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Article

Rational Thirst: Household Water Decisions in Rural India

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Abstract

This study examines household demand for drinking water in rural central India using a revealed preference framework applied to a stratified sample of households across villages with and without piped water supply. Departing from the contingent valuation methods prevalent in earlier literature, the study employs a discrete choice model to identify the determinants of water source selection. In settlements without piped supply, distance to the water source and female educational attainment emerge as the principal determinants of safe water preference, whilst household income is not significant. Where piped supply exists, income, price, and household size shape the decision to opt for a private yard connection. The monetary value of time spent collecting water indicates a substantial willingness to pay. The findings demonstrate that rural households already behave as rational economic agents in their water decisions, undermining paternalistic assumptions embedded in India's supply-driven policy framework. The paper argues for a tiered service model that guarantees a minimum standard of provision for all whilst permitting enhanced service levels for those willing and able to pay, thereby reconciling equity commitments with financial sustainability.

Keywords: rural water demand; revealed preference; discrete choice model; willingness to pay; female education

Introduction

It has long been recognised that having access to clean drinking water is a basic human need. Global Consultations met in September 1990 in New Delhi, India, to wrap up the International Drinking Water Supply and Sanitation decade. The New Delhi Declaration promoted the idea of "some for all, rather than more for some" in the area of drinking water provision while outlining measures intended to achieve universal coverage by the year 2000. It is rather amazing that an egalitarian stance of this kind was able to garner widespread agreement among those present at the Global Consultations, considering that this declaration came at a time when neo-classical counter-revolutionary ideology was in vogue.

As was perhaps inevitable, once the declaration began to generate concrete policy initiatives, economists at the international institutions and within certain aid-giving nations took issue with what they perceived as "welfare state" overtones in the Delhi Declaration. These critics dismissed the resulting initiatives as constituting a "first standard paradigm". Their objections reflected a broader unease with the redistributive implications that such a declaration carried for water governance.

The World Bank's opposition to the provision of drinking water free of charge has, in practice, exerted negligible influence over India's rural water supply programme, in which external funding contributes only a minor share. The largest drinking water programme in the world continues to operate on a supply-driven basis, and the appreciation of drinking water as an economic good has remained largely peripheral to the process of policy formulation. This gap between economic theory and actual policy practice has persisted despite sustained pressure from international financial institutions.

Earlier scholarship on water supply in poor nations was predominantly non-analytical in character, whilst more recent village-level studies in developing countries have concentrated on

examining water-vending activities. The present study attempts to examine the demand for drinking water in rural central India, where "demand" is understood to encompass both the capacity to pay and the willingness to do so. Whilst the United Nations has adopted the principle of "some for all rather than more for some" as its "strategy for the nineties," it is becoming increasingly apparent that this approach is failing to advance the ultimate goal of "Water for all by 2000." Ordinary people have already come to regard water as an economic private good, even as policymakers remain reluctant to abandon their paternalistic stance. There is therefore a pressing need to examine whether a policy of "some for all and more for some" might offer a more effective path towards universal coverage and long-term sustainability.

Literature Review

Historical and Normative Foundations of Rural Water Supply Policy

The recognition of access to safe drinking water as a fundamental human right has deep roots in international development thought. The International Labour Organisation in 1976 was amongst the earliest multilateral bodies to enshrine this principle formally, situating water access within a broader framework of basic human needs that states were expected to guarantee for their citizens. This normative position established the intellectual foundation upon which subsequent decades of water supply policy would be constructed, particularly in the developing world, where gaps between declared entitlements and lived realities remained wide.

The International Drinking Water Supply and Sanitation Decade of 1981-1990 represented the most sustained and coordinated global effort to translate this normative commitment into programmatic action. Evaluative work conducted towards the close of this period, including the country-level comparative analyses documented both the considerable progress achieved and the structural obstacles that had prevented the decade from meeting its targets. These studies were predominantly descriptive in character, cataloguing patterns of water use, distances travelled to water sources, and the time burdens borne disproportionately by women and children, rather than subjecting demand to formal economic analysis. Their contribution lay in establishing a rich empirical baseline from which subsequent, more analytically rigorous scholarship could depart.

The Global Consultations convened in New Delhi, India in 1990, at the close of the Decade, sought to chart a revised course towards universal coverage. The resulting New Delhi Declaration advanced the principle of "some for all, rather than more for some," articulating an explicitly egalitarian vision of water governance in which the extension of even minimal coverage to the unserved was to take precedence over the improvement of supply for those already connected. The timing of this declaration is of considerable intellectual significance: it emerged precisely at the moment when neo-classical counter-revolutionary thinking was at its most influential in shaping development policy, making the declaration's broadly redistributive character all the more remarkable as an instance of international consensus.

The Neo-classical Challenge and the World Bank's Demand Management Paradigm

The neo-classical critique of welfare-oriented water supply policy gained its most authoritative institutional expression through the 1993 work of the WB Water Demand Research Team, whose analysis dismissed programmatic initiatives flowing from the New Delhi Declaration as constituting a "first standard paradigm" wedded to outdated supply-driven assumptions. This critique drew on the broader intellectual tradition of public choice theory and welfare economics to argue that the provision of drinking water free of charge, or at heavily subsidised rates, generated perverse incentive structures that undermined both the efficient allocation of resources and the long-term financial sustainability of water supply infrastructure. The World Bank's position was that water should be treated as an economic good, with pricing mechanisms deployed to signal scarcity and to recover costs from users in a manner that would enable continuous investment in system maintenance and expansion.

The intellectual lineage of this demand management paradigm can be traced to earlier work on the economics of public utilities and natural resource pricing, applied with renewed vigour to the

water sector during the structural adjustment era of the 1980s. Some scholars such as developed the theoretical and empirical case for cost recovery in water supply, arguing that the political reluctance of governments in developing countries to charge users reflected a misguided paternalism that ultimately harmed the poor by denying them access to reliable services. These arguments were reinforced by cross-national evidence suggesting that systems reliant on donor funding and government subsidy were characterised by higher rates of breakdown and lower quality of service than those with more robust mechanisms for revenue generation.

The critique of demand-side approaches was not, however, without its own scholarly rejoinders. A number of researchers argued that the application of standard neo-classical welfare economics to the water sector in low-income rural settings was conceptually problematic, insofar as it assumed functioning markets, stable household incomes, and freedom of choice that did not characterise the contexts in which rural water supply programmes operated. The tension between treating water as a social good to which all are entitled and treating it as an economic commodity to be allocated through price signals remained unresolved in the theoretical literature, and this tension found direct expression in the contested policy environment of the 1990s.

Willingness to Pay, Contingent Valuation, and Rural Household Demand

The operationalisation of demand analysis in the context of rural water supply in developing countries has been substantially shaped by the application of contingent valuation methods, through which researchers elicit household willingness to pay for improvements in water quality or reliability. The most influential early applications of this methodology, examining water-vending markets in urban settings in the developing world found that poor households frequently paid unit prices for water that were substantially higher than those paid by wealthier connected households, suggesting that ability to pay was not the primary constraint on demand. This finding had significant implications for policy, as it undermined a central argument deployed by advocates of free water provision, namely that the rural and urban poor were categorically unable to pay for improved services.

Subsequent contingent valuation studies extended this line of enquiry into rural settings across sub-Saharan Africa, Latin America, and South and Southeast Asia. A study of households in Haiti, employing both open-ended and iterative bidding formats to elicit willingness-to-pay estimates demonstrated substantial heterogeneity in demand across households differentiated by income, education, and current water source. These methodological contributions were important not merely for the empirical findings they generated but for their demonstration that the tools of applied welfare economics could be deployed meaningfully in settings characterised by the absence of established market prices for the service in question. The methodological debate concerning the reliability and validity of contingent valuation estimates was, however, already under way, with critics raising fundamental questions about whether hypothetical willingness-to-pay responses could be taken as reliable indicators of actual demand behaviour.

The demand for drinking water is shaped by a complex interaction of supply-side conditions, household characteristics, and contextual factors that simple willingness-to-pay estimates may fail to capture adequately. The time cost of water collection, borne overwhelmingly by women and female children, constitutes an implicit price for current water access that standard monetary estimates of willingness to pay tend to understate or ignore. Recognising this, subsequent research has sought to incorporate shadow values of time into demand models, though the practical difficulties of estimating the opportunity cost of time in rural economies with limited formal labour markets have constrained the success of such efforts. The recognition that demand is genuinely multidimensional, encompassing both capacity to pay and willingness to do so, as well as the valuation of non-monetary costs and benefits, has increasingly been accepted as a necessary corrective to narrowly economic analyses.

Rural Water Supply in India: Policy Context and Demand Considerations

India's rural water supply programme, operating at a scale unmatched anywhere in the world, has historically been organised on a supply-driven basis in which the identification and meeting of

notional need has taken precedence over the analysis of effective demand. The programme's institutional architecture, developed over successive Five Year Plans, has emphasised the extension of physical infrastructure to unserved habitations, with per capita norms of service provision used as proxies for need rather than household-level assessments of willingness or capacity to pay. This supply-driven orientation has been reinforced by the programme's near-total reliance on domestic budgetary resources, which has insulated it to a considerable degree from the conditionality-driven demands for cost recovery and demand management that have shaped World Bank-funded programmes in other developing countries.

The gap between the normative framework governing India's rural water supply programme and the actual behaviour of rural households has been a persistent theme in the domestic and international literature. Studies conducted in various Indian states have found that rural households are already effectively treating water as an economic private good, in that they devote significant shares of household income, time, and labour to securing access to sources they regard as reliable and safe, irrespective of whether any formal pricing mechanism is in place. The persistence of open defecation and the continued use of unsafe surface water sources even in areas nominally served by government supply systems point to a mismatch between the services provided and those actually demanded by rural communities, a mismatch that supply-driven planning processes are structurally ill-equipped to detect or address.

The decentralisation of rural water supply governance, initiated under the Panchayati Raj framework and subsequently deepened through sector reforms in the late 1990s and 2000s, has created the institutional space for more demand-responsive approaches to water service delivery, though the realisation of this potential has been highly uneven across states. Scholars examining the performance of community-managed water supply schemes in India have found that schemes characterised by higher levels of community participation in planning and management, user contributions to capital and operation and maintenance costs, and locally accountable governance structures tend to exhibit better outcomes in terms of coverage, reliability, and financial sustainability. These findings lend empirical support to the argument that a policy framework that combines universal minimum provision with the option of enhanced service levels for those willing and able to pay may offer a more viable path to sustainable coverage than either the purely supply-driven model or the unmediated application of full cost recovery.

Towards a Synthesis: 'Some for All and More for Some'

The analytical and policy debate reviewed in preceding sections converges on a tension that has proved resistant to resolution within either the welfare paradigm or the neo-classical demand management paradigm taken alone. The welfare paradigm, in its insistence on universal provision financed by public resources without recourse to user charges, has foundered in practice on the fiscal limitations of developing country governments and the incentive problems associated with the absence of demand signals in supply planning. The demand management paradigm, in its prescription of cost recovery and market pricing as the path to sustainable and efficient provision, has struggled to accommodate the equity implications of full pricing in contexts of pervasive rural poverty, and has encountered resistance from governments and communities unwilling to treat an essential good as a purely commercial commodity. The intellectual challenge confronting researchers and policymakers alike is to develop frameworks that can navigate this tension without collapsing into one of its poles.

A number of scholars have proposed variants of what might be termed a differentiated or tiered access framework, in which a guaranteed minimum level of water provision is made available at subsidised or zero cost to all households, whilst additional consumption above this threshold is priced at rates that contribute to cost recovery and signal scarcity. This approach seeks to operationalise the distributional commitment of the New Delhi Declaration whilst incorporating the demand signals and revenue generation mechanisms advocated by the World Bank and aligned institutions. The practical implementation of such a framework raises a range of technical and institutional challenges, including the determination of the guaranteed minimum, the setting of block

tariffs, and the governance structures required to ensure that low-income households are not excluded from even the basic tier through inability to pay connection charges or registration fees.

The framing advanced in the present study, which characterises its analytical objective as an examination of whether a policy of "some for all and more for some" might offer a more effective path towards universal coverage than the existing supply-driven approach, is situated precisely within this emerging synthesis literature. By treating demand as encompassing both the capacity and the willingness to pay, the study acknowledges that rural households are active economic agents whose preferences and constraints must be understood if water supply policy is to be both effective and sustainable. The empirical investigation of demand in rural central India thus contributes to a wider scholarly effort to generate the evidence base needed to move beyond the polarised debate between welfare and market paradigms, and to design policies that are simultaneously equitable, financially viable, and responsive to the genuine needs and preferences of rural communities.

Methodology

Contingent valuation methodologies have found considerable application in wealthier nations, chiefly as a means of assigning economic worth to public goods and commodities that are not traded in conventional markets. When respondents are posed an open-ended question regarding their willingness to pay for a given commodity, the results tend to be of limited practical value. Some degree of improvement has been achieved through techniques such as the dichotomous choice approach and related methodological refinements. Researchers have since extended these methods to water policy analysis in developing nations though the outcomes have been inconsistent.

Notwithstanding such methodological advances, the contingent valuation framework remains susceptible to a range of systematic distortions in respondent answers. These include hypothetical bias, which arises from the speculative character of the questions posed; strategic bias, which emerges when respondents perceive that their answers may influence outcomes to their advantage; compliance bias, which occurs when respondents attempt to second-guess the responses that the interviewer may prefer; and starting point bias, whereby the bids offered by respondents are unduly shaped by suggestions made by the interviewer. In populations where literacy levels are low, these distortions are likely to be considerably more pronounced. For this reason, the present study adopts a revealed preference approach..

Prior research on water supply has typically relied on modest sample sizes, generally ranging between 50 and 60 observations. The present study considerably exceeds these precedents by encompassing 490 households, with 35 households drawn from each of the 7 villages, half of which lacked any water supply infrastructure whilst the remaining half benefited from piped water connections.

Data collection was carried out through structured schedules of inquiry administered across the selected households. The methodological framework closely mirrored that of the National Sample Survey, upon which this investigation was modelled. A stratified two-stage sampling design was employed, wherein census villages constituted the primary stage units, numbering 14 in total, and individual households served as the secondary stage units, with 35 selected from each primary unit. The measurement of water collection time encompasses both travel time and the duration spent queuing, though it excludes the time required to fill vessels as well as any time spent utilising water at or in the immediate vicinity of the source. Consequently, the collection time attributed to households drawing water from a yard tap is treated as nil.

Prior research on water supply has typically relied on modest sample sizes, generally ranging between 50 and 60 observations. In a notable Kenyan study, Whittington and colleagues (1990) drew upon a cross-sectional sample of 59 households to derive their findings. McFadden (1973) demonstrated that the maximum likelihood estimator performs reliably when applied to samples comprising fifty or more observations. The present study considerably exceeds these precedents by encompassing almost five hundred households, with almost equal number of households drawn

from each of the seven villages, half of which lacked any water supply infrastructure whilst the remaining half benefited from piped water connections.

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The model

The selection of a water source constitutes an economic decision that entails choosing amongst a set of discrete alternatives, and a discrete choice probabilistic model is therefore well suited to this line of enquiry. The analysis employs an indirect utility function as a practical substitute. The government has committed itself to bringing safe water closer to residential areas through the installation of hand pumps, with programme priorities assigned according to existing levels of access. Villages with no drinking water source whatsoever receive first consideration, followed by those settlements in which residents must travel in excess of 1.6 kilometres to reach a safe water source, and subsequently those where the nearest safe source lies approximately one kilometre away. Piped water supply is reserved for settlements with comparatively higher population densities. As this study is cross-sectional rather than longitudinal in nature, government policy on the siting of safe water sources does not feature as a variable in the model.

For analytical convenience, the individual household is treated as a single rational decision-making unit, and any intra-household conflicts that may exist are not accounted for in the analysis. Whilst household composition is taken into consideration, the utility function is defined at the level of the household as a whole rather than for its individual members. Water is categorised in this study as either safe or unsafe, a classification consistent with the practice followed by United Nations agencies such as UNICEF and WHO, which leave the determination of specific chemical, biological, or other qualifying criteria to individual member states. Accordingly, the standards set by the Government of India have been adopted.

In communities characterised by poor health standards and elevated morbidity rates, it is exceptionally difficult to establish a causal link between the consumption of particular water and specific illnesses, given the multiplicity of potential sources of infection. This renders trial-and-error learning about water safety largely impractical for households. Accordingly, the variable of information is excluded from the model, and it is assumed, consistent with government publicity campaigns..

Results

It can be shown that, under widely relevant conditions, maximum likelihood estimation applied to the conditional logit model produces estimators that are both asymptotically efficient and regularly distributed. The method therefore offers a reliable basis for inference across a range of practical situations. When the independent variables exhibit a high degree of correlation amongst themselves, their matrix becomes singular and the resulting estimates break down entirely. The challenge of choosing appropriate independent variables is considerably more pressing in logit models than it is in the context of ordinary linear regression. Such selection ought to be guided by economic theory and sound analytical judgement, rather than by automated computational procedures in which variables are added or removed sequentially on the basis of the Wald statistic or shifts in the likelihood ratio.

Given a sufficiently large sample, the significance of any given coefficient may be assessed using the This statistic, however, carries a notably problematic characteristic that limits its reliability in

certain circumstances. A regression coefficient's standard error tends to be overstated as its absolute value increases. The consequence is a Wald statistic that is artificially deflated, which in turn leads to erroneous acceptance of the null hypothesis. A more dependable approach is to estimate the model both with and without the variable in question, and to ground the hypothesis test in the difference between the two resulting likelihood chi-squares. An alternative-set specific constant has been incorporated into the regression specification, which, as Train (1986) clarifies, represents not a restriction upon the model but merely a normalisation.

Settlements lacking piped water

The time taken to collect water is closely linked to both the distance and the the household size. Regression analysis indicates that when these two variables are included whilst excluding the time variable, distance proves statistically significant but not the size of the household. Superior results could be achieved by incorporating time instead of distance and household size. Either way, income does not emerge as significant - understandable given that water sources in both cases are available free. As income is correlated with educational attainment, subsequent regressions yield better outcomes by excluding income.

When female educational level and overall household educational level are considered simultaneously, only female educational level proves significant. Household educational level attains significance only upon removal of the female educational level variable; however, the resulting outcomes are inferior. It may therefore be concluded that female educational level is important. The determining factors of source selection may be summarised as follows:

1. Distance of the source from the dwelling is highly significant with a negative sign. The smaller the difference between the distance to the safe source and that to the unsafe source, the greater the likelihood of households choosing safe water.
2. Given that seventy nine of water is carried by women, households with a greater share of female members possess a higher capacity to fetch water from more distant locations.
3. Household size is unimportant.

Settlements with piped water

Similar analysis finds that determinants of the choice to opt for a private household connection (yard tap) may be summarised as follows:

1. Higher prices reduce the likelihood of households going in for a private connection.
2. Income has a positive bearing on the choice of a yard tap. More economically comfortable households tend to prefer private connections, whilst lower-income households rely on public standposts.
3. Since the tariff for a yard tap remains fixed, allowing larger households to obtain greater quantities of water for the same outlay, larger households prefer a yard tap..
4. Educational level is significant. Economic standing rather than educational attainment that drives the decision.

Value of time

Two of the estimated parameters can be used to calculate the value of time, which is the marginal rate of substitution between the time spent collecting water and the money paid for it. Maximum likelihood parameter estimates from the yard tap decision model regression are used for this calculation. The monetary value of time amounts to INR 46 (USD 0.50) per hour. Willingness to pay for water is substantial.

Discussion

Considerable weight is placed on policy effectiveness as an additional criterion. The long-held assumption that water research and analysis in poor nations differs little from that undertaken in industrialised countries is gradually being displaced by a growing interest in country-specific challenges, particularly in contexts where the process is frequently deficient (Brookshire and Whittington, 1993).

Periodic dissent from neoclassical scholars affiliated with the international institutions and certain aid-giving nations (e.g., Churchill, 1987; Feder & Le Moigne, 1994) notwithstanding, United Nations agencies continue to prioritise cost cutting and suitable technology as the principal instruments of advancement. Questions of recovery of cost of provision of water and analysis of water demand occupy a marginal position within this framework and receive comparatively little attention.

The paternalistic approach to meeting basic needs gives rise to a fundamental problem of sustainability. In the drive to achieve universal coverage, the requirements of operation and maintenance tend to be overlooked and inadequately resourced. Furthermore, the capacity of government finances to absorb such considerable expenditure is finite, and the quality of service provision cannot be advanced beyond a certain threshold under these conditions.

Populations are travelling many kilometres and expending more time in the collection of safe water, even in circumstances where unsafe water is readily accessible in proximity. It is evident that public awareness of the benefits associated with safe water carries considerable weight, and female education is found to be a significant determinant in the preference for safe water, whereas household income does not appear to exert a comparable influence.

The variables of price and time are both found to be highly significant, indicating a readiness amongst populations to pay in monetary terms rather than absorb the time costs associated with water collection. On average, the sum that individuals want to spend to secure time savings is substantial.

Rural poverty in India has been declining markedly, although the precise extent of this decline and its underlying causes remain subjects of ongoing academic debate (Roy & van der Weide, 2024; World Bank, 2025). Should this trajectory be sustained, demand for higher standards of service will increase, and populations will demonstrate a greater willingness to pay accordingly, given that income is a significant variable in the preference for improved service levels. There is a compelling case for revisiting current policy, which remains anchored in egalitarian principles, and for permitting individuals to select the level of service that corresponds to their preferences and circumstances.

Given the externalities associated with public health, the provision of a minimum standard of service to all cannot reasonably be contested. Beyond this baseline, however, individuals ought to retain the right to access higher service levels upon payment. Within the egalitarian tradition of social science, some proponents have argued that communities should contribute financially to water provision because:

- By acquiring a financial stake in water infrastructure, communities develop a sense of ownership that fosters more conscientious operation and maintenance of facilities over the long term.
- The prior disposition of financial and psychological dependence upon the state is supplanted by a more equitable sense of partnership between communities and governing institutions.
- Communities develop greater confidence in their collective capacity to take consequential financial decisions, grounded in a thorough understanding of the likely outcomes of such decisions.

These arguments are not disputed here, and in any event the factors cited above resist meaningful quantification. However, such a policy effectively forecloses the exercise of individual choice. The critical element in bringing about substantive change lies in a shift in prevailing attitudes towards financing. Instead of persisting with a model premised on the provision of a subsidised low level water supply, policymakers would do well to consider a framework that guarantees an improved baseline of service to all whilst enabling those willing to pay more to access a higher standard of provision.

Conclusion

This study has examined the demand for drinking water through a revealed preference framework applied to a stratified sample of 490 households across villages with and without piped

water supply. By treating demand as encompassing both the capacity and the willingness to pay, it has been possible to identify the principal determinants of water source choice and to derive a monetary value for the time costs borne by water-collecting households. The findings demonstrate that rural populations are already behaving as rational economic agents in their approach to water, travelling significant distances to access safe sources and showing a measurable willingness to pay for proximity and reliability. Far from confirming the paternalistic assumption that rural communities require free provision because they are unable to pay, the evidence points towards a population whose preferences and constraints are sufficiently well-defined to sustain a more differentiated service framework.

The significance of female education as a determinant of safe water preference, and the non-significance of household income in settlements without piped supply, together suggest that public awareness and gender-sensitive programming may yield returns comparable to or greater than those from purely price-based interventions. Where piped supply is available, however, income becomes a significant factor, confirming that economic standing shapes the capacity of households to translate their preferences into effective demand. These results align with more recent experimental evidence from rural India, which finds that revealed willingness to pay for treated water delivery is substantially higher than prior indirect estimates would suggest, and that demand is robust even at moderate prices (Cameron et al., 2023; Kremer et al., 2025). The convergence of this study's findings with subsequent scholarship conducted in varied regional and methodological settings lends confidence to their generalisability.

The policy implications are clear. India's rural water supply programme, despite its remarkable scale, remains anchored in a supply-driven paradigm that is poorly equipped to detect or respond to the nuanced preferences revealed here. The Jal Jeevan Mission has made substantial progress in extending household tap connections across the country, with approximately 75 per cent of rural households connected as of early 2024 (Government of India, 2024), yet questions of financial sustainability and service quality remain pressing. The evidence presented here supports the case for a tiered service framework of the kind advocated in the synthesis literature: a guaranteed minimum standard of provision for all, funded through public resources on equity grounds, combined with the option of enhanced service levels for those willing and able to pay. Such a framework would respect both the normative commitment of the New Delhi Declaration and the economic realities that this study has documented. Continued adherence to a one-size-fits-all approach risks perpetuating a mismatch between what government systems supply and what rural communities genuinely demand.

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