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A Rapid Assessment of AEPC's Subsidy Delivery Mechanism for Solar Irrigation Pumps (SIPs) in Nepal

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EXECUTIVE SUMMARY

Alternative Energy Promotion Center (AEPC) is promoting solar irrigation pumps (SIPs) as guided by Renewable Energy Subsidy Policy (2016) and Subsidy Delivery Mechanism Guidelines (2016). This report outlines findings from a rapid assessment of AEPC's subsidy delivery mechanism based on data and information gathered through review of subsidy policy and guidelines, analysis of secondary data on SIPs applications and installations, field study and interaction with various stakeholders (e.g., farmers, local governments, AEPC, SIP service providers, financial institutions, representatives from different government departments, and water/energy experts). Detailed analysis on impact assessment is scheduled later in 2020.

The AEPC's subsidy delivery mechanism is unpacked in terms of subsidy allocation, subsidy release, monitoring and after-sale services, access to credit, and private sector's contribution. More than 80% of applications for SIPs are received through private sector SIP service providers, who are also helping farmers with disseminating call, sharing results, and preparing feasibility analysis report. Subsidy is reaching out to relatively well-off farmers (*with more than 1 bigha land*) than small-holder, marginal communities and landless

Over the years, AEPC has supported nearly 1,400 SIPs though its subsidy program, as characterized hereunder;

- More than 80% of applications for SIPs are received through private sector SIP service providers, who are also helping farmers with disseminating call, sharing results, and preparing feasibility analysis report.
- Three *Tarai* provinces (Provinces 1, 2, and 5) account for more than 74% of applications and 85% of the granted SIPs. The pattern holds true across districts and palikas as well.
- Even though land ownership certificate or lease agreement was mandatory to be eligible for SIP, it turns out this criterion was not always met. A total of 478 farmers who were not able to submit land title or lease agreement were also granted SIPs.
- Among the pool of SIP applicants, farmers with smaller landholding size are given priority in granting subsidy. The average land holding size of SIP granted farmers are lower (2.5 bigha or 1.7 hectares) than those not granted (5 bigha or 3.4 hectares).
- About 22% of SIP farmers are women.
- A large majority of pumps are between 1 horsepower (HP) and 2 HP size).
- Among the farmers who applied for SIPs, the most common source of irrigation water is groundwater in all the provinces except in Karnali.
- The average cost of SIP is high and consistently so for all pump sizes across all the provinces. Even with 60% subsidy, small-holder farmers cannot afford to have SIPs as a farmer a farmer still has to pay 263,793 rupees (2,180 USD) for a SIP, though it varies with pump size.

The rapid assessment has identified several gaps and challenges associated with implementation, as outlined hereunder;

- Subsidy is reaching out to relatively well-off farmers (*with more than 1 bigha land*) than small-holder, marginal communities and landless
- There are delays in publishing the subsidy award results though it is provisioned to publish on a quarterly basis. It has hindered rigorous checking and subsequent correction of feasibility study report to ensure optimal design and installation.
- Monitoring system for the installed SIPs and availability of after-sale services are relatively weak.
- Access to finance to manage equity amount is still a challenge for farmers
- Private sectors are interested to engage and invest more actively to support AEPC in subsidy delivery as return in the investment can be achieved in 3-4 years if pump can

be used optimally. However, emphasis should be given on creating enabling environment.

- Local governments have high willingness to join hands with resources leveraging in expanding SIPs as means to enhance access to irrigation and energy. Working together with them would be a way forward to reaching out to more beneficiaries.
- Some practices in demand collection, eligibility, and procedure for fixing maximum retail price (MRP), which are not defined in the subsidy delivery mechanism guidelines should be incorporated there to formalize the existing practices. MRP does not separate capital expenditure (CAPEX) and operational expenditure (OPEX) and often uses the term interchangeably.
- Criteria for selection of beneficiaries is not available in formal documents on public domain, thus, indicating areas for improvement in SIP governance.
- Several challenges remain, including enhancing return on subsidy, attracting private sector as a collaborator/partner, enhancing inclusive access to SIPs, sustainability of SIP systems, and coping with COVID-19 impacts.

Following are the key recommendations for making subsidy delivery program impactful and resilient;

- **Update subsidy policy and guidelines** reflecting the existing practices which are not documented in policy and guidelines. It also includes separating role of feasibility study and installation to different vendors to avoid potential conflict of interest.
- **Ensure better return on subsidy** through measures such as: reducing MRP, maximize use of water and energy in various ways; integrate SIP program with other agricultural-related initiatives of the government; trying out performance-based subsidy as a mechanism for delivering subsidy; densifying SIPs and connecting to grids.
- **Ensure inclusive access to SIPs** through measures such as: enhancing access to information; targeted program for subsidy; provisioning extra subsidy to applications from women and those from disadvantage groups (DAGs); using social mobilizers to reach-out to targeted group; collect applications on rolling basis throughout the year and publishing recipient's list periodically; and trying-out private service provider with cost of irrigation subsidized by local government for those who really can't afford.
- **Ensure sustainability of SIP systems** through targeted subsidy program in collaboration with local government; setting-up minimum quality benchmarks for SIP systems and its installation; integrating agro-advisory services and buy-back assurances; design and implement phase-wise programs to enhance coverage of after-sale services; developing on-line system (for demand collection, analysis, monitoring using smart meter, evaluation, and advisory); put emphasis on creating enabling environment for encouraging private sector engagement; work effectively with local governments; and invest in research and development areas.
- **Categorize private sector** (as A, B and C) depending upon various criteria (e.g., experience, capability, potential to mobilize financial resources, innovations, etc.) and set some incentives for each category so that it motivates them to perform more professionally and bring innovation to upgrade them to next category.
- Focus on **preparedness for coping with pandemic like COVID-19** by developing strategies to operate SIP business smoothly and effectively during crisis. Do this by integrating SIP program with strategically important programs such as livelihood, agriculture, WASH, etc. so that SIP can get continued funding in the post-COVID-19 as well.

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1. INTRODUCTION

Alternative Energy Promotion Center (AEPC) is a government institution responsible for developing and promoting renewable/alternative energy technologies in Nepal. AEPC is promoting solar irrigation pumps (SIPs) since 2016 as guided by Renewable Energy Subsidy Policy (2016) and Subsidy Delivery Mechanism Guidelines (2016). Over the years, AEPC has supported nearly 1,400 SIPs though its subsidy program and has contributed in raising a large number of demands. Subsequently, central as well as provincial and local governments are putting emphasis on expanding SIPs as a means to enhance access to irrigation and energy. AEPC is interested to evaluate impacts of its SIP subsidy program to get insights for moving forward. In this context, International Water Management (IWMI) is partnering with AEPC to assess impacts of SIPs under the project "Solar Irrigation for Agricultural Resilience in South Asia (SoLAR-SA)" supported by Swiss Development Cooperation (SDC). SoLAR-SA (http://solar.iwmi.org/) is a regional project with activities in Bangladesh, India, Nepal, and Pakistan. Though detailed impact evaluation of AEPC SIPs on farmers will be carried out later in 2020. In the meanwhile, AEPC was interested to get a quick feedback on its SIP subsidy delivery mechanism to have an input for designing the program for the fiscal year 2077/78 BS.

The objective of this report is to provide a rapid assessment of AEPC's subsidy delivery mechanism by interacting with different category of stakeholders.

2. DATA AND SOURCES

This study draws data and information from review of subsidy policy and guideline, analysis of secondary data on SIPs applications and installations provided by AEPC, field study, interaction with various stakeholders, and analysis/synthesis of learnings/observations from field study and stakeholders' interaction. Table 1 provides details of the data and sources

Table 1. Details of data, sources, and methods

Activity	Description	Data/Information extracted
Review	AEPC's renewable energy subsidy policy 2016 and subsidy delivery mechanism (2016)	Policy provisions in regard to subsidy delivery in SIPs
Secondary data on SIPs applications and installation	4,530 SIP application data were made available from AEPC. The data were cleaned, pre-processed and made it ready for the analysis.	Status of SIP implementation, spatial distribution of various parameters (e.g., number of SIPs, pump size, solar panel capacity, land holding, gender, etc.)
Field study	Commissioned in the early March 2020 with participants from AEPC, IWMI and NEA; five (5) districts (i.e., Bara, Parsa, Rautahat, Sarlahi, Udayapur), 9 Palikas (municipalities/rural municipalities), and 14 sites were vised; 70 (12 Female, 58 Male] persons representing local governments and farmers. Details of field visit are provided in Table A1.	Insights on access to SIPs, their impacts, inclusiveness, overall performance of installed SIPs

Stakeholder interaction	At least 41 stakeholders, with 8 females, were interacted over phone and/or using online platforms during 7th April to 10th May, 2020. The stakeholders include beneficiaries/ farmers and local government; private sector; experts; and government officials. Details are provided in Table A2. Also the list of vendors involved in installing AEPC's SIPs are provided in Table A8 in Appendix.	Evolution of SIPs in Nepal; key issues related to sustainability of SIPs, implementation challenges, potential solutions, and future of SIPs in Nepal

3. UNPACKING SUBSIDY DELIVERY MECHANISM

3.1 Demand collection and SIPs allocation

AEPC collects applications from farmers via various means such as email or hard copy submitted in person, through private sector vendors, or through local governments. More than 80% of applications are submitted with assistance of private sector vendors because farmers often do not have direct access to information, do not know how to fill and submit the application forms. Furthermore, in case of applications submitted through vendors, the vendor follows up with AEPC and communicates decisions without additional follow up by the farmers.

Applications are evaluated by a committee consisting of representatives from four departments in the AEPC, namely, procurement, technology, planning, and finance. There is no mention of a GESI-related criteria in the formation of committee as well as in the selection criteria. However, in the last year, priority was given to the female farmers and this is borne out by the fact that almost 20% SIPs were allocated to female farmers. While evaluating, the committee tries to allocate at least few SIPs to every *Palika* that puts in application. Criteria for selection thus remains flexible, which can vary with every lot of evaluation. Since a large number of applications (e.g., more than 5,000 in the last year) are received every year, it takes time to shortlist. Out of over 5,000 demands in the last year, only 1,574 were listed, and only 862 were actually installed.

Regarding amount of subsidy, AEPC sets maximum retail prices (MRP) as per geographical location, pump size, etc. The MRP is set based on review of local and international market, price in the last year, price quoted in tender document, and price suggested by Association of Private Companies. It is updated regularly. The MRP varies across the geographical regions, and so does the amount of subsidy even though 60% subsidy rate is uniform across the country. The subsidy is released only after successful functioning of the system for two years and subsequent recommendation from the monitoring team assigned by AEPC.

Farmers with more than 1 ha of land are more likely to be allotted SIPs, as compared to farmers smaller and land less farmers. While minimum land size for eligibility is not specified in AEPC guidelines, the high upfront costs where farmers have to bear and part of it, and that farmers need enough land to grow crops and break even the initial investments, does make it more likely that SIPs will be adopted by somewhat larger farmers (farmers with more than 1 ha land).

3.2 Release of subsidy

After AEPC publishes the list of successful applicants, vendors reach out to the listed farmers. They support the preparation of a feasibility study report and submit it to the AEPC. AEPC's "solar energy technical committee" reviews the feasibility report and approves it. They examine

primarily the soundness of technical aspects. Once it is approved, the vendor starts installation in coordination with farmers. It generally takes 7-8 months from the point of application to actual instalment. After the installation, the vendor submits installation completion report. Upon confirmation of the installation, AEPC releases 90% of the subsidy amount to the vendor. Remaining 10% is kept as retention money, which is released after successful running of the SIP systems for at least two years. There have been no issues for accessing the retention money so far for private actors.

One issue with subsidy is potential delay or no installation of the allocated SIPs as well. For example, last year, out of 1,574 listed farmers, only little more than 862 SIPs were installed. Such cases incur loss for the farmer, AEPC as well as the vendor. Potential reasons for delay or no installation at all could be mismatch of information provided in the application with actual field condition and/or because the farmer does not have a water source ready. Another issue is publishing the list late and/or not on a quarterly basis. It hinders rigorous checking of the feasibility report and subsequent design rectification. For example, in the last year, the list was published in mid-May but the SIPs were to be installed by the end of mid-June.

3.3 Monitoring and after-sale services

Monitoring system for the installed SIPs from AEPC-side is relatively weak, which might be due to limited resources, both financial and human, available with the AEPC. Though the subsidy policy and guidelines provision monitoring of SIPs every trimester, this is not in practice. Monitoring might be better enabled after all of AEPC's Project Implementation Units are been established. Local governments can also be capacitated and also brought in as local partners for this purpose. It is also possible to have remote monitoring systems with real time data. Furthermore, availability of a good network of after-sales services covering wider geographical area is a very important factor for sustainability of the SIP program. However, this is not the case so far due to lack of availability of SIP technicians in the respective locality.

3.4 Access to credit

AEPC's subsidy mechanism requires that farmers pay 40% of the upfront costs, while the agency bears 60% of the cost. In reality, because MRP of SIPs are over-estimated substantially, there might have been cases, when the farmers did not pay any upfront amount, or when the upfront amount was negligible. Amount of subsidy mobilized for the farmers in real need depends upon capacity to arrange equity amount by the framer. Access to finance to manage amount of equity while accessing the subsidy is still a challenge for farmers. It is important that financial institutions are brought on board along with subsidy delivery mechanism to mobilize credit. Three concerns for financial institutions while issuing loans are risk, administrative costs, and incentives to invest in the specific sector. From all these perspectives, direct lending to SIPs is less attractive as an investment portfolio for commercial banks, it is primarily because of small size of investment with higher transaction costs.

3.5 Private sectors' contribution

As provisioned in the subsidy delivery policy and guidelines released in 2016, every year AEPC prepares a roster of potential consultants for providing installation services for SIPs that would receive AEPC's subsidy. AEPC does not pre-qualify them per se, however, for all the consultants who wish to be in roster, AEPC provides an orientation on SIPs and mobilizes as required. If vendors do not perform professionally or engages in activities that would disqualify them as defined in SIP policy, AEPC blacklists them. There have been a few of these cases in the past.

Private players show a broad range of qualifications and capabilities; however, they are not categorized by AEPC based on qualifications, capabilities, and performance. There are cases of some highly competent and capable vendors not registered with AEPC simply because they believe that the subsidy mechanism destroys the market and removing it would enable the SIP market to perform in a competitive way. Some private actors are working very effectively with financial institutions such as MFIs for mobilizing credit.

4. CURRENT STATUS OF SIPs IMPLEMENTATION

4.1 SIPs are most prevalent in Tarai

Three *Tarai* provinces, Province 1, Province 2, and Province 5 account for more than 74% of applications and more than 85% of the granted SIPs. This region received the highest demand because it is the grain basket of the country, consists highly fertile plain land, abundant groundwater resources available at shallow depths. AEPC mostly supports smaller pumps which are suitable for the Tarai region.

As of December 2019, at least a total of 4,530 farmers had applied for SIPs of which more than 30% were granted subsidized SIPs. Table 2 provides further details.

Table 2. Number of SIP applications and granted, by province

Province	Applied for SIP	SIP granted	Granted (%)
Province 1	645	182	28.2
Province 2	1,635	698	42.7
Bagmati	731	138	18.9
Gandaki	61	14	23.0
Province 5	1,076	303	28.2
Karnali	65	8	12.3
Sudurpaschim	317	41	12.9
Total	**4530**	**1384**	**30.6**

Notes: Numbers are based on the data provided by AEPC; data are up to date until December 2019. The actual number of applications could be somewhat higher, however, detailed information was available for 4,530 applications only. Three provinces, Province 1, Province 2, and Province 5 are yet to be named.

Figure 1 shows distribution of SIPs across the districts. Clearly, almost all SIPs were installed in the flatbed of *Tarai* region. Receiving high number of applications from the *Tarai* indicates a high demand of irrigation support in the region. Granting most of the SIPs to farmers in the *Tarai* region demonstrates AEPC's priorities, but a much larger investment might be needed to meet the growing demand.

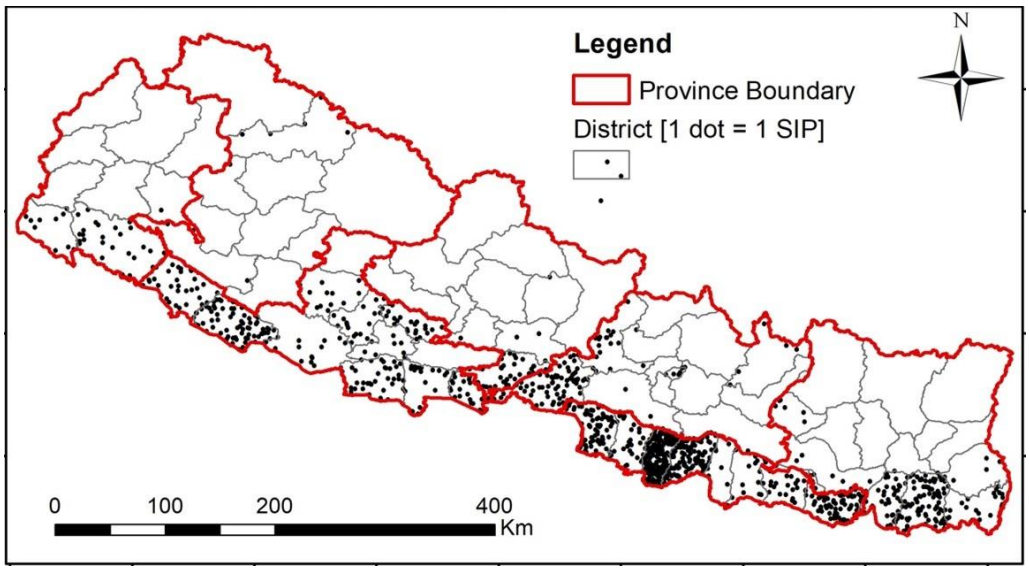

Figure 1. Distribution of SIPs in Nepal

The pattern of high number of applications and higher SIP grant rate in the *Tarai* region holds across provinces, districts, and palikas. The distribution of SIP applications and grant rate was also explored for districts and palikas (Table 3 and Figure 2). The three *Tarai* provinces accounted for 47% of the number of applying districts and more than 60% of the number of districts granted SIPs. Likewise, among the 360 palikas that applied for SIPs, the three Tarai provinces accounted for 65% and 83% of the palikas that were granted SIPs were in these provinces. In district level, 13 out of the top 15 districts were Tarai districts (Figure 2). Sarlahi district submitted the highest number of applications. Rautahat district received the highest number of SIPs, followed by Sarlahi, Saptari, and Morang. The district-by-district breakdown of number of applications and granted SIPs are available in Appendix Table A4.

Table 3. Number of districts and palikas with at least one SIP application received, by province

Province	*Number of districts*		*Number of palikas*	
	Applied for SIP	SIP granted	Applied for SIP	SIP granted
Province 1	11	6	63	39
Province 2	8	8	114	93
Bagmati	12	6	39	16
Gandaki	6	4	19	9
Province 5	11	10	57	34
Karnali	9	3	23	3
Sudurpaschim	7	3	45	7
Total	**64**	**40**	**360**	**201**

Notes: The column 'Applied for SIP' includes number of districts or palikas from where at least one SIP application was received. The column 'SIP granted' includes number of districts or palikas where at least one applicant was granted SIP.

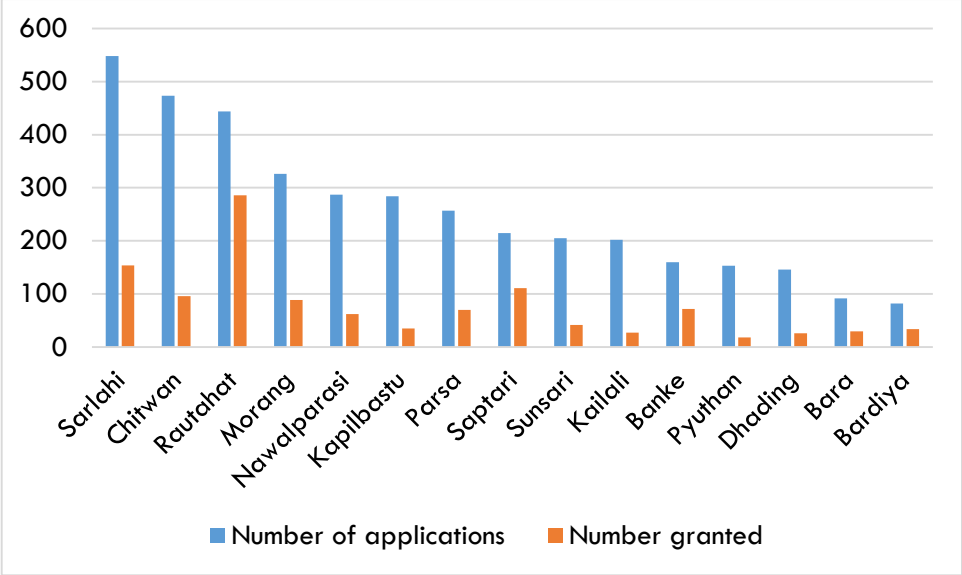

Figure 2. Top 15 districts with most number of SIP applications and number granted

Figure 3 presents the list of top 15 palikas in terms of number of SIP applications received. Palikas that had more applications did not necessarily receive more SIPs. In the three *Tarai* provinces, the SIP grant rate in several palikas was close to or greater than the national average SIP grant rate of 30.6%.

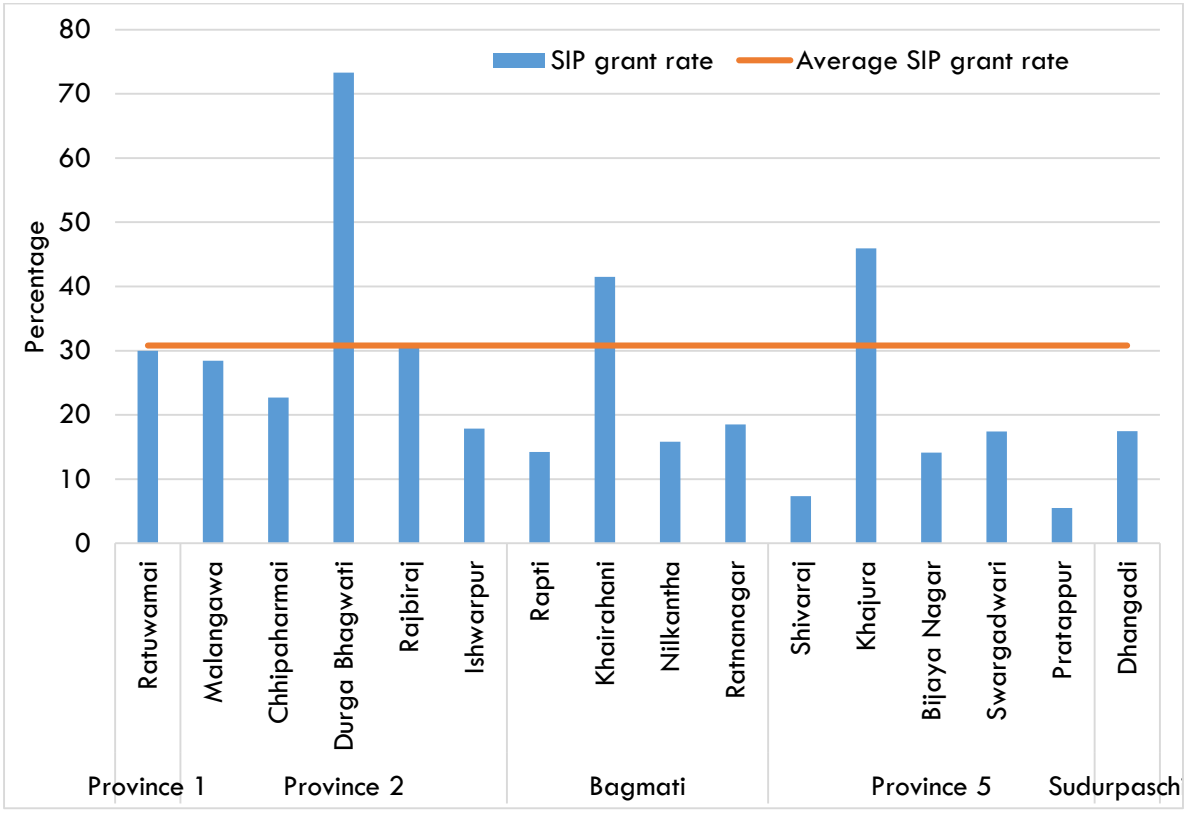

Figure 3. Top 15 palikas with most number of SIP applications and number granted

(Notes: SIP applications were received from 360 palikas and granted to 201 palikas. Full list of Palikas and distribution of SIPs are provided in Annex-B)

Figure 4 shows the number of SIPs installed over time in the last three years. **Since the SIP program begun in 2073/74, the number of SIPs granted drastically increased each year reaching 1,056 SIPs in 2075/76.** Information on number of applications over time was not available, but it is likely that number of applications also increased in a similar fashion.

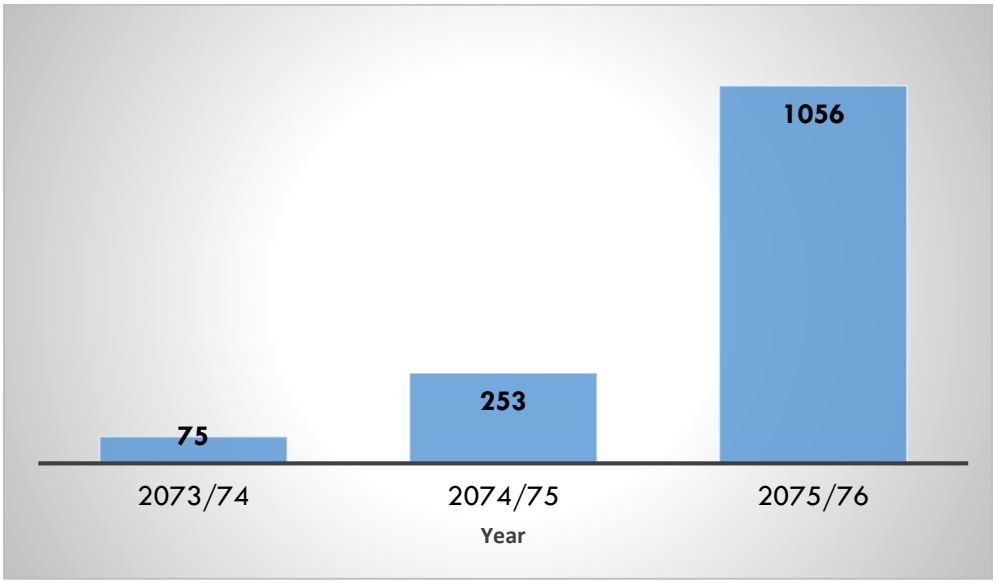

Figure 4. Number of SIPs supported by AEPC over the last 3 years

(*Notes: 2073/74 BS covers some months from both 2016 and 2017. In international date format, the timeline would be 2016/17, 2017/18, and 2018/19*)

4.2 Farmers with small landholding size were prioritized in the selection

Land ownership is defined as submission of a copy of land title along with the SIP application. **Even though land ownership certificate or lease agreement was mandatory to be eligible for SIP, it turns out this criterion was not always met (Table 4).** Overall, 81% of the farmers who applied for SIP owned agricultural land (or were able to submit a copy of the land title). Among the applicants, tenancy was not common, but this might be due to the additional requirements set by local governments that discouraged tenant farmers from applying.

A total of 478 farmers who were not able to submit land title or lease agreement were also granted SIPs. However, it does not necessarily mean these farmers did not own land. Perhaps, some of them were unable to submit a copy of the land title for various reasons.

Table 4. Land ownership and landholding size of SIP applicants and recipients, by province

		Land ownership		*Land area (bigha)*	
Province	Total applications	Land title (%)	Information not available (%)	All applicants	SIP recipients
Province 1	645	84.8	15.2	3.3	2.5
Province 2	1,635	79.2	20.8	2.2	2.2
Bagmati	731	87.1	12.9	2.3	1.8
Gandaki	61	32.8	67.2	6.5	2.3
Province 5	1,076	83.4	16.6	5.3	2.5

Karnali	65	55.4	44.6	18.8	48.4
Sudurpaschim	317	74.4	25.6	12.6	5.6
Total	**4530**	**80.9**	**19.1**	**5.0**	**2.5**

Notes: Land title or lease agreement information unknown for 19% of applicants. Land units were reported in local units. Following conversion rule was used to convert the land size to bigha. 1 bigha = 0.677 hectare = 13.31 ropani = 1.6735 acre.

The average land holding size of SIP granted farmers was lower than the average land size of other farmers. It was 5 bigha (3.4 hectare) for the applicants, but it was only 2.5 bigha (1.7 hectare) for the farmers who were granted SIPs. Similar pattern holds in district level as well (see appendix Table A5). For unknown reasons, Karnali province was an exception where leverage and size of farmers who were granted SIPs was much greater than other farmers.

Results show that, in the pool of SIP applicants, farmers with smaller landholding size were given priority in selection for SIP. This is confirmed in Figure 5 which plots the SIP grant rate by categories of land holding size. The inverted-U shaped curve indicates that the probability of getting a SIP increases with land holding size up to about 3 bigha and then it decreases. This implies that small holder famers (less than 4 bigha, but more than 1 bigha) were more likely to get a SIP compared to large holders. Similar pattern was evident for all provinces (see appendix Table A6).

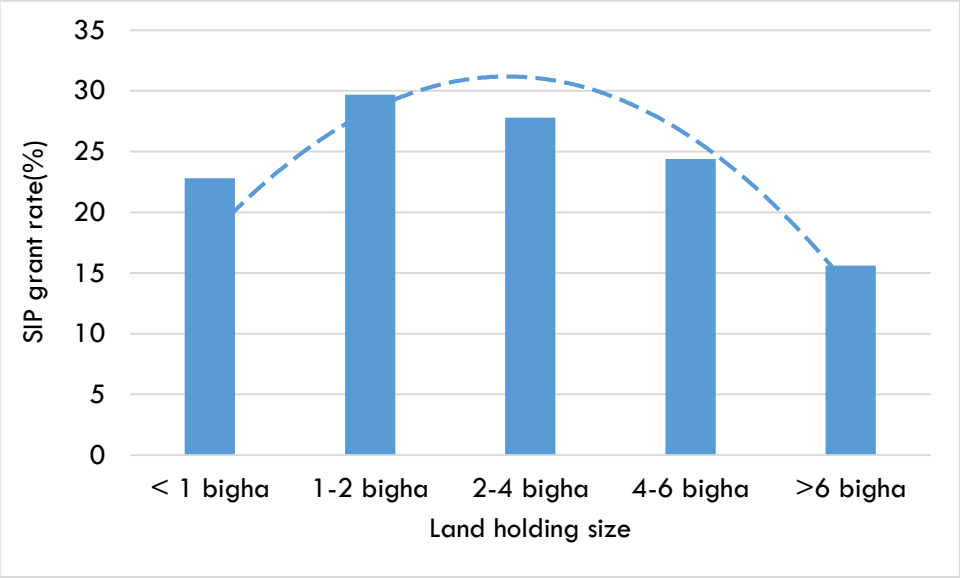

Figure 5. SIP grant rate by categories of land holding size

(*Notes*: the dotted line is the predicted probability of receiving a SIP for different land sizes)

4.3 One-fifth of the SIP beneficiaries were women

Table 5 presents the gender distribution of SIP applicants and SIP recipients. **Overall, about 22% of SIP farmers were women. The share of female SIP recipients was slightly higher than the national average in Province 1 and Province 2.** The share of women SIP recipients to total recipients was slightly greater than the share of women applicants to total applicants. This indicates that women applicants might have been prioritized in the selection process. This was evident in Province 1 and Province 2. However, the share of female SIP recipients may not be a good indicator by itself to assess the gender inclusiveness of the SIP program. Women who do not own land or the pump might also benefit from the program in

many different ways, or SIPs bought in the name of the women, may be completely operated by men.

It is important to note that the data provided by AEPC did not contain information on farmers' gender. For this analysis, individual's gender was identified by manually checking their names, and this approach has limitations because some of the names are unisex. Furthermore, individual names were recorded for the contact person of each of the application or installed pump. Since the contact person was not always the farmer and was more likely to be a male than female, the share of female SIP applicants or SIP recipients may be an underestimate of the true share.

Table 5. Share of female SIP applicants and recipients, by province

	Applicants		*SIP granted*	
Province	Total	Female (%)	Total	Female (%)
Province 1	645	22.9	182	23.3
Province 2	1,635	22.4	698	26.9
Bagmati	731	18.9	138	16.1
Gandaki	61	6.9	14	0.0
Province 5	1,076	14.5	303	15.5
Karnali	65	4.6	8	0.0
Sudurpaschim	317	15.5	41	7.3
Total	**4,530**	**19.1**	**1,384**	**21.8**

Notes: Data was not recorded on gender of the applicant or farmers who were granted SIPs. For this analysis, individual's gender was identified using by manually checking their names. So, the gender information is not perfect.

4.4 Most SIPs are between 1-2 Horsepower capacity

A significant majority of pumps were of size between 1 horsepower (HP) and 2 HP and most of them were granted to the three *Tarai* provinces – Province 1, Province 2, and Province 3. Table 6 presents the distribution of different sized pumps across provinces.

Table 6. Distribution of different sized SIPs across province

Province	*Pump Size (HP)*						Total
	< 1 HP	1 HP	2 HP	3 HP	5 HP	>5 HP	
Province 1	4	57	91	1	6	-	159
Province 2	-	322	279	68	1	1	671
Bagmati	-	80	1	-	43	3	127
Gandaki	-	11	2	-	-	1	14
Province 5	-	172	15	2	57	8	254
Karnali	-	-	-	-	7	1	8
Sudurpaschim	-	11	-	-	-	1	12
Total	**4**	**653**	**388**	**71**	**114**	**15**	**1,245**

Notes: Pump sizes are unknown for 149 SIPs

Table A7 in Appendix presents characteristics of SIPs – pump capacity, panel watt peak, pump head, and discharge rate – by province.

Most SIPs were individually managed, and the type of management was not known for more than 415 SIPs. Figure 6 presents SIP management types and number of applications received and granted under each management type. Farmers were asked to specify the type of SIP management during the application process, so these numbers reflect proposed management types rather than current management of SIPs.

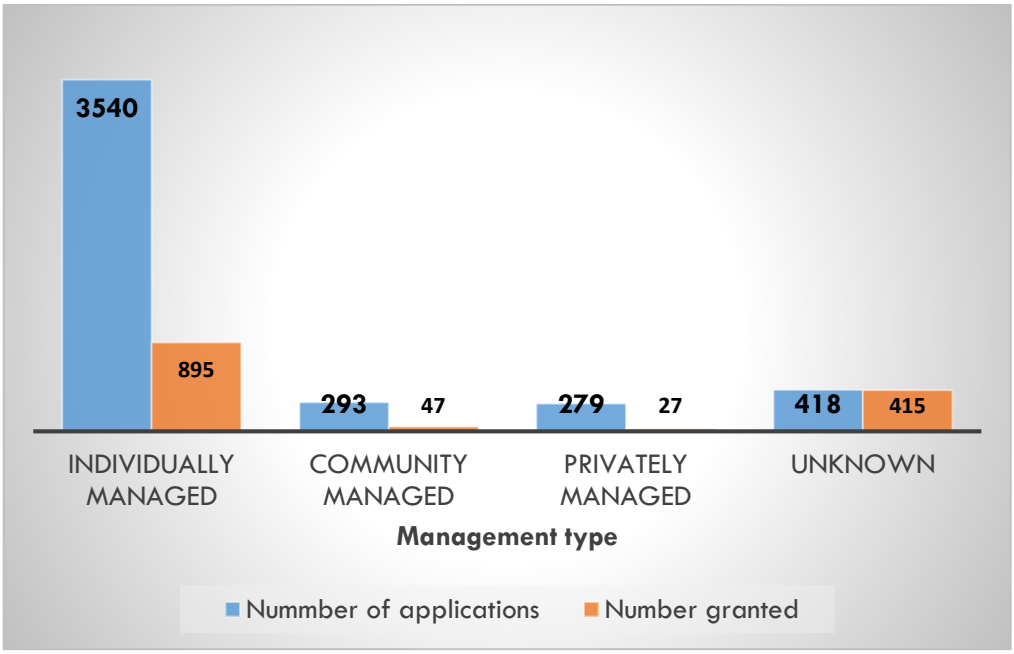

Figure 6. Number of SIP applications and number granted by management type

4.5 Groundwater was the primary source of irrigation water

Among the farmers who applied for SIPs, the most common source of irrigation water was groundwater in all except Karnali province. Groundwater was the primary source for more 62% of farmers. About 18% farmers identified surface water sources as the primary source and about 3% farmers were using a mix of groundwater and surface water sources (Table 7). In Karnali province, river water was the primary source (63%) and groundwater only accounted for 12%. Use of groundwater was most common in Province 1 where more than 77% farmers identified boring or tube bell as their primary source.

Table 7. Source of water SIP applicants reported in their applications, by province

Source of water	All	*Province*						
		Province 1	Province 2	Bagmati	Gandaki	Province 5	Karnali	Sudurpaschim
Groundwater								
Boring and tube well	62.8	77.3	66.0	58.0	54.1	60.2	12.3	48.9
River	10.7	5.4	0.8	18.7	19.7	18.7	63.1	14.8
Rainwater	5.3	3.0	4.7	0.0	0.0	5.6	0.0	27.1
Pond	1.9	0.2	0.9	9.3	0.0	0.1	1.5	0.0
Total surface water	17.9							
Groundwater and surface water								
Boring and River	1.7	0.2	2.9	0.7	0.0	1.8	3.1	0.6
Boring and Rainwater	0.7	0.8	0.3	0.1	0.0	1.3	0.0	1.9
Other unspecified sources	1.0	0.0	0.2	2.2	1.6	2.2	0.0	0.6
Both ground and surface water	15.8	13.3	24.2	10.9	24.6	10.1	20.0	6.0
Source unknown								
Number of farmers	**4530**	**645**	**1,635**	**731**	**61**	**1,076**	**65**	**317**

Notes: Point estimates are shares.

4.6 Average cost of SIPs was high across all provinces

The average cost of SIP was high and consistently so for all pump sizes across all provinces. Results show that even after receiving a 60% subsidy, small farmers are likely not able to afford to install a SIP (Table 8). Overall, the average cost of a SIP was 659,482 Rupees (5,450 USD at the exchange rate of 1 USD = 121 Rupees). Farmers contributed 40% of the total cost across all provinces. On average, a farmer paid 263,793 rupees (2,180 USD) for a SIP. Since the average cost increased with pump capacity, farmer's contribution also increased with it. These figures of average cost are quite high and are out of reach for many smallholders in Nepal.

The cost of SIP increases with pump size, as expected. The average cost of a one HP SIP was 3,93,000 rupees (3,248 USD) and a two HP SIP costed 4,80,900 rupees (3,975 USD). While most pumps were below two HP, about 200 pumps were of capacity greater than 3 HP.

Table 8. Average cost (in NRs lakhs) and the number of SIP by province and pump capacity

Pump capacity (hp)	Province 1	Province 2	Bagmati	Gandaki	Province 5	Karnali	Sudur-paschim
<1 hp	3.93 *(4)*						
1 hp	4.53 *(51)*	4.92 *(312)*	4.59 *(80)*	4.68 *(9)*	4.75 *(93)*		5.02 *(11)*
2 hp	6.66 *(91)*	8.38 *(279)*	4.99 *(1)*	4.99 *(2)*	6.88 *(15)*		
3 hp		11.93 *(65)*					
5 hp		29.86 *(1)*	15.92 *(21)*		23.40 *(6)*		
>5 hp		14.40 *(1)*	16.41 *(3)*	16.93 *(1)*	12.79 *(8)*	16.79 *(1)*	24.38 *(1)*
Total pumps	**146**	**658**	**105**	**12**	**122**	**1**	**12**

Notes: Point estimates are the average cost of the SIP in Nepali rupees Lakhs (100,000). The numbers in the parentheses are the number of pumps.

4.7 Farmer's contribution increased with land holding size

Figure 7 plots average contribution of farmers to their SIPs against land holding size. **The average cost of the farmers increases with land holding size suggesting that large holders installed larger pumps.**

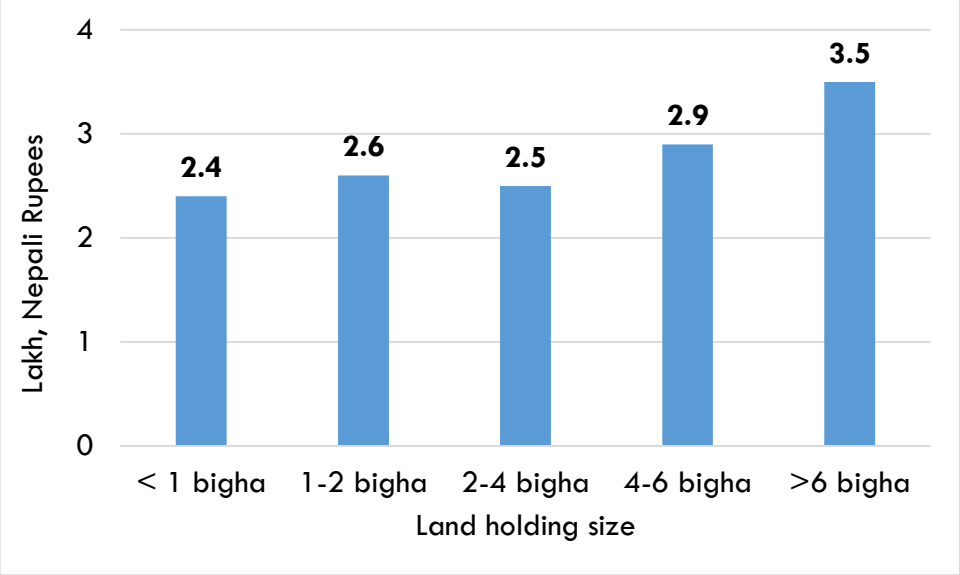

Figure 7. Average contribution of farmers to SIP (Lakh, rupees) by land size

5. GAPS IN POLICY AND IMPLEMENTATIONS

Two official documents related to subsidy, namely, "Renewable Energy Subsidy Policy 2016" and "Renewable Energy Subsidy Delivery Mechanism Guideline 2016", have several well-intentioned provisions related to subsidy delivery in SIP. The documents have very clear provisions on demand collection, eligibility criteria, demand processing and selection, monitoring and evaluation, and subsidy distribution and so on. Some of the differences in policy and practices are outlined in Table 9. Though policy and guideline itself are well made, the documents need streamlining in the changed governance structure in the Federal Nepal, where the constitution delegates all functions related to renewable energy distribution and promotion to the newly formed local governments.

Table 9: Differences in policy provisions and practice in selected areas

Aspects	Provisions or spirits (in policy/guidelines)	Practice
Major problems and challenges identified in 2016 Policy	• The subsidy policy and guidelines aimed to address following challenges identified back in 2016 – lack of credit mobilization and dependence on subsidy; policy barriers for private sector investors; flexibility in pre-qualifying systems has inhibited completion; there is need to extensively promote energy end-uses; large financial costs for verification, monitoring, quality assurance and testing	• Those issues are valid even today, nearly four years after provisioning of subsidy in SIP through subsidy delivery policy and guideline
Demand collection	• No mention of collection through email • Though there is mention of local bodies for promotion, demand collection and on-site monitoring, but no mention of recommendation from local government	• Demands are collected via email as well • Recommendation from local government is mandatory
Eligibility	• Water sources: Different water sources are eligible for subsidy, however, the spirit of policy is borewell in Tarai and	• There are cases of using SIP subsidy for pumping water from canals running nearby the farm in Tarai – which may

	canals/rivers/springs etc. for hills are expected to be water source • Distance from electricity grid: The farm shall be at a distance of more than 300m from the grid lines [Not clear – whether it is from water source or installation of panels or any specific point of farm]	be contravention with other existing laws regarding canal water use • There are cases of SIPs installed with subsidy in the farms located at less than 300m distance
Subsidy amount	• Maximum retail price (MRP): AEPC shall fix MRP for the year – no mention of process for fixing MRP • Review of subsidy amount: 60% subsidy is set without any study. Level of subsidy is expected to be reviewed as per need or every two years	• MRP is said to be set based on review of local and international market, price in the last year, price quoted in tender document, and price suggested by Association of Private Companies However, evidence of regular updating based on these criteria is missing. MRP does not separate CAPEX and OPEX and often uses the term interchangeably • There has been no revision on 60% subsidy since the SIP subsidy policy was put in place in 2016. No research on appropriate level of subsidy required for SIPs.
Application selection	• AEPC shall set criteria for selecting applications and publishes the list of selected applications on quarterly basis or as required	• Criteria are not properly defined in formal documents, kept flexible and normally changes for every list; lists are not published on quarterly basis; last year only one list was published that's also too late (in late March) • Announcements are made through website (but no mention on guideline)
Feasibility study	• Selected applicants shall conduct a detailed feasibility study on their own, which shall be verified by AEPC or its regional center or independent consultant	• There is a practice of conducting feasibility study only for the systems with costs exceeding NRs. 500,000 • Same consultant does feasibility study as well as installation (**potential conflict of interest**)
Monitoring and evaluation	• AEPC shall conduct on-site monitoring of the renewable energy systems and projects every trimester and annually • There shall be third party monitoring and evaluation of the impact of subsidy, field verification of installed RE systems or projects every two years • Local bodies shall conduct on-site monitoring at local level	• AEPC conducts verification of the systems only for releasing subsidy amount • AEPC conducts this after two years for the purpose of releasing retention money • Local bodies do not have adequate human resources or technical expertise for this task
Access to SIPs subsidy	• SIPs are expected to be affordable by most groups (including DAGs) based on subsidies awarded	• There is a high concentration of SIPs in some districts and Palikas • SIP subsidy is going to relatively well-off farmers (> 1 ha holding) than smallholders and landless • There is no special subsidy provision for DAG, but it seems that AEPC's flexible selection criteria does take into account land size and gender while allocating pumps

6. IMPLEMENTATION CHALLENGES AND POTENTIAL SOLUTIONS

There are several challenges associated with implementation of SIP systems. They challenges are elaborated hereunder and potential solutions are listed in Table 10.

6.1 Improving return on subsidy through better service to farmers

As SIP is a component of agricultural input, and agricultural self-sufficiency and reducing dependence on food imports remains a stated goal of the GoN, continuing SIP subsidy in some form may remain necessary in the near future. The challenge however is enhancing returns on subsidy and continuing it based on better working modality.

Subsidy program has raised awareness on usefulness of technology and created more demands. This awareness in rural areas has helped enhance access to irrigation, attracted more investments in SIPs, and has benefited farmers and household economy in various ways. In quantitative terms, ICIMOD's study conducted at 4 pilots in Saptari showed 30% net increase in net cultivated area, 2.5 times increment in vegetable farming income, and diversifying use of SIPs to aquaculture (fish farming), in addition to vegetables and cash crops, 80% reduction in diesel use – all these leading to enhanced income streams. However, in case of SIPs installed through AEPC's subsidy program, detailed impact evaluation is yet to be conducted and IWMI will do so by the end of 2020-early 2021. Nevertheless, in qualitative terms, based on focus group discussions, there was some evidence that increased irrigation demand has led to higher cropping intensity leading to more income and improved livelihoods. This will be quantified and verified with impact evaluation study later in the year.

For enhancing returns, various other parameters should be taken into consideration such as optimizing use of water and energy through multiple uses; adopting appropriate cropping pattern to yield maximum production; creating appropriate market linkage mechanisms to optimize profits; ensuring availability and quality of other inputs (e.g., seed, fertilizer, etc.); ensuring availability of after-sale services in terms of repair and maintenance; etc. Smart monitoring system can detect faults in the system even before farmers notice it and repair and maintenance support can be mobilized swiftly. Right now, after sales services is an Achilles heel of the program. Engaging a service provider for monitoring, evaluation, and support with after-sale services could help improve performance of SIPs and therefore increase agriculture yield, profit, and hence return on subsidy. Therefore, adequate attention on integrating SIP program with other activities will help improve returns.

Supporting technical knowledge centrally from AEPC alone is not feasible for many reasons, therefore a mechanism for engaging local governments in this process should be created as they are expected to have local technical personnel. As the new constitution has assigned roles related to renewable energy to the local governments, and aided by their local understanding and resources, they may be able to target the subsidies more effectively for better return. However, AEPC still need to support with policy and guidelines development, creating technical schemes, and as a knowledge hub for SIPs.

Another mechanism to improve returns is by reaching out to more beneficiaries with the same amount of subsidy, i.e., mobilizing more resources from farmers and/or private sectors. Introducing an idea of "**performance-based subsidy**" rather than current approach of "**capital subsidy**" may work to make the SIP program more resilient. The idea is to allocate a lump sum fund for SIP subsidy, set a minimum number of SIPs to be installed and operated, define minimum quality standards and performance indicators, and invite service providers to come up with competitive proposals on providing service including after-sales service for a stipulated number of years. A service provider is then selected based on the best deal offered and they work under direct monitoring of the local government. In this case, we can include criteria such as targeting vulnerable communities, smart monitoring system, efficient after-sale services, etc. IWMI can support in design, implementation, and evaluate effectiveness of the program

in consultation with wider stakeholders. For arranging the fixed sum, AEPC may consider allocating it partly by itself and/or pooling resources such as from Nepal Renewable Energy Program (NREP)'s challenge fund, asking KfW to utilize part of agreed support for next level for this purpose, and so on. Generating resources itself may not be a challenge on its own. AEPC may consider piloting it in this fiscal year and based on the learning, it can be launched as AEPC's subsidy program with phase-wise targets. This program has potential to be attractive for other renewable energy programs as well.

6.2 Creating business opportunities to private sector while benefitting farmers

Private sector will make more profit through expansion of market associated with SIPs. Demands on SIPs (and volume of business) increases if it is cost-effective or yield better return. For that the SIP system should be affordable and attractive to farmers and be promoted appropriately. It needs, efforts for lowering the cost of SIP systems, developing a mechanism to easily access loans in general, and soft loans in particular, and make SIPs competitive with diesel pumps. For that MRP of SIP system should be brought down, after-sale services should be available as and when required, advisory on suitable cropping patterns for the particular farmland should be provided, and market linkage of the produces should be ensured. Furthermore, SIP program needs to be integrated with other activities in the agricultural value chain such as input management, land and water management, market linkage, multiple use of water and energy, etc. to enhance profit. In this context, there is a need for more rigorous process of price discovery of SIPs and given how quickly prices of solar panels are falling, there is a need to do this price discovery every year. One idea for that could be making an open call and asking various vendors to submit proposals on the minimum cost that they can install the system at various geographical regions and fixing MRP based on that.

Enabling environments for operating private sectors can be created by supporting to establish private sector solar enterprise in collaboration with local governments, which supports farmers with upfront costs in collaboration with MFIs or cooperatives. In addition, measures like soft loans, tax-related advantages, discount in import, etc., as provisioned in Industrial Act (2075) can encourage private sector to invest in SIP sector. The model adopted by IDCOL in Bangladesh is a good one, from which we can learn and customize to our context. They include long-term soft-loan system by utilizing foreign grants for subsidizing interest rates.

Though private sectors are playing effective role in information dissemination, linking with prospective SIP users, technology development, and exploring market prospects, they are generally acting like "traders" rather than "partners/collaborators". As a result, after-sales service network has not yet been adequately established. Private actors should consider developing a long-term strategy on better service providing and creating value so that their network as well as business expands. A series of interactions might be needed between private actors to discuss potential models of public-private-partnership (PPP) would be useful.

Bringing financial institutions (e.g., commercial banks, MFIs, etc.) on-board as a part of subsidy delivery mechanism to ensure smooth financing for SIP-related business is another area that can help create enabling environment. Encouraging private sectors to perform professionally is another areas of challenge. In a fragile economy like ours, it is less likely that every sector performs professionally in full swing with full compliance with contractual obligations. In many cases, key performance indicators (KPIs) are also not well defined and therefore difficult to carryout periodic monitoring and provide timely feedback for improvement.

6.3 Create inclusive-access

Gender and Social Inclusion (GESI) is certainly relevant in SIP as large section of society do not have access to irrigation, and yet, irrigated agriculture is often one of the most effective pathways out of rural poverty. Massive male-out-migration is further increasing the agriculture

sector's dependency on women in two ways: i) bringing opportunity to women to become decision-makers; and ii) over-burdening them with more work in agriculture. SIPs are more women friendly as they do not need to be physically hauled everywhere and can be easily turned on and off. SIPs also help reduce workload by decreasing daily hourly input in agriculture, time saving in fetching water, and improvement in hygiene due to more water availability. Recent developments on tax exemption for women-owned lands and women-ownership of SIPs incentivised by ICIMOD in some Tarai districts have set examples and encouraged women to engage in SIP activities. AEPC has been also proactively selected women farmers; 22% of AEPC's SIP subsidy has gone to the SIP system owned by women. However, empowering them with knowledge, strengthening capacity, and enhancing their skills are yet to get adequate attention. Furthermore, from social inclusion perspective, SIP subsidy has not reached to socially and economically disadvantaged groups (DAGs). Mainstreaming DAGs and women in SIP program needs more concrete steps.

There are several entry points for enhancing inclusivity of SIP ownership. Once could be through appropriate promotion and demand collection for SIPs. ICIMOD in its experiment in Saptari district, used social mobilisers, and paid them a small incentive to reach out to female farmers and farmers from DAG. Second, women and farmers from DAG could e given extra subsidy – again experiment from ICIMOD showed that providing extra subsidy to women, provided that the land on which SIP is installed is also transferred to them, works in encouraging women to own SIPs and become asset owners – with possible positive implications on their empowerment in the long run.

Another problem is that famers from DAGs may not be able to shoulder the financial load to access SIPs as they have meagre earnings and/or have no networks with banks. Even if some of them are able to manage the money, they lack information regarding when SIP calls come out or are unable to correctly fill applications or could fail to get recommendation from local government. In this context, local government may need to have a program to support such farmers who lack the social capital to access even basic facilities. They can help translate AEPC's call in Nepali media to local languages and then disseminate this information to targeted communities.

Commercial larger farms in general are dominated by men while women head mostly smaller farms. Therefore, supporting small farms with SIPs will certainly enable better inclusion. Furthermore, promoting livestock and crops together with SIP program, in which women and marginalized communities are dominantly engaged may help enhance income, and improve livelihood of women and marginalized communities.

6.4 Sustainability challenges

SIPs have been garnering attention over the past years, however, key concerns related to the sustainability of the SIP systems still exists. Most of the challenges and potential solutions elaborate din earlier sections are certainly relevant here. Additional key challenges related to sustainability are listed hereunder and potential solutions are outlined in Table 10.

- Making after-sales services available across the country so that repair and maintenance services are available as and when required
- Making SIP a competitive option even after access to grid-based electricity becomes widespread by taking care of various technical and managerial aspects.
- Ensuring water availability at different hours of the day is a challenge as SIP system depends on climatic parameters (like sunlight) and solar energy is variable in a day. Having hybrid pumps that works with both AC and DC is important to ensure irrigation as and when required.
- Optimizing use of energy for better return - connection of SIPs with national grid using micro-grid technology or diversifying other end-uses of energy (e.g. solar drier) could be the options. Farmers get benefited by selling excess energy generated from solar

panel to the grid when not in use and again can utilize grid energy during hours with no sunlight. It helps deal with water availability issue as well as increases income for farmers by selling electricity. It further helps requirement of energy-mix for the stability of grid and improves quality fo voltage to the grid as well as to nearby farmers. Furthermore, requirement for energy-mix, demands for self-produced and green energy, and socio-political circumstances may still drive demands for SIPs at least for next 7-10 years.

- Maximize use of water for better water productivity: integrating SIPs with other agriculture-related programs (e.g., input management, market linkage, optimizing cropping pattern, capacity strengthening, etc.) and adopting optimal cropping pattern can help maximize use of water and therefore enhance return. Making farmers aware and skilled on these aspects are still considered as challenges related to sustainability
- Even if there is near 100% electrification, electricity is reaching homes and not farms. It needs multiple pumps, transformers, etc., which increases costs of irrigation.
- Proper targeting of the SIP program: It requires considerations such as prioritizing SIPs with subsidy for the farms unreachable from national grids. The subsidy policy 2016 mentions it clearly but need to be streamlined in practice. Synthesizing DOs and DON'Ts from past experience and adapting to design future programs would help.
- SIPs may promote over-extraction of groundwater (GW) in some areas, therefore, it should be promoted along with GW sustainability plans.
- SIP program may create synergetic impacts if integrated with other initiatives of the government, such as Prime Minister Agriculture Modernization Project (PMAMP). If AEPC's SIP program can be integrated with that program and can support with SIPs for irrigation, it will create larger impacts than supporting individual pumps.
- Application of smart technologies for monitoring, data analysis, data-based targeting, digital payment through private sector, online application collection and so on are likely to contribute to the sustainability of SIP systems. It may require designing and implementing an integrated online platform that has functions for online application collection, online monitoring of the installed systems, and issuing advisory on various aspects (e.g., cropping pattern, time for irrigation when soil moisture level depletes, mobilizing repair and maintenance team well before farmers knows technical faults, etc.), among others.
- Preparing knowledge products and design guidelines in local language and disseminate widely together with local governments and local media: SIP subsidy program should work together with local government, by making them aware on various aspects of SIP design (e.g., parameters, optimizing design, etc.), potential multiple uses of both water and energy, etc. It needs preparation of various knowledge products such as fact sheets; repair and maintenance manual including FAQs related to repair and maintenance and ways to deal with them. It may contain information such as key repair and maintenance issues; practical ways to address them; tools/equipment required; range of costs may require; things that can be addressed by farmers themselves with minimum cost; etc. When SIP reaches out to more, market will increase, more after-sale services will be spread, and finally contributes for making SIP program resilient.

6.5 SIPs in post-COVID19

Like other sectors, SIPs might also get affected due to the COVID-19 pandemic. There could be three dimensions of the COVID-19 impacts: i) change in future funding levels due to shift in priorities of government and development partners; ii) variability in costs of SIP system (panel and pump); and iii) change in installation volume and use of SIPs. Though the circumstances are unpredictable at the moment, the pandemic may push back mobility by several months and production of SIP systems by a year or two. Globally, there is a danger of

economic collapse, so funding level for SIPs as such is expected to get reduced. However, as agriculture will always be in priority, funding will be available for novel initiatives, farmer-connected/benefited activities. Therefore, SIPs will need to be re-oriented under livelihood, energy, WASH, resilience, COVID-19 impacts or similar sort of programs, which are priority even in post-COVID-19 scenarios, to ensure continued funding streams. Therefore, there could be more funding available for SIPs if re-framed and integrated appropriately in the post-pandemic context and worked in partnership with local governments.

In terms of cost of SIP systems, supply chain will be affected for a country like Nepal without sea-ports. Pumping part will also be affected as it might be difficult to find workers/manpower. Due to financial crisis, some companies may collapse. These indicate that cost of SIP systems may have initial spike, depending upon strength of the US dollar, then will slowly normalize within 1-2 years.

In terms of installation and use of SIPs, remittance may decrease, agriculture engagement may increase with return of large number of Nepali workforce working outside, and investments in irrigation schemes such as SIPs are expected to increase. However, for immediate future, the government of Nepal has decided that those projects that have not begun should remain untouched right now and only those already begun should continue. This may affect installation of SIP projects planned for this year. As this season is the major implementation time of government but it got paused, uses of SIPs will be limited, planting/harvesting periods are likely to be affected due to various reasons including availability of labor. This will ultimately affect agriculture production and impact food security for the next year.

There could be various ways of coping with crisis like COVID-19 in the renewable energy sector to ensure smooth operation. For example, there is something called a Regulatory Management Information System, which brings information from smart phone through online system. Use of that would be beneficial. SIP businesses may separate critical and non-critical staffs; prepare protective equipment for critical staffs; motivate; circulate level of information required at different levels (who should know what); etc. It may also be worthy putting resources on a study such as ways of making renewable systems adaptable to crisis. Crisis period like COVID-19 can be utilized effectively by engaging in capacity building activities using virtual platforms, motivating staffs, planning for cash flow management, offering stress management courses, planning for supply chain management (e.g., pump is available but panel is not available), etc.

Table 10: Challenges associated with SIPs and potential solutions

Challenges	Potential solution(s)
Return on subsidy	• Integrating SIP program with other activities such as promoting multiple uses of water as well as energy; cropping pattern advisory to suit to local context; appropriate market linkage mechanisms to optimize profits; ensuring availability and quality other inputs (e.g., seed, fertilizer, etc.); ensuring availability of after-sale services in terms of repair and maintenance; etc. • Work together with local government to minimize operational expenses, better targeting of SIPs, and use of local technical personnel • Learning from the models on smart monitoring, database management, targeting farmers, and customizing cropping pattern advisory, etc. used by private sectors and customizing them to suit for AEPC. • Introduce an idea of "**performance-based subsidy**" rather than current approach of "**capital subsidy**" with appropriate design, piloting, and evaluating.
Attracting private sectors as a collaborator/ partner	• A series of interactions with private sector, commercial banks, and MFIs to discuss on potential ways for making SIP products profitable to all • Reduce MRP by calling competitive proposal on minimum costs that vendors can install SIPs at different geographical regions of the country

	• Make provisions for releasing all subsidy amount right after installation against the bank guarantee so that vendors can offer service at more competitive rates • Promoting programs to support private sector solar enterprise with appropriate support in collaboration with local government • Promote measures like soft loans, tax-related advantages, discount in import, etc. as per the provisions made in Industrial Act (2075) so that SIP systems becomes comparable or beneficial against diesel and electric pumps. This measure can be customized with learning from IDCOL's model in Bangladesh. • All measures applicable for "enhancing return on subsidy"
Enhancing inclusive-access to SIPs	• Develop call for applications, knowledge products focusing on technology, advantages, returns, access to finance, etc. in local languages and disseminate them widely to ensure information reaches all. Mobilize women staffs and local women cooperatives, women's saving groups to disseminate information to women farmers. • Targeting disadvantaged section of society, coordinate with local governments to develop a special program focused on "reaching out to unreached", and mobilizing "social mobilizers" with incentives based on results/targets. • Consider having extra subsidy for the applications from women and disadvantaged communities, train them well, and make them responsible in handling the SIP system • Develop a pool of women technicians to encourage women ownership and management of SIPs; women in some communities do not feel comfortable reaching out to male technicians due to their cultural practices • Train and sensitize male and female staffs on GESI issues in the context of SIPs. • From inclusion perspective, small farms are generally owned by poorer section of community, therefore targeting subsidy for small farms may help making SIP program inclusive • Reduce requirements for collateral that often include land and property paperwork, and treat the SIP system itself as collateral
Sustainability	• Promote hybrid pumps that works with both DC and AC to ensure water availability in different hours • Optimize use of water by integrating crop agriculture with animal husbandry, aquaculture, WASH, etc. • Optimize use of energy by connecting SIPs to national grid or using solar for other end-uses of energy (e.g., solar drier, etc.). Connecting SIPs to national grids may also serve purpose of energy mix and enhancing quality/reliability of energy. • Design and implement a focused program on strengthening network of after-sale-services in different geographic regions of the country • Integrate SIP with other agriculture programs such as input management, market linkage, optimizing cropping pattern, capacity strengthening, etc. and work closely with agriculture department and Prime Minister Agriculture Modernization Program (PMAP). • Introduce smart-monitoring system for online monitoring of various technical parameters related to soil, water and energy; issuing agro-advisory; and collecting applications. • Work together with local governments to mobilize more resources, ensure local monitoring and maintenance support, and identify and fill local knowledge gaps.
SIPs in post-COVID-19	• Develop strategies to operate SIP business smoothly and effectively during crisis such as COVID-19 pandemic. It may include optimizing use of staffs for other productive activities, etc. • Try to embed SIP program under strategically important programs such as livelihood, agriculture, WASH, etc. so that SIP can get adequate funding in the changed context as well. • There is a possibility that agriculture will regain prominence once a large Nepali workforce employed in foreign countries return after/during the COVID-19 pandemic. In that case developing strategies on expanding SIPs to provide irrigation services to currently barren farmlands could help solve unemployment and food security concerns.

7. RECOMMENDATIONS

Based on this rapid assessment of AEPC's subsidy delivery mechanism, following are the recommendations for AEPC's consideration.

7.1 Updating subsidy policy and guidelines

There are some differences in policy and practice. It's therefore recommended to consider reflecting those practices in subsidy policy and/or guideline document.

- Though policy and guideline itself are well made, the documents need streamlining in the changed governance structure in the Federal Nepal, where the constitution delegates all functions related to renewable energy distribution and promotion to the newly formed local government. Mention shared roles and responsibilities of local government in regard to SIP demand collection, processing, and implementation.
- Mention clearly the type of water source considered in geographical areas/locations for accessing subsidy (e.g., borehole in Tarai and springs and rivers in hills, etc.)
- Mention explicitly the objective of subsidy, whether it is for irrigation or individual farmer or for promoting renewable energy as climate change mitigation option or all. The answer will guide the design for future strategies for SIP program.
- Include **recommendation from local authority (ward or Palika office)** as mandatory, as it is being practiced
- Scarp 300m requirement entirely, as it is followed only sporadically. Instead, coordinate with NEA to identify coverage of grid electricity and provide subsidy only in areas less likely to have access to grid in next 5-10 years.
- Make a clear provision on need of feasibility study for individual SIPs as there are practices of conducting feasibility study only for the systems with costs exceeding NRs. 500,000. Furthermore, consider making feasibility study simpler with ensuring a productive borehole on the plot that yields a certain minimum discharge
- It may be necessary to separate capital expenditure (CAPEX) and operating expenditure (OPEX) in the MRP calculation or publish components of MRP.
- Making a provision of accepting bank guarantee (BG) as an alternative to retention money would be win-win for AEPC as well as vendors. AEPC therefore may consider including this in the subsidy delivery mechanism guideline.
- Make it mandatory to have two different consultants for designing (or feasibility study) and implementing the SIP systems as a provision of check and balance for minimizing over-estimation of cost of SIP system.
- As email submission is also allowed, it needs to be included as an acceptable means for submitting SIP applications.

7.2 Ensuring better return on subsidy

- Maximize use of water and energy in various ways such as multiple uses of water and energy, growing crops which are remunerative, create local water markets where feasible; create local micro-grids where feasible etc.
- Reduce MRP by more frequent (at least once a year) calls for price discovery in the context of gradually decreasing prices of solar panels.
- Integrate SIPs with other programs such as improved inputs (e.g., seed fertilizer), land and water management, market linkages, training and awareness on various aspects of farming so that one complements to other for synergizing outputs. Here, local governments can play a very important role and AEPC can work closely with local governments.
- Integrate SIP program with other agriculture related initiatives of the government such as Prime Minister Agriculture Modernization Project (PMAMP) for integrated outcomes

- Try out "**performance-based subsidy**" model to reach out to targeted beneficiaries, encourage innovation, and reach out to more beneficiaries with better quality product but with same amount of subsidy
- Promote hybrid pumps so that it can work with both AC and DC current so that use of pump is maximized and return would be improved.
- Develop a suitable model for working effectively with local government to minimize operational expenses, better targeting of SIPs, and optimizing use of local technical personnel
- Consider customizing learning/experience from the models that private sector is implementing on smart monitoring, database management, targeting farmers, and customizing cropping pattern advisory, etc. to suit for AEPC and incorporate it as a part of subsidy delivery mechanism.
- Consider densifying SIPs and promote technologies for grid-connection of SIPs so that return can be maximized by selling excess energy to the national grid.

7.3 Ensuing inclusive access of SIPs

Though demand for SIPs as well as number of installations are increasing over the years and people consider it as useful technology, the subsidy program is benefiting relatively well-off farmers (land-holding of over 1 bigha, in case of AEPC's subsidy program) for various reasons as elaborated in earlier sections. Some recommendations for enhancing inclusive promotion to SIPs are provided hereunder;

- Access to information: Many marginal and smallholder communities still believe that the technology is expensive and they cannot afford it. Similarly, some have limited information regarding call for applications from AEPC. Therefore, developing appropriate knowledge products on facts about SIPs, their benefits, potential ways of accessing financial resources, and ways to improve livelihood would be very much useful. The knowledge products as well as call for applications may need to be translated into local languages and disseminated widely through local governments and local media such as FMs. A combination of knowledge products dissemination, awareness raising programs, and training implemented in collaboration with local governments would help enhance access to information, and therefore achieve inclusivity in SIP access.
- Targeted programs: Need for commercial and small farms are different. Commercial farms are generally owned by male and well-off farmers. They are looking for soft-loads and financing mechanism rather than subsidy. Whereas small farms owned by women and/or marginal/smallholder farming communities are in desperate need of subsidy. Therefore, designing a targeted program with consideration of this reality may help enhancing inclusive access to SIPs. Various ways for targeting could be lease-out, reverse auctioning, etc. For targeting, AEPC may consider working together with Farmer's Commission, which has categorized farmers based on various criteria and that would be useful information for better targeting of SIP program.
- Collect applications on rolling basis throughout the year and publish the recipient's list on regular basis so that there will be adequate time for improving feasibility study, and make improvements/corrections in installations, if any.
- Provision of extra subsidy for women and DAGs ownership and programs aimed at empowering them with knowledge, skills, and capacity.
- Provisioning of social mobilizer with incentives based on target/results for reaching out to targeted community or social group with information on SIP products.
- Trying out private service provider model with cost of irrigation subsidized by local government to those who really can't afford.

7.4 Ensuring sustainability of SIP system

All the recommendations outlined above are relevant for overall sustainability of the SIP system. Additional aspects that contributes to sustainability of SIP are outlined hereunder;

- Targeted subsidy program on need basis developed in collaboration with local governments.
- Set benchmark for quality: Rigorous check of feasibility study report to ensure robust design; setting minimum quality standard for pumps, panels and installation; and ensure its compliance through appropriate monitoring are required to ensure quality of materials as well as installation.
- Advisory service and buy-back assurance: In many cases, farmers grow crops as per the spirit of subsidence agriculture without knowledge on suitability of cash crops as per local conditions. Integrating SIP subsidy along with agro-advisory, access to finance, crop insurance, potential market, and buy-back assurance from the cooperative or government would encourage farmers to invest in SIP programs.
- Design and implement phase-wise programs to enhance coverage of after-sale services, including manpower/technicians, parts, etc., with adequate engagement of local manpower as and when possible. Furthermore, built-in 5-years of maintenance contract in the pricing of MRP.
- Create enabling environment for private sectors. Several ways to do so could be making arrangements soft loans and tax/import-related advantages; accepting bank guarantee as an alternative to retention money; categorizing private sector (as A, B and C) depending upon various criteria (e.g., experience, capability, potential to mobilize financial resources, innovations, etc.) and set some incentives for each category (e.g., defining size of project that each category can bid); designing targeted program for solar enterprises; etc.
- Developing an online platform for demand collection, monitoring (using smart-meters), and evaluation, and advisory.
- Pay adequate attention on governance focusing on principles of governance of SIP systems.
- Invest in research and development in various areas such as defining level of subsidy; crop suitability mapping; testing performance-based model; piloting “solar irrigation shop” to avail necessary inputs, equipment, information, and technical support; etc.

7.5 Preparedness for coping with pandemic like COVID19

- Develop strategies to operate SIP business smoothly and effectively during crisis such as COVID-19 pandemic. It may include optimizing use of staffs for other productive activities, etc.
- SIP program may need to be integrated with strategically important programs such as livelihood, agriculture, WASH, etc. so that SIP can get adequate funding in the changed context as well.

APPENDIXES

Table A1. Details of field visit scheduled, sites visited and interactions held

Palika, District	Site	# People Interacted	Male	Female
Day01/3rd March				
Kolbi-7, Bara	Dodharpa#1	2 (incl. Mayor)	2	0
Kolbi-7, Bara	Dodharpa#2	2	2	0
Kolbi-7, Bara	Dodharpa#3	6	6	0
Simraungadh-2, Bara	Khajani	13	7	6 (including Dy. Mayor)
Day02/4th March				
Gaur-4, Rautahat	Tikuliya	6	5	1
Gaur-4, Rautahat	Madhavpatti	8	5	3
Gaurda-2, Rautahat	Katahariya	3	3	0
Debahigonai-6, Rautahat	Karkach Village	2	1	1
Gaur, Rautahat	Tea shop	5	5	0
Day03/5th March				
Team-02: Chandranagar-2, Sarlahi	Babarjunj	9	9	0
Team-02: Chandranagar, Sarlahi and returned to Kathmandu	Chandranagar Gaupalika office	2 (incl Chairperson)	2	0
Team-01: Chhipaharmai-2, Parsa	Sambhawata	5	5	0
Day04/6th March				
Team-01: Belakha-2, Udayapur	Ramnagar	7	6	1
TOTAL		**70**	**58**	**12**

Table A2. List of stakeholders consulted

SN	Name	Sex	Affiliation	Designation
1	Ashok Shah	M	Chandranagar Palika, Sarlahi	Chief Administrative Officer
2	Achyut Hari Aryal	M	NREP Project	Advisor for Challenge Fund
3	Anjal Niraula	M	Ghampower	Chief Executive Officer
4	Avishek Malla	M	Sunfarmer	Founder/CEO
5	Bharat Bahadur Bhandari	M	Klobi Municipality, Bara	Mayor
6	Birendra Prasad Chaudhary	M	Kolti-7, Bara	Ward Chair
7	Chaitanya Prakash Chaudhary	M	AEPC	Engineer
8	Chaitya Narayan Dangol	M	Prime Minister Agriculture Modernization Project (MPAMP), Government of Nepal	Sr. Agricultural Officers]
9	Dipak Bhardwaj	M	Department of Agriculture	Sr. Agri. Engineer
10	Dipendra Chaudhary	M	Dodharpa village, Kolti Municipality 7, Bara	Farmer
11	Durga Thapa	M	Belakha Municipality, Udayapur	Mayor
12	Jageswor Kusuwa	M	Khajani village, Simraungadh-7, Bara	Farmer
13	Jaya Krishna Pandey	M	Gaurda-5, Rautahat	Farmer
14	Jigyasha Rai Yangkurung	F	DWRI	Sr. Divisional Engineer
15	Joshna Silwal	F	Ghampower	Asst. Operational Manager
16	Krishna Bahadur Shrestha	M	Sourya Energy	Representative
17	Lal Mohamad	M	Dodharpa village, Kolti-7	Farmer
18	Dr. Laxman Ghimire	M	AEPC	Senior Officer (Head of Solar Section)
19	Madhav Belbase	M	Ministry of Water Supply and Sanitation	Secretary
20	Mahendra Mahato	M	Chandranagar Palika, Sarlahi	Mayor
21	Manoj Gupta	M	Chhipaharmai Palika, Parsa	Mayor
22	Nabina Lamichhane	F	ICIMOD	Field Research Associate
23	Nanda Kishore Yadav	M	Ward-8, Gaur, Rautahat	Member of Ward Committee
24	Dr. Narayan Chaulagain	M	AEPC	Former Executive Director
25	Narayan Adhikari	M	AEPC	Director
26	Niki Maskey	F	iDE	
27	Niraj Subedi	M	KfW	Advisor for renewable energy
28	Pragyan Regmi	M	NMB Bank	
29	Rabindra Karki	M	iDE	
30	Ram Prabesh Shah	M	Environment Protection Center (EPC)	Social Mobilizer

31	Dr. Ram Prasad Dhital	M	Energy Regulatory Commission	Commissioner
32	Ranju Pandey	F	Nepal Electricity Authority (NEA)	Manager
33	Resha Piya	F	Winrock International	Program Specialist
34	Rima Devi Kuswa	F	Simraungadh Palika, Bara	Deputy Mayor
35	Sagar Mani Gyawali	M	Nepal Electricity Authority (NEA)	Asst. Directory
36	Siddhartha Gurung	M	Laxmi Bank	Asst. Relationship Manager (Energy)
37	Sandeep Kumar	M	Khajani village, Simraungadh-7, Bara	Farmer
38	Subha Laxmi Shrestha	F	AEPC	
39	Suman Dhakal	M	GIZ (for RERA project)	Energy Financing Advisor
40	Surendra Ray Yadav	M	Tikuliya, Gaur-4, Rautahat	Farmer
41	Zarif Husein	M	AEPC	Engineer

Note: Approximately other 15 farmers were consulted in two groups, 1 in Kamalpatti (Gaur-2, Rautahat) and another in Babargunj (Chandranagar-2, Sarlahi), but their names are not available and therefore, not listed.

Table A3: Various working models related to SIPs in practice

There are various models tested so far, however, more analysis and recommendations are required on how they work on a larger-scale covering wider geography with limited resources, which is the case/role of AEPC. Some of the tested models are outlined hereunder:	
RERL model: The Renewable Energy and Rural Livelihood (RERL) program started in July 2014 as a joint initiative of the Government of Nepal and the United Nations Development Program (UNDP) which supported the installation of 5 SIPs in 2015. It was a demonstration project through vendor financing and credit guarantee mechanisms at the time when AEPC's subsidy was not available for SIPs. RERL provided a grant and a loan guarantee to Sunfarmer to install the SIP systems. They used locally fabricated pre-paid energy meter to deal with challenges of timely collection of revenue. The RERL was focused on promotion, policy lobby, and development of business model. They introduced "rent-to-own model" was successfully implemented in which farmers have to pay minimal upfront cost and the rest is managed through vendor financing and credit guarantee mechanisms. The project successfully implemented more than 20 SIPs under the scheme and paved way for AEPC for introducing subsidy policy for SIPs as well.	***RERL model***: The Renewable Energy and Rural Livelihood (RERL) program started in July 2014 as a joint initiative of the Government of Nepal and the United Nations Development Program (UNDP) which supported the installation of 5 SIPs in 2015. It was a demonstration project through vendor financing and credit guarantee mechanisms at the time when AEPC's subsidy was not available for SIPs. RERL provided a grant and a loan guarantee to Sunfarmer to install the SIP systems. They used locally fabricated pre-paid energy meter to deal with challenges of timely collection of revenue. The RERL was focused on promotion, policy lobby, and development of business model. They introduced "rent-to-own model" was successfully implemented in which farmers have to pay minimal upfront cost and the rest is managed through vendor financing and credit guarantee mechanisms. The project successfully implemented more than 20 SIPs under the scheme and paved way for AEPC for introducing subsidy policy for SIPs as well.
ICIMOD model: ICIMOD tested various models and demonstrated that good quality systems and adequate human and financial resources, coupled with regular monitoring and after-sale services can certainly provide good returns. The price of pump in the ICIMOD model also included 3 years of O&M by the vendor. They identified that a "grant-cum loan" model worked well, in which a loan amount was tied-up with a co-operative at 5% interest rate. The co-operative kept a land registration certificate as collateral from the farmer, but it was released after a few months once they were confident that loan would be re-paid on time. In a Grant model, all 40% cost was paid in advance, and 60% was provided as subsidy. Farmers without land were not interested because they felt it risky to invest in land that did not belong to them	***Sunfarmer model***: This private company used a model in which farmers pay 20-25% as upfront cost and the remaining 70-80% is financed by the private actor (i.e., Sunfarmer in this case). To repay the loan, farmers sign a water sales agreement for 2-3 years. Once the loan is paid, the SIP system belongs to the farmer. This model was successfully implemented with more than 27 pumps in Chitwan in 2016.

Table A4. Number of households applied for SIP and granted, by district

District	Applied for SIP	SIP granted	Granted (%)
Province 1			
Morang	326	89	27.3
Sunsari	205	42	20.5
Jhapa	51	34	66.7
Okhaldhunga	22	6	27.3
Udayapur	16	6	37.5
Ilam	15	5	33.3
Khotang, Bhojpur, Dhankuta, Sankhuwasabha, Solukhumbu	10	0	0.0
Province 2			
Sarlahi	548	154	28.1
Rautahat	444	286	64.4
Parsa	257	70	27.2
Saptari	215	111	51.6
Bara	92	30	32.6
Siraha	36	24	66.7
Dhanusha	34	16	47.1
Mahottari	9	7	77.8
Bagmati Province			
Chitwan	473	96	20.3
Dhading	146	26	17.8
Makwanpur	48	2	4.2
Dolakha	31	6	19.4
Bhaktapur	12	6	50.0
Nuwakot	3	2	66.7
Lalitpur, Ramechhap, Kavre, Sindhuli, Kathmandu, Sindhupalchok	18	0	0.0
Gandaki Province			
Nawalparasi	37	9	24.3
Tanahu	16	3	18.8
Kaski, Lamjung, Gorkha, Syangja	8	2	25.0
Province 5			
Kapilbastu	284	35	12.3
Nawalparasi	250	53	21.2
Banke	160	72	45.0
Pyuthan	153	18	11.8
Bardiya	82	34	41.5
Rupandehi	46	20	43.5

Gulmi	37	25	67.6
Dang	29	26	89.7
Rolpa	24	12	50.0
Arghakhanchi	9	8	88.9
Palpa	2	0	0.0
Karlani Province			
Mugu	15	5	33.3
Jumla	12	0	0.0
Surkhet	10	2	20.0
Kalikot	9	1	11.1
Salyan, Rukum, Jajarkot, Dailekh, Humla	19	0	0.0
Sudurpaschim Province			
Kailali	202	27	13.4
Kanchanpur	70	12	17.1
Achham	16	2	12.5
Baitadi	12	0	0.0
Bajhang, Bajura, Dadeldhura	17	0	0.0

Table A5: Average land holding size of SIP applicants and recipients by district

District	Applied for SIP	SIP granted
Province 1		
Morang	2.1	2.2
Sunsari	2.6	3.6
Jhapa	2.4	3.0
Okhaldhunga	18.4	-
Udayapur	6.6	-
Ilam	9.3	0.6
Province 2		
Sarlahi	2.6	2.2
Rautahat	2.2	2.4
Parsa	1.7	2.2
Saptari	1.6	1.6
Bara	2.1	1.8
Siraha	3.3	2.0
Dhanusha	4.3	4.3
Mahottari	6.7	6.6
Bagmati Province		
Chitwan	1.7	1.3
Dhading	1.2	0.46
Makwanpur	2.9	15
Dolakha	7.9	8.2

Bhaktapur	1.6	-
Lalitpur	11.7	-
Gandaki Province		
Nawalparasi	4.2	3.0
Tanahu	9.0	1.8
Province 5		
Kapilbastu	2.5	2.6
Nawalparasi	9.0	3.6
Banke	2.3	2.3
Pyuthan	8.3	2.8
Bardiya	3.4	1.7
Rupandehi	1.4	1.1
Gulmi	6.1	2.4
Dang	10.3	3.8
Rolpa	14.8	5.0
Palpa	5.5	-
Karnali Province		
Mugu	6.6	-
Jumla	5.6	-
Surkhet	52.2	70
Kalikot	9.5	5.3
Sudurpaschim Province		
Kailali	6.0	0.31
Kanchanpur	8.6	12.0
Achham	36.6	-
Baitadi	70.3	-

Notes: Districts with no average values of land holding size either did not have anyone granted a SIP or land size information was missing for the SIP granted farmers

Table A6. Number of applications and SIP grant rate by different categories of land holding size, by province

Province	*Categories of land holding size*				
	< 1 bigha	1-2 bigha	2-4 bigha	4-6 bigha	>6 bigha
Province 1	135 (26.7)	153 (24.4)	70 (23.8)	26 (26.3)	54 (11.6)
Province 2	168 (37.2)	490 (37.8)	197 (38.5)	71 (34.7)	55 (39.4)
Bagmati	247 (17.3)	139 (16.7)	91 (17.7)	5 (25.1)	43 (10.3)
Gandaki	6 (23.3)	7 (22..9)	10 (16.6)	9 (13.4)	12 (12.3)
Province 5	194 (20.0)	306 (28.3)	114 (24.5)	61 (18.8)	170 (14.2)
Karnali	5 (0.9)	9 (0.0)	6 (11.1)	3 (44.4)	26 (3.8)
Sudurpaschim	85 (12.1)	26 (8.1)	13 (2.7)	22 (5.7)	65 (11.5)

Notes: Point estimates in parenthesis are SIP grant rates by province and by categories of landholding size

Table A7. Pump characteristics, by province

Province	Average pump capacity [min-ma] (hp)	Average panel watt peak [min-max] (wp)	Average pump head [min-max] (m)	Average discharge [min-max] (0,000 litre/day)
Province 1	1.7 [0.7, 5]	1476 [70, 4860]	12.4 [6, 70]	9.43 [1, 50]
Province 2	1.6 [1, 10]	1748 [70, 9850]	10.3 [0, 150]	14.83 [1, 30]
Bagmati	2.5 [1, 7]	2534 [900, 11200]	37.8 [4.6, 200]	6.84 [1, 10]
Gandaki	1.8 [1, 10]	1856 [1000, 9000]	28.0 [5, 100]	11.28 [1, 50]
Province 5	2.2 [1, 12.5]	1856 [70, 15120]	24.5 [4, 200]	8.11 [1, 22.5]
Karnali	6.2 [5, 15]	6134 [4796, 15120]	60.0 [50, 130]	10.0 [10, 10]
Sudurpaschim	1.7 [1, 10]	585 [70, 10240]	9.0 [6, 41]	3.54 [1, 20]
All provinces	**1.9** **[0.7, 15]**	**1808** **[70, 15120]**	**16.9** **[0, 200]**	**11.43** [1, 50]

Notes: Point estimates are averages. Numbers in brackets are range, the minimum and maximum values.

Table A8. List of service providers and number of SIPs installed by them

Service Provider	**Number of SIP installed**	**Share of SIPs installed**
Surya Roshni Industrial Pvt. Ltd.	327	23.63
Ultra Infoys	239	17.27
SunFarmer Nepal Pvt. Ltd.	162	11.71
Kulayan Energy Pvt. Ltd.	105	7.59
Krishna Grill & Engineering Works (P)..	100	7.23
Ultra-Solar Energy &Steel Engg.Pvt Ltd	100	7.23
Sol-Tronix (P) Ltd	75	5.42
Center For Resource Conservation Pvt ..	71	5.13
ShivaShakti Hardware Pvt. Ltd.	45	3.25
Sourya Energy Pvt. Ltd.	32	2.31
Systems and Energies Pvt. Ltd.	22	1.59
Kalash Solar & Electricity (P) Ltd	21	1.52
Public Solar Pvt. Ltd.	14	1.01
Environment Protection Center Nepal, ..	10	0.72
Topsun Energy Pvt. Ltd.	10	0.72
Solar Construction and Energy Pvt. Ltd.	8	0.58
Zen Oorja	8	0.58
Asian Ultra Energy Pvt Ltd	7	0.51

Narayani Power Solutions Pvt. Ltd	6	0.43
Himal Refrigeration & Electrical Indu..	5	0.36
Nation Wide Smart Solution Pvt Ltd	4	0.29
Urja Ghar Pvt. Ltd.	4	0.29
Nabikaraniya Urja Pvt. Ltd.	3	0.22
Sunshine Energy Pvt. Ltd.	3	0.22
Deeplight Energy (P) Ltd	1	0.07
Everest Soalr Energy Pvt. Ltd.	1	0.07
Nepal Energy Development Company (Pvt..	1	0.07
Total SIPs	**1,384**	

Annex-B: Distribution of solar irrigation pumps (SIPs) across the Palikas

Province	District	Palika Name	Total applications	SIPs granted	SIP grant rate (%)
Province 1	Bhojpur	Arun	1	0	0
	Bhojpur	Pauwadungma	1	0	0
	Dhankuta	Dhankuta	1	0	0
	Dhankuta	Sangurigadhi	1	0	0
	Ilam	NA	4	4	100
	Ilam	Chulachuli	3	1	33.33
	Ilam	Mai	7	0	0
	Ilam	Rong	1	0	0
	Jhapa	Barhadashi	6	4	66.67
	Jhapa	Bhadrapur	10	9	90.00
	Jhapa	Birtamod	7	4	57.14
	Jhapa	Birtamod	1	1	100
	Jhapa	Charpane	2	2	100
	Jhapa	Gaur	1	1	100
	Jhapa	Gauradhaha	1	0	0
	Jhapa	Gaurigunj	2	2	100
	Jhapa	Jhapa	1	1	100
	Jhapa	Kamal	6	4	66.67
	Jhapa	Kankai	2	0	0.0
	Jhapa	Mechinagar	3	1	33.33
	Jhapa	Shivasataxi	9	5	55.56
	Khotang	Ainselukhark	1	0	0
	Khotang	Halesi Tuwachung	1	0	0
	Khotang	Rupakot Majhuwagadhi	1	0	0
	Morang	Belbari	3	1	33.33
	Morang	Biratnagar	10	3	30.00
	Morang	Budhiganga	25	1	4.00
	Morang	Gramthan	10	4	40.00
	Morang	Jahada	3	1	33.33
	Morang	Kanepokhari	10	2	20.00

	Morang	Katahari	21	12	57.14
	Morang	Kerabari	1	0	0
	Morang	Rangeli	4	1	25.00
	Morang	Ratananagar Municipality	2	2	100
	Morang	Ratuwamai	190	57	30.00
	Morang	Sundarharaicha	5	2	40.00
	Morang	Sunwarshi	41	3	7.32
	Morang	Urlabari	1	0	0
	Okhaldhunga	NA	6	6	100
	Okhaldhunga	Champadevi	1	0	0
	Okhaldhunga	Chisankhugadhi	1	0	0
	Okhaldhunga	Likhu	1	0	0
	Okhaldhunga	Manebhanjyang	2	0	0
	Okhaldhunga	Sunkoshi	11	0	0
	Sankhuwasabha	Dharmdevi	2	0	0
	Solokhumbu	Soludhadkunda	1	0	0
	Sunsari	NA	1	1	100
	Sunsari	Barahachhetra Municipality	33	8	24.24
	Sunsari	Barju	12	1	8.33
	Sunsari	Dewangunj	26	4	15.38
	Sunsari	Dhuhabi	1	1	100
	Sunsari	Duhabi	36	2	5.56
	Sunsari	Gadhi	1	0	0
	Sunsari	Inaruwa	18	5	27.78
	Sunsari	Koshi	73	17	23.29
	Sunsari	Ramdhuni	4	3	75.00
	Udayapur	NA	1	1	100
	Udayapur	Belaka	1	0	0
	Udayapur	Chaudandigadhi	8	0	0
	Udayapur	Gaighat	1	1	100
	Udayapur	Katari	1	0	0
	Udayapur	Panchkanya	2	2	100
	Udayapur	Triyuga	2	2	100
Province 2	Bara	Adarshkotwal	2	2	100
	Bara	Bahuari	1	1	100
	Bara	Baragadhi	6	4	66.67
	Bara	Devtal	2	1	50.00
	Bara	Kalaiya	21	2	9.52
	Bara	Kolhabi	11	7	63.64

Bara	Mahagahdimai	11	4	36.36
Bara	Manaharwa	2	0	0
Bara	Nijgadh	2	0	0
Bara	Pachurauta	1	0	0
Bara	Simraungadh	33	9	27.27
Dhanusha	Chhireshwarnath Municipality	2	1	50.00
Dhanusha	Chirkhnath	1	1	100
Dhanusha	Ganeshman Chardham	2	2	100
Dhanusha	Kamal Rural Municipality	1	1	100
Dhanusha	Kamala	1	0	0
Dhanusha	Sabaila	27	11	40.74
Mahottari	Bardibas	1	1	100
Mahottari	Gaushala	1	0	0
Mahottari	Ramgopal	1	1	100
Mahottari	Samsi	5	4	80.00
Mahottari	Sonama	1	1	100.0
Parsa	Bahudaramai	15	11	73.33
Parsa	Birtamai Municipality	1	0	0.00
Parsa	Chhipaharmai	185	42	22.70
Parsa	Jagarnathapur	21	5	23.81
Parsa	Jirabhabani	20	5	25.00
Parsa	Kalikamai	6	2	33.33
Parsa	Parsa Gadhi	3	2	66.67
Parsa	Parterwa Sugauli	5	3	60.00
Parsa	Thori	1	0	0
Rautahat	NA	1	0	0
Rautahat	Bagahi	2	2	100
Rautahat	Brindaban	10	5	50.00
Rautahat	Dewahi Gonai	6	6	100
Rautahat	Dharhari	1	1	100
Rautahat	Dipahi	11	5	45.45
Rautahat	Dumariya	1	1	100
Rautahat	Durga Bagwati	90	66	73.33
Rautahat	Fatuwa Bijaypur	1	1	100
Rautahat	Gadhimai	56	32	57.14
Rautahat	Gaidahiguthi	1	1	100
Rautahat	Gamhariya Virta	5	3	60.00
Rautahat	Garuda	29	24	82.76
Rautahat	Garuda	6	5	83.33
Rautahat	Gaudahi Buthi	1	1	100
Rautahat	Gaur	22	20	90.91
Rautahat	Gujara	13	9	69.23
Rautahat	Ishanath	1	1	100
Rautahat	Katahariya	70	23	32.86
Rautahat	Maadanpur	1	1	100

	Rautahat	Madanpur	3	2	66.67
	Rautahat	Madhav Narayan	29	21	72.41
	Rautahat	Mahammadpur	10	9	90.00
	Rautahat	Malahi	3	3	100
	Rautahat	Maulapur	9	8	88.89
	Rautahat	Paroha	4	1	25.00
	Rautahat	Phatuwa Bijayapur	47	25	53.19
	Rautahat	Pothiyahi	6	5	83.33
	Rautahat	Rajpurpharhardawa	1	1	100
	Rautahat	Ram Nagar	1	1	100
	Rautahat	Samanpur	1	1	100
	Rautahat	Yemunamai	2	2	100
	Saptari	NA	26	26	100
	Saptari	Balan Bihul	7	4	57.14
	Saptari	Barhampur	1	1	100
	Saptari	Bishnupur	9	8	88.89
	Saptari	Bode Barsain	34	12	35.29
	Saptari	Dakneshwori	1	1	100
	Saptari	Hanumannagar Kankalini	3	2	66.67
	Saptari	Kanchanrup	5	3	60.00
	Saptari	Khadak	1	1	100
	Saptari	Mahadeva	10	4	40.00
	Saptari	Rajbiraj	84	26	30.95
	Saptari	Rajgadh	5	0	0
	Saptari	Rupani	10	10	100
	Saptari	Sambhunath	11	7	63.64
	Saptari	Saptari-1	2	2	100
	Saptari	Sarswar-3	1	1	100
	Saptari	Silhatprasahi	1	1	100
	Saptari	Surunga	1	0	0
	Saptari	Tilathi Koiladi	1	0	0
	Saptari	Tirahut	2	2	100
	Sarlahi	Babarjung	1	1	100
	Sarlahi	Bagmati Municipality	14	3	21.43
	Sarlahi	Balara Municipality	26	4	15.38
	Sarlahi	Barahathawa	2	0	0
	Sarlahi	Bishnu	2	1	50.00
	Sarlahi	Chakraghatta	5	3	60.00
	Sarlahi	Chandra Nagar	66	24	36.36
	Sarlahi	Ganesiya	1	1	100
	Sarlahi	Godaita	19	3	15.79
	Sarlahi	Godauna	1	0	0
	Sarlahi	Hariwan	1	1	100
	Sarlahi	Ishwarpur Municipality	84	15	17.86
	Sarlahi	Kabilasi	1	0	0
	Sarlahi	Kaudena	63	20	31.75

	Sarlahi	Khoriya	1	0	0
	Sarlahi	Khutauna	4	1	25.00
	Sarlahi	Lalbandi	19	8	42.11
	Sarlahi	Malangawa	225	64	28.44
	Sarlahi	Musaili	4	4	100
	Sarlahi	Ramnagar	5	0	0
	Sarlahi	Su.Chu.	3	0	0
	Sarlahi	Sunkoshi	1	1	100
	Siraha	Bhagawanpur	1	0	0
	Siraha	Bishnupurkatti	1	0	0
	Siraha	Dhanagadhimai	7	0	0
	Siraha	Golbazar	1	1	100
	Siraha	Karjanha Municipality	4	4	100
	Siraha	Lahan	10	9	90.00
	Siraha	Mirchaiya	10	9	90.00
	Siraha	Mukhipur	1	1	100
	Siraha	Pachal Jharana	1	0	0
Bagmati	Bhaktapur	NA	6	6	100
	Bhaktapur	Suryabinayak	6	0	0
	Chitwan	Bharatpur	24	8	33.33
	Chitwan	Kalika	8	2	25.00
	Chitwan	Khairahani	147	41	27.89
	Chitwan	Rapti	211	30	14.22
	Chitwan	Ratnanagar	81	15	18.52
	Chitwan	Sukranagar	1	0	0
	Chitwan	Sunbarshi Municipality	1	0	0
	Dhading	Benighat Rorang	1	0	0
	Dhading	Juwalamukhi	6	2	33.33
	Dhading	Nilakantha	120	19	15.83
	Dhading	Siddhalek	18	5	27.78
	Dhading	Thakre	1	0	0
	Dolakha	Baieteshwor	3	1	33.33
	Dolakha	Bhimeshwor	2	0	0
	Dolakha	Gaurishankar	2	0	0
	Dolakha	Jiri	5	2	40.00
	Dolakha	Kalinchok	14	2	14.29
	Dolakha	Melung	5	1	20.00
	Kathmandu	Nagarjun	1	0	0
	Kavre	Mahabhart	1	0	0
	Kavre	Panchakhal	1	0	0
	Kavre	Roshi	2	0	0
	Lalitpur	Bagmati Municipality	3	0	0
	Lalitpur	Mahankal	2	0	0
	Makwanpur	Bakaiya	1	0	0
	Makwanpur	Kailash	2	0	0
	Makwanpur	Manahari	42	1	2.38

	Makwanpur	Raksirang	1	0	0.00
	Makwanpur	Thaha	2	1	50.00
	Nuwakot	Meghang	1	0	0
	Nuwakot	Suryagadhi	2	2	100
	Ramechhap	Khadadevi	2	0	0
	Ramechhap	Manthali	1	0	0
	Ramechhap	Umakunda	2	0	0
	Sindhuli	Hariharpurgadhi	1	0	0
	Sindhuli	Sunkoshi	1	0	0
	Sindhupalchowk	Indrawati	1	0	0
Gandaki	Gorkha	Dharche	1	0	0
	Kaski	Machhapuchhre	1	0	0
	Kaski	Madi	3	0	0
	Lamjung	Madhyanepal	1	0	0
	Lamjung	Rainas	1	1	100
	Nawalparasi	Devchuli	2	0	0
	Nawalparasi	Gaidakot	13	3	23.08
	Nawalparasi	Hupsekot	1	0	0
	Nawalparasi	Kawasoti	2	1	50
	Nawalparasi	Palhi Nandan	3	3	100
	Nawalparasi	Pratappur	2	1	50.00
	Nawalparasi	Sarawal	14	1	7.14
	Syangja	NA	1	1	100
	Tanahu	Bardaghat Municipality	1	0	0
	Tanahu	Bhanu	5	2	40.00
	Tanahu	Bhimad	2	0	0
	Tanahu	Devghat	4	0	0
	Tanahu	Ghiring	3	1	33.33
	Tanahu	Myagde	1	0	0
Province 5	Arghakhanchi	NA	1	1	100
	Arghakhanchi	Sandhikharka	1	0	0
	Arghakhanchi	Shit Ganga Municipality	1	1	100
	Arghakhanchi	Shitganga Municipality	1	1	100
	Arghakhanchi	Sitaganga Municipality	5	5	100
	Banke	Khajura	148	68	45.95
	Banke	Kohalpur	2	0	0
	Banke	Rapti Sonari	10	4	40.00
	Bardiya	Badhaiyatal	20	4	20.00
	Bardiya	Bansgadhi	51	28	54.90
	Bardiya	Barbardiya	3	0	0
	Bardiya	Basgadi	2	2	100

	Bardiya	Geruwa	1	0	0
	Bardiya	Khajura	1	0	0
	Bardiya	Madhuban	1	0	0
	Bardiya	Rajpur	1	0	0
	Bardiya	Thakurbaba	2	0	0
	Dang	Ghorahi	2	2	100
	Dang	Lamahi	1	0	0
	Dang	Tulsipur	26	24	92.31
	Gulmi	NA	18	18	100
	Gulmi	Chatrakot	5	0	0
	Gulmi	Dhurkot	13	6	46.15
	Gulmi	Isma	1	1	100
	Kapilbastu	Bijaya Nagar	92	13	14.13
	Kapilbastu	Buddabhumi Municipality	9	5	55.56
	Kapilbastu	Kapilbastu	1	1	100
	Kapilbastu	Shivaraj	177	13	7.34
	Kapilbastu	Sunbarsi	1	0	0
	Kapilbastu	Yashodhara	4	3	75.00
	Nawalparasi	Bardaghat	66	43	65.15
	Nawalparasi	Binay Tribeni	65	2	3.08
	Nawalparasi	Bulingtar	8	0	0
	Nawalparasi	Kawasoti	1	1	100
	Nawalparasi	Pratappur	89	4	4.49
	Nawalparasi	Ramgram	16	3	18.75
	Nawalparasi	Susta	5	0	0
	Palpa	Ribdikot	2	0	0
	Pyuthan	Mallarani	1	0	0
	Pyuthan	Mandavi	22	1	4.55
	Pyuthan	Naubahini	4	0	0
	Pyuthan	Pyuthan Municipality	15	1	6.67
	Pyuthan	Sarumarani	19	0	0
	Pyuthan	Swargadwari	92	16	17.39
	Rolpa	Gangadev	1	1	100
	Rolpa	Rolpa	5	1	20.00
	Rolpa	Runtigadi	1	0	0
	Rolpa	Sukidaha	3	0	0
	Rolpa	Sunchhahari	1	0	0
	Rolpa	Suwarnabati	2	0	0
	Rolpa	Tribeni	11	10	90.91
	Rupandehi	Butwal	2	2	100
	Rupandehi	Marchawari	1	0	0
	Rupandehi	Rohini	1	1	100
	Rupandehi	Sammarimai	5	1	20.00
	Rupandehi	Shiddharthanagar	2	0	0
	Rupandehi	Shudhdhodhan	35	16	45.71
Karnali	Dailekh	Chamunda Bindrasaini	4	0	0

	Humla	Adanchuli	4	0	0
	Humla	Tanjakot	1	0	0
	Jajarkot	Kuse	1	0	0
	Jumla	Chandannath	2	0	0
	Jumla	Dhapa	2	0	0
	Jumla	Guthichaur	1	0	0
	Jumla	Hima	6	0	0
	Jumla	Sinja	1	0	0
	Kalikot	Khadahhakra	7	0	0
	Kalikot	Raskot	1	0	0
	Kalikot	Tilagufa	1	1	100
	Mugu	NA	5	5	100
	Mugu	Chhayanath Rara	1	0	0
	Mugu	Khatyad	3	0	0
	Mugu	Soru	6	0	0
	Rukum	Chaurjahari	1	0	0
	Rukum	Darmi	1	0	0
	Salyan	Bagchaur	5	0	0
	Salyan	Kumakhmalika	1	0	0
	Salyan	Sharada	1	0	0
	Surkhet	Birendranagar	6	2	33.33
	Surkhet	Chaukune	4	0	0
Sudurpaschim	Achham	Bannigadhi Jayagadh	1	0	0
	Achham	Mangalsen	9	1	11.11
	Achham	Sanphebagar	4	0	0
	Achham	Turmakhand	2	1	50.00
	Baitadi	Dasharathchanda	1	0	0
	Baitadi	Dogdakedar	10	0	0
	Baitadi	Sigas	1	0	0
	Bajhang	Bithadchir	5	0	0
	Bajhang	Chabispathivera	1	0	0
	Bajhang	Masta	1	0	0
	Bajhang	Sorgaduwari Municipality	1	0	0
	Bajhang	Talkot	1	0	0
	Bajura	Badimalika	2	0	0
	Bajura	Budhinanda	1	0	0
	Bajura	Pandav Gupha	1	0	0
	Bajura	Swami Kartik	3	0	0
	Dadeldhura	Ajaymeru	1	0	0
	Kailali	Ainselukhark	1	0	0
	Kailali	Bagmati Municipality	1	0	0
	Kailali	Bardaghat	5	0	0
	Kailali	Belaka	1	0	0
	Kailali	Bishnupurkatti	1	0	0
	Kailali	Dhangadhi	149	26	17.45
	Kailali	Gaidakot	7	0	0

	Kailali	Janaki	1	0	0
	Kailali	Kailari	26	1	3.85
	Kailali	Kawasoti	1	0	0
	Kailali	Mohanyal	7	0	0
	Kailali	Ratnanagar	1	0	0
	Kailali	Rupani	1	0	0
	Kanchanpur	Bardaghat	6	0	0
	Kanchanpur	Bedkot	1	0	0
	Kanchanpur	Belauri	21	8	38.10
	Kanchanpur	Bithadchir	1	0	0
	Kanchanpur	Devchuli	2	0	0
	Kanchanpur	Fatuwa Bijaypur	1	0	0
	Kanchanpur	Ishoworpur	1	0	0
	Kanchanpur	Kohalpur	1	0	0
	Kanchanpur	Krishnapur	17	3	17.65
	Kanchanpur	Mandavi	1	0	0
	Kanchanpur	Punarbas	1	0	0
	Kanchanpur	Punarbas	1	1	100.00
	Kanchanpur	Sarawal	14	0	0
	Kanchanpur	Shivasataxi	1	0	0
	Kanchanpur	Soludhadkunda	1	0	0
Total	**64**	**360**	**4530**	**1384**	**30.60**