A Comparative Analysis of Social and Physical Assets among UGPL Beneficiaries and Non-Beneficiaries in Surendranagar District

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Abstract:

This study examines the socio-economic and infrastructural differences between beneficiaries and non-beneficiaries of the Underground Pipeline (UGPL) project in Surendranagar district. Based on a primary survey of 744 respondents across six talukas, the analysis reveals significant disparities in gender composition, education, secondary occupation, housing, and digital access. Beneficiaries were more likely to be younger, educated, and reside in nuclear families, while non-beneficiaries showed greater engagement in diversified livelihoods and owned more household appliances. Infrastructure access, such as electricity and drinking water, was nearly universal in both groups, though digital device ownership and modern housing were slightly higher among beneficiaries. However, gender disparity in workforce participation and a digital divide persist. The study concludes that while UGPL has positively impacted mobility, housing, and irrigation access, broader strategies are needed to address inequalities in asset ownership, secondary employment, and digital inclusion to ensure equitable and sustainable rural development.

1. Introduction:

Water Conservation and Management-Economic Perspective (Khakhar, 2004) discusses several key issues related to water management. It highlights that people often do not consider collective water costs, focusing instead on their own financial expenses. Due to various subsidies in agriculture, the cost of water extraction is reduced, encouraging excessive exploitation of groundwater and resulting in multiple problems. The study emphasizes the importance of formulating and implementing effective and sustainable water resource management plans and policies.

Determination of Crop Water Requirement and Irrigation Scheduling for Major Crops of Surendranagar (Shah & Jadav, 2023) determine the irrigation schedule and water requirements for major crops in Surendranagar district, the CROPWAT 8.0 software was used. Based on FAO-56 Penman-Monteith method, water requirements were calculated for cotton, wheat, and sesame, with respective values of 876.3 mm/dec, 543.9 mm/dec, and 529.6 mm/dec using weather data from Wadhwan taluka. The research provides guidance on optimizing irrigation methods for efficient water use and sustainable agriculture.

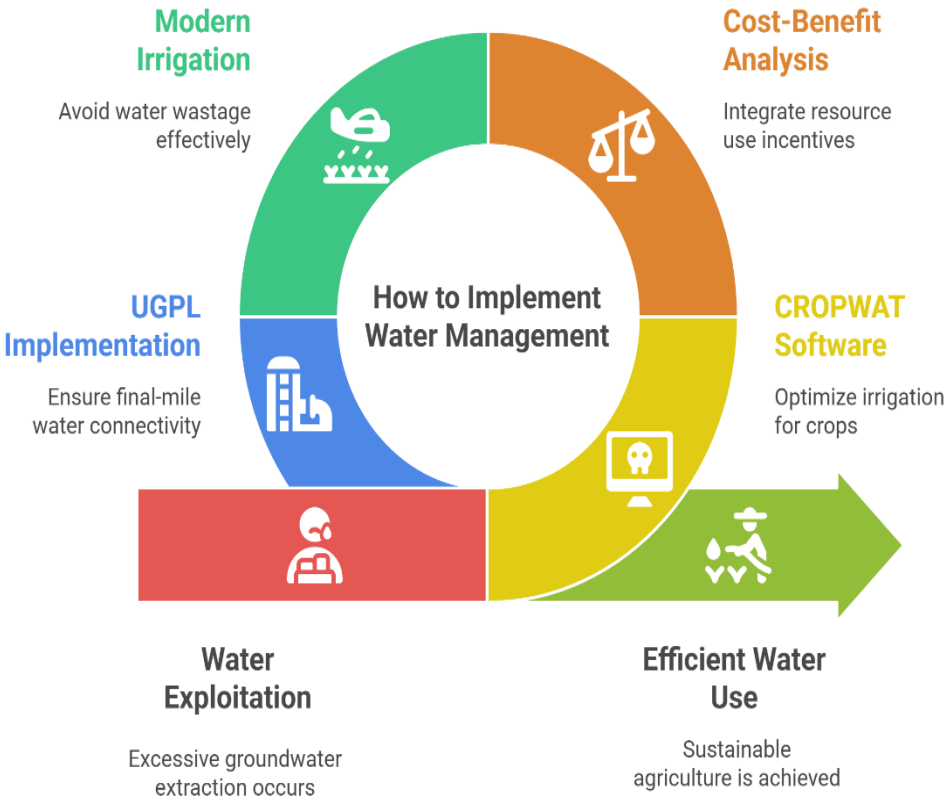
Economics of Irrigation: A Regional Perspective (A Case Study of a Dpap District, Surendranagar) (Singh, 1978) delves into the economics of irrigation, especially how effective water management influences agricultural productivity and economic outcomes. In the context of increasing water demand and scarcity, the study analyzes cost-benefit of different irrigation

techniques, technological efficiency, and profitability. Using a mixed-method approach across various fields, it offers policy recommendations to integrate sustainable resource use with economic incentives.

Sardar Sarovar Narmada Project: A study of its effects in context of Surendranagar district (Rana, 2016) examines the agricultural and economic impacts under the Sardar Sarovar Scheme in Surendranagar district. The main aim is to assess its effects on crop patterns, costs, employment, and income. Primary data from 300 beneficiaries was analyzed using averages, percentages, and frequencies. Results show that 94.33% adopted the flow method, 97.67% saw increased income, and per-acre cost decreased. Recommendations include avoiding water wastage and adopting modern irrigation techniques.

Recommendations on underground pipeline irrigation for SSP (IWMI, 2010) & PIPELINING THE SSP A Policy brief on Assessment of piped sub-minors in Gujarat (Singh, 2020) examined under the Sardar Sarovar Irrigation Project, underground pipeline sub-minors (UGPL) were implemented to overcome land acquisition issues and ensure final-mile connectivity (SSNNL, 2014-15). This approach especially benefited upstream farmers during the Rabi season. The study assessed UGPL's efficiency, technical challenges, and water management methods, revealing issues like leakage, improper distribution, and ownership disputes. Future suggestions include PPP models and tiered management to enhance effectiveness.

Groundwater exploitation, crop water requirements, and policy interventions based on a literature review: A multidimensional analysis of irrigation in Gujarat.



Source: Researcher's creation

The diagram outlines a comprehensive framework for effective water management in Gujarat, focusing on irrigation. It proposes six interconnected strategies: adopting modern irrigation techniques to reduce wastage, implementing underground pipelines (UGPL) for last-mile connectivity, and addressing groundwater overexploitation. It also recommends using CROPWAT software, as per FAO guidelines, to optimize crop-specific water needs. Conducting cost-benefit analyses is encouraged to align water use with economic efficiency. Ultimately, the framework emphasizes efficient water utilization as key to achieving sustainable agriculture, integrating technology, economic policy, and environmental management for long-term benefits in Gujarat's agricultural sector.

2. Importance of the Research Study:

This study will serve as a valuable resource for analyzing and understanding the social and infrastructural conditions of farmers who are either beneficiaries or non-beneficiaries of the Underground Pipeline (UGPL) system. By comparing the access, utilization, and impact of key

amenities among both groups, the research provides a comprehensive insight into the effectiveness and reach of the UGPL initiative.

Furthermore, the findings of this study will be instrumental for future researchers exploring issues related to rural irrigation infrastructure, equitable resource distribution, and agricultural development. In addition, the outcomes can guide government authorities and policymakers in making informed decisions about UGPL policy planning, implementation strategies, and potential expansion, ensuring that infrastructure investments are aligned with the actual needs and challenges of farming communities.

3. Research Objectives:

1. To assess the socio-demographic profile of UGPL beneficiaries and non-beneficiaries in the Surendranagar district, including gender, age, education, and marital status.
2. To compare the physical infrastructure conditions, such as housing type, electricity, drainage, water access, and fuel usage, between beneficiaries and non-beneficiaries.
3. To provide policy suggestions for improving the effectiveness and equity of UGPL and similar rural infrastructure projects based on the empirical findings..

4. Sampling Procedure:

A multi-stage sampling method was adopted to ensure representative coverage of the population.

1. In the first stage, Surendranagar was selected from 15 beneficiary districts under Sardar Sarovar Project using a non-probability method.
2. In the second stage, 6 beneficiary talukas were chosen, comprising 311 villages.
3. In the third stage, 20% of villages (62) were selected from each taluka using a systematic method.
4. In the fourth stage, two chak were selected per village based on convenience (124 chaks).
5. In the fifth stage, 6 beneficiary and 6 non-beneficiary farmers were selected per chak, covering initial, middle, and tail ends.

Thus, the total sample size was 744 respondents.

5. Data Collection and Analysis:

Both primary and secondary sources were used. Tools like interview schedules, observation, and Focus Group Discussions (FGDs) were employed. Data collection was conducted in November-December 2024.

The quantitative data was coded and analyzed using KoboCollect, Excel 2013, and SPSS (IBM SPSS Statistics 25.0). Results were presented using frequencies, tabulation, and graphs. In the present study, the quantitative data collected was encoded and analyzed using Excel 2013

(v15.0) and SPSS (IBM SPSS Statistics 25.0) software, based on data collected via KoboCollect. The presentation of this data has been done through frequency distribution, tabulation, and graphical representation.

6. UGPL Beneficiaries vs. Non-Beneficiaries: A Study of Social and Infrastructure Indicators

Distribution of Beneficiaries and Non-Beneficiaries by Gender, Age Group, Education, and Marital Status

Category	Group	Beneficiaries		Non-Beneficiaries	
		Frequency	Percentage	Frequency	Percentage
Gender	Male	366	98.40	361	97.00
	Female	6	1.60	11	3.00
Age Group	18–40	155	41.67	137	36.83
	41–60	162	43.55	160	43.01
	61–80	51	13.71	68	18.28
	80+	4	1.08	7	1.88
Education	Illiterate	49	13.17	55	14.78
	Primary	121	32.53	140	37.63
	Secondary	110	29.57	112	30.11
	Higher econdary	17	4.57	31	8.33
	Graduate	56	15.05	34	9.14
	Postgraduate	19	5.11	0	0.00
Marital Status	Married	315	84.68	347	93.28
	Unmarried	46	12.37	18	4.84
	Widow	6	1.61	7	1.88
	Widower	5	1.34	0	0.00

Source: Primary Data

The data presents a comparative analysis of beneficiaries and non-beneficiaries based on gender. Among the beneficiaries, males constitute a significant majority, with a frequency of 366, which is 98.40% of the total beneficiary group. In contrast, females are very few, with a frequency of 6, which is 1.60% of the beneficiaries. Similarly, in the non-beneficiary category, males also dominate, with a frequency of 361, representing 97.00% of the group. In this category, the number of females is 11, which is 3.00% of the non-beneficiaries.

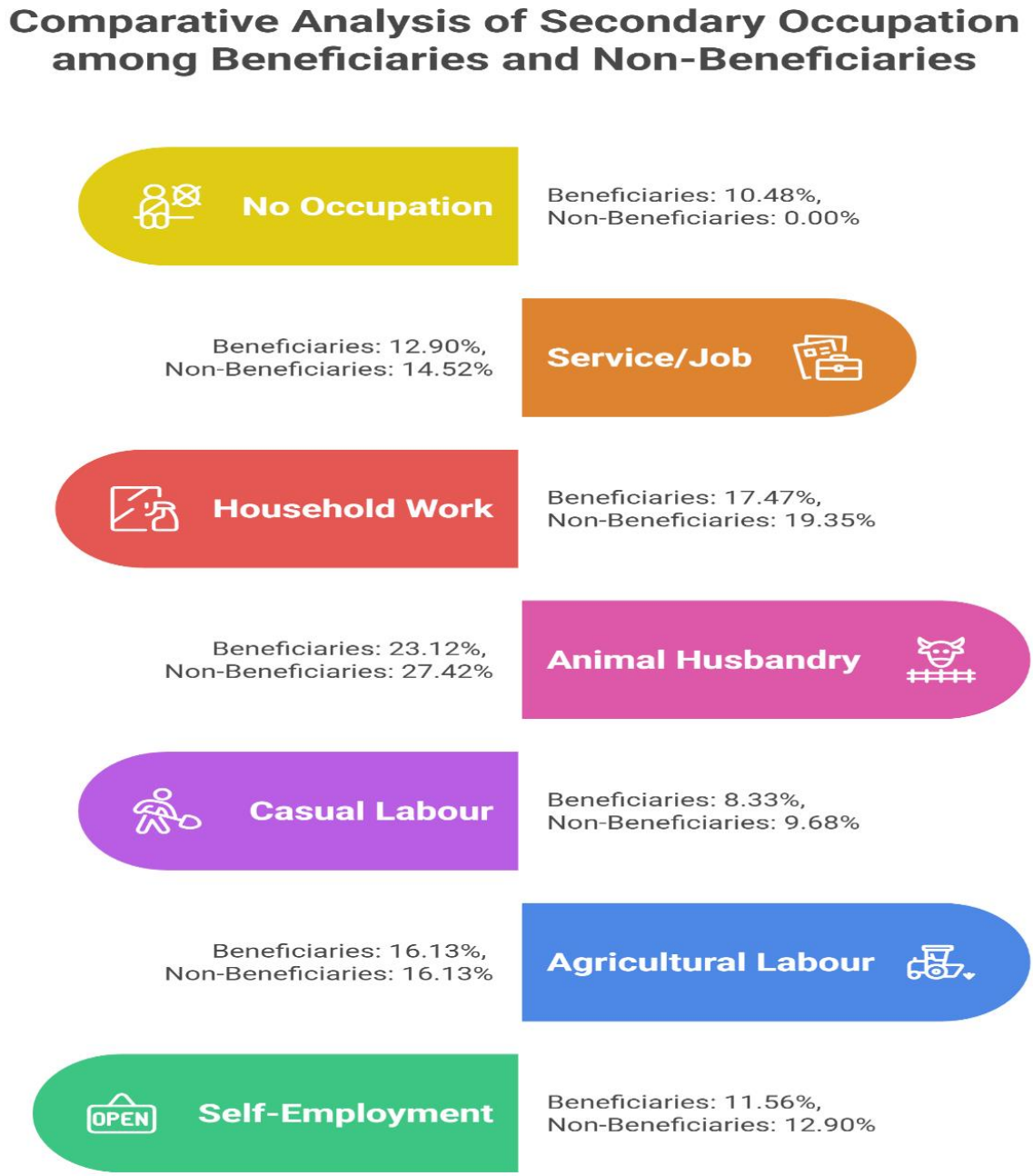
Considering the total count, the combined number of males in both groups is 727, which is 97.72% of the total surveyed population. Collectively, there are 17 females, accounting for 2.28% of the total. The total number of respondents in both groups is 744, confirming that the percentages in each category approximately sum to 100%. This distribution reveals a significant gender disparity in both the beneficiary and non-beneficiary groups, with a clear dominance of males in both categories.

In youth Age Group (18 to 40 years) group, 41.67% of beneficiaries and 36.83% of non-beneficiaries fall, with a difference of 4.84%. The highest proportions of beneficiaries in this group are in Dhangadhra (11.29%) and Limbdi (8.33%). In Dasada, youth beneficiaries (7.53%) are fewer than non-beneficiaries (9.41%). Here middle Age Group (41 to 60 years), 43.55% of beneficiaries and 43.01% of non-beneficiaries are represented, with a marginal difference of 0.54%. In most talukas, except Dhangadhra and Wadhwan, the number of beneficiaries and non-beneficiaries in this group is nearly equal. Dasada shows a slightly higher share of beneficiaries (9.68%). Senior Age Group (61 to 80 years) Beneficiaries constitute 13.71%, while non-beneficiaries account for 18.28%, indicating a difference of -4.57%. In Dhangadhra (5.11%) and Dasada (8.60%), non-beneficiaries in this group significantly outnumber beneficiaries. In Above 80 Years bracket, 1.08% are beneficiaries and 1.88% are non-beneficiaries, a difference of -0.80%. These lower percentages suggest that the majority of respondents fall below the age of 80.

According to the analysis of this table, 13.17% of total respondents among beneficiaries are illiterate, whereas among non-beneficiaries the figure is 14.78%. This reflects a difference of -1.61%, indicating that non-beneficiaries have a slightly higher illiteracy rate than beneficiaries. Among those with primary education, 32.53% are beneficiaries and 37.63% are non-beneficiaries, showing a difference of -5.10%. For the secondary level, the difference between the two groups is minimal, with 29.57% of beneficiaries and 30.11% of non-beneficiaries. At the higher secondary level, the difference is -3.76%, with 4.57% of beneficiaries and 8.33% of non-beneficiaries. In the graduate category, 15.05% of beneficiaries and 9.14% of non-beneficiaries are represented, indicating a 5.91% difference in favour of beneficiaries. At the postgraduate level, 5.11% of beneficiaries hold such qualifications, while there are no postgraduates among the non-beneficiaries.

This table shows that 84.68% of the selected beneficiaries are married, whereas among non-beneficiaries the percentage is 93.28%. The difference of -8.6% indicates that married individuals were slightly less likely to receive benefits compared to others. The scenario is different for unmarried individuals, who constitute 12.37% among beneficiaries but only

4.84% among non-beneficiaries. The 7.53% difference suggests that more unmarried individuals received benefits. The number of widows and widowers is relatively low in both groups. The difference for widows is -0.27%, indicating nearly equal representation in both groups. The case of widowers is more pronounced—1.34% among beneficiaries, while no widowers were found among non-beneficiaries. Thus, widowers appear to have received more assistance compared to other groups.



Source: Primary Data

Above data has been prepared to understand the secondary occupations of beneficiary and non-beneficiary groups. Among the beneficiaries, 10.48% have no secondary occupation, whereas there are no individuals without a secondary occupation among the non-beneficiaries. The

difference of 10.48% indicates that a larger portion of the beneficiary group lacks secondary employment.

Among non-beneficiaries, 27.42% are engaged in animal husbandry, compared to 23.12% among beneficiaries. The difference of 4.3% suggests that non-beneficiaries have a greater inclination towards animal husbandry. In terms of salaried jobs, 14.52% of non-beneficiaries are employed, compared to 12.90% of beneficiaries—showing a 1.62% difference. In domestic work, 19.35% of non-beneficiaries are involved compared to 17.47% of beneficiaries, with a difference of 1.88%.

The proportion of people engaged in agricultural labor is identical in both groups at 16.13%, indicating no significant difference in this category. Additionally, 12.90% of non-beneficiaries are engaged in independent business, slightly higher than the 11.56% among beneficiaries—a difference of 1.34%.

The data from the table indicates that non-beneficiaries have a higher rate of engagement in secondary occupations, particularly in areas such as animal husbandry, salaried employment, and domestic work. On the other hand, more people in the beneficiary group are without any secondary occupation. Participation in agricultural labor is equal in both groups.

Taluka Family Type: Beneficiaries vs. Non-Beneficiaries

Nuclear Family Joint Family

Taluka	Beneficiaries	Non-Beneficiaries
Lakhtar	11.56	6.72
Lakhtar	2.96	7.8
Limbdi	11.56	6.72
Limbdi	7.8	12.63
Dasada	24.19	16.4
Dasada	3.23	11.02
Wadhwan	6.99	4.03
Wadhwan	2.69	5.65
Dhrangadhra	5.38	9.95
Dhrangadhra	0	6.18
Chuda	7.26	4.57
Chuda	5.65	8.33

Source: Primary Data

This data provides information on the types of families (nuclear and joint) in both beneficiary and non-beneficiary groups. Among beneficiaries, 77.69% live in nuclear families, while only 48.39% of non-beneficiaries do. The proportion of beneficiaries living in nuclear families is 29.3% higher than that of non-beneficiaries. Taluka-wise, a higher proportion of beneficiaries from Dasada (24.19%), Limbdi (11.56%), and Lakhtar (11.56%) live in nuclear families. Among non-beneficiaries, the proportion of those living in nuclear families is comparatively lower in all talukas.

Only 22.31% of beneficiaries live in joint families, whereas 51.61% of non-beneficiaries live in joint families. Thus, the number of people living in joint families is 29.3% higher among non-beneficiaries. In Dhrangadhra, Dasada, and Limbdi talukas, a greater number of non-beneficiaries live in joint families.

A significantly larger proportion of beneficiaries live in nuclear families, indicating a stronger tendency towards independent lifestyles. Non-beneficiaries are more likely to live in joint

families, reflecting a more collective and traditional way of living. According to the taluka-wise analysis, Dasada shows a prominent trend towards nuclear families among beneficiaries (24.19%), whereas Dhrangadhra and Dasada have a higher number of joint families among non-beneficiaries.

Therefore, beneficiaries generally tend to live in nuclear families, while non-beneficiaries are more likely to live in joint families. These differences may arise due to economic, social, and cultural factors such as employment opportunities, family support systems, and lifestyle preferences.

Taluka-wise Comparison of Housing Type among UGPL Beneficiaries and Non-Beneficiaries

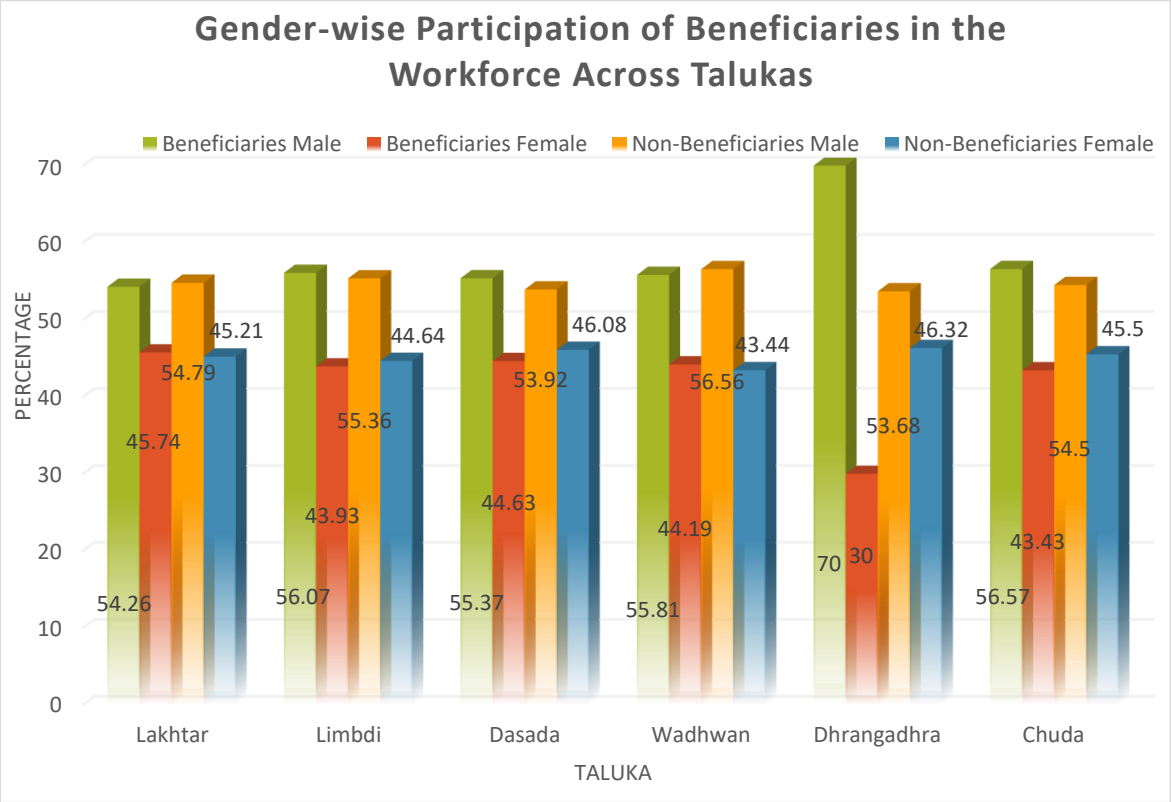
Taluka	House Type	Beneficiaries		Non-Beneficiaries	
		Frequency	Percentage	Frequency	Percentage
Lakhtar	Kutcha	19	5.11	19	5.11
	Semi-Pucca	2	0.54	3	0.81
	Pucca	33	8.87	32	8.60
Limbdi	Kutcha	43	11.56	47	12.63
	Semi-Pucca	4	1.08	4	1.08
	Pucca	25	6.72	21	5.65
Dasada	Kutcha	0	0.00	0	0.00
	Semi-Pucca	15	4.03	9	2.42
	Pucca	87	23.39	93	25.00
Wadhwan	Kutcha	11	2.96	11	2.96
	Semi-Pucca	5	1.34	4	1.08
	Pucca	20	5.38	21	5.65
Dhrangadhra	Kutcha	0	0.00	0	0.00
	Semi-Pucca	0	0.00	3	0.81
	Pucca	60	16.13	57	15.32
Chuda	Kutcha	28	7.53	32	8.60
	Semi-Pucca	2	0.54	2	0.54
	Pucca	18	4.84	14	3.76
Total	Kutcha	101	27.15	109	29.30
	Semi-Pucca	28	7.53	25	6.72

	Pucca	243	65.32	238	63.98
Total		**372**	**100**	**372**	**100**
Source: Primary Data					

Among non-beneficiaries, 29.30% reside in kutcha (non-permanent) houses, compared to 27.15% among beneficiaries. This trend is especially evident in Limbdi (12.63%) and Chuda (8.60%) talukas, where non-beneficiaries have a higher proportion of kutcha housing.

In semi-pucca housing, both groups show almost the same trend, but beneficiaries have a slightly higher share by 0.81%. For pucca (permanent) houses, 65.32% of beneficiaries and 63.98% of non-beneficiaries reside in such housing. Talukas like Lakhtar, Dhrangadhra, and Dasada have higher proportions of beneficiaries living in pucca houses.

This analysis indicates that non-beneficiaries are more likely to live in kutcha houses, whereas beneficiaries are slightly more likely to live in pucca houses. Based on qualitative insights, this difference may be attributed to economic conditions, government support, and access to infrastructure and services.



Source: Primary Data

Above chart provides a gender-based analysis of working family members among beneficiaries, non-beneficiaries, and combined groups across various talukas. Dhrangadhra shows the most significant gender disparity, with 70% of working members among

beneficiaries being male, indicating notably low female participation. In contrast, Lakhtar presents the most balanced gender ratio, with 54.52% male and 45.48% female workers overall, reflecting better gender inclusiveness. Wadhwan and Chuda follow with relatively balanced distributions, where male workers constitute around 56% and females 44%, and suggesting moderate gender equity. Limbdi and Dasada show similar overall patterns, with male participation ranging from 54% to 56%, though Dasada maintains a slightly more consistent gender ratio between beneficiaries and non-beneficiaries compared to Limbdi. Overall, the data highlights that while most talukas show moderate gender balance, Dhrangadhra stands out with a clear gap in female workforce inclusion.

The data shows that in all categories and talukas, the number of male workers exceeds that of female workers, with some areas like Dhrangadhra reflecting significantly higher gender disparity.

Use of Cooking Fuel and Water Sources in Different Talukas: Beneficiaries vs Non-Beneficiaries

Fuel and Water Sources	Taluka / Group	Lakhtar	Limbdi	Dasada	Wadhwan	Dhrangadhra	Chuda
Wood	**B**	4.24	10.68	0.47	2.67	8.32	6.91
	NB	4.93	12.32	1.58	3.17	1.58	8.27
Kerosene	**B**	0.16	0.47	0	0.16	0	0.31
	NB	0.18	0.35	0	0.18	0	0.18
LPG	**B**	6.59	4.71	16.01	4.71	9.42	2.67
	NB	6.69	3.87	17.43	4.23	10.39	2.29
Electric Stove	**B**	3.45	8.63	1.41	2.35	0	5.65
	NB	3.52	9.33	0.53	2.46	0.35	6.16
Home Tap	**B**	13.98	19.35	25.54	9.41	16.13	12.9
	NB	14.25	19.35	26.61	9.41	15.59	12.9
Public Tap	**B**	0.27	0	1.08	0.27	0	0
	NB	0	0	0	0	0.27	0
Pond	**B**	0.27	0	0.81	0	0	0
	NB	0.27	0	0.81	0.27	0.54	0

Source: Primary Data

B= Beneficiary , NB= Non-Beneficiary

An analysis of household fuel usage across different talukas reveals several important insights. Firewood remains the most commonly used fuel. Among beneficiaries, 33.28% use firewood, compared to 31.87% of non-beneficiaries, indicating only a minor difference. In Wadhwan taluka, there is little difference between beneficiaries (2.67%) and non-beneficiaries (3.17%) in firewood use. However, in Dhrangadhra taluka, a significant difference is noted—firewood use among beneficiaries is 8.32% while among non-beneficiaries it is only 1.58%, indicating variations in access or preference for fuel sources.

Kerosene is used in very small percentages by both groups: 1.10% of beneficiaries and 0.88% of non-beneficiaries. This suggests that kerosene is no longer a primary fuel source for households and has been largely replaced by other alternatives. There is no significant difference in kerosene usage between the two groups, as the percentage remains consistently low across talukas.

LPG (Liquefied Petroleum Gas) is the most commonly used household fuel in both groups—44.11% of beneficiaries and 44.89% of non-beneficiaries use it, showing minimal difference. In Dasada taluka, the difference is slightly more noticeable: 16.01% of beneficiaries and 17.43% of non-beneficiaries use LPG, showing a -1.42% variation. Limbdi and Wadhwan also show small differences, indicating near-equal LPG availability across both groups in those areas.

In terms of electric stove usage, 21.51% of beneficiaries and 22.36% of non-beneficiaries use them. Notably, no beneficiary households in Dhrangadhra taluka use electric stoves, while 0.35% of non-beneficiaries do, possibly due to differences in electricity availability or preferences.

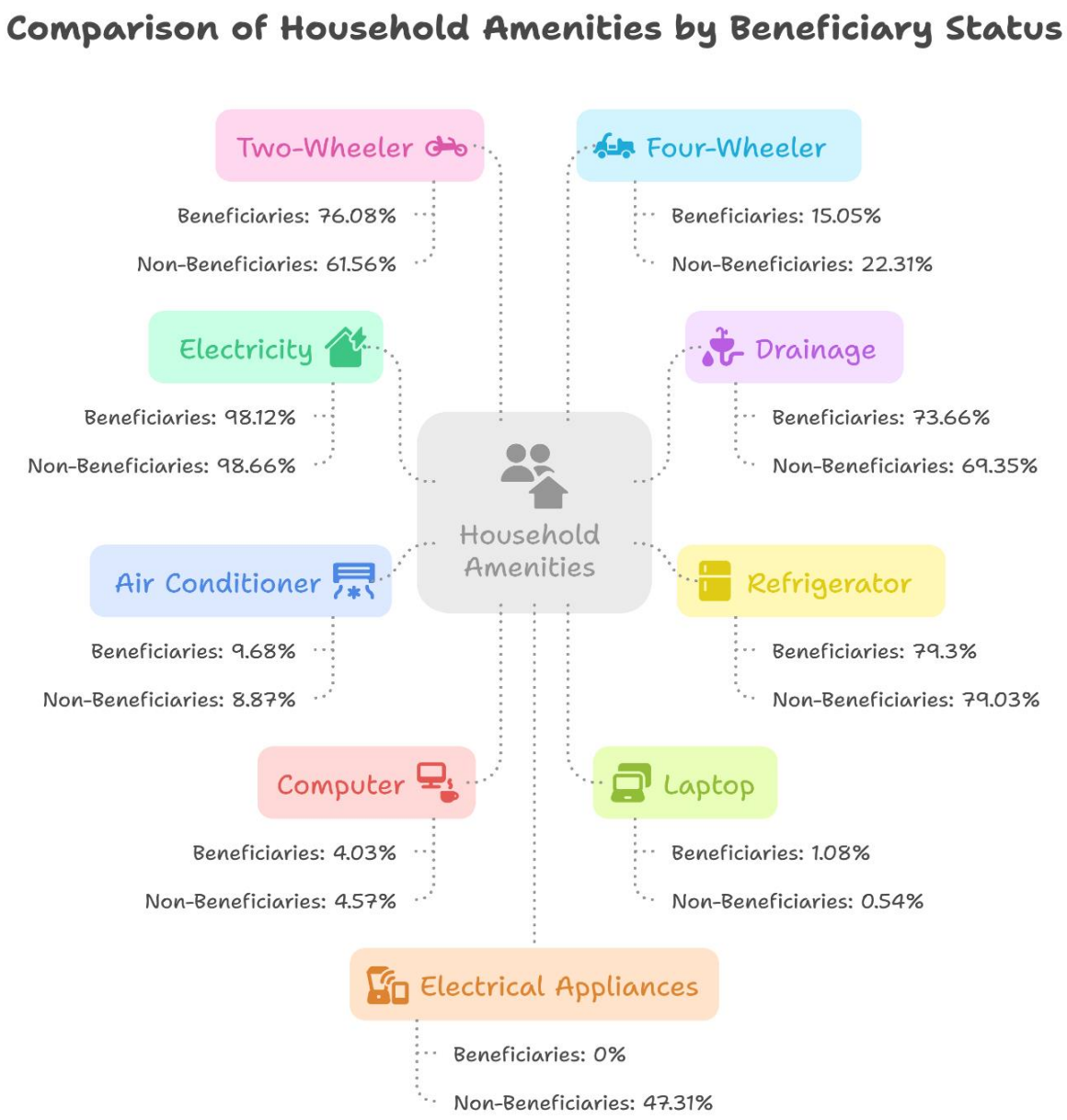
From this analysis, it can be concluded that fuel usage varies by taluka and respondent group. LPG and firewood are the most preferred fuels, while kerosene is rarely used. Use of electric stoves also varies by region, possibly reflecting differences in modern fuel access and

An analysis of drinking water sources by taluka shows that the majority of people use tap water at home. Among beneficiaries, 97.31% have access to drinking water from taps at home, compared to 98.12% of non-beneficiaries, indicating almost equal availability. In Dasada taluka, a slight difference exists—26.61% of non-beneficiaries and 25.54% of beneficiaries use home tap water—but in all other talukas, this difference is negligible.

Public taps are used very infrequently. Only 1.61% of beneficiaries and 0.27% of non-beneficiaries rely on public taps for drinking water. Dasada taluka shows a slightly higher use, while other talukas show zero or near-zero reliance on this source.

The use of ponds as a drinking water source is similarly low. Only 1.08% of beneficiaries and 1.88% of non-beneficiaries draw water from ponds. Slight differences are noted in Dhrangadhra and Wadhwan talukas, where use of pond water is marginally higher among non-beneficiaries.

From this analysis, it can be said that household tap water is the primary drinking water source for most people, and traditional sources like public taps and ponds are now rarely used. There are no major differences between the beneficiary and non-beneficiary groups in terms of access to water sources, indicating that water facilities are fairly evenly distributed across regions. Discussions with respondents revealed that only a few people use mineral water for drinking, and no such respondents were found in this study.



Source: Researcher's creation

Above data show that access to basic infrastructure such as electricity is nearly universal in both groups, with 98.12% of beneficiaries and 98.66% of non-beneficiaries having electricity connections. Similarly, drainage facilities are available to 73.66% of beneficiary households compared to 69.35% of non-beneficiaries, suggesting a slight advantage for beneficiaries in basic sanitation services.

Ownership of refrigerators is almost equal between the two groups, with 79.3% of beneficiaries and 79.03% of non-beneficiaries reporting access to this appliance. However, access to air conditioners remains low across the board, with only 9.68% of beneficiary households and 8.87% of non-beneficiaries owning one, indicating that such amenities are still perceived as luxury items rather than essential household goods.

In terms of digital access, both groups exhibit limited ownership of computers and laptops. Only 4.03% of beneficiaries and 4.57% of non-beneficiaries own a computer, while laptop ownership is even lower, at 1.08% and 0.54% respectively. This highlights a significant digital divide in rural areas, regardless of beneficiary status. When analyzing transportation facilities, two-wheeler ownership is considerably higher among beneficiaries (76.08%) than non-beneficiaries (61.56%), indicating improved mobility and possibly better economic engagement due to benefits received from the UGPL project. Conversely, ownership of four-wheelers is higher among non-beneficiaries (22.31%) compared to beneficiaries (15.05%), which may suggest that non-beneficiaries belong to relatively better-off households with additional income sources or landholdings.

A striking difference appears in the category of general electrical appliances, where 47.31% of non-beneficiaries report ownership compared to none among the beneficiaries. This disparity points to gaps in access to multi-purpose or modern household appliances, such as mixers, grinders, or washing machines, among those who have benefited from the UGPL scheme. Overall, while the UGPL project seems to have had a positive impact on certain aspects like two-wheeler mobility and drainage, the data also reveal continuing inequalities in access to modern technology and appliances. This suggests that alongside irrigation infrastructure, broader livelihood and asset-building support is essential to ensure holistic rural development.

7. Key Findings:

- Among the total 744 respondents, males overwhelmingly dominated in both groups: 98.40% of beneficiaries and 97.00% of non-beneficiaries were male, while females accounted for only 1.60% and 3.00% respectively, revealing a stark gender imbalance in agricultural participation.

- In terms of age distribution, 43.55% of beneficiaries and 43.01% of non-beneficiaries belonged to the 41–60 age group. However, 18.28% of non-beneficiaries were from the senior age group (61–80), compared to only 13.71% among beneficiaries, indicating relatively better access to UGPL schemes among middle-aged individuals.
- Educational data shows that 15.05% of beneficiaries were graduates and 5.11% were postgraduates, whereas only 9.14% of non-beneficiaries were graduates and none held a postgraduate degree. In contrast, illiteracy was slightly higher among non-beneficiaries at 14.78%, compared to 13.17% among beneficiaries.
- Regarding marital status, 84.68% of beneficiaries were married compared to 93.28% of non-beneficiaries. Notably, 12.37% of beneficiaries were unmarried compared to only 4.84% of non-beneficiaries, indicating a higher presence of young or single individuals among the beneficiary group. Secondary occupation data revealed that 10.48% of beneficiaries had no secondary occupation, whereas all non-beneficiaries reported at least one. Non-beneficiaries were more engaged in animal husbandry (27.42% vs. 23.12%), salaried jobs (14.52% vs. 12.90%), domestic work (19.35% vs. 17.47%), and small businesses (12.90% vs. 11.56%), suggesting a more diverse livelihood base.
- In terms of housing type, 65.32% of beneficiaries lived in pucca houses compared to 63.98% of non-beneficiaries. Kutcha housing was more common among non-beneficiaries at 29.30% compared to 27.15% among beneficiaries, especially in Limbdi (12.63%) and Chuda (8.60%).
- Family structure analysis showed that 77.69% of beneficiaries lived in nuclear families, while only 48.39% of non-beneficiaries did. Conversely, 51.61% of non-beneficiaries lived in joint families compared to just 22.31% of beneficiaries, indicating a stronger shift toward nuclear family setups among beneficiaries.
- A gender-wise analysis of working members revealed Dhrangadhra as the most unequal, with 70.00% of working members among beneficiaries being male. Lakhtar taluka showed better balance with 54.52% male and 45.48% female workers overall.
- Regarding fuel usage, LPG was the most used cooking fuel across both groups: 44.11% of beneficiaries and 44.89% of non-beneficiaries used it. Firewood remained significant too, used by 33.28% of beneficiaries and 31.87% of non-beneficiaries. Kerosene usage was minimal—1.10% among beneficiaries and 0.88% among non-beneficiaries.

- Water source data showed that 97.31% of beneficiaries and 98.12% of non-beneficiaries accessed drinking water from home taps, with negligible use of public taps (1.61% and 0.27% respectively) or ponds (1.08% and 1.88%).
- Electricity access was nearly universal: 98.12% of beneficiaries and 98.66% of non-beneficiaries had connections, indicating good infrastructural penetration.
- Refrigerator ownership was nearly equal at 79.3% for beneficiaries and 79.03% for non-beneficiaries. However, air conditioner ownership remained low in both groups—9.68% for beneficiaries and 8.87% for non-beneficiaries.
- Ownership of digital devices was limited: only 4.03% of beneficiaries and 4.57% of non-beneficiaries owned a computer, while laptop ownership stood at 1.08% and 0.54% respectively, revealing a persistent digital divide in rural areas.
- Two-wheeler ownership was notably higher among beneficiaries at 76.08%, compared to 61.56% among non-beneficiaries, possibly reflecting improved mobility linked to better economic outcomes. However, 22.31% of non-beneficiaries owned four-wheelers compared to only 15.05% of beneficiaries, suggesting higher wealth levels among certain non-beneficiary households.
- A significant gap was observed in the category of general electrical appliances: 47.31% of non-beneficiaries reported owning such items, while no such ownership was reported among beneficiaries, highlighting a disparity in access to multi-functional household tools and technology.

8. Suggestions:

✓ Based on the empirical findings of the study, several detailed and data-supported suggestions are proposed to strengthen the inclusivity and effectiveness of the UGPL initiative and related rural development efforts in Surendranagar district. The study reveals a significant gender disparity, with 98.40% of beneficiaries and 97.00% of non-beneficiaries being male, while only 1.60% and 3.00% respectively are female. This indicates a critical need for gender-sensitive interventions in irrigation access and decision-making. Programs aimed at increasing female participation in agricultural and infrastructural schemes—such as gender-based capacity building, dedicated credit lines, and extension services for women—should be actively pursued.

✓ The age-wise distribution shows that the majority of beneficiaries (43.55%) and non-beneficiaries (43.01%) fall within the 41–60 age group, while the elderly group (61–80 years) constitutes a larger proportion among non-beneficiaries (18.28%) than beneficiaries (13.71%). Tailored outreach strategies and support services should be designed for elderly

farmers to ensure they are not excluded from the benefits of irrigation infrastructure. In education, 5.11% of beneficiaries were postgraduates compared to none among non-beneficiaries, while 15.05% of beneficiaries and only 9.14% of non-beneficiaries were graduates. On the other hand, the illiteracy rate was slightly higher among non-beneficiaries (14.78%) compared to beneficiaries (13.17%). These findings suggest the need for targeted literacy and digital education initiatives, especially in non-beneficiary villages, to enable broader engagement with government schemes and modern agricultural techniques.

- ✓ Regarding secondary occupation, 10.48% of beneficiaries reported no secondary occupation compared to zero among non-beneficiaries, while non-beneficiaries were more engaged in animal husbandry (27.42%), salaried jobs (14.52%), and domestic work (19.35%) than beneficiaries (23.12%, 12.90%, and 17.47% respectively). These figures highlight the necessity of promoting skill development and livelihood diversification programs for beneficiaries to enhance income security and reduce dependency on primary agriculture.
- ✓ In terms of housing, 29.30% of non-beneficiaries lived in kutcha houses compared to 27.15% of beneficiaries. Pucca houses were occupied by 65.32% of beneficiaries and63.98% of non-beneficiaries. While the difference is not stark, it supports the case for integrating housing assistance with irrigation projects to elevate overall living standards, especially in talukas like Limbdi and Chuda where kutcha housing remains higher.
- ✓ The family structure data shows that 77.69% of beneficiaries live in nuclear families, while 51.61% of non-beneficiaries live in joint families. This 26.08% difference suggests that schemes should consider the socio-cultural dynamics of family types when designing outreach, training, and benefit distribution models. For example, nuclear families may benefit from personalized support services, whereas joint families may require collective engagement mechanisms.
- ✓ The gender composition of the working population indicates sharp differences across talukas. Dhrangadhra taluka had 70% male workers among beneficiaries, while Lakhtar showed a more balanced ratio with 54.52% male and 45.48% female workers. These variations underscore the importance of region-specific gender empowerment strategies to improve equity in labor force participation.
- ✓ Fuel use data indicates that firewood is used by 33.28% of beneficiaries and 31.87% of non-beneficiaries, while LPG usage stands at 44.11% and 44.89% respectively. This reflects relatively equal access to modern fuels, though electric stove usage remains limited at 21.51% for beneficiaries and 22.36% for non-beneficiaries. Promoting access to clean

cooking fuels and energy-efficient appliances through subsidies and awareness campaigns can enhance quality of life and reduce reliance on traditional biomass.

- ✓ In drinking water access, 97.31% of beneficiaries and 98.12% of non-beneficiaries reported access to home tap water, suggesting nearly universal access. Public taps and ponds are used by only a small fraction (1.61% and 1.08% of beneficiaries, and 0.27% and 1.88% of non-beneficiaries, respectively). These findings indicate that the basic water infrastructure is equitably distributed; however, improvements in water quality and reliability should continue to be prioritized.
- ✓ Infrastructure data further reveal that electricity access is widespread, with 98.12% of beneficiaries and 98.66% of non-beneficiaries connected. Drainage systems are present in 73.66% of beneficiary households compared to 69.35% of non-beneficiaries. However, access to modern appliances remains limited. For instance, only 9.68% of beneficiaries and 8.87% of non-beneficiaries own air conditioners, while computer ownership is low for both groups—4.03% and 4.57% respectively. Laptop ownership is even lower at 1.08% and 0.54%. These statistics highlight the urgent need for digital inclusion policies in rural areas. Notably, 76.08% of beneficiaries own two-wheelers compared to 61.56% of non-beneficiaries, suggesting improved economic mobility among the former. Yet, four-wheeler ownership is higher among non-beneficiaries (22.31%) than beneficiaries(15.05%), indicating that some non-beneficiaries may come from relatively affluent backgrounds or have diversified income sources. Furthermore, 47.31% of non-beneficiaries reported owning other general electrical appliances, while none among beneficiaries reported such ownership. This disparity points to a critical gap in access to household conveniences that should be addressed by integrating asset-building support with infrastructural interventions.

9. Conclusion:

The study comprehensively demonstrates that the UGPL project has contributed positively to improving certain socio-economic and infrastructural indicators among beneficiary households in Surendranagar district. Access to irrigation has supported better housing quality, increased two-wheeler ownership, and improved drainage availability among beneficiaries compared to non-beneficiaries. However, the data also reveal critical disparities that require attention. Gender imbalance remains pronounced, with male dominance in both beneficiary and non-beneficiary categories, and particularly low female participation in the workforce in some talukas. Digital and technological gaps persist, as reflected in limited ownership of computers, laptops, and modern household appliances among both groups, though especially acute among

beneficiaries. Educational attainment and access to secondary occupations are lower among beneficiaries, suggesting the need for complementary livelihood enhancement and skill-building programs alongside infrastructure support. The living arrangements further highlight a transition toward nuclear families among beneficiaries, possibly indicating shifting socio-cultural dynamics, while non-beneficiaries continue to rely more on joint family systems. In terms of fuel and water access, the study indicates near-universal access to home tap water and growing reliance on LPG, although traditional fuels like firewood remain in use. These findings underline the importance of adopting an integrated rural development model where irrigation infrastructure is aligned with efforts to enhance education, diversify income, improve gender inclusion, and expand access to technology. Future policies should be designed to address these multi-dimensional challenges, ensuring that infrastructure initiatives like UGPL translate not only into improved agricultural output but also into broad-based social and economic empowerment for rural communities.

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