

Research Article

Socio-Economic and Spatial Assessment of Rural Women Farmers' Access to Agricultural Resources in Tudun Wada Local Government Area, Kano State, Nigeria

Sanusi Aliyu Garba^a, Yusuf Saleh^{id}^b, Abdulkadir Yahaya Muhammed^{id}^b, Abubakar Aminu Usman^{id}^a

^aDepartment of Cartography and GIS, College of Environmental Studies, Barnawa. Kaduna Polytechnic, Kaduna State, Nigeria. ^bDepartment of Geography and Sustainability Studies, Kaduna State University, Kaduna, Nigeria.

ABSTRACT

Rural women constitute the backbone of smallholder agriculture in northern Nigeria, yet the spatial dimension of their access to agricultural resources remains poorly documented. This study assessed the socio-economic profile of rural women farmers and applied Geographic Information System (GIS) techniques to evaluate spatial disparities in resource accessibility in Tudun Wada Local Government Area (LGA), Kano State. A stratified random sample of 317 registered women farmers was drawn from the eleven wards of the LGA using the Yamane (1967) formula; 298 farmers responded to the questionnaire, and data were collected through structured questionnaires. GIS proximity analysis and choropleth mapping were used to examine the spatial distribution of farmers and their distance to key facilities. Results show that most respondents were smallholders (54.7% cultivated less than one hectare), had non-formal education (48.65%), and earned annual incomes well below the FAO minimum benchmark for smallholders. Land was mainly acquired through inheritance (45.64%), while access to credit (5.70% from banks) and farm machinery (34.23%) was severely limited. Proximity analysis revealed that distance from the LGA headquarters to bank facilities ranged from 5.37 km (Jan-Dutse) to 45.5 km (Borum-Borum), with remoteness correlating with lower registration and resource uptake. The study demonstrates the value of integrating GIS with socio-economic survey data in diagnosing rural gender inequities and recommends spatially targeted interventions to close accessibility gaps.

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1 Introduction

Agriculture remains the primary livelihood source for the majority of rural households in Nigeria, and women make up a substantial share of the farming labour force, contributing between 60% and 80% of food production activities across sub-Saharan Africa (World Bank, 2022). In Nigeria specifically, women are estimated to be 10% less likely than men to work in agriculture and 25% less likely to be primary plot managers, and among women who do manage plots, productivity remains on average 30% lower per hectare than that of male plot managers nationally, with the gap widening to 35% in the northern region (World Bank, 2022). These disparities are not merely a welfare concern; the World Bank's Nigeria Gender Innovation Lab estimates that forgone earnings arising from the agricultural gender productivity gap amount to roughly 0.6% of GDP, or about USD 2.3 billion annually, with the potential to raise GDP by up to 2% (approximately USD 8.1 billion) if closed.

Most existing assessments of this access gap rely solely on descriptive survey statistics and give little attention to the spatial dimension of resource accessibility, even though distance to markets, financial institutions and input distribution points is a well-established determinant of agricultural participation. Globally, Geographic Information Systems (GIS) have been increasingly applied to agricultural planning

problems such as shrinking arable land, water scarcity, and climate variability, using proximity analysis, land-use modelling, and precision-farming tools to support sustainable production decisions (Tashayo et al., 2020; Kumar et al., 2017). Within Nigeria, however, GIS applications remain rare in gender-focused agricultural research: a review of the literature identifies Usman et al. (2022) as one of the few Nigerian studies to apply spatial analysis techniques within an agricultural-economy context, though their focus was on market locations rather than gender disparities in resource access.

Studies that have examined women's access to agricultural resources in Nigeria and comparable developing-country contexts have instead relied on household surveys, interviews and descriptive or regression analysis. In India, women's participation in farm operations was found to be substantial, with landholding size, age and income identified as significant determinants, prompting calls for policy support to further raise participation (Chayal et al., 2010). In South Punjab, Pakistan, women were found to be more heavily engaged in livestock management than crop production, with age, education and access to credit shaping the extent of involvement (Zahoor et al., 2021). In Northern Kordofan, Sudan, women were found to be central to household food production yet systematically lacking in

access to inputs, credit and land, resulting in recurrent seasonal food shortages (Mahmoud & Daoud, 2023). Across Africa more broadly, structural constraints related to land tenure, policy design and weak institutional support have been shown to persistently undermine women's agricultural productivity despite their substantial contribution to food security (Amenyah & Puplampu, 2013), while limited access to extension services attributable in part to the male-dominated composition of extension agencies has been identified as a specific barrier to women's productivity gains (Adebayo & Worth, 2023).

This study integrates a household-level socio-economic survey with GIS-based spatial analysis to address a specific gap in the Nigerian literature: the near-absence of spatial accessibility analysis in gender-focused agricultural resource studies. The specific objectives are to (i) examine the socio-economic status of women farmers, and (ii) analyze their level of access to key agricultural resources across the eleven wards of Tudun Wada LGA, Kano State, using both descriptive statistics

and GIS proximity analysis. The findings are intended to provide an evidence base for spatially informed agricultural and gender policy in the study area and in comparable settings across northern Nigeria.

2 Materials and Methods

2.1 Study Area

Tudun Wada LGA lies between latitude 11°00' and 11°30' N and longitude 8°15' and 8°45' E in the southern part of Kano State, northwestern Nigeria (MapCarta, 2023). The LGA is bounded by Rano to the north, Sumaila to the east, Doguwa to the south, and Bebeji to the northwest (Figure 1). The LGA is administratively divided into eleven wards: Tsohon-Gari, Sabon-Gari, Yaryasa, Jan-Dutse, Karefa, Shuwaki, Jita, Nata'ala, Burum-Burum, Dalawa, and Baburi, each constituting a distinct socio-economic and political cluster within the LGA (Tudun Wada LGA Administrative Records, 2023).

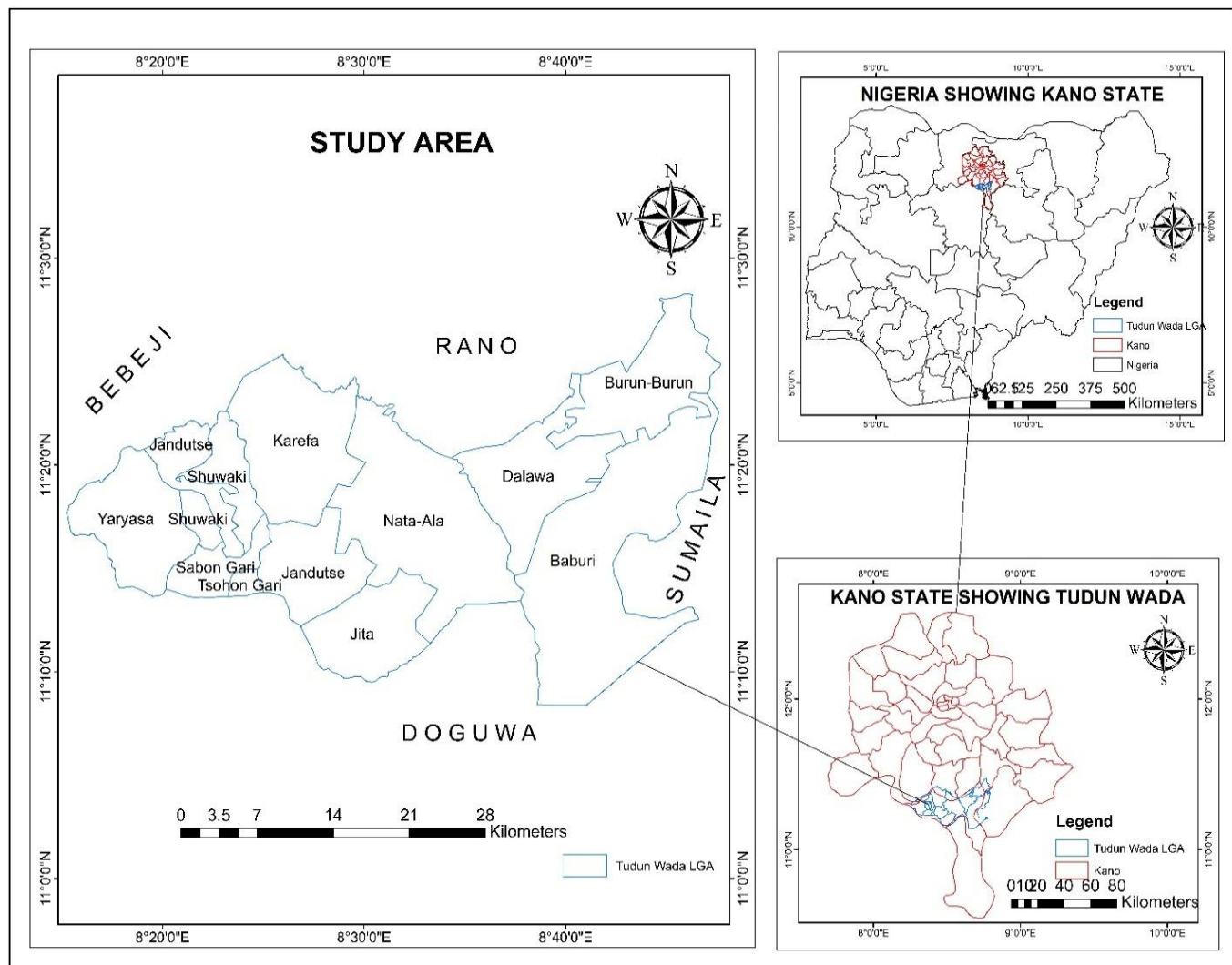


Figure 1: Location of the Study Area

2.2 Sampling and Data Collection

A total of 1,528 registered women farmers were enumerated across the eleven wards through the Department of Agriculture. Using the Yamane (1967) formula for sample size determination:

$$n = \frac{N}{1 + N(e)^2}$$

$$n = \frac{1,528}{1 + 1,528 (0.0025)}$$

$$n = \frac{1,528}{4.82}$$

$$n = 317$$

At a precision level of $e = 0.05$, a sample size of 317 was obtained.

This sample was proportionately allocated to each ward through stratified random sampling, with each ward treated as an independent stratum on the basis that farmers' responses were expected to vary systematically by location (Table 1). Respondents within each stratum were selected using a random number table.

Table 1: Sample Distribution of Respondents by Ward

Ward	Registered Farmers	Sample Drawn
Tsohon-Gari	151	31
Sabon-Gari	75	16
Yaryasa	299	62
Jan-Dutse	127	26
Karefa	224	46
Shuwaki	71	15
Jita	60	12
Nata'ala	345	72
Burum-Burum	33	7
Dalawa	81	17
Baburi	62	13
Total	1,528	317

Primary data were collected using a structured questionnaire administered to the 317 sampled respondents. Secondary data were sourced from departmental administrative records, prior academic theses on the LGA, and published literature. The study adopted a mixed-methods design, combining quantitative and qualitative approaches to enable triangulation of findings (Gilbert, 2006). Of the 317 questionnaires administered, 298 were correctly completed and used for quantitative analysis, giving a response rate of 94%.

2.3 GIS and Statistical Techniques

Descriptive statistics (frequencies and percentages) were

used to summarize socio-economic and resource-access variables, with results presented in tables consistent with standard survey-analysis conventions. GIS techniques were applied to complementary spatial layers. The spatial component of this study was implemented in a four-stage workflow: (i) compilation of base spatial layers; (ii) geocoding of facility and settlement locations; (iii) computation of inter-ward and ward-to-facility distances; and (iv) thematic (choropleth) mapping of registration and accessibility variables. All spatial operations were performed in a single project environment to ensure that the distance matrix, the proximity figures, and the choropleth maps share an identical spatial framework, following an approach comparable to spatial market and facility analyses previously applied within Kano State (Usman et al., 2022). Spatial analysis was conducted using ArcGIS 10.8, with supplementary distance computations performed in QGIS 3.28 and tabulated in Microsoft Excel 2019. The base coordinate system was WGS 1984 (EPSG: 4326) for data capture and geocoding. For all metric measurements, data were projected to WGS 1984 UTM Zone 32N (EPSG: 32632), which is the appropriate UTM zone for Kano State. All distance values reported in metres (Table 5) and kilometres (Figure 3) are therefore projected UTM distances rather than raw geographic (degrees) distances. Because all formal banking facilities are concentrated at the LGA headquarters, the ward-to-bank analysis in effect measures each ward's distance to the administrative core.

3 Results

3.1 Socio-Economic Profile of Respondents

From Table 2, the majority of respondents fell within the economically active age bracket of 36-45 years (22.48%), followed closely by the 46-55 years group (20.81%) and the 56-and-above group (19.8%), with the 16-25 and 26-35 brackets accounting for 18.79% and 18.12% respectively. This near-even spread indicates that both younger and older women remain actively engaged in agricultural production in the study area, consistent with findings by Chayal et al. (2010) that age is a significant determinant of women's farm participation. Most respondents were married (42.28%), while 35.91% were divorced and 21.81% single; family sizes of 7-9 members were most common (28.86%), followed by 4-6 and 10-and-above (22.48% each), suggesting that larger households may draw more heavily on women's labour for farm operations.

Educational attainment was low across the sample: 48.65% of respondents had only non-formal (predominantly Islamic) education, 28.19% had primary education, 10.74% had secondary education, and just 12.41% had reached tertiary level. This low educational profile is consistent with regional patterns documented elsewhere in northern Nigeria and constrains farmers'

capacity to engage with formal credit systems, extension technologies, and market information (Umunakwe et al., 2017).

Table 2: Demographic Characteristics of Respondents

Variable	Category	Frequency	Percent (%)
Age	16 - 25 years	56	18.79
	26 - 35 years	54	18.12
	36 - 45 years	67	22.48
	46 - 55 years	62	20.81
	56 years & above	59	19.8
Marital status	Single	65	21.81
	Married	126	42.28
	Divorced	107	35.91
Family size	1 - 3 persons	78	26.17
	4 - 6 persons	67	22.48
	7 - 9 persons	86	28.86
	10 & above	67	22.48
Educational level	Non-formal education	145	48.65
	Primary education	84	28.19
	Secondary education	32	10.74
	Tertiary education	37	12.41

Economically, most women earned between ₦300,001 and ₦600,000 per annum (39.26%), well below the FAO (2019) benchmark of USD 1,000-2,000 (approximately ₦1.65-3.3 million at prevailing exchange rates) recommended for viable smallholder livelihoods; over 72% of respondents earned less than ₦900,000 annually, and only 10.07% earned above ₦1,500,000, still below the FAO lower bound. Farm holdings were predominantly small, with 54.7% cultivating less than one hectare and a

further 23.49% cultivating between one and three hectares, consistent with land-inheritance patterns that favour male heirs. Farming was the primary occupation for 69.46% of respondents, with trading (15.1%) and civil service (15.43%) accounting for the remainder, yet only 45.3% belonged to a cooperative society, limiting collective bargaining power for credit and inputs (Table 3).

Table 3: Economic Status of Respondents

Variable	Category	Frequency	Percent (%)
Annual income	Less than ₦300,000	53	17.79
	₦300,001 - ₦600,000	117	39.26
	₦600,001 - ₦900,000	45	15.1
	₦900,001 - ₦1,200,000	22	7.38
	₦1,200,001 - ₦1,500,000	31	10.4
	₦1,500,001 & above	30	10.07
Farm size	Less than 1 hectare	163	54.7
	1 - 3 hectares	70	23.49
	3.1 hectares & above	65	21.81
Primary occupation	Farming	207	69.46
	Trading	45	15.1
	Civil service	46	15.43
Cooperative membership	Members	135	45.3
	Non-members	163	54.7

3.2 Spatial Distribution of Registered Women Farmers

Choropleth mapping of ward-level registration data shows marked spatial clustering (Figure 2). Nata'ala ward recorded the highest number of registered women farmers (345), followed by Yaryasa (299), Karefa (224), and Jan-Dutse (127), all wards located close to the LGA secretariat at Tsohon-Gari. In contrast, Burum-Burum

(33), Jita (60), and Baburi (62), which border one another at the periphery of the LGA, recorded the lowest registration figures. Notably, Tsohon-Gari itself, the smallest ward by land area, recorded a comparatively high registration figure of 151 farmers, while Baburi, one of the largest wards by area, recorded only 62. This pattern suggests that physical distance from the administrative

center, rather than farmland availability alone, is associated with reduced participation in formal farmer registration, and by extension, reduced visibility to government and development interventions. Mapping the distribution in this way allows implementing

agencies to visually identify priority wards for targeted registration drives and resource interventions, a practical application of GIS choropleth methods consistent with their broader use in agricultural planning (Kumar et al., 2017).

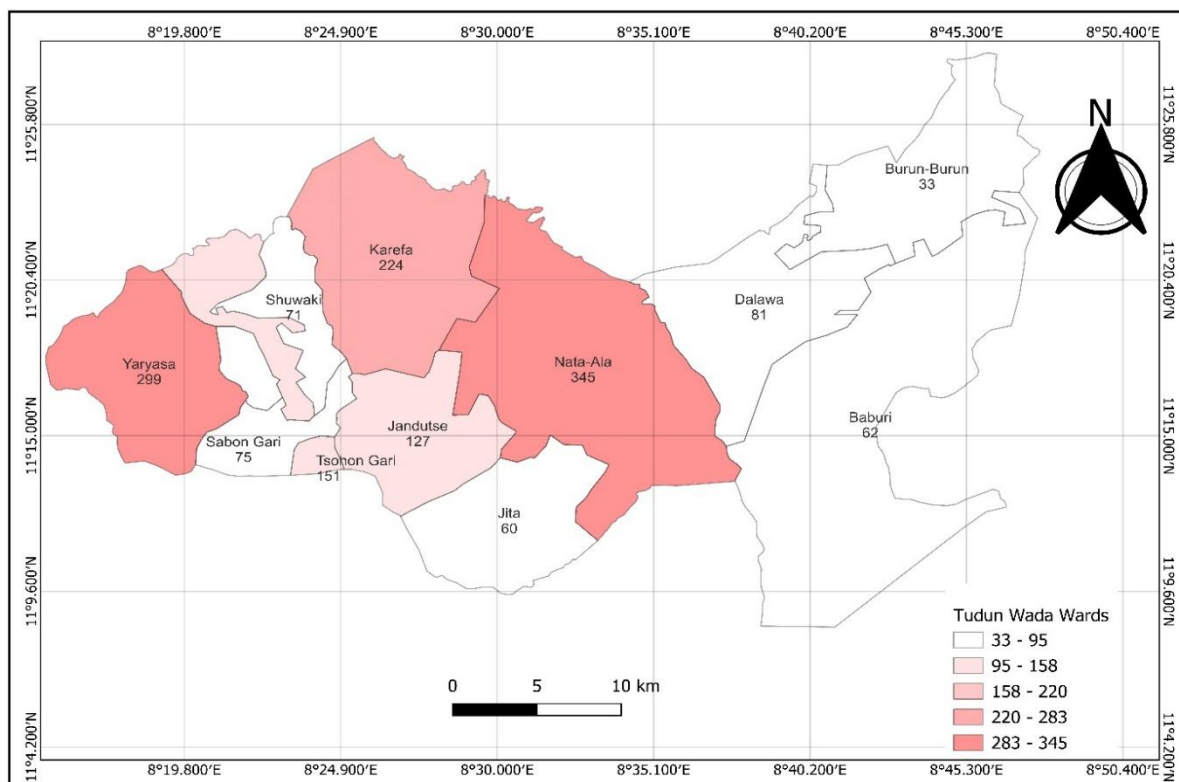


Figure 2: Number of Registered Women Farmers

3.3 Access to Land, Credit, Machinery and Agrochemicals

Table 4 revealed that land access was dominated by inheritance (45.64%), followed by purchase (18.79%) and lease (15.10%), with the remainder acquiring land through hire or borrowing (8.38%). While inheritance offers some tenure security and can facilitate credit access, the customary bias toward male heirs results in smaller, fragmented holdings for women, a pattern also reported among women farmers elsewhere in Nigeria (Odoemelam et al., 2013). Access to credit was markedly poor: 66.77% of respondents had never received any form of agricultural credit, and only 6.04% had accessed bank credit specifically, largely due to lack of collateral, limited institutional awareness, and greater lending attention historically extended to men. This finding aligns with broader evidence that cooperative membership, credit access, and education jointly shape women's agricultural earnings (Mukaila et al., 2021).

Farm machinery access followed a similarly constrained pattern: 65.77% of respondents had no access to mechanised implements such as tractors, harvesters or ploughs, relying instead on manual tools including hoes and cutlasses; among those reporting a machinery source,

14.09% cited government provision and 9.23% owned personal equipment. Agrochemical access was comparatively better, with 66.78% of respondents reporting reasonably easy access, chiefly through open-market purchase (51.68%) rather than government (11.4%) or cooperative (14.43%) channels, while 11.74% had no source at all. Although agrochemical access appears relatively favourable on aggregate, the heavy reliance on market purchase over subsidised or institutional channels indicates that women farmers largely bear the full cost of these inputs themselves, with limited benefit from public agricultural support programmes.

Table 4: Access to Agricultural Facilities and Resources

Facilities	Frequency	Percent
Farm Acquisition		
Inheritance	136	45.64
Borrowed/Hired	25	8.38
Gift	15	5.03
Purchased	56	18.79
Lease	45	15.1
Communal	21	7.04
Total	298	100
Access to Credit Facilities		
Family/friends	15	5.03
Government	18	6.04
Banks	17	5.07
Cooperative society	21	7.05
Community Associations	13	4.36
Nongovernmental Organizations	15	5.03
None	199	66.77
Total	298	100
Easy Access to Farm Machinery		
Very easy to access farm machineries	102	34.23
Not easy to access farm machineries	196	65.77
Total	298	100
Access to Agrochemicals		
Easy access to chemicals	199	66.78
Not easy to access chemicals	99	33.22
Total	298	100

3.4 GIS Proximity Analysis: Inter-Ward and Financial-Facility Distances

Beyond the aggregate access statistics, GIS proximity analysis was used to characterise the spatial configuration of the study area more precisely. Table 5 presents the full ward-to-ward Euclidean distance matrix, generated from ward centroid coordinates,

showing considerable variation in inter-ward distances across the LGA. The shortest inter-ward distances are generally recorded around the administrative core (Tsohon-Gari, Sabon-Gari, Jan-Dutse), while the longest distances involve the peripheral wards of Burum-Burum, Baburi and Dalawa, with several pairs exceeding 30,000-45,000 metres.

Table 5: Inter-Ward Distance Matrix (metres)

ID	Karefa	Jandutse	Jita	Tsohon Gari	Sabon Gari	Burum-Burum	Yaryasa	Shuwaki	Dalawa	Baburi	Nata-Ala
Karefa	0	9056	16696	9776	9019	33268	12490	5245	23401	31088	16789
Jandutse	9056	0	8424	5089	5618	34099	16072	10082	22665	27761	13136
Jita	16696	8424	0	12427	13343	31978	24274	18498	20172	22283	9907
Tsohon Gari	9776	5089	12427	0	1134	38903	12035	7941	27622	32831	18224
Sabon Gari	9019	5618	13343	1134	0	39005	11003	6842	27851	33358	18669
Burum-Burum	33268	34099	31978	38903	39005	0	45748	38477	11821	15219	22155
Yaryasa	12490	16072	24274	12035	11003	45748	0	7379	35749	42774	28039
Shuwaki	5245	10082	18498	7941	6842	38477	7379	0	28370	35543	20895
Dalawa	23401	22665	20172	27622	27851	11821	35749	28370	0	10021	10335
Baburi	31088	27761	22283	32831	33358	15219	42774	35543	10021	0	14784
Nata-Ala	16789	13136	9907	18224	18669	22155	28039	20895	10335	14784	0

The distance from Karefa to Jan-Dutse, for instance, is 9,056 metres, while the distance from Jita to Nata-Ala is 9,907 metres; the diagonal values are zero, representing each ward's distance to itself. This matrix further

confirms the proximity of the LGA headquarters at Tsohon-Gari to the administrative core wards, and the marked isolation of Burum-Burum, which records the single greatest distance in the matrix (45,748 metres from

Yaryasa).

Figure 3 presents the road-network proximity of each ward to the formal banking facilities located at the LGA headquarters. The closest ward to banking facilities was Jan-Dutse (5.37 km), while Burum-Burum was the most remote (45.50 km), a nearly ninefold difference. Notably, Burum-Burum also recorded the lowest number of registered women farmers (33) and, by extension, the smallest sample allocation (7 respondents), reinforcing the inference that spatial remoteness compounds

institutional and cultural barriers to resource access rather than operating independently of them. These findings corroborate broader evidence that geographic distance is a significant, and often overlooked, determinant of rural women's engagement with formal financial systems (Mukaila et al., 2021; Adebayo & Worth, 2023), and demonstrate the analytical value of embedding GIS proximity analysis within socio-economic assessments of gender and agriculture, an application still uncommon within the Nigerian literature (Usman et al., 2022).

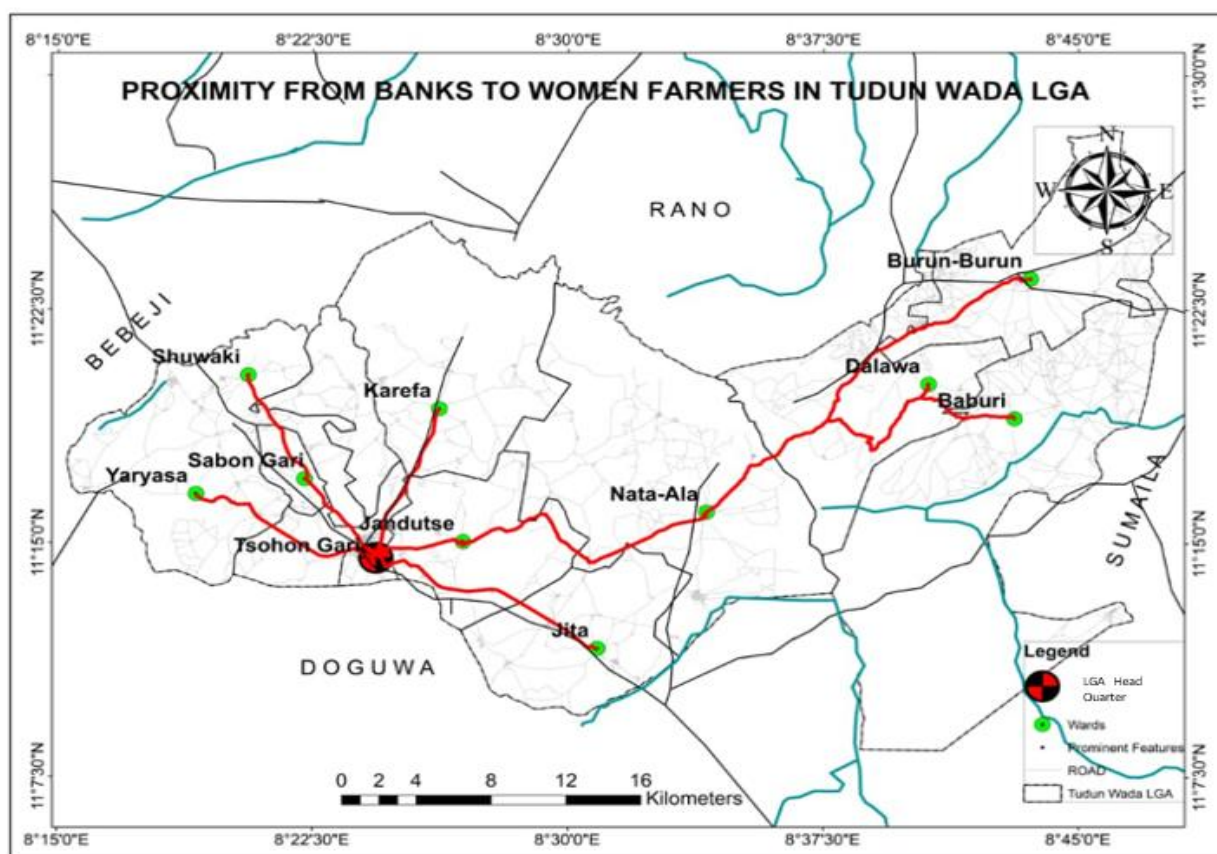


Figure 3: Proximity of Women Farmers to Bank

Taken together, the socio-economic and spatial evidence indicate that resource-access disadvantage in Tudun Wada LGA is not randomly distributed but is systematically concentrated in specific peripheral wards. This spatial concentration has direct implications for the design of interventions: aggregate LGA-level statistics on credit or machinery access, if reported without a spatial breakdown, would obscure the disproportionate disadvantage faced by women in wards such as Burum-Burum, Baburi and Dalawa.

4 Conclusion

This study shows that rural women farmers in Tudun Wada LGA operate under conditions of low education, small landholdings, and severely constrained access to credit and machinery, and that these constraints are compounded by measurable spatial disadvantage. GIS-

based proximity analysis identified specific wards, Burum-Burum, Baburi and Dalawa, as priority areas where distance from the LGA headquarters most severely limits access to banking services and, by inference, other institutional resources concentrated at the administrative centre. In light of these findings, the following recommendations are proposed:

- i. Establish women-friendly credit schemes with reduced collateral requirements, prioritized for wards identified as most spatially disadvantaged.
- ii. Integrate GIS-based planning into agricultural resource distribution, using proximity analysis to guide the siting of satellite input-distribution centers and mobile or agent-banking services in remote wards.
- iii. Invest in additional female agricultural extension agents to improve service reach and uptake among women farmers, particularly in peripheral wards.

- iv. Subsidize farm machinery access through women-focused tractor and equipment hiring schemes, reducing dependence on manual implements.
- v. Review land inheritance and tenure practices in partnership with community and religious leaders to support more equitable land access for women without displacing customary systems entirely.
- vi. Expand cooperative society membership drives in low-registration wards, since cooperative membership is closely linked to credit and market access.

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- Future research should extend the GIS component of this analysis beyond distance to banks to include proximity to input suppliers, markets, extension offices and water sources, and should incorporate a male comparator group to establish more precisely the extent to which the constraints documented here are uniquely gendered rather than general features of smallholder farming in the LGA.
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