Sustainable Consumption Pattern in India

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12.1 Introduction

The economic development agenda in the twenty-first century begins with the Millennium Development Goals (MDGs) for the global economy. The MDGs is the most significant global development programme with targeted goals, which has shifted the focus on sustainable development from unsustainable individualistic development approach. Truly, the MDG is a new global development doctrine, which initially focuses on poverty and human development, highlighting certain defined and targeted goals for achieving development. After five decades of economic development practices, it is realized that traditional development doctrines have failed to ensure development over time with limited resources on the Earth, and alternatively sustainable development approach emerges for sustaining human civilization (Dinda 2017). The UN has set up universal goals in the framework of Sustainable Development Goals (SDGs) initiated through the MDGs in the early twenty-first century. The UN goals are relevant for both developing and developed nations. The MDGs mainly focus on development of human capital, while SDGs sets a wide coverage on human capital formation and its protection for sustaining humankind. Now, the global human society feels an urgent need for interconnections among economic, social and environmental dimensions of development. Recently, the MDGs are set to be achieved integrating *Sustainable Consumption and Production (SCP)* patterns in the framework of new development goals. The core of sustainable development goals is to make sustainable consumption and production (Akenji and Bengtsson 2014). As consumption and production are interdependent, question arises on the operationalization of the SCP within the market system (Xu et al. 2018). Here is a need to develop the mechanics for promotion of sustainable consumption. Sustainable consumption should focus on non-polluting consumption, and consumption process should not generate pollution (Banerjee et al. 2016; Dinda 2014, 2016, Goswami et al. 2017; Nayak et al. 2015; Raman et al. 2014) and avoid resource waste. The above said are the initial indicators to assess the sustainable consumption. Any development suggests concomitant changes in environmental impacts, which can be attributed to the consumption households (Scherer et al. 2018). The indicators of sustainable consumption are directly or indirectly connected with energy and material consumption. Is there any evidence of sustainable consumption in India? This chapter

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attempts to provide the fuel consumption pattern and its distribution across states, and highlights some indicators like material consumption footprint per capita and its intensity in India.

For the said study purpose, this chapter is organized as follows: Sect. 12.2 describes and highlights sustainable consumption and production pattern for achieving sustainable development goals. Section 12.3 provides the energy consumption pattern in India. Section 12.4 reports with analytical focus on material consumption footprint in India. Final Sect. 12.5 concludes with remarks.

12.2   Concept of SCP and Its Relevance

The concept of sustainable consumption and production has emerged and is gaining importance in development policy meetings. Recently, it has been realized that sustainable consumption and production pattern is one of the most important global discourses, which is included in the MDGs to achieve the global development agenda in post-2015. Truly, consumption and production process are the pivotal or focal point of achieving sustainable development goals (SDGs). Truly, SCP is embedded in the SDGs. Now, the UN merges the MDGs with environmental agenda for achieving sustainable development. It is urgently necessary to integrate the production system and consumption patterns with sustainable development for its establishment with predominant goals. Currently, sustainable consumption and production patterns have gained importance in policy dialogues at the international arena (Gasper et al. 2019; Ma et al. 2019; Xu et al. 2018; Scherer et al. 2018). The Rio + 20 (the UN Conference on Sustainable Development) pointed out the mistake of cornering SCP in the MDGs and suggested a proposal for 10-Year Framework of Programme on SCP patterns. Research on SCP should address the integration of economic growth, environmental protection and social inclusiveness from both consumption and production sides.

12.2.1 SDG 12 Ensures SCP

Sustainable Development Goal 12 (SDG 12), ensuring sustainable consumption and production pattern, promotes increased human well-being while decoupling economic growth from resource use and environmental degradation. Goal 12 sets the targeted goal on sustainable consumption and production, emphasizing on '*doing more with less*' and ensures that the needs of the present generation are fulfilled without compromising that of the future generation. Goal 12 ensures sustainable consumption and production process, which is interconnected with other goals. Entire socio-economic development evolves over production and consumption pattern, which should ensure sustainability of this consumption and production process over time unless and until improving resource efficiency and/or reducing its degradation.

SCP encourages socio-economic development within possible market ecosystem and its carrying capacity in the global limits. Sustainable consumption reveals the consumer's choices of goods and services focusing on basic needs like food, shelter, clothing, leisure, etc (Heltberg 2005). This is the demand-side economy for quality consumption to sustain in the long run. Sustainable consumption suggests to fulfil the basic needs and improve quality of life without harming the environment, economy and society overall. So, the present choice of consumption should not be traded-off with damaging possible production (Ouedraogo 2006; Masera et al. 2000).

Sustainable production focuses on resource efficiency, highlighting minimizing risk on environment and human society. It is the supply-side economy assessing the impacts of production processes on environment, economy, and society. Sustainable production certainly refers to the optimum use of resources at all stages of production cycle, which aims to reduce its ecological footprint without any burden shifting between different stages of product life cycle. The global need is to adopt policy to reduce the footprint of each and every country. In this context, how do we gauge such complex issues? What are the tar-

gets and corresponding measureable indicators? The next sub-section discusses the main targets and potential indicators.

12.2.2 The Targets and Potential Indicators

This section describes possible ideological background of Goal 12 associated with targets and technical architecture for monitoring them and suggests some potential indicators. The goal on Sustainable Consumption and Production has 11 major targets and its progress is monitored by defined indicators. Now, we discuss on the guideline of implementation programme framework as mentioned as Implement the 10-Year Framework of Programme on sustainable consumption and production (10 YFP). All countries will take action; the developed countries will take the lead and help the developing countries with improving their capabilities and accountability. 10 YFP is more of an implementation framework and covers all other targets. Major targets related to achieve SCP by 2030 are (see SDG 12 in the UN website: http//in.one.un.org/sdg-12) as follows:

1. Achieve the sustainable management and efficient use of natural resources.
2. Reduce food losses along production and supply chains, including post-harvest losses. By 2030, per capita global food waste should be reduced to half, both at the retail and consumer levels.
3. Achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release into air, water and soil in order to minimize their adverse effects on human health and natural environment.
4. Reduce waste generation through reduction, recycling, reuse and prevention.
5. Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle.

6. Promote public procurement practices that are sustainable, in accordance with national policies and priorities.
7. Ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature.
8. Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production.
9. Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products.
10. Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities.

Relevant goals and their corresponding indicators are presented in Table 12.1, which briefly summarizes SDG Goal 12.

Table 12.1 describes briefly the relevant targets of Goal 12 and their corresponding possible indicators. SDG 12 ensures sustainable consumption and production patterns through eight specific targets, 12.1–12.8 and three target-related means of implementation (12.a–12.c). The sustainability is viewed in the lens of production efficiency in relation to use of natural resources (12.2), food production and supply-related losses (12.3), management of chemical and wastes (12.4), reduce waste generation (12.5), reporting of sustainable corporate practice (12.6) and public procurement (12.7) and ensure universal access to information for sustaining lifestyles (12.8). The target for rationalizing fossil fuel subsidies (12.c) and the least waste generation (12.5)

Table 12.1 Goal 12 ensures sustainable consumption and production patterns: targets and indicators

Targets	Indicators
12.1 Implement the 10-Year Framework of Programmes on Sustainable Consumption and Production Patterns, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries	12.1.1 Number of countries with sustainable consumption and production (SCP) national action plans or SCP mainstreamed as a priority or a target into national policies
12.2 By 2030, achieve the sustainable management and efficient use of natural resources	12.2.1 Material footprint, material footprint per capita, and material footprint per GDP
	12.2.2 Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP
12.3 By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses	12.3.1 Global food loss index
12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment	12.4.1 Number of parties to international multilateral environmental agreements on hazardous waste, and other chemicals that meet their commitments and obligations in transmitting information as required by each relevant agreement
	12.4.2 Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment
12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	12.5.1 National recycling rate, tons of material recycled
12.6 Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle	12.6.1 Number of companies publishing sustainability reports
12.7 Promote public procurement practices that are sustainable, in accordance with national policies and priorities	12.7.1 Number of countries implementing sustainable public procurement policies and action plans
12.8 By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature	12.8.1 Extent to which (1) global citizenship education and (2) education for sustainable development (including climate change education) are mainstreamed in (a) national education policies; (b) curricula; (c) teacher education; and (d) student assessment
12.a Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production	12.a.1 Amount of support to developing countries on research and development for sustainable consumption and production and environmentally sound technologies
12.b Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products	12.b.1 Number of sustainable tourism strategies or policies and implemented action plans with agreed monitoring and evaluation tools
12.c Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities	12.c.1 Amount of fossil-fuel subsidies per unit of GDP (production and consumption) and as a proportion of total national expenditure on fossil fuels

Source: The UNEP

might capture production and consumption, which could lead towards sustainability.

10 year framework of programmes on sustainable consumption and production should be implemented; all countries should take action, with developed countries taking the lead and taking into account the development and capabilities of developing countries. Is there any mismatch between targets and identified indicators? How do we implement Goal 12 in our daily life? Is there any evidence? In the next section, we attempt to answer these questions focusing on consumption pattern in India with empirical evidence.

12.3   State-Wise Fuel Consumption Pattern in India

Initially, this section describes the fuel consumption pattern at the household level in India, and also attempts how far it is consistent with SCP. The last part provides forecasting on material footprint in India by 2030.

12.3.1   Energy Consumption and Development

Energy consumption is essential for economic activities, and energy requirements are increasing at a high rate along with economic development. In a developing economy, domestic energy consumption forms a large part of total energy consumption. Household energy demand comes basically from the fuels they consume. Fuel forms an indispensable part of daily consumption basket of households. Household consumes fuel to serve three basic domestic purposes—cooking, lighting and space heating (Van Der Kroon et al. 2014). These purposes are served by a variety of sources of fuels namely coal, petroleum, LPG, electricity, gas, fuel oil, charcoal, dung cakes, firewood, etc. Some of these fuels are traditional fuels like coal, charcoal, dung cakes, crop residues, etc. The efficiency of these fuels is lower than that of other fuels like LPG, electric-

ity, etc. Apart from the efficiency standards, combustion of traditional fuels creates pollution, and they are also termed as *dirty fuels*. Their combustion also leads to several health hazards. Modern fuels like petroleum, LPG, biogas, electricity, etc. are termed as *clean fuels,* which are more efficient than traditional fuels (Adrianjen 2013; Takama et al. 2012).

Forest is often considered as a renewable source of energy (Couture et al. 2012), while firewood is considered as a dirty fuel since it adds to CO_2 emissions upon combustion. In developing countries, a large part of supply of firewood comes from deforestation, which also acts as a threat to environment (Barnes et al. 2010; Davis 1998; Gebreegziabher et al. 2012; Hosier and Dowd 1987; Couture et al. 2012; Arnold et al. 2006; Brouwer and Falcao 2004; Campbell et al. 2003; Kebede et al. 2010; Leach 1992). Developing economies are ushered into a world of uncertainty with unsustainable development. How do we ensure sustainable development? Obviously, fuel choice of households and their actual consumption decision are important research issues for achieving sustainable development goals (SDG) within 2030 (Jingchao and Kotani 2012; Hanna and Oliva 2015; Jumbe and Angelsen 2011). Household's fuel choice and amount of fuel consumption decision may certainly help to control the risk of uncertainty associated with climate change, which could be a potential threat to sustainable development in emerging economy like India (Gupta and Kohlin 2006; Gundimeda and Kohlin 2008; Pachauri and Jiang 2008). In this context, we have to study the recent fuel consumption pattern in India at the household level that might help to reformulate and redesign fuel consumption and subsidy policy focusing on targeted SDGs. To make effective energy policy design for achieving SDGs, we have to study the fuel consumption pattern and its distribution. Household fuel choice and consumption decision in any economy is an important aspect of study, which has recently adopted a new approach for sustainable consumption in the sustainable development goals (SDGs).

12.3.2 Data

The data used for this study are secondary data, which are collected and published by National Sample Survey Office (NSSO). The NSSO conducts nationwide sample surveys relating to various socio-economic topics to collect data for planning and formulation of policies (Gundimeda and Kohlin 2008). The NSSO 68th round Socio-Economic Survey data, which were collected during the period July 2011–June 2012, are used in the current study. These data were published in September 2015. From the data, it is observed that in India, individuals are faced with ten major alternatives for cooking purposes, namely coke or coal, firewood, LPG, gobar gas, dung cakes, charcoal, kerosene, electricity, others and no cooking arrangements.

12.3.3 Preliminary Results

Using Stata software, we have performed a tabulation, which reflects that out of these ten types of cooking fuel, rural households tend to prefer firewood as the most preferred fuel and urban households are inclined more towards LPG (i.e. LPG is the most preferred fuel urban India). Table 12.2 shows that firewood (62.68%) is the most preferred fuel of rural India, while LPG (68.9%) is the most preferred fuel in urban India. Since fire-

wood is a dirty fuel, its consumption should not be encouraged for cooking purposes.

Firewood consumed in rural India comes from various sources. Table 12.3 describes the distribution of sources of firewood in rural India. From Table 12.3, it is clear that the main source of firewood in rural India is free collection (34.32%) followed by purchase (30.05%) and home-grown (27.54%).

This study is mainly focused on fuel selection and their consumption in India. For in-depth analysis, we also examine it in rural and urban India. We consider a brief overview about the nature of the data. From the data, it is observed that in India, individuals are faced with ten major alternative sources of fuels for their energy consumption purposes, namely coke or coal, firewood, LPG, Gobar gas, dung cakes, charcoal, kerosene, electricity, others and no cooking arrangements.

12.3.4 Analysis

Our preliminary analysis begins with state-wise choice of major fuels in India and attempts to identify fuel choice preferences of each state. We have performed a state-wise tabulation of the major fuels consumed in India (Table 12.4). Table 12.4 describes the state-wise distributional pattern of household fuel consumption in India.

Table 12.2 Distribution of households as per sources of cooking fuels in India

Cooking code	Rural			Urban		
	Freq.	Percentage	Cum.	Freq.	Percentage	Cum.
Coke, coal	657	1.1	1.1	914	2.18	2.18
Firewood and chips	37,410	**62.68**	63.78	7483	17.83	20.01
LPG	14,562	24.4	88.18	28,912	**68.9**	88.91
Gobar gas	141	0.24	88.42	6	0.01	88.93
Dung cake	4203	7.04	95.46	520	1.24	90.17
Charcoal	25	0.04	95.5	115	0.27	90.44
Kerosene	619	1.04	96.54	1907	4.54	94.99
Electricity	77	0.13	96.67	245	0.58	95.57
Others	1669	2.8	99.46	313	0.75	96.32
No cooking arrangement	320	0.54	100	1546	3.68	100
Total	59,683	100		41,961	100	

Source: *NSSO 68th Round*

Table 12.3 Distribution of sources of firewood in rural India

Sources of firewood	Frequency	Percentage
Only purchase	14,562	30.05
Only home-grown stock	13,347	27.54
Both purchase and home-grown stock	1580	3.26
Only free collection	16,631	34.32
Only exchange of goods and services	93	0.19
Only gifts/charities	89	0.18
Others	2160	4.46
Total	48,462	100

Source: *NSSO 68th Round*

From Table 12.4, we observe the consumption of each fuel in each of the 35 states of India. The row totals reflect the total fuel consumption of each state while the column totals reflects the total consumption of each fuel in India. Along the rows, we observe the share of each fuel in the total fuel consumption of the particular state, while along the columns, we observe the share of each state in the total consumption of a particular fuel in India.

It is observed from Table 12.4 that 49.05% of the total fuel consumption of Jammu & Kashmir comes from LPG, which is followed by firewood, comprising of 42.76% of total fuel consumption of the state. Other important fuels are kerosene consumed by 3.63% of people and electricity by 2.66% of people. It is quite clear from Table 12.4 that LPG and firewood are the two main fuels consumed in Jammu & Kashmir. However, LPG consumption of this state consists of only 3.82% of total LPG consumption of India and firewood consumption is 3.22% of total consumption of India. *But the share of electricity consumption of this state in total electricity consumption of India is highest* **i.e.** *27.95%*.

The results show that 59.61% of people of Himachal Pradesh consume firewood and 36.27% consume LPG. Among the other fuels, 1.86% of people consume kerosene, 1.42% of people have no cooking arrangements and 0.44% of people of the state consume electricity. It is also observed that though firewood and LPG are the prime sources of fuel for this state, they contribute a share of only 2.71% and 1.7% of total India's

consumption. The most important fuel is LPG consumed by 57.83% of the people of Punjab and followed by firewood, which is consumed by 18.58% of the people and dung cake consumed by 15.92% of the people. However, the share of these fuels in total India's consumption is 1.29% for firewood, 4.15% for LPG and 10.5% for dung cake. In Chandigarh, the most important fuel is LPG consumed by 71.15% of people followed by *kerosene consumed by 16.03%* of people and firewood consumed by 5.77% of people of the state. Though LPG is consumed by most people of the state, the total consumption of LPG comprises 0.51% of total LPG consumption of India. In Haryana, the most important fuel is LPG consumed by 51.87% of people of the state, followed by firewood consumed by 27.81% of the people and *dung cake* consumed by 16.03% of people. But the share of Haryana in total LPG consumption is 3.09%, share in firewood consumption is 1.6% and dung cake consumption is 8.79% of total India's consumption. In Delhi, 81.38% people consume LPG, 2.65% people consume firewood, 1.69% people consume kerosene and *9.21% have no cooking arrangements*. Also, the LPG consumption of people of Delhi comprises only 1.77% of total LPG consumption of India. 62.02% people of Rajasthan consume firewood and 34.71% of people consume LPG. Firewood consumption of the people of Rajasthan comprises 5.71% of total firewood consumption of India. 50.67% of Uttaranchal people consume LPG followed by 45.57% people consuming firewood, which are the two most important fuels consumed in the state followed by kerosene and dung cake. However, the share of LPG is 2.08% and firewood is 1.81% in total LPG and firewood consumption of India. In Uttar Pradesh, 43.8% of people consume firewood, 27.48% of people consume LPG and *24.75% of people consume dung cakes*, which are the three major sources of fuel for the state. But the consumption of this fuel comprises a share of 8.79% for firewood, 5.7% for LPG and 47.24% for *dung cakes* out of the total consumption of these fuels in India. Of these, the share of firewood and dung cakes in total India's consumption is highest. 44.09% people of Bihar consume firewood, 25.33% of peo-

Table 12.4 State-wise consumption of different fuels in India

State	Coke, coal	Firewood	LPG	Gobar gas	Dung cake	Charcoal	Kerosene	Electricity	Others	No cooking arrangements	Total
Jammu & Kashmir	1	1447	1660	0	34	7	123	90	2	20	3384
	0.03	42.76	49.05	0	1	0.21	3.63	2.66	0.06	0.59	100
	0.06	3.22	3.82	0	0.72	5	4.87	27.95	0.1	1.07	3.33
Himachal Pradesh	1	1216	740	0	5	2	38	9	0	29	2040
	0.05	59.61	36.27	0	0.25	0.1	1.86	0.44	0	1.42	100
	0.06	2.71	1.7	0	0.11	1.43	1.5	2.8	0	1.55	2.01
Punjab	1	579	1802	22	496	0	130	10	48	28	3116
	0.03	18.58	57.83	0.71	15.9	0	4.17	0.32	1.54	0.9	100
	0.06	1.29	4.15	14.97	10.5	0	5.15	3.11	2.42	1.5	3.07
Chandigarh	0	18	222	0	4	0	50	0	0	18	312
	0	5.77	71.15	0	1.28	0	16.03	0	0	5.77	100
	0	0.04	0.51	0	0.08	0	1.98	0	0	0.96	0.31
Uttaranchal	1	812	903	2	5	0	37	0	0	22	1782
	0.06	45.57	50.67	0.11	0.28	0	2.08	0	0	1.23	100
	0.06	1.81	2.08	1.36	0.11	0	1.46	0	0	1.18	1.75
Haryana	0	720	1343	0	415	2	23	4	65	17	2589
	0	27.81	51.87	0	16	0.08	0.89	0.15	2.51	0.66	100
	0	1.6	3.09	0	8.79	1.43	0.91	1.24	3.28	0.91	2.55
Delhi	1	25	769	0	0	1	16	3	43	87	945
	0.11	2.65	81.38	0	0	0.11	1.69	0.32	4.55	9.21	100
	0.06	0.06	1.77	0	0	0.71	0.63	0.93	2.17	4.66	0.93
Rajasthan	5	2562	1434	0	24	1	48	3	4	50	4131
	0.12	62.02	34.71	0	0.58	0.02	1.16	0.07	0.1	1.21	100
	0.32	5.71	3.3	0	0.51	0.71	1.9	0.93	0.2	2.68	4.06
Uttar Pradesh	36	3948	2477	0	2231	3	56	14	196	53	9014
	0.4	43.8	27.48	0	24.8	0.03	0.62	0.16	2.17	0.59	100
	2.29	8.79	5.7	0	47.2	2.14	2.22	4.35	9.89	2.84	8.87
Bihar	75	2019	1160	0	836	2	22	3	445	17	4579
	1.64	44.09	25.33	0	18.3	0.04	0.48	0.07	9.72	0.37	100
	4.77	4.5	2.67	0	17.7	1.43	0.87	0.93	22.45	0.91	4.5
Sikkim	1	167	554	1	0	0	11	0	0	34	768
	0.13	21.74	72.14	0.13	0	0	1.43	0	0	4.43	100
	0.06	0.37	1.27	0.68	0	0	0.44	0	0	1.82	0.76

State											
Arunachal Pradesh	3	800	826	0	1	0	21	17	1	5	1674
	0.18	47.79	49.34	0	0.06	0	1.25	1.02	0.06	0.3	100
	0.19	1.78	1.9	0	0.02	0	0.83	5.28	0.05	0.27	1.65
Nagaland	0	300	723	0	0	0	1	0	0	0	1024
	0	29.3	70.61	0	0	0	0.1	0	0	0	100
	0	0.67	1.66	0	0	0	0.04	0	0	0	1.01
Manipur	3	1115	1353	0	2	71	7	3	0	6	2560
	0.12	43.55	52.85	0	0.08	2.77	0.27	0.12	0	0.23	100
	0.19	2.48	3.11	0	0.04	50.71	0.28	0.93	0	0.32	2.52
Mizoram	1	324	1197	0	0	1	12	1	0	0	1536
	0.07	21.09	77.93	0	0	0.07	0.78	0.07	0	0	100
	0.06	0.72	2.75	0	0	0.71	0.48	0.31	0	0	1.51
Tripura	0	1360	459	1	0	0	26	0	0	10	1856
	0	73.28	24.73	0.05	0	0	1.4	0	0	0.54	100
	0	3.03	1.06	0.68	0	0	1.03	0	0	0.54	1.83
Meghalaya	0	850	309	0	2	16	30	39	0	14	1260
	0	67.46	24.52	0	0.16	1.27	2.38	3.1	0	1.11	100
	0	1.89	0.71	0	0.04	11.43	1.19	12.11	0	0.75	1.24
Assam	3	1994	1345	7	3	1	38	0	10	38	3439
	0.09	57.98	39.11	0.2	0.09	0.03	1.1	0	0.29	1.1	100
	0.19	4.44	3.09	4.76	0.06	0.71	1.5	0	0.5	2.04	3.38
West Bengal	656	2494	2055	3	201	0	217	4	534	148	6312
	10.39	39.51	32.56	0.05	3.18	0	3.44	0.06	8.46	2.34	100
	41.76	5.56	4.73	2.04	4.26	0	8.59	1.24	26.94	7.93	6.21
Jharkhand	596	1404	591	0	57	1	17	6	1	64	2737
	21.78	51.3	21.59	0	2.08	0.04	0.62	0.22	0.04	2.34	100
	37.94	3.13	1.36	0	1.21	0.71	0.67	1.86	0.05	3.43	2.69
Orissa	59	2914	672	6	51	17	48	25	154	80	4026
	1.47	72.38	16.69	0.15	1.27	0.42	1.19	0.62	3.83	1.99	100
	3.76	6.49	1.55	4.08	1.08	12.14	1.9	7.76	7.77	4.29	3.96

(continued)

Table 12.4 (continued)

State	Coke, coal	Firewood	LPG	Gobar gas	Dung cake	Charcoal	Kerosene	Electricity	Others	No cooking arrangements	Total
Chhattisgarh	67	1553	412	5	47	2	34	12	5	37	2174
	3.08	71.44	18.95	0.23	2.16	0.09	1.56	0.55	0.23	1.7	100
	4.26	3.46	0.95	3.4	1	1.43	1.35	3.73	0.25	1.98	2.14
Madhya Pradesh	28	2726	1537	21	281	0	76	5	1	40	4715
	0.59	57.82	32.6	0.45	5.96	0	1.61	0.11	0.02	0.85	100
	1.78	6.07	3.54	14.29	5.95	0	3.01	1.55	0.05	2.14	4.64
Gujarat	7	1493	1529	10	17	0	218	2	94	59	3429
	0.2	43.54	44.59	0.29	0.5	0	6.36	0.06	2.74	1.72	100
	0.45	3.33	3.52	6.8	0.36	0	8.63	0.62	4.74	3.16	3.37
Daman & Diu	0	26	79	0	0	0	18	0	0	5	128
	0	20.31	61.72	0	0	0	14.06	0	0	3.91	100
	0	0.06	0.18	0	0	0	0.71	0	0	0.27	0.13
D&N Haveli	0	79	88	0	0	0	17	0	0	6	190
	0	41.58	46.32	0	0	0	8.95	0	0	3.16	100
	0	0.18	0.2	0	0	0	0.67	0	0	0.32	0.19
Maharashtra	11	2535	4467	26	7	4	384	7	374	229	8044
	0.14	31.51	55.53	0.32	0.09	0.05	4.77	0.09	4.65	2.85	100
	0.7	5.65	10.28	17.69	0.15	2.86	15.2	2.17	18.87	12.27	7.91
Andhra Pradesh	12	2735	3833	6	3	9	108	20	2	168	6896
	0.17	39.66	55.58	0.09	0.04	0.13	1.57	0.29	0.03	2.44	100
	0.76	6.09	8.82	4.08	0.06	6.43	4.28	6.21	0.1	9	6.78
Karnataka	0	1983	1763	21	0	0	169	15	0	145	4096
	0	48.41	43.04	0.51	0	0	4.13	0.37	0	3.54	100
	0	4.42	4.06	14.29	0	0	6.69	4.66	0	7.77	4.03
Goa	0	36	382	2	0	0	22	0	0	5	447
	0	8.05	85.46	0.45	0	0	4.92	0	0	1.12	100
	0	0.08	0.88	1.36	0	0	0.87	0	0	0.27	0.44
Lakshadweep	0	89	56	0	0	0	22	14	0	10	191
	0	46.6	29.32	0	0	0	11.52	7.33	0	5.24	100
	0	0.2	0.13	0	0	0	0.87	4.35	0	0.54	0.19

Region											
Kerala	3	2274	2025	14	0	0	16	9	2	119	4462
	0.07	50.96	45.38	0.31	0	0	0.36	0.2	0.04	2.67	100
	0.19	5.07	4.66	9.52	0	0	0.63	2.8	0.1	6.38	4.39
Tamil Nadu	0	2098	3962	0	0	0	343	6	0	237	6646
	0	31.57	59.61	0	0	0	5.16	0.09	0	3.57	100
	0	4.67	9.11	0	0	0	13.58	1.86	0	12.7	6.54
Pondicherry	0	83	426	0	1	0	18	0	0	48	576
	0	14.41	73.96	0	0.17	0	3.13	0	0	8.33	100
	0	0.18	0.98	0	0.02	0	0.71	0	0	2.57	0.57
A&N Islands	0	115	321	0	0	0	110	1	1	18	566
	0	20.32	56.71	0	0	0	19.43	0.18	0.18	3.18	100
	0	0.26	0.74	0	0	0	4.35	0.31	0.05	0.96	0.56
Total	1571	44,893	43,474	147	4723	140	2526	322	1982	1866	1,01,644
	1.55	44.17	42.77	0.14	4.65	0.14	2.49	0.32	1.95	1.84	100
	100	100	100	100	100	100	100	100	100	100	100

Source: Author's calculation

ple consume LPG and *18.26% of people consume dung cakes*. But the share of firewood is 4.5%, LPG is 2.67% and that of dung cake is 17.7% out of total India's consumption of these fuels.

In Sikkim, 72.14% of people consume LPG and 21.74% of people consume firewood. The share of these fuels in total consumption of the fuels in India is given by 1.27% and 0.37% respectively. 49.34% of people of Arunachal Pradesh consume LPG and 47.79% of people consume firewood. The share of LPG and firewood in the total consumption of LPG and firewood in India is 1.9% and 1.78%, respectively. In Nagaland, 70.61% of people consume LPG and 29.3% of people consume firewood and their respective shares in India's total consumption of LPG and firewood are 1.66% and 0.67%, respectively. 52.85% of Manipuri people consume LPG and 43.55% of people consume firewood and their respective shares in India's total consumption of LPG and firewood are 3.11% and 2.48%. In Mizoram, 77.93% of people consume LPG and 21.09% of people consume firewood, while their respective shares in India's total consumption of LPG and firewood are 2.75% and 0.72%. 73.28% of people of Tripura consume firewood and 24.73% of people consume LPG and their respective share in India's total consumption of firewood and LPG is 3.03% and 1.06%. In Meghalaya, 67.46% of people consume firewood and 24.52% of people consume LPG and their respective share in India's total consumption of firewood and LPG is 1.89% and 0.71%. In Assam, 57.98% of people consume firewood and 39.11% of people consume LPG and their respective share in India's total consumption of firewood and LPG is 4.44% and 3.09%, respectively.

In West Bengal, 39.51% of people consume firewood, 32.56% of people consume LPG and *10.39% of people consume coke or coal* as their major source of fuel. The respective shares in India's total consumption of these fuels are 5.56%, 4.73% and 41.76%. Among these, the share of coke or coal consumption of West Bengal has the highest share in India's total coke or coal consumption. 51.3% of people of Jharkhand consume firewood, 21.59% of people consume LPG and *21.78% of people consume coke or coal* as

their major source of fuel. The respective shares in India's total consumption of these fuels are 3.13%, 1.36% and 37.94%.

72.38% of people of Orissa consume firewood, 16.69% people consume LPG and their respective shares in total India's consumption of firewood and LPG are 6.49% and 1.55%. In Chhattisgarh, 71.44% of people consume firewood, 18.95% of people consume LPG and their respective shares in total India's consumption of firewood and LPG are 3.46% and 0.95%. In Madhya Pradesh, 57.82% of people consume firewood, 32.6% of people consume LPG and their respective shares in total India's consumption of firewood and LPG are 6.07% and 3.54%, whereas in Gujarat, 44.59% of people consume LPG, 43.54% people consume firewood and their respective shares in total India's consumption of LPG and firewood are 3.52% and 3.33%. In Maharashtra, 55.53% of people consume LPG, 31.51% of people consume firewood, 4.77% of people consume kerosene and their respective share in total India's consumption of LPG, firewood and kerosene is 10.28%, 5.65% and 15.2%. Among these, the share of LPG and Kerosene is highest in India's total consumption of LPG and kerosene. 55.58% of people of Andhra Pradesh consume LPG, 39.61% of people consume firewood and their shares in India's total consumption of LPG and firewood are 8.82% and 6.09%, respectively. 48.41% of people of Karnataka consume firewood, 43.04% of people consume LPG, which are the two major fuels consumed in the state. But the share of Karnataka in total firewood and LPG consumption of India is 4.42% and 4.06%. In Goa, 85.46% of people consume LPG and 8.05% of people consume firewood, but their share in India's total consumption of LPG and firewood is 0.88% and 0.08% respectively. 61.72% of people of Daman & Diu consume LPG, 20.31% of people consume firewood, 14.06% of people consume kerosene and their respective shares in total India's consumption of LPG and firewood and kerosene are 0.18%, 0.06% and 0.71%. In Dadra & Nagar Haveli, 46.32% of people consume LPG, 41.58% of people consume firewood, 8.95% of people consume kerosene and their respective shares in total

India's consumption of LPG, firewood and kerosene are 0.2%, 0.18% and 0.67%. In Lakshadweep, 46.6% of people consume firewood and 29.32% of people consume LPG, but their share in India's total consumption of firewood and LPG is 0.2% and 0.13%, respectively. In Kerala, 50.96% of people consume firewood and 45.38% of people consume LPG, but their respective share in India's total consumption of firewood and LPG is 5.07% and 4.66%. In Tamil Nadu, 59.61% people consume LPG and 31.57% people consume firewood, but their shares in India's total LPG and firewood consumption is 9.11% and 4.67%, respectively. 73.96% of Pondicherry people consume LPG and 14.41% of people consume firewood, but their shares in India's total consumption of LPG and firewood is 0.98% and 0.18%, respectively. In Andaman & Nicobar Islands, 56.71% of people consume LPG and 20.32% of people consume firewood, but their shares in India's total consumption of LPG and firewood are 0.74% and 0.26%, respectively.

Table 12.4 suggests that the state having highest share of LPG consumption in India is Maharashtra (10.28%) followed by Tamil Nadu (9.11%) and Andhra Pradesh (8.82%). It is seen that Uttar Pradesh has the highest share (8.79%) followed by Orissa (6.49%) and Andhra Pradesh (6.09%) in India's total consumption of firewood. West Bengal (41.76%) has the highest share in India's coke or coal consumption followed by Jharkhand (37.94%) and Bihar (4.77%). Maharashtra (17.69%), Punjab (14.97%) and Karnataka (14.29%) have the highest shares in India's gobar gas consumption and Uttar Pradesh (47.24%), Bihar (17.7%) and Punjab (10.5%) in India's total dung cake consumption. Manipur, Orissa and Meghalaya lead in charcoal consumption and Maharashtra, Tamil Nadu and Gujarat lead in kerosene consumption. It is also observed that Jammu & Kashmir, Meghalaya and Orissa have the highest share in India's electricity consumption.

From Table 12.4, we have also analysed the fuel preference patterns of each state of India. We have ranked the fuel preferences in terms of most preferred fuel, second most preferred fuel and third most favoured fuel. From this analysis of most preferred fuels in Table 12.4, it is observed that LPG and firewood are the most favoured fuels in almost all states of India. It is also observed that 20 states (14 states and 6 union territories) consider LPG as the most preferred fuel and 15 states (14 states and 1 union territory) consider firewood as the most preferred fuel. The results are displayed using a Bar diagram. Figure 12.1 shows the most preferred fuels in India.

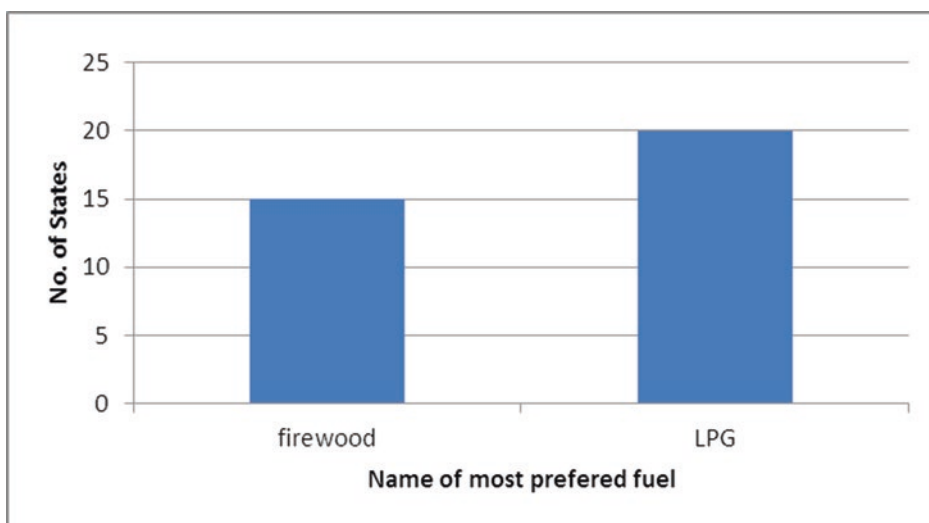It is also reflected from Table 12.4 that firewood is the second most preferred fuel of 18

Fig. 12.1 Most preferred fuels in India

major states of India; LPG is the second most preferred fuel for 14 major states of India (see Fig. 12.2). It should be noted that coke and coal, Kerosene and no cooking arrangement also turned to be the second most preferred fuel for one major state of India for each fuels.

Table 12.4 also shows the third most preferred fuel of different states of India. The results are reflected from Fig. 12.3, which shows that kerosene is the third most preferred fuel of 16 major states of India followed by dung cake and no

cooking arrangements in 5 major states and remaining fuels in the others states.

Now, this part of the study is mainly focused on fuel selection and their consumption in rural and urban India. Similar way, we also observe the consumption pattern of different fuels in rural as well as in urban India; however, the results are different.

Considering the fuel consumption pattern in rural India, it is observed that firewood is the most preferred fuel in 25 (23 states and 2 union
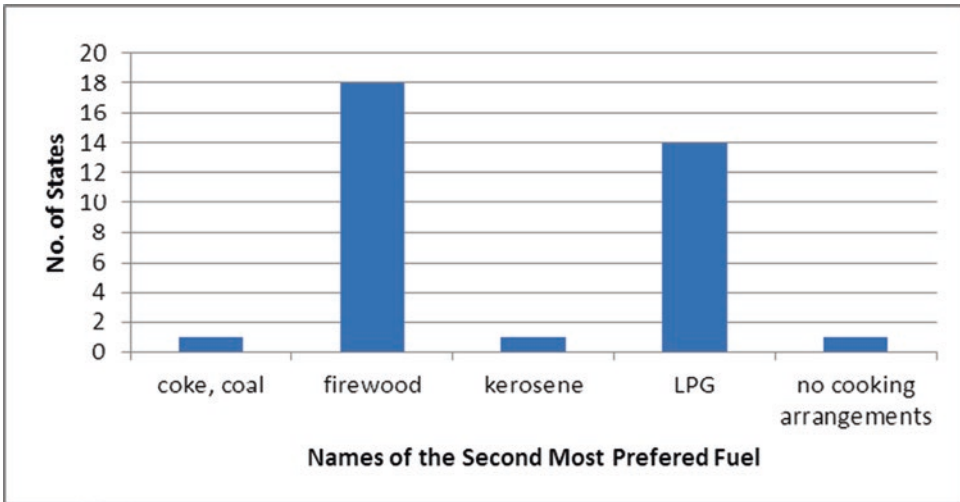
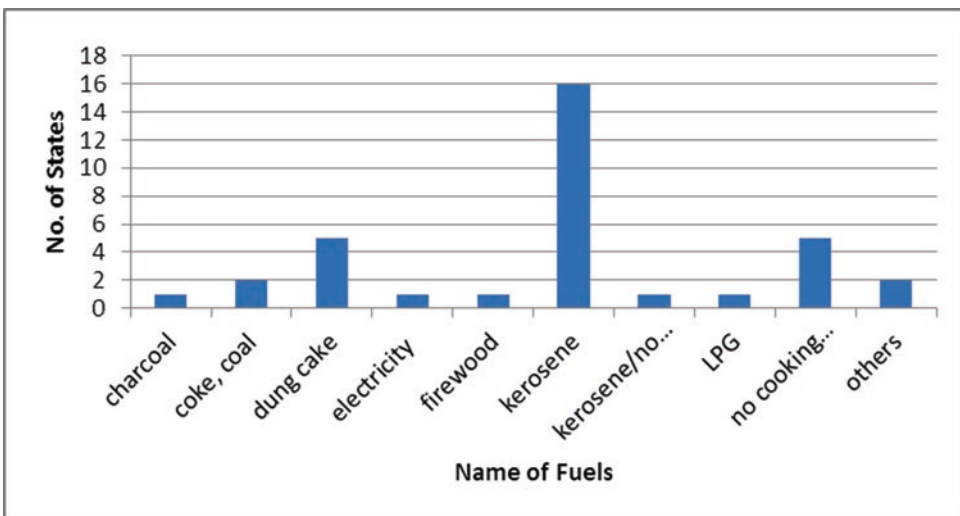**Fig. 12.2** Second most preferred fuels in India

Fig. 12.3 Third most preferred fuels in India

territories) states, while LPG is the most preferred fuel in 10 states (5 states and 5 union territories). However, considering the fuel consumption pattern in urban India, it is noted that LPG is the most preferred fuel in all states and union territories while firewood is the most preferred fuel in no state. These results are reflected in Fig. 12.4.

So, clean fuel LPG is the most preferred fuel in urban India, while dirty fuel like firewood dominates in rural India. Hence, it can be inferred that firewood is the most preferred fuel of rural India and LPG in urban India among available sources. It is also observed that Uttar Pradesh, Orissa and Andhra Pradesh have the highest shares in firewood consumption in rural India. Shares of each state in rural India's firewood consumption are represented in Table 12.5.

Table 12.5 reflects that Uttar Pradesh has the highest share in rural India's firewood consumption followed by Orissa and Andhra Pradesh. The results are reflected using Fig. 12.5:

The top 18 states out of 35 (28 states and 7 territories) which have the highest shares in rural India's total firewood consumption are considered high firewood-consuming states in India and the remaining are considered as low firewood-consuming states in our preliminary analysis. Comparing the poor and non-poor states with high firewood and low firewood-consuming states, we make a comparative analysis of state-wise fuel consumption patterns in rural India. The results are represented in Table 12.6.

Table 12.6 reflects that red-coloured states are rural poor states i.e. those lying below the national average MPCE of rural India, whereas yellow-coloured states are rural rich states i.e. those lying above the national average MPCE. Comparing these results, we can say that mostly rural rich states consume less firewood, whereas rural poor states consume more firewood. Hence, Government of India should design policy for improving their capabilities and adopt it through proper trainings. From our analysis, this study suggests to reduce fuel consumption-related subsidies in urban area. To achieve sustainable consumption and production pattern, material consumption should be reduced drastically following circular economy model. In this context, we tangentially touch the material consumption scenario.
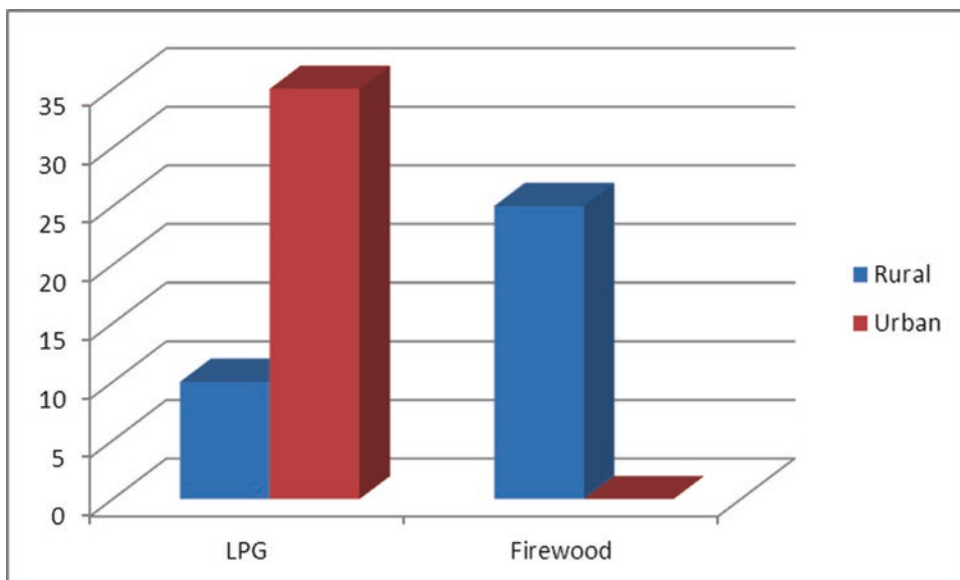

Fig. 12.4   State-wise most preferred fuel of rural and urban India in 2011–2012

Table 12.5 Shares of firewood consumption in rural area across of states in India

| State	Firewood	State	Firewood	State	Firewood
Uttar Pradesh	8.43	Jammu & Kashmir	3.46	Mizoram	0.75
Orissa	6.67	Jharkhand	3.45	Nagaland	0.59
Andhra Pradesh	6.16	Chhattisgarh	3.45	Sikkim	0.44
Rajasthan	5.93	Gujarat	3.33	A&N Islands	0.29
Maharashtra	5.81	Himachal Pradesh	3.14	D&N Haveli	0.2
Madhya Pradesh	5.8	Tripura	3.09	Lakshadweep	0.14
West Bengal	5.74	Manipur	2.12	Pondicherry	0.08
Assam	4.93	Meghalaya	2.03	Goa	0.07
Bihar	4.49	Uttaranchal	1.96	Daman & Diu	0.05
Tamil Nadu	4.33	Arunachal Pradesh	1.94	Delhi	0.01
Kerala	4.16	Haryana	1.68	Chandigarh	0
Karnataka	4.1	Punjab	1.21		

Source: Author's calculation
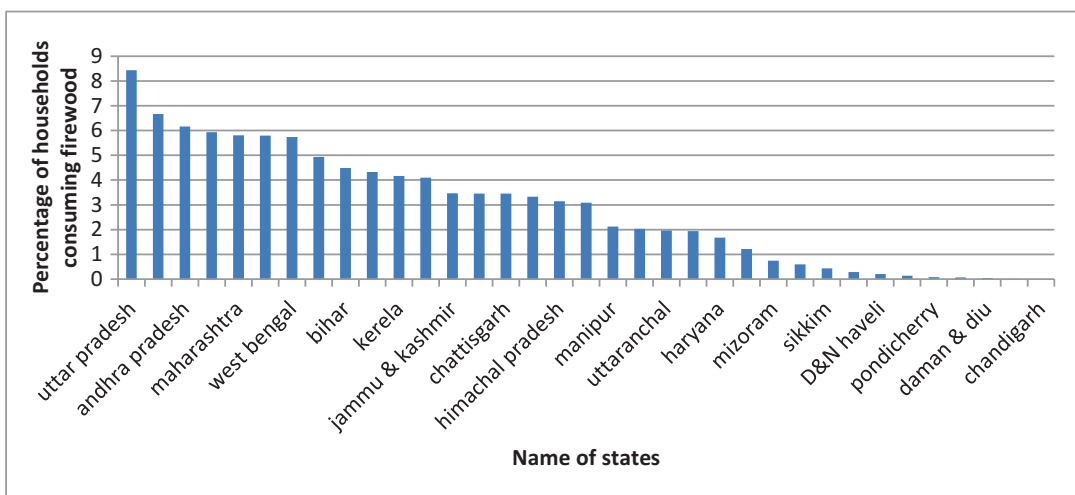
Fig. 12.5 State-wise share in rural India's firewood consumption

12.4 Material Consumption Footprint in India

From the global material consumption data, we extract relevant data of India for the period 2000–2010. Using these data, we estimate the trend line of material consumption per capita, material footprint per capita and we generate data for the period 2011–2030. Table 12.7 describes possible trends of material consumption, material footprint and its intensity during 2000–2030.

Considering the period 2000–2010 as the base for material consumption per capita (metric tons) and material footprint per capita (metric tons) in India, we forecast the trends of such consumptions and footprint for the period 2000–2030. Both material consumption per capita metric tons) and material footprint per capita (metric tons) increase over time (Table 12.7). However, material footprint per unit of GDP (Kilograms per US Dollar) or intensity of material footprint decreases during 2000–2030. Intensity of material consumption footprint ensures to achieve the sustainability goal in India. The existing trends of material consumption per capita (metric tons), material footprint per capita (metric tons) and material footprint per unit of GDP (Kilograms

Table 12.6   State-wise fuel consumption patterns in rural India

High firewood-consuming states	Low firewood-consuming states
Uttar Pradesh	Manipur
Orissa	Meghalaya
Andhra Pradesh	Uttaranchal
Rajasthan	Arunachal Pradesh
Maharashtra	Haryana
Madhya Pradesh	Punjab
West Bengal	Mizoram
Assam	Nagaland
Bihar	Sikkim
Tamil Nadu	A&N Islands
Kerala	D&N Haveli
Karnataka	Lakshadweep
Jammu & Kashmir	Pondicherry
Jharkhand	Goa
Chhattisgarh	Daman & Diu
Gujarat	Delhi
Himachal Pradesh	Chandigarh
Tripura	

Source: Author's calculation

per US Dollar) are clearly visible in Fig. 12.6. Table 12.8 describes the growth rate of domestic material consumption footprint in India for the period 1990–2010. Average annual growth rate of domestic material consumption per capita in India is 2.4% and that of domestic material consumption is 4.2%, and fossil fuel per capita growth rate is 5.9%, which are directly associated with India's GDP growth rate per annum over the said period. This raises the question of sustainable consumption in emerging economy like India. We need more focused study on it for identifying factors responsible such high domestic material consumption growth, and policy should guide de-growth material consumption for achieving SDG 12.

12.5   Conclusion

This chapter focuses on sustainable consumption and production in India highlighting sustainable development goals 12 (SDG 12). The chapter presents initially the basic development strategy with focusing targeted goals, and describes the development goals and related

indicators through which one can assess the achievement of goals. SDG 12 ensures sustainable consumption and production pattern and related issues, which are discussed in earlier studies. The next part of the chapter provides India's evidence on energy consumption, highlighting the state-wise distribution of consumption pattern, which may indicate viability of sustainable consumption. Connecting with this lastly, it analyses the trends of domestic material consumption and traces out its footprints. On the basis of this discussion and limited analysis of consumption pattern, we try to identify the shortcomings of SDG 12 and provide some suggestion for incorporating certain indicators for assessing SDG 12 in a better way in future.

Mostly rural poor states of India consume more firewood, while rural rich states reduce firewood consumption. Hence, Government of India should design non-fossil fuel policy for improving the capabilities of rural poor states and adopt it through proper trainings. From our analysis, this study suggests to reduce fuel consumption-related subsidies in urban area. To achieve sustainable consumption and production pattern,

Table 12.7 Possible trends of material footprint in India during 2000–2030

Year	Domestic material consumption per capita (metric tons)	Material footprint per capita (metric tons)	Material footprint per unit of GDP (kilograms per US$)
2000	3.01	2.47	4.39
2001	3.06	2.55	4.37
2002	3.06	2.49	4.19
2003	3.17	2.55	4.02
2004	3.21	2.64	3.9
2005	3.33	2.79	3.83
2006	3.54	2.95	3.76
2007	3.81	3.26	3.83
2008	3.97	3.29	3.78
2009	4.08	3.45	3.7
2010	4.17	3.56	3.51
2011	4.267455	3.628	3.452909
2012	4.396727	3.747818	3.372636
2013	4.526	3.867636	3.292364
2014	4.655273	3.987455	3.212091
2015	4.784545	4.107273	3.131818
2016	4.913818	4.227091	3.051545
2017	5.043091	4.346909	2.971273
2018	5.172364	4.466727	2.891
2019	5.301636	4.586545	2.810727
2020	5.430909	4.706364	2.730455
2021	5.560182	4.826182	2.650182
2022	5.689455	4.946	2.569909
2023	5.818727	5.065818	2.489636
2024	5.948	5.185636	2.409364
2025	6.077273	5.305455	2.329091
2026	6.206545	5.425273	2.248818
2027	6.335818	5.545091	2.168545
2028	6.465091	5.664909	2.088273
2029	6.594364	5.784727	2.008
2030	6.723636	5.904545	1.927727

Note: (1) 12.2.1—Material footprint per capita—EN_MAT_FTPRPC—Metric Tons (metric tons), (2) 12.2.2—Domestic material consumption per capita—EN_MAT_DOMCMPC—Metric Tons (metric tons per capita), (3) 12.2.1—Material footprint per unit of GDP—EN_MAT_FTPRPG—Kilograms (kilograms per US$)
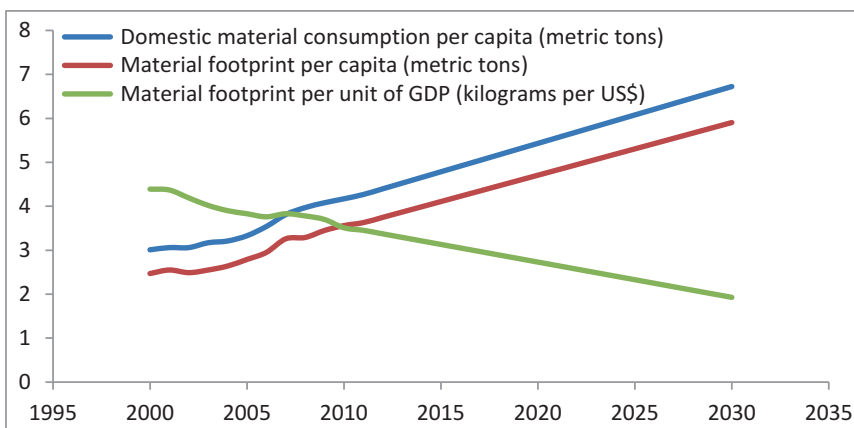

Fig. 12.6 Existing trends of material consumption and its footprint in India

Table 12.8 Growth rate of domestic material consumption in India during 1990–2010

Year	1990	1995	2000	2005	2007	2008	2009	2010	1990–2010
Domestic material consumption	3.3	5.9	0.5	5.3	9.1	5.5	4.2	3.5	4.2
Domestic material consumption per capita	1.2	3.9	−1.3	3.7	7.4	3.9	2.7	2.0	2.4
Domestic material consumption intensity	6.3	5.8	5.2	4.5	4.4	4.5	4.3	4.0	5.3
Fossil fuel per capita growth	10.1	−4.4	−11.5	−36.0	27.5	1.6	−12.0	−25.7	5.9

Source: UNESCAP (downloaded on 29.03.2019)

material consumption should be reduced drastically following circular economy model. Reuse is limited and recycle rate is lacking initiative due to the absence of awareness or feudal mindsets in India. New government may change this mindsets through new initiatives and hopes for better and green India.

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