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The future of hydropower development in Nepal: Views from the private sector

Christopher Schulz [a] * and Udisha Saklani [a]

[a] Department of Geography, University of Cambridge, Downing Place, Cambridge CB2 3EN, United Kingdom

* corresponding author at: cs998@cam.ac.uk

Highlights

- First detailed study on private sector views on hydropower development in Nepal
- Identifies three viewpoints on priorities for accelerating hydropower development
- Reforming Nepal's national hydropower policy and administration (viewpoint 1)
- Mobilising diverse funds for private hydropower development (viewpoint 2)
- Integrating South Asia's energy grids, beginning with India (viewpoint 3)

Abstract

Private sector actors are taking on an increasingly prominent role in energy transitions, including in hydropower development and finance. Yet, there is little empirical research on the topic. This study covers private sector views on accelerating hydropower investment in Nepal, using Q methodology. Three main viewpoints were identified among 17 interviewed hydropower developers, planners, and investors based in Nepal: 1) Efforts need to be focused on reforming hydropower policies and administration at the national level; 2) Funds for hydropower development need to be increased and sought from a diversity of domestic and foreign private sources; 3) Nepal needs to integrate its energy grid with its South Asian neighbours, starting with India. Areas of strong disagreement include the role of political stability in enabling hydropower development, as well as modes of engagement with Indian, Chinese, and Western partners. Areas of consensus include the need to smoothen land acquisition procedures as well as discomfort with the state-owned Nepal Electricity Authority's perceived monopolistic status in the sector. Overall, this study contributes to debates on private sector involvement in hydropower development with a nuanced empirical assessment of views which contain clear visions for an independent and domestically driven future of the country's hydropower sector.

Keywords

dam finance; energy transitions; hydropower development; Nepal; renewable energy; Q methodology

1 Introduction

Hydropower development in the 21st century is becoming ever more complex, with investors and developers from the private sector taking on an increasingly prominent role in realising projects [1–3]. After a lull that began in the early 2000s, there is resurgent interest in hydropower dams around the world, often within a climate change mitigation and adaptation discourse [4–7]. While many countries in North America and Europe are shifting towards dam decommissioning for economic and ecological reasons [8–10], Africa, Asia, Latin America, and the Balkans continue to see increasing investment in

dams, primarily for hydroelectric power production [11]. Some have argued that such investment in renewable energy technologies may contribute to meeting the United Nations' Sustainable Development Goals, specifically, on ensuring access to affordable, reliable, sustainable and modern energy (goal no. 7) [12,13]. The increasing role of the private sector therein is in line with broader trends in global development. Calls for more private sector leadership in progress towards global development targets have intensified in recent years [14], with private and 'blended finance' being promoted as sources of development funding [15–17].

Questions around the speed and shape of societal shifts towards renewable energy sources, including hydropower, have been explored in the novel field of energy transitions research. Such research seeks to identify the social, economic, political, technological, and environmental factors that enable, accelerate or obstruct energy transitions [18–21]. Many studies on energy transitions have focused on the role of public policy and the regulatory context in particular [21–24], to understand how governments can incentivise the adoption of renewable energy technologies. In contrast to that, Miller et al. [20] have highlighted the importance of individual and societal choices in shaping energy transitions, including those of business managers. They suggest that governments alone cannot achieve widespread adoption of renewable energy technologies. For a transition to happen, relevant stakeholders need to share visions for the future [24], and key decision-makers from private and public sectors need to collaborate [18,25]. Further research in the field has stressed the need to investigate energy transitions in emerging economies, which may be faster at moving towards new energy sources than countries with developed economies ([19], but see [26]), as well as to investigate locally specific conditions that may explain a country's pathway towards renewable energy [27].

Mountainous and landlocked Nepal makes an especially interesting case study for investigating the factors that enable, accelerate, or obstruct energy transitions. Described by some as an ever-aspiring "hydropower nation" [28,29] possessing "liquid gold" [30] (p.9) that would be to the country "what oil is to the gulf" [31] (p.109), Nepal has thus far failed to fully realise its considerable hydropower potential. The theoretical potential is often estimated at 83,000 MW [32], the economically feasible capacity may reach 43,000 MW [33], yet currently installed capacity stands at only 1,129 MW [34], even though plans to expand it have existed for many decades (see e.g. [35]). Many commentators have sought to interpret this discrepancy [32,36–45], which until recently contrasted sharply with power cuts of up to 12 hours per day [46]. While power cuts associated with load shedding are no longer necessary due to electricity imports from India [34], most policy-makers and stakeholder groups in Nepal would favour developing the country's hydropower sector (cf. [47]), both for domestic consumption and export to neighbouring countries. Unusually, this has included civil society representatives and critical scholars, who have advocated for economically, socially, and environmentally sound dam planning and construction to make hydropower development more sustainable and increase its benefits to local people [48–51], going against global trends, under which the construction of new dams has become increasingly contentious [5,52,53].

Specifically with regard to Nepal's energy sector, the private sector has emerged as a significant group of stakeholders. Under the umbrella of the Independent Power Producers' Association, Nepal (IPPAN)[1], a private sector professional association, which comprises some of Nepal's most reputed independent hydropower developers, independent power producers (IPPs) perform several important roles including conducting research and development, and engaging in advocacy at various levels to educate Nepali policy makers, bureaucrats, and the wider public to catalyse hydropower investment in Nepal [54]. Many domestic hydropower developers in Nepal have actively lobbied for new laws, guidelines, and regulations on behalf of the domestic and foreign private sector, and continue to actively participate in the drafting and discussions of new energy and infrastructure policies. Additionally, private sector capital has played a huge role in expediting Nepal's trajectory towards greater energy generation. Despite their relevance in hydropower development globally [1–3], private sector views remain particularly understudied.

[1] See IPPAN's website for details: www.ippan.org.np/ (last accessed June 2021).

This study presents an investigation of the views of private sector actors on the direction of Nepal's national hydropower sector. It has a particular focus on the conditions that they identify as the most relevant towards enabling private investment in Nepal's hydropower, recognising that they are (a) diverse actors, and (b) will promote their own interests in ways that are not necessarily congruent with those of other actors. To this end, a Q methodological approach is employed [55–57]. This empirical research method, which has both quantitative and qualitative components, allows identifying diverse viewpoints on a given topic within a pool of study participants with similar profiles [57]. It is often used to explore stakeholder views on environmental management challenges, including attitudes towards hydroelectric power and dams [58–62], particularly, where there is a strong degree of uncertainty and diversity of views.

The contribution of this paper is primarily empirical. It presents findings from the first detailed study of private sector views on hydropower development in Nepal, responding to the shift towards private-sector led global development in recent years [1–3,14–17], as well as the theoretical demands made in the energy transitions literature to explore visions, preferences, and beliefs of different stakeholder groups and key decision-makers [18,20,24,25] within country-specific scenarios [19,22,27]. A specific focus on private sector views allows exploring this topic with greater depth and clarity than a study on stakeholder views in general (e.g. including government officials, academics, or civil society representatives). The study thus complements previous research on the topic, which might have had a broader focus (see, e.g., [36–45]), describing a perspective that has thus far been missing in the academic literature. Moreover, an exclusive focus on private sector actors is helpful to understand the diversity of perspectives within this sector. Despite the common assumption of shared interests within the private sector, this study helps to understand the multiple and diverse potential pathways towards future hydropower development in Nepal.

2 Hydropower development in Nepal

Many different reasons have been cited for the relatively slow growth of Nepal's hydropower capacity over the years. These include: political instability [29,38,43,45,63,64], with the country having had an 11-year civil war from 1996 to 2006, and 25 different governments since 1990 [41]; lack of financial capital [33,36,37,45,63,64]; lack of technological and administrative know-how [36,39,45,64]; limited trust and cooperation with India, but strong dependence on India for exporting surplus hydropower [31,37,40,43,65–69]; strong seasonality of supply and higher production costs as compared to neighbouring countries [38,40,42,63]; poor planning and coordination between various government agencies [32,41,42,44,69–71]; lack of investor interest and public support for hydropower exports due to unmet domestic demand [40,41,63]; corruption [42,45]; conflictual relationships between the hydropower sector and local communities [29,41,49,51,64,72]; lack of investment and poor maintenance of transmission and distribution systems [37,41,42]; and insufficient domestic demand potential, including by energy-intensive industries [33,73].

Further (technological) difficulties arise from poor rock quality and an unstable geology [74], seismic activity [1,75], as well as the very high sediment loads in Nepal's rivers, which may impact the functionality of turbines, reduce storage capacity, increase maintenance costs, and shorten the lifetime of dams [1,43,45]. Climate change may pose a risk to the functionality of many hydroelectric power projects in the country in the future [1,76–78], although it has also been identified as a potential driver of hydropower development in Nepal given the opportunity to reduce greenhouse gas emissions from fossil fuels, including in the transport sector [73,79–82].

In the past few decades, many plans for hydropower dams, including a small number of large storage dams, have not materialised. Nevertheless, as Nepal has entered a more politically stable period, there is a renewed wave of optimism that dams will eventually be built, and the country will become a net exporter of hydroelectric energy. One symbolic case is the Arun III dam in Eastern Nepal, which was abandoned by the World Bank in the 1990s following extensive political debate and controversies between supporters and opponents inside the country [50,83,84]. The project has now been taken up by

an Indian public sector company, and is due to be completed in the coming years [69]. Another noteworthy development is the growing private sector share in Nepali hydropower [50]; the latest data suggest that Independent Power Producers (IPPs) contributed 29% of Nepal's electrical energy, whereas 37.25% was imported from India and 33.75% was produced by the state-owned Nepal Electricity Authority [34]. A large number of hydropower licences have also been handed out to private developers, although their seriousness is sometimes questioned [45].

Within this context of renewed optimism, it is worth asking: will this time be different? Will Nepal's hydroelectric energy future finally materialise, after having been part of the national imaginary for so long [29,48]? Not long ago, the challenges facing Nepal's electricity sector were summarised as "daunting", "overwhelming, and dire" [45] (p.518). Yet even critical commentators acknowledge that hydropower may have a role to play in the development of the country [1], although some may prefer a focus on the small, mini- and micro-hydropower sectors, particularly when it comes to supplying remote rural communities [39,85,86].

3 Materials and methods

Q methodology is a quali-quantitative method that was developed as an alternative to conventional, large-N statistical approaches [56] and is often used to explore subjective views [55,57]. It requires a pool of respondents with a relatively similar (e.g., professional) profile who are asked to give their opinion and rank a set of pre-formulated statements on a given topic. The ranking of statements is constrained by a grid (see Figure 1), which means that every respondent is forced to choose, for example, their two top priorities among a large number of statements (further details below). Opinions and rankings are then compared, and the use of factor analytical techniques allows the extraction of several common viewpoints among responses. In this sense, the method helps understand areas of consensus and disagreement among respondents, as well as relative importance of individual issues within a broader topic.

The present Q study, is based on interviews with 17 Nepali hydropower developers, planners, and investment specialists from the private sector in Kathmandu, Nepal, in January 2020. They included founders and managing directors, chief operating officers and chief financial officers of Nepali hydropower development companies. All respondents comprised senior management and had, on average, more than 20 years of professional experience in the hydropower sector (with a range from 10 to 31 years). Their educational background varied from economics, finance and business management to civil engineering and hydraulics; the majority had a master's degree (nine respondents), two respondents had a PhD, and six had a bachelor's degree. Three respondents were affiliated with international companies with local offices in Kathmandu and had vast experience in Nepal's domestic hydropower sector. Sampling of respondents was purposive, given the niche character of the research topic. Some respondents were approached at a hydropower conference, held in Kathmandu on 21-22 November 2019.[2] Others were reached via snowballing. Respondents spoke in a personal capacity, which reflected both their experience in the hydropower business, as well as their broader concern for the economic development of Nepal.

Respondents were asked to comment on 38 statements that captured a spectrum of opinions on enabling factors for increasing hydropower investment in the country (see section 4). The statements are in part based on a review of relevant literature (see section 2) as well as on opinions voiced in presentations at the above-mentioned hydropower conference, which the authors attended. This was done to ensure that the study would take into account the most recent developments or those not covered in the academic

[2] The "*Power Summit '19: Powering the Asian Century*", organised by the Independent Power Producers' Association Nepal (IPPAN), an organisation that unites primarily private sector actors and investors (although the conference was also attended by regulators, international partners, consultants, and constructors). For details, see: https://www.powersummitnepal.com/ (last accessed July 2020).

literature. The list of statements was also refined following consultation with two senior Nepali experts in December 2019, to ensure ease of comprehension and relevance of statements to respondents.

Interviews revolved around two basic steps. First, respondents were asked to familiarise themselves with the list of statements (see section 4), printed on small cards. In this first step, they expressed agreement, disagreement, or mixed views on each individual statement. In a second step, they were asked to place statements into a predetermined pattern (see Figure 1), the so-called 'response grid', which is a standard element of Q methodological studies. In this sorting exercise, respondents were asked to rank statements according to their importance for enabling Nepal's energy transition towards hydropower. While the grid contains values from -4 to +4, the ranking of statements represents relative importance only, that is, positive or negative values do not necessarily correspond with agreement or disagreement. Throughout the interview, respondents were encouraged to comment on statements and to justify their sorting pattern. On concluding the interview, they had the opportunity to highlight any missing factors that might be relevant for understanding Nepal's energy transition. Interviews thus produced quantitative data (the individual Q sorting patterns) as well as qualitative data (associated comments made throughout the interview), which will be analysed in the following sections.

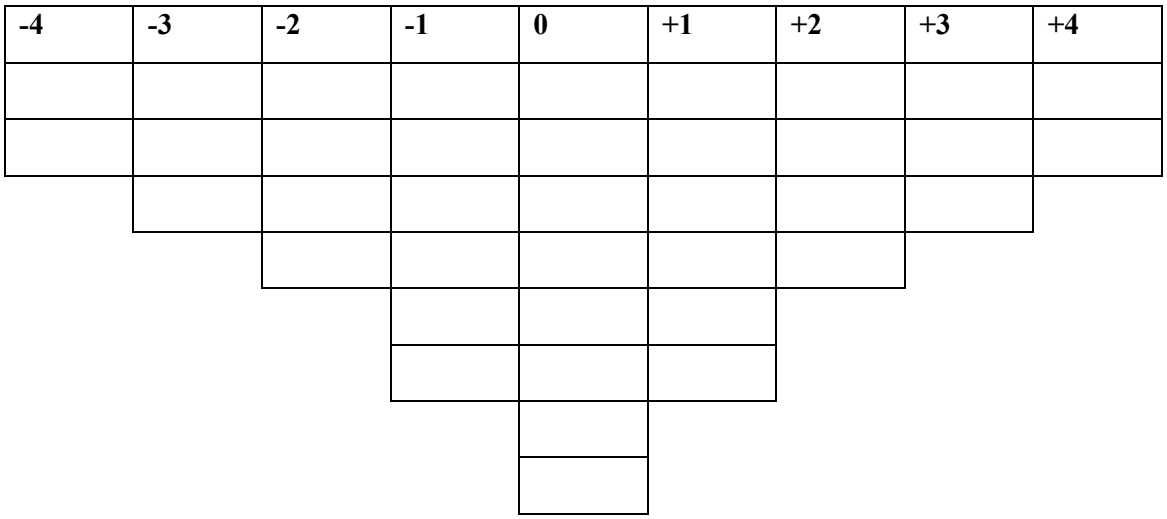

Figure 1: Response grid for Q sorting exercise

4 Results

The quantitative data for this study are the 17 Q sorts that study participants produced, each Q sort reflecting a different opinion on the importance of various factors that might enable hydropower investment in Nepal. These Q sorts were intercorrelated and subjected to a factor analysis with the help of the PQMethod software package (version 2.35, 2014).[3] Centroid factor analysis and varimax rotation were applied to the data. The three factors explained a total of 43% of the study variance. 11 Q sorts correlated exclusively with one of the three factors (significance level of $p<0.01$). These were manually flagged in PQMethod, i.e., their data was used to create the three factors described in this paper. 4 Q sorts correlated with two factors; 2 Q sorts correlated with all three factors (see Table 1).

Table 1: Rotated factor matrix; Q sorts in bold indicate a defining sort; values above 0.32 indicate significance level of $p<0.01$

Q sort	**Loadings**		
	Factor 1	**Factor 2**	**Factor 3**
1	0.1872	0.0903	**0.5855**

[3] Freely available at www.schmolck.org/qmethod (last accessed July 2020).

2	0.2645	0.3339	0.5976
3	0.4273	0.3275	0.4656
4	0.4332	0.1344	0.3821
5	0.0037	0.4986	0.4733
6	-0.1169	0.0606	**0.5209**
7	0.0987	**0.5242**	0.2530
8	**0.3914**	-0.1868	-0.1291
9	0.3340	0.4163	0.4237
10	**0.6760**	0.1192	0.1490
11	-0.0165	**0.6556**	0.1068
12	0.4391	0.4534	0.2843
13	**0.5981**	0.2400	0.2897
14	0.2734	0.1540	**0.7053**
15	0.2015	**0.4620**	0.1173
16	-0.0966	**0.6600**	0.0596
17	0.2974	**0.6324**	0.1014
% explained variance	**12**	**16**	**15**

Each factor is associated with an ideal-type response pattern in the Q sorting exercise (also known as 'factor array'). Table 2 shows these three factor arrays. The 'Q sort value' columns indicate the placement of statements in the response grid for that factor, as defined by their z-score. Q sort values in bold indicate 'distinguishing statements', that is, they were ranked differently in a factor at a level of statistical significance of $p<0.01$ (**) or $p<0.05$ (*). Statements in italics indicate 'consensus statements', that is, differences were statistically non-significant across all three factors, at a level of $p>0.01$ or $p>0.05$ (†). Correlations between factors ranged from 0.2675 (1 and 2) to 0.3053 (2 and 3) to 0.3375 (1 and 3).

Table 2: Factor arrays with z-scores for the three factors

Statement	**Factor 1**		**Factor 2**		**Factor 3**	
	Q sort value	z-score	Q sort value	z-score	Q sort value	z-score
1 Nepal needs a strategy to manage its future surplus energy.	**3**	**1.63***	**2**	**0.84***	**1**	**0.14***
2 Domestic demand for energy in Nepal needs to grow.	1	0.46	**3**	**1.50****	0	0.01
3 Neighbouring countries' demand for Nepal's hydroelectric energy needs to become more certain.	3	1.21	2	0.89	4	1.84
4 Greater awareness of the climate change mitigation benefits of dams is required.	0	-0.11	-1	-0.70	**-4**	**-1.66****
5 Social and environmental compliance issues need to be addressed.	0	0.29	-1	-0.34	-2	-0.96
6 Stronger regulatory norms are required.	*-2*	*-0.74*	*0*	*0.06*	*-1*	*-0.22*
7 Nepal's water and energy bureaucracy needs to become more efficient.	**4**	**1.78***	1	0.27	2	0.91
8 Currency risks need to be controlled to attract foreign investors.	**0**	**0.14****	4	1.98	3	1.69
9 Greater stability in India-Nepal political relations is required.	2	1.17	**0**	**-0.22****	3	1.72

10 Greater involvement of Western donors is required.	0	-0.21	**-4**	**-2.19****	1	0.32
11 Investment in cross-border transmission lines in the BBIN region is required.	**-1**	**-0.42****	3	1.77	4	1.93
12 Greater awareness regarding the benefits of multi-purpose dams is required. †	*-1*	*-0.42*	*-1*	*-0.44*	*0*	*-0.01*
13 Greater public investment in road infrastructure is required.	-1	-0.50	1	0.59	1	0.18
14 Greater financial incentives to private investors are required.	3	1.25	4	1.93	**-1**	**-0.14****
15 Electrification of Nepal's transport sector is required.	**-2**	**-0.68***	**3**	**1.17****	**1**	**0.14***
16 Local support for dams needs to grow.	*-1*	*-0.43*	*-3*	*-1.07*	*-3*	*-1.30*
17 Political will to make Nepal energy self-sufficient is required.	**2**	**1.17****	0	-0.22	-1	-0.60
18 Land acquisition processes need to be smoothened. †	*2*	*0.86*	*2*	*0.91*	*1*	*0.45*
19 The price of hydropower needs to become more competitive compared to other sources of electric energy.	*1*	*0.46*	*1*	*0.72*	*0*	*-0.10*
20 Greater involvement of Nepal's private sector in dam construction, management and operation is required.	-3	-1.42	-2	-0.81	**0**	**-0.04***
21 Greater political stability in Nepal is required.	4	1.81	**-3**	**-1.33****	2	1.30
22 More investment from India is required.	-2	-1.28	-3	-1.47	**2**	**1.10****
23 More investment from China is required.	**-4**	**-1.81****	-2	-0.72	-1	-0.32
24 Climate change risks need to be addressed.	0	0.10	1	0.40	**-3**	**-1.14****
25 Improved public-private partnerships are required. †	*0*	*0.07*	*0*	*0.10*	*0*	*-0.03*
26 The negotiations of long-term Power Purchase Agreements need to be streamlined.	1	0.60	-1	-0.39	0	-0.08
27 Competitive bidding for Power Purchase Agreements is needed.	1	0.57	**-4**	**-1.88****	1	0.24
28 Transmission charges need to be kept at a minimum. †	*-3*	*-1.39*	*-2*	*-0.79*	*-2*	*-1.12*
29 A paradigm shift from bilateral to multi-lateral energy trading is required.	0	-0.04	1	0.35	**3**	**1.34****
30 Nepal needs to invest in its human capital. †	*0*	*-0.18*	*0*	*-0.29*	*-2*	*-0.91*
31 Seasonality and variability in energy demand and supply need to be addressed.	*2*	*0.71*	*1*	*0.63*	***0***	***-0.07****
32 Scaling up of private sources of finance is required. †	*1*	*0.39*	*2*	*0.94*	*2*	*0.99*

33 The government needs to reduce subsidies for fossil fuels.	-3	-1.56	**0**	**-0.14***	-2	-1.02
34 Decentralisation of decision-making authority regarding hydropower is required.	**-4**	**-2.10***	**0**	**-0.09****	**-3**	**-1.27***
35 Improving resettlement and rehabilitation policies is required. †	*-1*	*-0.50*	*-2*	*-0.93*	*-1*	*-0.64*
36 Nepal needs to improve its water resources legislation to account for the needs of different water users.	-2	-1.00	-1	-0.60	0	0.08
37 Nepal needs to build a transmission line to China's electric grid.	*-1*	*-0.50*	*0*	*0.02*	*-1*	*-0.70*
38 Benefit-sharing arrangements with local communities need to be reformed.	**1**	**0.60****	**-1**	**-0.46****	**-4**	**-2.08****

*** indicates distinguishing statements at significance level of p<0.01; * indicates distinguishing statements at significance level of p<0.05; consensus statements at non-significance level of p>0.01 are marked in italics. Those marked with a † are also non-significant at a level of p>0.05*

4.1 Reforming Nepal's national hydropower policy and administration (Factor 1)

Factor 1 represents one of the viewpoints about the priorities for accelerating hydropower development in Nepal uncovered in the study: that is, that the country needs to concentrate its efforts on reforming hydropower policy and administration at the national level. The Q sorts of seven respondents had a statistically significant association with this factor, with three respondents scoring highly on this factor only. Factor 1 explains 12% of the study variance.

A common opinion among these respondents was that politics, bureaucracy and policy uncertainty often stand in the way of investments in hydropower as also reflected in their two top priorities (statement no. 7, 21). One managing director of an investment fund said his vision for the future was a regulatory system that works without licences, which in his view, were overly controlling and led to rent-seeking, rather than actual regulation. Another respondent commented that there are "too many things on paper, which are not executed in reality", putting off potential private investors, including those from India. One senior expert mentioned that political unrest in the past had deterred investments, since there was no access to hilly areas. Another respondent cited the recent establishment of a new national Electricity Regulatory Commission as a positive indicator that the greater political stability in recent years has already led to improvements in the regulatory context for hydropower investment.

Further highly ranked statements also suggested that reforming national hydropower policy and administration were a priority. For example, managing surplus energy (1) requires some centralised coordination, as does a strategy to make the country energy self-sufficient (17). One expert suggested that investors were waiting for Nepal's government to pass needed legislations so that investments could take place to make the country energy self-sufficient. Unusually among the sample, respondents rated the importance of reforming benefit-sharing agreements relatively highly (38), with one respondent reporting that Nepal's royalty system does not sufficiently redistribute benefits to local people. The common obstacle is the state. Another investor wished to see benefit-sharing policies simplified, to reduce overall project cost.

Respondents believed that reforms needed to take place at the national level, strongly disagreeing with the idea of further decentralisation (34). They were sceptical about the capacity of provincial governments to regulate hydropower development, proposing instead that this could be considered in the longer term, or for smaller projects of up to 20MW. Putting regional or local governments in charge of regulating large hydropower projects might lead to "complete chaos", as one respondent commented. When asked about the state of hydropower administration in Nepal, another respondent reacted to the

suggestion of involving new players in decision-making claiming: "Even with just one authority, i.e. the Department of Electricity Development, the efficiency and speed of decision-making is poor", again implying that no additional government entities should be tasked with regulating hydropower projects.

Respondents were equally vocal in their strong rejection of Chinese involvement in Nepali hydropower development (23), which went along with a sceptical attitude towards foreign investment in general (8, 11, 22, 37). The comparatively low score given to investment in cross-border transmission lines in the BBIN region particularly stands out (11).[4] These scores again illustrate a preference for focusing efforts at the national Nepali level, rather than counting on support from abroad. One respondent mentioned the lasting negative impact of Nepal's experience of an economic blockade by India in 2015, which undermined trust in Indian entities as partners.[5] Several others did not necessarily disagree with the idea of cooperating with neighbouring countries but felt that this was not the most effective strategy to bring about a faster energy transition. One developer justified his scepticism about China citing cultural and political differences, with Chinese investors not accustomed to operating in a democratic institutional environment, making them less desirable partners for Nepal.

Lastly, this group of respondents did not give high importance to the electrification of the transport sector (15). Although they were not opposed to the electrification of transport per se, the low ranking might express scepticism about the practical feasibility of achieving it, with the Nepali government having neither the capacity nor the resources to support such a massive transformation. This was expressed in a comment that at present, "even running a few electric buses in Kathmandu" was "not possible", with another respondent saying that this was a long-term process that would happen naturally as technology develops.

4.2 Mobilising funds for private hydropower development (Factor 2)

Factor 2 represents a second, common viewpoint about the priorities for accelerating hydropower development in Nepal: it is mainly concerned with how to raise funds for investment, which will then support private developers, independent of the political context. 10 Q sorts were significantly associated with this factor, 5 exclusively so. It explained 16% of the study variance.

This group expressed concern about the lack of domestic finance for hydropower investment and gave highest priority to supporting both foreign and domestic investors (8, 14), addressing currency risks, and providing additional financial incentives. One developer suggested that without foreign investment, hydropower development in Nepal was impossible, giving strong importance to hedging mechanisms to address the problem of fluctuating exchange rates (8). Another common opinion was that foreign investment should be maximised by attracting funds from many different sources.

In relation to financial incentives, developers pointed out the inflexible nature of the hydropower investment business, that is, the tariff paid to them by the Nepal Electricity Authority (NEA) is pre-determined and capped, whereas the interest rates of their loans might not be. Also, ownership of hydropower plants will pass to the state after 30 years, increasing financial risks and limiting profits, making investments less attractive. To mitigate, developers proposed more flexible terms for Power Purchase Agreements (PPAs), for example, adjustment of tariffs if interest rates increase, having electricity bought at a higher price in the initial period post-construction to aid with paying off loans, extending term periods from 30 to 50 years, or receiving subsidies for building hydropower plants with higher financial risk, to be able to compete with thermal and solar energies. One developer also proposed that interest rates for hydropower developers should be reduced or capped, to make investments more attractive.

This group of respondents felt strongly that domestic demand for energy in Nepal needed to grow (2), not only to make investments in hydropower more attractive, but to develop Nepal's economy and

[4] BBIN = Bangladesh, Bhutan, India, Nepal; a regional grouping of countries that cooperate regularly on issues such as water resources, transport, energy, and infrastructure [69].

[5] For an overview of this incident from a Nepali perspective, see [102] or [103].

increase standards of living more generally. For example, one respondent said that 70% of the country's population still relied on fuelwood for cooking, urgently requiring a switch to induction cooktops. Another pointed out that domestic consumption of energy would have multiplier effects and strongly contribute to GDP, which was not going to be the case if energy is exported elsewhere. They also supported investment in cross-border transmission lines in the BBIN region as a strategy to expand the market for Nepal's energy (11), with one respondent detailing Bangladesh's very high energy costs, which make exports from Nepal financially viable and beneficial to both countries.

The electrification of the transport sector (15) was sometimes cited as another opportunity to stimulate domestic demand, which would reduce dependency on India for fuel, and this way, lead to a surplus of foreign exchange, besides reducing emissions. One respondent felt that Nepal had to follow regional trends, however, and would switch to electric vehicles only once these became common in India and China. Respondents had mixed views on whether reducing subsidies for fossil fuels might be helpful (33), with some commenting that this could only be done once there was better access to electricity infrastructure throughout the country, while others pointed out that this would free up very limited government resources for other purposes.

Similarly, this group of respondents had mixed views on the decentralisation of decision-making authority (34), even if the associated statement was ranked higher in Factor 2 than elsewhere. One optimistic respondent felt that decentralisation would increase efficiency, reducing the distance between local people, authorities, and developers, leading to a feeling of inclusion and more tailored solutions. Others expressed scepticism about including additional levels of government, which might lead to conflicting regulations and guidance from various government agencies, making hydropower development less predictable.

Respondents strongly rejected the idea of competitive bidding for PPAs (27), ranked at -4 in Factor 2. They felt that the hydropower business already suffered from high uncertainties, with competitive bidding representing an additional and unnecessary burden on developers. What is more, this would crowd out small and medium-sized companies from the hydropower sector, which might not be able to afford the added ensuing risks, leading to concerns about fairness and market access. Total investment might also be reduced, if only big companies can participate in the sector and the equity from small-scale investors is lost.

The low (-4) ranking for increased involvement of Western donors (10) stood out in Factor 2. Comments, too, reflected a consensus that Western involvement in Nepal's hydropower sector should, if at all, remain at the existing level, but certainly not increase. Developers felt the conditions imposed by Western donors were too onerous, paying Western consultants would excessively raise project costs, and that Western donors lacked accountability. These opinions went along with strong confidence that the level of expertise and capacity in Nepal's hydropower sector had grown considerably over the years, taking away the need for foreign expertise, which may have existed in the past. One respondent commented that Western donors were only welcome for investments in infrastructure that were not commercially viable, citing the example of a recent donation of 0.5 billion USD towards transmission lines in Nepal, which was given by the Millennium Challenge Corporation, an independent US foreign aid organisation.[6]

While statements on Indian and Chinese foreign investment in Nepal (22, 23) also received low scores, these rankings (-3 and -2 respectively) should be understood as a rejection of conflating hydropower development with geopolitics. A frequent comment was 'why favour any one country', with any source of funding welcome. Moreover, these low rankings represented doubts about the business case for foreign investors. Respondents reported that Indian investors still had many investment opportunities in their own country, making Nepal an unattractive destination for them. They also felt that market dynamics would override political concerns, with one developer citing the example of India-Afghanistan political relations, which were friendly, but did not lead to an increase in trade. The Chinese, in turn, were seen as somewhat more willing to take risks, since they receive governmental

[6] For details, see: https://www.mcc.gov/where-we-work/program/nepal-compact (last accessed September 2020).

incentives to invest abroad, have an advanced production chain for turbines and other hydropower-related engineering products, while also having exhausted most domestic opportunities for dam construction. They were also often perceived as more strategic and savvier than their Indian counterparts. That said, connecting China's with Nepal's electricity grid (37) was seen as an unlikely scenario, given the difficult terrain and long distances that would need to be covered from Nepal to China's industrial hubs across the Tibetan mountains.

Further statements captured scepticism about the importance of political and geopolitical factors in accelerating hydropower development in Nepal (9, 21). The negative assessment (-3) of a statement on the role of political stability in Nepal (21) particularly stands out, with one respondent making the counterintuitive comment that hydropower development will in fact be sped up if domestic politics is unstable. He explained that unstable governments were weaker negotiators, more willing to sign off projects quickly, whereas in the present stable context, developers have to wait for long periods to obtain any decisions. Most other respondents simply thought that political stability was not a priority, because it already existed. With regards to India-Nepal political relations (9), one investor commented that this topic was beyond the control of the hydropower sector, and should thus not be a priority, despite acknowledging Nepal's dependence on good relations with India.

4.3 A strategic vision for integrating South Asia's energy grids (Factor 3)

Factor 3 captures a viewpoint that can be understood as a long-term vision, in which Nepal's hydropower resources are a strategic asset, embedded in South Asia's energy future. 8 Q sorts had a statistically significant association with this factor, of which 3 are exclusively associated with it. This factor explains 15% of the study variance.

Respondents associated with this factor gave priority to integrating Nepal's hydropower production with the South Asian energy market, calling for investment in cross-border transmission lines with the BBIN region as well as more stable demand from neighbouring countries, mainly India and Bangladesh (3, 11), since Bhutan is already a net exporter of hydropower to India.[7] They felt that this could be to the advantage of all countries, but would require further alignment of geopolitical thinking, particularly by India. There was high support for the idea of moving towards multilateral energy trading (29). Overall, these respondents felt that the technical challenges of integration could be overcome once a political agreement was reached and energy markets were well defined. One senior expert cited the integration of European countries' energy grids as a positive example, which could serve as a model for the energy future of South Asia.

Yet there was also a clear and somewhat pragmatic recognition that the country strongly depends on India for energy trade (22), including with third countries (notably, Bangladesh), making India Nepal's most important partner country, ahead of others, such as China (23), as also expressed by the different rankings of the two respective statements (22, 23). The geographical proximity would reduce transmission costs, and culturally, India and Nepal were seen as highly similar, facilitating communication and trade. The lack of visa restrictions was seen as another strategic advantage, meaning that the integration of energy grids needed to start with India.

This group of respondents was least critical about Western donors (10), with one developer seeing them as providers of subsidised capital and technical expertise on a long-term basis, since Nepal does not produce any electro-mechanical equipment of its own, and another envisioning them as builders of dams with large reservoirs, which were seen as too costly for private investors from Nepal. They also ranked the role of private involvement in dam construction relatively highly (20), with one developer mentioning that this would facilitate coordination if several hydropower projects were built on the same river. Lastly, competitive bidding for PPAs (27) was supported to enhance efficiencies in the domestic energy trade, contrasting directly with the perceived inefficiencies of the monopolistic administration of hydropower by the NEA.

[7] For an overview, see [104].

In this viewpoint, reforming benefit-sharing (38) and addressing climate change (4, 24) were assigned the lowest priorities. While hydropower is often seen as a potential mitigation measure for climate change (4), these respondents felt that investment in hydropower was independent of this potential strategic benefit. They also discounted the risks of climate change for hydropower production itself (24), with one respondent even stating that melting glaciers would help Nepal, giving it greater access to water resources.[8] A common opinion was that Nepal was too small a country to make a significant difference on a global level.

With regards to benefit-sharing (38), developers stated that existing policies were sufficient; if anything, implementation might need improvements. Overall, the low rankings of social and environmental issues (5, as well as 4, 24, 38) may reflect an attitude that considers Nepal to be a regional leader in this field, with one respondent citing the example of Nepal's standards being raised following the publication of reports by the World Commission on Dams and the International Hydropower Association's sustainability protocol.[9] While the country's limited budgets for dealing with social and environmental issues were also mentioned, it is possible that these respondents felt that other South Asian countries needed to catch up with Nepal's relatively high policy standards.

Lastly, this group of respondents did not strongly believe that further financial incentives for developers were required (14). One developer even suggested that colleagues who were complaining about lack of support might be unethical, trying to maximise subsidies by taking licences, without any real intention to develop hydropower projects.

4.4 Consensus statements: land acquisition, public-private partnerships, human capital, transmission charges, and more

Although the preceding sections have uncovered the main differences in opinion among the interviewed hydropower developers, planners, and investors, there were also some areas of consensus. The ranking of seven statements was not different at a level of statistical significance of $p>0.05$ across the factors (12, 18, 25, 28, 30, 32, 35), while for five statements the level was $p>0.01$ (6, 16, 19, 31, 37). Many of these obtained rankings of -1, 0 or 1, suggesting that respondents did not have strong views about them. Due to limitations of space, not all of these will be discussed here. Instead, there is a focus on those statements where respondents made particularly interesting comments, or were the ranking was universally high or low across all three factors.

There was relatively widespread agreement that land acquisition processes needed to be smoothened (18). One common concern was that land acquisition was not properly regulated yet, with an unclear allocation of responsibilities and land use rights between developers, local people, and the government. Several developers also mentioned concerns about rapidly rising land prices in areas of hydropower development, locals unwilling to sell at all due to very low minimum prices mandated by government, as well as unclear land titling.

Another area of widespread agreement was the need for scaling up of private sources of finance (32). Most developers felt that Nepal's private investment sector did not have sufficient resources to fund anything beyond small hydropower plants. Some respondents were optimistic about the growing capacity of Nepal's banks as lenders, while others thought the funding gap needed to be filled with private investment from abroad.

With regards to the competitiveness of hydropower pricing in Nepal (19), most respondents had mixed or supportive views. A common opinion was that the price was already very competitive, with some respondents mentioning the possibility that lacking support infrastructure such as roads, bridges or transmission lines might increase final costs to buyers, and others citing the risk of corruption in driving up prices. There was also a general sense that due to the different life cycles and timings of electricity generation by wind and solar energies, these were complementary technologies, with hydropower

[8] For an overview of the climate change impacts on Nepal's glaciers see [7].

[9] For a brief overview, see [105]. For a specific Nepali perspective, see [48].

unlikely to be outcompeted based on cost alone. Those who supported the integration of energy grids with India and Bangladesh commented that even a high price in Nepal might still be highly competitive in those countries.

Views on public-private partnerships (PPPs) in the hydropower sector (25) were quite mixed. Many respondents suggested that PPPs were necessary to realise hydropower projects, despite significant risks. Overall, there was little enthusiasm for PPPs, mainly, because government entities might slow down planning and construction and because developers preferred to have full decision-making autonomy. Some respondents thought that PPPs were useful because government partners had greater legitimacy to deal with any social issues that might arise, they could help in raising cheap capital, or they could build complementary infrastructure such as access roads. Such benefits might offset any additional costs arising from involving government agencies, particularly in the case of large projects.

There was a wide range of opinions on the need to invest in human capital (30), even though the average ranking in Q sorts was similar across factors. Some developers felt the dependency on outside expertise was too high and would prefer that Nepali engineers had the capacity not just to operate, but to manufacture hydropower machinery, which might reduce cost and also make Nepal a better negotiator with international partners. Others thought that this was not a priority, particularly with regards to large projects. They felt it was unlikely that Nepal's engineers could acquire sufficient experience from the very small number of large projects that might be implemented inside the country in the future. With regards to less skilled jobs, some respondents said that domestic human capital was already very high, while others said further training and growth of the capital base was required. The different opinions might reflect different long-term ambitions for the country, with one respondent hoping Nepal could become a net exporter of highly advanced technology and services despite its small population, comparing it with Australia.

There was widespread disagreement with the idea that local support for dams needed to grow (16), or that resettlement and rehabilitation policies needed to be improved (35). These were seen as foreign issues, not applicable to Nepal. Anti-dam NGOs were described as non-existent or sponsored by other countries and even the World Bank, while local people would normally support hydropower development. This was explained with the prevalence of run-of-river projects in Nepal, which have comparatively minor impacts on surrounding lands (as opposed to reservoir projects), as well as the low population densities in the remote areas where hydropower dams are typically being built. Sometimes local people were also dismissed as unable to understand complex projects such as hydropower, meaning they were not suitable negotiation partners or too easily influenced by foreign NGOs. Several respondents felt that the topic of resettlement was not relevant due to a lack of experience with large storage dams, but that resettlement and rehabilitation policies might need to be revised in the future (35).

Lastly, there was widespread disagreement with the statement that transmission charges needed to be kept at a minimum (28). Some said 'the market' should determine prices, since hydropower was likely to remain highly competitive even with an additional charge. Others explained their disagreement saying that this topic was not (yet) relevant, given that at present, there are no specific transmission or wheeling charges, with NEA exclusively in charge of transmission lines across the country, although charges might be introduced in the future. Some respondents expressed frustration about the lack of transparency around transmission, hoping for the new Electricity Regulatory Commission to address this issue and ensure that any potential future charges will be fairly priced and not put private developers at a disadvantage (as compared to hydropower projects built by NEA subsidiaries).

5 Discussion

5.1 The diversity of private sector views and lessons for energy transitions research

Private sector views are often portrayed in a simplistic fashion, with the entire sector assumed to favour liberalisation and dismantling of regulations, political stability, as well as financial incentives and state support. Yet, the factor analysis performed in this study (Table 2) uncovered the diversity of private

sector views on accelerating hydropower development in Nepal, making clear that this sector does not necessarily speak with one voice.

The most prevalent viewpoint uncovered in this study is the one encapsulated in Factor 2; it is perhaps also the most stereotypical, focusing on financial issues and giving less importance to political factors. This view is also well supported by previous research, which suggests that countries with sophisticated green finance sectors are more likely to invest in renewable energy technologies [87–89]. It is also consistent with the proposition that societies need to find ways to shoulder the costs of energy transitions, beyond merely liberalising energy markets [90], which, in turn, was one of the dominant themes in Factor 1. Yet, a significant share of respondents gave strong importance to the national and international politics of hydropower development (especially Factor 3), which suggests that the sector as a whole is not 'apolitical'. While important, energy transitions are dependent on a diversity of factors that go beyond creating demand for renewable energy [19] or reducing its cost [21]. As this study has shown, private sector actors are not removed from Nepal's unique geopolitical context, as is reflected in their contrasting views on Chinese vs. Indian partners (see section 4).

The strategic potential of engaging with such (geo-)political views may sometimes be missed, as there may be synergies between the political priorities of the Nepali government and private sector actors. This reinforces the importance of 'messy' and political engagement between various actor groups to accelerate energy transitions [24], in this case, private developers and the Nepali government, despite the risks of political and bureaucratic fragmentation entailed therein, which may sometimes lead to inconsistent decision-making in the hydropower sector [71]. It also suggests that the dominant focus on policies, regulations, and financial incentives in energy transitions research is insufficient to understand what drives change. Issues such as the integration of energy grids with neighbouring countries will require strong coordination between private and public sectors in any case. That said, this study has also shown that private developers are not considering all their options for engagement with sectors beyond their own. Overall, they gave comparatively less importance to the role of hydropower in combating climate change. Yet, a focus on climate change mitigation (including the mitigation of climate change-induced risks to hydropower production itself) and sustainable development would facilitate partnerships between private developers and (academic) researchers (cf. [91]), not least from Nepal's own hydropower research community, who have explored these issues in great depth (e.g. [7,79]). Neither did developers attribute priority to social aspects, which could help them establish partnerships with civil society, especially where smaller projects are concerned.

5.2 Pragmatism and agency in Nepal's hydropower development sector

All private developers interviewed for this study were enthusiastic about expanding the role of the private sector in Nepal's power market, and their desire to accelerate hydropower development was visible across all three viewpoints documented above. They demonstrated a certain pragmatism, responding to the long-term potential for growth in this sector, which follows a phase of reluctance to invest in new and uncertain hydropower markets due to the perceived political, commercial, and financial risks [92]. While there are divergent views regarding the strategy that will work best for Nepal, there is homogeneity across the three factors in terms of a perceptive and constructive approach that Nepal must adopt in handling its domestic and geopolitical impediments, rather than being limited by them.

Factor 2 expressed a forward-looking view peppered with cautious pragmatism, embracing investments from diverse international sources and a preference for developing projects on a commercial basis. As many respondents admitted, Nepal had understood from decades of experience as a recipient of Northern and Southern development assistance that power lies with those who control financial resources [93]. Therefore, in the long run, it was better for Nepal to build a more equal relationship with its partners and engage in mutually beneficial relationships. Nepal's reliance on imported fuels from neighbouring country, India, has also made it highly vulnerable to international price fluctuations, and, as a landlocked nation, to foreign trade policy and sudden geopolitical shifts.

These findings are of some significance to recent contemporary critical scholarship on North-South and South-South development cooperation that point towards the enactment of agency by recipient countries and their ability to shape the relationship and nature of engagement between donor and recipient countries [94–96]. Factor 3 gives stronger priority to the South Asian context, with a vision for cooperation that is similar to the cases of hydropower development on the Mekong River [97] and investment in power corridors, for example, the African Power Pools model (cf. [63]). Yet, Factor 3, too, expresses a certain pragmatism, with aspirations for transforming Nepal through increased connectivity, highlighting its independent agency as an energy trading partner.

5.3 Independent power producers (IPPs) and the Nepal Electricity Authority (NEA)

Finally, the tensions between IPPs, the NEA, and the Nepali government need to be mentioned as a topic of concern that is commonly overlooked in scholarly debates on hydropower development in Nepal, despite being an area of consensus within the private sector (see section 4.4). Although a government-owned entity attached to the Ministry of Energy, from the perspective of private developers, the NEA has assumed a monopolistic position in Nepal's energy market through its formal and informal power networks [98]. The institution was heavily criticised for enabling unfair competition through negotiating more favourable PPA rates from its subsidiary companies as compared to IPPs [99] and resisting attempts to unbundle to improve efficiency, despite sufficient pressure from donors and the government. Dominant discourses informed by geopolitical considerations, resource constraints and external influences often override Nepal's domestic energy politics, leading to a skewed representation of views in Nepal's contemporary energy debates among academics and policy-makers. The institutional politics between NEA, IPPs and Nepal's government are one example of how this conversation could be extended in the future, to encompass a wider set of perspectives.

6 Conclusions

In this paper, private sector views on factors and priorities for accelerating hydropower development were analysed through a Q methodology study with private developers and investors in Nepal. Three main viewpoints were identified among respondents, which highlight the importance of: 1) reforming Nepal's hydropower policies and administration at the national level; 2) mobilising funds for hydropower development from a diversity of domestic and foreign sources; and 3) advancing the integration of Nepal's energy grid with those of its South Asian neighbours.

These three viewpoints reflect various areas of disagreement among developers, such as on the importance of political stability, potential strategies to make investment in hydropower more financially attractive, cooperation with Chinese, Indian, or Western partners, the electrification of Nepal's transport sector, or the role of competition for Power Purchase Agreements between developers. The study also identified areas of consensus among developers, such as a need for smoothening land acquisition processes, further breaking up NEA's monopoly in the hydropower sector, as well as the view that local support for hydropower in Nepal is high and not an area of concern.

The present study thus complements existing research in the field of energy transitions by providing a more nuanced and localised assessment of private sector views. It suggests that Nepal's hydropower sector is characterised by a pragmatic attitude, aware of its own agency and that of Nepal as a country, which contrasts with traditional and long-standing views of Nepal as a passive playing ground for foreign forces. It also demonstrates that many private sector actors attribute high importance to political and strategic questions that go beyond narrow regulatory issues and financial incentives which are often central in energy transitions research, even if the latter were important for many respondents as well.

Future research could investigate concrete policies and strategies to implement the three visions that were described here, as well as their impacts on social, economic, and environmental indicators. The World Energy Council's World Energy Trilemma Index could serve as an inspiration, which has evaluated the performance of more than 100 countries on the indicators of energy security, energy

equity, and environmental sustainability [100]. In 2020, Nepal was ranked among the bottom 10 countries in this index, although this may change with further investment in hydropower. From a methodological point of view, a scenario analysis of various energy futures would also be a worthwhile follow-up approach. This has been tested and applied in similar contexts, for example, by the World Energy Council [101], which has described three global scenarios that explore the role of digital technology, markets, policy and planning, as well as international cooperation for the global energy sector.

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