Working Paper: Exploring different models of electricity distribution system management.

The Performance of Community-Based Versus Utility Model-Based Electricity Distribution Systems in rural Nepal

This paper provides sight of early results from research in Nepal looking at two different management models for rural electricity distribution systems. The authors summarise learning to date on the general performance of the two models in practice based on comparative studies across 4 districts. The research will eventually include an assessment of the impact of these two different approaches on the establishment and growth of economic enterprises.

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Exploring different models of electricity distribution system management: The Performance of Community-Based Versus Utility Model-Based Electricity Distribution Systems in rural Nepal

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Abstract

This paper is a part of an ongoing study carried out by Winrock International (supported by the Energy and Economic Growth (EEG) programme under Oxford Policy Management, funded by UKAid) that proposes to examine the impact of two different systems of electricity distribution on the growth of economic enterprises in Nepal. This working paper summarises early findings, mostly focussing on the general performance of distribution systems under the two management approaches. The study has adopted a comparative analysis framework. A total of five geographic areas were selected, and in each area two sites were then selected – one involving a traditional utility managed distribution system and one a community-managed system. Similar sites were selected by using criteria that included: location, number of households, years of system operation, access to market, operational model, access to revolving fund, and whether the system was agency-supported.

The early results show that community-based management systems are more responsive to consumers' needs than the traditional utility model, are quicker to issue new connections, and suffer less from electricity theft. Community managed systems are not entirely independent and still have to rely on the utility for major repairs or the provision of three-phase meters. Utility managed models have been more effective at promoting energy efficiency measures such as compact fluorescent lightbulbs through a nation-wide campaign.

Introduction

Electricity distribution systems play an important role in reaching consumers with the electricity generated by power developers. Distribution systems are major contributors to a functioning power sector. Power developers will be encouraged to invest in electricity development only if the distribution systems function well. An inefficient power distribution system will lead to high technical and non-technical power losses, resulting in a high price of electricity for consumers.

The Nepal Electricity Authority is a quasi-governmental utility and is responsible for the generation, transmission, distribution, and sale of electricity in the country. There are however two institutional models in use in Nepal to manage distribution systems (the localised sections of the grid between transmission lines and the consumer). One is where the Nepal Electricity Authority's Distribution and Consumers Service (NEA-DCS) manages distribution to consumers directly and the other is where Community Rural Electrification Entities (CREEs) are used.

This paper is a part of an ongoing study carried out by Winrock International (supported by the Energy and Economic Growth (EEG) programme under Oxford Policy Management, funded by UKAid) that proposes to examine the impact of these two different systems of electricity distribution on the growth of economic enterprises in Nepal. The study seeks to answer three main questions: a) what differences are there, if any, in the number of enterprises enabled to start up or expand by access to electricity between areas electrified by CREEs vs by NEA-DCS; b) what differences are there, if any, in the types and sizes of enterprises enabled by access to electricity between CREE-supplied and NEA-DCS-supplied areas. as well as in their ownership and management; and c) which factors might be responsible for any documented differences in either the quantity or quality of enterprises enabled by access to electricity through the two modalities. The study, so far, has collected data from four of its five intended focus districts, and this paper has been produced to provide a review of progress to date on the study, and to showcase some early results.

While the research has not yet collected sufficient data to be able to answer the above questions concerning the establishment of new enterprises, it has been able to uncover some initial findings on differences in the general performance of distribution systems run directly by NEA-DCS compared to those run by CREEs. This paper therefore highlights the progress of these two forms of electricity distribution system in Nepal, describes the methodology adopted by the study, and presents some preliminary findings on the different advantages and disadvantages of the two management systems.

Problem statement – Electrification in Nepal

In Nepal, the development of energy policies started with the fifth plan (1975–1980), when the Government realised the need to lower dependency on biomass and fossil fuel and increase the supply of renewable energy sources, including hydropower (Adhikari et al., 2014). The NEA was established in 1985 under the Nepal Electricity Authority Act (1984) by merging the Department of Electricity (under the Ministry of Water Resources), the Nepal Electricity Corporation, and other related development boards, with the objective of generating, transmitting, and distributing adequate, reliable, and affordable power. The NEA was established to make appropriate arrangements to supply power as regards generating, transmitting, and distributing efficient and reliable electricity. In 2003, NEA framed the Community Electrification Distribution By-Laws to reduce electricity theft and lower operational costs for NEA in the administration of rural electrification through community participation. As noted in the introduction, NEA distributes electricity in two ways: either directly through its own Distribution and Consumer Services (NEA-DCS) offices or via CREEs. Figure 1 shows the breakdown of customers / connections (blue bars) and

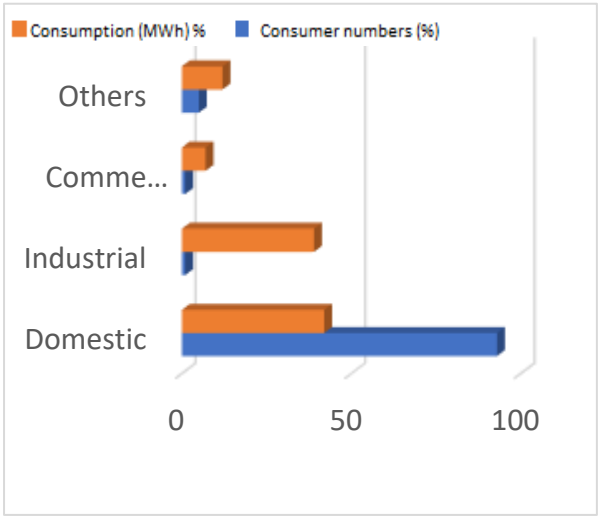

Figure 1:Sector-wise electricity consumption (source: NEA, 2019)

electricity consumption (orange bars) across four sectors (domestic, industrial, commercial and other) (NEA, 2019). Almost 94% of NEA customers are domestic consumers, while only 2% use electricity for industrial or commercial production. The remaining 4% of electricity consumed is used in irrigation and other non-commercial sectors. Domestic use is largely restricted to lighting and running household electric appliances like televisions, radios, refrigerators etc. The overall consumption (Megawatt hours (MWh)) by the domestic sector is roughly equal to the much smaller number of industrial consumers, at around 40%. Given Nepal aims to generate 5,000 MW of electricity in the next few years, there is huge scope for expansion of electricity-based enterprises in Nepal in the near future.

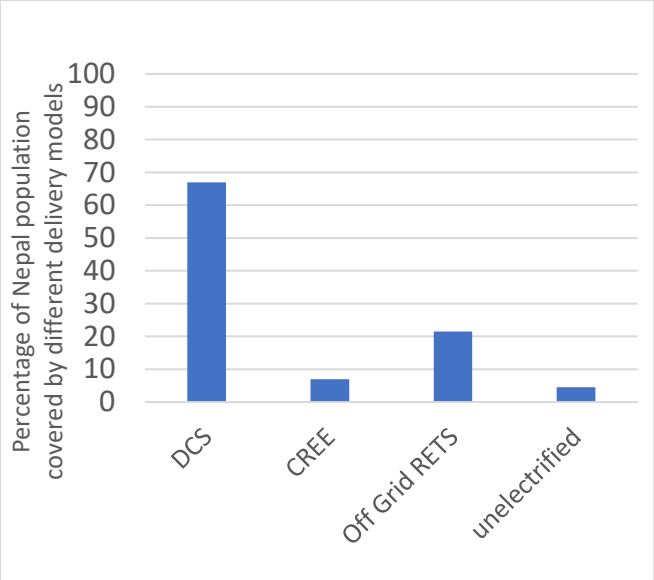

Figure 2: Electrification coverage % in Nepal

CREEs are legally formed electricity distributing entities registered by community-based organisations at the district level. They are responsible for rural electrification and operation and the maintenance of distribution systems under the NEA Community Electricity By-Laws 2003. A CREE has to submit an official request to the Community Rural Electrification Department (CRED), which sits under NEA. Upon receipt of a request, CRED initiates a survey and estimates cost. In some cases, existing distribution systems are handed over to be managed by CREEs. However, most CREEs come into being as a result of new grid expansions. In such cases, CRED installs step-down transformers and the entire distribution system, and then any subsequent replacement and maintenance required has to be carried out by the CREE itself. The household connections are entirely implemented by the CREE. However, NEA-DCS offices are engaged in technical monitoring and provides technical training to CREE staff.

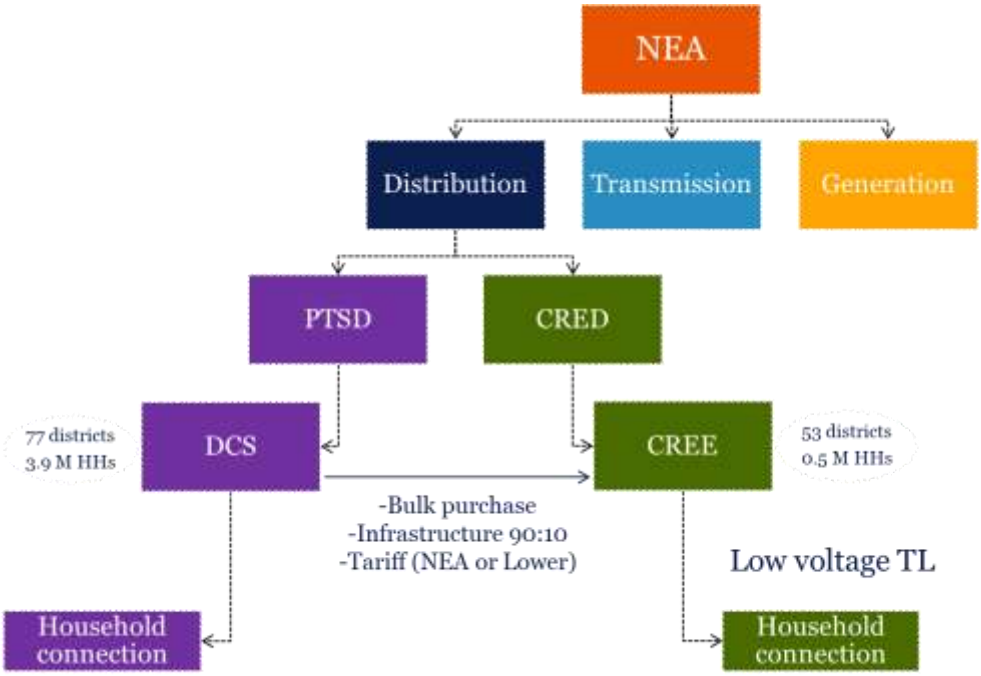

Figure 3: Grid electricity distribution model in Nepal

*PTSD = Planning and Technical Services department,

A CREE must deposit a 10% share of the total budgeted costs prior to work starting, although there is provision for establishing revolving funds for the CREEs in hilly/difficult terrain where communities would otherwise not be able to find the 10% deposit. After deposition, 90% of the remaining cost is released by the Government as a subsidy. Once the distribution system is in place, the CREE purchases bulk electricity from NEA at a reduced rate and then sells electricity to consumers at or below NEA national consumer tariffs. NEA remains responsible for any transmission losses. An electricity meter is installed at the entry point of the system to the community. Both the CREE and NEA conduct monthly meter readings. The bulk electricity consumption is then invoiced by NEA to the CREE. The CREE can decide on the tariffs for its customers but is not allowed to charge any higher than the regular NEA consumer tariffs.

CREEs are expected to cover all management, repair, and maintenance costs from the net income (retail price minus bulk price) generated from selling electricity. At present, most CREEs charge the same tariff as that charged by NEA-DCS. Repairs and maintenance work are carried out by CREEs themselves. The repair and maintenance activities are carried out on a needs-based and periodic manner, as per NEA standards. Only a few CREEs have appointed electrical engineers, with the rest using certified and trained technicians (sub-engineers) for repair and maintenance.

Methodology

The study has adopted a comparative analysis framework. A total of five CREEs were selected based on location (hill/Terai), number of households (upper and lower range as a proxy for the transformer size serving the community), years of operation (more than five years), access to market (less than two hours' walking distance), operational model (non-governmental organisation/cooperative), access to revolving fund (yes/no), and agency-supported (yes/no). Similarly, sampling of NEA-DCS localities close to the selected CREE locations has been carried out for the study. Where more than one NEA-DCS-served community existed in the vicinity of a selected CREE community, the NEA-DCS-served community that was closest to the CREE-served community in terms of size, culture, and economy was selected. The study has compiled both qualitative and quantitative information on access to and the quality of electricity in both CREE-served and NEA-DCS-served communities. It is also continuing to collect information in CREE and NEA-DCS locations on the number of new enterprises, the expansion of older enterprises, and new jobs created, along with information on the availability and quality of complementary inputs like credit, management services, market development initiatives, and roads/transportation facilities. Both the quantitative and qualitative data were collected by questionnaire survey, focus group discussion, key informant interviews, field observations, a literature study, and secondary data collection.

Table 1: Selection of CREEs based on criteria and adjoining NEA-DCS area

District	CREE Name	CREE location	HHs	Type	Operation since Year (A.D.)	Revolving fund	Nearest Market	Agency Support	DCS Name	DCS location
Rupandehi	Pragatinagar	Butwal 11	900	Co-operative	2006	No	Highway market 1 km	ENERGIA/ HIVOS, Give2Asia	Butwal	Devinagar, Butwal 11
Syangja	Samudayik Gramin Urja	Biruwa 1	1200	Co-operative	2007	Yes	Local market Biruwa	GIZ/ Endev	Syangja	Bhirkot 3
Tanahu	Ekikrit Samudayik Bidhut	Bhimad 9	1200	NGO	2007	Yes	Market Bhimad	ENERGIA/ HIVOS	Lekhnath	Bhimad 8
Dhading	Amilichhap Samudayik Bikash	Siddalek 7	1500	NGO	2007	No	Butwal	NA	Dhading	Siddhalek
Parsa	Gadi Bhidut Upabhokta	Paterwa Sugauli 2	700	NGO	2007	Yes	Rangpur Tadi Bazar	NA	Birgunj	Paterwa Sugauli 4

At the time of writing this paper, data collection had been completed for four districts (Butwal, Dhading, Tanahu, and Parsa – shown as blue dots on the map in Figure 4) only. Survey work in the fifth district (Syangya, the red dot in Figure 4) has yet to be started, so any findings in this paper are based on the first four districts only.

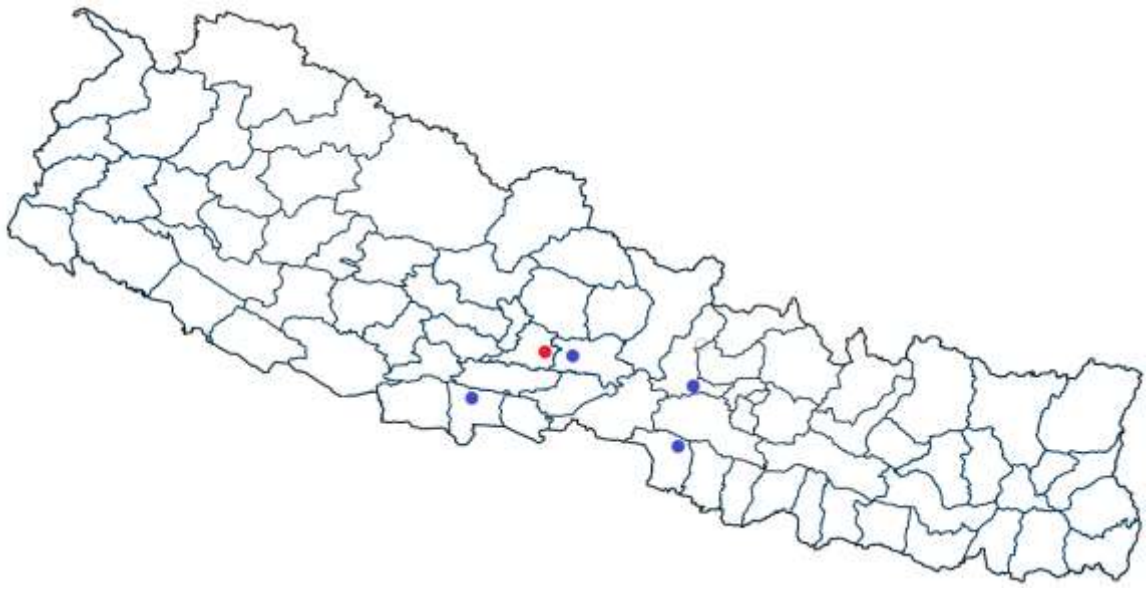

Figure 4: Study area

Results

Service levels found in CREE-supplied and NEA-DCS-supplied villages

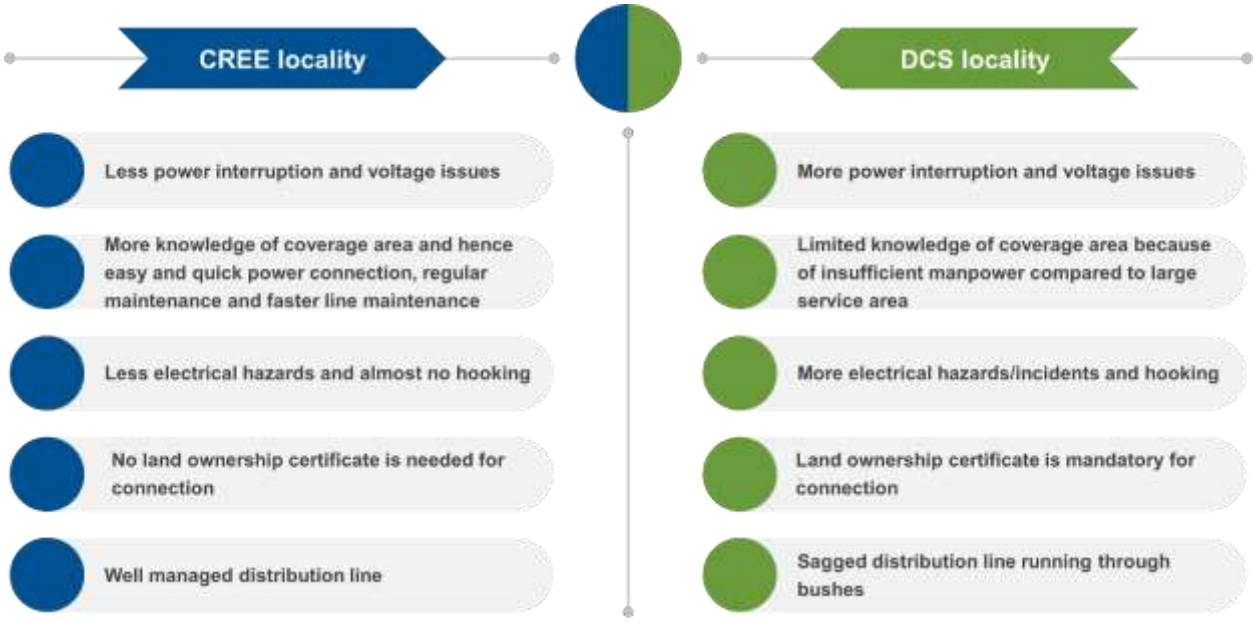

Figure 5: Services in CREE and NEA-DCS localities

Among the four study areas, CREEs seem to provide better services in terms of easy and quick power connection, regular patrolling, preventive maintenance (bush-cutting, replacing insulators, etc.), and timely repair and maintenance, compared to NEA-DCS, with the exception of Ekikrit CREE. This may be because CREEs have to cover just their local community, while NEA-DCS offices each have to cover much larger areas. Due to the small operational areas and the community ownership structure, CREEs are more active and tend to possess more detailed information on their coverage area. In contrast, there seems to be no direct communication/relationship between NEA-DCS staff and consumers in the NEA-DCS coverage areas, due to limited number of personnel relative to their large coverage areas.

Figure 6: Cable hooking at Paterwa Sugauli – 4

'Hooking' – the practice of attaching wires to the distribution system cables to steal power – is also seen as much less of a problem in CREE localities than NEA-DCS ones, with cases of hooking observed in Paterwa Sugauli during field visits. A longer and more bureaucratic procedure for getting an electricity connection from the NEA-DCS, the absence of local monitoring or sense of ownership, and unavailability of agricultural meters all contribute to the presence of cable hooking in NEA-DCS areas.

Although electricity connection processes are broadly similar for CREE and NEA-DCS, one difference that emerged in the study was that, to get a NEA-DCS connection, it is mandatory for prospective consumers to submit a copy of their land ownership documents, while for a connection in a CREE area this is not the case. An example of a case where this NEA-DCS requirement posed a challenge for consumers was in Pragatinagar village in Rupandehi District, which is a squatter settlement where none of the households possess land ownership documents. In absence of land ownership documents, NEA never scheduled the community to receive electricity access, despite it being next to a NEA-DCS-served locality (Devinagar), and the settlers were compelled to live in the dark. However, once a CREE was established in Pragatinagar in 2006, it was able to start electrification of the village, which transformed the lives and livelihoods of community residents. Many started to enjoy light at night and to operate electrical appliances, and some started enterprises. Unlike NEA-DCS offices, a CREE can provide an electricity connection upon submission of any utility bill. Moreover, the study found that CREE staff are able to provide necessary support during the application process for a connection, such as preparing documents and filling application forms.

CREEs are generally only able to provide single-phase meters for household and small business connections, as procuring three-phase meters from NEA is a lengthy process. Due to the lack of three-phase meters, some of the CREE commercial customers use two domestic meters (single-phase) to run their enterprises, as a single supply meter could not cope with the demand of the appliances used. Since regulations do not allow a customer to be issued with more than one meter, the study found that some consumers apply for an extra meter in the name of their relatives. This was particularly seen in Pragatinagar CREE.

That CREEs still have to rely on NEA-DCS for some issues can cause problems. CREEs rely on NEA to resolve issues arising at substations, which can mean delays to repair and maintenance from NEA's side, hampering CREEs' services. Likewise, transformers in CREEs have to be repaired by NEA-DCS, with the CREE having to bear the costs of transporting the transformer to the NEA-DCS office, which can be expensive. Ekikrit CREE had to bear a huge financial burden due to frequent damage to transformers over the last year from lightning strikes, with three transformers each having to be repaired twice in a single year.

With regard to safety issues, in some NEA-DCS localities, transformers were found to be installed in inappropriate locations, posing a high risk from bare conductors. Meanwhile, Samudayik and Pragatinagar CREEs were found to have sensitised consumers to the risks of electric fire hazards, either during the initial phase of their establishment or through technicians while collecting dues. NEA-DCS does not conduct such awareness programmes regularly, but they were found to hand out brochures on electric hazards published by NEA at the national level. NEA celebrates 'Electrical Safety Day' once a year, but this activity is mainly targeted at NEA staff and is not intended for customers. Although safety officers are appointed in each NEA-DCS office, fewer cases of electric accidents were reported in CREE localities than in NEA-DCS ones.

Consumers from NEA-DCS-supplied and CREE-supplied areas were both found to possess a basic knowledge of energy efficiency, being aware for example that compact fluorescent lightbulbs (CFLs) consume less power than incandescent lamps, and thus being interested in using them. NEA-DCS encourages its consumers to use LED and CFL lights as part of NEA's nationwide awareness campaign to promote efficient electric bulbs, via audio-visual and print media. Although CREEs do not have their own awareness programmes, their consumers have also benefited from NEA's national programme, gaining knowledge about efficient electric bulbs. Neither NEA-DCS nor CREEs were found to support enterprises to use energy-efficient equipment and appliances.

Finally, considering bill payment arrangements, in CREEs, consumers can pay their electricity bill during the meter reading or at the office counter, which is within their locality, so consumers do not have to travel far. By contrast, the bill payment process for NEA-DCS supplies is tedious. Although NEA-DCS has introduced an e-payment system, most of the NEA-DCS consumers in the study area are unfamiliar with that process and therefore have to visit the nearest NEA-DCS counter, which may be some distance away, which can involve

time-consuming travel. For example, NEA-DCS consumers in Bhimad have to walk 1.5 hours to reach the NEA-DCS office to pay a bill. This walking time extends to two hours for Siddhalek and three hours for Bhirkot. Where road transport is available, the travel distance can still be significant – while consumers in Devinagar can reach their NEA-DCS office within 15 minutes via vehicle transport, it takes up to 1.5 hours for the people at Paterwa to reach their NEA-DCS office via transport.

Gender and social inclusion

Both NEA-DCS and CREE utilities were found to have made only limited efforts to prioritise gender and social inclusion issues. CREE areas seemed to generally practise good governance in maintaining a gender balance within their executive committees. NEA-DCS, being a government organisation, has to follow government policies, including on social inclusion, by default. One example of this is that all NEA-DCSs provide free meters to deprived households (mainly Dalits). Aside from these limited actions, however, no special programmes were found to be implemented by either NEA-DCS or CREE areas for women, or deprived and marginalised people.

Access to reliable electricity

Scheduled power cuts (load shedding) no longer take place in Nepal, so neither NEA-DCS nor CREE areas were found by the study to experience load shedding. The study did find, however, that frequent unplanned power interruptions and problems of voltage drop were occurring in both NEA-DCS and CREE localities. Figure 7 shows the average weekly number of power interruptions. Generally, power interruptions are high during adverse weather conditions, such as storms and heavy rain with lightning. Interruptions and voltage drops are more frequent in NEA-DCS localities, which is mainly due to overloaded distribution lines and high loading in urban areas like Devinagar. Transmission line repair and maintenance is an additional reason for interruptions and was found to be less of a problem in CREE areas compared to NEA-DCS ones.

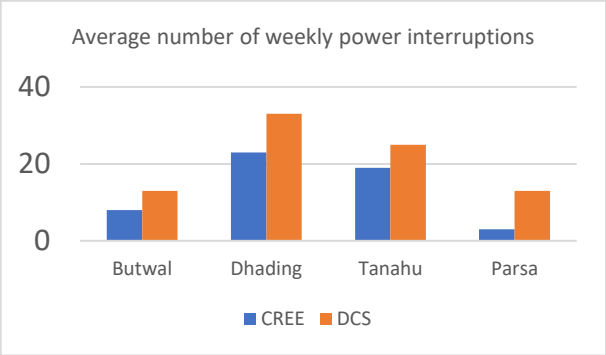

Figure 7: Average number of weekly power interruptions

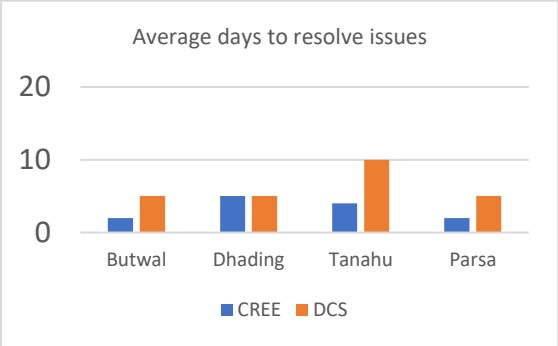

Figure 8: Average time to resolve issues

Figure 8 presents the average time taken to resolve problems in electricity supply and distribution. The average days taken to resolve issues for minor faults is lower in CREE areas because of the presence of local technicians. That said, due to a lack of skilled electricians, it often takes a few days for local technicians to identify faults, meaning the time taken to resolve issues is lengthened. Overall, though, for rural NEA-DCS areas, the average time taken to resolve issues even for minor faults is higher than for CREE areas, mainly due to the fact that the technicians working for NEA-DCS offices have to serve larger areas and are often located in the city centres, far from the rural villages.

Availability of financing

Out of the five CREEs studied, two (Samudayik and Pragatinagar) are operating a cooperative model and both are financially strong. Samudayik Urja is operating as a savings and credit cooperative and provides loans to its members at different interest rates for different purposes, such as agriculture, education, enterprise development, and hire purchase. Agriculture loans have lower interest rates compared to other types of loans. Pragatinagar CREE does not provide a credit service to its consumers, mainly because they do not have land ownership certificates, which would provide necessary collateral against any loan. Under the Samudayik Savings and Credit Cooperative Limited, the Samudayik CREE at Biruwa has been providing loans to its customers for agriculture, enterprise development, education, and hire purchase. All the CREEs except Ekikrit were reported to be financially stable. Samudayik, Pragatinagar and Gadi CREEs have made some savings. Samudayik and Pragatinagar CREEs have also built their own offices. The Gadi CREE in Parsa is fulfilling its social responsibilities by providing electricity to a birthing centre, running an ambulance service, which is free for maternity cases, and supporting a community school. Since there are lots of issues relating to low voltage and electricity interruption, the consumers of Ekikrit CREE do not pay their electricity bills regularly, which often leads to delayed payment of the electricity bill to NEA.

The National Association of Community Electricity Users Nepal (NACEUN) has a partnership with NIC Asia Bank and this allows CREEs to recommend their consumers to NIC Asia for loans for electricity-based enterprises or agricultural loans. There are a number of other financial institutions in both NEA-DCS and CREE localities, but they do not have any special schemes for electricity users and do not work directly with NEA-DCS and CREEs. In addition, cooperative-model CREEs provide shares to their consumers, with the electricity connection charge paid by the consumers converted into shares, which is an interesting initiative. Each member household in the Samudayik CREE is provided with four share certificates. By keeping one share certificate as a guarantee, the household can take a loan up to 20,000 Nepalese rupees without paying any interest.

Conclusion

This study reviewed the performance of two different systems of electricity distribution in Nepal: a community-based model (CREEs) and a more traditional model utility model (NEA-DCS). The study compared a range of key performance indicators around electricity distribution in five selected CREE and NEA-DCS areas. The preliminary findings of the study are as follows.

- Community-based (CREE) management systems are more responsive to consumers' needs than the traditional utility model (NEA-DCS). For example: CREEs provide a quicker service in terms of restoring faults, managing distribution wires etc.
- CREEs are also more effective in reducing cable hooking and electricity theft.
- CREEs are quicker to provide electricity connections to new consumers than NEA-DCS.
- Neither CREEs nor NEA-DCS management systems give special consideration to gender and social inclusion issues.
- CREEs are dependent on the NEA-DCS in regard to issues such as providing three-phase meters, repairing transformers, and resolving major faults etc.
- NEA-DCSs are mainly focused on electrifying new areas and, due to a shortage of manpower and the concentration of offices in cities, have not been able to provide prompt services to customers.
- NEA-DCSs have, on the other hand, made more effort to promote energy-efficient bulbs through NEA's nationwide campaign.

In conclusion, both CREEs and NEA-DCS have their strengths and weaknesses. While the community-based distribution systems (CREEs) seem more service-oriented and much more responsive to the needs of their customers, they lack the technical strength and investment capacity of the government utility. An ideal electricity distribution system should incorporate the strengths of both of these systems. One such model could be a more decentralised government utility with more community representation. Under the current arrangements, it may also be prudent to give CREEs more flexibility in the pricing of electricity, to help them to improve their financial strength, and to help them build their technical strength.

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