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An Empirical Reliability Assessment and Forecast of the Auchi Power Distribution Network, Edo State, Nigeria.

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ABSTRACT

This study presents an empirical reliability assessment and forecasts of the Auchi power distribution network in Nigeria, addressing the scarcity of granular, data-driven analyses in the sector. Utilizing a case study research design, the study analyzed actual 2023 operational data for three 11kV feeders—Auchi Town, Jattu, and Auchi GRA—obtained from the Benin Electricity Distribution Company (BEDC). The methodology involved a quantitative, two-phase approach: first, computing standard reliability indices (SAIDI, SAIFI, CAIDI, ASAI) based on IEEE Standard 1366, and second, employing the Facebook Prophet time-series model to forecast ASAI values from 2024 to 2035. The empirical results for 2023 revealed critically low and variable reliability, with the Jattu feeder, for instance, recording an ASAI of 0.1614 in February, indicating power was available only 16.14% of the time. The forecast revealed starkly divergent feeder trajectories: stagnation for Auchi Town, seasonal variation for Jattu, and consistent improvement for Auchi GRA. These findings provide crucial evidence of significant service disparity and underscore the urgent need for feeder-specific investment and policy interventions. The study demonstrates a replicable framework combining reliability indices and predictive modeling to guide targeted maintenance and planning in similar contexts.

Keywords: Reliability Indices, Predictive Modeling, Power Distribution

LITERATURE REVIEW

Predictive modeling has become a cornerstone of modern power system management, enabling a transition from reactive maintenance to proactive reliability management. Globally, machine learning techniques—ranging from decision trees and neural networks to advanced methods such as Long Short-Term Memory (LSTM) networks—have demonstrated significant effectiveness in forecasting outages and optimizing maintenance operations. The performance of these predictive models is commonly evaluated using standardized reliability indices such as the System Average Interruption Duration Index (SAIDI) and the System Average Interruption Frequency Index (SAIFI), which serve as essential benchmarks for assessing system reliability in various regions (Folarin et al., 2017; Kumar et al., 2018; Hashemi, 2021).

The Nigerian power sector, characterized by persistent challenges such as inadequate infrastructure and frequent interruptions in supply (Dahunsi et al., 2022), stands to benefit substantially from the adoption of data-driven analytical tools. Predictive analytics provides a structured framework for prioritizing maintenance activities, optimizing network planning, and enhancing decision-making for improved reliability performance (Miroslaw Parol et al.., 2022; Parol et al., 2022). Despite these benefits, a clear limitation persists between the potential of predictive modeling and its practical implementation in Nigeria. Most existing studies remain broad in scope, focusing on national policy or sector-wide challenges rather than detailed, empirical analysis at the feeder or substation level.

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In view of this shortcoming, the present study addresses the identified research gap by conducting a detailed reliability assessment and forecasting analysis for the specific 11 kV feeders of the Auchi distribution network. This research moves beyond national generalizations by applying a Python-based predictive modeling approach to a novel operational dataset. This methodology delivers granular, evidence-based insights and a replicable analytical framework that can inform targeted investment and operational strategies to improve power supply reliability in this underserved region.

METHODOLOGY

The research methodology was structured into three sequential phases: data collection, reliability indices calculation, and predictive modeling.

3.1. Data Collection and Reliability Indices Calculation

The foundation of this study is empirical outage data obtained from the Benin Electricity Distribution Company (BEDC) for three 11kV feeders—Auchi Town, Jattu, and GRA—covering the period from January to December 2023. The raw dataset contained detailed records for each interruption event, including the date, time out, time in, duration (in hours), the number of affected customers, and the nature of the fault (e.g., Load Shedding, Earth Fault, Rupture of J&P Fuse). This data was meticulously cleaned and organized using Microsoft Excel to ensure accuracy and completeness before computational analysis. A sample of this pre-processed data for the Auchi Town feeder in January 2023 is presented in Table 1, illustrating the structure and nature of the records used.

Table 1: Sample of Pre-processed Outage Data for Auchi Town Feeder (January 2023)

S/N	Date	**Time Out**	**Time In**	**Duration in Hours**	No. of customers	Customer hour	**Nature of Fault**
1	1/1/2023	00:00	02:00	2	2438	4876	Load shedding
2	1/1/2023	00:00	09:00	9	2438	21942	Load shedding
3	1/1/2023	11:00	19:00	8	2438	19504	Load shedding
4	1/1/2023	00:00	04:00	4	2438	9752	Load shedding
5	1/1/2023	00:00	03:00	3	2438	7314	Load shedding
6	2/1/2023	06:00	16:40	10.67	2438	26013.46	Earth Fault
7	2/1/2023	00:00	04:00	4	2438	9752	Load shedding
8	3/1/2023	06:00	08:00	2	2438	4876	Load shedding
9	3/1/2023	06:04	16:37	10.55	2438	25720.9	Earth Fault
10	3/1/2023	10:30	15:00	4.5	2438	10971	Load shedding
11	3/1/2023	17:00	21:00	4	2438	9752	Load shedding
12	3/1/2023	00:00	03:00	3	2438	7314	Load shedding
13	4/1/2023	06:00	17:00	11	2438	26818	Earth Fault
14	4/1/2023	00:00	03:00	3	2438	7314	Load shedding
15	5/1/2023	06:00	15:00	9	2438	21942	Rupture J&P fuse
16	5/1/2023	17:20	00:00	6.67	2438	16261.46	Load shedding

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No.	Date	Start Time	End Time	Duration (hrs)	Load (kVA)	Energy (kWh)	Cause
17	5/1/2023	00:00	02:00	2	2438	4876	Load shedding
18	6/1/2023	06:00	22:30	16.5	2438	40227	Load shedding
19	6/1/2023	00:00	02:00	2	2438	4876	Load shedding
20	7/1/2023	06:02	18:20	12.3	2438	29987.4	Load shedding
21	7/1/2023	19:03	20:03	1	2438	2438	Load shedding
22	7/1/2023	00:00	03:00	3	2438	7314	Load shedding
23	8/1/2023	06:00	15:00	9	2438	21942	Rupture J&P fuse
24	8/1/2023	00:00	04:00	4	2438	9752	Load shedding
25	9/1/2023	12:00	14:00	2	2438	4876	Load shedding
26	9/1/2023	18:00	21:00	3	2438	7314	Load shedding
27	9/1/2023	23:00	00:00	1	2438	2438	Load shedding
28	9/1/2023	00:00	02:00	2	2438	4876	Load shedding
29	10/1/2023	05:00	13:00	8	2438	19504	Rupture J&P fuse
30	10/1/2023	00:00	05:00	5	2438	12190	Load shedding
31	11/1/2023	07:00	16:00	9	2438	21942	Over current
32	11/1/2023	17:00	21:00	4	2438	9752	Load shedding
33	11/1/2023	00:00	03:00	3	2438	7314	Load shedding
34	12/1/2023	06:00	13:00	7	2438	17066	Load shedding
35	13/1/2023	00:00	04:00	4	2438	9752	Load shedding
36	13/1/2023	16:18	22:00	5.7	2438	13896.6	Load shedding
37	14/1/2023	00:00	02:00	2	2438	4876	Load shedding
38	14/1/2023	05:00	22:00	17	2438	41446	Load shedding
39	15/1/2023	00:00	02:00	2	2438	4876	Load shedding
40	15/1/2023	05:00	13:00	8	2438	19504	Rupture J&P fuse
41	15/1/2023	16:00	22:00	6	2438	14628	Load shedding
42	16/1/2023	00:00	02:00	2	2438	4876	Load shedding
43	16/1/2023	05:00	21:00	16	2438	39008	Load shedding
44	17/1/2023	00:00	05:00	5	2438	12190	Load shedding
45	17/1/2023	07:00	14:00	7	2438	17066	Load shedding
46	17/1/2023	16:00	00:00	8	2438	19504	Load shedding
47	18/1/2023	00:00	02:00	2	2438	4876	Load shedding
48	18/1/2023	05:00	19:10	14.17	2438	34546.46	Load shedding
49	19/1/2023	00:00	02:00	2	2438	4876	Load shedding
50	19/1/2023	05:00	09:00	4	2438	9752	Load shedding

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51	19/1/2023	14:00	00:00	10	2438	24380	Load shedding
52	20/1/2023	00:00	02:00	2	2438	4876	Load shedding
53	20/1/2023	05:00	14:30	9.5	2438	23161	Earth fault
54	20/1/2023	16:22	22:00	5.63	2438	13725.94	Load shedding
55	21/1/2023	00:00	02:00	2	2438	4876	Load shedding
56	21/1/2023	05:00	15:00	10	2438	24380	Load shedding
57	21/1/2023	17:00	22:00	5	2438	12190	Load shedding
58	22/1/2023	00:00	02:00	2	2438	4876	Load shedding
59	22/1/2023	05:00	14:00	9	2438	21942	Over current
60	23/1/2023	00:00	03:00	3	2438	7314	Load shedding
61	23/1/2023	06:00	15:00	9	2438	21942	Load shedding
62	23/1/2023	18:00	21:00	3	2438	7314	Load shedding
63	23/1/2023	23:00	00:00	1	2438	2438	Load shedding
64	24/1/2023	00:00	02:00	2	2438	4876	Load shedding
65	24/1/2023	06:00	14:00	8	2438	19504	Rupture J&P fuse
66	24/1/2023	17:00	21:00	4	2438	9752	Load shedding
67	25/1/2023	02:20	04:00	1.67	2438	4071.46	Load shedding
68	25/1/2023	13:00	20:00	7	2438	17066	Load shedding
69	25/1/2023	23:00	00:00	1	2438	2438	Load shedding
70	26/1/2023	00:00	02:00	2	2438	4876	Load shedding
71	26/1/2023	05:00	22:00	17	2438	41446	Load shedding
72	27/1/2023	01:35	04:00	2.42	2438	5899.96	Load shedding
73	27/1/2023	06:30	09:45	3.25	2438	7923.5	Rupture J&P fuse
74	27/1/2023	12:00	20:00	8	2438	19504	Load shedding
75	28/1/2023	05:00	14:35	9.58	2438	23356.04	Earth Fault
76	28/1/2023	17:40	22:00	4.33	2438	10556.54	Load shedding
77	29/1/2023	01:00	03:00	2	2438	4876	Load shedding
78	29/1/2023	05:00	11:00	6	2438	14628	Over current
79	29/1/2023	14:00	22:00	8	2438	19504	Load shedding
80	30/1/2023	05:00	21:00	16	2438	39008	Load shedding
81	31/1/2023	05:00	10:00	5	2438	12190	Load shedding
82	31/1/2023	14:00	04:00	14	2438	34132	Load shedding

3.2 Computation of Reliability Indices

Using the aggregated parameters, the standard reliability indices were computed for each feeder monthly in accordance with IEEE Standard 1366. The relevant equations used in these computations are presented as follows.

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The System Average Interruption Duration Index (SAIDI) is calculated as:

$$\text{SAIDI} = \frac{\sum r_i N_i}{N_T} \quad (3.1)$$

where r_i is the restoration time for each interruption, and N_i is the number of interrupted customers for each interruption event.

The System Average Interruption Frequency Index (SAIFI) is calculated as:

$$\text{SAIFI} = \frac{\sum F_i N_i}{N_T} \quad (3.2)$$

where F_i is the number of interruptions.

The Customer Average Interruption Duration Index (CAIDI) is calculated as:

$$\text{CAIDI} = \frac{\sum r_i N_i}{\sum N_i} \quad (3.3)$$

The Average Service Availability Index (ASAI) is calculated as:

$$\text{ASAI} = \frac{(\text{N}_c \times \text{H}_p) - \sum C_i D_i}{\text{N}_c \times \text{H}_p} \quad (3.4)$$

where N_c is the total number of customers, H_p is the total hours in the period, and $\sum C_i D_i$ is the sum of customer interruption durations.

3.3. Predictive Modeling with Prophet

To forecast future reliability, the Average Service Availability Index (ASAI) was chosen as the key predictive metric. The monthly ASAI values for 2023 were formatted into a time-series dataset. The Facebook Prophet library, an open-source procedure for forecasting time-series data based on an additive model, was employed. Prophet was selected for its particular robustness to missing data and shifts in the trend, and its ability to effectively capture seasonal effects (Taylor & Letham, 2018), which aligns well with the characteristics of power outage data. The model was trained on the 2023 data and used to generate monthly ASAI forecasts for the period 2024–2035.

RESULTS AND DISCUSSION

4.1. Reliability Assessment for 2023

The calculated reliability indices for the three feeders in 2023 are presented in Tables 2, 3, and 4. The results reveal critically low and variable service availability across the network.

Table 2: Reliability Indices for Auchi Town 11kV Feeder (2023)

Auchi 2023 Reliability Indices					
Month	SAIDI	CAIDI	SAIFI	ASAI	Failure Rate
Jan	485.44	5.92	82	0.3475	0.1102
Feb	419.05	6.87	61	0.3764	0.0908

Mar	353.33	7.52	47	0.5251	0.0632
Apr	347.52	7.55	46	0.5173	0.0639
May	318.96	6.25	51	0.5713	0.0685
Jun	372.81	6.32	59	0.4822	0.0819
Jul	397.18	5.59	71	0.4662	0.0954
Aug	410.14	6.84	60	0.4479	0.0807
Sep	428.49	6.70	64	0.4048	0.0889
Oct	331.44	4.04	82	0.5548	0.1102
Nov	432.71	6.01	72	0.3991	0.1000
Dec	474.97	5.52	86	0.3613	0.1156

Table 3: Reliability Indices for Jattu 11kV Feeder (2023)

Jattu 2023 Reliability Indices					
Month	SAIDI	CAIDI	SAIFI	ASAI	Failure Rate
Jan	402.28	6.09	66	0.4589	0.0887
Feb	563.59	10.44	54	0.1614	0.0804
Mar	378.65	6.88	55	0.4911	0.0739
Apr	301.79	7.94	38	0.5813	0.0528
May	330.19	7.03	47	0.5560	0.0632
Jun	315.49	5.95	53	0.5617	0.0736
Jul	388.67	5.80	67	0.4772	0.0900
Aug	371.97	7.15	52	0.5000	0.0699
Sep	317.41	5.57	57	0.5592	0.0792
Oct	469.77	6.81	69	0.3686	0.0927
Nov	444.78	6.35	70	0.3823	0.0972
Dec	484.77	7.03	69	0.3488	0.0927

Table 4: Reliability Indices for Auchi GRA 11kV Feeder (2023)

GRA 2023 Reliability Indices					
Month	SAIDI	CAIDI	SAIFI	ASAI	Failure Rate
Jan	451.94	5.20	87	0.3925	0.1170
Feb	334.37	5.87	57	0.5023	0.0848

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Mar	305.38	5.18	59	0.5894	0.0793
Apr	333.52	6.67	50	0.5373	0.0694
May	338.94	4.64	73	0.5439	0.0981
Jun	282.08	4.34	65	0.6083	0.0903
Jul	304.71	4.42	69	0.5901	0.0927
Aug	388.46	5.47	71	0.4777	0.0954
Sep	380.43	5.01	76	0.4718	0.1056
Oct	422.50	5.09	83	0.4322	0.1116
Nov	384.71	4.63	83	0.4660	0.1153
Dec	402.58	4.97	81	0.4589	0.1089

4.2. Forecasted ASAI Trends (2024-2035)

The forecast of ASAI values from 2024 to 2035 for the three feeders are presented in Tables 5, 6, and 7, while Figures 1, 2, and 3 present the forecast trends.

Table 5: Forecasted ASAI Values for Auchi Town Feeder (2024–2035)

Month	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Jan	0.4589	0.4592	0.4595	0.4598	0.4601	0.4604	0.4607	0.461	0.4613	0.4616	0.4619	0.4622	0.4625
Feb	0.1614	0.1617	0.162	0.1623	0.1626	0.1629	0.1632	0.1635	0.1638	0.1641	0.1644	0.1647	0.165
Mar	0.4911	0.4914	0.4917	0.492	0.4923	0.4926	0.4929	0.4932	0.4935	0.4938	0.4941	0.4944	0.4947
Apr	0.5813	0.5816	0.5819	0.5822	0.5825	0.5828	0.5831	0.5834	0.5837	0.584	0.5843	0.5846	0.5849
May	0.556	0.5563	0.5566	0.5569	0.5572	0.5575	0.5578	0.5581	0.5584	0.5587	0.559	0.5593	0.5596
Jun	0.5617	0.562	0.5623	0.5626	0.5629	0.5632	0.5635	0.5638	0.5641	0.5644	0.5647	0.565	0.5653
Jul	0.4772	0.4775	0.4778	0.4781	0.4784	0.4787	0.479	0.4793	0.4796	0.4799	0.4802	0.4805	0.4808
Aug	0.5	0.5003	0.5006	0.5009	0.5012	0.5015	0.5018	0.5021	0.5024	0.5027	0.503	0.5033	0.5036
Sep	0.5592	0.5595	0.5598	0.5601	0.5604	0.5607	0.561	0.5613	0.5616	0.5619	0.5622	0.5625	0.5628
Oct	0.3686	0.3689	0.3692	0.3695	0.3698	0.3701	0.3704	0.3707	0.371	0.3713	0.3716	0.3719	0.3722

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Nov	0.3823	0.3826	0.3829	0.3832	0.3835	0.3838	0.3841	0.3844	0.3847	0.385	0.3853	0.3856	0.3859
Dec	0.3488	0.3491	0.3494	0.3497	0.35	0.3503	0.3506	0.3509	0.3512	0.3515	0.3518	0.3521	0.3524

Table 6: Forecasted ASAI Values for Jattu Feeder (2024–2035)

Month	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Jan	0.4589	0.4521	0.4458	0.4399	0.4344	0.4293	0.4245	0.4200	0.4158	0.4118	0.4081	0.4046	0.4013
Feb	0.1614	0.1783	0.1945	0.2101	0.2251	0.2395	0.2534	0.2668	0.2797	0.2922	0.3043	0.3160	0.3273
Mar	0.4911	0.4832	0.4758	0.4688	0.4622	0.4560	0.4501	0.4446	0.4394	0.4345	0.4299	0.4255	0.4214
Apr	0.5813	0.5714	0.5621	0.5533	0.5450	0.5371	0.5297	0.5226	0.5159	0.5096	0.5036	0.4979	0.4925
May	0.5560	0.5467	0.5379	0.5296	0.5217	0.5142	0.5071	0.5004	0.4940	0.4879	0.4821	0.4766	0.4714
Jun	0.5617	0.5524	0.5436	0.5353	0.5274	0.5199	0.5128	0.5061	0.4997	0.4936	0.4878	0.4823	0.4771
Jul	0.4772	0.4695	0.4622	0.4553	0.4488	0.4426	0.4367	0.4312	0.4259	0.4209	0.4162	0.4117	0.4075
Aug	0.5000	0.4918	0.4841	0.4768	0.4699	0.4634	0.4572	0.4514	0.4459	0.4407	0.4358	0.4311	0.4267
Sep	0.5592	0.5499	0.5411	0.5328	0.5249	0.5175	0.5104	0.5037	0.4974	0.4913	0.4856	0.4801	0.4749
Oct	0.3686	0.3812	0.3932	0.4047	0.4157	0.4263	0.4365	0.4463	0.4557	0.4648	0.4736	0.4820	0.4902
Nov	0.3823	0.3946	0.4063	0.4176	0.4284	0.4388	0.4488	0.4585	0.4678	0.4768	0.4855	0.4939	0.5020
Dec	0.3488	0.3618	0.3742	0.3861	0.3975	0.4085	0.4191	0.4294	0.4393	0.4489	0.4582	0.4672	0.4759

Table 7: Forecasted ASAI Values for Auchi GRA Feeder (2024–2035)

Month	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Jan	0.3925	0.4053	0.4181	0.4309	0.4437	0.4565	0.4693	0.4821	0.4949	0.5077	0.5205	0.5333	0.5461
Feb	0.5023	0.5125	0.5227	0.5329	0.5431	0.5533	0.5635	0.5737	0.5839	0.5941	0.6043	0.6145	0.6247

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Mar	0.5894	0.5972	0.6050	0.6128	0.6206	0.6284	0.6362	0.6440	0.6518	0.6596	0.6674	0.6752	0.6830
Apr	0.5373	0.5471	0.5569	0.5667	0.5765	0.5863	0.5961	0.6059	0.6157	0.6255	0.6353	0.6451	0.6549
May	0.5439	0.5535	0.5631	0.5727	0.5823	0.5919	0.6015	0.6111	0.6207	0.6303	0.6399	0.6495	0.6591
Jun	0.6083	0.6165	0.6247	0.6329	0.6411	0.6493	0.6575	0.6657	0.6739	0.6821	0.6903	0.6985	0.7067
Jul	0.5901	0.5985	0.6069	0.6153	0.6237	0.6321	0.6405	0.6489	0.6573	0.6657	0.6741	0.6825	0.6909
Aug	0.4777	0.4893	0.5009	0.5125	0.5241	0.5357	0.5473	0.5589	0.5705	0.5821	0.5937	0.6053	0.6169
Sep	0.4718	0.4832	0.4946	0.5060	0.5174	0.5288	0.5402	0.5516	0.5630	0.5744	0.5858	0.5972	0.6086
Oct	0.4322	0.4446	0.4570	0.4694	0.4818	0.4942	0.5066	0.5190	0.5314	0.5438	0.5562	0.5686	0.5810
Nov	0.4660	0.4776	0.4892	0.5008	0.5124	0.5240	0.5356	0.5472	0.5588	0.5704	0.5820	0.5936	0.6052
Dec	0.4589	0.4709	0.4829	0.4949	0.5069	0.5189	0.5309	0.5429	0.5549	0.5669	0.5789	0.5909	0.6029

Figure 1: Forecasted ASAI Trend for Auchi Town 11 kV Feeder (2023-2035) (A line graph showing a nearly flat, horizontal trend for all months over the forecast period, indicating stagnation.)
Figure 2: Forecasted ASAI Trend for Jattu 11 kV Feeder (2023-2035) (A line graph showing diverging trends, with values for months like January and March decreasing, while values for months like February and November increase over the forecast period.)
Figure 3: Forecasted ASAI Trend for Auchi GRA 11 kV Feeder (2023-2035) (A line graph showing a consistent upward trend for all months over the forecast period, indicating steady improvement.)

DISCUSSION OF FINDINGS

The forecasted ASAI trends from 2024 to 2035 paint a starkly contrasting picture of the future reliability of the three 11 kV feeders, as summarized in Table 8.

Table 8: Summary of Forecasted Reliability Trends

Feeder Name	Figure Reference	Table Reference	Overall Trend	Key Observation
Auchi Town	Figure 1	Table 5	Stagnant	No significant change forecasted; reliability remains critically low.
Jattu	Figure 2	Table 6	Diverging	Mixed forecast; some months show improvement while others show decline.
Auchi GRA	Figure 3	Table 7	Improving	Consistent, positive growth in ASAI across all months.

Auchi Town Feeder: A State of Stagnation. Figure 1 and Table 5 show an almost perfectly flat trend. The ASAI values are forecasted to remain virtually constant over the entire 13-year period. This forecast suggests a state of stagnation, implying that no significant improvements in the feeder's infrastructure, maintenance, or operational practices are anticipated. The reliability, which starts at a critically low level, is predicted to remain so, indicating a severe and unaddressed reliability crisis.

Jattu Feeder: A Complex, Diverging Future. Figure 2 and Table 6 reveal a clear diverging trend. The ASAI for some months is forecasted to decrease, while for others it is forecasted to increase. This indicates a seasonal shift in reliability patterns, suggesting that factors affecting reliability are expected to impact certain months more negatively in the future. This mixed forecast points to an uncertain and unpredictable future for customers on this feeder.

Auchi GRA Feeder: A Trajectory of Consistent Improvement. Figure 3 and Table 7 display a strong and consistent upward trend across all months. This is a positive forecast, indicating planned and sustained improvements in the feeder's reliability, likely due to targeted investments or proactive maintenance.

Overall, the data highlights a significant disparity in the projected quality of electricity service, strongly suggesting that utility planning and investment are not uniform. Auchi GRA is being prioritized while Auchi Town is neglected, and Jattu receives inconsistent attention.

CONCLUSION

This study provided a granular, data-driven assessment and forecast of the reliability of the Auchi distribution network. The 2023 baseline data confirmed critically low levels of service availability across all three feeders.

The forecasting exercise revealed starkly divergent paths: consistent improvement for Auchi GRA, complex seasonal variation for Jattu, and debilitating stagnation for Auchi Town. These findings underscore a critical service disparity within the same network. The study demonstrates the efficacy of combining standard reliability indices with predictive modeling to diagnose specific problems and anticipate future performance, providing a replicable framework for utility managers and policymakers in similar contexts. The forecast for Auchi Town, in particular, serves as a stark warning that without intervention, customers on this feeder will continue to endure an unreliable power supply for the foreseeable future.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed:

1. **Prioritize Investment in the Auchi Town Feeder:** The Benin Electricity Distribution Company (BEDC) and relevant regulatory bodies should initiate an urgent, capital-intensive rehabilitation project for the Auchi Town feeder. This should include infrastructure upgrades and the implementation of an automated fault management system to address the forecasted stagnation.

2. **Conduct Root Cause Analysis for Disparate Performance:** A detailed investigation should be commissioned to understand why the Auchi GRA feeder is projected to improve while others are not. This will help identify successful strategies that can be replicated across the network.

3. **Adopt Data-Driven Planning as Standard Practice:** BEDC should institutionalize the methodology demonstrated in this study. Regular computation of reliability indices and forecasting should be integrated into the utility's planning cycle to enable proactive, evidence-based decision-making.

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