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DEMOGRAPHIC LOAD OF THE DISTRICTS OF THE REPUBLIC OF KARAKALPAKSTAN

Abstract. This study examines the spatial differentiation of demographic load across the 16 administrative districts of the Republic of Karakalpakstan, Uzbekistan. Using official district-level statistics, the demographic load coefficient – the number of dependents (children aged and pensioners) per 100 working-age persons – is calculated for each district. The republic-wide coefficient stands at 64.3, but district values range widely from 41.5 (Takhtakupir) to 78.1 (Muynak). High demographic burden is driven by elevated fertility in rural districts and by working-age out-migration in Aral Sea-affected areas. The findings highlight significant intra-regional disparities and the need for targeted social policy at the district level.

Keywords: demographic load, dependency ratio, Karakalpakstan, age structure, Aral Sea, regional demography, district-level analysis.

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ДЕМОГРАФИЧЕСКАЯ НАГРУЗКА РАЙОНОВ РЕСПУБЛИКИ КАРАКАЛПАКСТАН

Аннотация. В данном исследовании рассматривается пространственная дифференциация демографической нагрузки по 16 административным районам Республики Каракалпакстан, Узбекистан. Используя официальную статистику районного уровня, по каждому району рассчитывается коэффициент демографической нагрузки – количество находящихся на иждивении (дети в возрасте и пенсионеры) на 100 человек трудоспособного возраста. Коэффициент по республике составляет 64,3, но районные значения варьируются в широких пределах от 41,5 (Тахтакупыр) до 78,1 (Муйнак). Высокое демографическое бремя обусловлено повышенной рождаемостью в сельских районах и миграцией трудоспособного возраста в районах, пострадавших от Аральского моря. Результаты подчеркивают значительные внутрирегиональные различия и необходимость проведения адресной социальной политики на районном уровне.

Ключевые слова: демографическая нагрузка, коэффициент зависимости, Каракалпакстан, возрастная структура, Аральское море, региональная демография, районный анализ.

INTRODUCTION. Population dynamics and age structure are central concerns in both applied demography and regional geography. Among the key indicators used to assess the socio-economic capacity of a territory, the

demographic load coefficient defined as the ratio of the economically inactive population (children aged 0–15 and elderly pensioners) to the working-age population (men age 16-60, women age 16-55), expressed per 100 working-age persons occupies a prominent place [1, 11]. A high demographic load signals that a relatively small share of the population must sustain a disproportionately large number of dependents, placing significant pressure on social infrastructure, healthcare, education, and pension systems [1].

The Republic of Karakalpakstan, an autonomous republic within Uzbekistan, presents a particularly compelling case for the study of demographic load at the district level. With a population of approximately 2.0 million people (2024) distributed across 16 administrative districts and the city of Nukus, Karakalpakstan combines high natural population growth rates with profound structural challenges — including the environmental consequences of the Aral Sea crisis, internal and external labour migration, widespread rural settlement patterns, and historically elevated fertility [5, 6]. These factors together produce a distinctive demographic structure that varies markedly across the republic's districts.

Uzbekistan as a whole is characterised by a young age structure: approximately 30 percent of the national population is under 14 years of age, and the total fertility rate stood at around 3.4 children per woman as of 2024 [9]. Karakalpakstan's demographic indicators generally mirror and in some districts significantly exceed these national averages, resulting in a youth-dominated dependency structure. At the same time, emigration of working-age adults for labour purposes tends to reduce the effective working-age base, artificially inflating the measured demographic load in certain districts [6, 12].

Against this backdrop, the present study aims to analyse the spatial differentiation of demographic load across the districts of Karakalpakstan using district-level statistical data, to identify which districts face the most acute dependency challenges, and to examine the underlying socio-demographic drivers of these spatial patterns. The study contributes to a body of literature that applies

dependency ratio analysis to sub-national, district-level units in Central Asia a scale at which policy interventions in education, healthcare, and labour are most practically designed and delivered [4, 9].

The relevance of this research extends beyond academic geography. Understanding intra-regional variation in demographic load is essential for evidence-based resource allocation by regional authorities, for planning the expansion of social services, and for anticipating future labour market conditions in one of Uzbekistan's most environmentally and demographically distinct territories [12].

LITERATURE REVIEW. The concept of demographic load also referred to as the dependency ratio or demographic burden has a well-established theoretical foundation in demography and economic geography. Foundational work on population age structures and their socio-economic consequences was systematically elaborated by Coale and Hoover [1], who demonstrated that high youth dependency ratios constrain savings rates and retard per capita income growth. This framework remains a cornerstone of demographic transition theory and continues to inform studies of developing economies.

The formal definition and statistical operationalisation of the dependency ratio are grounded in United Nations methodological standards. The UN Department of Economic and Social Affairs [11] defines the total dependency ratio as the number of persons aged 0–14 and 65 and over per 100 persons of working age (15–64), distinguishing between the youth dependency ratio and the old-age (pension-age) dependency ratio. This framework provides the methodological basis for cross-national and sub-national comparisons of demographic load, and has been directly applied in the present study.

In the context of post-Soviet Central Asia, demographic research has increasingly focused on the tension between ongoing high fertility a legacy of Soviet pronatalist policies and cultural traditions and the structural transformation of economies following independence. Falkingham [3] provided one of the earliest comprehensive analyses of demographic change in the Central Asian republics

after 1991, noting that countries such as Uzbekistan retained high birth rates and young population structures that produced persistently elevated youth dependency ratios, even as mortality decline progressed.

Studies specifically addressing Uzbekistan's demographic dynamics have noted the country's dual challenge: a large young cohort entering the labour market simultaneously with a still-growing dependent child population. Djumabaev and Yusupov [4] examined regional demographic differentiation within Uzbekistan, demonstrating that peripheral regions including Karakalpakstan, Surkhandarya, and Fergana consistently recorded higher total dependency ratios than the national capital and more urbanised oblasts. Their findings underscore the need for district-level rather than only regional-level analysis, a need confirmed by the data presented in Table 1 of this study, which reveals a demographic load coefficient ranging from 41.5 in Takhtakupir district to 78.1 in Muynak district [8].

The specific demographic context of Karakalpakstan has attracted scholarly attention primarily through the environmental and public health consequences of the Aral Sea disaster. Crighton et al. [5] documented elevated rates of infant and child morbidity in the Aral Sea zone, with consequences for the age structure of surviving populations and for the burden placed on households and local health systems. Muynak district the community closest to the now-receded Aral Sea shoreline records the highest demographic load coefficient in the republic (78.1), a finding consistent with the compound effects of ecological degradation, out-migration of the able-bodied population, and a relatively elderly remaining population [5, 8].

Research by Bennecker [6] on livelihoods in the Aral Sea region identified out-migration of working-age adults as a pervasive coping strategy among households, effectively reducing the denominator of the dependency ratio and increasing the functional demographic load experienced by communities. This mechanism helps explain the elevated coefficients observed in environmentally stressed and economically marginal districts such as Chimbay (73.8), Karauzek

(73.8), Nukus district (73.2), and Khodjeyli (74.1), where labour out-migration is particularly pronounced [6, 8].

At the theoretical level, the demographic dividend literature is directly relevant to the study of Karakalpakstan's districts. Bloom, Canning, and Sevilla [2] argued that the transition from a high-fertility, high-dependency structure to a lower-fertility regime with a temporarily enlarged working-age cohort can generate a “demographic dividend” a period of accelerated economic growth. For Karakalpakstan, however, the conditions for realising such a dividend remain constrained by limited labour market absorption capacity, emigration, and inadequate vocational infrastructure, as noted in World Bank assessments of Uzbekistan's human capital [12]. Districts such as Takhtakupir (41.5) and Kanlikul (47.4), which display the lowest demographic load coefficients, may be better positioned to benefit from a nascent dividend if appropriate investment policies are pursued.

The spatial analysis of demographic indicators at the sub-regional level has been advanced by GIS-based approaches to population geography. Plane and Rogerson [10] established methodological principles for the geographic analysis of demographic data, emphasising the importance of distinguishing between absolute population size and structural indicators such as the dependency ratio when assessing the burden of population on social systems. Applications in Central Asia, including work by Agadjanian and Dommaraju [9], have employed multi-level models to disentangle regional and district-level effects on fertility and age structure an approach consistent with the district-unit analysis undertaken here.

The primary statistical data employed in this study are drawn from the Karakalpakstan Republic Department of Statistics [8], which publishes annual district-level population counts disaggregated by age group, thereby enabling the construction of the demographic load coefficient as reported in Table 1. These official data complement the theoretical and comparative frameworks provided by the academic sources reviewed above.

In summary, the existing literature provides robust theoretical and methodological grounding for the analysis of demographic load, establishes the broader demographic context of Uzbekistan and Central Asia, and offers partial accounts of Karakalpakstan's distinctive population challenges. The present district-level analysis, anchored in official statistical data [8], builds upon and extends these contributions by producing a systematic spatial differentiation of demographic load across all administrative units of the republic.

DATA AND METHODOLOGY. The analysis is based on official district-level demographic data published by the Karakalpakstan Republic Department of Statistics [8]. For each of the 14 districts, the city of Nukus, and Takhiatash city (16 territorial units in total, plus the republic-wide aggregate), the dataset provides three population counts: (1) children aged; (2) pensioners (elderly population); and (3) the working-age population aged. The demographic load coefficient (DLC) is computed as:

$$DLC = [(Children + Pensioners) / Working-age population] \times 100$$

This formula is consistent with the standard definition of the total dependency ratio as applied in United Nations demographic methodology [11] and in Central Asian demographic research [4, 9]. A DLC of 64.3, as recorded for the republic as a whole, means that for every 100 working-age residents there are approximately 64 dependents. The coefficient is used to classify districts into three burden categories: low (DLC < 55), moderate (55–70), and high (DLC > 70) [10, 11].

RESULTS AND ANALYSIS. Table 1 presents the demographic load coefficients for all districts of Karakalpakstan. The republic-wide DLC of 64.3 confirms that Karakalpakstan carries a moderately high demographic burden relative to the national average, consistent with Uzbekistan's young population structure [9]. However, this aggregate figure conceals considerable intra-regional variation, with district-level coefficients ranging from 41.5 (Takhtakupir) to 78.1 (Muynak) a spread of 36.6 points.

Table 1. Demographic load coefficient of the Republic of Karakalpakstan by district

№	District	Children (0–14)	Pensioners	Working-age population	Demographic Load Coefficient
1	Republic of Karakalpakstan	615,564	167,430	1,216,895	64.3
2	Nukus city	95,309	30,683	212,770	59.2
3	Chimbay	52,732	18,088	95,978	73.8
4	Karauzek	42,549	14,749	77,637	73.8
5	Takhtakupir	9,292	1,744	26,601	41.5
6	Amudarya	41,837	5,222	77,878	60.4
7	Beruni	45,003	6,731	83,649	61.8
8	Shumanay	28,845	12,531	66,199	62.5
9	Ellikkala	35,844	4,335	59,955	67.0
10	Bozatau	8,329	3,327	18,095	64.4
11	Kegeyli	20,107	4,398	38,905	63.0
12	Kungrad	31,608	6,687	57,595	66.5
13	Kanlikul	14,083	3,104	36,276	47.4
14	Muynak	41,697	17,402	75,670	78.1
15	Nukus district	28,226	11,794	54,707	73.2
16	Takhiatash	29,702	8,980	55,533	69.7
17	Tortkul	43,042	4,681	90,402	52.8
18	Khodjeyli	47,359	12,974	81,445	74.1

Source: Karakalpakstan Republic Department of Statistics [8]

Two districts fall into the low-burden category. Takhtakupir district records the lowest DLC in the republic at 41.5, owing to its small absolute populations of both children (9,292) and pensioners (1,744) relative to its working-age base (26,601). The extremely low number of pensioners suggests a younger-than-average age profile, possibly reflecting recent in-migration of younger working-age families associated with oil and gas industry employment in the district [4, 8]. Kanlikul district follows with a DLC of 47.4 (14,083 children; 3,104 pensioners; 36,276 working-age), reflecting moderate fertility and a relatively limited elderly population. Tortkul district (DLC 52.8) stands at the threshold of this category, with a particularly low pensioner count (4,681) relative to its large working-age base (90,402) the second largest in the republic after Nukus city suggesting a youthful, economically active population structure.

Eight territorial units cluster in the moderate range. Nukus city – the capital and most urbanised centre records a DLC of 59.2, reflecting the typical urban demographic pattern of lower fertility and a more age-diversified population [3, 9]. Amudarya (60.4), Beruni (61.8), Shumanay (62.5), Kegeyli (63.0), Bozatau (64.4), Kungrad (66.5), and Ellikkala (67.0) all fall within this band. Among these, Shumanay is notable for its relatively high pensioner count (12,531) compared to its child population (28,845), indicating a more aged structure than the youth-heavy profile typical of the region. Kungrad, as the second-largest urban centre and an industrial hub, exhibits a moderate DLC (66.5) consistent with its more diversified economy and younger in-migrant labour force [4, 8].

Five districts register a high demographic load. Muynak records the highest DLC in the republic at 78.1, with 41,697 children and 17,402 pensioners supported by a working-age population of only 75,670. The large pensioner cohort relative to district size reflects the ageing of those who remained after decades of out-migration triggered by the Aral Sea catastrophe [5, 6]. This combination of ecological degradation, persistent out-migration of the working-age population, and a retained elderly population creates the most extreme demographic burden in the republic. Khodjeyli (74.1), Chimbay (73.8), Karauzek (73.8), and Nukus

district (73.2) complete this high-burden group. All four are characterised by above-average child populations and moderately sized pensioner cohorts, suggesting that high fertility – rather than population ageing alone – is the primary driver of elevated load in these districts [3, 4].

The spatial distribution of demographic load in Karakalpakstan reflects a clear geographic pattern. Districts along the Amu Darya delta and the former Aral Sea coastline (Muynak, Chimbay, Karauzek, Nukus district) tend to record the highest DLCs, shaped by the interplay of high fertility, ecological displacement, and out-migration [5, 6]. By contrast, districts in the eastern and southern portions of the republic – particularly Takhtakupir, Kanlikul, and Tortkul – record lower DLCs, partly attributable to resource-sector employment that attracts working-age in-migrants and partly to lower fertility rates [4, 8].

The urban-rural divide is also evident: Nukus city (59.2) and the industrial town of Takhiatash (69.7) both record coefficients below the republic average and several rural districts, consistent with the well-documented urban fertility transition [3]. Bozatau, the smallest district by population, records a DLC of 64.4, close to the republic average, with its small absolute numbers making the coefficient relatively sensitive to minor population shifts [8].

From a policy perspective, these findings have significant implications. High-burden districts particularly Muynak and Khodjeyli require prioritised investment in social infrastructure, including schools, health centres, and elderly care facilities, to manage the pressure of a large dependent population on a limited working-age tax base. The demographic dividend potential identified by Bloom et al. [2] could be partially realised in lower-burden districts if accompanied by sustained investment in vocational education and local employment creation, reducing the out-migration that currently inflates the burden in the more ecologically stressed parts of the republic [6, 12].

CONCLUSION. This study has presented a systematic district-level analysis of demographic load in the Republic of Karakalpakstan, using official statistical data on age-group populations for all 16 territorial units. The republic-

wide demographic load coefficient of 64.3, meaning approximately 64 dependents per 100 working-age persons, masks a striking spatial diversity, with coefficients ranging from 41.5 in Takhtakupir to 78.1 in Muynak.

The analysis identifies three groups of districts: low-burden (Takhtakupir, Kanlikul, Tortkul), moderate-burden (Nukus city, Amudarya, Beruni, Shumanay, Kegeyli, Bozatau, Kungrad, Ellikkala, Takhiatash), and high-burden (Muynak, Khodjeyli, Chimbay, Karauzek, Nukus district). The drivers of high burden are found to be twofold: persistently elevated fertility in rural districts, and the structural ageing and depopulation of the working-age cohort in Aral Sea-affected districts — particularly Muynak.

These findings underscore the importance of sub-regional demographic analysis for regional planning. Aggregate republic-level indicators obscure the acuteness of demographic pressure in specific districts and therefore underestimate the targeted investment needed in social infrastructure and human capital development. Future research should incorporate temporal trend analysis to track the evolution of demographic load across census periods, and should integrate spatial modelling with economic and migration data to more fully explain the observed patterns.

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