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A Literature Review on the Challenges of Data Collection among Nomadic Populations and Their Implications for Population Data Accuracy in Indonesia

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Abstract
Achieving universal coverage in population censuses remains a major challenge when enumerating nomadic groups in Indonesia. High mobility, remote living conditions, and socio-cultural differences complicate standard census procedures and raise concerns about data quality and inclusiveness. This study aims to synthesize findings from academic literature, official reports from Statistics Indonesia (BPS), and ethnographic studies to identify the main difficulties in collecting data on nomadic populations and to assess their implications for the accuracy of population census data in Indonesia. This study employed a qualitative literature review approach. Relevant peer-review articles, institutional reports, and ethnographic studies were systematically examined and thematically analyzed to identify recurring patterns of barriers in census data collection among nomadic communities, including Orang Rimba, Suku Anak Dalam (SAD), and other Remote Indigenous Communities (KAT). The analysis revealed three interrelated dimensions of challenges: methodological, operational geographical, and socio cultural. Methodological challenges stem from the incompatibility of standard census concepts with nomadic lifestyles. Operational geographical barriers include limited accessibility, weak infrastructure, and high population mobility. Socio cultural constraints involve language differences, belief-systems, historical stigma, and difficulties in translating census concepts into local contexts. Together, these factors contribute to systematic undercounting and significant content errors. These challenges place nomadic populations at risk of statistical invisibility in official statistics, potentially reinforcing cylces of exclusion. More adaptive, context sensitive census approaches are therefore required to improve data accuracy and inclusiveness in Indonesia.

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Introduction

One of the most fundamental instruments for obtaining comprehensive, accurate, and sustainable demographic information on a country's population is the population census. Census data constitute the primary foundation for national development planning, public policy analysis, and academic research. Beyond measuring population size, censuses also capture the social, economic, and geographical characteristics of a population.

Censuses are defined by four essential characteristics: individual enumeration, universality within a defined territory, simultaneity, and defined periodicity [1]. These characteristics ensure that census data are collected comprehensively and can be compared over time.

1. **Individual Enumeration:** The characteristics of each person are recorded separately, allowing individuals to be analyzed independently. This enables cross-classification of data based on various demographic variables.
2. **Universality within a Defined Territory:** The census must cover all persons within a country's defined administrative boundaries, without exception, to ensure that the data represent the total population.
3. **Simultaneity:** Enumeration is conducted at the same time, or within a very short period, so that the data reflect the population at a specific reference point.
4. **Defined Periodicity:** Censuses are carried out at regular intervals, generally 10 years in Indonesia, allowing comparisons across time.

According to Bryan and Heuser [2], the census is considered the most reliable source of primary demographic data because it aims to cover the entire population without discrimination based on any demographic criteria. The authors emphasize that successful enumeration, rigorous data validation, and the capacity of the census system to reach all individual, including those remote areas or with non-sedentary lifestyles, are crucial for maintaining data quality. Consequently, census accuracy and completeness are essensial for estimating fertility, mortality, migration, population age structure, and other key demographic indicators.

However, in practice, censuses encounter significant difficulties in enumerating certain population groups, including nomadic communities. Nomadic populations are characterized by high mobility, the absence of permanent residence, and, in some cases, settlement along administrative borders. These conditions make them difficult for census officers to locate and enumerate, increasing the risk of undercoverage, whereby segments of the population are omitted from the census. Undercoverage is a major source error that can substantially reduce the quality and accuracy of census data.

Evidence from various countries shows that data collection among nomadic populations is consistently problematic. For example, highly mobile pastoralist groups in Africa are often missing from demographic records because of difficulties in reaching mobile individuals, leading to inaccurate estimates and exclusion from census and survey datasets [3]. Contributing factors include frequent movement, lack of formal identification, geographical barriers, limited communication between enumerators and local communities, and low awareness of the census. Similar challenges are observed in Indonesia among groups such as the Suku Anak Dalam (SAD) in Jambi, forest dwelling communities, and seasonal fishing populations. Trawoco *et al.* [4] report that languange differences, cultural barriers, and difficult geographical access significantly complicate census data collection among the SAD. In addition, high population mobility poses challenges in determining locations, timing of visit, and approproate enumeration strategies.

From a public policy perspective, the difficulty of collecting data on nomadic groups in the census has a serious impact on various aspects of development. Infrastructure planning, health services, education, budget allocation, and social welfare programs use population data as a basis. If the government does not collect data on certain groups properly, causing interventions to be designed without taking their needs into account, then certain groups are at risk of being neglected in development. In addition, inaccurate data can affect national statistical analysis, population projections, and scientific research related to population dynamics.

Meanwhile, errors in recording nomadic groups can cause bias in important indicators such as cohort size, dependency ratio, migration rates, and population distribution by region. Coverage error is one of the most crucial errors in census implementation, as its impact not only reduces data quality but can also continue and affect demographic analysis results in subsequent years [2].

A literature study on the difficulties of collecting data on nomadic groups and its impact on the accuracy of population data is highly relevant, especially in the context of Indonesia, which has geographical, ethnic, and cultural diversity. The government, academics, and statistical agencies can design more inclusive and adaptive data collection strategies with in-depth insights into the challenges and potential solutions, so that population data can reflect the conditions of society more comprehensively. This study is expected to contribute to the demographic literature and serve as a reference for improving the quality of future population censuses in Indonesia.

Based on the background described above, it can be identified that data collection on nomadic groups in Indonesia faces various fundamental problems.

1. There is a gap between the principle of universality of the census and the technical capabilities of data collection to reach nomadic groups.
2. Nomadic groups are included in the category of Special Populations that are at high risk of undercoverage.
3. The definition of "nomadic" in Indonesia has complex socio-cultural dimensions.
4. Differences in social systems and geographical barriers make it difficult for enumerators to determine the method, time, and location of enumeration.

Based on the identification of these issues, this study was formulated to answer two main questions.

1. What methodological, operational, and socio-cultural difficulties have been identified in the literature related to data collection on nomadic groups in Indonesia?
2. How does the literature document the impact of these difficulties on the accuracy and completeness of population data?

In addition, the purpose of this literature study is to analyze and synthesize findings from the literature (academic, BPS reports, ethnography) to map the difficulties in collecting data on nomadic groups and evaluate the impact on the accuracy of census data in Indonesia. This study is limited to the context of the post-reform Indonesian Population Censuses, specifically the 2000, 2010, and 2020 censuses, and includes the latest relevant studies discussing methodological, operational, and socio-cultural issues in data collection on nomadic groups.

Method

This study employed a descriptive-quantitative design based on a literature review, drawing on data and findings from official national and international sources, namely Statistics Indonesia (BPS) and the United Nations (UN). Indonesia data were obtained from BPS publications, including Indonesia Population Projection 2020-2050 based on the 2020 Population Census. For the global perspective, this study

used the World Population Prospects 2024 published by the United Nations Department of Economic and Social Affairs (UN DESA) and Population Division, along with supporting datasets available on the official UN World Population Prospects (UN WPP) website.

The research procedure consisted of the following stages [5]:

1. **Data Collection:** Compiling official population projection outputs from BPS (Indonesia) and the UN (global), including methodological report and supporting visual materials.
2. **Methodological Review:** Examining the projection methods applied by BPS and the UN, including deterministic and probabilistic approaches, as well as assumptions regarding fertility, mortality, and migration.
3. **Projection Analysis:** Analyzing demographic trends and patterns in both Indonesian and global projections for the 2020-2050 period based on official results.
4. **Method Evaluation:** Assessing the strengths and limitations of the cohort-component method in national and global contexts from both technical and policy perspectives.
5. **Conclusion Formulation:** Drawing conclusions based on the comparison of projection outcomes and the evaluation of methodological approach in relation to the research objectives.

Results and Discussion

1. Three Dimensions of Data Collection Difficulties

Data collection on nomadic groups in Indonesia faces a series of structural, methodological, geographical, and socio-cultural obstacles. A literature review shows that these challenges are not isolated but rather mutually reinforcing, resulting in systematic differential undercounting of communities such as the Orang Rimba, Suku Anak Dalam, Baduy, and various remote indigenous communities (*Komunitas Adat Terpencil*). The findings in this section are presented across three main dimensions, such as methodological, operational-geographic, and socio-cultural.

1.1. Methodological Dimension: Mismatch of Standard Census Concepts

The fundamental challenges in enumerating nomadic populations stem from the misalignment between standard census operational definitions and the lived realities of mobile communities. In the 2020 Population Census (SP2020), Statistics Indonesia [6] defines residents as individuals who have resided within Indonesia's territorial boundaries for one year or more, or those who have lived there for less than one year but intend to remain for at least one year. This definition, which relies on de jure concepts of residence and prolonged duration of stay, becomes problematic when applied to groups such as the Orang Rimba or the Suku Anak Dalam (SAD). The literature consistently shows that these groups maintain livelihoods deeply embedded in forest ecosystems and characterized by high levels of mobility and nomadic living patterns [7]. Customary practices such as *melangun* which require families to leave their place of residence for extended periods following the death of a family member, render the notion of "residing for at least one year" largely inapplicable. As a result, even de facto approaches to enumeration prove ineffective, as high mobility across village and sub-district administrative boundaries makes it difficult for census enumerators to capture their presence simultaneously within a single administrative unit on Census Day.

Beyond definitional issues of residence, a further dilemma arises concerning the unit of analysis in census enumeration. The ideal census standard, as recommended by the United Nations and adopted by Statistics Indonesia, aims to collect detailed individual level population characteristics such as age and sex [8]. In practice, however, the enumeration of nomadic populations is frequently forced to shift toward group enumeration of estimation methods that rely on key informants due to limited individual access [3]. Dependence on group-based approaches or representation by tribal leaders (*Tumenggung*) carries the risk of overlooking individuals who may have become fragmented from their primary groups as a result of differing interventions by development agencies or non-governmental organizations. Consequently, the resulting data fail to accurately represent each individual and instead provide only a rough snapshot of the groups that are accessible to enumerators [9, 10].

These methodological failures become even more pronounced in the domain of geographical work, particularly in census mapping. Population censuses rely heavily on clearly delineated enumeration areas to ensure that no individuals are omitted or double-counted, with data subsequently aggregated at provincial and island levels. For the *Orang Rimba*, however, their life space does not correspond to static administrative polygons but consist of forest landscapes that have increasingly been transformed into oil palm plantations or industrial timber estates (*Hutan Tanaman Idustri*). Their residences are often in the form of *sudung*, which are temporary huts without walls that are easy to dismantle and move [7]. Ongoing displacement driven by the expansion of the oil palm plantations forces nomadic Indigenous communities to remain in constant motion in search of safety, rendering their mobility patterns increasingly unpredictable and further complicating efforts at systematic census enumeration [11].

1.2. Operational and Geographic Dimension: Challenges on the Ground

Operational barriers in enumerating nomadic populations are strongly shaped by Indonesia's diverse and challenging geography, particularly in remote interior regions. The literature identifies physical accessibility as a major constraint, as the availability of high-quality statistical work-area maps remains limited in several regions, including Papua, complicating field navigation for enumerators. These conditions have led Statistics Indonesia [6] to adopt special strategies, such as classifying Papua and West Papua into "Zone 3", which relies on fully face-to-face interviews due to infrastructural and terrain constraints. Limited accessibility consequently increases census operational cost and necessitates the formation of specialized task forces to reach isolated indigenous and nomadic populations, requiring substantially greater logistical resources than regular areas [6].

Beyond physical and logistical challenges, the high mobility of nomadic populations creates significant difficulties in locating respondents within predefined enumeration periods. In the 2020 Population Census, BPS designated Census Night on 15 September 2020 to enumerate individuals without fixed residences, including nomadic groups [6]. However, this snapshot approach is limited in capturing dispersed populations with unpredictable locations. Evaluations of SP2010 show that Papua recorded the highest undercoverage rate at 16.5 percent, partly due to difficulties in tracking

populations across vast and mobile territories [12]. These challenges are compounded when enumerators must verify individuals who are de facto present but administratively uncertain in terms of de jure residency duration.

1.3. Socio-Cultural Dimension: Barriers to Interaction

According to Tirtosudarmo [7], public reactions and level of community trust toward external actors are critical determinants of census enumeration success among vulnerable populations. In specific communities such as the *Orang Rimba*, this distrust is deeply rooted in a historical pattern of interactions with outsiders that has frequently placed them in a defensive position. The term "*Kubu*" itself is etymologically associated with self-defense or concealment, reflecting strategies of seeking protection and resisting inclusion into the social world of dominant groups. Fear and suspicion toward outsiders, including census enumerators, are further reinforced by traumatic experiences of displacement and intimidation by plantation security forces operating within their customary territories. In situations of agrarian conflict, the presence of outsiders is often perceived as a threat, as communities experience themselves as being at the mercy of exploitative development agents.

Beyond issues of trust, significant barriers also arise from language and the translation of census concepts into local cultural contexts. Negative stigma attached to the label "*Kubu*", such as perceptions of being dirty, uneducated, or uncivilized, can distort interactions between enumerators and respondents. These challenges are compounded by difficulties in translating standard questionnaire concepts into lived realities that diverge from census assumptions, such as hunting-and-gathering livelihoods that do not align with formal employment categories [7]. Such conceptual difficulties are reflected in data from the Post Enumeration Survey (PES) of the 2010 Population Census, where regions with substantial Indigenous populations, such as Papua, recorded high inconsistency indices for Age (40.13) and Education (45.04), indicating substantial response errors or respondents' limited understanding of the underlying concepts [12].

2. Impacts on Data Accuracy

The body of evidence indicates that a range of operational, geographical, and methodological challenges in enumerating nomadic populations directly affects the quality and accuracy of census data. Enumerators' difficulties in reaching highly mobile areas, the use of alternative enumeration techniques such as group enumeration, and the limited information obtained through proxy respondents result in data that are not only incomplete but also systematically biased against specific population groups. These findings reveal two major types of problems: direct impacts in the form of systematic exclusion and undercount, and indirect impacts manifested as content errors that reduce the precision of demographic information. Ultimately, these data deficiencies contribute to significant policy consequences, creating a vicious cycle of exclusion in which nomadic populations become increasingly invisible in development planning and public service provision.

2.1. Direct Impacts: Exclusion and Net Undercount

Numerous international studies demonstrate that nomadic populations are highly vulnerable to omissions in census enumeration due to their high mobility and non-permanent or constantly changing settlement patterns. Many national censuses are still designed around static geographic areas and assumptions of permanent residence, resulting in nomadic camps or migration routes being excluded from census blocks or not enumerated at all. The United Nations [8] emphasizes that census approaches based on permanent residence are inherently incompatible with mobile lifestyles, thereby generating structural bias against nomadic and pastoralist populations.

In this context, undercoverage is not caused solely by technical limitations such as restricted geographic access, but also by administrative tendencies to "exclude" areas considered too difficult to reach or incompatible with conventional household definitions. Carr-Hill [13] shows that such administrative decisions are often made in the interest of operational efficiency, yet they have serious implications for statistical injustice. Consequently, nomadic groups are absent from official registers, reflecting recurrent and systematic omissions rather than isolated administrative errors [3, 8].

Undercounting of nomadic populations is therefore not random but differential and systematic. Since conventional census methods rely heavily on territorial mapping and residence-based estimates, highly mobile individuals are either incompletely identified or entirely missed. As a result, officially reported figures are often substantially lower than the actual population size on the ground. This finding is consistent with Poston and Micklin [14], who argue that highly mobile populations almost always experience net under-enumeration in national censuses.

Pastoral studies in East Africa further document that seasonal mobility patterns and communal living arrangements make it highly likely for enumerators to miss a large proportion of households, leading to mobile populations being consistently recorded at lower levels than sedentary populations [3, 15]. These findings reinforce the argument that undercounting of nomadic populations stems primarily from methodological misalignment in census design, rather than from isolated technical failures in the field.

2.2. Indirect Impacts: Content Errors

In attempts to enumerate nomadic populations, many countries adopt group enumeration approaches, whereby population counts are obtained at an aggregate level through tribal leaders, customary authorities, or local officials. Information on nomadic populations is often reduced to total population figures without individual-level detail [3]. While this approach serves as a pragmatic shortcut to obtain overall numbers, it results in the erosion of individual-level data.

Census literature refers to this practice as data thinning, whereby data collection is so minimal that key demographic variables are lost [13]. Essential information such as age, sex, educational attainment, employment status, and individual health characteristics is not recorded, as only aggregate figures are considered feasible to collect. Consequently, the resulting data fail to capture the internal demographic structure of nomadic populations, which is crucial for analyzing social inequalities and service needs [15].

When enumerators rely on proxy respondents, such as tribal leaders, customary authorities, or local officials, data accuracy tends to decline further. Census research consistently shows that proxy reporting increases the risk of misreporting, particularly for variables such as age,

education, and employment status [8]. Proxy responses are inherently subjective and often incomplete due to limited knowledge, spatial dispersion, and the mobility of household members.

Wild *et al*. [16] demonstrate that women and children are the groups most frequently misreported or inaccurately recorded in proxy-based enumeration. Similar findings are reported by Randall and Coast [17], who argue that content errors among mobile populations are not merely technical in nature but reflect underlying social and power relations in data reporting processes. As a result, age structures, sex composition, and socioeconomic indicators become distorted, producing census data that do not accurately represent the real conditions of nomadic populations.

2.3. Policy Implications: The Vicious Cycle of Data Exclusion

The accumulation of omissions, undercounts, and content errors renders nomadic populations effectively "invisible" in official statistics. This invisibility does not merely imply numerical miscalculation, but also the absence of their social and economic characteristics from national data systems. Such absence creates the illusion that nomadic populations are small or insignificant, when in fact their statistical absence is a consequence of methodological failure in census enumeration. Demographic literature refers to this phenomenon as statistical invisibility, wherein certain groups do not appear in official state representations despite their empirical existence [3, 13]. When data fail to capture their presence, nomadic populations are positioned outside the scope of state attention, as if they are not part of the population structure.

Census data that do not reflect the existence of nomadic groups pose serious risks for policy formulation. The United Nations [8] emphasizes that population statistics constitute the primary foundation for public service planning; when groups are not represented in the data, they are almost inevitably excluded from resource allocation. As a result, nomadic populations are omitted from priorities in education, healthcare, social assistance, and infrastructure development, thereby reinforcing their social and economic vulnerability [15].

This exclusion exacerbates existing deprivation and reinforces vulnerability. Without targeted interventions, states continue to rely on inaccurate data, causing planning processes to systematically fail in reaching mobile populations. This is consistent with demographic findings that populations invisible in statistics are also marginalized in planning and public service delivery [3]. "Thin" or missing data deprive policymakers of a robust evidence base to include nomadic populations in budgetary priorities and service provision, further entrenching their social and economic marginalization.

In the long term, this situation creates a vicious cycle of exclusion: populations are not counted → they are excluded from policy → they do not receive services → they become increasingly marginalized → they become even harder to enumerate in subsequent data collection efforts. Studies on hard-to-count populations show that without methodological innovation and inclusive census approaches, these statistical inequalities will continue to be reproduced across census cycles [13, 8].

3. Discussion

This literature study shows that efforts to achieve the principle of universality in Indonesia's census are complicated by structural and layered challenges in collecting data on nomadic groups. The obstacles encountered can be grouped into three main dimensions: methodological, operational-geographical, and socio-cultural. In the methodological dimension, nomadic groups do not fully comply with the enumeration framework used by BPS due to the incompatibility of definitions and standard census concepts, such as the one-year residence requirement and the assumption of permanent residence. Basic census concepts such as de jure and de facto cannot be effectively applied due to high population mobility, such as among the people of the jungle or seasonal migration among fishing communities. In addition, the use of a group enumeration approach and reliance on informants are key factors in reducing the accuracy of individual data and leading to classification errors.

In the operational-geographical dimension, enumerators' ability to find respondents at the time of enumeration was hampered by physical access difficulties, varying quality of statistical working area maps, and challenging geographical conditions, especially in the interior of Papua, the forests of Sumatra, or remote areas of the archipelago. High population mobility among nomadic groups makes census strategies based on a "snapshot in time," such as Census Day, the enumerators are unable to adequately capture the population. This has been proven by previous census findings that recorded high undercount rates in areas inhabited by indigenous communities with dynamic population movements.

The socio-cultural dimension also plays an important role in creating barriers to population data collection. Indigenous communities' distrust of outsiders, historical experiences of agrarian conflicts, and negative perceptions by the dominant society create social distance that hinders interaction between census officers and nomadic groups. Language barriers, differences in concepts of work, education, and family structure also affect the quality of responses and increase the risk of content errors, especially in variables such as age, education, and occupation.

The combination of these three dimensions of barriers results in nomadic groups that are not only undercounted but also not fully "visible" in official state data. The consequences are structural in nature; groups that are not recorded in statistics will not be prioritized in development planning, budget distribution, or social policy formulation. This creates a vicious cycle in which the invisibility of nomadic groups in the data causes them to be increasingly neglected in public policy, which ultimately makes them even more difficult to reach in subsequent data collection.

Overall, this study confirms that the standard census approach is not yet fully capable of addressing the complexity of nomadic groups' lives. In order to improve the accuracy, completeness, and validity of population data in Indonesia, methodological changes and more flexible, adaptive, and culturally sensitive data collection strategies are needed. This research also emphasizes the importance of good collaboration between statistics, anthropology, geography, and public policy to produce fair and inclusive census techniques for vulnerable groups with high mobility.

4. Conclusion

Achieving the principle of universality in census data collection for nomadic groups in Indonesia remains challenging due to a range of methodological, operational-geographical, and socio-cultural factors. High levels of undercounting and data entry errors are driven by population mobility, limited accessibility to remote areas, and low levels of trust in census enumerators. These challenges reduce data accuracy and completeness, placing nomadic populations at risk of statistical invisibility in official records. Consequently, current census data have not yet been able to fully and inclusively represent the structure and dynamics of Indonesia's population, particularly with respect to nomadic groups.

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