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400 Million Dreams!

Examining volume and directions of domestic migration in India using novel high frequency data

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Devi Prasad Misra**#**

Abstract

Movement of people is a fundamental economic activity having significant influence on public policy. Typically, studies on migration have relied either on the decennial Census or on irregular Surveys. By the time Census data is published, typically 6-7 years after collection, it is already dated. Moreover, Census data – though comprehensive and granular – captures a stock of migrants rather than dynamic, seasonal trends. This paper seeks to address this gap by harnessing three high frequency and granular datasets – Indian Railway Unreserved Ticketing System (UTS) data on passenger volumes; mobile telephone roaming data from the Telecom Regulatory Authority of India (TRAI); and district level banking data, to provide near-real time insights into migration flows. Our findings indicate that overall domestic migration in India has slowed. Since Census 2011, the number of migrants has reduced by about 11.78%, to ~40 Crore and the migration rate (percentage of migrants in the population) reduced to 28.88%. We hypothesize that this is on account of improved conditions and opportunities at the places of origin. Further, spatial trends in migration appear to be in line with gravity models of migration, with short distance migration accounting for the largest share. We go on to identify popular destinations, major origin districts, and build dyads of popular migration routes.

Keywords: Transportation Economics, Migration, Urban Economics

JEL Codes: J61; O15; R23; R30

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1. Introduction

Migration is amongst the most studied phenomena in the social sciences (Leloup, 1996). As complex as it is dynamic, migration has demographic, economic, sociological, spatial, legal, behavioural, cultural and a myriad other dimensions (Lech, 2020).

Given the relatively easier availability of cross border immigration/emigration figures, coupled with data on international travel and remittances, the study of international migration, legal or otherwise, has received substantial scholastic and research attention.

On the other hand, tracking domestic movement of people can be significantly more difficult (Obeng-Odoom, 2021). In the Indian context, the primary data source that most domestic migration research relies on is the decennial population Census (Chandrasekhar and Sharma, 2022).

Although there are other data sources such as surveys carried out from time to time – for example, the Ministry of Statistics & Programme Implementation (MoSPI) *Migration in India 2020-21 Report* (2022) or the Ministry of Housing and Urban Poverty Alleviation (MoHUPA) *Report of the Working Group On Migration (2017)* – tracking the volume, direction and trends in migration on a regular basis remains a challenge.

The primary reason for this is time lag between data collection, collation, publication, and eventual analysis – by which time the trends may have changed significantly. This paper seeks to address this issue, by making use of novel high-frequency and granular datasets to develop a model to examine the trends in domestic movement of people on a more regular basis.

We also explore related topics such as the impact on urbanization - especially the growth of cities, commuter zones, and popular movement dyads. Further, given that most migration is borne out of a desire for better opportunities and is seen as having an impact in improving incomes (Chetty and Hendren, 2016), we also make an attempt to discern the extent of impact that out-migration has in the places of origin.

This paper also works as a companion piece for our previous work titled "*India on the Move: An examination of the volume and direction of internal trade in India*" which used Goods and Services Tax (GST) data to examine the volume and direction of the flow of goods within the states of India. (Debroy and Misra, 2023).

2. Hitting a moving target: Tracking people on the move!

On account of its coverage, sheer volume, and richness of data, there can hardly be a more comprehensive dataset than the decennial Censuses for tracking population and migration trends. We base our preliminary findings on the last Census i.e. the 2011 Census and the data tables published subsequently (2011).

However, in order to get a more updated insight and to develop a high-frequency indicator of the movement of people, we use a massive dataset (with more than a billion data points): *Unreserved Ticket bookings* sourced from the Indian Railways, Centre for Railway Information Systems (CRIS)[1].

Amongst the many systems that CRIS runs is the *Unreserved Ticketing System (UTS)*. On an average, the system serves over 21 million passengers, issuing over 8 million tickets across 100 variations [concessional, seasonal, etc.] and involving revenue in excess of Rs. 500 Million – every day (CRIS n.d.).

The UTS is the backbone that serves passengers using the *Unreserved* or *General* Tickets – typically the most affordable tickets on the Indian Railways network. We analyse this large and high frequency dataset, which gives interesting insights into the movement of people within the country.

While it is rich and nuanced, the dataset is not without its limitations – for example it has Station-Station dyads and not City-City dyads – therefore we use it with certain caveats. The details of the dataset and the model used to analyse it for migration patterns is discussed in the Section titled, "*Using high frequency railway reservation data to track migration".* The model builds on and extends some of the metrics discussed in the 2016-17 edition of the Economic Survey[2] (2017).

The other major dataset we use is the monthly Telecom Subscriptions Reports, published by the Telecom Regulatory Authority of India (TRAI)[3]. This publicly available dataset contains the number of Active Wireless Subscribers (or Visitor Location Register (VLR) Data) listed according to their respective *telecom circles* (service areas defined by the Department of Telecommunications)[4].

There are 22 *Telecom Circles* in the country, out of which, the cities of Delhi, Mumbai, and Kolkata are each defined as telecom circles. Therefore tracking the Visiting (Roaming) Telecom Subscribers can give a sense of the number of people coming into or '*visiting*' the aforesaid three cities. An analysis of movement of people using telecom data, in the backdrop of the pandemic, was attempted by Nizam, Sivakumar & Irudaya Rajan. (2022)

However, the major drawback in using TRAI/VLR data is that the dataset does not help build dyads i.e. who is travelling from where? Moreover, a home or visiting subscriber is defined with regard to the place where the Subscriber Identity Module (SIM) data is procured. This may not be the place of origin of our putative traveller. However, this dataset does help us understand seasonal trends in movements of people for certain cities. We discuss our methodology and findings in Section titled, "*Using Roaming to track trends in Migration*".

We move on to examine the impact of outward migration on the places of origin. This is done by analysis of publicly available banking data published by the Reserve Bank of India (RBI)[5] and disaggregated at the District level.

Further, we use publicly available Geospatial Datasets, both for visualizing the movement of people as well as for examining the impact of migration. This is an area that is rapidly evolving, with newer

and more innovative applications of high resolution satellite imagery and earth observation data coming out by the day.

In the interest of brevity and in order to maintain our focus on the analysis and interpretation of the data on hand, discussion of the theoretical underpinnings of migration and of previous work in the area has been kept to a minimum. There are however, many excellent resources that comprehensively cover these areas, and also have references to other outstanding academic work on the topic. (Chandrasekhar and Sharma, 2022) and (Farwick, 2009)

3. The questions we ask/the answers we seek

In the study of migration the questions are typically broadly clubbed into four broad groups – who migrates (gender, age, professions); from where and to where do they migrate (between/within cities, from rural to urban); why do they migrate; and what are the economic benefits/ consequences of this migration (for the migrants, the geographies that they migrate to, and the place that they migrate from).

The following frameworks provide a theoretical underpinning of study of the phenomenon of migration:

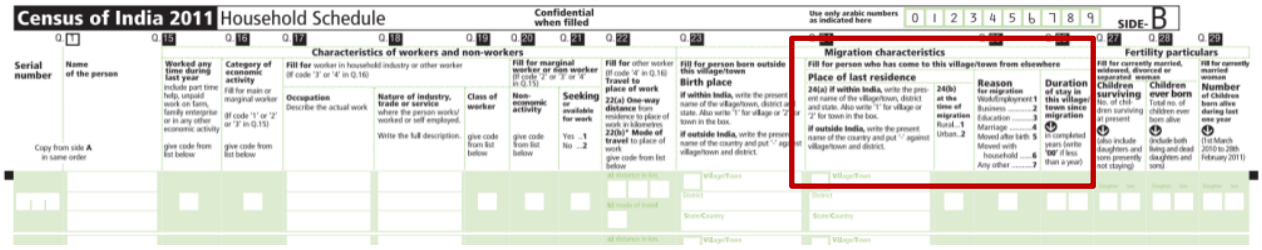
> Ravenstein's *Theory of Human Migration* (1880s that proposed a set of *9 observations*. Among these are that every migration causes a return/counter migration; migrants who move long distances primarily do so for economic reasons; rural residents tend to be more migratory than their urban counterparts; working-age males are more likely to migrate as compared to other demographic subsets (Ravenstein, 1885), and that migration often happens gradually – a process he referred to as *step-migration*.
>
> Sir Arthur Lewis' *Dual Sector model*, or the *Lewis model* (1954), which proposed that over time labour shifts from traditional primary sectors such as agriculture, typically characterized by low productivity, low wages, and labour intensity, to the modern industrial sector, which has higher marginal productivity, better wages and, at least initially, a greater demand for labour (Lewis, 1954).
>
> John R. Harris and Michael Todaro's *Harris–Todaro* model (1970) which holds that migration is based on expected income differentials between rural and urban areas rather than actual wage differentials. This implies that rural-urban migration in a context of high urban unemployment can be economically rational if expected urban income exceeds expected rural income. (Harris and Todaro, 1970)

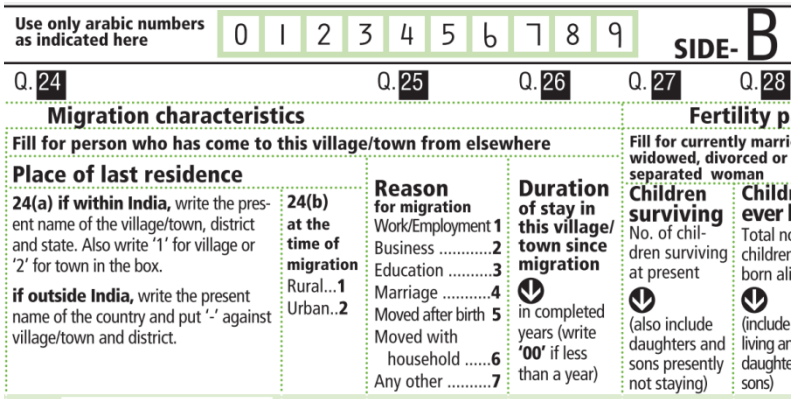
4. Indians on the Move: Where we were in 2011

Before we begin taking a deeper dive into answering the above questions and examining the volume and directions in domestic migration in India, it would be useful to see where we stood at the time of the last decennial Census i.e. in 2011.

Questions that implicitly capture migration status or behaviour have long been a part of the Census Questionnaire. However, at least since 1961, there have also been direct and specific questions on Migration in the Censuses. In the 2011 Census, *Question 24-26* in the *Household Schedule* captured the metrics related to migration (Figure 1).

Fig. 1: 2011 Census Household Schedule [Side B: Questions related to Migration highlighted]





The analysis of the collated Census Data is subsequently published as Census Tables (2011). Details regarding *Migrants by Place of Last Residence, Age, Sex, Reason for Migration and Duration of Residence* is published as Table D5 [*PC11_D05*].

For Census purposes, *Migration* is of two types – by *Birth place* and by place of *last usual place of residence* (*ibid*). When a person is enumerated in the Census at a place other than her/his place of birth, she/he is considered a migrant by *place of birth*. On the other hand, a person is considered to be a migrant by place of last residence, if their last usual place of residence (UPR), at any time in the past, was different from the present place of enumeration (MoSPI, 2022).

Here the *Usual Place of Residence* (UPR) of a person is defined as the place (village/town) where the person has been staying continuously for at least six months. Even if a person was not staying in the village/town continuously for six months but was found to be staying there during the

enumeration with an intention to stay there continuously for six months or more then that place is defined as being his/her UPR. (MoSPI, 2022)

With that in mind, the Census D5 table lists the **total number of migrants** in the country with segregation by **Rural/Urban origin** and **reason for movement**. The same is captured in Table 1.

Table 1: Migration statistics as per Census, 2011

	Persons	Male	Female
Population of India	**1210854977**	**623270258**	**587584719**
Total Migrants	**455787621**	**146145967**	**309641654**
Migrants from Rural Areas	295114410	73522596	221591814
Migrants from Urban Areas	106355920	45962228	60393692
Migration for Work/Employment	41422917	35016700	6406217
Migration for Business	3590487	2683144	907343
Migration for Economic Reasons	45013404	37699844	7313560
Migration for Economic Reasons [moved within last one year]	3364993	2662350	702643
Participation in Labour Force (% of Population)	39.79	53.26	25.51
Total Workforce	481799195	331953739	149892862
% of Migrants in Workforce	**9.34**	**11.36**	**4.88**
% of Total Migrants who have moved within last one year	**7.48**	**7.06**	**9.61**

Population Figures as per Census 2011; Labour Force Participation Rates as per MoSPI Data

From the above we get an idea of the total number of migrants, as well as those migrating on account of economic reasons (i.e., those stating that they are moving for *Work/Employment* or *Business*). As per Census 2011, the total number of persons migrating on account of economic reasons are 4,50,13,404 (*Males* - 3,76,99,844 and *Females* - 73,13,560). The corresponding figures stood at 3.27 Crore as per Census 2001 and 2.6 Crore as per Census 1991. (2017)

Therefore in the period 1991 to 2001 the compounded annual growth rate of the number of migrants was 2.7%. This increased to 3.7% in the period 2001 to 2011. Interestingly, in the period 1991 to 2001, India's workforce grew from 3.17 Crore to 4.02 Crore [an annual average growth of 2.6%], whereas in the period 2001 to 2011, the workforce grew from 4.02 Crore to 4.82 Crore [an annual average growth of 1.99%]. Therefore it is evident that, between 1991 and 2011, the share of migrants in the workforce increased steadily.

Census Data also makes it evident that percentage of migrants in the total workforce increased from 8.15% in 2001 to 9.34% in 2011. We delve deeper into migration figures and take a look at the migration statistics as captured by Census, 2001 (Table 2).

Table 2: Migration statistics as per Census, 2001

	Persons	Male	Female
Population of India	**1,02,70,15,247**	**53,12,77,078**	**49,57,38,169**
Total Migrants	**31,45,41,350**	**9,33,61,809**	**22,11,79,541**
Rural Migrants	22,66,67,548	5,22,46,555	17,44,20,993
Urban Migrants	5,04,74,068	2,15,32,764	2,89,41,304
Migration for Work/Employment	2,99,04,442	2,62,29,666	36,74,776
Migration for Business	28,26,874	23,82,559	4,44,315
Migration for Economic Reasons	3,27,31,316	2,86,12,225	41,19,091
Migration for Economic Reasons [moved within last one year]	22,13,720	16,83,506	5,30,214
Participation in Labour Force (% of Population)	39.10	51.7	25.6
Total Workforce	40,15,62,962	27,46,70,249	12,69,08,971
% of Migrants in Workforce	**8.15**	**10.42**	**3.25**
% of Total Migrants who have moved within last one year	**6.76**	**5.88**	**12.87**

Population Figures as per Census 2001[6]; Labour Force Participation Rates as per MoSPI Data[7]

The above discussion is an indicator of the increasing numbers of people migrating for economic reasons, as well as the increase in the share of migrants in the workforce. A quick look on the directions of the movement, as per Census 2011, is at Appendix A.

We visualize the movement between States using the DS-0000-D02-MDDS India Table from Census, 2011 for the data (Table 3). It may be recalled that using Goods & Services Tax (GST) data we had earlier carried out a similar exercise for the domestic movement of goods in the country (Debroy and Misra, 2023).

Given the width of Table 3, it is split into two parts. RTO Codes are used to denote States. The rows represent the origin states whereas the columns are the destinations. Accordingly, the total at the end of the rows denote the total out-migration from the respective States in the Rows.

Similarly, the totals in the columns are the total in-migrants into the respective States in the columns. As per Census 2011, the total number of migrants [*all reasons; all lengths of stay; all ages*] stood at **45,57,87,621.**

Some important takeaways from Table 3 are:

- Just five states – Uttar Pradesh, Maharashtra, Andhra Pradesh, Bihar and West Bengal together account for about 48% of the total outbound migrants. This includes within-State migrants as well.
- Similarly, just five states – Maharashtra, Uttar Pradesh, Andhra Pradesh, West Bengal and Tamil Nadu together account for about 48% of all incoming migrants. This includes within-State migrants as well.

Table 3: Total Migrations between States – Origins in Rows; Destinations in Columns [Part 1 of 2], Census 2011

	AN	AP	AR	AS	BH	CH	CG	DN	DD	GA	GJ	HR	HP	JK	JH	KN	KL	LD	MP
AN	131118	3049	2	93	38	125	312	6	36	323	332	199	47	51	265	1106	2303	39	182
AP	15681	36625573	383	4732	1760	1528	42362	748	386	5652	46784	10386	1933	2085	8661	890697	19228	47	17375
AR	18	239	483725	19486	395	99	166	10	5	22	233	387	1052	105	185	2300	738	4	305
AS	459	7155	88963	10035507	15221	2166	3888	1484	1622	1502	13030	14088	2134	1906	4940	23651	8469	5	4901
BH	1779	48120	18811	147742	25728400	50703	143216	20848	28202	8334	361010	390937	37600	13200	1336048	86083	9904	12	125836
CH	53	1110	11	258	404	30733	310	29	37	100	1603	71890	11136	611	244	2124	423	1	695
CG	2600	28383	138	1162	2655	1123	7554503	343	336	916	12397	11813	5008	9949	42750	7582	2563	2	167340
DN	1	16	1	20	654	7	14	46921	159	27	10779	20	8	17	16	110	27	119	60
DD	11	51	0	3	23	10	32	1080	21927	287	14501	32	31	6	5	57	38	87	287
GA	212	2209	22	52	213	94	177	117	127	853232	1951	571	111	116	274	22190	2557	6	730
GJ	254	23299	94	1271	4149	2082	13704	30177	23072	3720	22761198	11250	1578	1237	5268	38953	10443	56	88702
HR	278	6220	527	3225	3902	93037	12807	304	159	953	32206	6797636	35750	5987	3729	12511	2228	5	19224
HP	55	1757	305	1827	8883	60254	2567	104	96	403	3761	60586	2184176	8609	1345	6763	743	0	5894
JK	100	6583	369	3831	15594	5997	8321	45	57	761	4883	17700	15565	2618467	1677	9326	4293	6	12100
JH	7612	13024	1308	11139	433696	3023	111325	2205	3386	3583	49576	20853	10645	2210	7430091	21064	3109	1	30272
KN	493	466951	191	991	1923	1514	2752	1000	569	116865	30437	8084	1538	1313	2159	23103518	110833	137	7048
KL	4829	40113	1397	1437	1432	1016	10747	1400	792	8218	44356	8302	775	1485	3905	334181	17053517	4379	22566
LD	21	337	4	423	3249	19	648	68	53	20	55	230	102	264	97	602	2026	14170	794
Last residence outside India	3926	138095	10901	110314	398592	13092	62961	1481	1720	15060	87160	160290	60335	35428	31729	105356	153545	131	90291
MP	648	18444	252	2478	6067	3730	276527	4707	7579	2612	274773	56240	6509	7599	10885	22610	8345	23	21894713
MH	1052	263216	421	2557	13544	4999	117487	25860	14738	71943	971975	30907	5752	4722	9727	586864	47464	563	494312
MN	20	1369	1465	12203	326	623	81	30	12	268	531	601	220	227	372	4897	608	0	566
MG	21	499	1143	40755	370	183	107	0	4	49	585	481	197	139	329	1959	410	1	417
MZ	10	228	298	3157	45	47	30	1	0	23	32	115	77	57	134	468	156	1	265
NL	24	331	1218	23707	797	84	136	4	5	91	313	487	172	97	198	1325	1104	0	278
DL	437	16907	311	3040	23412	20889	9266	612	438	2503	28596	468298	18467	5269	7643	35162	15303	26	28597
OD	1244	185872	1613	5153	6014	1600	242404	4339	4590	4389	176072	16280	3295	2233	126320	64032	12223	23	24038
PY	76	7322	6	27	150	32	33	9	6	59	552	233	14	18	83	3222	21352	4	76
PB	429	6861	395	3617	7994	148481	17217	291	165	797	27549	538328	130851	43938	10387	11819	3402	6	31895
RJ	257	72554	1498	27778	8358	9446	21188	6830	4584	4830	747445	611160	8652	6079	10240	150359	8893	8	500481
SK	13	189	234	1077	368	70	68	0	0	31	122	325	844	109	125	1615	196	0	210
TN	18136	266720	305	1193	1293	3223	4879	559	341	4239	28620	7724	668	1842	3373	736821	311347	380	9099
TR	77	349	855	39906	185	73	237	4	32	33	627	1204	131	173	408	1896	232	2	446
Unclassifiable	30	5086	195	2714	5923	397	2943	4053	423	2709	133853	1216	7052	547	2361	6636	1934	23	5783
UP	3114	49889	6054	35441	319887	179574	168385	28719	27657	20136	929411	1113535	66005	20190	107724	92495	12203	11	1090881
UK	255	2306	450	1194	1144	31164	2509	707	405	658	11938	77179	22740	3180	1396	5177	790	2	12253
WB	20998	50218	6966	94724	227809	6951	53766	2962	4872	5342	89040	75893	5897	10164	494609	67639	30470	121	46207
TOTAL [In-migrants in States in Col.]	**216341**	**38360644**	**630831**	**10644234**	**27244869**	**678188**	**8888075**	**188057**	**148592**	**1140690**	**26898286**	**10585460**	**2647067**	**2809629**	**9659702**	**26463170**	**17863419**	**20401**	**24735119**

Source: Census, 2011; DS-0000-D02-MDDS India Table; PC11_D02: Total Migrants; all reasons; all Durations of Stay; RTO Codes for State Names

Table 3: Total Migrations between States – Origins in Rows; Destinations in Columns [Part 2 of 2], Census 2011

	MH	MN	ML	MZ	NL	DL	OD	PY	PB	RJ	SK	TN	TR	UP	UK	WB	**TOTAL** [Out-migrants from States in Rows]
AN	2043	33	3	2	15	677	246	146	253	195	84	6235	7	423	110	1720	**151818**
AP	437034	71	384	92	407	23436	122491	32330	7789	12193	423	286427	167	16060	3565	16707	**38655577**
AR	790	114	1024	195	900	1404	581	19	405	369	515	481	337	931	1232	2322	**521093**
AS	30614	7720	61022	15056	51397	26233	4732	283	11925	12936	2621	7860	29423	30157	5731	166400	**10695201**
BH	568667	2983	14112	1404	17539	1106629	119231	680	352537	134402	13282	29277	12063	1072739	76116	1103757	**33182203**
CH	3576	11	49	8	42	8328	291	30	149591	1961	36	922	14	6028	2850	869	**296378**
CG	168379	10	62	16	138	12634	129371	28	8403	7266	53	2174	52	56676	3239	8071	**8248135**
DN	3066	1	16	0	11	91	75	0	17	127	4	318	10	375	66	403	**63556**
DD	2067	0	0	0	0	38	11	5	6	72	27	38	0	34	45	22	**40833**
GA	68358	14	19	7	21	1193	400	91	435	555	29	1689	7	929	236	484	**959428**
GJ	983653	40	216	13	103	24153	24420	2102	10436	200767	110	21024	150	25459	5344	14563	**24333060**
HR	48673	110	494	83	442	666331	5206	130	545584	533963	661	5172	116	230740	33899	11259	**9113551**
HP	15721	136	294	34	309	79272	1042	36	214213	11325	431	898	88	21072	24089	2911	**2719999**
JK	25774	218	601	113	375	40146	8277	163	70299	19100	974	7221	328	33008	9268	5846	**2947386**
JH	100285	93	544	1149	1283	69196	167377	123	19950	13183	1267	7581	14203	110358	10768	459436	**9134918**
KN	1399591	182	450	90	540	15386	4829	2978	4470	11697	191	289302	131	10455	2330	5536	**25606474**
KL	214889	118	810	269	1165	60297	4763	21345	5910	16128	227	447701	156	17106	1962	7149	**18344842**
LD	1138	45	1	4	6	123	232	8	600	961	2	81	16	2812	328	311	**29850**
Last residence outside India	324654	2702	7648	15370	6433	177900	73609	5938	277287	164361	18470	270353	222431	355488	82198	2005945	**5491194**
MP	824624	139	405	73	294	134867	12725	253	32869	554058	459	10917	161	668537	13268	15815	**24874205**
MH	47924588	286	635	125	498	63692	14902	2037	32781	73366	277	82197	260	88310	13114	27648	**50992819**
MN	2824	664018	6336	12241	14093	6164	334	36	774	753	732	1595	613	1260	926	2651	**739769**
MG	1842	770	643823	2378	1792	2569	275	23	507	1226	356	567	1309	1125	880	7000	**714091**
MZ	480	1041	2127	330584	386	678	52	1	311	363	53	207	18411	281	286	544	**360949**
NL	1401	1589	1752	541	435046	1921	486	14	569	789	225	558	751	868	729	3170	**480780**
DL	86131	652	2	188	10	676519	8006	802	45310	83134	481	12139	250	566210	52002	15815	**2232827**
OD	114411	87	525	65	1236	41162	14488013	1753	11717	12991	602	22863	303	35269	4224	142179	**15759134**
PY	1568	0	8	3	15	537	149	366400	310	114	2	252312	16	206	69	251	**655234**
PB	73951	102	986	106	470	247966	6832	169	10968355	213308	319	6082	108	142235	45667	18154	**12709232**
RJ	570233	706	1901	104	2480	315238	12203	1267	202166	19240666	675	88474	495	284056	18410	57668	**22997382**
SK	551	288	145	43	145	995	143	22	330	327	167125	231	18	476	612	11537	**188584**
TN	226029	203	343	107	412	45862	6256	270900	5540	9042	156	29351926	407	9458	1748	7932	**31337083**
TR	1577	766	2868	5606	2923	1490	465	33	385	717	92	374	989623	698	501	20497	**1075485**
Unclassifiable	40154	115	168	36	119	40030	5075	96	1675	62157	291	1057	191	33725	1566	8676	**379009**
UP	2754706	853	3098	477	4076	2854297	33063	907	649557	585982	2280	27985	1518	52000937	890663	238819	**64320529**
UK	42968	81	1191	142	751	294704	931	51	55392	23233	359	1040	141	393540	2983115	3599	**3976685**
WB	309766	638	5492	646	3746	182356	164699	1202	46958	67695	33158	28829	5349	234042	26298	29052806	**31458328**
TOTAL [In-migrants in States in Col.]	**57376776**	**686935**	**759554**	**387370**	**549618**	**7224514**	**15421793**	**712401**	**13735616**	**22071482**	**247049**	**31274107**	**1299623**	**56452083**	**4317454**	**33448472**	**455787621**

Source: Census, 2011; DS-0000-D02-MDDS India Table; PC11_D02: Total Migrants; all reasons; all Durations of Stay; RTO Codes for State Names

- With the exception of Assam we see little outward migration from most states of the Northeast. Even when there is outward migration it is typically to neighbouring states.
- Most migrants tend to move close to their origin states. We need to keep in mind that these are total migrants, which would include migration on account of marriage.
- With the exception of Delhi, there is little out-migration from most of the Union Territories.
- Similarly, we see little out-migration from the hill states.
- As per Census 2011, there were a total of 54,91,194 migrants who indicated their last place of residence as being outside of India. Out of these, more than a third were resident in West Bengal. Other states with significant international immigrants were Bihar, Uttar Pradesh, Maharashtra and Punjab.

5. Tracking Indians on the Move

While Censuses are typically conducted once in ten years, migration is a continuous phenomenon. There are a number of reasons why we would like to track migration, on a more regular basis.

As per Census 2011, the percentage of migrants [for economic reasons] in the total workforce stood at a little over 45 Million [9.34% of the total workforce; up from 8.15% from Census, 2001. However, there have been alternative estimates which have placed the number and proportion of migrants in the workforce at a significantly higher level.

For example, a paper titled, "*Migration and Human Development in India*" (Deshingkar and Akter, 2009), used field evidence from employing sectors to synthesize that there were over 100 million migrants. The authors averred that the Census tends to understate the levels of migration since it does not take into account circular migration and therefore intra-year/seasonal movements are not adequately captured.

Further, presently Census Data on the reasons for migration is captured as one of the following:

- Work/Employment
- Business
- Education
- Marriage
- Moved after Birth
- Moved with household

It may be noted that while the reason for the migration may have been on account of *Marriage* or *Moved with household*, however at the destination it is possible that some of these individuals would now be in the workforce. This would be especially true for women, who are often enumerated as having moved on account of marriage.

Economic Survey 2016-17 (Ministry of Finance, 2017), had also discussed this issue, and had gone on to estimate that the workforce is likely to exceed 500 Million by 2016, with about 100 Million [20%] constituting migrants. We would get a clearer picture in the next decennial Census.

Further, an updated sense of the numbers and location of migrants helps in targeting social sector welfare programmes; in planning urban infrastructure as well as understanding the impact of migration in the places of origin. In order to address the issue of more updated numbers, we look towards some novel datasets viz. Railway Reservations Data; Data on Telecom Mobility, Geospatial data and data on banking transactions from the RBI.

Each of these datasets have their own advantages and shortcomings and admittedly they would not be as comprehensive as the decennial Census, however our attempt here is to discern trends in the inter-decennial period and to build on the data captured in the Census.

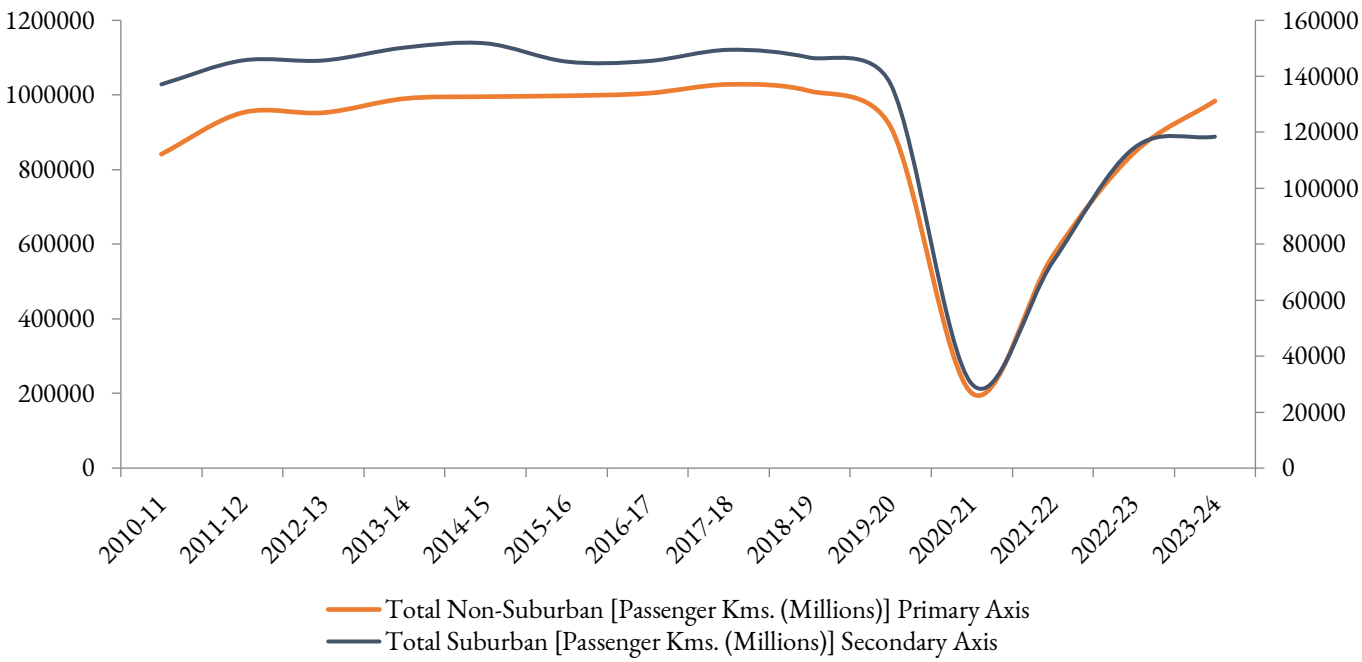
6. You can hear the whistle blow, a hundred miles:

Using high frequency railway reservation data to track migration.

With an estimated passenger volume close to a 1,000 Billion Passenger-Kilometres[8,9] over the last decade, the Indian Railways remains a popular mode of transport for passengers travelling across cities/states, especially those travelling longer distances. The total number of passengers carried by the Railways in 2023-24 stood at 6,843 Million (Ministry of Railways 2024). This includes **3,852 Million Suburban passengers** and **2,991 Million non-Suburban passengers**. Indian Railways defines **suburban services** as those being **up to 150 Kms.** from the origin[10]. In order to maintain uniformity, we continue to use this distance as our basis for further analysis.

We use publicly available data sourced from the Rail Budget and from the Annual Reports (Ministry of Railways, 2024) of the Indian Railways to get a sense of how passenger volumes have moved since the last Census in 2011. The trend in passenger volumes [*in Passenger-Kms.*] since 2011, shown separately for non-suburban passenger volume [*Red Line; primary axis*] and suburban passenger volume [*Blue Line; secondary axis*] is as under [Figure 2].

Fig. 2: Indian Railways Passenger Nos. and Volume (in Passenger Kms. Millions); All Classes; All Gauges



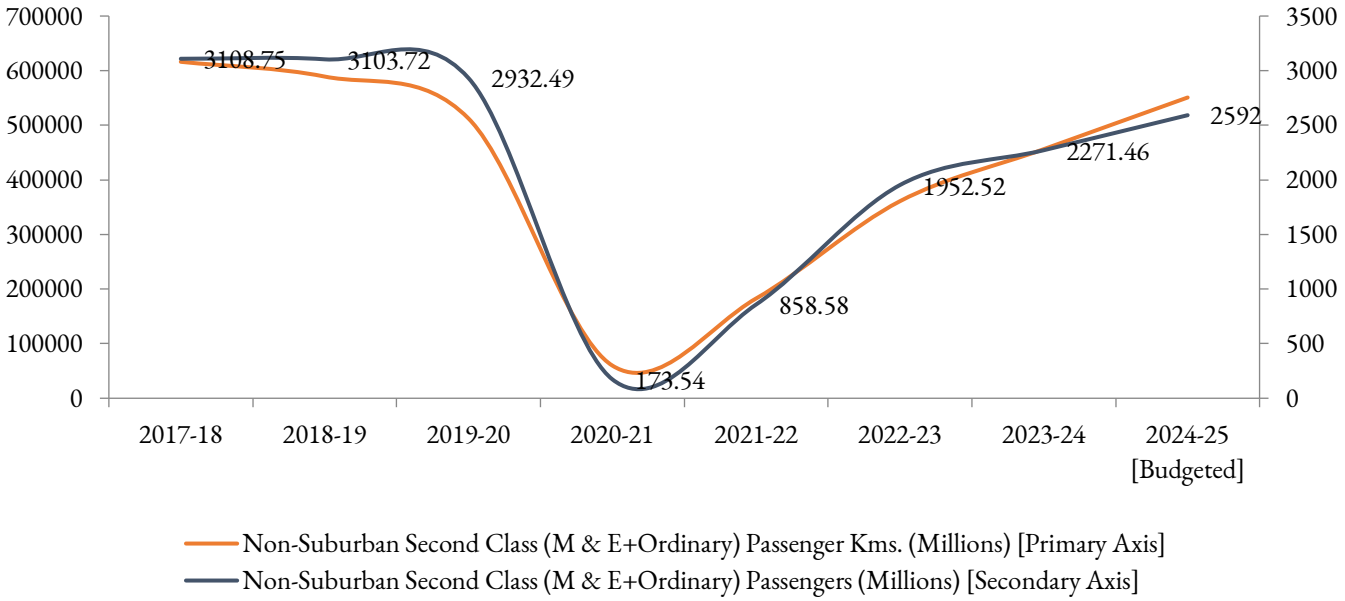
We can see that barring the years 2019-20 and 2020-21 [Covid years], the trend in passenger volume (especially for non-suburban travel) has shown a consistent upward trend, and has since bounced back to near pre-Covid levels.

In the absence of a high frequency, granular dataset to track migration, we propose to track the movement of people on Indian Railways In particular we use data from the Indian Railways (IR) *Unreserved Ticketing System* (UTS), which is used to book unreserved tickets. In particular, we propose to use data for unreserved tickets booked on the Indian Railway (IR) network as a marker of trends in the movement of migrants.

Unreserved Second Class (*Mail & Express/Ordinary*) tickets are the cheapest class of tickets (Ministry of Railways, 2019) on the IR network. Unreserved tickets are required for boarding a train, but typically do not guarantee a seat. We use these tickets as a proxy for blue collar migrants, primarily on account of their price.

We look at the total passenger volumes and numbers for Non-suburban, Second Class (*Mail & Express and Ordinary Trains*) for the period 2017-18 to 2024-25 [Budgeted] (Ministry of Railways, 2017-2025) The results are plotted as under [Figure 3].

Fig. 3: Passenger Numbers and Volumes; II Class (*Mail & Express and Ordinary*) [Non-suburban]



From above, we note that the number of non-suburban, second class passengers has reduced from 3,108 million in 2017-18 to 2,592 million in 2024-25 [Budgeted]. In the same period, the second class passenger volume has also reduced from 6,16,202 Million Passenger Kms. to 5,50,814 Million Passenger Kms.

It is instructive to note that while second class passenger numbers have reduced by 16.62% in the period 2017-18 to 2024-25 [Budgeted]; however the passenger volumes [passenger kms.] has reduced only by 10.6%.

Since passenger volumes are computed as the number *of journeys* x *mean kilometric distance*, the divergence between the two could indicate relatively longer journeys being undertaken by fewer passengers.

For the purposes of this paper we have used UTS II Class ticket bookings. These, as we saw above, are the cheapest tickets on the IR network, and are noted as being most preferred by blue collar migrants (Ministry of Finance, 2017). Given the geographic spread and density of the IR network, this forms a robust mechanism to track trends in domestic migration.

Prior to beginning our examination, we run a regression between the 2012 non-Suburban, UTS II Class passengers destined to each State and compare that with the State-wise number of total migrants enumerated in Census (2011) The regression results are in Table 4.

Table 4: Regression results comparing State-wise UTS II Class Non-Suburban Passengers and numbers of Migrants as per Census 2011

Regression Statistics	
Multiple R	0.930293275
R Square	0.865445578
Adjusted R Square	0.86046208
Standard Error	6090151.032
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	6.44112E+15	6.44112E+15	173.6623009	2.82775E-13
Residual	27	1.00143E+15	3.70899E+13		
Total	28	7.44255E+15			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1074038.7	1581964.829	0.678927041	0.502962775	-2171885.013	4319962.413	-2171885.013	4319962.413
X Variable 1	0.607612158	0.046107723	13.17809929	2.82775E-13	0.513006924	0.702217392	0.513006924	0.702217392

From the above, it is seen that state-wise railway passenger data is a robust predictor of the actual migrants. That said, we would like to highlight certain limitations.

- Firstly, all railways data is recorded from Station to Station, therefore the actual origin and destinations may not always be captured accurately. This is more so if there are multiple stations in or around a major urban centre, or if a station serves a large catchment area. (For example, some passengers travelling to Thane may eventually be headed to Mumbai. Or, it may be that passengers taking a train from Prayagraj may actually be residing outside the district.)
- Secondly, since the data captures passenger numbers (i.e. journeys), Circular Migration/Short term migration or travel around festival/marriage seasons would inflate the figures. Therefore the data would need to be used with some caution. Thirdly, the data does not capture details such as age, gender, reasons for migrating etc.
- Thirdly, there is a possibility that new lines/services/trains may have been since have been added or discontinued which might have a bearing on the figures.

In general, while the data is useful for discerning trends, routes, changes in directions, hotspots for origin/destination etc., it has limited utility for use as absolute figures.

Data on number of tickets booked on the unreserved ticketing system from the Indian Railways Centre for Railway Information Systems (CRIS)[11] was used to conduct this analysis. This data captures the month and year of travel, the place (district) of origin of the journey and the place (district) of destination as well as the number of passengers travelling on the route. We query the dataset looking for answers to the following questions:

- What have been the overall trends in migration, as indicated by unreserved train travel moved since the 2011 Census
- Which are the top origin districts for in-/out-migration
- Origins for Cities (Districts) with the maximum migrant in-flows
- Destinations for Places (Districts) with the maximum migrant out-flows
- Top District and State Routes
- Seasonal trends in flow of railway traffic

We also attempt to delve into the trends in sub-urbanization of Indian Cities. In particular, we explore the number of people travelling in the suburban zone for major cities in India. We use the same definition of *suburban* as the Indian Railways i.e. places within 150 kms. of the origin (Ministry of Railways, 2017). This is done in order to maintain continuity and comparability.

In order to account for sub-urban movement, each City (District) is geocoded and distanced between city/district pairs are computed using the *Haversine Formula* (Kettle, 2017):

$\text{hav}\,\theta = \text{hav}(\Delta\varphi) + \cos(\varphi_1) \cdot \cos(\varphi_2) \cdot \text{hav}(\Delta\lambda)$

where

- φ_1, φ_2 are the latitude of point 1 and latitude of point 2;
- λ_1, λ_2 are the longitude of point 1 and longitude of point 2;
- $\Delta\varphi = \varphi_2 - \varphi_1, \Delta\lambda = \lambda_2 - \lambda_1$

The distance calculated here is the *orthodromic* or spherical distance, which in some cases might differ from the actual road distances. However, for uniformity of application, we use the above to compute distances and use the 150 km mark for segregating suburban and non-suburban travel. For the purposes of this paper, we define '*passenger*', as a *UTS II Class, non-Suburban passenger*, unless otherwise qualified.

We begin by taking a look at **State-wise** migration. Table 5 depicts States which were the top destinations in 2023 along with the percentage of total passengers destined to those States. The figures include intra-State non-suburban travellers as well.

For comparison, the state-wise percentage of total passengers as well as the number of Statewise in-migrants enumerated as per Census, 2011 is also included.

Table 5: Top Destinations for Passengers; 2023/2012; UTS II Class Non-Suburban Passengers and Statewise in-migrants as per Census, 2011 [including intra-State Migrants]

STATES TO	% of Total Passengers 2023	% of Total Passengers 2012	Statewise In-migrants [Census 2011]	% of Total In-Migrants [Census 2011]
UTTAR PRADESH	12.68	13.16	56452083	12.39
MAHARASHTRA	10.74	12.34	57376776	12.59
WEST BENGAL	7.33	5.00	33448472	7.34
RAJASTHAN	7.19	6.17	22071482	4.84
MADHYA PRADESH	6.75	6.89	24735119	5.43
BIHAR	6.54	6.47	27244869	5.98
KARNATAKA	6.36	5.84	26463170	5.81
TAMIL NADU	6.08	5.89	31274107	6.86
ANDHRA PRADESH	5.73	6.64	38360644	8.42
DELHI	5.16	5.38	7224514	1.59
GUJARAT	5.10	6.00	26898286	5.90
TELANGANA	3.60	3.79		0.00
HARYANA	2.93	2.90	10585460	2.32
KERALA	2.89	2.55	17863419	3.92
ODISHA	2.57	2.33	15421793	3.38
PUNJAB	2.27	2.53	13735616	3.01
JHARKHAND	2.19	2.26	9659702	2.12
CHHATTISGARH	1.15	1.44	8888075	1.95
ASSAM	0.94	0.75	10644234	2.34
UTTARAKHAND	0.73	0.78	4317454	0.95
JAMMU AND KASHMIR	0.42	0.41	2809629	0.62
CHANDIGARH	0.28	0.19	678188	0.15
GOA	0.18	0.14	1140690	0.25
NAGALAND	0.07	0.08	549618	0.12
HIMACHAL PRADESH	0.04	0.05	2647067	0.58
TRIPURA	0.04	0.03	1299623	0.29
PUDUCHERRY	0.03	0.02	712401	0.16
ARUNACHAL PRADESH	0.00	0.00	630831	0.14
MEGHALAYA	0.00	0.00	759554	0.17
		TOTAL In-migrants [Census, 2011]	455787621	

Source: IR UTS Data; Census 2011; DS-0000-D03-MDDS; Migrants within the State/UT by place of last residence, duration of residence and reason of migration – 2011[12]

From the above we can see the following:

- The composition of the top five States attracting migrants has changed. West Bengal and Rajasthan are the new entrants, while Andhra Pradesh and Bihar are now ranked a notch lower.
- Even amongst the top five, the percentage of passengers headed to the respective States has reduced. This could be on account of an overall reduction in the migration rate, or it could indicate a greater spatial spread of outward movement of passengers.
- West Bengal, Rajasthan and Karnataka are the States showing the maximum amount of growth in percentage share of the arriving passengers. Similarly, Maharashtra and Andhra Pradesh are States where the percentage share of total migrants has reduced.
- As regards, the quality of IR UTS II Class Passenger data, it may be noted that as a percentage of the total numbers, the railway data closely corresponds to the data captured as part of the Census 2011 exercise in most cases. (The passenger arrivals and Census enumerated migrants in Delhi do show a deviation. This may be on account of Delhi being used as a transit station.)

We may note that the above figures include *all* non-suburban arriving passengers/migrants, irrespective of the state of their origin. Therefore the figures above include those who might be arriving or migrating from within the respective State as well.

We move on to attempt a comprehensive perspective on the percentage of passengers arriving and departing from each State. Table 6 captures the percentage of arrivals in each State [columns] from other states [rows] in the year 2023. For example, we can see that Gujarat, Uttar Pradesh, Bihar, Karnataka, and Telangana are the major origin states for arrivals in **Maharashtra**. Similarly, for **Delhi**, the major origin states are Uttar Pradesh, Bihar, Rajasthan, Haryana, and Madhya Pradesh.

In the same vein, Table 7 captures the state-wise percentage of destinations [States in columns] for outbound UTS II Class non-suburban travellers from each origin [States in rows]. We can see that the major destinations for UTS II Class travellers heading out from **Uttar Pradesh** are Delhi, Bihar, Maharashtra, Madhya Pradesh and Haryana. Major Destinations for UTS II Class non-suburban travellers heading out from **Bihar** are Delhi, West Bengal, Uttar Pradesh, Maharashtra and Jharkhand.

Table 6: Percentage of UTS II Class passengers from States [Rows] arriving in States [Columns], 2023 [Non-Suburban]

Origin States in Rows; Destination States in Columns

	AP	AR	AS	BH	CH	CG	DL	GA	GJ	HR	HP	JK	JH	KN	KL	MP	MH	NL	OD	PY	PB	RJ	TN	TG	TR	UP	UK	WB
AP	46.60	0.00	0.37	0.36	0.03	2.39	0.21	1.70	0.18	0.01	0.00	0.04	1.45	11.94	0.87	0.30	0.72	0.09	13.80	18.39	0.02	0.08	7.51	36.19	0.01	0.27	0.00	1.22
AR	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AS	0.06	96.34	57.61	1.21	0.04	0.02	0.22	0.00	0.02	0.01	0.00	0.14	0.19	0.20	0.47	0.01	0.03	74.24	0.05	0.00	0.01	0.02	0.21	0.05	61.66	0.15	0.00	1.79
BH	0.57	2.58	8.75	16.12	3.94	2.68	18.20	4.84	4.39	7.24	0.04	7.04	27.85	1.24	0.41	1.29	7.33	16.67	2.24	0.02	15.76	1.66	1.54	2.82	14.09	7.12	4.70	12.49
CH	0.00	0.00	0.03	0.22	0.00	0.00	0.67	0.26	0.04	1.14	0.00	1.70	0.06	0.01	0.01	0.02	0.02	0.05	0.00	0.00	1.04	0.10	0.00	0.01	0.00	1.36	1.81	0.02
CG	0.52	0.00	0.03	0.42	0.00	21.60	0.47	0.28	0.42	0.16	0.00	1.94	1.75	0.09	0.08	2.94	2.11	0.00	5.70	0.00	0.35	0.16	0.19	0.67	0.00	0.58	0.15	0.44
DL	0.17	0.00	1.16	11.21	11.26	1.95	0.00	3.42	1.37	9.33	29.70	14.39	2.19	0.45	0.42	4.56	0.76	0.26	0.46	0.49	12.83	6.94	0.30	0.70	0.62	11.65	15.31	0.76
GA	0.04	0.00	0.00	0.11	0.13	0.04	0.14	0.00	0.11	0.01	0.00	0.00	0.11	0.79	0.55	0.12	0.63	0.00	0.20	0.00	0.00	0.05	0.02	0.03	0.00	0.09	0.01	0.09
GJ	0.16	0.03	0.12	2.65	0.59	1.90	1.63	2.88	37.45	0.60	0.32	0.65	1.20	0.28	0.13	5.22	12.29	0.00	1.48	0.00	0.62	6.19	0.13	0.40	0.00	3.55	0.91	0.42
HR	0.01	0.00	0.08	2.80	15.63	0.39	10.07	0.18	0.38	26.02	56.57	12.08	0.36	0.01	0.03	1.14	0.14	0.03	0.02	0.00	16.92	7.14	0.00	0.01	0.19	4.30	4.02	0.08
HP	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.05	0.06	0.00
JK	0.00	0.00	0.05	0.43	1.99	0.85	1.62	0.00	0.07	1.85	0.00	0.00	0.20	0.00	0.00	0.24	0.04	0.00	0.02	0.00	4.75	0.22	0.01	0.01	0.00	0.83	2.19	0.06
JH	0.58	0.00	0.47	10.36	0.38	3.29	1.13	1.73	0.67	0.32	0.01	0.83	14.66	0.42	0.36	0.40	0.58	0.10	9.14	0.39	0.40	0.24	0.72	0.59	7.11	1.45	0.50	7.20
KN	10.40	0.00	1.67	1.13	0.15	0.50	0.61	24.53	0.36	0.03	0.00	0.01	1.23	57.51	7.92	0.44	5.42	0.21	1.70	10.25	0.01	0.23	8.51	5.50	0.00	0.63	0.01	0.93
KL	0.54	0.00	1.57	0.19	0.06	0.13	0.24	7.35	0.07	0.02	0.00	0.02	0.57	3.22	69.26	0.11	0.17	0.35	0.79	11.98	0.01	0.05	7.16	0.20	0.00	0.13	0.07	0.79
MP	0.31	0.03	0.07	1.54	0.51	17.28	7.03	4.15	7.43	2.51	0.18	4.67	1.27	0.39	0.21	55.41	3.71	0.04	0.50	0.06	1.28	9.09	0.32	1.05	0.10	5.95	1.26	0.14
MH	1.37	0.00	0.38	11.93	0.68	20.47	1.79	35.16	25.46	0.50	0.02	0.94	2.37	9.04	0.69	5.72	50.91	0.06	1.48	0.75	0.71	2.26	0.65	11.35	0.00	6.00	0.57	1.18
NL	0.00	0.00	5.01	0.14	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.01	0.00	0.05
OD	5.80	0.00	0.17	0.86	0.02	12.20	0.26	1.85	0.94	0.02	0.00	0.11	10.22	0.64	0.66	0.19	0.34	0.08	44.10	5.46	0.04	0.05	1.24	1.53	0.04	0.24	0.07	4.66
PY	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.25	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.02
PB	0.01	0.00	0.05	5.41	11.44	0.84	6.31	0.05	0.29	12.51	0.34	24.69	0.38	0.00	0.01	0.48	0.15	0.04	0.04	0.00	11.85	1.62	0.01	0.01	0.02	4.40	11.19	0.07
RJ	0.13	0.00	0.17	1.88	2.65	1.01	10.20	1.66	9.02	16.54	2.29	3.90	0.67	0.29	0.15	9.30	1.59	0.12	0.15	0.00	5.26	54.72	0.11	0.44	0.00	4.44	9.71	0.32
TN	7.51	0.00	1.47	1.05	0.09	0.82	0.39	0.51	0.13	0.01	0.00	0.06	2.23	8.30	15.28	0.37	0.40	0.26	3.04	46.76	0.02	0.08	67.91	1.16	0.02	0.46	0.00	1.53
TG	22.94	0.00	0.36	1.20	0.10	2.08	0.54	1.01	0.32	0.02	0.00	0.05	0.88	3.28	0.28	0.68	3.94	0.02	2.00	0.08	0.02	0.18	0.75	33.42	0.38	0.74	0.00	0.86
TR	0.00	0.00	2.33	0.08	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
UP	0.63	0.26	1.95	14.11	44.23	6.83	33.81	5.83	10.03	19.36	10.10	21.84	7.00	1.16	0.48	10.77	7.94	1.29	1.13	1.19	24.47	7.67	0.92	2.62	1.01	41.54	43.95	2.47
UK	0.00	0.00	0.01	0.55	5.77	0.18	2.90	0.06	0.23	0.94	0.43	4.05	0.19	0.00	0.02	0.15	0.07	0.00	0.03	0.00	3.38	0.99	0.00	0.00	0.00	2.69	3.13	0.06
WB	1.46	0.75	15.63	14.04	0.31	2.56	1.18	2.55	0.61	0.16	0.00	0.86	22.85	0.67	1.44	0.13	0.67	5.59	11.89	4.18	0.24	0.26	1.34	1.23	14.38	1.38	0.36	62.28
GRAND TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Description: What % of arrivals in a State in Column is from States in Rows
Source: UTS Data for II Class from CRIS; RTO Codes for State Names; Columns formatted individually

Table 7: Percentage of UTS II Class passengers departing State [Row] and destined to State [Column], 2023 [Non-Suburban]

Origin States in Rows; Destination States in Columns

	AP	AR	AS	BH	CH	CG	DL	GA	GJ	HR	HP	JK	JH	KN	KL	MP	MH	NL	OD	PY	PB	RJ	TN	TG	TR	UP	UK	WB	Grand Total
AP	45.16	0.00	0.06	0.39	0.00	0.47	0.18	0.05	0.16	0.01	0.00	0.00	0.54	12.86	0.43	0.34	1.31	0.00	5.99	0.09	0.01	0.10	7.73	22.02	0.00	0.59	0.00	1.52	100.00
AR	0.00	0.00	95.63	3.22	0.01	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.19	0.00	0.87	100.00
AS	0.38	0.43	58.88	8.59	0.01	0.03	1.23	0.00	0.13	0.05	0.00	0.06	0.46	1.39	1.48	0.06	0.41	5.58	0.15	0.00	0.04	0.14	1.36	0.21	2.57	2.11	0.00	14.26	100.00
BH	0.48	0.00	1.21	15.50	0.16	0.45	13.83	0.13	3.29	3.12	0.00	0.44	8.96	1.16	0.17	1.28	11.58	0.17	0.85	0.00	5.26	1.75	1.38	1.49	0.08	13.28	0.51	13.46	100.00
CH	0.02	0.00	0.08	4.59	0.00	0.01	10.92	0.15	0.65	10.56	0.00	2.26	0.39	0.14	0.06	0.48	0.78	0.01	0.02	0.00	7.49	2.18	0.09	0.08	0.00	54.39	4.18	0.47	100.00
CG	2.62	0.00	0.02	2.40	0.00	21.72	2.10	0.05	1.88	0.40	0.00	0.72	3.34	0.49	0.19	17.30	19.82	0.00	12.77	0.00	0.68	1.01	1.01	2.11	0.00	6.43	0.10	2.84	100.00
DL	0.24	0.00	0.26	17.45	0.75	0.53	0.00	0.15	1.67	6.52	0.28	1.45	1.14	0.68	0.29	7.33	1.95	0.00	0.28	0.00	6.94	11.87	0.43	0.60	0.01	35.18	2.67	1.33	100.00
GA	1.15	0.00	0.01	3.78	0.18	0.25	3.76	0.00	2.81	0.14	0.00	0.00	1.18	25.49	8.02	4.24	34.56	0.00	2.59	0.00	0.05	1.65	0.48	0.52	0.00	5.67	0.05	3.42	100.00
GJ	0.19	0.00	0.02	3.50	0.03	0.44	1.70	0.11	38.56	0.35	0.00	0.06	0.53	0.36	0.07	7.10	26.64	0.00	0.77	0.00	0.28	8.98	0.16	0.29	0.00	9.09	0.13	0.62	100.00
HR	0.01	0.00	0.03	5.74	1.37	0.14	16.32	0.01	0.61	23.92	0.71	1.60	0.25	0.03	0.03	2.40	0.48	0.00	0.02	0.00	12.05	16.07	0.01	0.01	0.00	17.09	0.92	0.19	100.00
HP	0.00	0.00	0.00	0.57	0.00	0.00	40.38	0.00	0.40	41.52	0.00	0.00	0.01	0.00	0.00	0.74	0.06	0.00	0.00	0.00	0.42	1.97	0.00	0.00	0.00	12.90	1.02	0.01	100.00
JK	0.04	0.00	0.10	6.10	1.20	2.11	18.17	0.00	0.76	11.79	0.00	0.00	0.96	0.04	0.01	3.55	1.03	0.00	0.10	0.00	23.37	3.35	0.11	0.04	0.00	22.68	3.47	1.02	100.00
JH	1.40	0.00	0.19	28.78	0.04	1.61	2.48	0.13	1.45	0.40	0.00	0.15	13.63	1.15	0.45	1.15	2.64	0.00	9.97	0.00	0.39	0.73	1.85	0.90	0.12	7.80	0.15	22.43	100.00
KN	9.54	0.00	0.25	1.18	0.01	0.09	0.51	0.71	0.30	0.01	0.00	0.00	0.43	58.63	3.68	0.47	9.33	0.00	0.70	0.05	0.00	0.27	8.30	3.17	0.00	1.27	0.00	1.09	100.00
KL	1.07	0.00	0.51	0.42	0.01	0.05	0.43	0.46	0.13	0.02	0.00	0.00	0.43	7.11	69.55	0.25	0.63	0.01	0.71	0.12	0.01	0.14	15.12	0.25	0.00	0.55	0.02	2.01	100.00
MP	0.26	0.00	0.01	1.46	0.02	2.89	5.28	0.11	5.50	1.07	0.00	0.29	0.40	0.36	0.09	54.30	5.80	0.00	0.19	0.00	0.42	9.48	0.28	0.55	0.00	10.96	0.13	0.15	100.00
MH	0.74	0.00	0.03	7.36	0.02	2.23	0.87	0.60	12.27	0.14	0.00	0.04	0.49	5.43	0.19	3.65	51.63	0.00	0.36	0.00	0.15	1.53	0.38	3.86	0.00	7.18	0.04	0.82	100.00
NL	0.14	0.00	75.87	14.76	0.01	0.00	0.43	0.00	0.00	0.03	0.00	0.00	0.08	0.34	0.62	0.04	0.12	0.00	0.07	0.00	0.02	0.04	0.36	0.01	0.23	1.32	0.00	5.51	100.00
OD	12.93	0.00	0.06	2.19	0.00	5.46	0.53	0.13	1.87	0.02	0.00	0.02	8.70	1.59	0.75	0.51	1.42	0.00	44.01	0.06	0.03	0.14	2.93	2.14	0.00	1.20	0.02	13.28	100.00
PY	20.46	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	7.29	13.79	0.10	0.51	0.00	2.37	0.00	0.00	0.00	52.33	0.05	0.00	0.66	0.00	2.25	100.00
PB	0.02	0.00	0.02	15.38	1.39	0.42	14.19	0.00	0.65	15.95	0.01	4.54	0.37	0.01	0.01	1.41	0.72	0.00	0.04	0.00	11.70	5.06	0.02	0.01	0.00	24.28	3.56	0.23	100.00
RJ	0.10	0.00	0.02	1.71	0.10	0.16	7.31	0.04	6.38	6.72	0.01	0.23	0.20	0.25	0.06	8.69	2.37	0.00	0.05	0.00	1.65	54.50	0.09	0.22	0.00	7.81	0.98	0.32	100.00
TN	7.08	0.00	0.23	1.13	0.00	0.16	0.33	0.02	0.11	0.00	0.00	0.00	0.80	8.69	7.28	0.42	0.71	0.00	1.28	0.21	0.01	0.09	67.96	0.69	0.00	0.96	0.00	1.85	100.00
TG	36.08	0.00	0.09	2.16	0.01	0.66	0.76	0.05	0.45	0.02	0.00	0.01	0.53	5.73	0.22	1.26	11.63	0.00	1.41	0.00	0.01	0.36	1.25	33.01	0.00	2.59	0.00	1.72	100.00
TR	0.00	0.00	59.80	13.86	0.00	0.00	1.30	0.00	0.00	0.17	0.00	0.00	6.90	0.00	0.00	0.13	0.01	0.94	0.00	0.00	0.02	0.01	0.03	0.00	0.00	1.25	0.00	15.58	100.00
UP	0.28	0.00	0.14	7.10	0.95	0.61	13.45	0.08	3.94	4.37	0.03	0.71	1.18	0.57	0.11	5.59	6.57	0.01	0.22	0.00	4.28	4.24	0.43	0.73	0.00	40.55	2.47	1.40	100.00
UK	0.00	0.00	0.01	4.47	2.02	0.25	18.75	0.01	1.44	3.46	0.02	2.14	0.53	0.02	0.06	1.27	0.89	0.00	0.10	0.00	9.59	8.88	0.00	0.01	0.00	42.68	2.86	0.52	100.00
WB	1.17	0.00	2.06	12.82	0.01	0.41	0.85	0.06	0.44	0.07	0.00	0.05	6.98	0.59	0.58	0.12	1.01	0.05	4.26	0.02	0.08	0.26	1.14	0.62	0.08	2.44	0.04	63.78	100.00

Description: What % of departures from a State in Rows goes to States in Columns
Source: UTS Data for II Class from CRISRTO Codes for State Names; Rows formatted individual

We now take a look at the ten most popular **State-to-State Routes**. This is based on passenger movements in 2023. Here intra-State and suburban movement is excluded.

Table 8: Top Ten State-to-State Routes [2023]

State From	State To
Uttar Pradesh	Delhi
Gujarat	Maharashtra
Telangana	Andhra Pradesh
Bihar	Delhi
Bihar	West Bengal
Bihar	Uttar Pradesh
Uttar Pradesh	Maharashtra
Bihar	Maharashtra
Andhra Pradesh	Karnataka
Jharkhand	Bihar

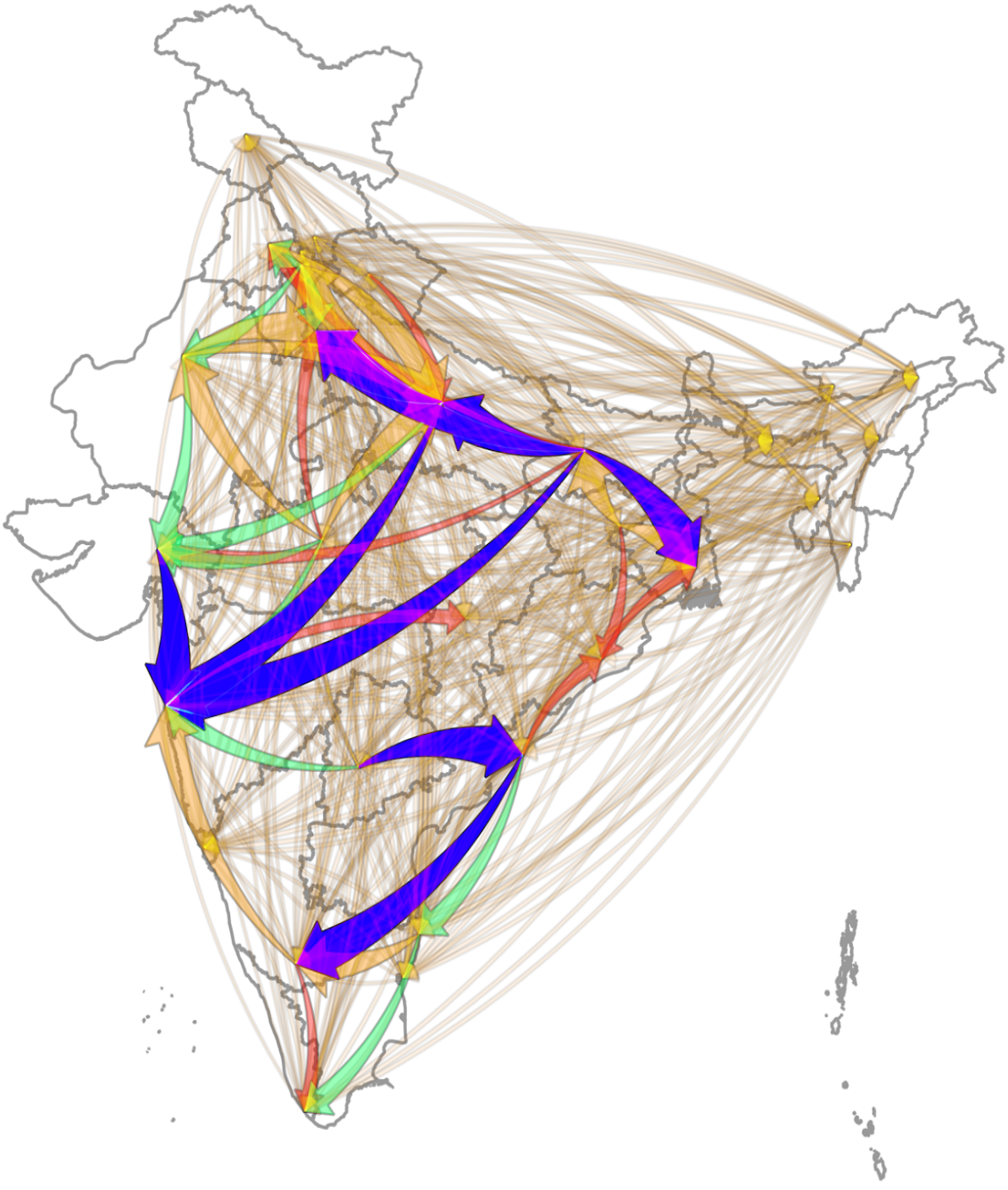
For better visualization, we map State-to-State routes [Figure 5]. As above, intra-State and suburban movement is excluded.

Another visualization of the above is a chord diagram [Figure 4]. The size of the arcs indicates the proportional size of the movements in the respective States [RTO Codes are used to denote States]. Both inter-State as well as intra-State movements are depicted.

Fig. 4: Predicted Inter-State and Intra-State Movement [2023]

Data: UTS II Class IR Passengers [Non-Suburban], 2023
Data includes both inter-State and intra-State movement

Fig. 5: State-to-State Predicted Migration Routes [2023]



Basemap: India States Shapefile [ADM1]; Data: UTS II Class IR Passengers, 2023
Intra-State and suburban movement is excluded

We now take a look at the month-on-month changes in the total number of non-suburban as well as suburban passenger movement, from January 2012 to December 2023. The figures are indexed, with January 2012 set at 100. Figure 6 tracks the monthly trends in movement of non-suburban UTS II Class passengers.

Fig. 6: Trends in movement of non-suburban UTS II Class passengers; Jan, 2012 indexed at 100

[Jan, 2012 to Dec, 2023]

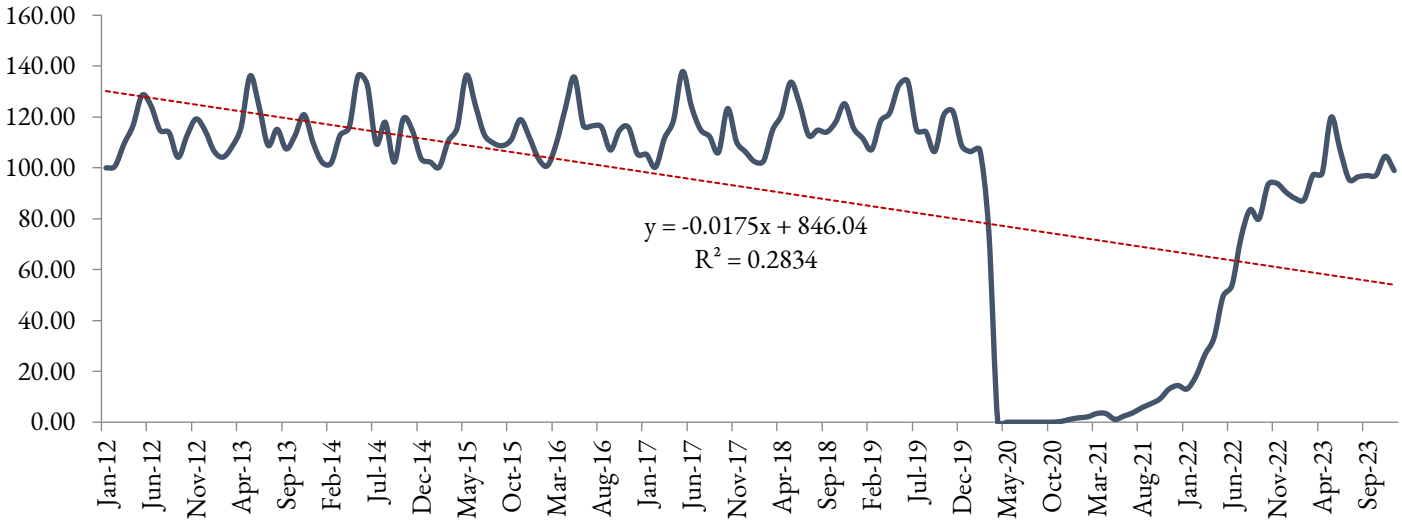


Figure 7 indicates a distinct seasonality of movements, with May-June being the high months and November-December witnessing secondary highs. These are perhaps months where most migrant labour travel back to their places of origin. A secondary high in winter time is perhaps indicative of travel around the festival/marriage season. January, on the other hand, appears to be the month of lowest travel.

However, the seasonal rhythms appear to have been affected by the Covid-19 pandemic. We can clearly see April-May 2020 as a month which saw passenger movements plummeting to nil as the Covid-19 related lockdown brought regular rail movement to a standstill. While the numbers have steadily come up once the Covid-19 related restrictions were lifted, the level of movement is yet to reach pre-pandemic levels.

Even prior to the pandemic related lockdowns, there were signs of the passenger movement showing little growth, however after the pandemic, even the high months i.e. Apr-May are at a distinctly lower level as compared to the corresponding period before the pandemic - passenger levels for May 2023 being 6.67% lower than the corresponding number for May 2012.

A reduction in the overall levels of migration is indicated on the basis of passenger movement data. The overall non-suburban UTS II Class passenger numbers in 2023 are about 11.78% lower than the corresponding numbers in 2012. In this period, India's population has grown by 14.98%, from 121,08,54,977 in 2011 (National Commission on Population, 2019) to an estimated 139,23,29,000 in 2023 [13].

Moreover, as per Census (2011), the number of migrants [*all persons, all reasons, all durations*] were enumerated as 45,57,87,621. Therefore, the migration rate, based on Census 2011, stood at 37.64%. Analysing corresponding trends in railway passenger movement, we hypothesize that the migration rate has since reduced to 28.878% of the population [as of 2023].

Consequently, we estimate the number of migrants in the country, as of 2023, to be 40,20,90,396. We eagerly look forward to next round of the Census to verify our estimates!

There is considerable academic literature indicating that when an economy grows and the benefits of this growth are broadly distributed, rural/semi-urban areas – typically areas of out-migration – also tend to grow. This leads to a broader spread of economic opportunities, and is seen as reducing the incentive to migrate to urban centres (Jia et al. 2022).

Further, it is seen that multiple factors – improved infrastructure (roads, education, healthcare, public transport), social security nets, and localized economic growth that creates jobs closer to rural areas – together allow people to remain in their hometowns, or to migrate shorter distances (Ratha, Mohapatra, and Scheja 2011)

Indicators of such developments are seen in India in the period since the last Census i.e. from 2011 to 2023.

- For example, *completed road length* under the *Pradhan Mantri Gram Sadak Yojana* (PMGSY)[14], increased from 3,25,576.26 kms. in 2011-12 to 12,47,459.42 kms in FY 2022-23 (an increase of 283%)[15].
- Similarly, 2,64,87,910 houses have been completed under the *Pradhan Mantri Awaas Yojana-Gramin* (PMAY-G)[16] in the period 2014 to 2024[17].
- Under the *Deen Dayal Upadhyaya Gram Jyoti Yojana* (DDUGJY), launched in December 2014, as on 31.03.2019, all households in India have been reported as electrified[18].
- Similarly, as of August 14th, 2024, the Jal Jeevan Mission (JJM) [launched on August 15th, 2019] has successfully provided tap water connections to 11.82 crore additional rural households, bringing the total coverage to more than 15.07 crore households, which accounts for 77.98% of all rural households in India. For context, at the time of its inception, only 3.23 crore (17%) of rural households had tap water connections[19].
- Similarly, as of April 2024, 95.15% villages have access to internet with 3G/4G mobile connectivity[20]. (2024)

Cumulatively, these developments have led to 24.82 crore Indians escaping Multidimensional Poverty in last 9 years. (NITI Aayog, 2024)

7. Minding the Data Gap:

Using Railway Reservations to Track Migration at the District Level

In addition to being high frequency, an important feature of Railway reservation data is its granularity. Using the data we delve deeper to get a sense of the originating and destination districts.

As noted above, however, these are start and end points of train journeys, and passengers may not be residents of that particular district, such as when the catchment area of the station of origin extends beyond the district where the Station is located. Similarly, there is a fair possibility that the district/station where the journey terminates might not necessarily be the final destination for the migrants.

As in the case of States, we use district-wise railway passenger data as an indicator of trends rather than of actual numbers.

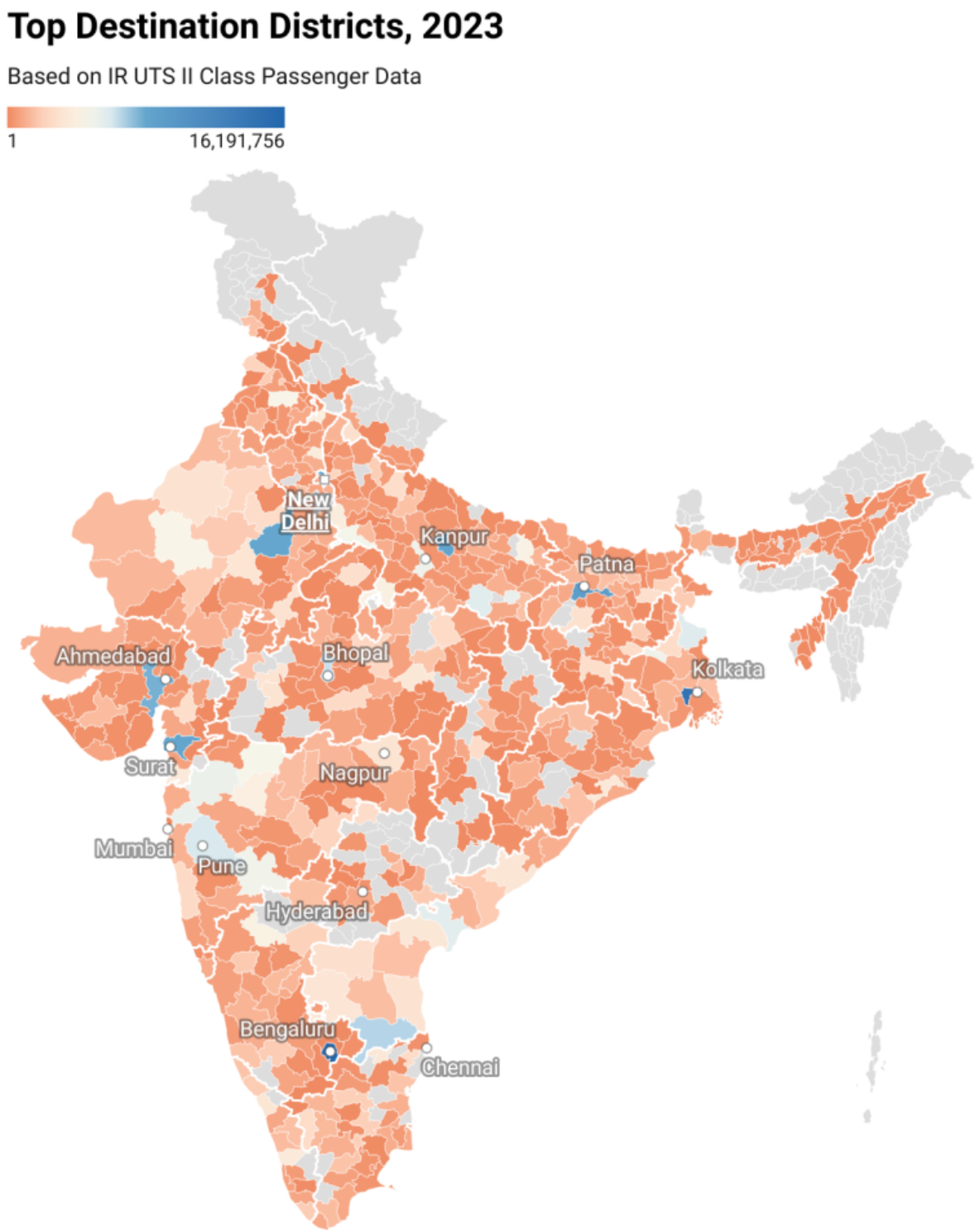
The following are the districts which were the top destinations for non-suburban [150+ km.] travel in 2012 as well as in 2023 (Table 9). While the order of the districts might have changed, the composition of the top ten stays constant.

Table 9: Top ten destination districts for non-suburban UTS II Class Passengers [2012, 2023]; All Origins

2012	2023
Mumbai	Mumbai
Central Delhi	Bengaluru Urban
Howrah	Howrah
Bengaluru Urban	Central Delhi
North Delhi	Hyderabad
Hyderabad	Chennai
Chennai	Patna
Surat	North Delhi
Lucknow	Lucknow
Patna	Surat

We map the top destination districts [2023] for predicted in-migration [Figure 7]. We see that the top destination districts are the major urban agglomerations viz. Delhi, Mumbai, Chennai, Bangalore, Kolkata etc. Given the relative geographic size of Mumbai City and the districts of Delhi, the two cities are not as prominent in the map [Figure 7].

Fig. 7: Top destination Districts [Non-Suburban, 2023]



Similarly, the following are the districts which were the top originating districts for non-suburban [150+ km] travel in 2012 as well as in 2023 (Table 10). Here we see some new source districts feature in 2023 (that were not there in 2012).

Table 10: Top ten source districts for non-suburban UTS II Class Passengers [2012, 2023]; All Destinations

2012	2023
Valsad	Valsad
Patna	Chittoor
Paschim Bardhaman	Paschim Bardhaman
Chittoor	Agra
Agra	Guntur
Guntur	Villupuram
Spsr Nellore	Saharsa
Mumbai	Moradabad
Prayagraj	Prayagraj
Bhagalpur	Murshidabad

While Valsad remains the top source district, however being 193 kms from Mumbai there is likelihood that this travel is actually daily suburban travel. However, for sake of completeness we include Valsad in the above list.

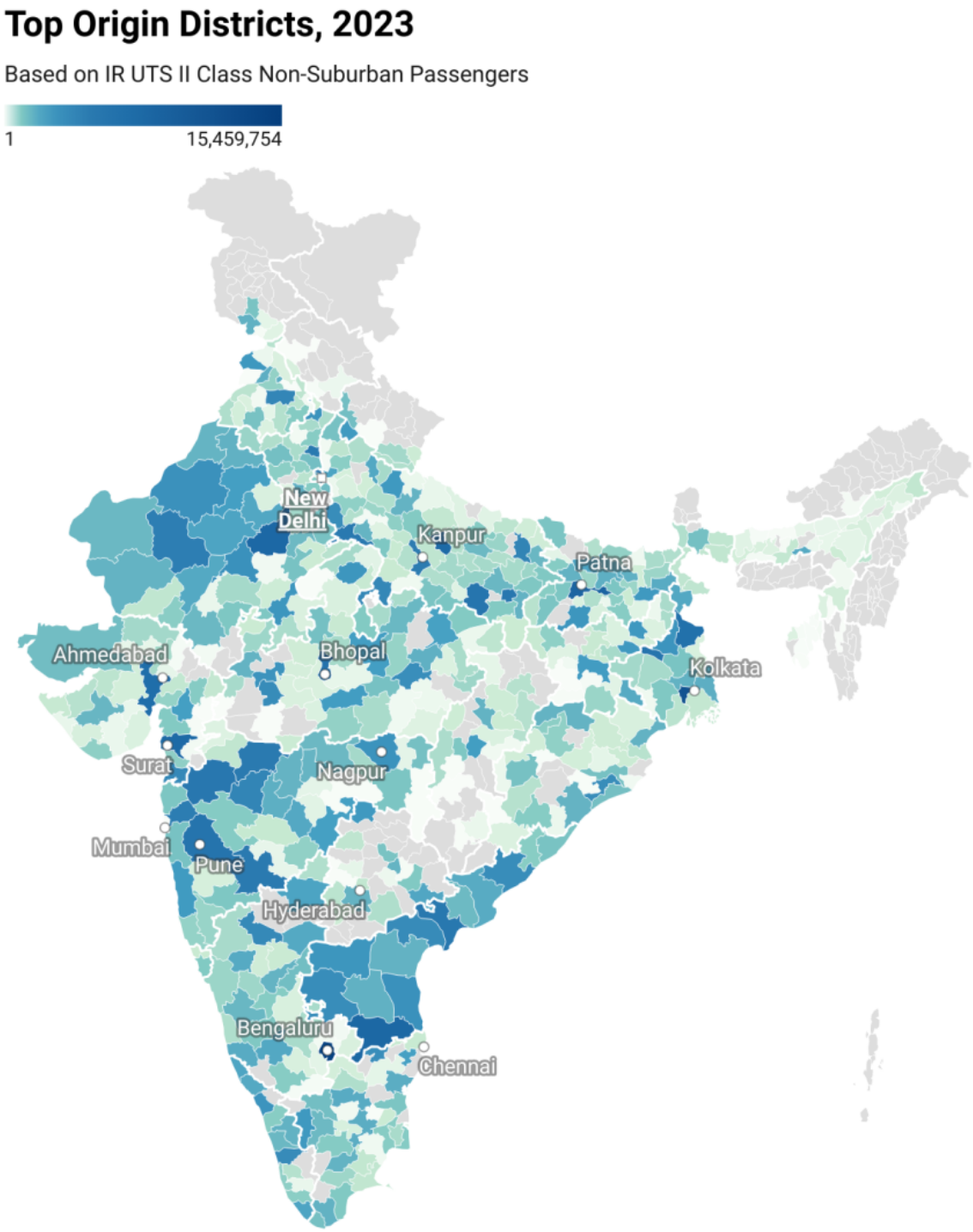
We map the top origin districts [2023] for predicted out migration [Figure 8]. We see that the top origin districts are coalesced around major urban agglomerations viz. Delhi, Mumbai, Chennai, Bangalore, Kolkata etc. This is not only in line with gravity models of migration, (Tobler, 1975) but also a tentative confirmation of priors i.e short-distance migration accounts for the largest share of migrants, (Singh and Biradar, 2022) and distance has a negative effect on labour flows. (Ministry of Finance, 2017)

Similarly, the top ten routes for passenger movement, at the district level, is at Table 11.

Table 11: Top ten routes for non-suburban UTS II Class Passengers [District Level, 2023]

From	To
Murshidabad	Kolkata
Paschim Bardhaman	Howrah
Valsad	Mumbai
Chittoor	Bengaluru Urban
Surat	Mumbai
Birbhum	Howrah
Vellore	Bengaluru Urban
Hassan	Bengaluru Urban
Nashik	Mumbai

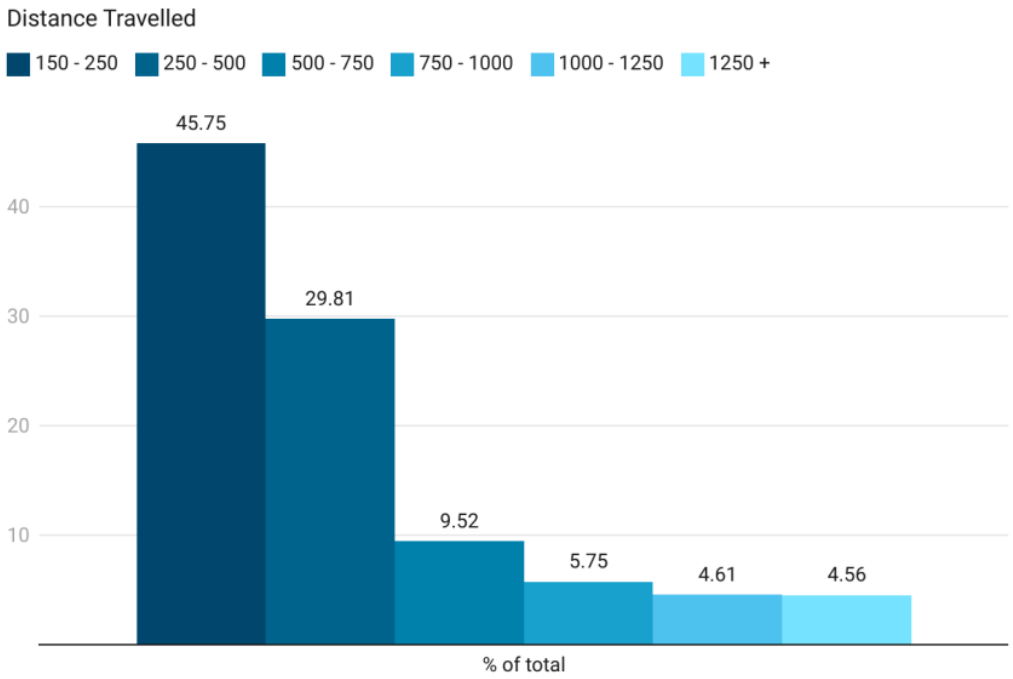
Fig. 8: Top origin Districts [Non-Suburban, 2023]



It is interesting to note that that a majority [>75%] of our predicted migration flows are within 500 kms of the origin (Figure 9). This is in line with gravity models, as well as Ravenstein's *Theory of Human Migration*. (Ravenstein, 1885)

Figure 9: Percentage Distribution of passenger numbers by distance travelled (km)

[Non-Suburban, 2023]



Before we move on the next section, we quickly visualize the district-to-district movement on a map (Figure 10). Given the sheer number of connections, the map is admittedly somewhat busy! The blue lines denote the highest amount of non-suburban travel, and are clustered around Mumbai, Chennai, Bangalore, and Kolkata. As earlier, flows to Delhi are split amongst the districts of Delhi, and therefore do not show up as Blue lines.

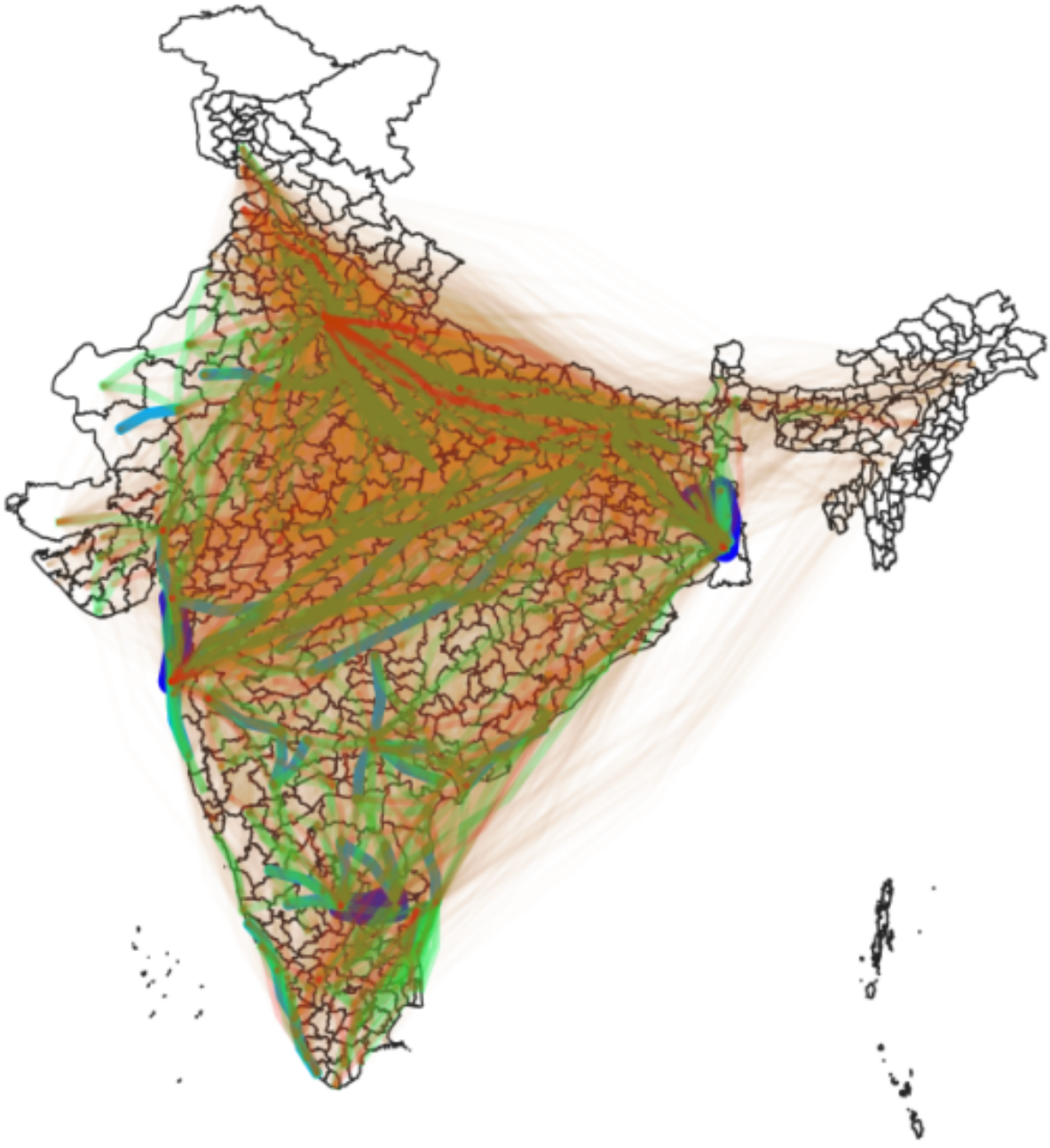
We extend the above model to examine the districts of origin for predicted migration to Delhi (Table 12A). The districts are ranked by their respective percentage contribution to the total non-suburban arrivals in Delhi.

Table 12A: Top source districts for non-suburban UTS II Class Passengers [2012, 2023]; Destination Delhi [All Districts]

2012		2023	
Origin District	% Of Total	Origin District	% Of Total
Agra	5.18	Agra	4.54
Patna	3.07	Patna	2.90
Moradabad	2.45	Kanpur Nagar	2.01
Kanpur Nagar	2.27	Jhansi	1.97
Jhansi	2.24	Bareilly	1.80
Bareilly	2.18	Jaipur	1.75
Darbhanga	2.02	Haridwar	1.69
Gorakhpur	1.98	Moradabad	1.69
Jaipur	1.70	Dausa	1.66
Muzaffarpur	1.57	Ludhiana	1.58

From the above, we can see that districts like Dausa and Ludhiana now feature in the top ten origin districts for predicted migration into Delhi. However, in the period 2012 to 2023, the relative weightage of the top ten districts to the total has reduced. This is perhaps an indicator of a greater spatial spread of the origins of migration.

Fig. 10: District -to-District Predicted Migration Routes [2023]



Basemap: India Districts Shapefile [ADM2]; Data: UTS II Class IR Passengers, 2023
Intra-District and suburban movement is excluded

Using the same model, we take a look at the figures for Mumbai (Table 12B). In the case of Mumbai, we note that the relative weights of the origin districts have changed from 2012 to 2023, and here too the share of the top ten in the total has reduced; also, there is one new entrant.

Table 12B: Top source districts for non-suburban UTS II Class Passengers [2012, 2023]; Destination Mumbai

2012		2023	
Origin District	% Of Total	Origin District	% Of Total
Valsad	15.93	Valsad	13.49
Nashik	11.98	Surat	10.02
Surat	11.35	Nashik	8.75
Gorakhpur	3.39	Ratnagiri	4.92
Varanasi	3.14	Varanasi	2.77
Navsari	2.73	Gorakhpur	2.45
Ahmadabad	2.56	Ahmadabad	2.45
Lucknow	2.07	Prayagraj	2.01
Solapur	1.73	Navsari	1.76
Vadodara	1.73	Sindhudurg	1.73

We also take quick look at some of the routes showing the biggest increases and decreases in the period between 2012 and 2023. The district-to-district routes showing the greatest increases are summarized in Table 13. Similarly, district-to-district routes showing the greatest decreases are summarized in Table 14.

Table 13: Top 10 District-to-District Routes showing the greatest increase in predicted migration between 2012 and 2023

Routes
Murshidabad-Kolkata
Ratnagiri-Thane
Ratnagiri-Mumbai
Kolkata-Murshidabad
Bengaluru Urban-Hassan
Hassan-Bengaluru Urban
Ratnagiri-Raigad
Agra-Central Delhi
Panipat-South Delhi
Saharsa-Patna

Table 14: Top 10 District-to-District Routes showing the greatest decrease in predicted migration between 2012 and 2023

ROUTES
SPSR NELLORE-CHITTOOR
CHITTOOR-BENGALURU URBAN
BENGALURU URBAN-VELLORE
NASHIK-JALGAON
MUMBAI-NASHIK
MUMBAI-SURAT
PASCHIM BARDHAMAN-HOWRAH
PUNE-SOLAPUR
NASHIK-MUMBAI
VALSAD-MUMBAI

8. "I just called to say..."

Using *Roaming* to track trends in Migration

Not only are Indians mobile; increasingly, more of them are on the mobile! India is home to the second-largest telecommunication network [measured by number of phone connections] in the world, (World Bank, n.d.) and the second-highest number of internet users (International Telecommunications Union, n.d.). Overall wireless Tele-density (National Commission on Population, 2019) – Number of wireless telephone subscribers per 100 people – in India for the month of April, 2024 stood at 83.31%, with wireless Tele-density for Urban areas at 127.12%, and that for Rural areas at 59.12% (Telecom Regulatory Authority of India, 2012).

As on 30th of April, 2024, India's total Wireless Subscribers stood at 1166.96 Million, with Rural subscribers accounting for 533.42 Million [45.71%] and Urban Subscribers making up 633.53 Million [54.29%].

The Telecom Regulatory Authority of India (TRAI) publishes monthly statistical reports regarding the telecom sector in the country. Included in this monthly report are the figures for subscribers in the *Visitor Location Register* (VLR). Under the Global System for Mobile Communication (GSM) standards, the *Visitor Location Register* (VLR) is a database of Mobile Stations (Mobile Devices) that have roamed in the jurisdiction of the Mobile Switching Centre (MSC) it serves.

Each Mobile Device (Base Transceiver Station) is served by exactly one VLR, and a subscriber can be present in only one VLR at a time. This system is used by Cellular Service Providers to keep track of home and visiting (roaming) subscribers. Therefore, tracking the VLR subscribers could be a useful proxy for the number of subscribers roaming/visiting the home location. (It is useful that the telecom

circles in India typically correlate with state boundaries, with the cities of Delhi, Mumbai, and Kolkata[21] being distinct telecom circles.)

This helps us track the trends in the number of cellular devices/mobile phones '*visiting*' the respective cities. A similar approach was been used to understand interstate migration during the COVID-19 Pandemic (Nizam, Sivakumar, and Rajan, 2022).

While using telecom data is a useful measure for understanding trends in movement of people, however, there are a number of caveats. Firstly, we cannot build a dyad, as there is no information in public domain of the home location of a roaming mobile subscriber. As a result it is difficult to correlate origins/destinations.

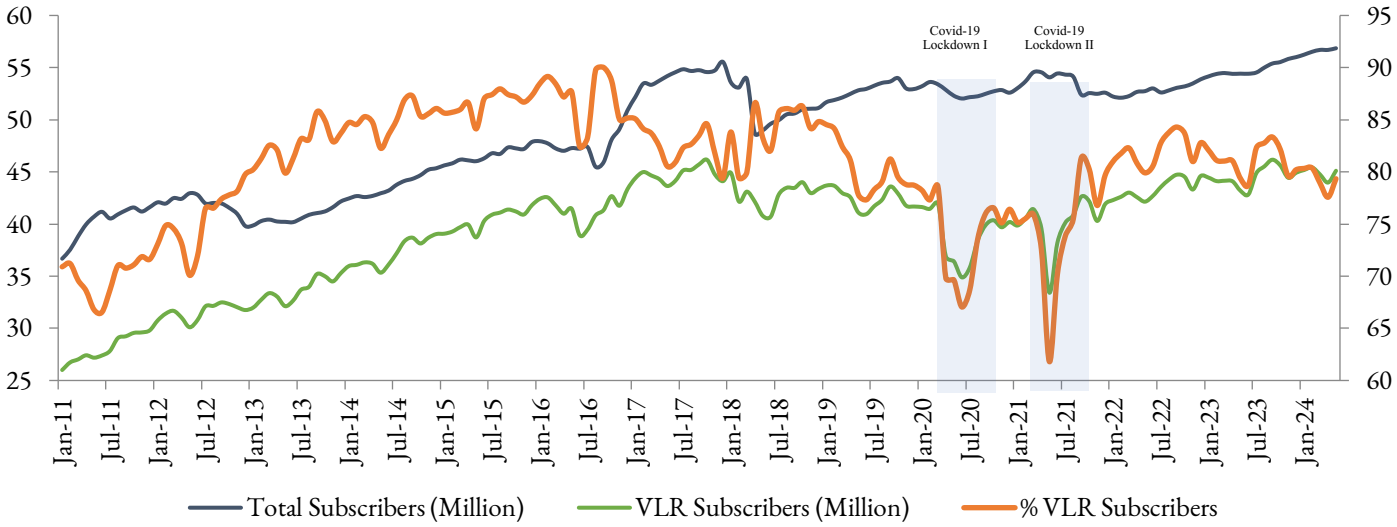
Secondly, a number of migrants – even blue collar migrants – may not have obtained their mobile connections at their place of origin, that is, they may only obtain mobile connections after having reached their destination. These too will not be reflected in the roaming numbers. There may also be other factors (such as festivals, marriages etc.) which might lead to temporary spikes or troughs in the inflow/outflow of people. This would be reflected in the data on the number of subscribers on roaming.

However, despite these caveats, TRAI telecom data is a high-frequency, publicly-available dataset which can help in discerning trends in the number of mobile subscribers, and can act a useful proxy for the movement of migrants. Keeping that in mind, we take a look at the trends in VLR subscribers, expressed as a percentage of total subscribers.

We begin by taking a look at the three telecom service areas contiguous with cities viz. Delhi, Mumbai & Kolkata. Starting with Delhi, we track the trends in total number of wireless subscribers, total number of VLR Subscribers (in-*roamers*) (both on left axis) and VLR Subscribers as a percentage of total subscribers (right axis), for a period from January 2011 to May 2024, using historical TRAI Monthly Subscription Data[22] (Figure 11).

The two shaded areas correspond to the two Covid-19 lockdown periods viz. April-June 2020 and April-July 2021, (Ministry of Home Affairs, 2020) which saw large numbers of migrant workers moving back to their places of origin. (Mitra and Shrivastav, 2024) Given that in this period there was little other movement/travel, it is reasonable to assume that this movement is reflective of movement of migrants.

Fig. 11: Monthly trends of Total Wireless Subscribers; Total VLR Subscribers (both Left Axis); % of VLR Subscribers (Right Axis) for Delhi; January 2011 to May 2024



It is evident that as compared to the first lockdown (April - June 2020), the second lockdown (April - June 2021) saw a more pronounced drop in the percentage of VLR Subscribers (in-roamers). Looking at the absolute numbers, comparing the number of VLR Subscribers in May 2019 [the month-year prior to the peak levels of the Pandemic in Delhi] to the number at the peak of the lockdown (i.e. May 2021,) we note a reduction of 7.69 Million. Similarly, the reduction in the number of in-roamers in May 2020 as against VLR Subscribers in May 2019 stood at 4.68 Million.

It is instructive to note that while the percentage of VLR Subscribers (in-roamers) quickly bounced back post the pandemic, the growth in the total numbers appears to have slowed.

We now go on to use Telecom Data for analysing seasonal trends in the movement of people. We do this by tracking the trends in the deviations in the VLR Subscribers as a percentage of the Total Subscribers from the average percentage of VLR Subscribers in that year.

We do this to account for internal seasonality and smoothen for growth/de-growth between years. Looking at seasonal trends since January 2011 (Figure 12), we can see that December-January and August-September are the months with the highest inflows, whereas May-June and October-November are the months with the highest outflows in Delhi.

Undertaking a similar exercise for the city of Mumbai, we see that the first lockdown (April - June 2020) witnessed a bigger drop in the percentage of VLR Subscribers (in-roamers) as compared to the second lockdown (April - June 2021) (Figure 13).

Fig. 12: Monthly Deviation from the Avg. Annual % of VLR Subscribers - Delhi, [2011 - 2024]

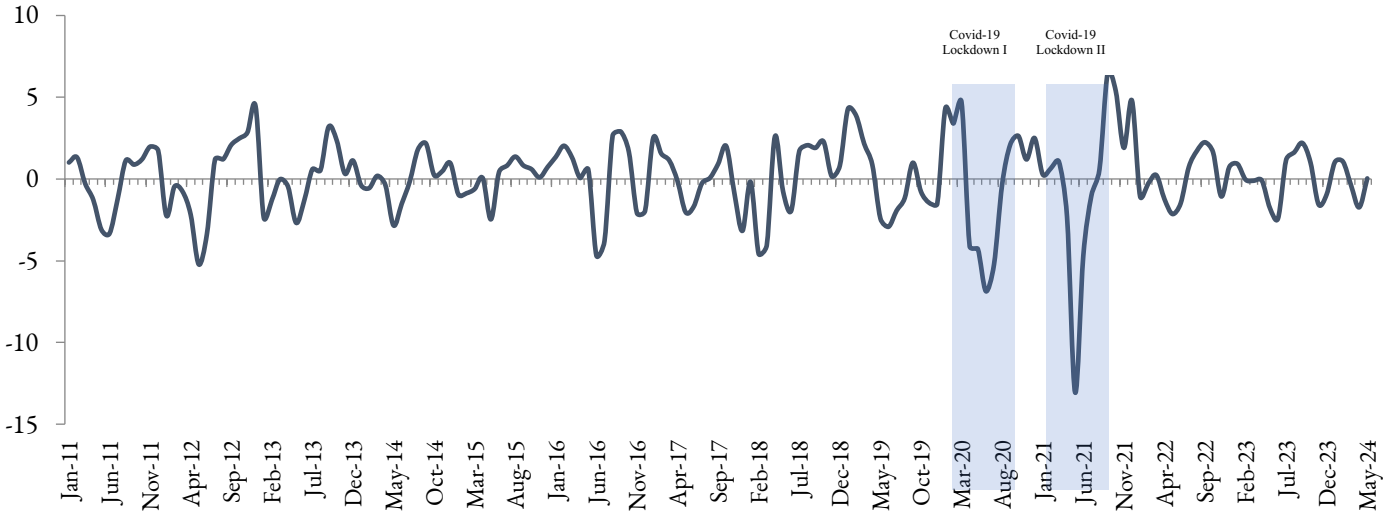
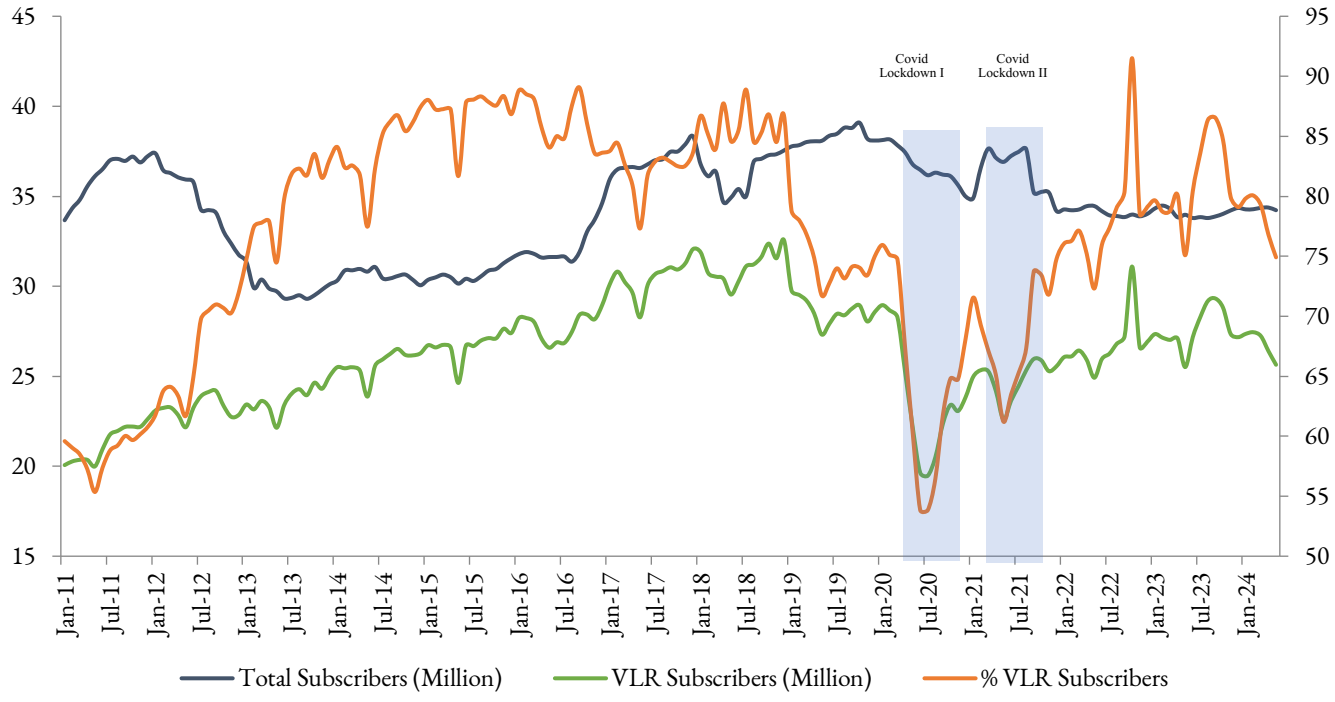


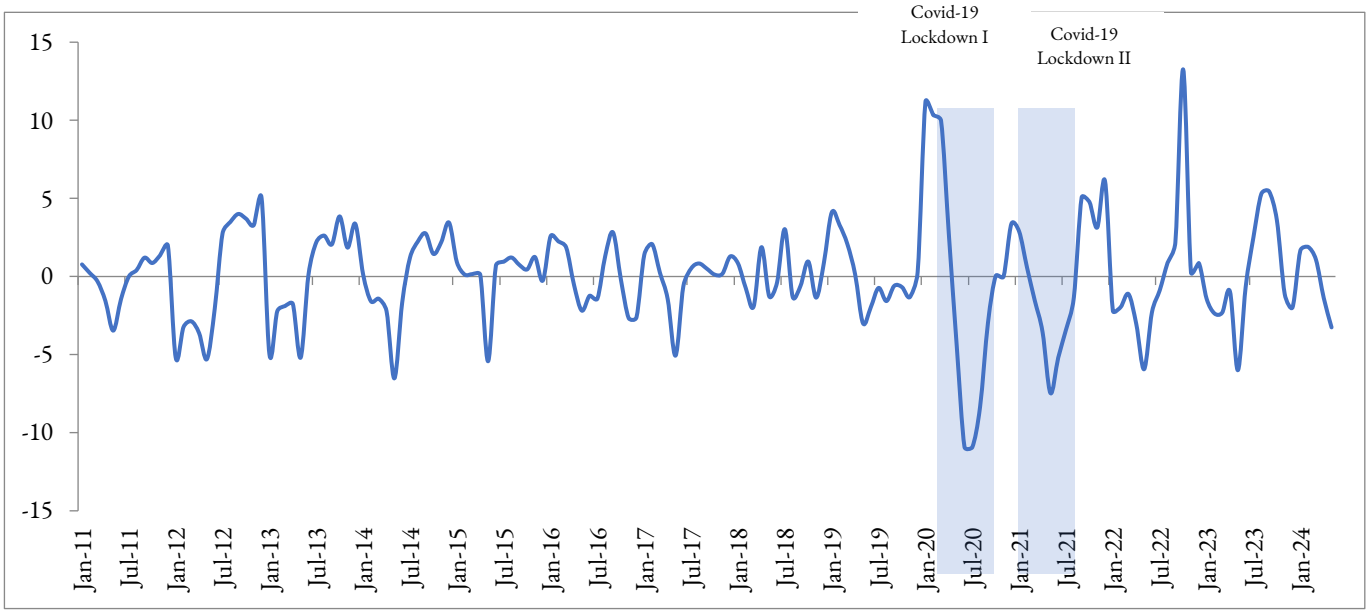
Fig. 13: Monthly trends of Total Wireless Subscribers; Total VLR Subscribers (both Left Axis); % of VLR Subscribers (Right Axis) for Mumbai; January 2011 to May 2024



Looking at the absolute numbers, we again compare the number of VLR Subscribers in July 2019 [the month-year prior to the peak levels of the Pandemic in Mumbai] to the number at the peak of the lockdown in Mumbai (i.e. July 2020), and note a reduction of **8.99 Million**. Similarly, the reduction in the number of *in-roamers* in the second lockdown in July 2021, as against VLR Subscribers in July 2019, was **4.02 Million**.

We now proceed to look at the trends in deviations in the VLR Subscribers as a percentage of the Total Subscribers from the average percentage of VLR Subscribers in that year (Figure 14).

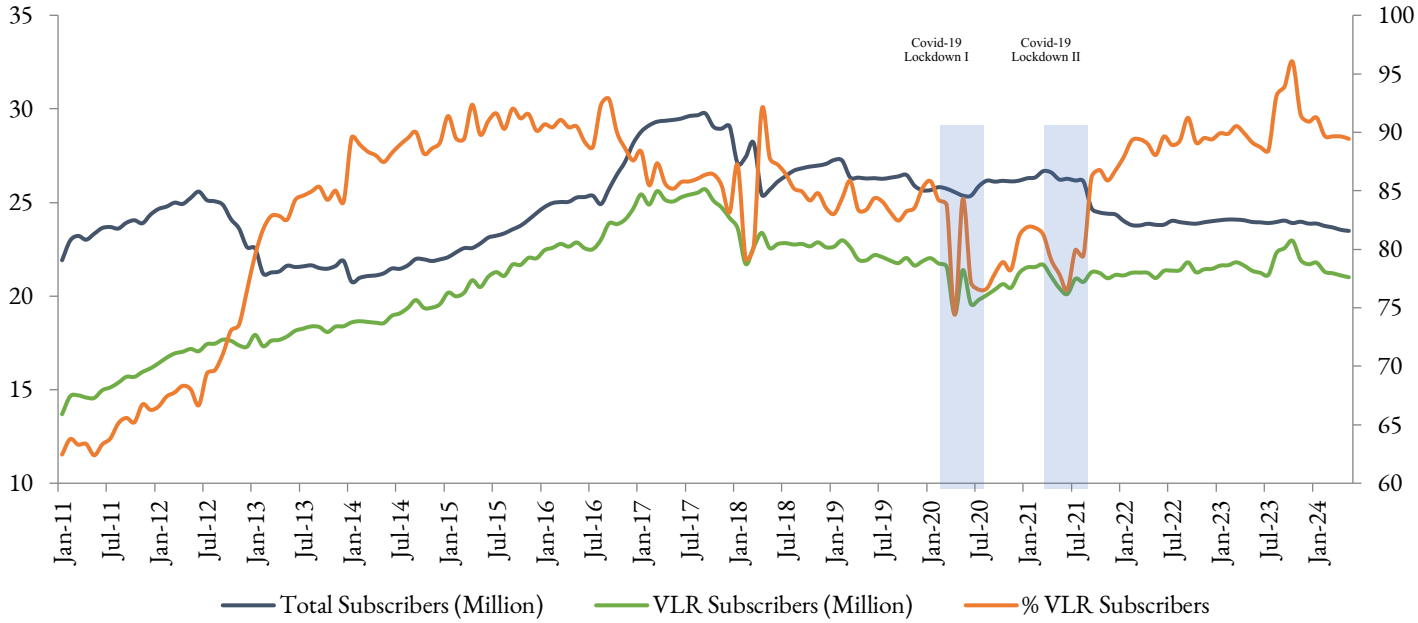
Fig. 14: Monthly Deviation from the Avg. Annual % of VLR Subscribers - Mumbai, [2011 - 2024]



From the seasonal trend, we can see that December-January and September-October are the months with the highest inflows, whereas May-June and January-February are the months with the highest outflows in Mumbai (Figure 8).

Moving on to the city of Kolkata, while we can see a drop in the percentage of VLR Subscribers in the months April - June 2020 (first lockdown) and April - June 2021 (second lockdown), the reduction is far lesser than in Mumbai or Delhi (Figure 15).

Fig. 15: Monthly trends of Total Wireless Subscribers; Total VLR Subscribers (both Left Axis); % of VLR Subscribers (Right Axis) for Kolkata; January 2011 to May 2024



In terms of absolute numbers, comparing the number of VLR Subscribers (*in-roamers*) in June 2019 [the month-year prior to the peak levels of the Pandemic in Kolkata] to the number at the peak of the lockdown in Kolkata (i.e. June 2020), there is a reduction of about 2.6 Million. Similarly, the reduction in the number of VLR Subscribers (*in-roamers*) in the second lockdown in June 2021, as against VLR Subscribers in July 2019, was about 2.08 Million.

Looking at the seasonal trends in the numbers of VLR Subscribers, we see September-November as the months with higher VLR Subscribers (*in-roamers*) i.e higher inflows. On the other hand, the months of June-July were the months of higher outflows.

We now look take a quick look at the other side, i.e. the trends in in-flows and out-flows at the origin. Since there is no data in public domain that could be used to build origin-destination pairs, we take a look at the movement trends in two regions (corresponding to telecom circles) which have been noted for higher outflow of migrants (Ministry of Finance, 2017) viz/ Uttar Pradesh (East) and Bihar. We begin by looking at data from Uttar Pradesh (East) (Figure 17).

Fig. 16: Monthly Deviation from the Avg. Annual % of VLR Subscribers [Kolkata, 2011 - 2024]

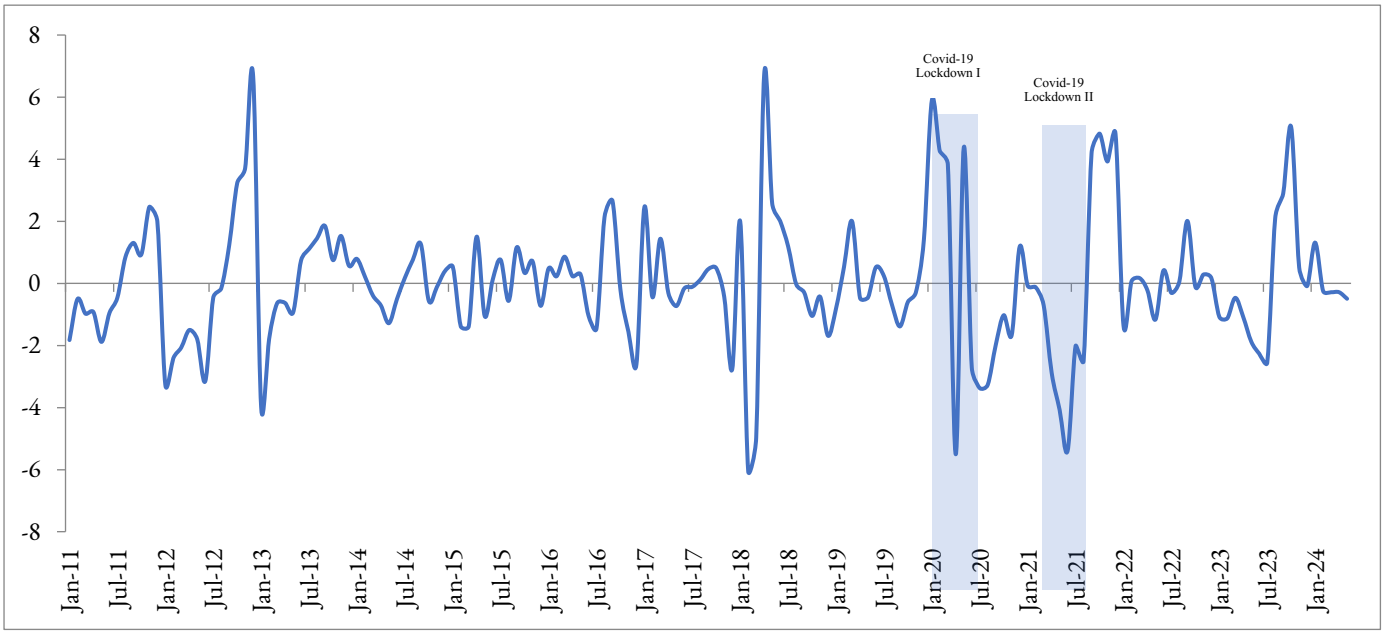
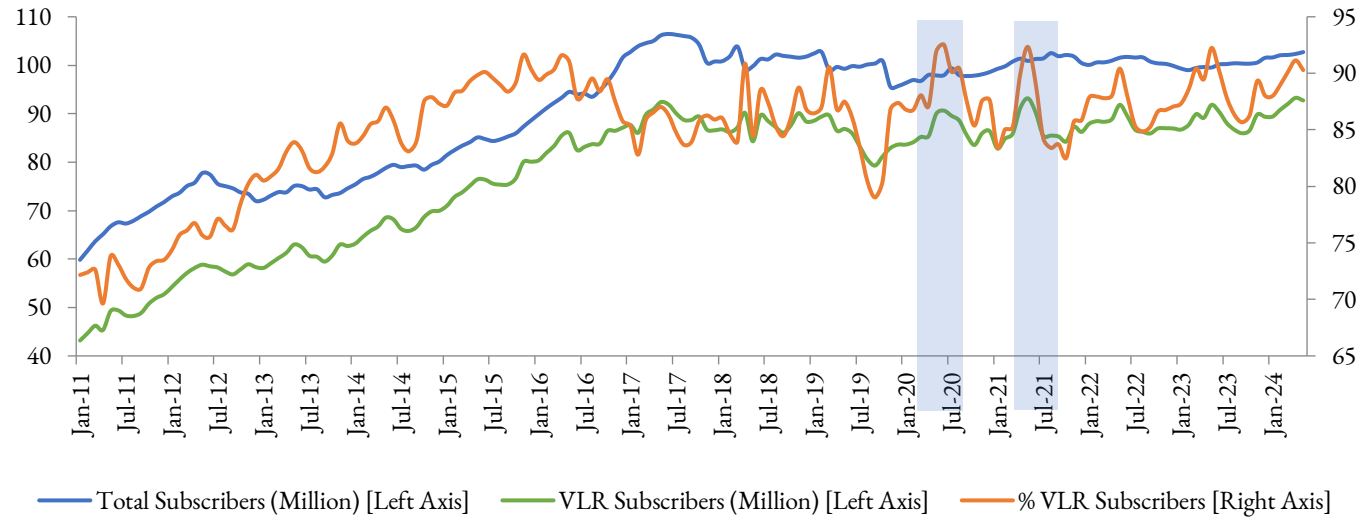
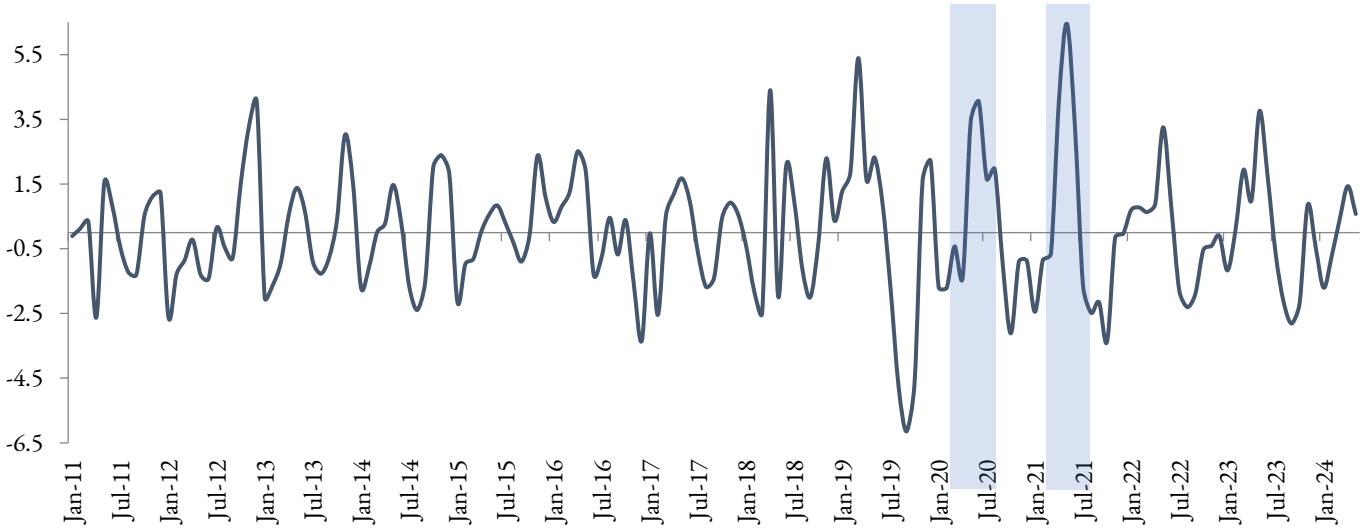


Fig. 17: Monthly trends of Total Wireless Subscribers; Total VLR Subscribers (both Left Axis); % of VLR Subscribers (Right Axis) for UP (East); January 2011 to May 2024



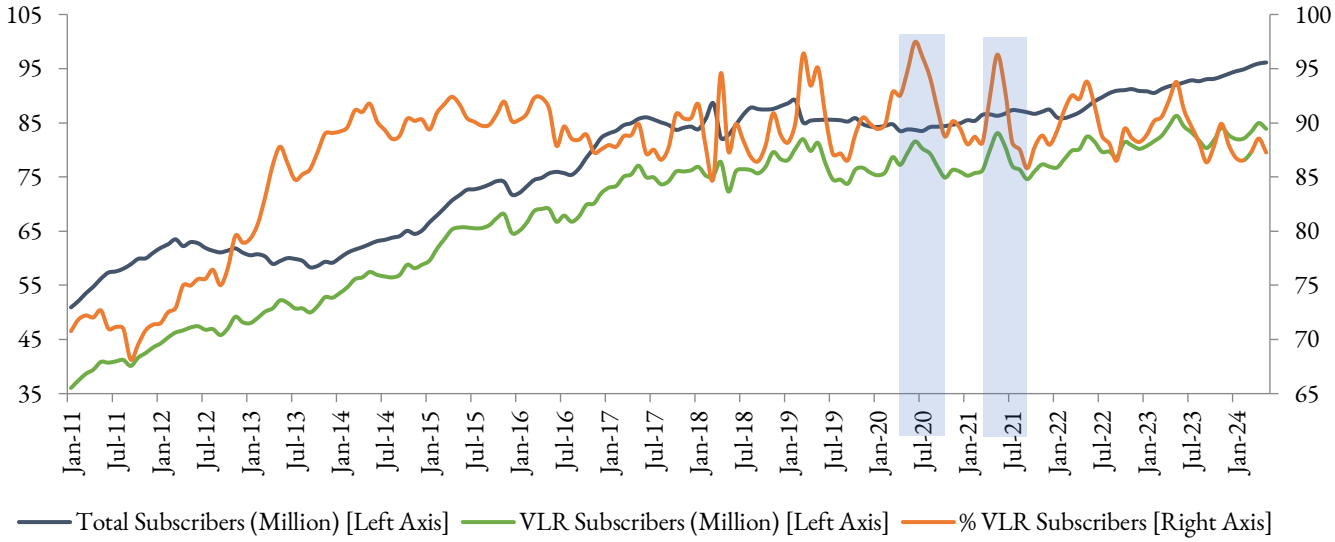
From the above we see that in the period of the two lockdowns, the percentage of in-roamers has shown a substantial increase, indicating a higher than usual return of migrants. Looking at seasonality of movements, we see that the months of highest inflows are April-May and December-January, and the highest outflows are seen in the months of August-September. (Figure 18).

Fig. 18: Monthly Deviation from the Avg. Annual % of VLR Subscribers [UP East, 2011 - 2024]



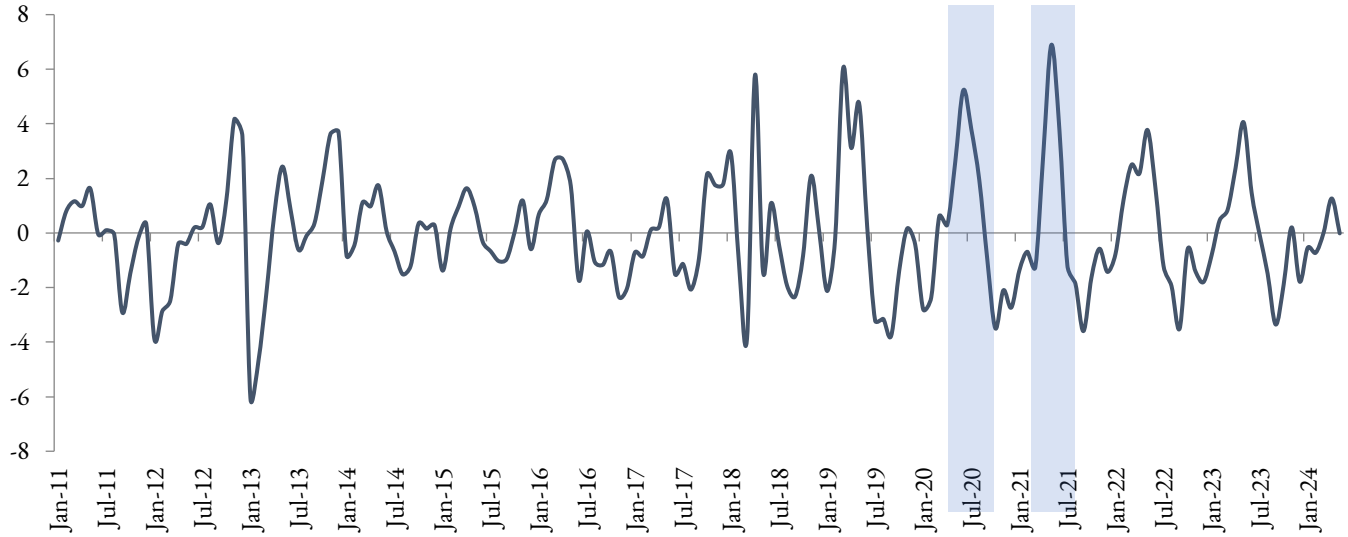
Similar trends for the state of Bihar are at Figure 19.

Fig. 19: Monthly trends of Total Wireless Subscribers; Total VLR Subscribers (both Left Axis); % of VLR Subscribers (Right Axis) for Bihar; January 2011 to May 2024



Here also we can see a higher than usual in-flow of VLR Subscribers (*in-roamers*) in the period corresponding to the Covid-19 Lockdowns (shaded regions in Fig. 20). Looking at the seasonal movement of VLR Subscribers for Bihar (Figure 20), we can see that the months of highest inflow are April-May, and the month with higher-than-average annual percentage of VLR Subscribers is September.

Fig. 20: Monthly Deviation from the Avg. Annual % of VLR Subscribers [Bihar, 2011 - 2024]



The above analysis is an attempt to discern trends in the movement of people using publicly available telecom data. Given a number of constraints, this data has limited applicability for aggregate numbers and for building origin-destination dyads; however, low months in the destinations seem to correspond to high months in the sources. Typically, the summer months of April-June and the winter (festival?) months of September-November are seen as months of maximum movement.

9. Wheels on the bus go round and round...

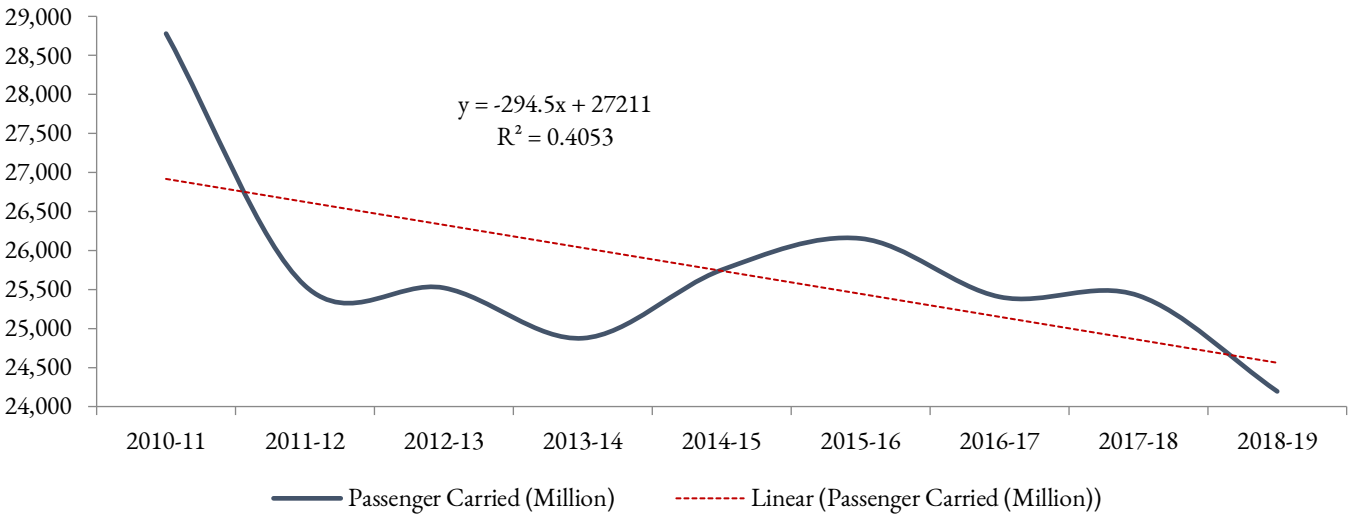
Before we move on to examining the effects of migration on the respective places of origin, we take a quick look at trends in travel by the buses – the other popular mode of inter-city public transport.

Here we make use of data from the *Review of the Performance of State Road Transport Undertakings* (SRTUs) published by the Transport Research Wing of the Ministry of Road Transport & Highways (MoRTH). (Ministry of Road Transport and Highways, n.d.) Tracking the number of passengers carried from 2010-11 to 2018-19 [the last year for which data is available on the MoRTH website], shows a downward trend. It may be kept in view that the figure is of passengers carried or journeys performed, in other words an individual undertaking multiple journeys will be counted multiple times.

Therefore, looking at the trends in passenger numbers travelling in buses does not indicate any significant shift away from Railways to buses. However, there may be variations from State to State.

Fig. 21: Passengers Carried by State Road Transportation Corporations

[Millions, 2010-11 to 2018-19]



10. "Show me the money!"

Evaluating the impact of migrant remittances

Having taken a look at the directions, volumes and seasonal variations of internal migration, we now turn our gaze in the other direction i.e. the impact that migration has at the place of origin, primarily on account of flow of remittances.

Migration of labour has been viewed as a critical component of economic growth and development. It enables the equalization of capital and labour across an economy, incentivizing movement of labour from areas of surplus labour, and movement of capital from areas of surplus capital. (Kone et al. 2018)

Recent trends have indicated that there has been a significant level of migration from rural to urban areas; however, for most rural migrants, there continues to be significant attachment to the place of origin (Bhagat, 2010). Moreover, labour remittances have been noted to be significant contribution to rural household income. (Deshingkar, 2008) Previous studies have shown that remittances received from out-migrants have a significant impact on the socio-economic development in the areas of origin. (Das, Saha, and Chouhan, 2020)

Most prior studies have depended on data from the Census or Surveys for this analysis. Use of such static and non-frequent data sources impairs the analysis of the economic impact of migrants in the place of origin. District-level economic/income data, at regular intervals, and with uniformity across districts, is not always publicly available. In order to address this issue, we use banking data published by the Reserve Bank of India (RBI). In particular, we use the District-wise Deposits of Scheduled Commercial Banks (SCBs) [*Statement No. 4B*] from the RBI Quarterly Statistics on Deposits and Credit of Scheduled Commercial Banks (Reserve Bank of India, n.d.).

This data is granular to the level of districts, and is available at a quarterly interval. The data contains Savings/Capital and Term Deposit account balances in the reporting period.

11. The Debroy-Misra Index of Endogenous Prosperity (DMIEP)

A metric to measure prosperity based on endogenous economic activity

Tracking the economic impact of domestic migration at the place of origin can be a challenge, especially in the absence of domestic remittance data. Some studies have made use of primary survey data, (Das, Saha, and Chouhan, 2020) sample surveys such as the MoSPI, Household Consumption Expenditure Survey, (MoSPI, 2024) or All India Debt & Investment Survey (NSO MoSPI, 2021) for data on ownership of assets etc. However, the challenge has been how to control for endogenous economic activity, i.e. economic growth on account of activities undertaken within the area under observation.

By themselves, savings account balances are a good indicator of income and prosperity; however, increases/decreases in saving account balances could be on account of endogenous economic activity (arising within the district) as well as from transfers [remittances] from other districts.

In order to account for this and to isolate the impact of transfers [remittances] from other districts, instead of looking at saving account balances as such, we analyse the ratio of saving account balances to current account balances. This is because a current account is typically operated by businesses, and offers features that a saving bank account does not.

This gives us a sense of remittances/savings from outside the district. This is qualified with the caveat that there is still a likelihood of income growth from non-formal sectors, such as agriculture or trades, which may not be reflected against a current account.

The ratio of savings account to current account balances captures the relative size of cumulative saving account balances as compared to the cumulative current account balances in the district. A ratio of 1 would therefore indicate that the savings account balances and current account balances are comparable.

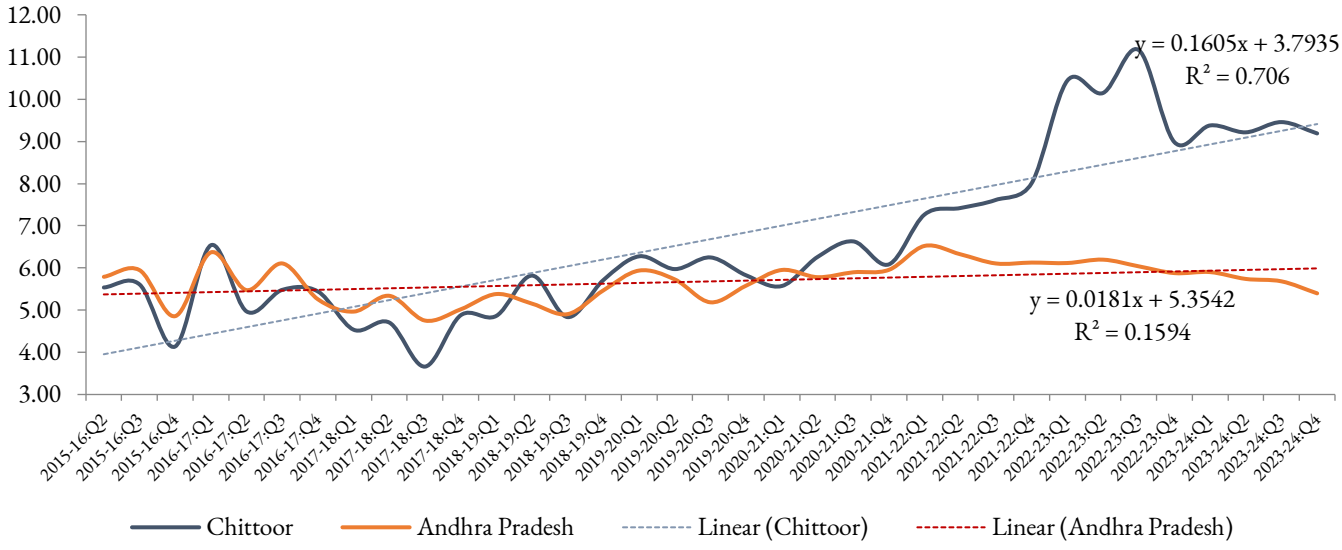
Ratios less than one indicate higher current account balances (a proxy for economic activity in the district) and ratios greater than one indicate higher saving account balances. High ratios for a district are therefore be an indicator of remittances from outside the district since current account balances (a proxy for economic activity in the district) are relatively low.

We see that **districts/cities with greater economic activity** such as Mumbai [0.56], Delhi [2.24], Bangalore [2.21], Chennai [2.08] have a relatively lower ratio [average ratio from 2017-18 to 2022-23]. The **median value** for the **all-India ratio was 3.72**.

We begin by taking a look at the trends in select districts for out-migration (as identified in Economic Survey 2016-17). (Ministry of Finance, 2017) We compare our results against the corresponding ratio of savings to current account deposits for the respective States for context.

We begin by taking a look at Chittoor in Andhra Pradesh, a district noted for high outward migration (Figure 22). We can see that the saving bank deposits have shown a significant uptick post the 2020-21 Q4, broadly corresponding to the Covid-19 lockdown period.

Fig. 22: Trends in Ratio of Quarterly Savings Account Balances and Current Account Balances in for the District of Chittoor and State of Andhra Pradesh [2015-16 to 2023-24]



This is an indicator of the transfer deposits [remittances] increasing in the district at a far higher rate than the rest of the State, especially in the post-Covid period.

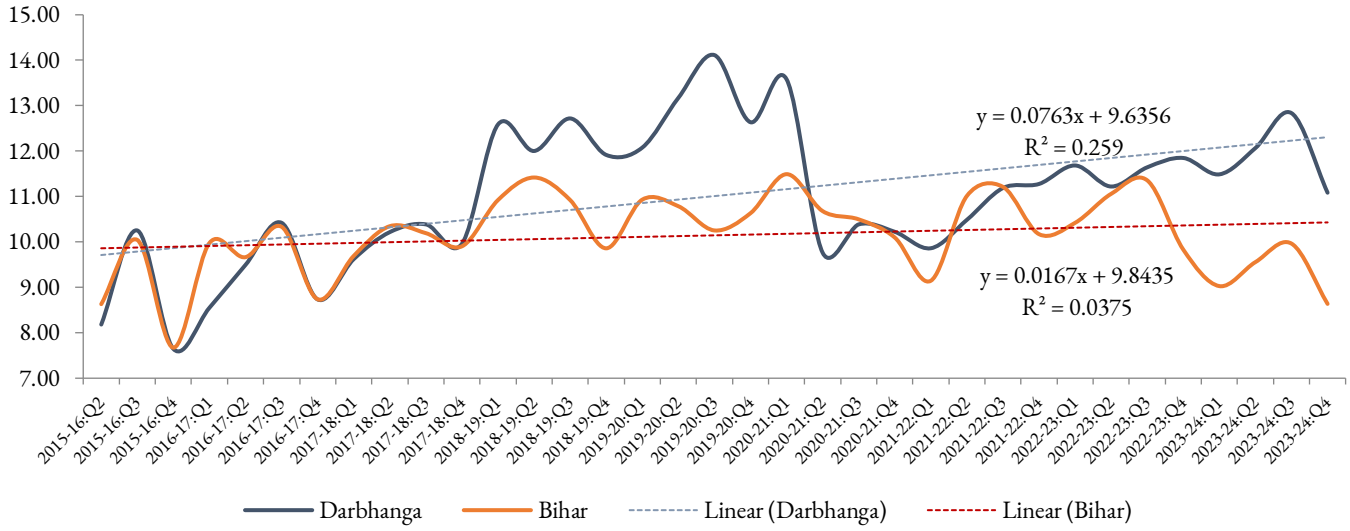
Similarly, we look at the trends in Darbhanga and compare it to average trends for the State of Bihar (Figure 23). It may be noted that Bihar's average ratio of Savings Deposits to Current Account Deposits for the period 2015-16 to 2023-24 is 10.14 which is significantly higher than the all India figures of 3.6 across the same period.

Even when compared against these already high figures, we can see the ratio for Darbhanga has remained higher than the State average.

In order to scope a more macro-level view, we look at the average ratio of Savings Account Deposits to Current Account Deposits from 2017-18 to 2022-23, for all districts in the country.

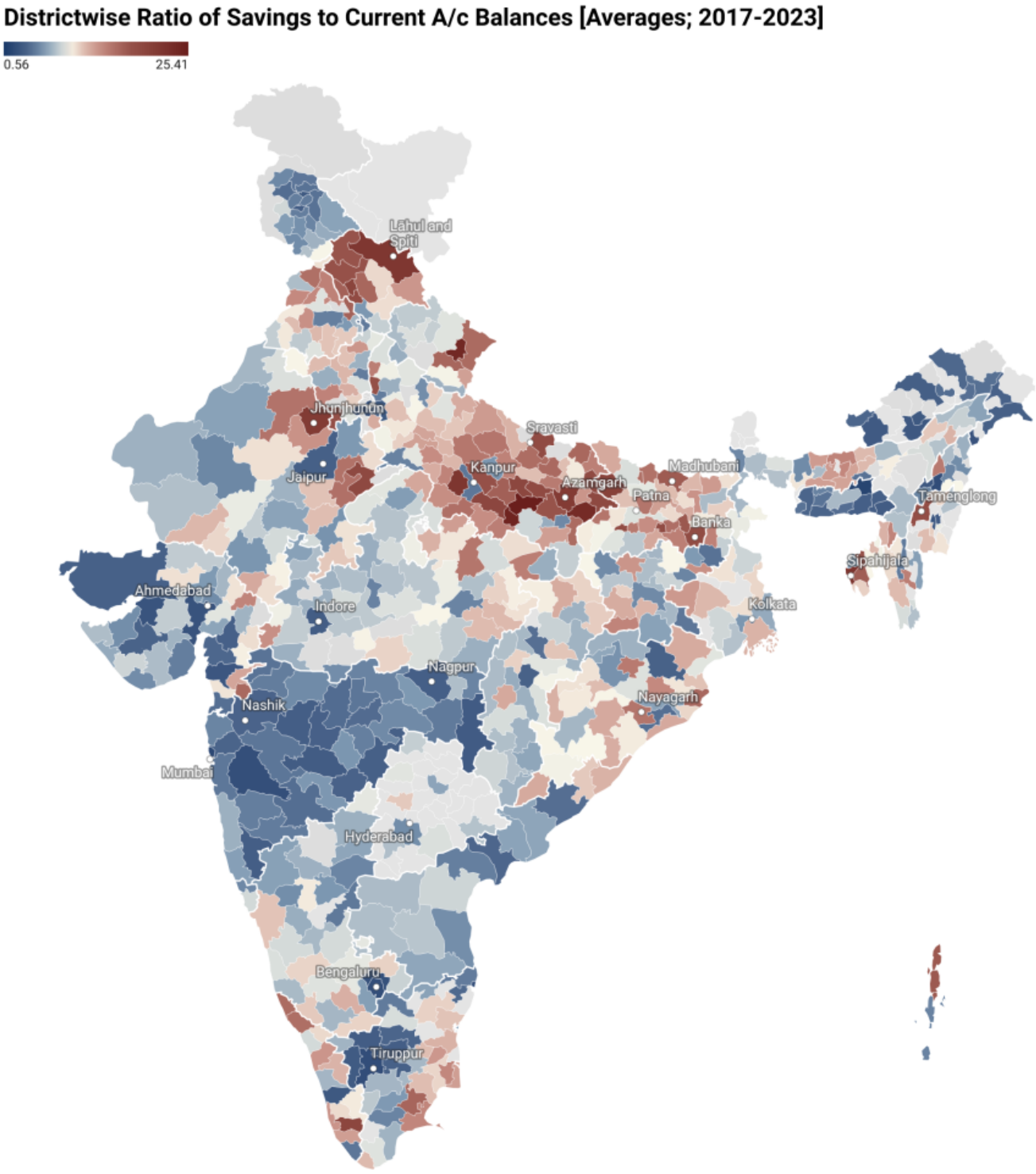
The districts/cities with low savings-to-current account ratios are typically places with high levels of economic activity, which often act as a magnet for migration. (Ministry of Housing and Urban Affairs, 2019) On the other hand, cities with relatively higher savings to current account balances are seen as having limited economic activity.

Fig. 23: Trends in Ratio of Quarterly Savings Account Balances and Current Account Balances in for the District of Darbhanga and State of Bihar [2015-16 to 2023-24]



A district level map of the average ratio of Savings Account Deposits to Current Account Deposits from 2017-18 to 2022-23 is Figure 24. We might add here that not all districts with a high DMIEP ratio would be witnessing out-migration; however districts with high out-migrations are likely to see a growth in saving account deposits.

Fig. 24: District-wise ratio of Savings to Current Account Deposits [avg.; 2017-18 to 2022-23]



12. Conclusion

While we study its economics and geography, migration is essentially a journey of hope, of dreams and aspirations and of the unyielding human pursuit of a better tomorrow. Understanding the patterns and the ebbs and flow of migration helps us gain a better understanding of how many are

moving, from where and to where are they moving, when is it that they move, and what the impacts of this move might be.

This paper is an attempt to address the issue of timeliness of availability of data for analysing trends in domestic migration, especially that of blue-collar migration. While the decennial Census provides comprehensive and granular migration data, there remains a significant lag by the time the data can be analysed. Household surveys capturing data on domestic migration are restricted by the size of their dataset, and have limited use in studying source-destination dyads, seasonal trends, event study on trends in migration etc.

In this paper, we use high-frequency, granular data from multiple sources to address the above issues. Our primary data sources are data from the Indian Railways Unreserved Ticketing System (IR-UTS) and data from the Telecom Regulatory Authority of India (TRAI) on Visitor Location Register (VLR) roaming subscribers.

Further, in order to track the impact of out-migration on the originating districts, we use publicly-available, district-level, quarterly banking data published by the Reserve Bank of India (RBI) to construct an index to isolate and track effects of remittances originating from outside of the district. This is intended as a quick proxy for examining the economic impact of out-migration in the source districts.

In addition to migration we also explore related topics, such as the impact on urbanization - especially the growth of cities, commuter zones, and popular movement dyads. Further, given that most migration is borne out of a desire for better opportunities, and is seen as having an impact in improving incomes, we attempt to discern the extent of impact that out-migration has in the places of origin.

The highlights from our study are as under:

- Overall domestic migration in India is slowing. We estimate the overall **number of migrants** in the country, as of **2023**, to be **40,20,90,396**. This is about 11.78% lower as compared to the number of migrants enumerated as per Census 2011 [45,57,87,621]. Consequently, the migration rate which stood at **37.64%** as per Census, 2011 is estimated to have since **reduced to 28.88%** of the population.
- We hypothesize that this is on account of **availability of improved services**. such as education, health, infrastructure, and **connectivity**, as well as **improved economic opportunities** in or near in major sources of migration, and is an indicator of overall economic growth.
- Looking at the spatial dimensions of travel, the top origin districts are coalesced around major urban agglomerations, viz. Delhi, Mumbai, Chennai, Bangalore, Kolkata etc. Not only is this in line with **gravity models of migration**, but also a tentative confirmation of priors, i.e. **short-distance migration** accounts for the largest share of migrants, and **distance has a negative effect** on labour flows.

- The composition of the top five recipient States attracting migrants [all migrants including intra-State migrants] has changed. West Bengal and Rajasthan are the new entrants, while Andhra Pradesh and Bihar are now ranked a notch lower.
- Even amongst the top five recipient States the percentage of predicted migrants headed to the respective States has reduced. This could be on account of an overall reduction in the migration rate, or could indicate a greater spatial spread in the outward movement of passengers.
- West Bengal, Rajasthan, and Karnataka are the States showing the maximum amount of growth in percentage share of the arriving passengers. Similarly, **Maharashtra and Andhra Pradesh** are States where the percentage **share of total migrants has reduced**.
- Mumbai, Bengaluru Urban, Howrah, Central Delhi, and Hyderabad are the districts attracting **most migrant arrivals**, while Valsad, Chittoor, Paschim Bardhaman, Agra, Guntur, Villupuram and Saharsa are the **top origin districts.**
- We use the data to identify **popular State-to-State** and **district-to-district dyads**. At the State level, *Uttar Pradesh - Delhi*; *Gujarat - Maharashtra*; *Telangana - Andhra Pradesh,* and *Bihar - Delhi* emerge as the primary dyads of movement.
- At the district level, *Murshidabad - Kolkata*; *Paschim Bardhaman - Howrah*; *Valsad - Mumbai*; *Chittoor - Bengaluru Urban,* and *Surat - Mumbai* are the most popular routes for migration between districts. This has implications for urban planning as well as for planning of transportation networks.
- We make use of TRAI roaming data to identify the seasonality of movement of migration. We find that **April-June** are the high months for movement with **November-December** witnessing secondary highs. These are perhaps months where most migrant labour travel back to their places of origin. A secondary high in winter time is perhaps indicative of travel around the festival/marriage season. January, on the other hand, appears to be the month of lowest travel.
- Even prior to the pandemic related lockdowns, there were signs of the passenger movement showing little growth, however after the pandemic, even the high months (i.e. Apr-May) are at a **distinctly lower level** as compared to the corresponding period before the pandemic - passenger levels for May 2023 being **6.67% lower** than the corresponding number for May 2012.
- Further, it is interesting to note that that a **majority** [>75%] of our predicted migration flows are **within 500 kms of the origin** (Figure 10). This is in line with gravity models, and theories such as Ravenstein's Theory of Human Migration.

Having made the above observations regarding domestic migration in India, we do acknowledge the challenges in being able to completely capture the spatial-temporal trends of a phenomenon as complex as migration. While our methods can give a general idea about the trends, we eagerly await the decennial Census to check the accuracy of our findings.

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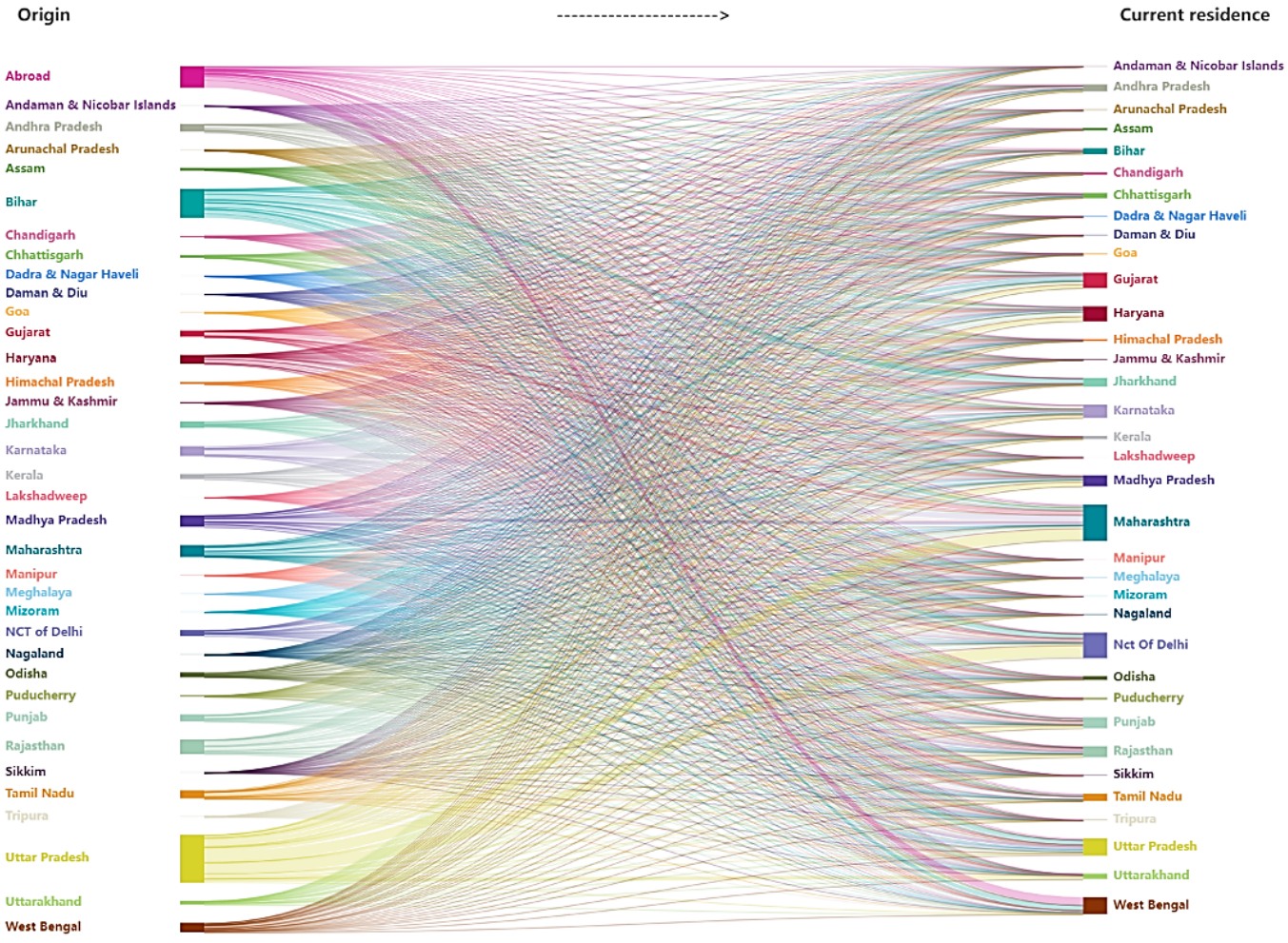
Appendix A

Trends and patterns of the migration as per Census 2011

We begin by capturing the State-to-State movement of migrants (Figure A1). In the figure, the states on the left hand side are the origin states while those on the right are the recipient/destination states. The relative thickness of the lines indicates the volume of movement.

Fig. A1: Migrant population by State/UT of origin and State of Current Residence

Source: Census, 2011



Above figures are for Total Persons; All durations of stay

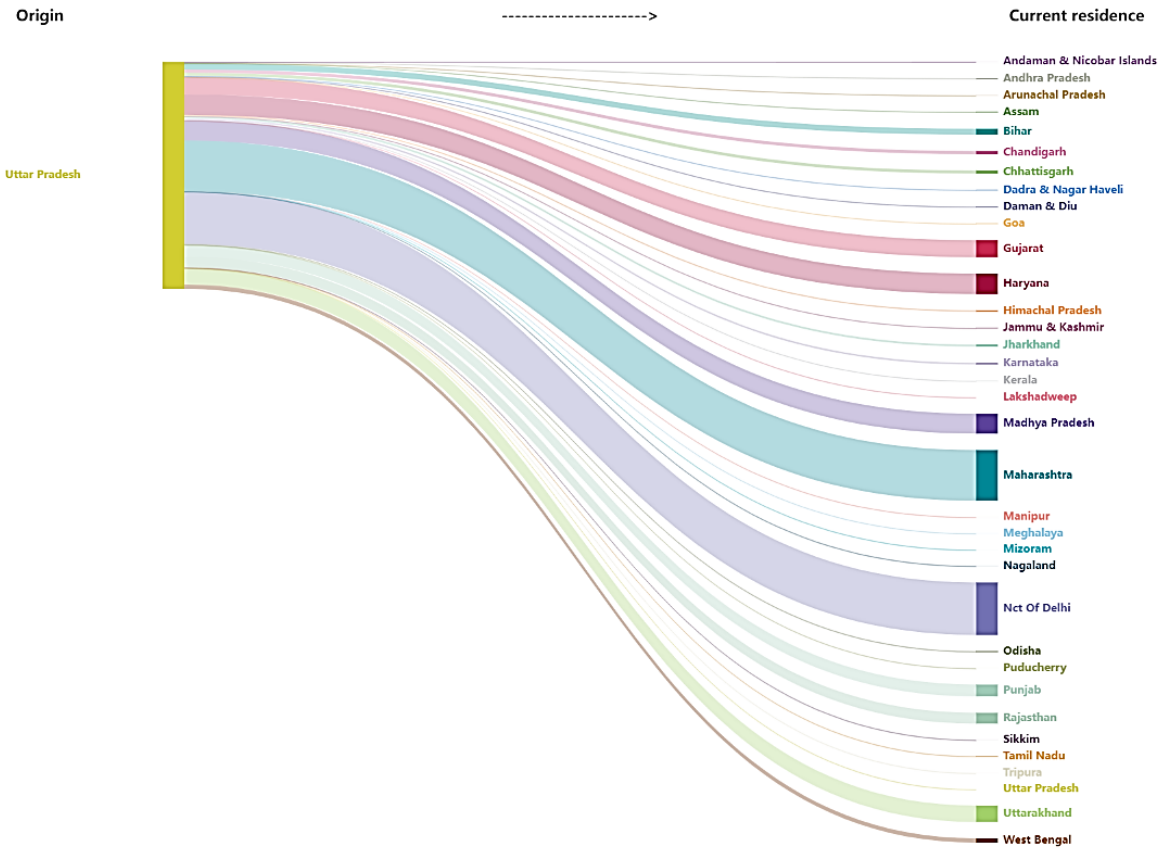
While, the above figure is far too dense for meaningful analysis, however there are a few important takeaways – the left (origin) side clearly indicates that the primary sources/**origin States** for inter-State migration are Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh (MP), Maharashtra, and 'Abroad'. Similarly, the major **destination States** for inter-State migration are Maharashtra, Delhi, Gujarat, West Bengal and Haryana.

The Census Tables have granular details of the exact numbers of migrants, along with parameters such as gender, duration of residence at the destination, educational attainment etc. Since the focus of the instant paper is more on the recent trends in migration, we refrain from going into too great a detail on the 2011 Census migration patterns.

However, for context, we take a quick look at the direction and volume of migration from the primary origin States. It needs to be kept in mind that these are total migrations i.e. due to all causes. The out migrations from select origin States and from Abroad are Figure A2 – E2.

Fig. A2: Migrant population by State of origin – Uttar Pradesh and State of Current Residence

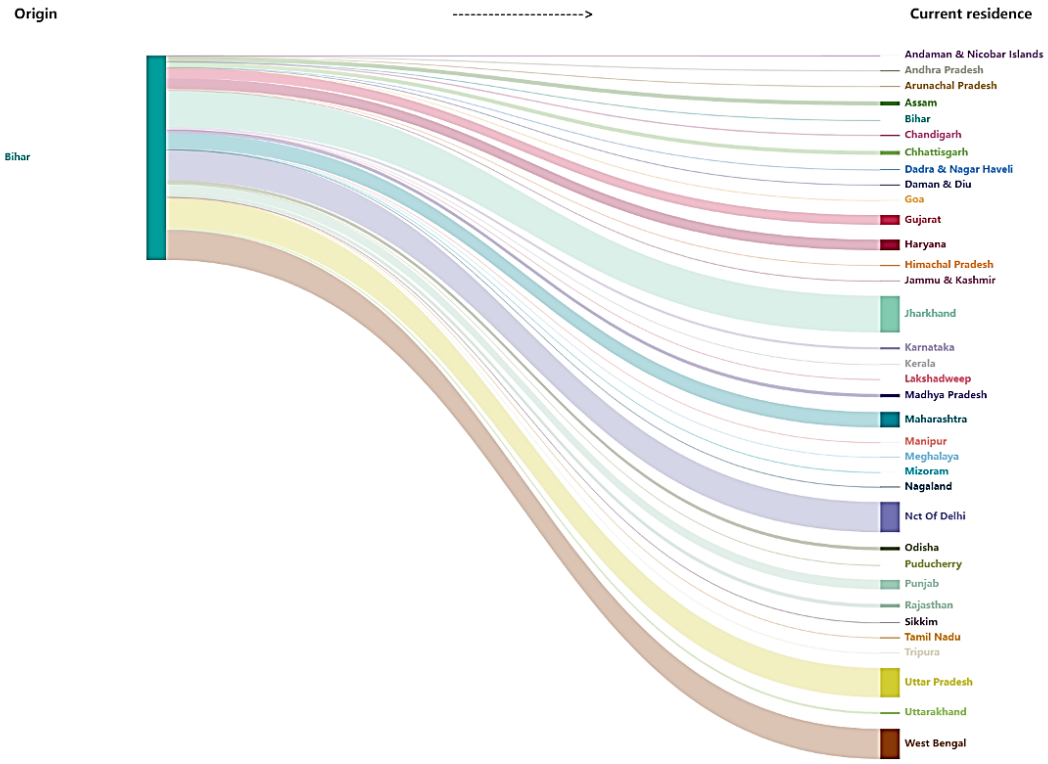
Source: Census, 2011



Above figures are for Total Persons; All durations of stay

Fig. B2: Migrant population by State of origin – Bihar and State of Current Residence

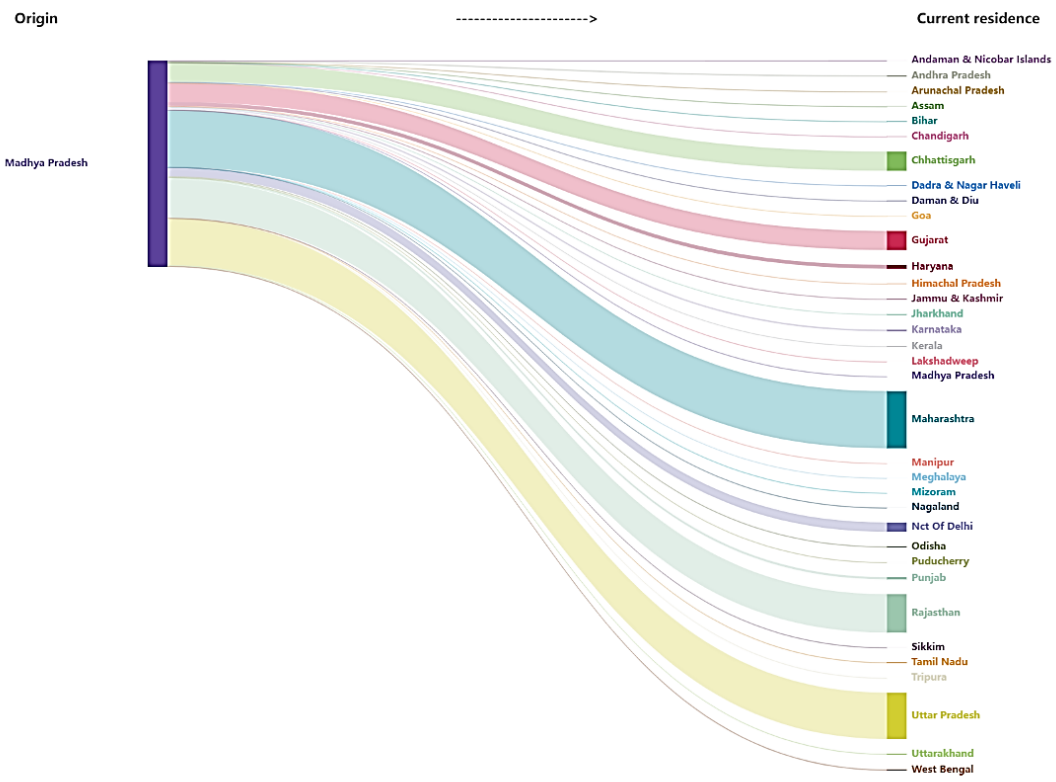
Source: Census, 2011



Above figures are for Total Persons; All durations of stay

Fig. C2: Migrant population by State of origin – Rajasthan and State of Current Residence

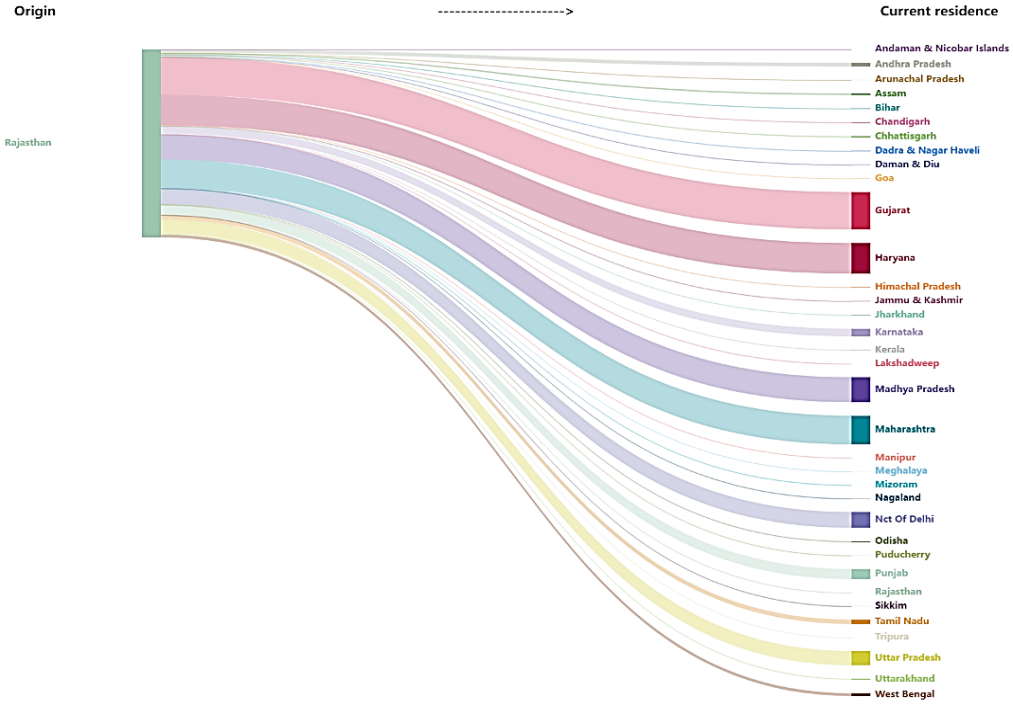
Source: Census, 2011



Above figures are for Total Persons; All durations of stay

Fig. D2: Migrant population by origin – Madhya Pradesh and State of Current Residence

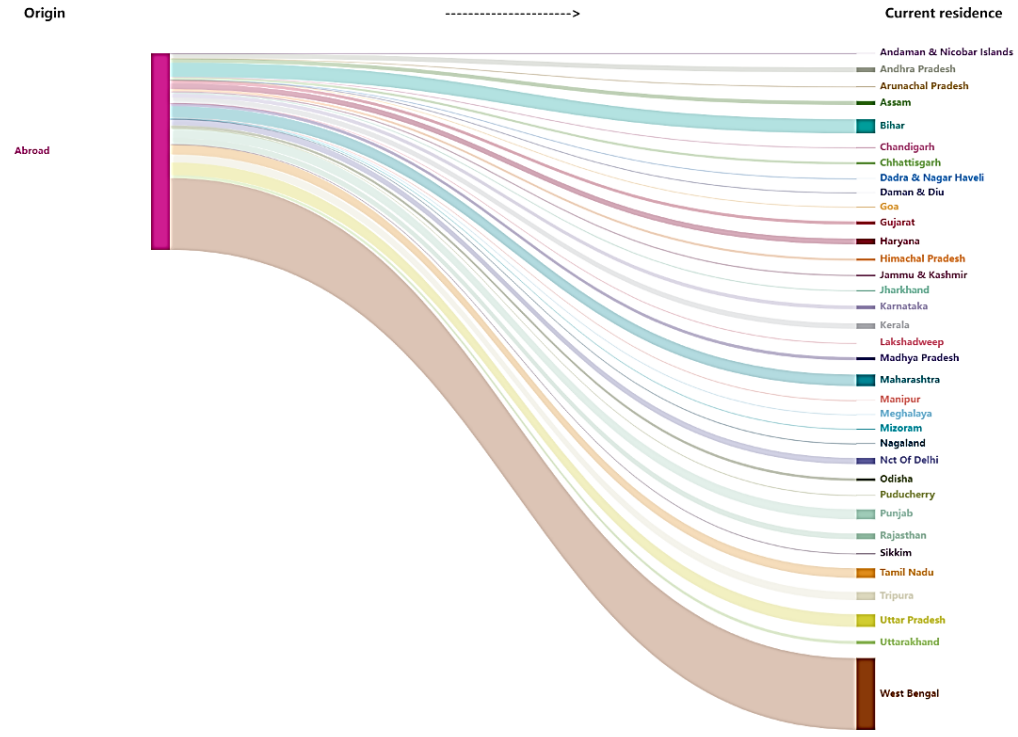
Source: Census, 2011



Above figures are for Total Persons; All durations of stay

Fig. E2: Migrant population by origin – Abroad and State of Current Residence

Source: Census, 2011



Above figures are for Total Persons; All durations of stay

Based on the above, the popular Source-Destination pairs along with number of persons moving between them [as per Census, 2011] is summarized below [Table 1].

Table 1: Top 30 Source and Destination State Pairs with total number of Migrants, Census 2011

Origin State	Destination State	Total Migrants
Uttar Pradesh	State - NCT OF DELHI (07)	28,54,297
Uttar Pradesh	State - MAHARASHTRA (27)	27,54,706
Karnataka	State - MAHARASHTRA (27)	13,99,591
Bihar	State - JHARKHAND (20)	13,36,048
Uttar Pradesh	State - HARYANA (06)	11,13,535
Bihar	State - NCT OF DELHI (07)	11,06,629
Bihar	State - WEST BENGAL (19)	11,03,757
Uttar Pradesh	State - MADHYA PRADESH (23)	10,90,881
Bihar	State - UTTAR PRADESH (09)	10,72,739
Gujarat	State - MAHARASHTRA (27)	9,83,653
Maharashtra	State - GUJARAT (24)	9,71,975
Uttar Pradesh	State - GUJARAT (24)	9,29,411
Andhra Pradesh	State - KARNATAKA (29)	8,90,697
Uttar Pradesh	State - UTTARAKHAND (05)	8,90,663
Madhya Pradesh	State - MAHARASHTRA (27)	8,24,624
Rajasthan	State - GUJARAT (24)	7,47,445
Tamil Nadu	State - KARNATAKA (29)	7,36,821
Madhya Pradesh	State - UTTAR PRADESH (09)	6,68,537
Haryana	State - NCT OF DELHI (07)	6,66,331
Uttar Pradesh	State - PUNJAB (03)	6,49,557
Rajasthan	State - HARYANA (06)	6,11,160
Maharashtra	State - KARNATAKA (29)	5,86,864
Uttar Pradesh	State - RAJASTHAN (08)	5,85,982
Rajasthan	State - MAHARASHTRA (27)	5,70,233
Bihar	State - MAHARASHTRA (27)	5,68,667
NCT of Delhi	State - UTTAR PRADESH (09)	5,66,210
Madhya Pradesh	State - RAJASTHAN (08)	5,54,058
Haryana	State - PUNJAB (03)	5,45,584
Punjab	State - HARYANA (06)	5,38,328
Haryana	State - RAJASTHAN (08)	5,33,963

Source: Census, 2011 [Table DS-0000-D03-MDDS]
Figures are Total Migrants; All Reasons; All Durations; States names are as per Census Codes

While, the above captures all migrants – irrespective of the reason for migrating, we also look at the numbers for migrants moving for economic reasons i.e. for reasons stated as *Work/Employment* or *Business*. The top 30 routes for movement for economic reasons is Table 2.

Table 2: Top 30 Source and Destination Pairs for Migrants moving for Economic Reasons

Origin State	Destination State	Migrants for Economic Reasons [Work/Employment or Business]
Uttar Pradesh	State - MAHARASHTRA (27)	11,36,753
Uttar Pradesh	State - NCT OF DELHI (07)	9,19,207
Bihar	State - NCT OF DELHI (07)	4,10,601
Uttar Pradesh	State - GUJARAT (24)	3,74,311
Bihar	State - WEST BENGAL (19)	3,15,180
Uttar Pradesh	State - HARYANA (06)	3,07,409
Bihar	State - JHARKHAND (20)	3,06,335
Karnataka	State - MAHARASHTRA (27)	2,89,474
Bihar	State - MAHARASHTRA (27)	2,68,628
Uttar Pradesh	State - PUNJAB (03)	2,35,894
Tamil Nadu	State - KARNATAKA (29)	2,21,881
Andhra Pradesh	State - KARNATAKA (29)	2,13,578
Uttar Pradesh	State - UTTARAKHAND (05)	2,09,047
Rajasthan	State - GUJARAT (24)	2,04,967
Maharashtra	State - GUJARAT (24)	2,01,991
Madhya Pradesh	State - MAHARASHTRA (27)	1,95,855
Gujarat	State - MAHARASHTRA (27)	1,93,065
Uttar Pradesh	State - MADHYA PRADESH (23)	1,81,027
Rajasthan	State - MAHARASHTRA (27)	1,80,959
Bihar	State - UTTAR PRADESH (09)	1,68,222
Haryana	State - NCT OF DELHI (07)	1,41,792
Uttar Pradesh	State - RAJASTHAN (08)	1,10,512
NCT of Delhi	State - UTTAR PRADESH (09)	87,778
Rajasthan	State - HARYANA (06)	66,919
NCT of Delhi	State - HARYANA (06)	66,599
Punjab	State - HARYANA (06)	65,423
Jharkhand	State - WEST BENGAL (19)	63,504
Maharashtra	State - MADHYA PRADESH (23)	61,348
Madhya Pradesh	State - RAJASTHAN (08)	61,303
Maharashtra	State - KARNATAKA (29)	60,207

Source: Census, 2011 [Table DS-0000-D03-MDDS]
Figures are Total Migrants; Economic Reasons; All Durations; States names are as per Census Codes

Notes

[1] Established in 1986, the Centre for Railway Information Systems (CRIS) is an organization under Ministry of Railways tasking with developing/maintaining software for key functional areas of the Indian Railways. CRIS secure file transfer communication dated 13.02.2024 and 03.05.2024 are referred. See https://cris.org.in/loadpage?page=proUTS

[2] https://www.indiabudget.gov.in/budget2017-2018/es2016-17/echapter.pdf

[3] See https://trai.gov.in/release-publication/reports/telecom-subscriptions-reports

[4] See https://dot.gov.in/sites/default/files/list%20of%20unifiedaccess%20licensees_0.pdf?download=1

[5] See https://website.rbi.org.in/web/rbi/publications/chapters?category=24928085

[6] https://www.indiabudget.gov.in/budget_archive/es2001-02/chapt2002/chap107.pdf

[7] https://mospi.gov.in/sites/default/files/national_data_bank/census_data_pro/Work_Participation_rate_Census%202001.pdf

[8] Railway Statistics Synopsis 2020 (Statistics for 2019)" (PDF). International Union of Railways

[9] *Number of journeys x mean kilometric distance*; https://indianrailways.gov.in/railwayboard/uploads/directorate/stat_econ/yearbook10-11/Passenger_business.pdf

[10] See Lok Sabha PAC 69th Report (2016-17); Suburban Train Services In Indian Railways; https://eparlib.nic.in/bitstream/123456789/65704/1/16_Public_Accounts_69.pdf

[11] CRIS secure file transfer communication dated 13.02.2024 and 03.05.2024 refers

[12] Census 2011; DS-0000-D03-MDDS; Migrants within the State/UT by place of last residence, duration of residence and reason of migration – 2011

[13] Lok Sabha Unstarred Q. No. 890; Answered on 25th July, 2023; *https://sansad.in/getFile/loksabhaquestions/annex/1712/AU890.pdf?source=pqals*

[14] Launched on 25th December, 2000 the Pradhan Mantri Gram Sadak Yojana is a scheme aimed at providing all-weather access to eligible unconnected habitations; https://omms.nic.in/ReferenceDocs/PMGSY_Guidelines.pdf

[15] Pradhan Mantri Gram Sadak Yojana (PMGSY) Dashboard; *https://omms.nic.in/dbweb/Home/TimeSeries*

[16] Launched on 20th November 2016, Pradhan Mantri Awas Yojana – Rural (PMAY – Rural) aims to provide housing for the poorest segments of society with the beneficaries being selected by a three stage process. https://pib.gov.in/PressReleasePage.aspx?PRID=2074713#:~:text=Under%20the%20Pradhan%20Mantri%20Awas,of%20millions%20of%20rural%20families

[17] https://rhreporting.nic.in/netiay/PhysicalProgressReport/YearWsHsCompSchemePhaseWise_InterimRpt.aspx

[18] https://pib.gov.in/PressReleasePage.aspx?PRID=1883918

[19] https://pib.gov.in/PressNoteDetails.aspx?NoteId=152025&ModuleId=3&reg=3&lang=1

[20] https://pib.gov.in/PressReleasePage.aspx?PRID=2040566

[21] https://dot.gov.in/sites/default/files/list%20of%20unifiedaccess%20licensees_0.pdf?download=1

[22] TRAI Monthly Reports; https://trai.gov.in/release-publication/reports/telecom-subscriptions-reports?field_start_date_value%5Bvalue%5D=&page=16

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IPPR

Compensating for the Fiscal Loss in India's Energy Transition

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Abstract

India has committed to ambitious targets, aiming to achieve net-zero emissions by 2070; however, this transition away from fossil fuels presents significant fiscal and institutional challenges, that warrant careful examination. This study primarily explores the dynamics of tax revenues and the fiscal implications of India's transition. As fossil fuel consumption declines over time, government revenues generated from fossil fuels are also expected to decrease relative to GDP. The research delves into the institutional challenges related to enhancing existing tax systems, and considers the viability of implementing a carbon tax as an alternative revenue source to replace fossil fuel taxes. The study assesses various tax revenue options, evaluating their effectiveness in revenue generation, long-term sustainability required institutional changes, and the preservation of state autonomy. Allocating revenue between the union and individual states can be an intricate task. The study highlights the potential of carbon taxes as a valuable medium-term solution to address revenue loss. However, it also underscores the challenges associated with their implementation, including institutional barriers and political-economic complexities, particularly within India's fiscal-federal structure. Active engagement from institutions like the Finance Commission and the GST Council is emphasised, recognising their critical roles in managing this transition and mitigating its impact on state-level fiscal autonomy.

Keywords: Energy Transition, Tax Restructuring, Fossil Fuel Revenue, Carbon Tax, Goods and Services Tax

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1. Introduction

The global energy landscape is undergoing a significant transformation, as countries strive to transition from fossil fuel-based systems to more sustainable and renewable energy sources. This shift, commonly referred to as the energy transition, is driven by the pressing need to address climate change by reducing greenhouse gas (GHG) emissions created by conventional fuels such as coal, petroleum, and natural gas.

India is in the midst of a transformative energy transition as it seeks to move away from fossil fuels and embrace clean, sustainable energy sources. India has committed to achieving its goal of reaching net-zero emissions by 2070. This shift poses significant fiscal and institutional challenges that require careful consideration. In this study, we will explore a crucial question: how to effectively handle the fiscal transition accompanying the move away from fossil fuels.

Fossil fuels have long served as a significant source of revenue for both the Union and state governments in India. These revenues primarily stem from the consumption of petroleum products, with coal contributing to a lesser extent, while income generated from production (extraction) is relatively lower. Laan and Maino (2022) estimate that about 87% of total revenues are generated from consumption. The key issue, however, lies in the magnitude of these revenues. Bhandari and Dwivedi (2022a, 2022b) estimated that the total revenues from fossil fuels in 2019-2020 accounted for 3.2% of India's GDP, which respectively translated into 15.0% and 6.2% of total Union and aggregate State government budgetary expenditures.

As India moves away from fossil fuels, a significant part of its revenue will reduce. So, both the Union and State governments will need to find alternative methods of revenue collection. This paper focuses on identifying these sources of additional revenue. The objective is not to identify a single solution, but rather to consider the range of possible solutions.

The issue is not simply of tax revenue collection, but also of what is feasible under India's federal structure, which divides various powers of taxation between Union and State governments. Moreover, some states are more dependent on fossil fuel revenues, such as Jharkhand, Orissa, and Chhattisgarh, the key coal-producing states. This fact poses another challenge: income generated from any new sources would either need to be allocated more to States that stand to lose more, or States should be granted autonomy to choose their own tax rates. While the Constitution of India provided significant tax collection powers to State governments, the introduction of a nationwide Goods and Services Tax (GST) regime has reduced it, and individual States are not free to change GST rates for items that are covered under it.

Some may argue that allowing differential rates across States is an avoidable measure. In this paper, our objective is not to advocate for a specific viewpoint, but rather to comprehensively outline the array of available options and examine their implications.

There is also a growing discussion in India about introducing taxes based on carbon emissions. However, it is not clear how these might be instituted under its federal structure. That is, it is unclear who would levy these taxes, who would collect them, and how they would be distributed.

Therefore, to ensure the long-term sustainability of the energy transition and support India's economic growth, new revenue sources as well as institutional frameworks for managing such revenues must be identified and developed. This necessitates modifications in the existing institutional setup. It warrants a thorough review of the roles played by bodies such as the Union and state government departments, Finance Commissions, the GST Council, etc.

The fact that the role, structure, and operations of such institutions are mandated constitutionally implies that any solutions will either have to fit within these constitutional boundaries, or that the Constitution of India itself might need to be changed. While the latter isn't implausible, it should be avoided if possible, because it would involve lengthy discussions and negotiations between many parties at the national level and in each of India's 28 states.

The discussion above makes it evident that a key step that precedes India's energy transition is a better understanding of the resultant fiscal challenge and compensatory options available to the country. This is precisely the aim of this paper, and it proceeds as follows.

Section two seeks to better understand how revenues from fossil fuels will fall over time. To achieve this, a time path of India's transition is necessary, and we rely on figures from the International Energy Agency for India (IEA 2021) up to 2040, with the goal of reducing the use of fossil fuels to insignificance by 2070. Under fairly plausible assumptions, it identifies the key challenge for India within the 2020-2040 period.

After 2040, the annual loss in fossil fuel revenues would be relatively low. Tax reforms should thus be evaluated in the context of (a) a medium-term strategy of making up for the shortfall, and (b) a long-term strategy of identifying other revenue possibilities for both state and Union governments.

Section three examines aggregate tax revenues in India, comparing them over time and with those of other countries. It finds that tax revenue growth in India has been accompanied both by economic growth as well as tax reforms or changes. It suggests that the Indian experience should align with global experience over an extended time frame, albeit with some qualifiers. While there may be divergences from the global trend and experience for some time, India can achieve higher tax-revenue-to-GDP ratios with the right kind of taxation and economic policies.

However, achieving an adequate increase in general tax revenues might take some time, and carbon emission taxes could play a medium-term role, both in terms of revenue generation and in accelerating the transition to more sustainable and renewable energy sources. It is apparent that carbon taxes can, at best, serve as a medium-term measure. As fossil fuel consumption falls with India's march towards net zero, so will the capacity of carbon taxes to generate adequate revenues. Therefore, India will need to explore alternative sources of tax revenue in the long run.

Section four examines various possible avenues for the implementation of carbon taxes in India and the challenges they might face. The section evaluates the possibility of carbon taxes substituting fossil fuel tax revenues, and underscores the importance of monitoring emissions as the foundation for such taxation. Furthermore, it highlights the contrast between existing fossil fuel taxes in India and a potential carbon tax, which would be predicated on emissions-related criteria. It discusses the issues involved with various forms of carbon taxes, including whether they can work in tandem with the GST, and explores their potential ramifications.

Section five concludes with a brief discussion of the various options available to India. It refrains from singling out the best option, as each would have differing impacts on the economy. The section ends by calling for a more comprehensive study and understanding of the potential environmental, equity, and growth impacts of taxation options. This information can contribute to the debate on superior taxation alternatives for India.

2. Falling Fossil Fuel Revenues

The (IEA 2021) studied different factors impacting India's future energy requirements and proposed three potential scenarios.[1] Among these, the base case (STEPS) was considered a scenario where India gradually reduced its dependence on fossil fuels. Based on this assumption, the IEA estimated the quantity of different fuels required. The IEA's horizon extended until 2040, predating India's commitment to achieve net-zero status by 2070, and the target of 500GW capacity from renewable energy by 2030, among other goals.[2]

Bhandari and Dwivedi (2022a) adopted scenarios from the IEA and projected the current revenues generated by both the Union and State governments from fossil fuels, as well as how these revenues would change over time. Using the base case scenario from IEA, Bhandari and Dwivedi (2022a) estimated that as of 2019, fossil fuel revenues for both Union and State governments accounted for 3.2% of India's GDP. They projected that this figure would decline to 1% by 2040. Under ceteris paribus assumptions from 2019 to 2040, they estimated a reduction from 15% to 4.5% of Union government fossil revenues as a proportion of total budgetary expenditure, and from 6.2% to 2% for the combined State governments (refer to Table 1).

Table 1: Revenues from Fossil Fuels

Year	In Rs. 000 Crores	Share of GDP (%)	Share of Government Expenditure (%)
	Union Government Fossil Fuel Revenue		
2019	404.75	2.0	15.0
2030	703.03	1.1	10.8
2040	995.37	0.6	4.5
	State Government Fossil Fuel Revenue		
2019	242.71	1.2	6.2
2030	434.75	0.7	5.4
2040	625.38	0.4	2.0
	General Government Fossil Fuel Revenue		
2019	647.46	3.2	9.8
2030	1,137.78	1.8	7.8
2040	1.620.75	1.0	3.0

Note: Overall government budget figures have been projected at a nominal GDP real growth rate of 10%; the same levels of taxation on fossil fuels. Future budgetary expenditures are also projected at a 10% nominal growth rate in the table above.

Source: Bhandari and Dwivedi (2022a).

For both the Union and State governments, the majority of the decline in revenue shares would occur during the first two decades. During this period, even though aggregate revenues from fossil fuels may increase, the rate of increase in fossil fuel usage and the resulting revenues would be significantly lower than the rise in GDP and the expected budgetary expenditures.[3]

What this also indicates is that fossil fuel revenues, equivalent to 1% of the GDP in 2040, would then fall to zero by 2070, the net zero date. In other words, the key challenge for Indian State and Union governments is to address the rapidly-reducing fossil fuel revenue shares until the year 2040. After 2040, if India can manage a steady improvement in overall tax revenues through other means, it should be relatively easy to compensate for the loss of fossil fuel tax revenues.

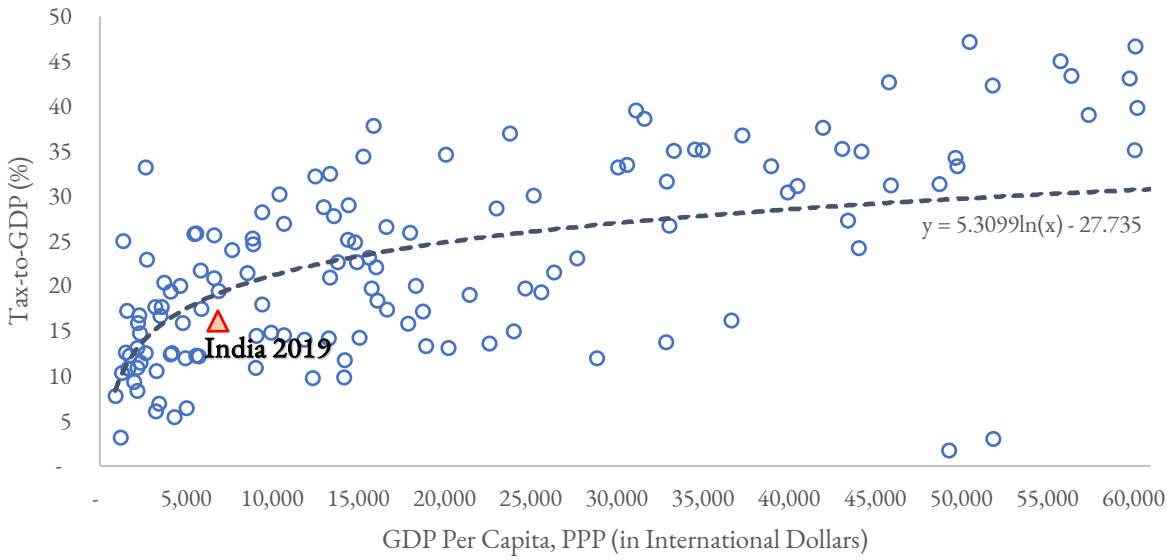
Another related issue that is not understood very well is the major differences between states. On the revenue side, different states are differently dependent on revenues from fossil fuels. Bhandari and Dwivedi (2022b) examines this aspect and finds that state-level energy transition would also impact each state differently and fairly significantly.

It is therefore apparent that adequate flexibility will be required to address the variations in scale and scope of challenges at the state level. An important criterion in addressing this issue has to do with flexibility, which could be addressed through state autonomy in designing the tax solution, or flexibilities built into the solutions designed at the Union government level.

3. Tax Revenues in India

To better understand how aggregate tax revenues in India may change over time, let's first consider the global scenario. Figure 1 shows data on the general government (national plus sub-national) tax-to-GDP ratio (on the vertical axis), charted against per capita GDP (on the horizontal axis).

Figure 1: Tax Revenue to GDP and GDP Per Capita in 2019



Source: UNU-WIDER (2022) & World Bank (n.d.)

The chart reveals a few well-known relationships.

- First, taxes as a share of GDP are positively correlated with incomes, as reflected in per capita GDP.
- Second, India's tax-to-GDP ratio is lower than what one might expect for its income levels.
- Third, while the link between tax revenues to GDP and per capita GDP is robust, there is still significant variation. This variation is attributed to various factors, including the efficiency of tax collection, the structure of the economy, and path dependence, among others.

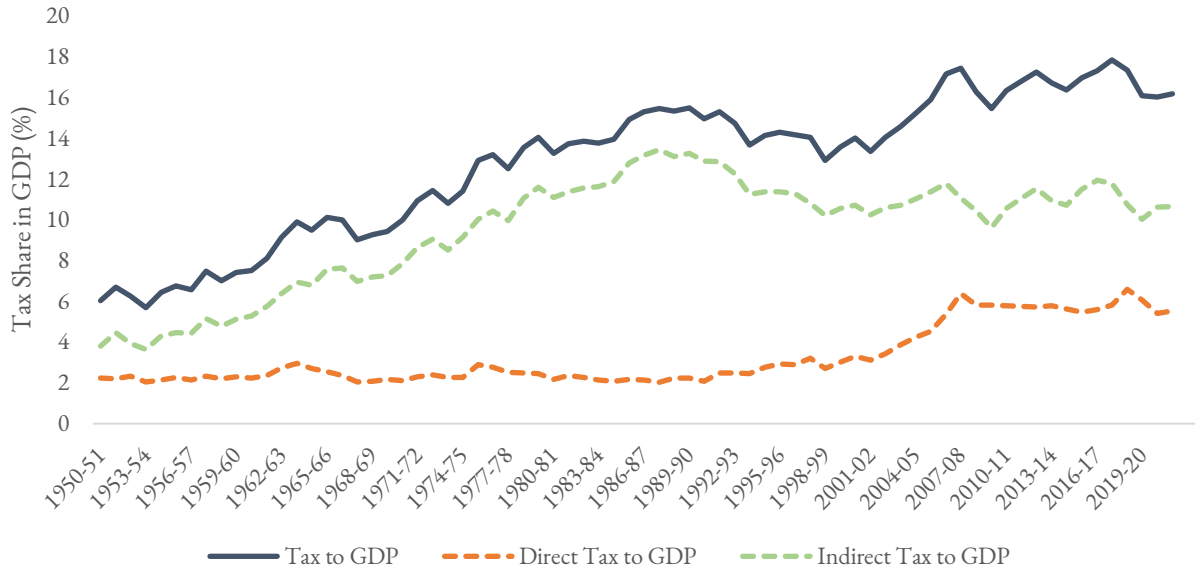
These factors suggest that while India has the potential to significantly increase its tax revenues over time, especially with rapid economic growth, the growth is not guaranteed. It is not the focus of this work to look at these issues in detail. However, we can straightforwardly deduce that for India to ensure greater revenue collection that outpaces GDP growth, it requires broader tax coverage, improved efficiency in tax collection, tax rates aligned with the nature of the economy, and the ability to collect taxes.

Figure 1 graphically represents the tax-to-GDP ratio in PPP terms for the year 2019. India's value for the year 2019 is denoted by a triangle. The graph indicates that India has a lower tax-to-GDP ratio

than one might expect. However, it is also evident that as India's GDP grows, the tax-to-GDP ratio can be expected to increase.

Historically, the tax-to-GDP ratio in India has increased. To illustrate this point, Figure 2 maps the tax-to-GDP ratio for direct, indirect, and total taxes for India, encompassing both Union and State tax revenues. The figure shows that India's aggregate tax revenues have been growing since independence, albeit not always in a smooth or linear fashion and have been stable between 16-18 per cent in the last 15 years.

Figure 2: Share of Direct and Indirect Tax Revenue in GDP for General Government



Note: The share of tax revenue in GDP for 2022-23 is based on budget estimates and has been taken from the Economic Survey (2022-23).

Source: Ministry of Finance (2019, 2023) & RBI (2022)

Consider the period from Independence to 1990, which saw modest economic growth, interventionist indirect taxation policies, and high levels of direct taxation. High tax rates are known to contribute to tax evasion and avoidance. While the proportion of direct taxes as a share of GDP remained relatively stable during the 40 years from 1950 to 1990, hovering between 2% to 3%, the share of indirect taxes rose from about 4% to more than 12% as a share of GDP. This shift also drove the aggregate Tax-to-GDP ratio to more than 15%.

Next, let's consider the period from 1991 to 2008. The economic reforms during this period aimed to enhance efficiency and release resources for investment and growth. One of the intended outcomes was to improve efficiency, making the increased role of direct taxes a desirable result. The Chelliah Committee Report was submitted in 1992-93, and a sequence of direct tax reforms were subsequently introduced. These reforms included, among other things, (a) the rationalisation of tax rates, including a reduction in some, (b) fewer direct taxation slabs, and (c) an improved coverage of the TDS mechanism (Singh 2019).

In later years, customs tariffs and excise duties were reduced as a part of India's tax reform program. While this may have initially contributed to the decrease in overall tax revenue shares, the 2000s saw a significant increase in the proportion of direct taxes in total tax revenues. Since the aforementioned reforms preceded the surging economic growth rates in the 2000s, direct taxes as a share of GDP increased from a historically stable 2% to about 6% by 2008.

After 2008, there has been a period of stagnation, extending into the early 2020s, with some fluctuations. The tax-to-GDP ratio is estimated at 17.6% in 2022-23. Stagnating growth has been identified as the primary cause of this medium-term trend; see, for instance, Rao (2016) and Singh (2019). However, this remains one of the major unanswered questions, despite significant tax reforms, including the introduction of VAT, GST, digitization, etc.

Nevertheless, it is evident that if we consider global experience, an increase in the aggregate tax-to-GDP ratio is plausible. As tax revenues from sources like fossil fuels, decline, other measures will be required. The trends and fluctuations in the tax revenue-GDP ratio also shed light on the importance of tax policies, economic conditions, and structural reforms over time.

We can conclude the following from the discussion above.

- International and recent experience suggests that the tax-to-GDP ratio may increase; however, it is uncertain how this increase will play out in terms of its time path and quantum.
- Historical evidence suggests that there is a significant time gap between cause and effect; that is, reforms, whether structural or tax-related, take some time to manifest in terms of tax revenue generation. Therefore, economic growth may not automatically lead to tax revenue growth, especially at a rate high enough to cover the loss of revenues from reduced usage of fossil fuels.

For illustrative purposes, let's conduct the following exercise. We estimated the trend growth rate of tax-to-GDP ratio for India and found that there may have been a stagnation in recent years, even though over a longer-term horizon, there has been an increase in the ratio. This is in line with global experience, as discussed above (Refer to Table 2). Our question is, for what time horizon would fossil fuel revenues be a significant part of the total revenue?

We find that by 2040, fossil fuel tax revenues would be about 0.9% of the GDP, and fossil fuel non-tax revenues would be 0.1%. Under standard growth assumptions, the overall tax-to-GDP ratio is expected to be about 23% by 2040. In other words, after 2040, fossil fuel revenues are not likely to be a significant part of the total revenue, as the share of fossil fuels in the menu of energy sources would have also reduced. By 2070, fossil fuel revenues would be insignificant given India's net-zero commitments.

Table 2: Projection of Tax Revenues As % of GDP (2019-70)

Year	Total Tax Revenue	Non-Fossil Tax Revenues	Fossil Fuel Tax Revenue	Fossil Non-Tax Revenues
	I=II+III	II	III	IV
2019	16.1	13.2	2.9	0.3
2030	21.2	19.5	1.7	0.1
2040	23.0	22.1	0.9	0.1
2070	28.5	28.5	0.0	0.0

Source: Authors' Calculations for I and II, (B&D 2022a) for III and IV. Tax revenues have been estimated by using the information in Figure 1.

To summarise this section, as fossil fuel use reduces over time, the bulk of the relative fall in fossil fuel revenues will occur between 2019 to 2030 and 2030 to 2040. Natural growth in tax revenues may not be rapid or certain enough to compensate for this decline. Therefore, India faces two revenue challenges.

- In the long term, overall tax revenue growth is feasible, but it will require proactive efforts. However, these efforts may take time to yield results, as international and national experience have shown.
- During the intervening period – between the fossil fuel transition and increased revenues through growth and reform – there will be a revenue gap.

The question concerning how effective carbon taxes can be to address the medium-term gap motivates the discussion below.

4. Taxation Alternatives

The previous sections provide three key elements for further discussion. First, the revenue challenge is more pronounced for the period spanning the next two decades, the period 2019-2040. Second, carbon taxes have a limited effective lifespan, and beyond a certain point, their ability to compensate for the fossil fuel revenue loss is limited. And finally, tax revenues rise over time with incomes and improved economic and taxation policies.

There has been significant discussion in the literature on potential avenues for increasing tax revenues. The topics include expanding the tax base, improving tax efficiency, rationalising tax rates, reducing deductions, and more. These issues have been addressed for both for direct and indirect taxes.

In addition, there is a growing momentum towards imposing greater user taxes, such as electricity duties and tax on distance travelled. This is a rich discussion, with significant revenue generation possibilities in the long run. However, these are all long-term and uncertain possibilities[4].

Table 3 provides a brief overview of the discussion. In the table, we consider four aspects to evaluate potential tax revenues:

1. The likely capacity to generate significant revenues in the future (revenue potential).
2. Whether the potential for tax revenue generation is of a long-term nature (labelled for our purposes as 'continuity').
3. Whether a significant institutional change would be required, such as a constitutional amendment.
4. Whether potential taxation solutions provide the flexibility and control to the State governments of generating funds (state autonomy).

Each of these are important for different reasons.

- Some possible options may not provide significant-enough revenues to cover the gap caused by the reduced share of fossil fuels.
- It is essential to determine whether these revenues can increase in the long term for tax sustainability.
- Deep institutional changes, such as constitutional amendments or requiring broad consensus, are difficult and time-consuming; for instance, the implementation and conceptualisation of GST took a decade-and-a-half.
- India's ongoing concern is the need to reduce its reliance on indirect taxes due to the consistency of the direct tax-to-GDP ratio.
- Finally, state autonomy will be an important criterion to consider in achieving a timely consensus and response to the revenue challenge facing India.

Table 3: Tax Revenue Options for India

Taxation Heads	Potential Options Available	Significant Additional Revenue Generation	Long-Term Revenue Potential - Continuity	Institutional Change Required	State Autonomy over Additional Resources	Miscellaneous
Personal Income Tax	Increase tax rate at higher income levels	Low to moderate	Yes	No	Low	Revenues less sensitive to higher tax rates
Personal Income Tax	Reduce minimum threshold	Low	Yes	No	Low	Generally believed to be costly to implement, with little returns[5]
Personal Income Tax	Include agricultural income	Moderate to high	Yes	Yes	Low	Constitutional amendment required
Corporate Income Tax	Increase tax rate	Low	No	No	Low	Globally comparable rates currently, foreign investment sensitive to tax rates

Taxation Heads	Potential Options Available	Significant Additional Revenue Generation	Long-Term Revenue Potential - Continuity	Institutional Change Required	State Autonomy over Additional Resources	Miscellaneous
Goods and Services Tax	Rate Rationalization	Moderate	Yes	No	Low	Difficult to get a common agreement with the GST Council
Goods and Services Tax	Inclusion of more goods and services ex. electricity, liquor	Moderate to high	Yes	Yes	Low	Moving from state VAT/sales tax to GST reduces state autonomy
User Taxes	Distance Travelled Tax	High	Yes	Perhaps	Low	Requires monitoring distance travelled by vehicles. If Union Government only – No amendment needed (Article 248 applies). For Union and State Governments together – Constitutional amendment needed.
User Taxes	Electricity Duties	High	Yes	Perhaps	High	For State Governments only – No amendment needed (as electricity duties are in the state list.) For Union and State Governments together –Constitutional amendment needed.
Carbon Tax	Single national carbon tax (all fuel taxes subsumed)	High	No*	Yes (Constitutional Amendment)	Low#	*Carbon taxes will eventually become negligible. #States will lose autonomy over fuel taxes.
Carbon Tax	Dual carbon tax - separate for centre	High	No*	Yes (Constitution	High#	# States have autonomy, but a double taxation

Taxation Heads	Potential Options Available	Significant Additional Revenue Generation	Long-Term Revenue Potential - Continuity	Institutional Change Required	State Autonomy over Additional Resources	Miscellaneous
	and states (all fuel taxes subsumed)			al Amendment)		regime will be inefficient
Carbon Tax	Implemented by the centre under Article 248 (state-level fuel taxes continue)	High	No*	No	Moderate	States retain some autonomy as fuel taxes are retained, but a double taxation regime will be inefficient
Carbon Tax	Subsumed under GST (on the basis of emissions by fossil fuel users)	High	No	Not clear	Low	Emissions monitoring + mapping of emissions to notional output value required.
Carbon Tax	Subsumed under GST (on the basis of potential emissions of fossil fuel seller)	High	No	Not clear	Low	Mechanism to monitor and map potential emissions to tax rate

In broad terms, there are limited avenues for rapidly increasing revenues from direct taxes, and they are unlikely to yield the desired results. On the indirect taxes front, due to India's federal nature and related mechanisms, the rationalisation of rates and the inclusion of additional items do not appear likely either. User Taxes (such as Electricity Duties and Distance Travelled tax) have some potential, but they come with numerous implementation challenges.[6]

In this context, carbon taxes can yield relatively high returns. However, they are not a long-term solution, as the revenue from these taxes will reduce as fossil fuel dependence decreases. What seems to be a more significant issue is that unlike fuel taxes, which provide a high level of autonomy to State governments, carbon taxes typically do not. Therefore, obtaining buy-in from State governments would be a challenge unless special measures are undertaken to protect state government autonomy.

4.1 New Mechanism for Emission or Carbon Taxes

One possible approach to increase revenue is implementing an emissions-based tax on polluting sectors. The tax increases the production costs of undesirable by-products (pollution, carbon dioxide emissions, etc.), and therefore can accelerate the shift towards greener technologies. The primary objective of such taxes is not revenue generation but correcting negative externalities. If successful in enabling the shift towards greener technologies, they are in fact aimed at generating fewer revenues over time.

Pollution/emission-based taxes can be imposed on specific sectors or the entire economy. They can target carbon emissions and/or other emissions or effluents as well. Moreover, like any tax, these taxes increase costs for businesses, reduce output, and have a consequent negative impact on growth. Therefore, it is not possible to introduce such taxes without a serious impact on output and growth (Verma 2021; Bohringer et al. 2018).

The discussion in this section focuses on the question of how well carbon taxes revenues could help cover the fossil fuel tax revenues gap. The Union and State governments tax different fossil fuels under distinct laws and Constitutional arrangements.7 Carbon taxes can potentially take many forms, but the key underlying factor is that these taxes are quantified on the basis of harmful emissions. Therefore, carbon taxes (as well as other similar pollution-related taxes) require appropriate monitoring of emissions.8

Currently, India taxes both coal and petroleum differently. However, these taxes cannot be labelled as carbon taxes because their taxation criteria are not based on emissions. The discussion in the following section presupposes that a carbon tax is imposed separately from the GST. The possibility of imposing GST on GHG-generating activities will be discussed in a later section on GST.

Revenue Generation

Consider the three key fossil fuels: Coal, Oil and Natural Gas. IEA (2021) estimated the use of these fuels under various scenarios and reported their CO2 emissions. Table 4[9] shows that the growth rates of the consumption of various fossil fuels decline over the periods of 2019-2030 and 2030-2040. Beyond 2040 to 2070, however, there will be a decline in total consumption, implying negative growth.

Table 4: Growth of Fossil Fuels and CO_2 Emissions from 2019-40

Fossil Fuel	Primary Demand (PJ)			CO2 Emissions (Mt)			Annualized Growth Rates of Primary Demand	
	2019	2030	2040	2019	2030	2040	2019-30	2030-40
Coal	17,292	20,851	22,652	1,622	1,951	2,108	1.87%	0.86%
Oil	10,133	14,026	17,209	612	842	1,030	3.49%	2.27%
Natural Gas	2,303	4,731	7,244	84	156	220	9.59%	5.31%

Source: IEA (2021) & Authors' Calculations.

Table 5: Carbon Tax Rate

Scenarios	2019	2030	2040
Case 1 – Revenue gap if fossil fuels taxes are replaced by carbon tax (% of GDP)	3.2	3.2	3.2
CTR – Rs. per tonne of CO_2	2,793	4,029	5,633
In current USD	34.1	49.1	68.7
Case 2 – Revenue gap if carbon tax is on top of current fossil taxes (% of GDP)	–	1.5	2.2
CTR – Rs per tonne of CO_2	–	2,053	4,046
In current USD	–	25.0	49.3

Note: The Carbon Tax Revenues (CTR) are in real terms assuming a 5% inflation rate from 2019.

Source: IEA (2021) & author calculations

Using these figures and the corresponding carbon emissions for each fuel, we can estimate potential revenues from carbon taxes under different emission-based tax rate assumptions. Table 5 shows the revenue target for each of the years. In Case 1, all fuel taxes currently imposed on fuels are removed and replaced with a carbon tax on CO2 and GHGs, respectively. In Case 2, current fuel taxes are retained, and carbon taxes are imposed on top of them.

We find that in Case 1, where fuel taxes are replaced by carbon taxes, a tax rate of Rs. 2,793 per tonne of CO2 needed to be levied in 2019 to cover the revenue gap. Over time, this rate will grow and reach Rs. 5,633 (in real terms) by 2040 to match the decline in fossil fuel revenue share. In Case 2, where existing fuel taxes are not removed, and carbon taxes are imposed on top of them, the initial tax rates would be lower. However, they would become significant by 2030 and subsequently, rising from Rs 0 to 2,053 per tonne of CO2 from 2019 to 2030 to Rs 4,046 by 2040.

As discussed earlier, beyond 2040, carbon tax revenues will start to decline due to the reduced use of fossil fuels. This paper does not estimate when that will occur, as it would require us to make assumptions about the time path and divert from the main objective of this story: to better understand the various fiscal possibilities for India. What is clear is that carbon taxes can be a significant revenue source, but their rates will need to rise significantly to bridge the expected revenue gap.

It's important to note that carbon taxes will need to be consistently increased over time, both to increase the incentive to shift to greener technologies and from a revenue equalisation perspective. Another significant aspect is that these taxes will involve much higher taxation of coal and a much lower taxation of petroleum and natural gas compared to the current situation in India.

In other words, depending on their imposition, carbon taxes may result in reduced tax revenues from petroleum products in India, and increased taxes and subsequent revenues from coal (see Table 6).

- Column V shows that in Case 1, where carbon taxes are imposed and all other fuel taxes removed, overall revenues for oil and natural gas would have fallen from 5.5 lakh crore to 1.9

lakh crore in 2019, while that for coal would have risen from 0.9 lakh crore to 4.5 lakh crore. This difference narrows by 2030, as petroleum consumption would have risen.

- Column VI shows the case for when carbon taxes are imposed on top of the existing the fuel taxes. The difference between coal and petroleum is less for the year 2030 than in the previous scenario, but still substantial.

Table 6: Estimation of Carbon Tax Revenue

Fossil Fuel	Quantity (PJ)	Emissions (Mt CO_2 Emissions)	Current Tax Revenues (Rs. Crores)	Carbon Tax Revenue – In Rs. Crores and as Share of GDP (%)	
				Case 1	Case 2
I	II	III	IV	V	VI
2019					
Coal	17,292	1,622	91,935 (0.5%)	4,53,057 (2.2%)	–
Oil and Natural Gas	12,435	696	5,55,528 (2.7%)	1,94,406 (1.0%)	–
2030					
Coal	20,851	1,951	63,959 (0.2%)	7,86,009 (2.1%)	4,00,618 (1.1%)
Oil and Natural Gas	18,758	998	5,18,572 (1.4%)	4,02,069 (1.1%)	2,04,929 (0.5%)
2040					
Coal	22,652	2,108	29,861 (0.1%)	11,87,596 (2.0%)	8,52,939 (1.4%)
Oil and Natural Gas	24,452	1,250	5,33,234 (0.9%)	7,04,220 (1.2%)	5,05,775 (0.9%)

Note: The tax revenues are in real terms, assuming a 5% inflation rate from 2019. The numbers in parentheses represent corresponding tax revenues as a proportion of GDP at 2019 prices.

Source: IEA (2021) for Columns II and III, Bhandari and Dwivedi (2022a) for Column IV & Authors' Calculations for Columns V and VI.

Continuity and Constitutionality

Currently, there is no legal mandate for a comprehensive or partial carbon taxation regime. However, Article 248 of the Constitution of India allows the Union government to impose taxes on any item not mentioned in the state or the concurrent list. Therefore, the Union government could impose a carbon emissions tax, but it does not enable it to stop State governments from taxing fuels.

There are two potential alternatives for implementing a tax on carbon emissions in India.

1. Mandate the removal of all fuel taxes and empower both the Union and the State governments to levy a carbon tax, which could be economy-wide or to specific sectors or items. This would require introducing a Constitutional (Amendment) Bill in both houses of the Parliament and obtaining ratification from at least half of the state legislatures. After the amendment, new legislation for the tax would need to be drafted and passed by the Union and each of the states. While this may be more acceptable to the States, it could lead to another source of inter-state differences that the introduction of GST sought to undo.
2. Alternatively, only the Union government can levy a tax. It can utilise Article 248 of the Constitution for framing a new legislation for the proposed tax on polluting sectors. The latter option can empower the Union government to unilaterally impose the tax, in addition to the fuel taxes that are already in place at the Union and state government levels.

Both these possibilities, whether a constitutional amendment or the utilisation of Article 248, would no doubt be a significant break from past practices.

Sharing, Flexibility and Autonomy

In the case of empowering both Union and State governments to levy a tax through a Constitutional amendment, we must consider three alternatives.

- The Union and State governments can levy carbon taxes separately, similar to how states have their respective VATs on petroleum products, along with excise duty levied by the Union. Each government can independently set its own tax rates and collect revenue from carbon taxes. This approach ensures complete autonomy for the States to determine the tax rates and utilise the generated revenue as per their specific needs and priorities. This could result in significant variations in carbon tax rates among different states.
- Alternatively, the carbon tax could be included within the ambit of Goods and Services Tax (GST), an option we will discuss later.
- Finally, the Union government may use its fiscal powers, as defined by Article 248, to unilaterally levy a carbon tax. In this route, only the Union government will have the authority to levy the carbon tax. The revenue generated from this tax would go into the divisible pool, through which the funds may be allocated to the Union and State governments based on the tax devolution formula recommended by the Finance Commission. In this case, the Union government would have absolute control over the tax rate and its base. However, fuel taxes at the state level will continue, and therefore it would reduce state autonomy but not eliminate it.

4.2 GST and Carbon Taxes

There are many forms of indirect taxes, including excise duties imposed and collected by the Union government, VAT collected by State governments, and taxes on specific products and activities such as intoxicants, among others. Some of these taxes persist for certain items despite the co-existence of

GST for most goods and services. Additionally, the Union government imposes and collects import tariffs. Among the indirect taxes, excise duties, VAT, import tariffs, and GST constitute the major components.

At present, crude oil and petroleum products such as diesel, petrol, aviation turbine fuel, and natural gas are not subject to GST. Instead, the Union government levies excise duty, while the states impose VAT on these items. Petroleum-related products significantly contribute to state government revenues, as discussed in Section two. For example, Mukherjee (2020) found that between 2010 and 2017, the petroleum sector accounted for an average of 45% of the total Union taxes collected. During the same period, an average of 26% of the state taxes collected from sales tax or VAT was attributed to the petroleum sector.

In the discussions between the Union government and the States that preceded the levying of GST, they had agreed that taxes on petroleum and alcohol for human consumption be left out of the GST fold. States may not have been willing to include these for fear of losing independent authority and autonomy over these revenue collections, as well as uncertainty over the adequacy and continuity of compensation mechanisms (Dutta 2020).

While GST is not a carbon tax, since it is already well implemented, we examine how and whether the current GST mechanism can be adjusted to include some form of carbon taxes. Carbon taxes are imposed on emissions and are not levied on inputs, outputs, or the technology utilised. The GST, however, is levied on an *ad valorem* basis. For instance, the GST on coal is currently imposed at the rate of 5% of the sale value of coal. Therefore, the current GST cannot be classified as a carbon tax.

We consider two possibilities, using coal as an example. The first case involves levying a charge on the coal producer, while the second involves levying a charge on the coal user.

1. Where the coal seller is taxed on its potential emissions (Case A).
    - Since coal is predominantly used in thermal power plants and industrial furnaces, we can estimate the average emissions per unit of coal used.
    - The GST rate on coal paid by the coal producer can be made proportional to the per-unit emissions of the users. Applying this principle, we estimate that the current GST on coal can be equated with Rs. 1,392 per tonne of coal for it to be equivalent to a carbon tax of USD 25 per tonne of CO2.
    - In this scheme, some authority would need to regularly monitor users' emissions and impose a GST rate on the seller based on the users' emission parameters.
    - Moreover, in this scheme, the GST would be a tax on a bundled product: the sales value of coal plus the value of the potential harm caused by its buyer.
    - However, please note that the above is not an *ad valorem* tax, and therefore, does not fit well in the GST scheme. Furthermore, it would require a high degree of credibility to frequently monitor and update the tax rates.

- Finally, the GST mechanism is not designed to support rapidly varying rates, so it is not clear how and whether this can be implemented.

2. Where a charge is levied on the coal user for its emissions (Case B), such as in a thermal power plant.

- Since GST is an *ad valorem* tax, it is imposed on the output value. Carbon emissions are a form of output, albeit a 'bad' and not a 'good.' This type of carbon-tax regime under the GST scheme would therefore need to take a form where the tax is imposed on a notional value, that is either proportional to the emissions, or proportional to the amount of 'bad' being caused by the emissions.
- That is, the carbon tax revenue, Ct, is the function of a tax rate, k, imposed on the notional value n(.), levied on the CO2 or GHG emission (e), or Ct = k*n(e). In this scheme, the greater the emission, the greater the notional value and greater the Ct paid, though the rate k may remain the same.
- Since it is based on a regular and firm-specific monitoring process, the notional value may differ across firms and over time. Therefore, an authority will have to be assigned the responsibility with built-in accountability for high- quality monitoring and valuation capacities.
- In this case, as well, the system would rely on high- quality monitoring. A standardised mechanism where, for instance, specific technology and inputs are mapped against different notional values may work.
- Moreover, in this case as well, the GST would be a tax on a bundled product; in the case of a thermal power plant, it would be based on the value of electricity produced plus the notional value of emissions.
- However, it is not clear whether a GST based on a notional value is feasible within the current legal framework.

In other words, while it may be feasible, conceptually, to incorporate a carbon tax mechanism under the current GST, there will be significant implementation and institutional challenges that will need to be overcome. Moreover, as earlier discussion shows, an efficient carbon tax regime will tend to reduce state autonomy over fossil fuel revenues unless other corrective mechanisms are designed.

5. Way Forward

In any tax reform, it is evident that the Union and State governments will need to arrive at a common agreement on design, implementation, and sharing. Such a consensus would be easier to achieve if the instrument under consideration is (a) placed under a currently operational mechanism such as the FC or GST council, or (b) centralised under the Union government with a good compensation scheme built in for States with a greater dependence on fossil fuels.

This study has examined the dynamics of tax revenues and fiscal implications of energy transition in the context of the advancement of developing economies towards developed status. The analysis of tax revenue-GDP ratios has highlighted the potential for higher ratios for developing economies as they transition towards development.

The role of non-conventional taxes such as carbon tax has shed light on alternative revenue sources that can reduce India's reliance on fossil fuel taxes. A carbon tax is a potential source of revenue generation that can either be levied on the CO2 emissions under two distinct scenarios – over and above the existing taxation on fossil fuels, or by removing these existing taxes – however, there will be significant implementation and political-economic challenges in either case.

The implementation and institutional challenges associated with both conventional (existing taxes such as personal income tax, corporate income taxes and GST) and non-conventional taxes emphasised the need for institutional changes to effectively raise revenues through these sources in the long run.

India needs to develop a comprehensive revenue strategy for the immediate future. This strategy should consider the unique context of India and focus on enhancing revenue collection through measures such as expanding the tax base, increasing tax rates, and introducing new taxes while also incorporating the key objectives of equity sustainability and growth. Furthermore, strengthening tax administration systems, enhancing taxpayer compliance, and establishing effective governance mechanisms are crucial steps in ensuring the successful adoption and execution of these fiscal measures.

Overall, the transition from developing to developed status requires a strategic and proactive approach to revenue generation. By embracing alternative revenue sources, addressing institutional challenges, and adopting innovative fiscal policies, India can navigate the challenges posed by declining fossil fuel revenues, and establish a sustainable and resilient fiscal framework for long-term growth and development.

However, there will be significant implementation, institutional, and political-economic challenges, given state autonomy considerations. Since the bulk of the fall in fossil revenue shares is frontloaded (over the next two decades), it is imperative that additional revenue generation options be identified and implemented urgently.

Further work needs to focus on some such possibilities that include the analysis of dearth of property tax revenues, whether electricity duties can become the main component of government revenues from energy etc. Other smaller revenue potential items but important revenue sources, nevertheless, include vehicle registration, parking fees etc.

Another possibility are taxes based on the distance travelled, the rate for this can be varied depending upon the type of vehicle (and its emissions and/ or energy efficiency). Here, as well, a mechanism for monitoring would be required. Therefore, fossil fuel-based vehicles could be taxed at a significantly higher rate than other. The greatest advantage of this mechanism is that it would be technology agnostic, and therefore, revenue need not reduce as fossil fuel use goes down.

This paper focused on various possibilities related to carbon taxes, which were found to be fairly challenging for India to implement smoothly and in a short span of time. However, some possibilities exist, even though it is unclear whether that would be most feasible and effective options. Another possible source of revenues is that of a cap-and-trade mechanism for GHGs / carbon emissions; as is the case with carbon taxes, these would be difficult to implement, given the lack of emission monitoring capacity and nascent emission trading mechanisms. But if we focus on the larger emitters initially, it may be a more feasible option to implement.

Finally, further study is required to better understand the revenue, equity, environmental, and efficiency implications of the range of possible solutions available to India. A comparison of the efficacy of carbon pricing approaches to that of subsidising renewables is also an important area for further research.

In addition, the experiences of the countries that have effectively designed carbon taxes within their existing structures of VAT can provide pragmatic ways of designing these taxes for India. This requires careful examination. The possibility of utilising these revenues to lower the tax rates from other distortionary taxes such as CIT, PIT, and indirect taxes is yet another possibility that needs to be explored. Since it creates an additional burden on the exchequer, curbing expenditures on non-merit goods also requires a closer examination.

We propose to undertake further study on some of these issues in future work. More specifically, what could be the possible path for India, which would depend on how each option measures against the multidimensional objectives of equity, employment, growth, and emissions reduction. Without a better understanding of these aspects, it would be difficult to ascertain what the superior taxation options are for India.

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Notes

[1] The IEAs are not the only such estimates, others such as (BP 2023) different estimates which (Bhandari and Dwivedi 2022a)) did not consider, however, the broad trends and deductions remain the same.

[2] *Prime Minister's Panchamrit commitments at COP26 include: First - India will reach its non-fossil energy capacity to 500 GW by 2030; Second - India will meet 50% of its energy requirements from renewable energy by 2030; Third - India will reduce the total projected carbon emissions by one billion tonnes from now onwards till 2030; Fourth - By 2030, India will reduce the carbon intensity of its economy by less than 45%; And fifth - by the year 2070, India will achieve the target of Net Zero. The Panchamrit will be an unprecedented contribution of India to climate action.* (PIB 2021a)

[3] In a subsequent study, (Bhandari and Dwivedi 2022b) estimated the impact on individual states, and found large differences between them, as different states have different energy consumption and energy source profiles.

[4] There are other revenue generation possibilities as well, such as generating revenue from property taxes. However, these are under the purview of local governments, which we do not consider.

[5] Normally, the union budgets tend to increase the minimum threshold limits to provide tax relief to the low-income taxpayers, which is also the case with the latest budget proposals. However, lowering the minimum threshold is an option for generating continuous stream of revenue.

[6] It is sometimes argued that a cess can be levied over the existing GST. However, there are limits to what amount can be generated from them, moreover, state government may not have the same level of autonomy as fuel taxes.

[7] Union levies excise duty and CGST on fossil fuels. Excise consists of cess, special additional excise duty, and road and infrastructure cess (which depends on the type of fuel). While the states charge varying rates, they largely generate their revenues from VAT. The other revenue sources are SGST/IGST, Octroi, duties, entry tax etc. For a detailed description, please refer to Bhandari and Dwivedi (2022a and 2022b).

[8] Arguably, we could also envisage carbon taxes as based on output, if credible emission-to-output parameters are monitored and updated regularly.

[9] We haven't identified the exact period for this potential decline in total consumption, as Table 4 focuses on the next two decades. To reiterate, we recognise that by 2070, consumption will eventually become insignificant, but that horizon is not pertinent for this analysis.

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IPPR

Fiscal Federalism and Climate Change: Building the Institutional Framework in India

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Abstract

This paper examines India's evolving climate change governance framework, emphasizing the role of its federal structure in shaping national and subnational climate action. Given India's commitment to ambitious climate goals like achieving net-zero emissions by 2070 and aligning with the Paris Agreement, the study underscores the need for a cohesive, multi-level governance approach to effectively implement these targets. It critically assesses the current institutional landscape, identifying gaps in coordination and sectoral integration of climate action. India's reliance on sector-specific laws and policies, coupled with the absence of overarching climate legislation, highlights the urgent need for a unified legal framework to mainstream climate considerations into governance. Drawing on international experience, it explores how fiscal federalism principles can strengthen India's climate governance by empowering state governments and decentralizing climate action, while maintaining national coherence. The paper proposes strategies to optimize institutional support, enhance financial mechanisms, and foster cross-sectoral coordination. It outlines a roadmap for strengthening India's climate governance, focusing on establishing national climate laws, integrating climate change into fiscal and policy planning, and improving coordination between central and state authorities. By offering a pathway for scaling up climate action in India, the paper aims to ensure equity and sustainability in India's transition to a low-carbon, resilient economy.

Keywords: climate change governance, fiscal federalism, climate legislation, net zero, framework law, carbon pricing.

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"Despite governmental policy and rules and regulations recognising the adverse effects of climate change and seeking to combat it, there is no single or umbrella legislation in India which relates to climate change and the attendant concerns." [1]

1. India's Global Commitments

India has made critical and relatively ambitious global commitments to achieving net-zero by 2070, with milestones for the path toward this target, including to enhance renewable energy use and decrease carbon intensity by 2030.[2] India has committed to balancing economic growth with environmental sustainability, focusing on phased transitions across various sectors.

- **Net Zero Emissions by 2070:**
  - **Goal:** India aims to reach net-zero greenhouse gas emissions by 2070, balancing emissions with removals.
  - **Alignment with Global Goals:** This commitment aligns with the Paris Agreement, aiming to limit global temperature rise to well below 2°C, with efforts towards 1.5°C.

- **Intermediate Targets for 2030:**
  - **Carbon Intensity reduction:** India plans to reduce its emissions intensity (emissions per unit of GDP) by 45% from 2005 levels by 2030. This includes improving efficiency, and reducing overall carbon output relative to GDP.
  - **Renewable Energy Capacity:** India aims to achieve 500 GW of non-fossil fuel-based installed power capacity by 2030. This includes solar, wind, hydro, and nuclear power expansion (*Asian Development Bank, 2024*; *Grantham Research Institute, 2019*).
  - **Energy Demand from Renewables:** By 2030, India intends to meet 50% of its energy requirements from renewable sources. This will further advance the transition to a low-carbon economy.
  - **Carbon Emission Reduction:** Lower cumulative projected carbon emissions by approximately 1 billion tonnes by 2030.

- **Sustainable Development Goals:**
  - **Energy Transition:** India's strategy involves gradually reducing its coal dependence and increasing investments in renewable energy, electric mobility, and energy efficiency (*Thomas, 2023*).

- **Afforestation and Carbon Sequestration:** Increase carbon sinks through reforestation and forest management, contributing to its net-zero targets by increasing natural carbon sequestration.
- **Support for Green Technologies:** Invest in green technologies, including hydrogen, battery storage, and carbon capture, to facilitate the transition.

- **Mobilizing Climate Finance:**
  - **Domestic and International Investments:** Achieving net zero will require substantial investments in clean energy infrastructure. India is actively seeking both domestic and international climate finance to support these efforts.
  - **Private Sector Participation:** India seeks to leverage public-private partnerships to drive innovation and scale renewable energy projects.

- **Enhanced Resilience and Adaptation:**
  - **Climate Adaptation Initiatives**: India's net-zero objectives also include strengthening resilience to climate impacts through adaptation initiatives, particularly in vulnerable sectors such as agriculture, water resources, and coastal areas.
  - **Community and Ecosystem-Based Adaptation**: Efforts are being made to integrate community-led and ecosystem-based approaches to enhance local resilience and protect.

These international commitments need to be complemented by a comprehensive domestic climate policy framework to drive action. In its absence, the lack of enforceable legal mandates across the levels of government is a significant gap (*Dubash et al., 2024*). A driver for change in this direction should come from the recent Supreme Court formulation of a new constitutional right to be free from the adverse effects of climate change (*Kumar & Naik, 2024*).

2. India's Federal Structure for Climate Change

India's federal structure presents unique challenges for climate governance, as it is highly centralized, with the federal government holding significant fiscal, bureaucratic, and jurisdictional powers compared to more decentralized federations. However, the reality is that Indian states effectively bear responsibility for critical areas tied to climate action, such as water management, healthcare, and the electricity sector, which is heavily reliant on fossil fuels. This duality necessitates careful building of mechanisms for cooperation between the federal and state levels that recognize regional differences while ensuring cohesive governance for national climate goals.

2.1 Evolving but Uncoordinated Climate Institutions

The federal system has gradually created certain institutions and practices to respond to climate demands. However, these efforts still lack coordination and long-term strategic alignment. As Pillai and Dubash (2023) emphasize, in this situation, policies tend to be transient without clear links to overarching climate goals, which reflects a broader issue of central-level dominance in Indian climate federalism.

One such institution is the **Prime Minister's Council on Climate Change (PMCCC)**, established in 2008. The PMCCC was designed to oversee India's climate agenda at the highest level, providing direction for national programs and ensuring the integration of climate considerations into the broader development agenda:

- **Role in Overseeing the NAPCC and SAPCCs**: The PMCCC supervises the National Action Plan on Climate Change (NAPCC) and its eight flagship missions, including the National Solar Mission, National Mission for Enhanced Energy Efficiency, and National Water Mission. It ensures that these missions align with India's long-term goals for climate resilience and sustainable development. It also serves as an important mechanism for linking national policies to State Action Plans on Climate Change (SAPCCs), by providing financial and technical guidance to align state and central priorities (Dubash et al., 2021).
- **Inter-Ministerial Coordination**: Chaired by the Prime Minister, the PMCCC includes senior cabinet ministers, academics, and domain experts, making it a critical platform for inter-ministerial coordination on climate policy. Members include the Ministers of Power, Environment, Agriculture, and others, ensuring collaboration across key sectors to address the multifaceted challenges of climate change (Government of India, 2021).
- **International and National Climate Strategy**: The PMCCC has played an important role in shaping India's positions in international climate negotiations, including its commitments under the Paris Agreement. At the national level, it has sought to balance climate priorities with developmental imperatives, emphasizing the co-benefits approach in areas like renewable energy, forest management, and disaster resilience.

Despite its significant mandate, the PMCCC has suffered from irregular meetings, lack of consistent follow-up mechanisms, and limited state-level engagement. To address these challenges, it is necessary to institutionalize more regular interactions, strengthen its monitoring and evaluation role, and create platforms for better inclusion of state governments and civil society.

Another pivotal institution is the **Ministry of Environment, Forest and Climate Change (MoEFCC)**, which acts as the nodal agency for formulating and implementing India's climate policies. The MoEFCC is responsible for coordinating the country's compliance with international climate commitments, including the Paris Agreement, and managing domestic frameworks such as the NAPCC.

- **Policy Formulation and Oversight**: The MoEFCC oversees key programs like the NAPCC, the Green India Mission, and the National Adaptation Fund on Climate Change (NAFCC).

It also plays a vital role in framing state-level guidance for SAPCCs, ensuring alignment between national and subnational climate action strategies (Ahluwalia & Patel, 2023).

- **International Negotiations**: The MoEFCC represents India in global climate forums such as the United Nations Framework Convention on Climate Change (UNFCCC) and provides technical and legal inputs for negotiating international agreements. It is also central to tracking and reporting India's Nationally Determined Contributions (NDCs) (Chen et al., 2022).
- **Capacity Building and Awareness**: Through initiatives like the Climate Change Knowledge Network and collaboration with academic institutions, the MoEFCC fosters research, knowledge sharing, and capacity building at all levels of government. It has also engaged with stakeholders to promote climate awareness and innovation, particularly in renewable energy and biodiversity conservation (Government of India, 2021).

While the MoEFCC has made notable strides in advancing India's climate agenda, its limited budgetary allocation, understaffing, and challenges in engaging effectively with states hinder its ability to scale up its initiatives. Strengthening the MoEFCC's institutional capacity and expanding its mandate to address emerging climate risks are critical steps for improving India's climate governance framework.

The **Apex Committee for the Implementation of the Paris Agreement (AIPA)** is relatively new, and plays a more specific role, focusing on implementing India's Nationally Determined Contributions (NDCs) under the Paris Agreement. While it coordinates across ministries at the national level, AIPA does not currently have a strong framework for state-level coordination, a key gap in India's federal structure for climate governance.

2.2 Absence of Formal Climate Legislation

India currently lacks formal climate legislation at both federal and state levels. Significant political milestones, such as the ratification of the Paris Agreement, have not catalysed substantial legislative changes, either by enacting new laws or amending existing ones to incorporate climate considerations (Dubash, 2024). Climate action has instead been pursued within existing legislative frameworks, including the Electricity Act of 2003 and the Energy Conservation Act of 2001 (Dubash & Ghosh, 2019).

As Dubash (2024) notes, this reliance on sector-specific laws leads to inconsistencies and gaps in governance. A comprehensive climate framework law, similar to those in Germany and Canada, could integrate climate considerations across all sectors and levels of government (Grantham Research Institute, 2019).

2.3 Constitutional Division of Powers in Climate Governance

The division of powers outlined in the Constitution (particularly in Schedule VII) assigns significant roles in climate governance to both the Centre and the states. The central government has

authority over key sectors relevant to climate action, such as mining, petroleum, industry, and interstate waters; the 42nd Constitutional Amendment moved forests and wildlife to the Concurrent List, allowing both levels of government to legislate on these matters.

Local governance, agriculture, and water resources remain primarily within the states' jurisdiction. As Pillai and Dubash (2023) have pointed out, national schemes and legislations have frequently influenced state actions in these areas.

The electricity sector, which accounts for a significant portion of India's emissions, is an area of concurrent jurisdiction, with the federal government setting broad frameworks. and states exercising discretion within those parameters. In summary, while states play a major role in adaptation and mitigation, the overarching structure of Indian federalism often reinforces central dominance in climate governance.

2.4 Need for Institutional Coordination and Deliberation

This asymmetry in legal and fiscal powers underscores the importance of institutional forums for consensus-building on climate governance. Current climate-specific interactions are primarily mediated by the National Steering Committee on Climate Change (NSCCC), a body comprising senior bureaucrats from the Centre and some state representatives. As Pillai and Dubash (2023) have pointed out, the NSCCC serves more as a mechanism for ensuring "uniformity and coherence" in State Action Plans on Climate Change (SAPCCs), guiding individual projects, and approving funding allocations.

In addition to the NSCCC, there are other forums (not climate-specific) whose decisions could influence climate outcomes. These include the annual meeting of energy ministers, the Forum of Regulators for electricity policy, and the Inter-State Council – which, while currently relatively inactive, could play a significant role in addressing interstate climate challenges. However, the lack of a dedicated platform for climate policies limits the potential for strategic climate governance across the levels of government (Dubash & Pillai, 2023).

3. International Evidence

India can draw lessons from several countries that have effectively used fiscal federalism to coordinate climate action across government levels. Each of these countries has unique strategies and institutions suited to its federal structure, helping to manage the complex interaction of national, regional, and local climate policies. The Climate Action Tracker provides key insights into the successes and challenges of global climate governance frameworks.[3]

As highlighted by the Grantham Research Institute (2019), there is a clear need for countries to adopt an overarching "framework law" on climate change, which aims at being both comprehensive

and unifying. Such a framework law would set the legal context for other laws and policies, and provide the basis for local government, business, and community action on climate change.[4] #

To be effective, such framework climate laws need to be carefully tailored to the national context. Further, international experience also suggests that having a dedicated climate ministry does not necessarily resolve coordination challenges.[5] In many countries with climate-specific ministries, such as Germany, Canada, and South Africa, there remain difficulties in aligning national and subnational priorities, coordinating across economic sectors, and integrating climate targets within broader development plans.

For instance, Canada's federal climate ministry, Environment and Climate Change Canada (ECCC), has struggled with provincial opposition to national carbon pricing, while South Africa's Department of Forestry, Fisheries and the Environment (DFFE) faces gaps in financial support and inter-agency coordination. Even Germany, which has one of the most structured climate ministries (Federal Ministry for Economic Affairs and Climate Action – BMWK), faces challenges in aligning state (Länder) policies with federal emissions targets, particularly in energy and transportation.

Thus, while a dedicated climate ministry can provide institutional focus, its effectiveness is dependent on how well it integrates with other ministries, state and local governments, and national planning bodies. Countries that have improved coordination, such as New Zealand and Switzerland, have done so through strong intergovernmental councils and independent oversight institutions. These lessons can help India design a governance structure that maximizes efficiency while avoiding coordination pitfalls.

Assessments like the Climate Action Tracker (2023; Table 1) offer additional insights into the performance of countries in meeting their Paris Agreement goal of limiting global warming to 1.5°C. The Tracker categorizes countries into five performance levels: "compatible," "almost sufficient," "insufficient," "highly insufficient," and "critically insufficient." (Table 1). These ratings emphasize the importance of aligning domestic action with international commitments. Notably, countries with advanced climate frameworks and coordinated subnational action tend to perform better, while others (including India) require ambitious reforms to bridge the gap.

This section reviews the approach and experience of key comparator countries' climate policy and institutional framework.

Table 1. International Experience: Climate Action Tracker (CAT) Ratings

Country	CAT Rating	Key Challenges	Key Opportunities
Germany	Insufficient	Coal reliance, sectoral decarbonization	Strong renewable energy investments
Canada	Insufficient	Federal-provincial alignment issues	Dual carbon pricing system
Australia	Highly Insufficient	Federal inertia, fossil fuel exports	State-level initiatives
United States	Insufficient	Federal-state policy gaps	Inflation Reduction Act[6]
Switzerland	Almost Sufficient	Transport and agriculture emissions	Decentralized governance
Brazil	Highly Insufficient	Deforestation, weak enforcement	Potential for Amazon reforestation
Indonesia	Highly Insufficient	Limited carbon pricing coverage	Recent carbon tax introduction
South Africa	Insufficient	Subnational funding gaps	Just Energy Transition Partnership
China	Highly Insufficient	Coal dependency, lack of absolute caps	Leading renewable energy deployment
New Zealand	Almost Sufficient	Transport emissions	Innovative methane reduction policies

3.1 Climate Policies of Key Comparator Countries

3.1.1 Germany

Germany has a central framework law, the Federal Climate Protection Act (Klimaschutzgesetz), enacted in 2019. This law sets legally binding emission reduction targets for various sectors, and mandates annual emissions budgets, holding federal and state governments accountable for climate goals.[7] The Lander (states) play a significant role in implementing regional climate strategies aligned with federal goals.

- **Renewable Energy Sources Act** (EEG): This Act incentivizes renewable energy through feed-in tariffs, enabling Länder to pursue renewable projects that suit their regional energy capacities.
- **Energy Transition** (Energiewende): Germany's federal strategy is closely linked to its long-term energy targets and is implemented with cross-governmental cooperation, allowing states to adapt initiatives to local contexts while aligning with federal emissions targets.
- **Federal Ministry for Economic Affairs and Climate Action** (BMWK): Oversees the Energiewende, collaborating with states to guide renewable energy growth. However, BMWK

faces significant coordination challenges, particularly in balancing its dual mandate of economic growth and climate action. Conflicts between energy security concerns, industrial competitiveness, and emissions reduction targets have slowed Germany's phase-out of coal and its transition to cleaner energy sources. The interplay between federal and state-level policies—where some Länder prioritize industrial jobs tied to fossil fuels—further complicates efforts to meet national emissions targets.

- **Regional Climate Initiatives**: German states develop individual climate action plans aligned with federal targets. The Federal Environment Agency (UBA) provides data and policy advice to support state-level planning. However, state-level energy policies sometimes diverge from national climate goals, contributing to delays in emissions reductions.
- **National Climate Initiative** (NKI): Provides funding for local projects to reduce greenhouse gas emissions, with financial support extended to states and municipalities to achieve emissions targets and promote sustainable infrastructure.

CAT assessment: Germany is rated as "insufficient." While its legal frameworks and renewable energy investments are strong, reliance on coal and slow progress in decarbonizing certain sectors, exacerbated by coordination challenges between federal and state governments, hinder its ability to meet the Paris Agreement's 1.5°C target.

3.1.2 Canada

Canada has a central framework law, the Canadian Net-Zero Emissions Accountability Act, which was passed in 2021. This act mandates national targets to reach net-zero emissions by 2050, and requires annual progress reports, creating accountability measures at the national level.

- **Pan-Canadian Framework on Clean Growth and Climate Change**: This framework allows provinces and territories flexibility in designing carbon pricing systems that meet or exceed national benchmarks. A federal backstop applies if provincial systems do not meet these standards.
- **Output-Based Pricing System** (OBPS): This is a performance standard for industrial emitters, applying a price on emissions while offering flexibility for trade-exposed, heavy-emitting industries. Emitters pay only for emissions that exceed a baseline threshold, allowing them to remain competitive while contributing to emissions reductions.
- **Green Infrastructure Fund**: Supports provinces and territories in building climate-resilient infrastructure, promoting green projects across diverse regions, and works with the Net Zero Accelerator Fund in this regard.
- **Environment and Climate Change Canada** (ECCC): Sets national climate goals and coordinates with provinces to align provincial and federal efforts toward emissions reduction.

- **Equalization Payments and Low Carbon Economy Fund**: These funding mechanisms help less wealthy regions invest in climate initiatives, ensuring that all provinces can participate in achieving national goals.

CAT assessment: Canada is rated "insufficient," reflecting the need to strengthen policies for heavy emitters and ensure better provincial alignment. Canada's dual carbon pricing mechanism (OBPS and consumer-facing pricing) is a globally noted model but requires deeper integration across provinces to ensure uniform emissions reductions.

3.1.3 Australia

Australia does not have a central framework law on climate change. Instead, it relies on federal oversight with state-driven initiatives, allowing adaptation to unique regional needs, such as drought and bushfire management.

- **Emissions Reduction Fund** (ERF): Provides funding for local adaptation projects, such as reforestation and energy efficiency, managed by the Department of Industry, Science, Energy and Resources, and was updated in 2020 with the Climate Solutions Fund which provides additional funding in this regard.
- **Clean Energy Finance Corporation** (CEFC): A government-owned green bank that collaborates with state governments and the private sector to finance renewable energy projects and other green initiatives.
- **National-Regional Coordination**: Federal and state governments share responsibilities for environmental issues, encouraging region-specific adaptation strategies. States can set climate goals suited to their unique environmental and economic conditions.
- **State-Led Climate Initiatives**: States like New South Wales and Victoria have developed their own emissions reduction and renewable energy targets, furthering climate action within a flexible federal framework.

CAT assessment: Australia is rated "insufficient," with its reliance on state initiatives highlighting the need for stronger federal leadership and targets. Federal inertia and continued investment in fossil fuels remain major concerns.

3.1.4 United States

The United States does not have a single federal framework law on climate change. Instead, climate policy is governed by a combination of sector-specific regulations, state-led programs, and federal initiatives that may change under the new Administration.

- **Clean Air Act and State Programs:** The Clean Air Act enables the Environmental Protection Agency (EPA) to set national emissions standards, while states can implement their own climate policies.

- **Regional Greenhouse Gas Initiative (RGGI):** A collaboration among northeastern states that caps carbon emissions and reinvests proceeds into renewable energy.
- **(California's) Cap-and-Trade Program:** Demonstrates the potential of state-led climate policy, supported by federal tax credits and funding initiatives.
- **Infrastructure Investment and Jobs Act:** Provides federal funding to support state-led renewable energy and resilience projects, ensuring resources are available for climate adaptation.
- **Inflation Reduction Act (IRA):** The most comprehensive federal climate law to date, allocating significant funds for clean energy incentives, electric vehicles, and climate adaptation projects. However, its future implementation remains uncertain amid shifting political dynamics.

CAT assessment: The U.S. is rated "insufficient" due to policy volatility and lack of a comprehensive federal framework. While the Inflation Reduction Act (IRA) represents a major step forward, its viability faces significant uncertainty, particularly in light of a Trump administration that has signalled a rollback of climate commitments, potential weakening of EPA authority, and renewed support for fossil fuels. This raises concerns about inconsistencies in federal climate leadership and the continued reliance on state-level initiatives to drive progress. The absence of legally binding federal climate targets leaves the U.S. vulnerable to frequent shifts in policy direction depending on electoral outcomes.

3.1.5 Switzerland

Switzerland has a central framework law, the CO_2 Act, which establishes national CO_2 emissions targets and mandates measures across sectors, setting binding emissions reductions for the country. The CO_2 Act was updated and expanded in 2023 by the Federal Act on Climate Protection Goals, Innovation, and Strengthening Energy Security, with enhanced funding for innovation and green technology.

- **Federal Office for the Environment** (FOEN): Coordinates climate policies at the national level, ensuring alignment with cantonal initiatives.
- **Decentralized Governance**: Cantons create local climate action plans supported by national funding to achieve Switzerland's climate goals.
- **National Funding Support**: Regular funding from the federal government assists cantons in implementing regional climate strategies, promoting emissions reduction and resilience initiatives at the local level.

CAT assessment: Switzerland is rated "almost sufficient," reflecting leadership in integrating climate goals into decentralized governance, but requires additional measures to enhance renewable energy deployment and emissions reduction in transportation and agriculture for full alignment with 1.5°C goals.

3.1.6 Brazil

Brazil does not have a single comprehensive framework law on climate change. Instead, it uses a combination of fiscal transfers and high-level environmental policies to incentivize conservation and support climate resilience across states.

- **National Policy on Climate Change** (PNMC): While Brazil lacks a binding framework law, the PNMC provides high-level emissions reduction targets and climate goals for states to follow, with sectoral targets for regions.
- **ICMS Ecológico**: A fiscal mechanism linking state tax revenue distribution to environmental conservation, incentivizing sustainable practices.
- **Amazon Fund**: Recently strengthened to channel resources to reduce deforestation and support reforestation in the Amazon region.
- **Ministry of Environment** (MMA): Oversees national policies and coordinates with states on environmental and renewable energy initiatives.
- **National Development Bank** (BNDES): Finances green infrastructure, ensuring regional governments have access to funds for sustainable development.

CAT assessment: Brazil is rated "highly insufficient," highlighting the fact that deforestation in the Amazon remains a critical issue, undermining Brazil's global climate commitments, and that substantial reforms are needed to address illegal logging and land use.

3.1.7 Indonesia

Indonesia does not have a single framework law, and relies on multiple policies and decentralized financing mechanisms to promote climate resilience and adaptation.

- **National Action Plan on Climate Change Adaptation**: Provides a high-level policy framework for addressing climate resilience across sectors.
- **Dana Alokasi Khusus (DAK) Lingkungan Hidup (Special Allocation Fund for Environmental Affairs)**: Allocates resources to regional governments for reforestation, waste management, and other sustainable practices.
- **Ministry of Environment and Forestry**: Sets environmental standards and supports local climate resilience initiatives.
- **Village Fund** (Dana Desa): Originally focused on rural development, now includes climate resilience, encouraging local adaptation strategies.
- **Carbon Tax Revenue Distribution**: Distributes revenue from carbon taxes, promoting sustainable practices across localities.

CAT assessment: Indonesia is rated "highly insufficient," underscoring the need to expand policy ambition and strengthen implementation at the local level. Limited sectoral coverage and weak enforcement mechanisms remain significant barriers to progress.

3.1.8 South Africa

South Africa has recently enacted a central framework law, the Climate Change Bill, which will be the country's first comprehensive climate legislation, setting legally binding emissions targets and establishing a framework for resilience and sustainable development.

- **Adaptation Framework and Climate Resilience Funds**: National adaptation plans allocate grants to provinces based on climate risk, enabling tailored regional responses.
- **Department of Environment, Forestry and Fisheries** (DEFF): Coordinates climate policy across national, provincial, and local levels, ensuring cohesive efforts.
- **South African National Biodiversity Institute** (SANBI): Focuses on integrating climate resilience into biodiversity conservation.
- **Green Fund**: Managed by the Development Bank of Southern Africa, this fund finances regional projects in renewable energy and water management, supporting climate goals across provinces.
- **Just Energy Transition Partnership (JETP)**: Launched in 2021, the JETP mobilized $8.5 billion in international finance from countries to support South Africa's transition away from coal. The partnership focuses on decommissioning coal plants, developing renewable energy, and addressing the socio-economic impacts on coal-dependent communities. While promising, its success depends on effective utilization of funds, robust governance mechanisms, and coordination between national and provincial levels.

CAT assessment: South Africa is rated "insufficient," reflecting progress but highlighting gaps in implementation and funding for subnational initiatives. The JETP represents a significant opportunity for South Africa to address these gaps, but its outcomes will rely heavily on the government's ability to integrate international finance into its broader climate strategy.

3.1.9 China

China does not have a single, central framework law for climate change. Instead, it employs a centrally coordinated, multi-sectoral strategy, integrated within broader national development and regional green development plans. Recent legislative efforts, including the new Energy Law, aim to provide a cohesive framework to support China's energy transition, enhance energy security, and achieve climate targets.

- **Five-Year Plans and Climate Goals**: Climate objectives are embedded within China's Five-Year Plans, with the 14th Plan targeting peak carbon emissions by 2030 and carbon neutrality by 2060. These plans serve as roadmaps for sustainable development across sectors.
- **Renewable Energy Law and Subsidies**: China's Renewable Energy Law promotes solar, wind, and hydropower development, providing subsidies and incentives that enable provinces to leverage local renewable resources according to their geographic advantages.

- **New Energy Law** (Effective January 1, 2025): This recently-adopted law establishes a comprehensive framework for energy management and is central to China's emissions targets. Key provisions include:
    - Development and use of renewable energy, such as wind, solar, biomass, geothermal, and hydrogen.
    - Construction of a modernized power grid capable of supporting high levels of renewable integration.
    - Energy security measures, emergency management protocols, and a unified electricity market by 2030 to facilitate renewable energy integration.
- **National Carbon Market**: China's Emissions Trading System (ETS), launched in 2021, initially covers the power sector and allows for regional flexibility, supporting tailored emissions reduction approaches across provinces.
- **Ministry of Ecology and Environment (MEE)**: The MEE oversees climate policy at a national level, working with regional governments to implement and monitor policies that align with national climate objectives, ensuring coordinated action across sectors.
- **Green Development Funds**: Established in 2020, the National Green Development Fund finances regional adaptation and emissions reduction projects, demonstrating China's approach to government-led green financing in support of sustainable development goals.
- **Integrated approach**: Strengthened by the new Energy Law, China's climate governance framework tries to align economic development with sustainable practices, emphasizing renewable expansion, regional adaptability, and green financing to meet its long-term climate goals.

CAT assessment: China is rated "highly insufficient," with significant progress in renewable energy but continued reliance on coal-fired power plants and lack of stringent absolute emission caps as major barriers to 1.5°C alignment.

3.1.10 New Zealand

New Zealand offers a well-structured and comprehensive approach to climate governance, underpinned by its Climate Change Response (Zero Carbon) Amendment Act of 2019. This legislation sets legally binding targets and institutionalizes oversight mechanisms, ensuring accountability and consistency in climate action.

- **Climate Change Response (Zero Carbon) Amendment Act:**
    - The Act mandates net-zero carbon emissions by 2050, with specific provisions for biogenic methane reductions (10% by 2030 and 24-47% by 2050, compared to 2017 levels).

- Establishes a system of five-year emissions budgets, providing a clear and incremental pathway to achieve climate targets.
- Requires the preparation of National Adaptation Plans to address vulnerabilities and climate risks.

- **Climate Change Commission (CCC):**
  - The CCC is an independent advisory body that provides evidence-based recommendations to the government on setting emissions budgets and policies.
  - It monitors progress and publishes regular reports, ensuring government accountability.
  - Facilitates public and stakeholder engagement, including indigenous Māori communities, to ensure inclusivity.
- **Emissions Trading Scheme (ETS):**
  - New Zealand operates a cap-and-trade ETS, covering multiple sectors such as energy, waste, forestry, and agriculture.
  - Revenue generated from the ETS is reinvested in climate adaptation, renewable energy, and other green projects.
- **Sector-Specific Focus on Agriculture:**
  - Recognizing that agriculture accounts for nearly half of its total emissions, New Zealand has adopted a unique approach to reduce biogenic methane emissions while providing transitional support to farmers.
  - Financial incentives encourage the adoption of sustainable farming practices and technological innovations.
- **Community and Māori Involvement:**
  - New Zealand's approach emphasizes collaboration with Māori communities, incorporating traditional ecological knowledge into climate policies.
  - Specific programs address the socio-economic impacts of climate change on indigenous groups, ensuring equitable participation in climate action.

CAT Assessment: New Zealand is rated "almost sufficient," reflecting robust frameworks but needing additional measures to achieve net-zero by 2050 in particular the need for greater ambition in reducing emissions from transport and other high-emission sectors.

3.2 Key Takeaways for India:

These international examples provide a range of fiscal federalism models India could adapt to enhance its climate governance framework:

I. Decentralized Financial Incentives

India could follow the lead of countries like Germany, Canada, and New Zealand, which have established mechanisms that provide autonomy and incentives to subnational governments based on climate performance.

- **Germany**: Sector-specific emission budgets and the integration of climate targets within states' plans align national and subnational goals effectively. India could adopt a similar approach, setting emission budgets across sectors and rewarding states for performance.
- **New Zealand**: The system of five-year emissions budgets, combined with legal mandates for net-zero by 2050, offers a structured, decentralized model to drive state-level action. India could develop state-specific targets aligned with broader national objectives.
- **China**: Integration of climate objectives in its Five-Year Plans demonstrates how aligning climate policies with economic growth can incentivize states to actively participate in achieving national goals. India's own development plans could embed climate goals more comprehensively to encourage state compliance and integration.

II. Public-Private Partnerships and Capacity Building

Countries such as Brazil, Australia, and New Zealand demonstrate the importance of leveraging public-private partnerships and building technical capacity:

- **Brazil**: Fiscal mechanisms incentivize sustainable practices by linking state-level revenue with conservation outcomes, particularly through the ICMS Ecológico and Amazon Fund. India could emulate this model to mobilize resources for climate resilience.
- **New Zealand**: Sector-specific focus on agriculture and investment in sustainable farming practices highlight the importance of targeting high-emission sectors with tailored solutions. India could support similar efforts in agriculture by creating dedicated funds and providing technical support to high-emission states.
- **Australia**: The Clean Energy Finance Corporation (CEFC) model demonstrates how green banks can partner with the private sector to fund renewable energy projects. Establishing such institutions could boost India's clean energy transition.

III. Targeted Environmental Funds

Inspired by Indonesia's and Switzerland's models, India could establish funds based on state-specific climate needs, enabling more effective local adaptation strategies:

- **Indonesia**: The Carbon Tax Revenue Distribution showcases how revenues from carbon pricing can be reinvested in state-level climate initiatives.
- **New Zealand**: Reinvestment of emissions trading revenue into renewable energy and adaptation projects demonstrates how targeted funds can support region-specific priorities while ensuring financial sustainability.

• **South Africa**: The Just Energy Transition Partnership (JETP) offers an innovative funding model for coal-dependent regions transitioning to renewable energy. India could explore similar financing for its coal-intensive states like Jharkhand and Chhattisgarh.

IV. Carbon Pricing with Revenue Sharing

Similar to Canada and Indonesia, India could implement flexible carbon pricing, with revenue shared back to states to support regional climate initiatives (Thomas, 2023):

• **Canada**: The Output-Based Pricing System (OBPS) ensures industrial competitiveness while incentivizing emissions reductions. India could adopt a similar mechanism for energy-intensive industries (Box 1).

• **New Zealand**: The cap-and-trade emissions trading scheme (ETS), covering multiple sectors, provides a robust framework for India to develop its own sector-specific ETS, with revenues reinvested in climate resilience.

• **China**: The National Carbon Market highlights the potential of piloting regional carbon markets for India's energy and heavy industries.

• **Germany** (EU ETS): The EU's absolute carbon pricing through auction-based systems offers a clear, predictable model India could adapt to set stronger market signals while minimizing loopholes.

Box 1. Canada's Carbon Pricing Model: Lessons for India

Canada's dual carbon pricing model—combining an Output-Based Pricing System (OBPS) for industries with consumer-facing carbon pricing—offers valuable insights for India's carbon pricing strategy. This framework balances flexibility, equity, and emissions reductions across sectors, providing a pathway that can be tailored to India's diverse economic landscape and federal structure.

1. Output-Based Pricing System (OBPS):

- **Mechanism:** Sets emissions intensity benchmarks for high-emission, trade-exposed industries like steel, cement, and chemicals. Firms pay only for emissions exceeding these benchmarks, with those below the threshold receiving credits or allowances.
- **Relevance to India:** The OBPS approach can help India balance industrial growth and emissions reductions. With a rising manufacturing sector, particularly in energy-intensive industries, India can adopt an intensity-based pricing system to encourage cleaner production. However, transitioning to absolute carbon pricing over time—especially in trade-exposed industries—would offer more consistent, predictable market signals, encouraging deeper decarbonization. A phased approach would allow industries in coal-dependent regions to transition without hindering economic growth.

2. Consumer-Facing Carbon Pricing:

- **Mechanism:** Applies to fuels and carbon-intensive products, directly engaging individuals and small businesses. Revenue from this pricing is often recycled back into the economy through rebates, tax credits, or investments in green projects.
- **Relevance to India:** Ensures broader participation and public acceptance by redistributing revenues to vulnerable communities, such as coal-dependent regions and low-income households.

Adapting Canada's Model to India's Federal Structure

India's federal structure, marked by significant regional disparities, requires a tailored carbon pricing approach. Canada's fiscal federalism model provides a blueprint:

1. Federal Framework with State Flexibility:

- A national system with minimum benchmarks allows states to innovate based on their unique contexts. For instance, Gujarat could pursue ambitious renewable energy goals, while coal-dependent states like Jharkhand might require phased implementation.

2. Revenue Recycling and Redistribution:

- Carbon pricing revenues should return to states for investments in local priorities, such as renewable energy, climate-resilient infrastructure, and disaster management.
- Equitable redistribution can address regional disparities and foster public support, mirroring Canada's rebate system for households.

3. Integration of the Power Sector:

- OBPS-like mechanisms can set intensity benchmarks for power generators, encouraging cleaner energy production without increasing costs for consumers.
- Addressing financial losses in electricity distribution companies (discoms) is critical. Discom reforms—subsidy rationalization, linking payments to performance metrics, and debt restructuring—could improve their finances, enabling investments in renewable energy integration and emissions reductions.

4. Incentives for Innovation:

- States achieving emissions targets or implementing innovative carbon pricing mechanisms can be rewarded with additional funding to promote healthy competition and ambition.

5. Complementary Mechanisms:

- Feebates (fees for above-average emissions and rebates for below-average emissions) could complement carbon pricing, offering flexibility while reducing administrative complexity, and it could be applied in specific sectors like transportation and manufacturing.

Challenges and Considerations

- **Economic Disparities:** A tiered pricing approach can balance growth and emissions reductions in less-developed states.

- **Discom Financial Challenges:** Financially viable discoms are essential for integrating carbon pricing in the power sector. Revenues from carbon pricing could help alleviate discom losses and fund modernization efforts.
- **Public Awareness:** Transparent communication and equitable revenue recycling are crucial to gaining public acceptance and ensuring the system's success.

Conclusion Adopting Canada's dual carbon pricing model offers India a structured yet flexible pathway to achieving its emissions goals while addressing developmental needs. Integrating revenue recycling, regional flexibility, discom reforms, and complementary mechanisms like feebates – along with a shift toward absolute carbon pricing for trade-auctioned sectors – could enable India's transition to a sustainable, low-carbon economy without compromising economic growth.

V. Institutional Support for Local Adaptation

India could establish an independent Climate Commission, modeled after South Africa's and New Zealand's frameworks:

• **South Africa**: The Climate Change Act aligns national goals with localized adaptation efforts, offering lessons for India in integrating state-level priorities into federal strategies.
• **New Zealand**: The Climate Change Commission (CCC) ensures independent oversight and monitoring of climate policies. India could establish a similar institution to depoliticize climate action and provide technical and financial guidance to states.

VI. Strengthening the State Finance Commissions (SFCs)

While the Finance Commission plays a role in national-level fiscal transfers, as discussed later in this paper, India's State Finance Commissions (SFCs) could be leveraged to allocate climate funds at the local level—an approach similar to Switzerland's cantonal system. This would ensure that local bodies (municipalities, panchayats) have direct access to climate-responsive fiscal transfers.

VII. Coordination and Accountability Challenges

Ensuring transparency in climate finance and accountability in achieving targets is critical:

• **Germany**: While Germany's Federal Ministry for Economic Affairs and Climate Action (BMWK) plays a key role in Energiewende, coordination challenges exist between federal and state governments, leading to inconsistent implementation of policies. India must ensure vertical integration across government levels to avoid similar bottlenecks.

• **United States**: Given the potential for political shifts, U.S. climate policies are highly dependent on electoral cycles. India must avoid this instability by ensuring legislative backing for climate actions at all levels.

• **Canada**: Progress reports and independent audits ensure compliance and alignment. India could implement similar mechanisms, involving institutions like the Comptroller and Auditor General (CAG), to ensure state-led climate projects are aligned with national objectives and provide value for money

3.3 Adapting Global Models to India's Context

India's diversity in climate vulnerabilities and socio-economic conditions necessitates a flexible yet robust approach. Lessons from international experiences (Table 2) can be tailored to India's needs at every level of governance by:

- Embedding climate goals in national and state plans: This would ensure alignment between economic development and climate resilience, similar to China's integration of climate objectives in its Five-Year Plans.
- Establishing targeted funds for vulnerable states and regions: Following models like Indonesia's carbon tax revenue distribution, India could direct funds where they are most needed.
- Providing fiscal incentives for achieving state-level climate targets: Drawing from Brazil's ICMS Ecológico, fiscal transfers could reward states that show measurable climate performance.
- Encouraging innovation through public-private partnerships and capacity building: Supporting green financing models, as demonstrated by Australia's Clean Energy Finance Corporation, could help India attract private investment and foster clean technology solutions.

Drawing from the international experiences discussed, India must focus on creating a cohesive yet decentralized framework for climate governance. The country can adapt successful models by integrating sector-specific targets, financial incentives, and accountability mechanisms that support states' diverse needs. A comprehensive, structured approach will ensure that both national and regional climate goals are met, and that India's transition to a low-carbon economy is just and inclusive.

As well documented in the literature, a central, legally-binding climate framework, paired with decentralized adaptation strategies and targeted financial mechanisms, will be critical to help India achieve its ambitious climate goals while addressing regional disparities. This balanced approach, fostering innovation and ensuring transparency, will pave the way for India's successful climate governance transformation.

Additionally, India should explore a centralized regulatory approach for mitigation—where uniform standards prevent free-ridership—while enabling decentralized adaptation measures to address regional vulnerabilities effectively.

By adapting these models to its unique federal structure, India can create a cohesive yet decentralized framework for climate governance. A strong institutional backbone, coupled with financial incentives and transparency mechanisms, will be essential to achieving India's climate goals while ensuring sustainable development.

The following table summarizes the experiences of 10 countries with comprehensive climate frameworks, with lessons for India.

Table 2. Analysis: Lessons from Key Countries

Country	Key Features	Lessons for India
Germany	Federal Climate Protection Act (Klimaschutzgesetz) mandates legally binding sector-specific emission budgets and annual targets. The National Climate Initiative funds subnational projects.	India could adopt sector-specific emission budgets across industries and create a National Climate Fund for subnational projects, ensuring that states align with national goals.
Canada	Net-Zero Emissions Accountability Act (2021) mandates national net-zero targets by 2050 and uses flexible carbon pricing (OBPS).	Flexible carbon pricing systems with fiscal incentives for states to ensure compliance and equity.
Australia	State-led initiatives dominate, complemented by the federal Emissions Reduction Fund and Clean Energy Finance Corporation, which support renewable projects and adaptation measures.	Decentralized climate initiatives allow for state-specific solutions; India can establish a Green Bank at the national level, while empowering states to implement specific climate policies tailored to their needs (e.g. coastal, agriculture- focused, etc.)
United States	No federal framework law; states lead with individual policies like California's cap-and-trade program and the Regional Greenhouse Gas Initiative (RGGI).	Allow states to set their own ambitious targets, supported by federal funding mechanisms, while aligning national policies like renewable energy promotion.
Switzerland	The CO_2 Act (2023) integrates federal and cantonal policies, supported by decentralized governance and national funding.	Decentralized climate action with federal funding can empower Indian states while maintaining national oversight.
Brazil	National Policy on Climate Change (PNMC) establishes high-level emissions targets. Incentives like the ICMS Ecológico link fiscal transfers to environmental conservation, while the Amazon Fund supports reforestation efforts.	Incentivize state conservation efforts by linking fiscal transfers to environmental outcomes and creating dedicated funds.
Indonesia	Decentralized funding mechanisms like Carbon Tax Revenue Distribution and Dana Desa support local adaptation.	Establish state-specific funds for local climate adaptation strategies. A decentralized framework, like Indonesia's, could address India's diverse climate challenges.
South Africa	The Climate Change Bill sets national adaptation frameworks and legally binding mitigation targets, supported by targeted funds like the Green Fund for regional initiatives.	Targeted regional funds for adaptation can address the diverse needs of India's states and national coordination.

Country	Key Features	Lessons for India
China	Centralized, sector-specific targets embedded in Five-Year Plans. The National Carbon Market covers the power sector and promotes regional flexibility.	Embed climate goals within India's development plans and pilot regional carbon markets for energy and heavy industries.
New Zealand	Zero Carbon Act (2019) establishes legally binding targets for net-zero emissions and emission budgets. Independent Climate Change Commission ensures oversight and accountability.	India can benefit from an independent oversight body to depoliticize climate action and ensure continuity across government administrations.

4. Specific Proposals for India's Institutional Structure

India's institutional framework for addressing climate change requires significant enhancements to ensure cohesive and effective action across governance levels. Drawing on successful international and domestic models, these proposals aim to establish a stronger foundation for climate governance in India, fostering collaboration and capacity-building while addressing local developmental priorities. However, these proposals will, of course, need to be carefully developed for their full consistency with India's needs.

I. Establish a Clear Legal Framework for Climate Action

As Pillai and Dubash (2023) have emphasised, a robust legal framework is the foundation for effective climate action, providing clear mandates, timelines, and enforcement mechanisms.

- **Comprehensive National Climate Law**: A unified national climate law carefully tailored to India's federal context and diversity is needed. It would provide the necessary legal backbone to climate action across India, clarifying roles, timelines, and sectoral targets to ensure cohesive and enforceable measures. This should include clear mechanisms for implementation, enforcement, and review, ensuring states know their obligations and timelines. As Dubash et al. (2020) and Pillai and Dubash (2023) highlight, the absence of a single, overarching climate law in India has led to fragmented policy implementation across states, with climate action being pursued through sector-specific policies that lack legal enforceability and long-term coordination
- **Inclusive Approach**: This law should not only regulate emissions but also guide development choices, ensuring that all new policies, infrastructure, and planning decisions align with low-carbon and climate-resilient goals. It must provide enforceable mandates, sectoral targets, and institutional structures for review and enforcement. Additionally, the law must embed principles of social equity, ensuring vulnerable populations are prioritized in adaptation and resilience measures. According to a number of studies, such laws must also include social equity measures, to address the impacts on marginalized groups.

Current Challenges: India does not yet have a comprehensive climate law, which means climate policies are often pursued through sector-specific laws that were not initially designed with climate change in mind. This leads to fragmented and reactive approaches that lack enforceability and fail to promote cohesive climate governance across sectors. Without a dedicated climate law, it is challenging to establish long-term strategies that align with both national and state priorities. Moreover, addressing the environmental goals in the (now dated) Environment (Protection) Act, 1986, requires a modernized approach. The challenge is for India's law to carefully balance a regulatory approach (focused on emissions reduction) with an enabling approach (integrating climate resilience into broader development goals) while aligning climate policy with India's developmental priorities.

II. Strengthen the Role of State Governments

Empowering state governments is crucial for tailoring climate action to local conditions and fostering innovative, region-specific solutions:

- **Decentralized Implementation**: Empower states with greater fiscal and legal autonomy to tailor climate actions to local conditions. Decentralization should include mandates for local adaptation plans at the district and municipal levels to address region-specific vulnerabilities, such as urban flooding or rural drought. Pillai (2023) argues that decentralization promotes better-targeted climate solutions and enhances local responsiveness.
- **State-Level Climate Action Plans (CAPs)**: Each state must develop dynamic CAPs, regularly updated with new data and climate projections. These plans should address both emissions reductions and adaptation needs, integrating inputs from local communities and experts to ensure equitable development. Dubash (2019) highlights that while many states have made significant strides, their plans remain insufficiently aligned with national targets and often lack the institutional capacity for implementation. (Box 2 summarizes lessons from the past CAPs).
- **State Climate Commissions**: Establish state-level climate commissions that coordinate between local governments, industries, and civil society. These commissions should align state efforts with national goals while fostering innovation and best practices within the state. They should work closely with a newly established national low-carbon development commission to ensure coherence across India.
- **State Finance Commissions** (SFCs): SFCs should be tasked with allocating climate finance equitably across local governments, ensuring that resources are directed towards climate adaptation and mitigation projects at the grassroots level. Integrating SFCs into climate finance allocation will promote efficient fiscal federalism and improve local accountability.

Box 2: Lessons from State Action Plans on Climate Change (SAPCCs)

Since their inception in 2010-11 as part of the National Action Plan on Climate Change (NAPCC), State Action Plans on Climate Change (SAPCCs) have offered critical lessons for improving state-level climate governance in India:

- **Strengths:**
  - Enhanced awareness and action at the state level, especially in sectors like water, agriculture, and forestry.
  - Some states, like Odisha and Tamil Nadu, have integrated climate adaptation into disaster management (MoEFCC, 2022)
- **Challenges:**
  - SAPCCs often lack alignment with the NAPCC and national policies.
  - Insufficient funding and capacity hamper implementation (Rao, 2021).
  - Limited stakeholder engagement at the local level reduces effectiveness (Singh and Sharma, 2020).
- **Lessons Learned:**
  - Strengthen vertical and horizontal coordination to ensure SAPCCs complement national goals.
  - Enhance funding and technical support from the central government (Dubash et al., 2020),
  - Periodically revise SAPCCs to integrate updated climate data and science (ICRIER, 2021)

Implications for Future Policy:

To address these challenges, India must institutionalize mechanisms to ensure greater integration and provide states with financial and technical resources to update and implement SAPCCs effectively.

Current Challenges: India's current centralized structure restricts the ability of states to implement localized climate solutions effectively. States have limited fiscal and legal autonomy to drive their own climate agendas, resulting in a top-down dominance that stifles local innovation and responsiveness to specific climate vulnerabilities. Expanding state roles is critical to fostering more effective and context-specific climate responses, particularly in addressing regionally distinct vulnerabilities such as drought-prone agriculture or coastal resilience planning. Greater fiscal and legal autonomy would enable states to innovate and implement locally tailored climate strategies while ensuring accountability mechanisms align with national goals.

III. Enhance Coordination Mechanisms

Effective intergovernmental coordination is essential for aligning national, state, and local climate actions. Among these, Pillai and Dubash (2023) highlight the need for institutional platforms to resolve conflicts, align goals, and share best practices.

- **Intergovernmental Coordination Council**: Form a permanent climate-focused council comprising central, state, and local government representatives. This body should ensure inter-

ministerial and inter-state collaboration on climate action. For instance, it should address cross-border challenges such as shared water resources, air pollution, and energy grids. The Council would provide a formal platform for dialogue, coordination, and conflict resolution.

- **Integrated Planning**: Embed climate considerations into all national and state development plans. Require joint ministerial accountability for meeting climate goals, particularly in energy, agriculture, transport, and urban planning. A climate resilience framework should be integrated into urban master plans, emphasizing sustainable transport, flood defences, and green infrastructure.

Current Challenges: The existing National Steering Committee on Climate Change (NSCCC) and other intergovernmental forums discussed earlier in the paper (such as the PMCCC or AIPA) are not equipped to handle comprehensive climate coordination across states. They often focus on ensuring uniformity rather than facilitating deep collaboration. Lack of a dedicated climate platform prevents states from jointly addressing cross-border issues like river basin management and air pollution,

IV. Legal Mandates for Financial Mechanisms

Dedicated financial mechanisms are essential to sustain climate action across governance levels.

- **Climate Finance Allocation**: Introduce budget tagging to track and report climate-related expenditures across all levels of government. Establish a dedicated Climate Fund to support state and local initiatives, prioritizing high-impact projects and innovations. World Bank, 2022 advocates performance-based incentives to reward states that exceed climate targets or lead in adaptation and mitigation measures.
- **Incentives for States**: Channel part of the climate finance to fund R&D in renewable energy, sustainable farming practices, and urban resilience technologies. Legal provisions for performance-based financial incentives would reward states that demonstrate leadership and effectiveness in climate action.

Current Challenges: India's current climate finance mechanisms are insufficient to meet the vast investment needs of climate resilience and mitigation. The lack of a dedicated and consistent funding mechanism limits long-term planning and restricts states' ability to initiate impactful projects. Additionally, central government funding often comes with restrictive criteria that may not align with local priorities (IMF, 2021).

V. Accountability and Transparency

A robust accountability framework ensures that climate funds are used effectively and achieve intended outcomes.

- **Mandatory Reporting**: Implement a national climate reporting framework that requires states to submit periodic progress reports. Reports should include metrics on emissions reductions, adaptation progress, and financial expenditures. Make all climate progress reports publicly available to enhance accountability. Leverage digital platforms to engage citizens in monitoring and reporting on local climate initiatives (CAG, 2022).
- **Independent Audits**: Pillai and Dubash, 2023 argue that regular, independent audits by India's Comptroller and Auditor General (CAG) would verify that funds are being used appropriately, strengthening domestic and international confidence in India's climate policies.

VI. Public Participation and Rights-Based Approach

Public engagement and the protection of environmental rights are vital for ensuring equitable and effective climate action.

- **Public Involvement:** Grassroots consultations in climate planning can strengthen resilience by aligning policies with community needs. Kenya's bottom-up adaptation approach offers a model, engaging local bodies in climate initiatives to ensure equitable policy implementation (Wanjiru, 2021). Successful models in India, such as Tamil Nadu's Climate-Sharp Village Project and Maharashtra's Jalyut Shivar Abhiyan should be well integrated (Sharma, 2020).
- **Environmental Rights:** Strengthening environmental rights would help citizens hold governments accountable. Mechanisms such as the National Green Tribunal (NGT) play a critical role in adjudicating environmental disputes, and expanding legal pathways for climate-related grievances would reinforce India's commitment to sustainable development (Pillai and Dubash, 2023; CSE, 2021).

Current Challenges: While India's institutional structure includes some mechanisms for public engagement, these are often limited to high-level consultations. There is a need for greater inclusion of local stakeholders, particularly vulnerable communities, in decision-making processes to ensure that climate policies are equitable and reflective of on-the-ground realities.

Successful Practices at States: As mentioned above and as Annex 2 highlights, there are already many successful climate-change practices in states with greater community-led initiatives and public engagement—in areas like renewable energy adoption, water conservation, and sustainable farming practices. These practices provide good models to be used across India to build community and public engagement in implementing climate change policies.

VII. Legal Support for Mitigation and Adaptation

Tailored sectoral regulations can ensure effective mitigation and adaptation efforts.

- **Sectoral Regulations:** Tailoring climate regulations for key sectors would provide clear and enforceable standards, ensuring sectors like energy and transport contribute effectively to

mitigation and adaptation goals. This could include specific mandates for renewable energy adoption, green building standards, and waste management reforms.

- **Climate-Resilient Infrastructure:** Enforcing standards for climate-resilient infrastructure would mitigate the risks of climate impacts on public assets, enhancing long-term sustainability and reducing future costs related to climate damage and adaptation.

Current Challenges: India's focus has been predominantly on mitigation through renewable energy targets, while adaptation efforts are less emphasized and often lack dedicated institutional support. There is a need for regulations that specifically address climate resilience across sectors, especially those heavily affected by climate impacts such as agriculture and water resources.

VIII. Capacity Building and Knowledge Sharing

Capacity building is critical for enabling subnational governments and institutions to implement effective climate strategies.

- **Formal Capacity Building Mandates:** Create a national technical assistance program to strengthen subnational governments' ability to implement climate initiatives. Training programs should focus on building local expertise in renewable energy, climate-smart agriculture, and urban resilience.
- **Research and Innovation:** By encouraging state-level research and innovation, India can also tap into localized knowledge and foster innovations suited to regional climate challenges—including the timing of reductions in methane and nitrous oxide. Providing tax incentives or grants would stimulate investment in climate technology and solutions.

Current Challenges: India's subnational governments often lack the technical capacity to implement climate adaptation and resilience initiatives effectively. This is recognized internationally as a key constraint. The federal government can play a crucial role by establishing units with the necessary capacity and then transferring this expertise to the states. The capacity gap hampers the ability to plan and respond to climate threats and limits access to data and expertise needed for local-level innovation.

IX. Legal Mechanisms for Conflict Resolution

Effective dispute resolution mechanisms are essential for addressing inter-state and state-centre disagreements over climate resources, governance, and funding allocations.

- **Dispute Resolution:** Establish climate arbitration panels to resolve disputes between states or between states and the central government. These panels should address resource-sharing conflicts (e.g., river basins) and disagreements over climate-related funding allocations. Given India's federal structure, strengthening intergovernmental conflict resolution mechanisms is

essential to ensuring that states can pursue coordinated climate policies without unnecessary legal or political gridlock (Pillai and Dubash, 2023).

Current Challenges: India's existing dispute resolution mechanisms, such as the Inter-State Council, are not fully utilized for climate-related issues. Many climate-related conflicts—including disputes over water resources, forest conservation, and energy policy—remain unresolved due to the absence of a climate-specific arbitration mechanism. ICRIER (2021) highlights that many of India's climate disputes, such as those concerning river basin management, remain politically sensitive and lack structured mechanisms for resolution. Sharma and Rao (2020)argue that arbitration could provide a neutral and systematic approach to addressing disagreements on funding allocations and responsibilities among different levels of government.

Structured climate arbitration could facilitate smoother conflict resolution, particularly for contentious issues like river basin management and shared resources, which are likely to intensify as climate impacts worsen. Dubash et al. (2020) emphasize the need for institutional mechanisms to prevent climate-related disputes from derailing policy progress.

X. Long-Term Monitoring and Legislative Review

Monitoring and periodic review of climate policies are critical for ensuring long-term success and adaptability.

- **Monitoring Framework:** A long-term monitoring framework would provide a consistent, data-driven basis for tracking climate impacts and policy effectiveness. Establishing climate observatories at the national and state levels would enable systematic data collection and analysis to inform decision-making. MoEFCC (2022) highlights the importance of real-time climate data for ensuring that policies remain adaptive to changing environmental conditions.

  The framework should incorporate independent climate assessments conducted by research bodies, such as ICRIER, NIPFP, and CSE, to provide unbiased evaluations of India's climate strategies (ICRIER, 2021). Additionally, ensuring that state-level climate monitoring units align with national goals would help in aggregating climate data across regions.

- **Periodic Legislative Review:** Regular reviews of climate legislation would ensure that laws remain relevant and responsive to scientific advancements, technology developments, and shifting climate realities. This adaptive approach would keep India's climate policy agile and effective.

  Pillai and Dubash (2023) argue that India's legal framework must be periodically reviewed and updated to remain in line with international climate commitments, such as those under the Paris Agreement. Additionally, Dubash et al. (2020) highlight that periodic legislative reviews help maintain alignment between climate goals and India's socio-economic priorities.

Current Challenges: India lacks a centralized framework for monitoring and reviewing climate policies, which limits the ability to adapt and refine strategies based on progress and emerging data.

The absence of standardized indicators for emissions reductions, adaptation efforts, and financial expenditures has made it difficult to track national and state performance in a meaningful way (Pillai and Dubash, 2023).

CAG (2022) recommends that climate expenditure tracking should be integrated into India's budgetary processes to ensure transparency and accountability in climate-related financial flows. IMF (2021) similarly emphasizes the importance of climate finance audits in strengthening governance and attracting international climate investments.

Summary: A Framework for Federal Response

By implementing these proposals and addressing the identified challenges, India can establish a more effective institutional framework for climate action. This would:

- Empower state governments with the autonomy and capacity to lead climate initiatives.
- Ensure transparent and accountable financial flows, improving climate finance governance.
- Foster intergovernmental collaboration for coordinated policy implementation.
- Develop structured mechanisms for climate dispute resolution between states and the central government.
- Institutionalize long-term monitoring mechanisms for policy evaluation and adaptation.

Through a decentralized approach that aligns national and state efforts, India can leverage its federal structure to drive meaningful progress on climate goals. By drawing from international best practices and adapting lessons from other federal systems, India can design an institutional climate framework that is both legally robust and socio-economically inclusive.

5. Role of the Finance Commission in India

India's Finance Commission has increasingly recognized the importance of environmental conservation in fiscal planning. In recent years, it has incorporated ecological criteria into its horizontal resource allocation framework to encourage sustainable practices at the state level.

The 14th Finance Commission (2015–20) made a notable step by including forest cover as a criterion for resource allocation, assigning it a 7.5% weight among other criteria. The 15th Finance Commission (2021–26) increased this weight to 10%, further incentivizing states to maintain and expand forest cover. Both Commissions took a straightforward approach by using net forest cover as the ecological indicator within the devolution formula, alongside non-ecological factors like population, area, and income distance.

By integrating forest cover into fiscal transfers, these Commissions incentivized states to protect and grow forested areas. They argued that states should be compensated for the opportunity costs associated with maintaining forests, a consideration that helps create political space for pro-forest

policies. The 15th Commission's interim report also noted that both state and central governments advocated for a stronger focus on environmental and climate change issues during consultations.

Empirical evidence suggests that these ecological criteria in intergovernmental fiscal transfers (IGFT) have had mixed results on net forest cover in India. While some econometric studies (Busch & Mukherjee, 2017; TERI, 2019; Busch et al., 2020) show a positive correlation between IGFT and increases in net forest cover, others highlight the absence of earmarking and uncertainty about continued fiscal incentives as limiting factors. This has important implications for the 16th Finance Commission in India as it will likely look to expand its approach to climate and environmental criteria.

Looking ahead, India's climate change framework should work in tandem with the Finance Commission to ensure that climate policies are effectively implemented and incentivized across states, with a focus on financial resources, incentives, and accountability mechanisms. Considering the vastly different climate risks, resources, and capacities across India's states, and with equity in resource allocation and public service delivery already being a major plank of their mandate, the Finance Commission should be part of the process of implementing overlapping climate responsibilities in India. This approach is part of a global trend where fiscal commissions and intergovernmental bodies in federal systems come together to play a central role in climate policy and environmental governance.

5.1 Strengthening the Forest Cover Criterion in Fiscal Transfers

As of February 2025, the 16th Finance Commission has been constituted under the chairmanship of Arvind Panagariya, with its recommendations expected to cover the period from 2026 to 2031. While the specific criteria for the devolution formula are yet to be finalized, discussions are underway on expanding the ecological parameters within this framework.

Several options exist for enhancing the role of forest cover in fiscal transfers:

a) **Dynamic Forest Cover Assessment**: Instead of relying solely on static forest cover data, the Commission could implement a system that rewards states for year-on-year improvements in forest density and quality. This would encourage not only the preservation of existing forests but also active afforestation and reforestation efforts.

b) **Biodiversity and Ecosystem Services Index**: Develop an index that accounts for biodiversity richness and the provision of ecosystem services, such as carbon sequestration and water purification. States with higher scores on this index could receive greater fiscal incentives, promoting the conservation of diverse and ecologically valuable forest ecosystems.

c) **Community-Based Forest Management Incentives**: Allocate additional funds to states that successfully implement community-based forest management programs. Empowering local communities in forest conservation has been shown to enhance forest cover and health, and recognizing these efforts fiscally could strengthen participatory governance models.

d) **Integration of Climate Resilience Metrics**: Incorporate metrics that assess the role of forests in enhancing climate resilience, such as their capacity to prevent soil erosion, mitigate floods,

and maintain groundwater levels. States that effectively leverage their forests for climate resilience could be rewarded, aligning fiscal incentives with broader environmental and societal benefits.

5.2 A Legislative Mandate for Climate Action

Future climate change legislation in India could explicitly require the Finance Commission to consider climate action as a core criterion in its recommendations. This would involve integrating factors such as climate vulnerability, adaptation needs, and mitigation efforts into the criteria for distributing central funds to states.

5.2.1 International Experience

The experiences of Finance Commissions and similar bodies in other federations—such as Brazil, South Africa, and Indonesia—offer valuable insights that could help India enhance climate policy implementation through its Finance Commission:

I. Brazil: Leveraging Fiscal Transfers for Conservation

- Brazil's fiscal federalism includes environmental performance in fiscal transfers through mechanisms like the ICMS Ecológico, which links financial incentives to conservation efforts. Municipalities that protect natural resources and biodiversity receive rewards, promoting ecological stewardship.
- *Lesson for India*: Adopting a similar model could expand India's ecological fiscal transfers to support a wider range of climate actions, including reforestation, emission reductions, and climate-resilient infrastructure. The Finance Commission could structure incentives for states and local bodies that demonstrate measurable climate benefits.

II. South Africa: Targeted Funds for Climate Adaptation

- South Africa's adaptation framework emphasizes resilience, with the national government providing targeted grants to provinces and municipalities based on climate vulnerability. This decentralized approach enables tailored responses to local climate challenges.
- *Lesson for India*: The Finance Commission could create climate-resilience funds specifically for regions highly vulnerable to climate impacts, such as coastal, drought-prone, and flood-prone areas. These funds would be allocated based on vulnerability assessments, supporting adaptation initiatives across India.

III. Indonesia: Performance-Based Transfers and Local Empowerment

- Indonesia's fiscal framework includes performance-based grants that incentivize subnational governments to achieve environmental targets. Localities are rewarded for milestones like reducing deforestation or improving waste management.
- *Lesson for India*: The Finance Commission could implement performance-based funding mechanisms for states and local bodies in India, focusing on key climate indicators such as renewable energy adoption, pollution reduction, and sustainable land use. This approach would encourage accountability and progress toward national climate goals.

5.3 The Future Role of India's Finance Commission

To become a central player in climate policy implementation, and act as a bridge between policy and funding gaps, India's Finance Commission could expand its mandate to integrate environmental considerations into fiscal policy more comprehensively:

a) **Integrating with National Institutions** (e.g., NITI Aayog, Inter-State Council, RBI, MoEFCC)

b) **Expanding Ecological Fiscal Transfers to Drive Climate Goals** (e.g., carbon sequestration, renewable energy, water conservation, urban greening)

c) **Engaging with State Finance Commissions and Local Bodies for Ground-Level Implementation** (e.g., targeted grants, capacity-building programs)

d) **Institutionalizing Climate Performance Grants and Incentives** (e.g., rewards for emissions reduction, renewable energy installation, climate-resilient infrastructure)

e) **Promoting Transparency and Accountability in Climate Spending** (e.g., regular reporting, audits, public expenditure tracking)

Through strategic collaboration, targeted funding mechanisms, and adopting international best practices, India's Finance Commission can evolve into a key institution for climate action. Expanding its mandate to incorporate ecological and climate-based criteria can help drive ambitious environmental policies, ensuring effective allocation of resources and incentivizing climate leadership among states. Collaborating across federal, state, and local levels, and aligning with institutions like NITI Aayog, the Inter-State Council, and the RBI, the Finance Commission can become a unifying force in India's journey toward a sustainable and resilient future.

6. Summary and Conclusions

India's commitment to achieving net-zero emissions by 2070, as announced at COP26 in 2021, underscores the need for a robust legislative framework to guide its ecological transition. This

framework must clarify roles, enhance coordination, provide financial mechanisms, and ensure accountability across all levels of government to effectively implement climate policies.

A well-designed climate governance framework will balance adaptation and mitigation needs, ensuring that while states take the lead in resilience-building, national oversight maintains consistency in emissions reductions and regulatory coherence. By integrating fiscal federalism, transparent governance, and grassroots engagement, India can align national climate goals with regional implementation strategies.

6.1 Elements of a Legislative Framework for Climate Action in India

1. Clarification of Roles and Responsibilities

A clear delineation of duties among federal, state, and local governments is essential to prevent overlaps, foster collaboration, and ensure efficiency. The framework should specify responsibilities at each level, from setting national climate goals to implementing localized projects.

- The central government should focus on national targets, carbon pricing mechanisms, and international commitments.
- State governments should develop tailored action plans, addressing regional vulnerabilities and sectoral priorities.
- Local bodies, such as municipalities and Panchayats, should lead in community-driven initiatives, including urban greening, waste management, and disaster preparedness.

Drawing from Germany's sector-specific emission budgets and South Africa's Climate Change Bill, India could set legally binding targets for emissions reductions and introduce accountability mechanisms for states.

2. Enhanced Coordination Mechanisms

Effective climate action requires seamless coordination across ministries, departments, and states. Establishing permanent mechanisms, such as intergovernmental councils and joint committees, can help align climate policies and facilitate cross-sectoral collaboration.

- State-level climate commissions should align with a national oversight body, such as a reformed Prime Minister's Council on Climate Change or a new independent Climate Commission, modelled on New Zealand's Climate Change Commission.
- This structure can also help manage transboundary environmental issues, such as river basin management, shared forest resources, and regional air pollution control.

3. Provision of Financial Mechanisms

A comprehensive climate framework must be financially sustainable, incorporating dedicated climate funds, performance-based incentives, and long-term investment strategies.

- The Finance Commission should expand ecological fiscal transfers to reward states for broader climate actions, such as renewable energy adoption, carbon sequestration, and climate-resilient infrastructure.
- State Finance Commissions (SFCs) should be mandated to allocate climate finance equitably across local governments, ensuring that climate funds reach urban and rural local bodies.
- Carbon pricing mechanisms should incorporate absolute pricing models, such as those used in the EU's Emissions Trading System, to generate revenue for climate projects.
- Climate-responsive budgeting should be institutionalized, drawing from the Philippines' mandatory climate tagging model to track climate-related expenditures systematically.

4. Transparency and Accountability

To build public trust and ensure the efficient use of climate funds, the legislative framework must prioritize transparency in spending and policy outcomes.

- Annual climate action reports should be mandatory for states, linking progress with funding incentives.
- The Comptroller and Auditor General (CAG) should conduct climate-specific audits to ensure efficient use of resources and track climate-related expenditures.
- A national climate finance dashboard should be created to publicly track financial flows, allocations, and climate project outcomes in real-time, ensuring accessibility for policymakers, investors, and civil society.

5. Local-Level Engagement and Empowerment

Local governments play a critical role in implementing adaptation and mitigation projects. The framework should empower municipalities and Panchayats through technical assistance, financial resources, and regulatory autonomy.

- Targeted climate funds should support projects such as flood control, sustainable farming, and renewable energy adoption.
- Local capacity-building programs, in collaboration with the Ministry of Panchayati Raj, should train local officials in climate adaptation, risk assessment, and sustainable infrastructure.

6. Adaptability and Responsiveness to Scientific Advancements

Given the rapid evolution of climate science and technology, the framework must be dynamic, allowing periodic updates.

- Inspired by New Zealand's Climate Change Response Act, India could mandate five-year reviews of its climate legislation and policies to reflect new scientific findings and technological advancements.
- States should be encouraged to pilot region-specific initiatives, scaling successful approaches nationally.

7. Conclusion

India must institutionalize a comprehensive legislative framework that integrates climate finance, legal mandates, and federal cooperation while ensuring state and local-level empowerment.

A balanced approach will allow states to lead in adaptation efforts while maintaining central oversight for emissions reductions and regulatory uniformity. Carbon pricing mechanisms, particularly absolute pricing through trade-auctioned benchmarks, can serve as a financial backbone for both mitigation and adaptation efforts.

Drawing from international best practices, such as New Zealand's Climate Commission (for policy accountability), South Africa's targeted resilience funds (for climate adaptation), and Brazil's fiscal incentives for conservation (for ecological fiscal transfers), India can create a flexible, yet binding climate governance structure that supports its diverse regional needs.

Through national leadership, regional innovation, and local engagement, India has the opportunity to become a global leader in climate governance. A clear legal framework, empowered institutions, and sustainable financial mechanisms will enable India to achieve its net-zero ambitions while ensuring equitable and inclusive development for all citizens.

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Annex 1. Countries with Climate Framework Laws

This list reflects countries that have enacted comprehensive climate change framework laws, specifying national policies and legally binding targets for reducing greenhouse gas emissions. The years indicate when each law was adopted or enacted. Some laws have been amended or updated since their original adoption.

Country	Framework Climate Law	Year Adopted
Albania	Law No. 155/2020 on Climate Change	2020
Andorra	Law 21/2018 on the Promotion of the Energy Transition and Climate Change	2018
Argentina	Law 27,520 on Minimum Budgets for Adaptation and Mitigation to Global Climate Change	2019
Australia	Climate Change Act	2022
Austria	Climate Protection Act	2011
Bahamas	Climate Change and Carbon Market Initiatives Act	2022
Benin	Law No. 2018-18 Regulating Climate Change Actions	2018
Brazil	Law No. 12,187 Establishing the National Policy on Climate Change	2009
Bulgaria	Climate Change Mitigation Act	2014
Canada	Canadian Net-Zero Emissions Accountability Act	2021
Chile	Framework Law on Climate Change	2022
China	Energy Law	2024
Colombia	Law 1931 Establishing Guidelines for the Management of Climate Change	2018
Croatia	Law on Climate Change and Ozone Layer Protection	2019
Denmark	Climate Act	2014 (Revised in 2020)
European Union	European Climate Law (Regulation (EU) 2021/1119) Establishing the Framework for Achieving Climate Neutrality	2021
Fiji	Climate Change Act	2021
Finland	Climate Change Act	2015 (Amended in 2022)
France	Law No. 2021-1104 on Climate and Resilience	2021
Germany	Federal Climate Protection Act (Bundes-Klimaschutzgesetz)	2019 (Amended in 2021)

Country	Framework Climate Law	Year Adopted
Ireland	Climate Action and Low Carbon Development (Amendment) Act	2021
Kenya	Climate Change Act	2016
Mexico	General Law on Climate Change	2012
Netherlands	Climate Act (Klimaatwet)	2019
New Zealand	Climate Change Response (Zero Carbon) Amendment Act	2019
Nigeria	Climate Change Act	2021
Norway	Climate Change Act	2017
Pakistan	Pakistan Climate Change Act	2017
Peru	Framework Law on Climate Change	2018
Philippines	Climate Change Act	2009
South Africa	Climate Change Act	2024
South Korea	Framework Act on Carbon Neutrality and Green Growth to Respond to the Climate Crisis	2021
Spain	Law 7/2021 on Climate Change and Energy Transition	2021
Sweden	Climate Act	2017
Switzerland	Federal Act on Climate Protection Goals, Innovation, and Strengthening Energy Security	2023
Uganda	National Climate Change Act	2021
United Kingdom	Climate Change Act	2008

Notes:

- Belgium: While Belgium has multiple laws related to climate change, it does not have a single comprehensive climate framework law. Climate policy is coordinated through various federal and regional legislations.
- Switzerland: In June 2023, Swiss voters approved the Federal Act on Climate Protection Goals, Innovation, and Strengthening Energy Security, aiming for net-zero emissions by 2050.

Source: Climate Change Laws of the World database maintained by the Grantham Research Institute on Climate Change and the Environment.

Annex 2. India's Case Studies of Community-Led State Climate Action Plans

State	Project	Type	Primary Focus	Model	Success Highlights
Maharashtra	Jalyukt Shivar Abhiyan	Water Conservation	Groundwater recharge and drought resilience	Community-led water management	Improved water availability, reduced reliance on tankers; strong community ownership.
Maharashtra	Climate-Resilient Agriculture in Marathwada	Climate-Resilient Farming	Drought-tolerant crops and water-efficient farming	Grassroots training in climate-smart farming	Increased crop resilience, reduced water dependency, sustainable irrigation practices.
Maharashtra	Solar Microgrids	Renewable Energy	Rural electrification through solar power	Community-managed microgrids	Affordable and reliable power access for remote areas; locally managed for sustainability.
Tamil Nadu	Climate-Smart Village Project	Climate-Resilient Farming	Organic farming, water efficiency, crop diversification	Farmer training, cooperative planning	Enhanced resilience to climate variability, scalability to other regions.
Tamil Nadu	Mangrove Restoration	Nature-Based Solution	Coastal resilience and biodiversity conservation	Community-driven mangrove replanting	Increased coastal protection, biodiversity gains, new income through ecotourism.
Tamil Nadu	Tamil Nadu Green Climate Company (TNGCC)	Integrated Climate Action	Renewable energy, afforestation, water resource management	Public-private partnerships, decentralized renewables	Advanced renewable energy goals, effective collaboration across sectors.
Gujarat	Charanka Solar Park	Renewable Energy	Large-scale solar power generation	Centralized solar park with community employment	Enhanced energy security, job creation, and rapid renewable expansion.
Rajasthan	Bhadla Solar Park	Renewable Energy	Large-scale solar power generation	Public-private partnerships	World's largest solar park, significant renewable energy capacity, and job creation.
Rajasthan	Traditional Water Harvesting (Johads)	Water Conservation	Groundwater recharge using traditional methods	Revival of traditional methods and community involvement	Improved water availability, revitalized traditional knowledge, engaged local communities.

State	Project	Type	Primary Focus	Model	Success Highlights
Kerala	Community-Led Flood Management	Disaster Resilience	Proactive flood forecasting and disaster response	Local disaster committees and decentralized planning	Reduced flood damage, high community engagement, enhanced early warning systems.
Kerala	Food Waste Management	Waste Management	Reduction and recycling of food waste	Urban-local partnerships and community involvement	Minimized food waste, improved waste management infrastructure, and community benefits.
Sikkim	100% Organic Farming	Sustainable Agriculture	Organic farming practices across the state	State-led organic policy with grassroots training	First fully organic state, improved soil health, increased rural incomes.
Odisha	Joint Forest Management (JFM)	Forest Conservation	Sustainable forest management and livelihoods	Government-community partnership	Increased forest cover, sustainable incomes, and community stewardship.
Andhra Pradesh	Zero Budget Natural Farming (ZBNF)	Climate-Resilient Farming	Chemical-free, low-cost farming	State-supported natural farming model	Reduced farming costs, enhanced soil fertility, high adoption rates.
Bihar	Off-Grid Solar Projects	Renewable Energy	Electrification for remote communities	Community-owned solar microgrids	Improved quality of life, community-managed systems ensuring sustainability.
West Bengal	Sundarbans Coastal Resilience	Disaster Resilience	Mangrove restoration and cyclone protection	Community-led mangrove restoration	Enhanced coastal resilience, biodiversity recovery, and reduced disaster vulnerability.

Notes

[1] The Supreme Court of India's judgement on climate change and human rights in M.K. Ranjitsinh and Others v. Union of India and Others on March 21, 2024.
[2] These goals listed in this section are contained in a number of official documents, notably in Government of India 2021, Ministry of Power 2022, Ministry of Environment, Forest and Climate Change 2023, Ministry of Finance 2022, and in international reports such as United Nations 2021, International Energy Agency 2022, United Nations Framework Convention on Climate Change 2021, International Renewable Energy Agency 2023, and United Nations Development Programme 2022.
[3] https://climateactiontracker.org/
[4] The Intergovernmental Panel on Climate Change (IPCC) reports that by 2020, 56 countries had passed laws with the objective of limiting greenhouse gases, covering 53% of emissions. Since then, the number of countries has substantially increased (Annex 1).
[5] Thomas, 2023 discusses the challenges of coordinating climate action across different levels of government, particularly in federal systems. He points out that even countries with dedicated climate ministries, such as Germany and Canada, discussed further below, face difficulties in aligning national and subnational priorities.
[6] The Inflation Reduction Act represents a significant federal initiative by the United States to address climate change. However, the effectiveness of this act may be influenced by the election of Donald Trump, which could impact the implementation of climate policies by the United States.
[7] The Federal Climate Protection Act was amended in 2021 to increase emission reduction targets.

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IPPR

Examining exclusions in the Public Distribution System

A policy ethics perspective on ensuring the right to food

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Abstract

Article 21 of the Indian Constitution guarantees the right to life, with the right to food being a fundamental aspect of this guarantee. Policies concerning beneficiary coverage and Aadhaar biometric identification have led to significant exclusions within the Public Distribution System, which undermine this right. This raises critical ethical questions regarding these policies. The ethical framework embedded in the Indian Constitution has substantial implications for contemporary policymaking. How can policy ethics ensure the right to food—the right to life—for all individuals? This study assesses policies through evidence-based research, centred on the implementation of the PDS in Nagaland, India. Exclusions primarily stem from the interplay of census and identity politics, coupled with a technological determinism largely influenced by centralized state control and surveillance. This often overshadows constitutional values and objectives in policy decisions, compromising the foundational ethical principles of policymaking. Policy formulation grounded in reliable population data, targeted inclusion initiatives, flexible identity verification, and dedicated support for the most vulnerable groups is essential for ensuring inclusivity. Empowering local institutions and community-led organizations, particularly self-help groups in the management of welfare programs, can significantly enhance inclusivity. Public policies must rekindle the radical spirit of the Constitution and actualize the ethical framework envisaged within it.

Keywords: Aadhaar, exclusion, constitution, policy ethics, PDS, right to food

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1. Introduction

The Constitution of India has enshrined fundamental rights for its citizens under part III. Article 21 of the Constitution specifically guarantees the right to life and personal liberty, stating that no individual shall be deprived of these rights except through procedures established by law. In the landmark case of *Maneka Gandhi v. Union of India* (1978), the Supreme Court emphasized that any exceptions to these procedures must be reasonable, fair, and just, and that any deprivation of life or personal liberty must be justifiable based on the specific facts and circumstances of each case.

In the case of *Francis Coralie Mullin v. Union Territory of Delhi* (1981), the Supreme Court recognized that Article 21 enshrines the right to live with human dignity, which includes access to basic necessities such as adequate nutrition. The interpretation of Article 21 in judicial rulings has profoundly shaped the imposition of positive obligations on the state to ensure the provision of necessaries that support the right to life. The recognition of the right to food in India has broadened the state's obligations by establishing it as a legally enforceable entitlement.

The National Food Security Act (NFSA) 2013 places the responsibility on the state to guarantee rights-based food entitlements. This right to food is anchored in Article 21 of the Indian Constitution, which secures the right to life and personal liberty, as a lack of access to food would amount to a violation of the right to live with dignity. (The Supreme Court ruling in *Francis Coralie Mullin* stated that any law that infringes upon dignity can be deemed unreasonable.)

There is, however, a need for a more comprehensive framework delineating the nature and scope of these rights, as well as the intended beneficiaries (Surendranath 2016). The Indian judiciary has yet to develop a cohesive normative framework that links the concept of dignity with the right to life and personal liberty as enshrined in Article 21 (Surendranath 2016). In practice, the substantive political equality and the corresponding rights of citizens are often compromised, as policies routinely neglect the needs and coverage of the many impoverished individuals in India (Jayal 2024).

The NFSA being primarily implemented through the Public Distribution System (PDS) highlights two significant policy issues, which lead to exclusion of eligible beneficiaries.

The **first issue** pertains to the coverage of beneficiaries based on published population figures, referenced in Chapter IV, Section 9 of the Act. It establishes a maximum coverage of eligible beneficiaries at 67% of the Indian population based on the published census data. The government of India has not conducted the decennial census scheduled for 2021, citing challenges posed by the Covid-19 pandemic and administrative difficulties. Consequently, over the past decade, the coverage of beneficiaries in the PDS has largely relied on outdated census data from 2011, significantly contributing to ongoing exclusions.

The PDS generally provides 5 kg of foodgrains of rice and wheat at a highly subsidised rate (Rs. 3 and Rs. 2, respectively) per person per month. It currently serves around 800 million beneficiaries, representing 67% of India's population of 1.21 billion according to the 2011 census (Ministry of Consumer Affairs, Food & Public Distribution, 2023). With the latest population projection

estimating India's total population at 1.45 billion, this 67% figure would be approximately 971 million individuals. This indicates that an additional 171 million individuals could potentially be covered as eligible beneficiaries if updated census data were available. Overall, determining the number of excluded eligible individuals presents a significant challenge, as individual states and union territories (UTs) establish their own criteria for identifying beneficiaries once the central government establishes the maximum coverage limits. The backlog of ration card applications at the state level may offer some insight into the extent of exclusions; however, it is important to note that there are also eligible individuals who have yet to submit applications for a ration card, for whom data remains unavailable.

The **second issue** relates to the use of Aadhaar, a biometric identification system for beneficiary identification, as outlined in Chapter V, Section 12 of the Act. This policy mandate of Aadhaar for unique identification and targeting of beneficiaries has raised concerns of exclusion.

During the initial three years following NFSA implementation, there was uncertainty among local administrators regarding the relevance of Aadhaar in distributing benefits. While surveys from multiple states showed improved coverage, reports of exclusions and corruption also surfaced (*Economic and Political Weekly* 2016). Empirical studies highlighted exclusions related to Aadhaar issues, and with reports indicating that individuals faced challenges even after submitting all necessary documentation, including Aadhaar cards (Nayak and Nehra 2017; Ngullie and Ansari 2021; Ngullie 2018).

Jha and Kumar (2016) recounted the experiences of homeless migrants in Mumbai, arguing that the neo-liberal state's approach to the poor is exclusionary and apathetic. Even when some of these poor, migrant homeless individuals possess multiple documents such as Aadhaar, ration card, PAN card, and so on, they still lack access to basic amenities necessary for a decent life.

Dreze et al. (2017) observed that the Aadhaar system has encountered difficulties detecting biometric information, and has been susceptible to issues related to poor connectivity and technological glitches. Bhardwaj et al. (2016) argued that the implementation of an Aadhaar-enabled PDS has led to exclusions, particularly among the most vulnerable members of society, including widows, elderly citizens, and manual laborers. Khera (2017) criticized Aadhaar, calling it a tool of exclusion due to issues during implementation that threatened the right to life.

Biometric identification processes can also be humiliating for the homeless, as technology may discriminate and reject individuals with impaired bodies (Rao 2013). The challenging conditions associated with living on the streets contribute to the vulnerability of individuals, resulting in physical characteristics that may not be readily identifiable by automated systems. Consequently, biometric technology may categorize these individuals as non-compliant bodies, leading to their exclusion from state recognition and digital identity processes (Rao 2013). This concern is also relevant for daily wage laborers who may struggle to maintain consistent biometric readings. The cases of the elderly and disabled when implementing such technology were of concern (Khera 2011). The challenge is to

reconcile the fact that the human body is subject to change and decay, while the unique identification number remains the same (Nayar 2012).

Studies also brought attention to the impact of Aadhaar in the digital identity process, on social programs and development, access to welfare, and data injustices (Masiero and Das 2019). In India, the poorest of the poor – Dalits, Muslims, women, and migrants – bear the burden of digital identity distorting their citizenship status, rights, and identity (Jayal 2019). The conditionality of digital identity undermines their legal entitlement to food, as marginalized people endure the hardship in all processes, including identification, documentation, authentication, authorization, and datafication thereby facing numerous injustices (Masiero and Bailur 2021; Masiero and Das 2019; Rao and Nair 2019). Datafication pertains to the growing quantification of digital data, encompassing a range of elements such as user information, welfare entitlements, service automation, and dimensions of effectiveness and accountability, among others (Masiero and Das 2019).

Furthermore, it is argued that the use of digital identity in welfare has contributed to the government's centralizing tendencies, exacerbating the already weak connection between citizens and the state (Chaudhuri 2021). Information sharing between citizens and the state is unequal (Carswell and Neve 2022; Rao and Nair 2019): Citizens often find the state to be distant and inaccessible (Chaudhuri 2021), while the state has easy access to citizens' data and profiles (Carswell and Neve 2022), using tools like Aadhaar to monitor them (Rao and Nair 2019). This unbalanced state-citizen relationship highlights the state's lack of responsibility and accountability in governance.

2. Contextualizing the study within the framework of policy ethics

This literature situates the moral framework of the Indian Constitution as a foundational basis for the formulation of public policy. It aims to integrate ethical considerations into the decision-making processes inherent in democratic and constitutional governance. The text delineates the ethical foundation as a distinct field of inquiry within public policy studies. The discussion also encompasses various approaches to policy ethics, with a particular focus on the significance of democratic engagement throughout the policy-making process.

The efficacy of the NFSA, with its rights-based approach, in ensuring food security and subsequently safeguarding the right to live with dignity, is of significant importance. The PDS has proven to be an effective program, particularly evident in its high utilization rates, underlining its essential role in aiding impoverished populations (*National Council of Applied Economic Research* 2015).

When policies governing beneficiary coverage and Aadhaar lead to exclusions, this undermines the right to live with dignity. It provokes critical ethical questions concerning these policies. The ethical framework woven into the Indian Constitution has significant implications for contemporary policymaking.

The Constitution serves as a moral document that promotes a welfare state built on the principles of justice, equality, and fraternity, advocating for the resolution of socio-economic inequalities to fully achieve political freedom. Overall, the Preamble and Parts III (Fundamental Rights) and IV (Directive Principles of State Policy) of the Indian Constitution underscore the commitment to the socio-economic upliftment of the populace and the enhancement of living conditions alongside individual freedoms (Gajendragadkar 1969). These fundamental components establish the ethical framework for policymaking. They reflect the philosophy of the Indian Constitution and its vision of a social welfare state.

Within this context, the role of the judiciary extends to interpreting the Constitution's moral objectives. When adjudicating cases or disputes, addressing violations of fundamental rights, or evaluating the validity of legislation or executive actions that affect these rights, the Judiciary must take into account the prevailing needs of the time (Gajendragadkar 1969). Legal interpretations should align with the overarching goals of fostering a just and equitable society.

The potential for actualizing the objectives of the ethical framework of the Indian Constitution is reflected in the degree to which these objectives are incorporated into public policies. This alignment between ethics and public policy requires navigating the interplay of competing values and decision-making processes within the public sphere, thereby fostering practical ethics within a democratic environment.

In *Democracy through Public Opinion*, Laswell (1941) emphasizes the importance of values and goal-setting in policy studies, in order to propose appropriate public policies to achieve these values and goals. This approach to the study of politics, known as policy science, places emphasis on morality as a means for a democratic society to pursue justice (Easton 1950).

According to Laswell, the goal of democracy is to achieve justice, and justice entails respecting human dignity (Easton 1950). Central to this approach is the power of the people, their participation in decision-making, and the impact of such participation on democratic leadership and the achievement of democratic goals (Easton 1950).

The framework set forth by Lasswell for the policy sciences emphasizes the integration of both normative and positive arguments through reasoned discourse, drawing on multiple disciplines, and considering the specific context of time and place, aiming to serve as a bridge between citizens and government (Shapiro and Schroeder 2008). Public policy thus encompasses both empirical and normative approaches to tackle the practical challenges and ethical responsibilities that arise in democratic settings.

Wolff (2019) contends that an effective approach in public policy ethics is to delve into the real-life events and issues that require attention, as well as the debates surrounding them. This approach, known as engaged philosophy, involves identifying the issue, analysing arguments and values, assessing historical and comparative factors, creating a profile of potential solutions, evaluating options, and making policy recommendations (Wolff 2019).

An investigation grounded in the public policy ethics framework necessitates the involvement of democratic engagement, characterized by direct participation and direct observation of individuals' lived experiences. Orr and Johnson (2019) argue that policy inquiries conducted within democratic institutions necessitate the active involvement of citizens. Their discussion references the contributions of Nobel laureates such as Elinor Ostrom and Amartya Sen, who have underscored the significance of models, mechanisms, and metrics in the evaluation of evidence and the formulation of policy decisions through democratic participation.

One of the foundational sources for such policy ethics inquiry with democratic possibilities is Elinor Ostrom's influential work, *Governing the Commons* (2015). Ostrom argues that neither the state nor the market, in isolation, is sufficient for attaining policy objectives; rather, meaningful involvement of the intended beneficiaries is essential for successful governance. Ostrom advocates for collaborative governance that encourages active citizen participation, promoting self-governance as an effective model for policy implementation. Similarly, Amartya Sen, in *The Idea of Justice* (2009) argues that while institutions play a crucial role in addressing injustices and shaping values, a deeper understanding of justice can be gained through practical reasoning based on observing how people exercise their freedoms and lead their lives.

The models and metrics referenced within Ostrom and Sen's framework for policy inquiry, which incorporates democratic elements, effectively capture strategic interactions and their outcomes. These frameworks links unobservable mechanisms to causal relationships, and conceptualizing and measuring the results of policy initiatives (Orr and Johnson 2019). Ultimately, these methodologies of policy inquiry are critical for ensuring democratic participation in the policy-making process, which should encompass not only policymakers and government officials but also the active engagement of ordinary citizens (Orr and Johnson 2019). Policy ethics process unfolds through informed dialogue that respects the rights and opinions of citizens, aimed at enhancing the quality of individuals' lives and improving community well-being (Provis 2007).

In the context of democratic engagement and ethical inquiry, this study evaluates policy perspectives through evidence-based research focused on the implementation of the PDS in Nagaland, a region in northeastern India. It highlights the real-life challenges faced by vulnerable groups in accessing welfare services, while also exploring the broader context of digital identity governance and the roles of institutions in contemporary India.

Additionally, the study reflects on the socio-political landscape of tribal and indigenous societies, along with their governance structures. It specifically seeks to address the question: How can policy ethics ensure the right to food—a right integral to the right to life—for all individuals?

3. Method

The field visit took place in January 2024 in Nagaland, India, focusing primarily on the Kohima district, which includes both rural and urban areas. As the capital of Nagaland, Kohima also serves as the district headquarters. The majority of the district's residents belong to the Angami Naga tribe. However, owing to its status as the state capital, the city is home to a diverse array of ethnic groups, including individuals from various tribes and outside communities, creating a rich social mosaic.

The study focused on five key social categories for the target respondents: the elderly (80 years and older), individuals with disabilities, widows, manual laborers (including marginal farmers), and migrants – all of whom represent some of the most marginalized groups in society. These groups were specifically selected due to their heightened vulnerability to social exclusion. The criteria for selecting respondents were based on their belonging to any of the five social categories, regardless of access to PDS.

50 semi-structured interviews were conducted with the target respondents, who also represented their households. Out of the 50 respondents, 11 were individuals aged 80 years and above, 10 were persons with disabilities, 10 were manual laborers (mainly marginal farmers), 9 were migrants, and 10 were widows. The age range of respondents varied from 16 to 103, with an average of 59. The majority of respondents (72%) were female, with 28% identifying as male.

As in occupation, among the 50 participants, 15 were homemakers, 15 were manual labourers (mostly marginal farmers), 8 were unemployed, 2 were self-employed (running small businesses), 1 individual was employed in the private sector as a sweeper, and 2 individuals worked in the government sector – one as a Peon, and the other in a contracted position with a fixed salary. Additionally, 1 respondent was a student with disability, and another had previously been a student but had to discontinue their studies due to a disability. All 8 of the unemployed respondents were persons with disabilities.

Out of the 31 respondents who provided information about their household income, five reported zero income, and the average monthly income was Rs. 15971 (approximately 186$).

In terms of religious identification, 96% identified as Christian, while 4% identified as Hindu. The Hindu respondents were migrants from Nepal, with one being in the old age group. All respondent migrants were from Nepal, including some indigenous Naga women married to Nepali migrants. All migrants have established permanent residency in Nagaland and, like most of the local population, most identified as Christians.

In addition to the above interviews, Key informant interviews (KIIs) were conducted with representatives from the Directorate of Food and Civil Supplies Department in Nagaland, Fair Price Shops, and Aadhaar Enrollment Agencies. In addition, a Focus Group Discussion (FGD) was held with members of the Village Council alongside the FPS dealer.

The KIIs and FGDs were conducted to evaluate the roles and functions of these institutions, as well as to examine the potential implications of their actions, with particular emphasis on welfare governance, Aadhaar, and issues related to exclusion. Responses to interview questions from the Directorate's office were provided via email, undersigned by the Joint Director. The office also shared data regarding FPSs in Nagaland, detailing their numbers and administrative structure.

An onsite interview with the FPS dealer was conducted in the rural area of Kohima village to observe the implementation of the Aadhaar-based identification system for ration delivery. Interviews with officials from two Aadhaar enrollment agencies in urban Kohima provided insights into their hands-on experiences with the biometric registration process and their perspectives on the system's functionality.

Overall, the study aimed to deepen understanding of the policy implications surrounding welfare access and digital governance. The questionnaires for the target respondents focused on assessing access to welfare by examining the mechanisms of inclusion and exclusion within the PDS, the modes and preferences for identity verification, and overall experiences with Aadhaar, including concerns related to data privacy and protection.

The primary data was analyzed to assess current policies and identify the factors contributing to both inclusion and exclusion in welfare, and the implications of Aadhaar biometric governance. This analysis aims to propose potential solutions and options, as well as to provide further recommendations for enhancing inclusivity in welfare programs.

4. Findings

A significant and supported finding indicates that legislation aimed at enhancing beneficiary coverage contributes to greater inclusivity in access to welfare services. The NFSA plausibly facilitated the inclusion of beneficiaries within the PDS. Nagaland implemented the NFSA in 2016, and over the last decade, the majority of surveyed registered households have been integrated into the PDS. Notably, while 36% of these households have been receiving rations for ten years or more, 64% of these households have been receiving ration for periods ranging from less than one year to up to nine years.

An important observation is that, despite the high utilization rate of welfare within the PDS, there exists an underlying issue of exclusion that is not immediately apparent in this overall assessment. The significant utilization rate of the PDS among households, evidenced by the consistent collection of allocated rations, underscores the program's essential role in supporting vulnerable populations. However, this heightened engagement simultaneously masks the underlying exclusions experienced by registered households; over one-third of these households indicate that one or more members are not beneficiaries of the PDS.

The primary reasons for these exclusions are related to the challenges encountered in acquiring the application form for ration cards, as well as difficulties associated with the Aadhaar identification system.

- Among the 50 persons interviewed, 47 were registered, while three were unregistered (excluded from the PDS).
- Of the registered households, while 64% had all household members included on their ration cards, 36% faced exclusions for one or more members. Specifically, within the 215 individuals representing the 47 registered households, 32 were not included on their family's ration card.
- Among the 32 individuals excluded from the study, 62% were omitted due to the non-application or non-renewal of their ration cards, which resulted in the exclusion of these members at the registration stage.
- Issues with Aadhaar verification accounted for 25% of the exclusions.
- The remaining excluded individuals included two who had applied and were awaiting inclusion, two whose names had been deleted for unspecified reasons, and a three-year-old infant.

Another form of exclusion to note within registered households is when individuals or households receive less than their legal entitlements. In these cases, some benefits may be diverted at the delivery point, leading to a denial of rights. Nearly one-quarter of beneficiaries reported that they did not receive their full entitlements, highlighting the gaps and potential instances of corruption within the system or service delivery.

Households and individuals that were completely excluded from the PDS have been identified as the most vulnerable in relation to their health status. These included the elderly and individuals with disabilities. An elderly woman, aged 103, was bedridden and had not updated her ration card in the past decade, resulting in her exclusion from the program.

A 25-year-old blind man and his visually-impaired younger sister were excluded from the PDS. Although they possessed Aadhaar cards, the siblings and their family of six had yet to apply for a ration card due to reported bias in the distribution of application forms in their urban Kohima locality. Allegations suggested that the colony chairman exercised discretion in distributing forms, favoring members of the Angami tribe, the district's local inhabitants. The respondents belonged to a different tribe from another district, not Kohima.

Similarly, a 66-year-old man with an intellectual disability faced challenges in acquiring an application form, and thus dispossessed a ration card. His sister-in-law attempted to inquire about the form in their nearby village but was told that it was unavailable. When asked if they needed rations, she replied ‘ *We need it but what can we do?*’

At the state level, the predominant factor contributing to exclusion from the PDS was attributed to the Aadhaar compliance policy. The data obtained from the Directorate indicates that over one hundred thousand individuals in the state have been excluded from PDS due to inadequate levels of Aadhaar enrollment. The precise number of households and individuals pending receipt of ration

cards remains unclear; however, reports indicate that the elderly and minors are disproportionately affected.

The integration of new applicants into the system remains an ongoing endeavor; however, the processing of certain individuals' ration applications is hindered by incomplete updates to their Aadhaar information. Complaints and grievances from the Directorate concerning the exclusion of eligible individuals or households were also linked to issues related to Aadhaar.

At the village level, findings indicate that exclusion has occurred due to the relevant department's failure to process ration card applications in a timely manner. For example, the FPS dealer in Kohima village, which has 351 registered beneficiaries, reported that four or five individuals have been excluded from the locality. This group includes married women and never-married men, whose names were removed from their family ration cards upon marriage or when they moved out of their primary household.

Despite having re-applied, it has been a year since the FPS dealer submitted their applications to the Department of Food and Civil Supplies at PR Hill in Kohima for new ration cards, and the process remains ongoing at the departmental level. The Village Council members confirmed that new cards for these applicants have yet to be issued by the department. However, they were unable to specify the exact number of people excluded in their locality, as a significant portion of the village's population resides in the adjacent urban area of Kohima.

The Aadhaar policy has the potential to result in the exclusion of individuals, particularly those who experience biometric failures during the enrollment and verification processes. These complications are often linked to various health-related and social factors. Findings indicate that occurrences of biometric failures are significantly more prevalent during the verification phase at FPS than during the Aadhaar enrollment phase. Specifically, while 6% of individuals reported experiencing difficulties with biometric recording during the Aadhaar enrollment process, a notable 40% encountered challenges during the Aadhaar biometric verification conducted at FPS.

The elderly faced significant obstacles in biometric verification, attributed to factors such as mobility issues, memory loss, bedridden conditions, and difficulties with fingerprint detection. Individuals with disabilities face distinct challenges, both intellectual and physical, that often necessitate specialized transportation or assistance in order to access biometric venues.

For instance, the biometric data of a patient with palsy proved difficult to detect. The patient's father requested that the Deputy Commissioner's office permit the recording of his son's biometrics at home, given his lifelong bedridden condition. 'Typically, individuals visit the office for biometric registration, but in my son's case, a staff member came to our home,' he explained. He noted that the process took three to four hours because the biometrics were not successfully captured on the first attempt. After multiple attempts, they were able to record the fingerprints, reporting that 'out of 10 fingers, only 2 were detected and accepted.'

Manual laborers, such as farmers and migrant workers, encounter difficulties during the biometric verification process. Young children face challenges in both the registration and verification phases.

According to Aadhaar enrollment agencies, young children, farmers with injured hands, and elderly individuals frequently experience obstacles during the biometric recording process. It has been reported that young children experience difficulties with biometric devices due to their fingers being 'very tender,' resulting in lower detection rates, particularly for those under seven or eight years old.

The Aadhaar enrolment agency indicated that during the biometric recording process, fingers are pressed onto the machine five times. If they achieve success rates of only 20%, 30%, or 40%, or if one or two fingerprint records display a green signal, they proceed with the enrolment. The agency emphasized that fingerprints not fully captured during registration are more likely to lead to verification failures when individuals attempt to collect their rations at service delivery points.

Findings indicates that providing flexibility in identity verification—whether through hand signatures or biometric methods—promotes greater inclusion in accessing welfare services. At the time of this study, the Aadhaar biometric verification system had not yet been fully implemented in the state. Some FPSs were in the process of transitioning from hand signature verification to biometric verification, with the linking of biometric details to the system still underway. In this context, beneficiaries were given the option to either provide a hand signature or verify their biometric information at the service delivery point. This flexibility has significantly contributed to enhancing the usage rate and overall success of the PDS. Nevertheless, certain individuals who have not completed the verification of their biometrics with the FPS dealers may be at risk of exclusion.

With respect to the preferences of beneficiaries regarding identity verification, the findings revealed that 42% of respondents favored hand signatures as their preferred method of verification, while 28% opted for biometric verification. Additionally, 30% of participants indicated that they found both hand signatures and biometric methods to be convenient.

The preference for hand signatures were attributed to concerns such as health issues, machine malfunctions, difficulties in fingerprint detection, network connectivity problems, and limited power availability. On the other hand, some individuals, particularly the elderly and farmers, favored biometric verification due to illiteracy-related challenges, such as being unable to write their names, as well as for security reasons. Others appreciated the option to choose between both methods.

A significant number of beneficiaries were found to be unaware of the Digital Personal Data Protection Act (DPDPA), 2023, and largely unable to articulate concerns regarding data privacy or misuse. Additionally, FPS dealers did not receive training on data privacy and protection. The Directorate confirmed that officials, including FPS dealers, had not participated in e-governance training specifically addressing data privacy and protection issues.

5. Discussion

This study suggests that policies designed to enhance coverage for beneficiaries, including providing flexibility in identity verification and addressing health and social factors, promote

inclusivity in access to welfare. Conversely, policies that inhibit coverage and impose constraints on biometric identity create potential risks of exclusion.

The lack of comprehensive coverage can largely be traced back to a reliance on outdated census data and the absence of policy measures that leverage reliable population data for beneficiary inclusion. Aadhaar policy compliance, combined with a backlog of applications for ration cards that are tied to maximum coverage determined by the 2011 census data, contribute significantly to social exclusion.

Nonetheless, neither of the underlying rationales provides sufficient justification for exclusion, thereby resulting in the denial of the fundamental right to food. In particular, the most vulnerable individuals often struggle to even obtain the application form for a ration card, despite holding an Aadhaar card. The following discussion centers on the identification of the determinants that influence policy decisions related to census data and compliance with the Aadhaar system, followed by examining potential solutions to mitigate exclusionary practices.

The country's political discourse influences how census data is collected and how people are categorized to serve the interests and agenda of the ruling political class (Gill 2007). In India, census data has served as a political tool closely connected to issues of caste, religion, gender, and ethnicity, all of which are central to identity politics. Demographic questions surrounding the census fostered a communal discourse during British colonial rule, shaping Hindu-Muslim consciousness and relations even after independence (Bhagat 2012).

Since gaining independence, India has maintained a decennial census process that has generally functioned smoothly; however, recent disruptions raise concerns. India’s latest census, as of now, is of 2011. Over the past decade, the coverage of beneficiaries in the PDS has been largely based on the outdated census data of 2011, which has significantly contributed to ongoing exclusions.

Exclusions occur right at the outset—specifically, the inability to obtain the application form for a ration card, even for those who possess Aadhaar cards. Furthermore, those who have submitted their applications often find themselves in prolonged waiting periods, without any clear communication regarding the reasons for the delays.

The government of India has not conducted the decennial census scheduled for 2021, citing the challenges posed by the Covid-19 pandemic and administrative difficulties. However, this failure has been described as indicative of a 'flailing state,' characterized by institutional breakdown, insufficient state capacity, and politicized institutions (Daniyal 2023).

Pritchett (2009) posited that India can be characterized as a ‘flailing state’ due to the Indian administration's inadequacy in delivering public services, while suggesting that this failure may be rooted in identity politics related to caste and communitarian issues, which are often disconnected from the provision of broad-based benefits to the citizenry. In the recent past decade, the intensified politics of citizenship in India, based on religious faith while undermining secularism, has resulted in the exclusion of marginalized sections of society, which in turn affects their access to government benefits (Jayal 2022).

The politicization of the census, especially in relation to the controversial Citizenship Amendment Act (CAA) and the National Register of Citizens (NRC), has transformed its role into one of exclusion and marginalization based on religious classification. This shift dilutes the original purpose of the census as a mechanism to assist in socio-economic policy planning and to empower disadvantaged groups, particularly minorities (Bhagat 2012).

The lack of reliable census data has significantly hampered the planning and implementation of public policies, disproportionately affecting marginalized groups (Koya and Kumar 2023). It raises considerable concerns regarding the status of democracy in India and the accountability of its representative government (Fernandez 2024). The census, a key defining characteristic of the modern state, serves as evidence of a functioning government (Whitby 2020). The opacity surrounding data complicates governance, making policy-making and resource allocation not only difficult but also illogical and unethical.

In the 21st century, digital welfare has become a crucial element of reforming public service delivery on a global scale. The Aadhaar initiative serves as an example of a large-scale big data resource that collects and stores a wide array of citizens' identity information, including biological features. While uniqueness through biometrics and identification numbers may seem valid for targeted programmes, Aadhaar is not impervious to shortcomings, and may inadvertently result in the exclusion of individuals from welfare programs, particularly affecting the most marginalized populations. The policies surrounding Aadhaar are primarily responsible for instances of exclusion within the state, notably due to low enrollment figures and the inadequate updating of Aadhaar information.

Challenges related to biometric identification manifest at both the Aadhaar enrollment and verification stages conducted at FPS. Although the system is designed to eliminate ghost or unintended beneficiaries, it unfortunately risks disqualifying legitimate beneficiaries in the process. The inadequacy in accurately recording and verifying biometric identities presents a considerable threat to the inclusion of these individuals in welfare initiatives. With Aadhaar, there has been a lack of proactive assessment of its potential impact and risks, both for individuals and institutions, including the government (Young 2019).

In its current form, Aadhaar governance represents a dysfunctional centralization. The implementation of Aadhaar registration is directly overseen by the statutory authority—the Unique Identification Authority of India (UIDAI) under the Ministry of Electronics and Information Technology, Government of India. 'It is the UIDAI authority that accepts or rejects applications through system detection.', said the Aadhaar enrolment agency.

Despite the presence of Aadhaar enrolment agencies nationwide, neither the state government nor the enrolment agencies have any control over the system nor solution over the failures of Aadhaar biometric registration and identification. There exists a significant deficiency in communication and coordination among governing systems at all levels—central, state, and local—regarding the implementation of Aadhaar policies and the attainment of associated policy objectives.

The centralized governance structure of Aadhaar possesses the authority to accept or reject individuals and to monitor their activities; however, it fails to offer a mechanism for citizens to seek redress for grievances. In instances where biometric recognition systems prove ineffective, FPS dealers, Aadhaar enrollment agencies, and citizens encounter significant limitations in terms of recourse. Commonly-adopted methods to mitigate recognition failures include rubbing the hands or applying substances such as Vaseline or oil. Additionally, some individuals are counseled to either create new Aadhaar cards or update their biometric information.

The FPS dealer, reflecting on this issue, remarked, '*We witness and experience this problem firsthand, and yet, for the time being, we continue to operate in this manner. We are not the only ones facing this challenge.*' This underscores the widespread nature of the problem within the ecosystem reliant on biometric verification.

In a related context, Aadhaar governance exemplifies a form of knowledge that is abstracted and generalized within the framework of modernist statecraft, often overlooking the intricate realities encountered in everyday life (Scott 1998). While the government assumes no responsibility for the exclusions arising from the Aadhaar, the onus of transparency and accountability is predominantly placed upon the citizens. This distribution of responsibility does not correspond with the tenets of democratic governance. The core principle of democracy is rooted in the ultimate sovereignty of the populace, with elected representatives serving as conduits for the articulation of the public's will (Jayal 2001). When the formulation of digital laws, policies, and governance structures is primarily oriented toward enhancing state authority rather than prioritizing the needs of citizens, there is a significant risk of fostering a centralized dystopia rather than a decentralized utopia (Cengiz 2023). This shift from centralization and state planning to authoritarianism poses a threat to democratic principles, and can engender moral decline within society (Ellul 1964).

The ethical considerations presented herein highlight the potential risks linked to governmental interventions and public policy formulation (Cohen 2015). They raise critical questions about democracy and the functionality and accountability of a representative government, particularly regarding the government's failure to execute census population data for effective policy implementation.

Further, the judiciary serves as the key authority in interpreting and upholding the ethical principles enshrined in the Constitution, especially those articulated in the Directive Principles of policymaking, striving to balance individual rights with the collective good of society. However, the policy decisions stemming from its ruling on Aadhaar, particularly its implementation without adequate prudence and risk assessment, have faced criticism. The government's actions were seen as contrary to the rule of law, and the Supreme Court was criticized for not providing adequate oversight (*Economic and Political Weekly* 2015).

6. Conclusion

Census data and identity politics, along with technological determinism driven by centralized state control and surveillance, significantly contribute to exclusion within the PDS. These elements frequently overshadow constitutional values and objectives in policymaking, undermining the foundational principles that govern policy decisions and effectively denying individuals their legal entitlement to food. This denial poses a serious threat to the inherent right of marginalized populations to lead dignified lives.

The central government should formulate and implement policies, grounded in updated population data, to safeguard the fundamental right to life, with particular emphasis on the right to food. A significant policy initiative to uphold this right could involve targeted inclusion drives through door-to-door surveys, specifically aimed at the most vulnerable populations, including individuals with disabilities, the elderly, and the homeless. It is essential to provide dedicated support for elderly individuals, particularly those facing mobility challenges, intellectual disabilities, and those who are bedridden, to ensure they receive their entitled rations.

In this regard, introducing doorstep delivery of rations and making Aadhaar verification optional for this demographic are critical steps. Implementing flexible identity verification methods—such as biometrics or handwritten signatures—could significantly improve inclusivity and the overall success of the program.

The NFSA outlines directives prioritizing public institutions or local bodies, including self-help groups and women's collectives, for the licensing and management of FPSs. It is vital for the government to effectively implement these directives to promote inclusivity and strengthen the welfare system. We can then anticipate a significant transformation toward a future welfare-based digital society, that emphasizes sustainable policies focused on solidarity and social cohesion.

Public policies should reinvigorate the radical ethos of the Constitution and actualize the ethical framework it espouses. It is essential to recover the radical impetus inherent in the Constitution by exploring avenues to transform the fundamental directive principles into enforceable rights (Baxi 1992).

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Diffusion, innovation and the tech-politics underlying power transitions

Review article based on Technology and the Rise of Great Powers: How Diffusion Shapes Economic Competition by Jeffrey Ding

Lokendra Sharma & Arindam Goswami*

Klaus Schwab, founder of the World Economic Forum, first popularised the term 'Fourth Industrial Revolution' (Schwab 2015). Schwab identified artificial intelligence (AI), robotics and biotechnology as some of the key emerging technologies of the unfolding Fourth Industrial Revolution (4IR). Recent developments have elevated one technology over all others as being the defining feature of the Fourth Industrial Revolution — AI.

The great power rivals of the twenty-first century — the United States and China — have both intensified their efforts to become the global leader in AI. Previous industrial revolutions have been associated with great power transitions. Will the geopolitical winners and losers of this century be decided by who leads the battle for AI supremacy? Will China eclipse the US as the preeminent global power?

Technology and the Rise of Great Powers: How Diffusion Shapes Economic Competition (Princeton University Press, 2024) by Jeffrey Ding attempts to answer the above questions. Challenging alarmist accounts that have highlighted China's lead in various AI innovation indicators, Ding argues that diffusion of general-purpose technologies (GPTs)[i] such as AI matters more than just innovation. Highlighting the uphill challenges China faces in unseating the US, he argues that the US is ahead of China as far as GPT diffusion metrics related to AI are concerned.

In this book, Ding applies the GPT diffusion theory to provide a fresh retelling of historical industrial revolutions. His argument has relevance beyond the great power rivalry between the US and China; it has lessons for rising powers such as India.

Unpacking Ding's GPT and leading-sector theories

The central theme that motivates Ding's scholarly inquiry is one that has inspired a lot of international relations scholarship (Kennedy 1987; Yang 2013; Brooks and Wohlforth 2015; Chen

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and Evers 2023) — what *causes* the rise and fall of great powers? More specifically, what role do technological revolutions play in power transitions?

In answering this, Ding challenges the dominant idea of a leading-sector (LS) mechanism that 'stresses a country's ability to dominate innovation in leading sectors' (p.15). Building on decades-long scholarship on GPTs (Bresnahan and Trajtenberg 1995; Petralia, 2020), Ding argues that it is the diffusion of GPTs, as opposed to the LS model, that best explains the historical winners and losers during power transitions.

Demonstrating the analytical rigour that is present in the entire volume, Ding describes the contrasting causal chain for the LS and GPT mechanisms. In the case of LS, the domination of one great power in certain leading sectors leads to monopoly profits (following classic first-mover advantage), thereby catapulting the great power to economic pre-eminence. In case of GPT, however, 'some great powers sustain economic growth at higher levels than their rivals do because, during a gradual process spanning decades, they more intensively adopt GPTs across a broad range of industries' (p.16). While not discounting the significance of innovation in cutting-edge sectors, Ding favours the diffusion of GPTs over LS mechanism because the former leads to economy-wide productivity growth. For instance, according to Ding, while Japan achieved 2.4 per cent annual total factor productivity (TFP) growth from 1983–1991 through leadership in high-tech sectors like semiconductors, its reliance on LS mechanisms led to stagnation (0.2 per cent TFP growth in the 1990s) and a widening GDP gap with the US, which prioritized GPT diffusion. Similarly, during the second Industrial Revolution, the US surged ahead of Britain by diffusing electricity broadly: the US GDP grew 5.3 times (1870–1913) versus Britain's 2.2 times. By 1912, US per capita electricity production was double of Germany's and five times that of Britain. This diffusion enabled the US to establish a per capita GDP lead over Britain by 1900, despite comparable starting points.

The three industrial revolutions

Ding analyses in a very nuanced manner the First, Second, and Third Industrial Revolutions, that were defined by Britain's rise, the US's ascent, and Japan's challenge, respectively. He compares and assesses LS and GPT theories to find out which one of these provides a compelling understanding of how technological leadership and transformation helps states achieve economic leadership. In Ding's view, all three case studies provide support for the GPT theory.

Britain became the world's most advanced economic power during the (first) Industrial Revolution (1780–1840) not through breakthrough innovations, as claimed by the LS theory, but because it was able to spread mechanical skills across industries, which aligns with the GPT theory. Using different technological candidates for both the theories, Ding shows that it was Britain's unique institutional strengths that helped mechanisation diffuse across sectors, which in turn contributed to Britain's economic leadership.

For instance, France produced elite engineers, but failed in disseminating technical knowledge widely. Unlike France, Britain developed a flexible apprenticeship system and created institutes which helped spread mechanical expertise. Mechanics in Britain had superior access to technical publications and training opportunities. The GPT skills infrastructure contributed immensely to Britain's success.

Similarly, during the second Industrial Revolution (1870–1914), the US emerged as the technological and economic leader, again not so much through technological innovations as through systematic technological diffusion. The candidate leading sectors for this IR were steel, electrical equipment, chemicals, and automobiles; while the candidate GPTs were interchangeable manufacturing, electrification, chemicalisation, and internal combustion engines.

The US created comprehensive engineering education systems which emphasised practical, experience-based learning. Some institutional innovations like land-grant schools, technical institutes, and strong university-industry linkages helped the spread of technological knowledge. In chemical engineering, the US pioneered the 'unit operations' concept, breaking down complex processes into standardized, transferable components that could be applied across multiple industries. Therefore, while Germany led in chemical breakthroughs, and the US actually trailed in initial innovations, what helped the US was systematising, standardising, and creating institutional mechanisms for spread of technological understanding. Per Ding, this approach proved far more economically transformative.

Unlike the first and second IR historical case studies, the third Industrial Revolution — or the Information Revolution — serves a different purpose. In the case of IR-3, Japan and the US were engaged in a close economic competition, spurred by the developments in information and communications technologies (ICT) during the period 1960–2000. During the 1970s and (especially) 1980s, scholars and policymakers in the US anticipated Japan eclipsing the US as an economic powerhouse. However, such fears were not realised as Japan's growth story stalled in the 1990s (often referred to as Japan's 'lost decade'), and its economy has struggled ever since. That is to say: '*[t]he feared economic power transition [...] never occurred*' (p.133).

Ding uses the IR-3 case study to make the case that while conditions for LS mechanism existed for Japan — which dominated innovation in key technology sectors such as semiconductors, consumer electronics and computers — the economic transition did not take place, as the US was ahead in diffusing ICTs during the same period. More specifically, Ding establishes that the US led in diffusing computerisation (the chosen candidate GPT for IR-3). In particular, '*institutional adaptations that widened the base of computer engineering skills and knowledge proved crucial to the enduring technological leadership of the United States in the IR-3*' (p.148).

Therefore, the IR-3 case study, according to Ding, disconfirms the LS mechanism. It does not undermine the GPT theory, because Japan trailed the US with regard to diffusion of GPTs.

Shortcoming: Inadequacy in threat-based explanations

In addition to the GPT and LS theories, Ding also uses two other theories — varieties of capitalism (VoC) and threat-based explanations — to explain developments during the industrial revolutions. The VoC explanation 'highlights differences among developed democracies in labour markets, industrial organization, and interfirm relations and separates them into coordinated market economies (CMEs) and liberal market economies (LMEs)' (p.39). Threat-based explanations, on the other hand, 'assert that external threats are necessary to incentivize states to innovate and diffuse new technologies' (p.82).

Like in IR-1 and IR-2, the author is able to convincingly demonstrate that the VoC approach does not provide a sound explanation of the failure of Japan to eclipse the US in IR-3. However, he does not provide sufficient grounds to discard threat-based explanations in the case of IR-3. Ding notes that 'tensions in East Asia and the oil crises of the 1970s' and 'dangers of the Cold War' created a 'threatening international environment' for Japan and the US, respectively (p.154). He argues that '*General threat-based explanations therefore cannot explain differences in technological outcomes between the United States and Japan, namely, why the United States was more successful in ICTs than Japan.*' (p.154)

The book fails to acknowledge that Japan and the US did not face threats on a similar scale. The US was embroiled in an ideologically-fuelled great power rivalry with the Soviet Union at the global level, and was directly engaged in multiple proxy wars during the IR-3 period. Japan's threat environment, in contrast, was a regional one. There is therefore scope to strengthen the threat-based explanations approach (especially for the IR-3 period), and clarify the significance of the differences in the nature and scale of threats.

GPT and LS are not either-or

There is a risk of policymakers misinterpreting argument of the book to mean that it is necessarily and always an either-or choice between the LS and GPT theories. States can focus on both trying to gain a first-mover advantage in critical sectors, and in building up GPT skill infrastructure[ii] to help diffuse knowledge and technological expertise from research to various application sectors. In the highly charged geopolitical environment of the present, gaining expertise and knowledge of critical sectors is essential, and research in academic institutions and laboratories could yield significant benefits.

Application of Ding's framework to India

While the book is primarily concerned with the rise and fall of great powers, it has lessons for rising powers such as India. India did not feature as a power of global significance during any of the previous industrial revolutions. During IR-1 and IR-2, India was one of the many colonies of the British

empire. For most of IR-3, India was a newly-independent state with extreme poverty and sluggish economic growth. It was only towards the end of the IR-3 period — the 1990s — that India's economy started to grow at a faster rate. This period also saw the spread of computers, telecom, and internet in India.

India undertook some diffusion of the GPT of IR-3—computerisation—beginning in the 1980s, and accelerating through the 1990s and 2000s (Rajaraman 2015).

- In 1990, the size of India's IT and IT-enabled services (ITeS) sector was about USD 100 million (Gopalakrishnan 2016). In the financial year 2024, '*India's IT-BPM [Business Process Management] industry (excluding e-commerce) is expected to reach USD 254 billion*' (MEITY n.d.).
- In 1997, 160,000 people were employed in the software industry (Arora and Athreye 2002). In 2024, the IT-ITeS industry employs more than five million people in India (MEITY n.d.).
- In 1993, there were about 100 engineering colleges in India that offered a bachelor's degree in computer science; about 3000 students graduated with computer science degrees (Rajaraman 1993). There were 2,461 All India Council for Technical Education (AICTE-approved) institutions offering computer science education at the undergraduate level in India in 2022-23; while 3,76,048 students were enrolled in these colleges for computer science engineering (Shrangi 2024).

While not strictly comparable (being gathered from different sources and with different methodologies), these numbers still give a rough idea of India's success with diffusion of computerisation. In the IR-4 phase, given that AI has all the characteristics of GPTs, going by Ding's GPT Diffusion Theory, it follows that AI's diffusion across different sectors of the economy is necessary to contribute towards economic growth. IR-4 offers India an opportunity to increase its relative power in the international system, and the country could do this by focusing on GPT diffusion mechanism outlined by Ding: expanding AI engineering and knowledge so as to create the necessary skill infrastructure.

AI diffusion would also require significant financial resources. The trade-offs would be potential risks of lack of enough focus on other important technologies given India's resource constraints, increased job displacement and managing computational resource constraints. These, however, have to be weighed against productivity gains that are possible because of AI diffusion, and also against the opportunity costs of not doing so.

Notwithstanding the focus on diffusing GPT such as AI during IR-4, it is of paramount importance that India also works on pioneering, breakthrough AI innovation. Trade wars, supply chain issues and national security concerns have made global value chains very unstable, making the sourcing of high-tech innovation products/services difficult. In such an environment, India cannot afford to just build GPT skill infrastructure.

A GPT skill infrastructure can lead to better diffusion and eventually economic development when global trade is relatively open, and knowledge and expertise flow with less hindrance. The world is in a constant state of flux, where till recently globalisation was a phenomenon, but after the COVID-19 pandemic and due to the trade wars, trade barriers are rapidly going up. The concept of comparative advantage still holds, but it is increasingly being sacrificed at the altar of national security. In such an environment, India cannot afford to continue with the status quo on research and development (R&D) spending. R&D is a component of both LS and GPT theories.

- For the LS theory, doing R&D for staying at the cutting-edge in leading sectors is the most important endeavour.
- As per the GPT theory, R&D can happen anywhere as long as the underlying technology can be sourced and diffused across different sectors. Diffusion is the key.
- With AI, R&D can also be in models (such as foundational open-source models) that are more suited for diffusion as opposed to cutting-edge proprietary models. India should also therefore focus on the development and deployment of open-source AI models as a GPT diffusion mechanism.

Further, the relative resource crunch in India (as compared to China and the US) means that deployment of public funds will have to be optimised for short-to-medium term impact. This is because it takes decades for the GPT diffusion to become significantly impactful. As Ding has argued, 'if the lessons of past industrial revolutions hold, the key driver of a possible US-China economic power transition will be the relative success of these nations in diffusing AI throughout their economies over many decades' (p.189). Therefore, in the current geopolitical environment, rising powers such as India should focus on both LS (for short-to-medium term returns) and GPT mechanisms (for long-term returns).

Why the book matters

The work featured in this book started out as Ding's dissertation at the University of Oxford, and continued to take shape during Ding's stints at Stanford University and George Washington University. A dense academic treatise, the book presents new ideas regarding technological innovation, economic development, and global power dynamics. It provides a framework that can help scholars and policymakers examine ongoing technological transformations, and understand how technologies actually transform economies.

Where the book really challenges readers is in thinking beyond individual inventions. and considering the broader institutional and other skill-related systems that truly drive technological and economic progress. While the book might seem a bit repetitive at times, the repetition does drive home the point being made — diffusion of GPTs (as opposed to innovation in some leading sectors) during industrial revolutions decides the winners and losers of power transition.

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Notes

[i] Note that this is different from the 'GPT' in ChatGPT.
[ii] Ding defines GPT skill infrastructure as '*education and training systems that widen the pool of engineering skills and knowledge linked to a GPT*' (p.8).

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