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AN ANALYSIS ON MODERN METHODS OF POPULATION AND HOUSING CENSUSES

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Abstract

Understanding demographic, socioeconomic and cultural indicators are vital for decision-making especially in governance. Hence, census being the largest producer of such information on people and places, its evaluation and modernisation for error free information generation and timely availability is critical. Across the world, the census methods used are highly dependent on the age of the country, technological advancement and level of human development. Though the traditional method of census was the stepping stone for framing necessary definitions and nomenclatures of various aspects in census taking, the requirement for data on frequent intervals and upto date is effectively driving the countries towards register based or virtual censuses that could deliver actionable data at desired interval and granularity. This paper is focused on the census methods and its evaluation through last two centuries across the world with specific focus on Census of India.

Keywords: *Census methods, Enumeration, Housing, Household, Virtual Census, Traditional Census*

1. INTRODUCTION

Place and People are the most important elements for everything we do and furthering human development. Hence to know how many we are and where we live, work and leisure is the most critical information that would facilitate to arrive at what we need to do for achieving them. Information on people and places are being collected through many sources and census is one of them. However, the characteristics which differentiate a census from other sources of data are individual enumeration, simultaneity, universality and defined periodicity (UN, 1991). Thus, a census not only obtains information on every individual but it does so at the same time within the defined territory, and repeated on a regular basis. It acts as a catalyst in devising demographic, socioeconomic goals and to understand the cultural changes for framing new policies, effecting planning and managing the resource allocations by the state and local institutions in the areas of health, education, housing and other public services (Bailar, 2001; Narzary et al., 2019).

The necessity of census could well be summed up, through the words of R.A. Gopalaswami, the *Registrar General, India and ex-officio Census Commissioner for India, 1951*

> *"How many are "WE, THE PEOPLE OF INDIA"? In what places do WE live? In what manner do WE obtain our means of living? At 'What rate have WE been growing in number during the last few -decades? What has been the effect of this growth upon our means of living? What is the inference to be drawn from the experience of the last few decades about the probable growth of our numbers and our means of living during the next few decades? We need answers to these questions. We need them, not because of idle curiosity, but in order to help us achieve higher purposes enshrined in our CONSTITUTION"* (Gopalaswami, 1953)

Hence, census provides not only snapshot on the overall development achieved by the nation at a given point of time, but also helps us to understand how we have transformed thus far and what shall be our plan of action for the future. Furthermore it has been used as a primary source for evidence-based decision making (Hall, 2015), demarcating electoral constituencies, for allocating representation in local bodies (UNSD, 2011), more and above to understand the basic demographic under currents that will shape up the future generations. The need for a population census has been debated on the grounds of financial burden and suggestion to explore the alternative sources of population information doing the round. However in a diverse country like India the same is a challenge and does pose greater chance of generating misleading statistics because the very premise of generating population data through existing administrative mechanism still to be strengthened and systemised for integrated data streaming and mining. It is then imperative on the part of NSO's to explain what is meant to be acquiring of statistical data and necessarily how important it is and the cost of not having the same for a nation.

2. OBJECTIVES OF THIS PAPER

- To summarise the history and evolution of modern census around the world and the role played by United Nations in formalising and advancing the World Population and Housing Census programme across the globe.
- To enumerate the methods of data collection been executed for conducting the population and housing census around the world and appreciate its advantages and disadvantages.
- To evaluate various process of census taking in the important countries (India, China, United States of America, United Kingdom, Netherlands, France and Sweden) who have advanced the modern census methods.
- To analyse and appreciate the census methods employed by the Census of India through the past 150 years in India.

3. TRANSFORMATION OF CENSUS SINCE 17TH CENTURY

The foundations for the modern census were most probably laid in Europe towards the middle or end of the 17th century. However none can be claimed as of first modern census, as the early enumerations covered one or more features of a modern census, but none have covered all the characteristics of it (Srivastava, 1971). Like other forms of conceptual development, population census was an evolving information gathering process and that solely depended on the necessities felt by then rulers or governments at that point of time. The exclusion of Native American Indian population (resulted from their non-taxable status) from first six censuses (Lujan, 1990) on the other hand US census also been done as part of revolutionary system of representative government (PRB, 2009) are examples. Until the beginning of 19th century, these processes remained headcounts, estimates, non-synchronous and not so scientific except

few efforts that were done for specific utilities like that of the census of Barbados in 1680 (Dunn, 1969).

One of the earliest countries to conduct census is Sweden, where between 1748 and 1775, the census was conducted triennially and from 1775 onwards taken quinquennially (Hendricks, 1862). The Swedish had strong data collection mechanism through Parishes which were maintaining six types of registers, since 1749, the returns are submitted in common schedules, processed and archived for tabulation and analysis (Berg, 1855). Thus the presence of long and well established administrative mechanism played very important role in the successful collection of data at the desired level. It will not be too generalised assertion to say that in other parts of the world with few exceptions, the census taking was begun to formalise along with the strong national governance structure and past experiences around the world. In the middle of 19th century, more countries have started conducting censuses based on established methodologies which were at the nascent stage and there was concerted effort to improve them through the internationally agreed definitions and recommendations (Baffour, 2013).

In the year 1853, with the realization of the International Statistical Congress (ISC) in Bruxelas (Brussels) it was propounded to conduct the census under the common framework and determined that the best time to perform is year 0 of each decade (Brown, 1853). Since then, population census remains the only exercise of universal in nature and largest with sole purpose of creating vital population information for governance, planning, security and resource allocation. As decades rolled on, more established means of discussion, sharing of expertise and guidance from the earlier censuses culminated in the UN forums especially after the World War – II and there was enough thrust been advocated to universalise the Census so that comparable population data could be generated for the whole world.

4. THE ROLE OF UNITED NATIONS

The United Nations plays vital role in the standardising concepts, universalising the census and continues to advocate the need for national census-taking worldwide through the World Programmes on Population and Housing Censuses spanning over successive 10-year periods. The effort of UN forum could be acknowledged through the jump in number of countries that have conducted their National census between the decades of 1935-44 and 1945-55 (UNESC, 1965). In the thirty-sixth UN session in March 2005, the Statistical Commission under the United Nations, initiated the "2010 World Population and Housing Census Programme" covering the period 2005-2014 and urged Member countries to carry out a population and housing census at least once in the period 2005-2014 and to disseminate the census results in a time bound manner (figure. 1).

In the period between 2010 and 2011, 197 countries (UNSD, 2011) or areas worldwide have carried out census operations covering 94% of the world's population and thus only 6 per cent of people are yet to be counted. During the 2010 census round, most of the countries put some effort to use new and improved technologies in different phases of the census operations (UNSD, 2011). There is considerable investment in technology and alternative methodologies to reduce costs, improve the quality and for the timely dissemination of census results.

The technologies includes, Geographic Information Systems, handheld devices for data collection, online questionnaires, mobiles for executing and monitoring the field operations while for data processing, optical character reading, intelligent character recognition etc., (UNSD, 2011). For effective dissemination of census results, web-based data dissemination has been widely explored. More countries especially the Scandinavian countries on the North Western Europe, the use of register-based censuses are being implemented. However, the countries that lack expertise and financial resources, torn by civil unrest, conflicts, war and

internal turmoil are still not able to produce reliable national statistics which is most essential for meeting desired social and economic goals.

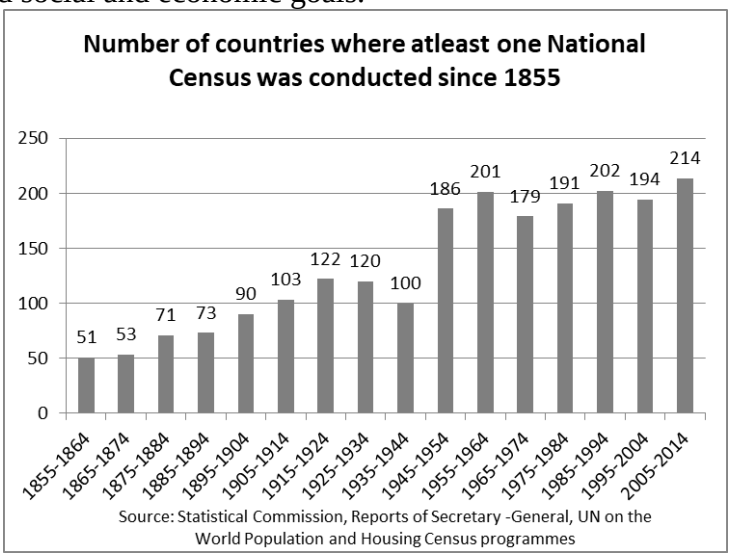

Figure 1. Number of countries where atleast one National Census was conducted since 1855

5. MODERN CENSUS METHODS

As proposed in the International Statistical Congress, 1853 (ISC) in Bruxelas (Brussels) (Brown, 1853) most of the stabilised nations begun their national census programmes adhering to larger context of the standard rules specified however with modifications necessitated due to prevailing conditions in the respective countries. In this year the journey towards modern Census was born and these definitions were used as framework for conducting census. The following broad framework was advocated by the ISC, 1853 for conducting the population census;

1. *That the census of a population **should comprise the name of every individual** actually in the country (population de fait) at the date of enumeration; but that information should also be required as to **individuals legally domiciled**, though absent at the time (population de droit).*
2. *That the interval of taking the census **should not exceed ten years**, and that it should be in the month of December.*
3. *A **special return for each family***
4. ***Special agents to be employed** to deliver and collect the lists; and either to see that they are properly filled up, or to enter the necessary particulars themselves, as obtained by them from the inhabitants.*
5. *The **returns to include- full name, age, place of birth, language, religion, civil condition, profession, residence (distinguishing temporary from permanent), children receiving public or private instruction, houses by stories, with the number of rooms to each family, gardens, to distinguish individuals suffering under such infirmities as affect the labour of the country, as, the blind, the deaf and dumb, and the insane in public and private establishments**.*

The modern census taking intertwined along with three parallel developments: **(1) the idea of countrywide enumerations for reliable data (2) the efficiency of administrative machinery and (3) the legal safeguards for information obtained** (Britannica, 1911). All three developments focused on the reliability of censuses as the source of essential information. As the decades progressed, the countries have started using a precisely delimited territory within each of its administered areas which is an essential frame for avoiding omission and duplication and dividing them into subareas with the aid of detailed maps. The aim was to enumerate every individual within the designated unit and account them only once. Census methods can be classified on the basis of

1. Place of Enumeration
    a. De facto (Actual place of residence on the day of enumeration, (UN, 1991))
    b. De jure (Place of Legal or regular residence) UN,1991)
    c. Modified De jure (Usual residence) (Natarajan, 1972)
2. Enumeration
    a. Canvasser (trained enumerator fills the schedules)
    b. Householder (Head or member of household fills the schedules)
3. Interval
    a. Annual (Yearly)
    b. Quinquennial (5 Years)
    c. Decadal (10 Years)
4. Coverage
    a. Universal
    b. Sampling
    c. Rolling

However in broader sense they are all confines to four categories i.e., **i) Traditional, ii) Register- based, iii) Rolling and iv) Virtual Censuses.** These methods continues to be improving over every census based on four key principles, i) Reducing Operational cost ii) Frequency of census data availability, iii) Accuracy of the returns and iv) Robust disclosure control.

More than eighty per cent of the countries around the world produce population and housing statistics by conducting a traditional census, which in principle consists of **a) Universal coverage, b) Canvassing every single household c) Individual enumeration and d) Defined period (decennial)**. However, the developed countries which are maintaining accurate administrative records on its people use alternative methods for compiling key statistics that is being used to generate population and housing data (figure 2). The ten year cycle is far stretched and does not fit into the demands of modern world as the decisions are to be taken much faster and completely depends on the very data used for making such decisions. Apart from the actual conduct of census operations, the cycle does not include the time taken for processing the data for results hence more time-lag between two successive census results from the reference date. As such the usability of data for decision making become complicated and at times unrealistic. Since the traditional census needs to cover entire country at a defined period, the operational cost on implementing cutting edge technology become unviable. The lengthy forms with intrusive questions make the respondents vulnerable to biasness that can lead to systematic errors in the outcome.

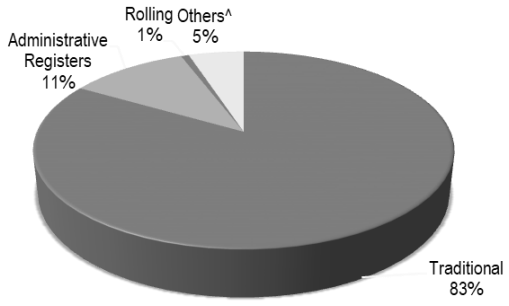

Figure 2. Main source of Census data (the main source of census data refers to the source used for producing the total population**.** *Source: UNSD.*

5.1 Traditional Census

The traditional census model has evolved over two centuries but in general have three common attributes, **a) Census-Questionnaire b) Trained Enumerator for door-to-door canvassing**

and c) Simultaneity. Albeit the changes adopted by the individual countries, the broader concept of traditional census model remains the same with country specific adjustments. The traditional model has generally been adopted by countries where the census has a relatively young history, including most of the developing countries with lesser technological advancement (Baffour, 2013).

One of the earliest countries to devise modern method of population census is England. The journey towards a more scientific population census begun to evolve after the influential treatise 'Principle of Population' by Thomas Malthus written in the year 1798, in which he argued that population growth would supersede agricultural production leading to starvation and famine (UKParliamentaryArchives, 1800). The need for more authentic and reliable statistics on population and households necessitated as the resource generation and growth of population during the industrial revolution started to create ripple effects on the overall socio-economic conditions. The Parliament of England and Wales passed the Census Act in 1800 and the first official census of England and Wales was conducted on 10th March 1801. However, a truly modern census in England using the traditional model of census with core principles was conducted in the year 1841 (ONS, 2016). The trained enumerators were employed to undertake the count of population and collecting information on all the individuals present in the household on the specified **"Census Day"** resulting in the canvassing of approximately 10 million persons living in 2 million households. This model of census-taking spread across the British Empire and continued even today with changes needed for recent necessities.

As per the survey on census methods for 2010 round of census conducted by the UNSD, among the 138 countries or areas that have responded to the survey, 83 per cent (115) have used the traditional census. The countries or areas in Africa, Latin America and the Caribbean and Oceania in general have employed the traditional census methods while in Asia all countries except four, namely Bahrain, Israel, Singapore and Turkey have conducted census using traditional method. Except Greenland (register-based census) rest of the Northern American countries rely on the traditional census. About 46 per cent of the European countries moved away from traditional census to register based census however the eastern part of European countries still use traditional census method.

Traditional Census with Yearly Update

Since 1940 census and until the 2000 census, Census Bureau in the United States of America used the 'short form' for collecting basic demographic information from every household while the 'long form' to collect information on education, employment and housing from sampled households (Edmonston, 1995). However from 1960, the US Census Bureau has started to mail out questionnaires to the households rather than using enumerators and only the unreturned household has been canvassed by the trained enumerators. In order to fill the decennial gap for data from the general census, the US Census Bureau introduced the American Community Survey (ACS) in 2010 for collecting wide range of yearly statistics. The ACS covers 250,000 addresses each month (About 3 million households per year) for collecting information on an ongoing basis. Thus data produced by the ACS supplements the census data which continues to be the sample frame for all surveys.

5.2 Rolling Census

The concept is unique and necessitated by the requirement of demographic data at regular interval and ability to estimate the same accurately made it possible for France to abandon traditional census method and embrace the 'Rolling Census' as a new method of census taking (UNECE, Measuring Population and Housing, 2014). The National Institute for Statistics and Economic Studies (INSEE) fore see the work of conducting census In France. The reason for

adopting the new method stated to be that a) it spreads the costs of the census; b) it eases the burden on respondents and c) leads to better quality control (Pofantis, 2008). The fundamental difference of this method is that the data collection is spread over a five-year cycle, generating information each year relating to the median year of that cycle.

The communes with populations of below 10,000 (35,750) which account for half the population of France has been divided into five groups, every year, each of the communes in one such group is exhaustively surveyed. The communes in the first group are surveyed again five years later, and so on. The communes with populations of 10,000 or more (900), conducts census surveys every year, but only a part of their population is involved. Each year's survey covers 8 % of dwellings in these communes. Thus, by the end of the first five years, around 70 % of the population will have been surveyed in the entire country. The sampling frame used for the large communes (10,000 & above population) is a building register (Répertoire d'immeubles localises, RIL). This register contains the list of all buildings like residential, administrative, industrial or commercial premises. The register has been created during the 1999 general census however kept updated since then by using administrative data such as building permits and local tax records, and postal records. Each commune checks this list every year and finally validated by INSEE. The results are estimated based on moving averages calculated over the five-year cycle, and are updated yearly. This method was developed mainly to improve the frequency of the data releases putting more faith in the sampling and estimation capabilities (François Clanché, 2013).

5.3 Register based Census

Each country has some established systems for collecting details on the citizen for the better governance and delivery of services. This may include details on births and deaths, employment, income, education, language and so on through their established means of administrative mechanisms. Potentially they all can form the core socio-demographic indicators of the people in the country, based on which the decisions can be being made, policies could be devised and the goals may be set. The efficiency at which these databases are created and maintained completely depends on the technological advancement, governance structure and trained manpower in the respective countries. The countries with smaller population, long history of established governance and acquired technological advancement would be in better position to produce such administrative records. With legal backing, they are able to build efficient system of registers that not only captures the information but also maintains them up-to-date as well.

The Nordic countries (Denmark, Finland, Norway and Sweden) have a long tradition of using administrative registers in the production of official statistics (UNECE, Register-based statistics in the Nordic countries, 2007). In the years between 1964 and 1969, the Central Population Registers were established in all the Nordic countries with unique personal identification numbers to each of the residing person (Lange, 2014). Many other administrative registers were also established through different stratum of governance and these registers form a strong base to build the required database of individuals, household and buildings which are generally been the backbone of census taking (Table 1). Most of these registers were linked through unique personal identification numbers assigned to each and every individual and thus enable the aggregation of statistics from various registers created for different subject matters.

Table 1: The introduction of Registers in Census statistics by type of Registers

Type of Registers	Countries							
	Denmark		Finland		Norway		Sweden	
	Established	First use in census	Established	First use in census	Established	First use in census	Established	First use in census
Central Population	1968	1981	1969	1970	1964	1970	1967	1975
Business	1975	1981	1975	1980	1965	1980	1963	1975
Dwellings	1977	1981	1980	1985	2001	2011	2008?	2011?
Housing Conditions	1977	1981	1980	1985	2001	2011	2008?	2011?
Education	1971	1981	1970	1975	1970	1980	1985	1990
Employment	1979	1981	1987	1990	1978	2001	1985	1985
Family	1968	1981	1978	1980	1964	1980	1960	1975
Household*	1968	1981	1970	1975	2001	2011	2011?	2011?
Income	1970	1981	1969	1970	1967	1980	1968	1975
Totally register based census		1981		1990		2011		2011
* Household-dwelling unit i.e. all the persons living in one dwewlling								

Source: UNECE, 2007: Register based statistics in Nordic countries

Table 2. Modern Census: Methodological review

Key characteristics	Most populace		Oldest Modern Census history		Register based	Rolling / Sampling
	India	China	United Kingdom	The United States of America	Netherlands#	France^
Organisation responsible for Census	Office of the Registrar General & Census Commissioner	National Bureau of Statistics	Office of the National Statistics	US Census Bureau	Statistics Netherland	The National Institute for Statistics and Economic Studies (INSEE)
First Modern Census	1871-72	1953	1841	1790	1795 / 1829	1801
Frequency in Years	10	6~	10	10	10	7/9
Last census year	2011	2010	2011	2010	1971#	1999^
Method of Census used in the latest round	Traditional	Traditional	Traditional/ Online	Traditional with yearly update	Virtual	Rolling
Current census	15th	6th	22nd*	23rd	17th	Not Applicable
Canvasing method	Canvasser	Canvasser	Householder	Householder/ "non-response follow-up" (NRFU)	Social Statistical Database	Householder
Phases	1. Houselisting & Housing Census, 2. Population Enumeration	Population Enumeration	1. Address Register updation, 2. Census Day (Enumeration)	1. Address Canvasing, 2. Population Enumeration	Data from different Registers were combined to produce the 2011 Census tables	1. Each Year updation of Building / Business Registers. 2. Year wise proportionate sampled units (70%) are surveyed
Population Coverage Method	Modified de jure	de jure / de facto	de jure / de facto	de facto	de facto	de jure
Questionnaire**	2 page Form	Short & long form	32 page Questionnaire	Short form	Social Statistical Database	Dwelling & Person Forms
No. of Questions	Houselisting : 35 Household: 29	Short form: 8 Long form: 6+12	Household: 14 Individual person: 43, Visitor Q: 4	Short Form: 10	NA	Bulletin individual: 30 Dwelling: 13
Language	16	Chinese	English	2 (Assistance 60)	Dutch / English	French
Quality assessment	Post Enumeration Survey	Not Available	Census Coverage Survey and Census Quality Survey	Census Programme of Evaluation and Experiments (CPEX), Census Coverage Measurement	Stringent quality measures at all the levels of Register maintenance	Multiple level of statistical quality controls starting from sample design to final data processing and estimation
Under Count / Over Count	2.3 (Under count)	0.12 (Under count)	6.1 (Under count)	0.01 (Over count)	Not applicable	Not Applicable
Population size	1.210.854.977	1.339.724.852	63.182.000	308.745.538	16.655.799	64.618.400
Households	249.501.663	401.517.330	23.366.044	131.704.730	7.5 Million	28.550.300
Literacy	73,0	95,92%	99%	86%	99%	99%
Internet usage	3,12	38,30%	95,50%	78,20%	93%	75,90%
Reference date	0.00 hrs. of 1st March	0.00 hrs. of 1st November	27th March	1st April	0.00 hrs. of 30th November	1st January of the median year of the five years
Enumeration period	20 Days	15 days	Census Day	Census Day	NA	Not Applicable
Per capita spending	$ 0,40	Not Available	$ 11,82	$ 33,33	$ 0,10	$ 1,20
~ First known census took place in China during the Han Dynasty 2AD						
*1941 census did not take place due to WW II, Additionally there was a mid-term census in 1966						
#After 1971 Census, the required variables of census has been generated through administrative registers only.						
^ After1999 census, the traditional census method has been replaced with rolling census based on yearly sample surveys and estimates						
**https://unstats.un.org/unsd/demographic/sources/census/censusquest.htm#F						

The register based census was implemented first in Denmark in the year 1981 (StatisticsDenmark, 2018) followed by Finland (1990), Norway and Sweden (2011). These countries first produced subject wise statistics for testing and published them after vetting through stringent evaluation and quality processes. The variables derived from these registers

were introduced in the census after systematic quality checks for errors. When statistics had been developed for all areas relevant for censuses, a totally register-based census has been realized and form the base for future census as well. One of the key aspects of register based census is the legal backing for the National Statistical Institutions to collect required statistics on individuals and maintain them without violating the legal rights of the individual citizen with regard to the protection and integrity of his/her data (UNECE, Register-based statistics in the Nordic countries, 2007). The NSI's are obliged to make sure the intended statistics does exists in the administrative registers or not and then start a direct data collection process if need be. This mandates the NSI's to act economically and that leads to saving enormous amount of time and causes minimum inconvenience to the respondents if at all the there is a requirement for survey to be done.

5.4 Virtual Census

After the 1971 census based on a complete enumeration in Netherlands, it was found that the willingness of the people to participate in such exercise on the decline (Statistics Netherlands, 2004). The Statistics Netherlands pondered on the alternatives and found that the usage of existing data available in different registers thought to be an answer. The Virtual Census if built under the robust public database designs could cut the expenditure, reduce the processing time and save tons of paper and peoples time. The census 2001 in Netherlands was completely virtual (Eric Schulte, 2004) and the results derived from the census are comparable with the earlier Dutch censuses as well as with those of the other countries. The backbone of the virtual census in the Netherlands is the central Population Register (PR), which is the combination of all municipal population registers linked to the Social Statistical Database (SSD). The SSD contains coherent and detailed demographic and socio-economic statistical information on persons and households, for which the population register forms the backbone. The Population Register data as on 1st of January were used as the basis for the set of tables generated for census 2001.

The reasons put forth for moving away from traditional census in the Netherlands apart from the privacy questions was that in spite of the mandatory class for people participation in a traditional census, the chances of "unit non-response" (certain people may not participate) and "item non-response" (answer for some questions may not be given) were prevalent (Nordholt, 2015). If the robust system of database design is used to generate population statistics, the same will pave way for seamless information flow with assured quality control intertwined with safeguards for privacy. Although the process of census 2001 round in the Netherlands was started later than in other countries where a traditional census was conducted, the compilation of the forty census tables for 2001 completed much earlier than the other countries which had used traditional census methods and data processing techniques.

6. CENSUS OF INDIA

6.1 Earlier history

The collection of data on population was practiced in India prior to 17th century, primarily for military and taxation as done elsewhere. In the Book II (out of XV) titled "The Duties of Government Superintendents" in Kautilya's "Arthasastra (written during the third century B.C.) it is stated about the use of number of households criterion to form village settlements, size classification, delimiting areas under each military overseers, collection of revenue on land holdings and for resource allocation (Shamasastry, 1915). During the Moghul period too

extensive records on population, land and production were said to be collected. However, in modern sense the census history in India begun under the British rule in the earlier 19th century. Most part of the subcontinent being under the rule of English, the modern population census in main land (1841) provided essential impetus for similar exercises in the colonies. The earliest attempts were made at the provincial level like in the Madras presidency during 1822 and subsequently in many other provinces (Natarajan, 1972).

6.2 Quinquennial returns of Provincial Governments

In the year 1849, the Imperial government in India has ordered for "Quinquennial returns of population" through revenue officials. The first quinquennial census was held non-synchronously across the provinces during 1851-52, second 1856-57, third 1861-62 and fourth was held during 1866-67 (Natarajan, 1972). The enumerators visited the head of households and collected information on how many children, young and adults of each sex was sleeping under his roof and whether as a member of family or as visitors. In the 4th quinquennial census held in North-western provinces on 10th January, 1865, W.C. Plowden has used **the principle of an actual house to house enumeration** on the same day throughout the provinces. This was the census of population and houses with well-drafted common schedule. The exercise gathered information on sexes, two great creeds and classifying the people according to agricultural, non-agricultural, trades of people and various cases. The effort was also the first attempt on detailed age classification of population (Natarajan, 1972).

6.3 The beginning of Modern census in India

The fifth quinquennial census of provinces under British rule was the last one but merged with first "Imperial census of India" held during 1871-72 which was the first attempt on pan India basis however held non-synchronously through provincial governments (Natarajan, 1972). But for the non-synchronous nature, it is probably the first attempt to obtain statistics of the age, caste, religion, occupation, education, and infirmities of the population; and the results, for their respective provinces for entire British India. The reports for the provinces were written by Mr. Beverley for Bengal, Mr. Plowden for the North-West Provinces, Mr. Neill for the Central Provinces, Surgeon-Major Cornish for Madras, Surgeon-Major Lumsdaine for Bombay, Mr. M`Iver for British Burma, and Major Lindsay for Coorg and for Mysore, which State, though administered for its Native Prince (Census, 1875).

Thus, the 2nd decennial census held in the year 1881 is considered the first modern census in Indian history that has covered entire sub-continent synchronously and collected population details using common schedule under W.C. Plowden, Census Commissioner of India for census 1881. The effort was not only first synchronous census across India but also on the classification of demographic, economic and social characteristics. The census 1881, adopted 6 classes, 18 orders, 75 sub-orders and 480 groups of occupations (Natarajan, 1972). Since 1881 census, the saga of Indian census history rolling on for decades with unbroken series undeterred by even the World Wars, internal turmoil's for independent nation and continues to evolve on each count. In between the scope of schedules was enlarged, data processing modernised, definitions on marital status, language spoken and economic activities were meticulously redefined for better outcomes.

6.4 The features of census in post-independent India

The census of 1951, the first after the birth of India, set forth a new trend in data collection by deviating vastly from the classification of population on the basis of economic activity rather

than completely relying on religion and caste which were the prime templates for tabulations in the earlier censuses. The necessity of a new nation and aspiration of people have been heavily loaded in the way the census schedules been canvassed, results tabulated (through 52 temporary tabulation offices across the country) and analysis were drawn by focusing the inferences towards devising futuristic planning. The reports of Census 1951 spread into seventeen volumes divided into 63 parts, sixteen volumes for the provinces (58 parts) and one for the nation as a whole (5 parts).

Table 3. Census Questionnaires in Pre- Independence Indian Censuses, Since 1872

Sl.No.	Census Year	Reference dates[&]	Questionnaire used for canvasing*	No. of Questions *	Important Additions / Changes^	Tabulation^	Remarks
1	1872	21st February	House Register	17		Totalling	Simultaneous single night enumeration
2	1881	17th February	Census Schedule	12	Mother Tongue	Tick and Tally" / Slip Copying	
3	1891	26th February		14	Foreign Language known(if any), Sect of Religion	Abstraction by sorting of schedules	
4	1901	1st March		16	Change in Occupation question, Know or Does not English	Improvised slip copying using Bavarian system of abstraction[$]	
5	1911	10th March		16	Whether English Literate		
6	1921	18th March		16			
7	1931	26th February		18	Age (nearest birth day), Earner or Dependant, Industry in which employed, Other languages commonly used		
8	1941	1st March	Individual Slip (de jure)	22	No. of children born to married women, number surviving, Age at birth of first child, Current employment, modification in literate question	Enumeration itself carried out directly on the slips. Every 50th slip marked for random sample.	Due to World War-II, the tabulations had been restricted using just 2% Samples.
Census Questionnaires in Post-Independence Indian Censuses, Since 1951							
9	1951	Sunrise of 1st March	Individual Slip (de jure)	14	Nationality (National Register of Citizen) Bilingualism, Q.13 has state specific options	10% Sample	Census Population register has been created and handed over to Sub-District level offices for latter use.
10	1961	Sunrise of 1st March	Houselist, Household Schedule cum Census Population Record and Individual Slip	13	Housing, Rural / Urban, Broad classification of economic activity. Materials of walls, roof and floor of houses have been collected	20% Sample	First time schedule for Housing has been introduced
11	1971	Sunrise of 1st April	Houselist, Establishment Schedules and Individual Slip.	17	Economic activity (Main and Secondary activity)	10% Rural ; 20% Urban	Population record prepared to provide frame for future studies.
12	1981		Houselist, Establishment Schedules and Individual Slip.	16	20% on the field sampling of slips for capturing Migration, Fertility	10% Rural ; 20% Urban	Disk to Key
13	1991	Sunrise of 1st March	Schedules for Houselist, Household, Economic (enterprise list) and Individual slip	23	Un-paid Economic activity has been captured along with Non-Workers seeking / available for employment	Smaller States: 100%, Bigger States: 20% for B,C,D,F series data, 100% for Economic and SC/ST	J&K census could not be conducted
14	2001	00.00 hrs. of 1st March	Schedules for Houselist, Household	34+23	Television, LPG/PNG, Computer, Telephone, Banking Services	100% through ICR and ODE	Permanent Location Codes for administrative units (PLCN)
15	2011	00.00 hrs. of 1st March	Schedules for Houselist, Household and National Population Register	35+29+14	Availability of Computer/Laptop with or without internet, Mobile phone, Treated Tap water, LPG/PNG for cooking	100% through ICR and ODE	Meta Data Data Standards (MDDS) Codes for Administrative units

Post Graduate Degree Holders and Technical Personnel schedule canvassed from 1961 onwards.

[&]Natarajan, D. (1972). Indian Census Through a Hundred Years Part I & II. New Delhi: ORGI. Pg.348

*www.censusindia.gov.in/Data_Products/Library/Indian_perspective_link/Census_Questionaires_link/questions.htm

^Natarajan, D. (1972). Indian Census Through a Hundred Years Part I & II. New Delhi: ORGI.

[$]J.H. Hutton. 1933. Census of India 1931 Part-I Report. ORGI. New Delhi

The national volume Part I-A of the census reports consist of five chapters focusing on Land and People, Pattern of Living, Livelihood Pattern, Before and since 1921 (Year 1921 been treated as the "Great Divide" for the visible changes in pattern of growth) and the last "The prospect of 1981" to forecast the population scenario on the basis of past and present growth patterns (Gopalaswami, 1953). One of the prominent and essential outcomes of the Census 1951 was the results and analysis presented in the form of District Census Hand Books which captured myriad of indicators both through census and non-census data gathered for 307 districts in the country. During 1961 Census, in addition to the individual slip canvassed in the earliest censuses, separate Houselisting Schedule for capturing condition and amenities available to the households and Household schedule cum Census Population Record (Mitra,

General Population Tables Part II-A (i), 1964) were canvassed. Further a detailed publication plan for 1961 was also programmed with scope and planned for (Mitra, A guide to the 1961 Census Publication Programme, 1965) 26 broad themes ranging from Population Tables to Special Local Surveys and Census Bibliography. The changes in census of housing and population through decades after 1951 census are presented in the Table No.3.

The significant changes in data processing brought in census 2001 made it possible for 100 per cent schedule processing for tabulation and thus all schedules canvassed during 2001 and 2011 censuses were scanned and through ICR/ ODE/ the data extraction were done (ORGI, Drop-in Article-5, 2010). By using US Census Bureau designed Census and Survey Processing (CSPRO) Application, the tabulations are generated as per the predefined tabulation plans. All the data tables have been made available in electronic formats and at the same time use of Micro-data at 1% and 5% sample basis have also been initiated through dedicated Workstations established in ten leading institutions across the country.

6. CONCLUSIONS

Depending on the age of a country, technological advancement, governance structure and existing administrative system of public service, the census methods are either improvised from existing traditional method of census to reduce the timeline, costing, gap between successive data availability or continued to be executed through traditional methods with some modification in the overall processes. Among the top ranked countries in Human Development Index (UNDP, 2017) which have more than 0.9 HDI Score, fifty per cent of them use Register based data for producing required census indicators, Germany use Registers and Traditional survey while Hong Kong use sample survey (Table 4).

The countries that use Traditional census method are either mail out the questionnaires or provide portal for filling out the schedules. Hence the role of canvasser either has been completely removed or deployed only for non-response units. The evident paradigm shift in method of census is primarily due to two enabling factors, first, the countries have high literacy and well developed in most of the basic indicators (used in HDI) and secondly they have well integrated public record management system (Diagram 1) with strong data protection protocols. The basic requirement of Register based Census is well maintained integrated Digital data with multiple layers of stringent data quality standards which not only take care of data input, streaming and security but also enforces the necessary data quality parameters. If necessary, the gaps in existing digital data can be filled through limited surveys by generating sampling frame from available registers itself.

Likewise, the sampling method used where homogenous population or budgetary constraints exist. In the case of French Rolling Census, there is existence of Registers of dwellings and businesses and the sampling frame has been created using robust statistical principle for estimating necessary statistics for entire country using moving averages. However in the least developed countries with severe budgetary constraints, the lack of technology, poor literacy, weak system of administrative and public record management systems are the impediments in the advancement of census methods. The system of data gathering through existing administrative records largely been adopted in the countries with small population where the presence of highly literate people and better governance structure provides amble opportunity for modernising the census data collection processes.

In India, the creation of census population record for further updation and use was initiated during 1951 Census which was probably a first attempt to create pan-India level population register. The information contained in individual slips which were filled out by the enumerators during population enumeration was transcribed in the National Register of Citizens of which one part is allotted to every village and every ward of every town expected to be updated

continuously. The Register contained all the occupied houses and households arranged in numerical order; and against each household every line records the information relating to one member of the household (Gopalaswami, 1953). However neither it has been regularly updated by the respective state governments nor could be used during the next census as envisioned. The creation of National Population Register was once again attempted during the 1st phase of Census of 2011 create a comprehensive identity database of every usual resident in the country containing demographic details (15) of every usual resident (ORGI, IntroductionToNpr.html, 2017).

Table 4. The relation between HDI Score and Method of Census

HDI Rank	Country	HDI	Type of Census	Remarks
1	Norway	0,942	Register	
2	Switzerland	0,932	Register	
3	Australia	0,923	Traditional	Questionnaire Mail out
4	Germany	0,921	Register+Traditional	
5	United States	0,914	Traditional	Questionnaire Mail out / Non-Response Follow U
6	Denmark	0,910	Register	
6	Netherlands	0,910	Register	
7	Ireland	0,909	Traditional	Questionnaire Mail out / Internet
7	Singapore	0,909	Register	
8	Sweden	0,905	Register	
8	United Kingdom	0,905	Traditional	Questionnaire Mail out / Internet
9	Liechtenstein	0,904	Traditional	
10	Belgium	0,903	Register	
10	Finland	0,903	Register	
11	Canada	0,902	Traditional	Questionnaire Mail out / List & Leave / Internet
12	Hong Kong, China (SAR	0,901	Sampling	

* HDI Score as per Year 2010. For methods, the Census 2010 round is being taken.

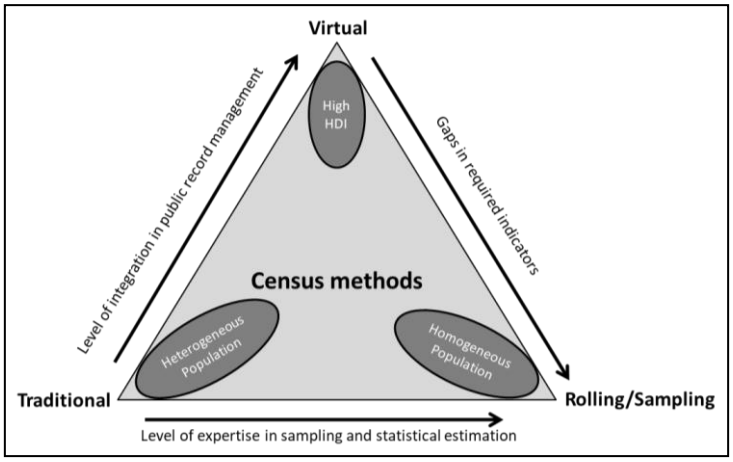

Diagram 1. Genesis of census methods

The inherent problem for populous countries like India which could not move towards completely register based census are, i) lack of standardised addressing system at pan-India level which is a primary requirement for identifying the buildings and structures ii) non-existence of unitary authority to oversee the data flow (Birth, Death, In-Migration and

Emigrations) on vital identifiers of population provided with strong legal backup and privacy protocols. In the absence of either of them will make it impossible to maintain registers efficiently which can be used for conducting census at national level.

The register based census could be treated as foundation for bettering the traditional method of census taking to nullify the coverage errors and ultimately leads to virtual census. The registers in general are not produced in isolation; they are part of larger governance system and hence except system integration, standardisation and privacy protocols there are no additional cost involved in maintaining them. Thus effectively reduces the creation or updation of census frame to be prepared of each decennial census, ensures non-occurrence of coverage error. It is a huge challenge indeed for diverse country like India with strong federal structure to bring in unitary system of addressing and registers on people and their dwellings.

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