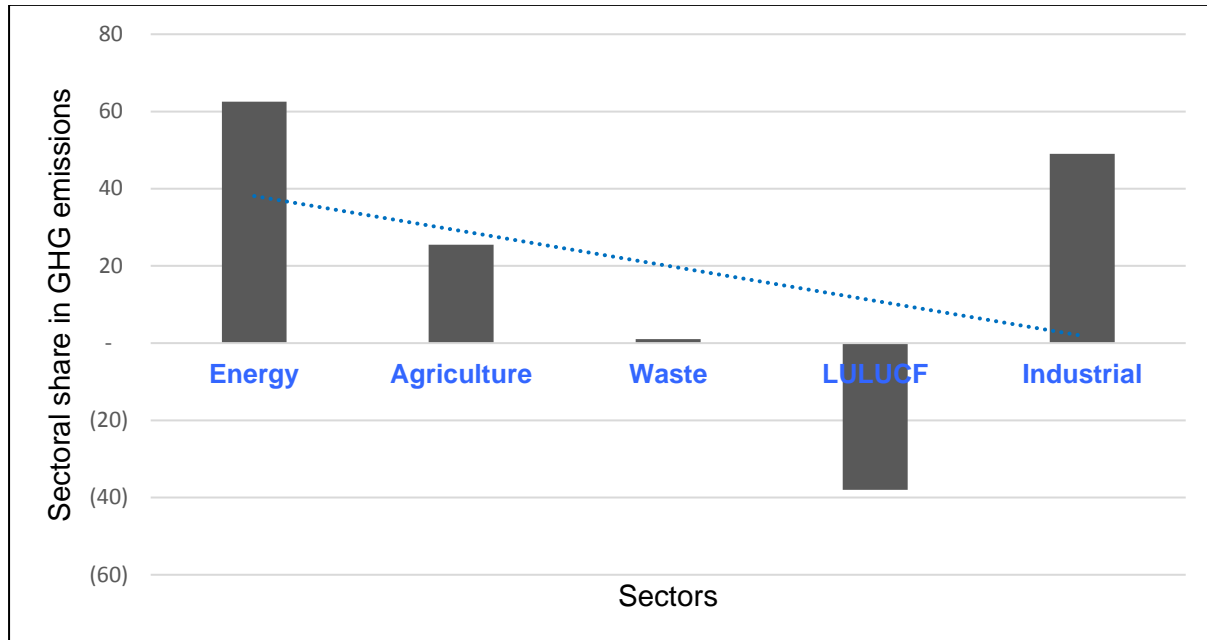


Figure 4: Share of Total GHG Emissions

Source: CII, 2011

Emissions in the agriculture sector were mainly due to diesel usage in tractors, irrigation pump sets, rice cultivation and enteric fermentation while rest were from agricultural soils and crop residue. Agricultural practices release significant amounts of methane (CH₄) and nitrous oxide (N₂O). Some of the carbon emission intensive industries with a significant contribution to the Odisha state's industrial economy include power plants, aluminium, iron and steel, Ferro-alloys and cement sector. These sectors utilise high amount of fossil fuel and have process emissions, which have contributed to higher per capita emission for the state.

Chapter 3. – Profile of Assam

3. Profile of Assam

Assam is located in the North - eastern region of India bordering seven states – Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, and West Bengal and two countries viz. Bangladesh and Bhutan. It has a geographical area of 78,438 sq. km and is the second largest state by area in the Northeast. Assam is also considered as a gateway to northeastern states of India.

A large majority of Assam's workforce depend on the farm livelihood. Assam is also the third-largest producer of petroleum and natural gas in the country and has ample reserves of limestone. The incidence of poverty in Assam remains higher than the national average, with poverty levels being very high in some parts of the state.

3.1 Demographics

As per Census 2011, Assam has a total population of 31.20 million. Total Fertility Rate (TFR) of 2.3 (SRS, 2013) shows that the State is yet to achieve the target for replacement level fertility i.e. 2.1 and its population will keep on growing. The decadal growth during 2001-2011 of the State's population was 17.07% against 17.68% growth for the country as a whole. Population growth moderated further and it grew by merely 4% during 2011-17 (Figure 5). Assam has merely 14 % population living in urban area and 86 % in rural areas, which is higher than all-India average (69%). However, urban population in the state is increasing gradually over decades. The population density of Assam in 2011 was 398 persons per sq. km. as compared to 340 persons in 2001. High population concentration has been recorded in Guwahati, Silchar and Dibrugarh districts. The progress of literacy rate in Assam is slower than India. Although there has been significant improvement in the recent past but still literacy rate remains low at just 72.13%, which can be attributed to low quality of education systems of the state. Sex ratio (no. of female per thousand male) is showing an encouraging sign in Assam as it has increased to 958 in 2011 from 935 in 2001.

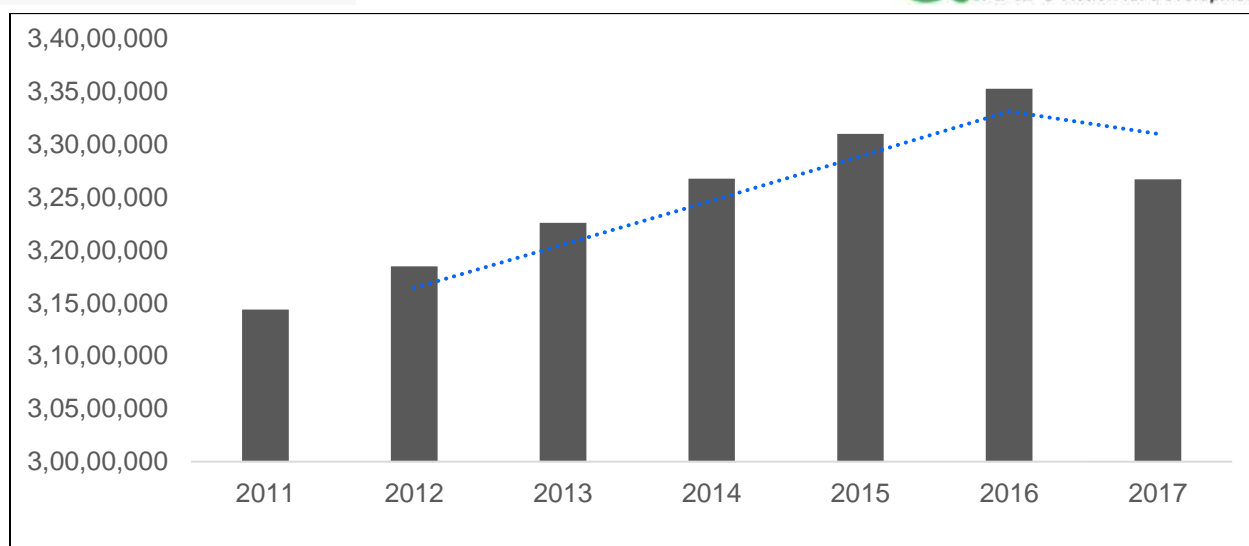


Figure 5: Population of Assam 2011 - 2017

3.2 Economy

As per quick estimates, GSDP of Assam at current price increased by 10.55% in 2016-17 over the previous year. The GSDP of the state grew at a CAGR (in Rs) of 11.78 percent from 2011-12 to 2016-17. Agriculture sector continues to occupy a significant place in the state economy even though the sectoral composition of GSDP is undergoing a change in the recent past. From 2011-12 and 2016-17, share of agriculture and its allied activities in GSDP at current price had marginally reduced from 19.89% in 2011-12 to 19.34% in 2016-17. During the same period, share of industry sector at current prices has slightly declined from 30.63% to 28.72%. The decline in share of agriculture and industry sector lead to increase in service sector share in GSDP.

More than 600 ha of land has been dedicated to industrial use. To capitalize on its pool of natural resources, the state has a dedicated tea park, food-processing park and four oil refineries. The state contributes 50% to India's total tea production, houses 300 medicinal plants and herbs and is the third largest producer of petroleum and natural gas with a capacity of 150,000 barrels per day. The state is also rich in water resources and has vast tracts of fertile land. This is because it is situated along the Brahmaputra river and receives very heavy rainfall. It acts as a vital link with the Southeast Asian countries. Six airports, two inland waterways and one inland container depot connect Assam with major cities of the country and with nearby international cities. The state is known for sericulture and enjoys a global monopoly in the production of muga silk of over 95%. It is the largest producer of gold silk and produces 51 species of bamboo. It has large pool of weavers and ranks third in the production of Vanya silk. In 2016-17, many pharmaceutical units

have come up in Assam due to presence of 952 species of plants used in medicinal practice inviting investments of 142 million dollars.

3.3 Energy/ Power Sector

The status of power generation in the state is not satisfactory from the point of power requirement of consumers. However, the Assam State Electricity Board (ASEB), has been trying to meet the power shortage by importing power from the Central Government and private foreign sources. As of March 2019, Assam had a total installed power generation capacity of 1710.11 MW, of which 1226.16 MW was under central utilities, 433.22 MW was under state utilities and 59 MW was under the private sector. The centre provided 72% while the state provided 25% of the total energy. The private sector controlled capacity comprises gas-based power plants and accounted for mere 3% of total supplied energy sources.

Of the total installed power generation capacity, thermal power contributed 1196.79 MW, hydropower contributed 457.08 MW & renewable power contributed 56.51 MW i.e. 70%, 27% and 3% respectively. The state is an ideal destination for energy, oil and gas based industries. It accounts for almost 15% of India's total crude oil output with one of the biggest and oldest refineries being located in Digboi. It accounts for 50% of India's onshore production of natural oil. It also has great hydro, solar and wind power potential.

Although the state has achieved 96.8% village electrification, 36.36 lakh rural and 1.74 lakh urban households still remain to be electrified. The state is far behind from the all India average of total rural households electrified and is one of the worst states in terms of electrified households of the country. The lowest number of rural households electrified was in the district of Hailakandi (only 32%). As on march 2018, 2500 route km railway remains completely un-electrified.

The demand for electricity exceeds the supply of electricity resulting in power unavailability in the state. The maximum energy shortage in North-Eastern Region was in Assam and Manipur at 3.5% and 5.2%, respectively. The shortages witnessed were partly because of constraints in transmission, sub-transmission & distribution system. However, Assam is anticipated to have surplus in 2018-19 on annual basis, only in terms of energy.

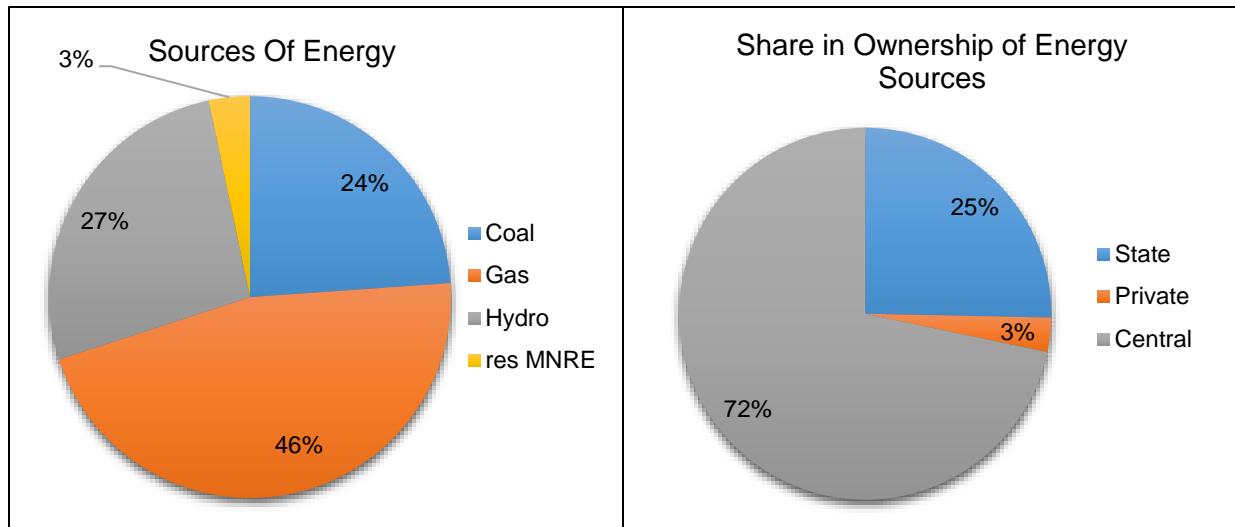


Figure 6: Sources of Energy and Ownership Share

For meeting peak deficit, the state may arrange power from surplus states. The average energy demand of the state in 2018-19 as per CEA (Central Electricity Authority) was 9075 MU while supply of electricity was only 8776 MU i.e. a deficit of 316 MU or 3.5%. The average peak demand was 1822 MU against available supply of only 1745 MU meaning a deficit of 77 MU or 4.2%. In 2015-16, the city of Guwahati had an average supply of 20 hours while other urban areas got an average supply of only about 15 hours. The rural areas in the State have much lower power availability with average duration of supply being just about 12 hours. In addition to inadequacy of generation capacities, the power availability has also been severely constrained by availability of transmission and distribution network.

3.4 Resource Potential

As per Energy Statistics (2018) issued by Central Statistics Office, Assam has 160 million tonne reserves of crude oil (26 per cent of India's estimated reserves). The state also has 159 billion cubic meters reserves of natural gas (12% of India's estimated reserves). This makes Assam highly rich in fossil fuel energy resources. Assam also has 0.51 billion tonne coal reserves. In 2017-18, six new power projects with an installed capacity of 247 MW have been proposed in the Budget. Moreover, Ministry of New and Renewable Energy (MNRE), Govt. of India has proposed 688 MW of Generating capacity from the renewable energy sources in Assam till 2021-22, out of which 663 MW will be from solar and 25 MW will be from hydroelectric power projects.

The Central Electricity Authority (CEA) data shows that the North East India has hydropower potential of 63,257 MW (43% of the total assessed hydropower of the country). Among the North Eastern states, Assam has a capacity to produce 680 MW hydropower. A large share of these

agricultural lands has biomass potential of 1-3 tonnes/hectare. Assam has potential to generate 279 MW power through biomass potential.

The state government announced the “Assam Solar energy policy, 2017” with the objective of inviting investments to increase the states solar power capacity to 590 MW by 2019-20 and encourage its adoption for all uses- agricultural pumps, residential, commercial.

3.5 Transport Sector

Since Assam is a gateway to Northeast India, the need to have a good transport system is essential for economic development. The sector accounted for 6% for the SGDP of the state. The road network in Assam comprises of total 58202 Km. of roads consisting of 3900.44 Km. National Highways, 2530 Km. State Highways, 4379 Km. Major District Roads, 1615 Km. Assam State Transport Corporation (ASTC) operates a fleet of 1,100 buses and is supported by another fleet of 1,200 privately owned buses. The state does not have any significant number of electric vehicles.

The State has the highest numbers of operational civil airports in the Northeast and these are located at Guwahati, Tezpur, Jorhat, Dibrugarh, North Lakhimpur and Silchar. In Guwahati, the movement of air traffic as well as passenger traffic (both domestic and international) has been increasing rapidly since 2004-05. The Directorate of Inland Water Transport is operating more than 200 ferry services for the purpose of public utility. The total number of registered vehicles in 2016 was 2817 thousand up from 2510 thousand in 2015 an increase of 12.23% from previous year. In 2015, it is estimated that 19% of the energy demand was from the transport sector at 1.2 Mtoe.

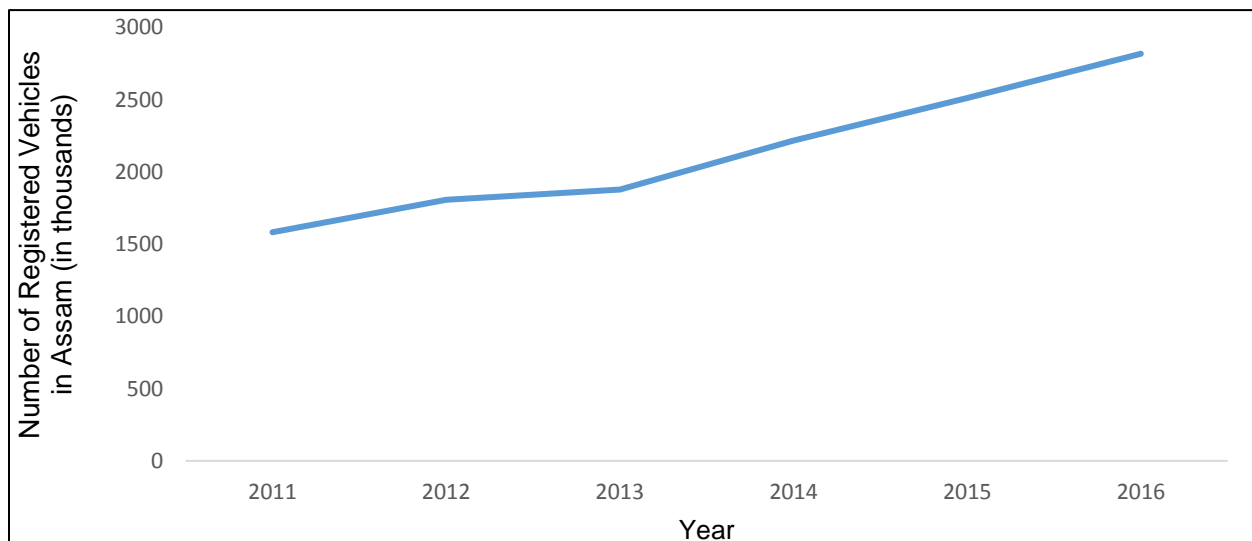


Figure 7: Number of Registered Vehicles in Assam (In Thousands)

3.6 Agriculture Sector

Agriculture accounts for almost a third of the SGDP of Assam and employs a majority of the population. The soil, topography, rainfall and climate are very conducive for agricultural activity, mainly for the cultivation of paddy. It is situated in a high rainfall zone and receives annual average rainfall of 2297.4 mm. However, many parts are dry during the winter months. The state is a pioneer in tea production worldwide. The state also produces jute, mustard, potato, bamboo, sugarcane. Sugarcane is one of the main cash crops of the state during the kharif season.

With the increase in population and development of agro technology, changes have taken place in the agricultural scenario of the state. Almost 54% of the total area of the state is now used for agriculture. Both the net sown area as well as gross cropped area have increased significantly in recent years. There is also increased focus on the horticulture sector by the state. Horticulture crops of Assam namely- coconut, citrus, black pepper, banana and papaya have been given top priority. Marketing of agricultural produce is a major problem for the state due to lack of organized market facility, lack of storage infrastructure near the field, debt ridden farmers.

In 2015-16, the total area under paddy declined in the state due to reduction in area covered under autumn rice and summer rice as per the economic survey. The area under wheat and pulses also declined while area under production of oil seeds has gone up. The total food grain production in 2015-16 in the state was 53, 59,000 tonnes.

Agricultural activities that cause pollution include confined animal facilities, grazing, pesticide spraying, irrigation, fertilizing, planting, and harvesting. The major agricultural pollutants that result from these activities are sediment, nutrients, pathogens, pesticides, and salts. Agricultural activities also can damage habitat and stream channels.

3.7 GHG Emissions

Assam contributes 1.1% to the total GHG emissions in the country. The emissions per capita were at 0.50 (t CO₂ per capita) and emissions per GDP were at 7.72 (t CO₂ per GDP). The total emissions from the energy sector were 16.29 Million tons CO₂ of which 48.44 % were due to petroleum products, 8.35% were due to coal and 43.22 % were due to natural gas.

The total number of registered vehicles in 2016-17 were 2,817 thousand, an increase of 12.3% from the previous year. The total GHG emissions estimated from the transport sector were 7.89 million tons CO₂. The lack of adequate public transport in the state leads to higher emissions. Assam accounts for 69.1% of the GHG emissions in the Northeast.

Chapter 4. – Profile of Gujarat

4. Profile of Gujarat

4.1 Demographics

The Arabian Sea borders Gujarat both to the west and the south-west. It is the sixth largest state of India by area and the ninth largest state of India by population with a population of 63,264,000 in 2017-18. It has a population density of 308 people per Sq. km whereas it was 258 persons per sq.km. in census 2001. This shows a rapid increase in the density of population in the state during the last decade. However, the population density of Gujarat is below the National average of 382 persons per sq.km. Gujarat accounts 5.97% of the area and 4.99% of the population of India. Population of Gujarat was 5.07 crore in the beginning of the 21st Century. As per Census 2011, Gujarat has population of 6.04 crore persons showing a decadal growth rate of 19.3% as compared to all India growth rate of 17.7%. As per 2011 census, 57% of the population resides in urban areas and 43% in rural areas. Ahmedabad, Surat and Vadodara are the most populated cities in the state. The Infant Mortality Rate in Gujarat has reduced sharply by almost half from 60 in 2002 to 30 in 2016. It has a population ratio of 918 females per 1000 males. It ranks 15th among the Indian states on the human development index. The state had 31.46 lakh registered BPL families in 2018.

4.2 Economy of Gujarat

Gujarat is one of the key drivers of India's economic development and contributes 7.6% to national GDP. Gujarat is the largest producer of Cotton, Groundnut and Condiments and Spices in India. Gujarat is 3rd largest state in milk production in India. 7.9 % of milk production of the country is from Gujarat. Gujarat enjoys the status of industrially developed state of India with its 18.4 per cent share to country's industrial output, the largest among the states of India. There are 13 major sectors that contribute 93.21% towards the total output of the state namely – chemicals, petrochemicals, dairy, drugs and pharmaceuticals, cement, gems and jewellery, textile, engineering, etc. The manufacturing sector unlike in other Indian states contributes over 30%

towards the total GDP of Gujarat. The world's largest petroleum refining hub is situated in Jamnagar district of Gujarat. It is also the largest manufacturer of processed diamonds contributing to 72% of the world's total production of processed diamonds. Gujarat is a leader in exports with more than 20 percent share to India's aggregate exports. 39.82 % of all cargo and more.

Gujarat is one of the most industrially developed states having the highest geographical area under SEZ development in India. Gujarat is the top performer in construction and manufacturing sector growth.

4.3 Energy Sector

Energy is a building block of economic development. The state offers a reliable power supply of 1175 units against the country's average of 592 units. The total installed capacity of electricity of the State as on 31st October, 2017 is 19555 MW of conventional sources comprising of 5517 MW by GSECL, 2604 MW by State IPPs, 7207 MW by Private IPPs and 4227 MW by Central sector share. The total consumption of electricity in the state during the year 2016-17 was 77881 MUs as against 75841 MUs in the previous year. The per capita consumption of electricity reported by GUVNL during the year 2016-17 was 1916 units as against 1910 units of the previous year 2015-16.

Wind energy is a clean and safe energy emerged as a potential source of renewable energy. As per the National Institute of Wind Energy, the estimated installable potential at 80 metre height is found to be over 35000 MW in Gujarat State. At the end of the March 2017, installed capacity of wind farms in Gujarat State was 5318.4 MW. An additional capacity of more 163.5 MW has been added during the year 2017-18 (up to November -2017). So, the total installed capacity of wind farms in the state, by the end of November-2017 became 5481.95 MW.

The state encourages the participation of private players in the power sector. The major source of energy is fossil fuels mostly coal, contributing 68.94% to the total energy supply followed by renewable energy sources which provide 26.94% (of which a major part comes from wind energy) of the total energy requirement. The Ukai thermal power plant has the largest installed capacity of 1350 MW contributing 20% to the overall generation of thermal power. The most energy intensive sector is the industrial sector accounting for about 40% of the total energy consumption followed by agriculture sector consuming 27%.

The state contributes 12% towards India's total renewable energy basket. Gujarat has installed capacity of 1584 MW Solar Power Projects as of November 2017. The works of 15 MW Canal Bank and 10 MW Canal top Solar Power Plant i.e. total 25 MW solar power plant on Vadodara Branch Canal have been completed in September, 2017. 5 MW grid connected Solar Rooftop project each at Gandhinagar and Vadodara has been commissioned. During the year 2016-17, the total power generation of Wind Farm was 372.69 MUs.

State's installed capacity through conventional resources has increased in past few years. Even though state's peak demand has been increasing at CAGR of 7.2%, (CEA, 2017) it has been successful in mitigating increase in power demand without any load shedding. Due to uninterrupted, quality and reliable power supply the growth is apparent and visible in all the fields. Gujarat's power demand is constantly increasing hence huge investments are being made in the generation, transmission and distribution segments. The key lies in improving efficiency so that consumers do not have to pay anything extra for the investments proposed in the short, medium or long term. Per capita consumption of electrical energy in the state in 2017-18 was at 2007 units. The state energy sector is the most advanced and progressive in comparison with other states of India. Gujarat is the second highest coal consuming state in India. This is despite the fact that it has no domestic resources of coal.

4.4 Transport Sector

Gujarat has a strong public transport system with a total fleet of 7117 buses. There are 125 depots operating 31 lakh kilometres daily with 45,281 trips catering to 22 lakh passengers. There are even special services such as sleeper coaches and AC coaches covering 99% of the population of Gujarat. Due to a large coastline, it has the advantage of large global access and lower transportation costs. The total number of vehicles in Gujarat in 2017-18 were 23,286,418, an increase of 5% from the previous year. The total length of railway lines in the State as on 31st March, 2016 was 5258.49 route kms comprising 3506.55 kms of Broad Gauge (BG), 1193.04 kms of Meter Gauge (MG) and 558.90 kms of Narrow Gauge (NG) lines.

The total length of roads (except Non-plan, Community, Urban and Project roads) in the State has increased to 80582 kms at the end of 2014-15 from 79894 Kms at the end of 2013-14. Out of the total road length of 80582 Kms, the length of surfaced roads was 78647 Kms (97.60 percent) whereas unsurfaced roads was 1935 Kms (2.40 percent) at the end of 2014-15.

As per socio economic survey of Gujarat-, aircraft movements have increased by 9.93% in the year 2016-17 as compared to previous year at the Domestic and International airport in the Gujarat. Passenger traffic has increased from 81.90 lakhs in the year 2015-16 to 93.75 lakhs in the year 2016-17 (14.47% increased) and cargo traffic has increased from 70.19 thousand tonnes in the year 2015-16 to 79.90 thousand tonnes during the year 2016-17.

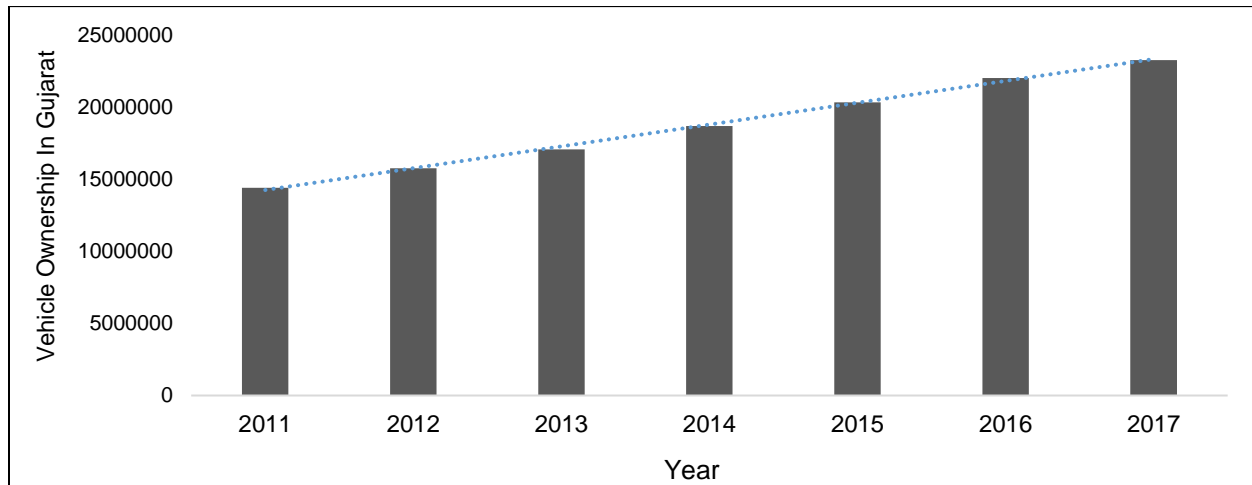


Figure 8: Vehicle Ownership in Gujarat 2011 – 2017

There is mass consumption of petroleum products (almost 28.5% including both petrol and diesel) by transportation sector. Bullet trains, DMIC (38% of the corridor lies in Gujarat) and Mumbai-Gujarat projects are expected to make public transport systems more efficient and reduce travel time.

4.5 Agriculture Sector

The state has a diversified agriculture economy. It has varying topographic features though a major part of the state is dominated by parched and dry region. It is the main producer of tobacco, cotton, and groundnuts in India. Other major crops produced are rice, wheat, jowar, bajra, maize, tur, and gram. The state has seen a shift towards high value crops from low value cereals crops. The total food grain production in 2017-18 was estimated to be 66.88 lakh tonnes down from 74.2 lakh tonnes in the previous year while production of oilseeds, tobacco and cotton has increased over the years. The total cropped area of the state is 13.9 million hectare while net irrigated area is 4.32 million hectare i.e. 31.07% of total cropped area. Most of the landholders are marginal or small farmers. Major oil seeds grown in the state are Mustard, groundnut and castor. The growth of agriculture and allied sectors is still a critical factor in the overall performance of the state economy. During the period 2011-12 to 2016-17(Q), the GSDP at constant (2011-12) prices for

agriculture sector including animal husbandry sector has increased from Rs.98015 crore to Rs. 106037 crore.

Major expansion in irrigation, water management, implementation of drip and sprinkler irrigation in the past years have led economy towards the inclusive growth. The role of the agriculture sector, however, remains critical as it accounts for about 49.6 per cent of employment in the state (Census, 2011). Considering the importance of agriculture sector for the economy government has decided to cover maximum possible command area under Participatory Irrigation Management. Under “Gujarat Water Users Participatory Irrigation Management Act-2007,” 1806 Water Users Associations have been formed having 555366 hectares of land by the end of March-2017. Government is also carrying out extension, renovation and modernization of canal system of existing major and medium Irrigation Schemes to bridge the gap between irrigation potential created and its utilization.

Gujarat has also introduced energy efficient pump sets for irrigation. Recently, the government has announced the Suryashakti Kishan Yojana (SKY) enabling farmers to generate solar electricity for irrigation and sell the surplus power to the DISCOMs.

4.6 GHG Emissions

The total CO₂ emissions of Gujarat stood 120.68 million tons in 2017-18. A majority of these emissions were due to consumption of petroleum products (60.90%) and coal (56.26%) while Natural gas had a minor share (3.52%). The emissions per capita were at 1.91 mt CO₂, one of the highest in the country. Emissions per GDP were 11.14 mt CO₂ in the state.

Increasing number of vehicles in the transport sector is the major source of GHG emissions. More than a dozen flyovers are being executed in the city to facilitate easy transit of vehicles. Total greenhouse gas emissions from this sector in 2014-15 were 60.90 (million tons CO₂). The seventh largest in the country contributing about 50.46% of the total emissions of the state.

In the agriculture sector most of the energy demand comes from water pumps used for irrigation. Consumption of energy for agricultural purpose was 13,492.34 GWh in 2011-12. The emissions in this sector are primarily due to methane emission from rice paddies, enteric fermentation in ruminant animals and nitrous oxides from application of manures and fertilizers to agricultural soils. There is scope to reduce energy consumption by pumps and tractors to reduce emissions.

By making use of the available wind energy potential of the region, the State can save 4.68 million tonnes of coal per annum and as a result reduce its CO₂ emissions by 6.70 million tonnes per annum. According to State Government estimates, by using the solar potential of the State there would be coal savings of around 1.00 million tonnes per annum thereby leading to reductions in CO₂ emissions of 1.43million tonnes per annum.

In view of reducing carbon emission, Government is promoting power generation from renewable energy sources. Government has increased cess charge on carbon emitting fuels. With tightening of NO_x & SO_x emission norms, the capital cost of new coal base thermal plants is expected to increase by 1 to 1.5 Cr/MW. This will increase retail tariff from coal based power generation sources.

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