Positive Effects of Solar Powered Irrigation Pumps on Subsistence Farmers in Rural Nepal

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Acknowledgments:

Reflection:

In the past eight weeks, my time in Nepal has given me experiences and opportunities that I honestly never could have imagined. This had been my first experience living out of the country on my own, and no matter the level of preparation, there was nothing that could have prepared me for how this experience has had an impact on me. Being able to experience different parts of Nepal and working with smallholder farmers has given me a new perspective on so many things. I am so grateful for what I have, the life I live and the experiences that this adventure has given me. However, I also have found so much happiness here. Everywhere you go, no matter the circumstances, these people have pure happiness. This level of joy is contagious and it makes you count your blessings each and every day. It also inspires me to work toward the future, with this audience in mind I am inspired to continue into this field working toward a better future.

My fieldwork was the most challenging and rewarding part of my journey. It started the week after I got to Nepal, and I was still adjusting. We were gone for twelve days and went to the southernmost part of Nepal. We were visiting the subsistence farmers that were utilizing Solar Powered Irrigation Systems and completing a questionnaire with each farmer. These farmers are rural, and in southern Nepal it was summer time and extremely hot. The culture shock was a lot to take in at first. Seeing farmers living in clay houses with so many limited resources really gave me a lot to think about. Each farmer I met had such a different story, an interesting past, and a hopeful future. After my first interview I was incredibly grateful to be experiencing this part of Nepal that very few got to see. The adjustment was difficult but also

eye-opening. Seeing the contrasts in everyday life has given me an appreciation for the simple things in life. The ability to adapt with your environment and just "go with the flow" has been crucial during my time abroad. It's incredibly hard to prepare for experiences and work you have limited background and knowledge about. So you prepare the best you can, and adjust along the way.

The people I have met here are what I believe have made this journey so great. At the research center there are people from all around the world, actively engaging in making a difference for the environment and the people who affect it. I have made friends and connections that will last a lifetime, along with stories and memories I am fond of. My experience here in Nepal was highlighted because of the collaboration of employees turned friends, with a common goal in mind.

The independent factor is where I think I have grown the most. Not having a designated host family and showing up to a foreign country alone at first was a little startling. However, you grow and you adapt. You make connections, bring a book to read when you eat out alone, and you try to never miss an opportunity. I have made enough friends at my research center to always have someone to rely on and help me get around. People are kind here, and you can always stop and ask for help. I never felt unsafe during my time abroad, but I did feel myself mature. Being independent makes you realize that anything you need is your responsibility. You adapt to your surrounding through the maturity that comes with independence.

All in all my time in Nepal was truly an adventure of a lifetime. The people and places I have met and experienced have had an impact on who I am today. The skills I have developed during my time abroad are going to help me navigate through life much easier in the upcoming

years. I am always going to have this experience to look back on and learn from in the future. As well as the connections I have made and the friends I have met and relied on. This experience has had such a great impact on who I am, and what I now feel like I can accomplish. The world isn't such a scary place, it's actually quite small with a lot to offer. The more connections you develop and experiences you collect the broader your opportunities seem to get.

Credits:

Like I had mentioned earlier the best part of this trip was the people I have met and worked with along the way. This experience would not have been the same without the help of such amazing and intelligent colleagues.

I would first like to extend my gratitude to Dr. Aditi Mukherji, my mentor and a truly an inspiring woman. "Dr Aditi Mukherji is Theme Leader, Water and Air, at ICIMOD. Before joining ICIMOD in April 2013, she served as Senior Researcher at the International Water Management Institute (IWMI) in Colombo, Sri Lanka, and New Delhi, India. She has over 18 years of experience working on policies and specializes in water resources management with a special focus on the water-energy-food nexus." (Dr. Aditi Mukherhji, ICIMOD) Dr. Aditi has been an inspiration to me during my time here. Her determination and dedication to her work is inspiring to many including myself. I am so thankful that I had a

mentor who is so passionate about the work she is accomplishing and helping me to be a part of it.

I would also like to thank Nabina Lamichhane. A field research associate at the International Centre for Integrated Mountain Development (ICIMOD). I worked closely with Nabina during my field work at ICIMOD, she has helped me with my work and has also been a great friend during my time in Nepal. I am grateful to have had such an amazing colleague to work and collaborate with.

Lastly, I would like to thank Ambassador Kenneth M. Quinn and the late Norman Borlaug for giving me this opportunity. Ambassador Quinn is continuing Mr. Borlaug's ambitions in this fight against global food insecurity, and is the reason opportunities like the Borlaug-Ruan International Internship is available for students like me. This internship has given me the inspiration and determination to be actively involved now and in the future to helping to solve global food insecurity. I am deeply grateful that I had the opportunity to experience this adventure.

To all the friends and coworkers I have met along the way; thank you for making this experience so impactful and enjoyable. I will miss you all, and wish you nothing but the best of luck in all your endeavours.

Dedication:

I would like to dedicate my work and this experience to my grandfather and guardian angel, James Chilcot. He passed away a month before I embarked on this experience, however his teachings helped me navigate through this internship and insured that I made the most out of this opportunity. He is the man that taught me life's greatest adventure is found within the people you meet and the friends and family your share the journey with along the way. That you can

accomplish anything with the right creative mindset, and ambition. Above all he taught me that the destination has little impact on the adventure, but the journey is where the true value lies.

Abstract:

The main focus of this paper is on the positive affects Solar Powered Irrigation Pumps (SPIP) are having on subsistence farmers in rural parts of Nepal. The project that I completed at the International Centre for Integrated Mountain Development (ICIMOD) was recording how SPIP are affecting the farmer's overall livelihood. I wrote profiles on each farmer, telling the stories of their farms and their families. While completing this work, I had discovered just how beneficial this new technology is to smallholder farmers and how much of an impact it is having on their livelihoods.

Introduction:

Subsistence farmers in rural parts of Nepal face many issues in everyday life. These farmers are reliant on successful yields to provide for their families. The underdevelopment of these areas lead to limited access to water, electricity, new technologies and farming practices. This makes access to sufficient amounts of water for irrigation challenging and the success of their harvests uncertain. Providing sufficient food for your family isn't something you want to leave to chance. Having a reliable and affordable way to irrigate their farmland is a much sought after ambition for many of these farmers. Imagine having to grow all of the food your family needs to consume throughout the year with unreliable access to water, this makes a hard task more difficult. Fortunately ICIMOD has recognized these struggles and has a solution to help

these subsistence farmers. Solar Powered Irrigation Pumps (SPIP) are changing the lives of many smallholder farmers throughout Nepal.

Before most farmers relied on diesel or electric pumps, to pump groundwater for irrigation. However, both of these systems have major flaws and inconveniences for the farmers. Both of these systems have very high operating costs. There are fuel, maintenance, transportation, and labor expenses that are all associated with these two systems. In these rural areas income is extremely low and the ability to constantly supply money to break even in production is a balancing act. The electricity cut-off is also an issue when utilizing an electric pump. With very common power outages, the electric pump shuts off and has to be restarted when the power supply comes back. This system is unreliable and extremely timely for farmers. These issues have made irrigation a very difficult and expensive task to maintain. However with SPIP most of these challenges are eliminated.

Solar Irrigation is affordable and effective solution for irrigation for subsistence farmers. The most beneficial aspects of SPIP is it's affordability; there are no fuel costs. Completely operated by solar energy farmers never have supply expensive diesel or pay electric bills. The availability and reliability of water with Solar Pumps are having many positive effects on subsistence farmers in rural Nepal.

Methodology:

I. Participants

The participants of this study were the subsistence farmers from the Terai region of Nepal. Terai is the southern strip of Nepal when the climate is much hotter and the access to

water, electricity, and modern technology is limited. There were a total of 50 participants in this study, all of whom were Solar Powered Irrigation Pump owners or operators. All of the farmers lived in the Terai region but were spread out into various districts. Including; Rautahat, Sarlahi, Bara, and Saptari.

II. Apparatus & Materials

- Questionnaire- custom made to inquire about the affects SPIP is having on the livelihood of smallholder farmers. Responses were translated and recorded.
- Computer- used to record responses and craft profiles.

III. Procedure

The design process of this experiment was simple and straightforward. First, I designed a questionnaire that inquired about various aspects of their livelihood focusing on; income, production, nutrition, and home atmosphere. These questions were designed to tell the story of each farmer's past, present, and future ambitions. I was able to determine affects SPIP has had on each aspect listed above, which has helped lead me to a conclusion. Next, we identified our participants. Tracking whom and where the owners of SPIP resided and recorded how long each pump has been installed. We planned our 12 day field excursion, mapping where and how we would be able to travel to each farm and complete the interviews in a timely manner. Finally, we headed out into the field to gather our information from each site.

In my experiment my independent variable was that each participant owned or operated a SPIP within the last three years. The participants in this experiment only experienced one

change; the utilization of Solar Powered Irrigation. This variable helped us to determine the effects it had on the dependant variable; impacts after the installation. No other changes had been made to the independent variable (the participants) and the various effects on the dependant variable had been recorded.

When arriving at the site, simple instructions had been given to each participant. First, they were asked to demonstrate their SPIP. Observing that each Pump was working and that each farmer knew how to correctly operate the system. The participants had also been asked to show us some form of their farmland; a field, a pond, etc. This gave us an idea about what kind of agricultural practices the Pump was being used for. Then, we sat down with the farmer and started the interview.

Three steps;

- Demonstration of SPIP
- Observation of farmland
- Interview & Record Responses

During the interview the participants were asked about various changes and similarities in their practices since the installation of SPIP. The questions gave a perspective of affects SPIP has had on their farms and how this has impacted their overall livelihood. Many farmers specified a larger diversity of crops, and an increase in production since the installation of SPIP.

Results:

The main focus of this experiment was to gather enough evidence and information to support that Solar Powered Irrigation Pumps (SPIP) are having a positive impact on smallholder

farmers in rural parts of Nepal. In order to obtain the necessary evidence, interviews had been conducted with each of the participants. In the interview the questions asked where focused around income, production, nutrition, and family atmosphere before and after SPIP had been installed. These aspects were chosen to represent each family's overall livelihood.

After conducting each interview there has been major support concluding to positive benefits on overall livelihood for each participant. Due to the limited access to resources in the Terai area and these rural districts, Solar Powered Irrigation is impacting the lives of many. The ability to have a reliable source of water for irrigation is groundbreaking for subsistence farmers. The affordability of the system is also contributing to the impact on livelihood. Now farmers do not have to constantly supply expensive fuel or electricity in order to irrigate their land. They are seeing an influx in production because they have access to the capacity to the water they require. 100% of the participants have seen some form of production increase since the installation of SPIP. This affect on their production is also increasing their income. Now with an excess of food many subsistence farmers are able to sell the extra at the market or expand into more commercialized production. This increase in income is getting invested, mainly back into agriculture or in children's education. Many participants are also expanding their practices and their overall land value, now that they have a reliable source of water. Farmers are expanding into aquaculture and vegetable farming, both of which require a sufficient amount of water that was not available to them before the installation of SPIP. Aquaculture and vegetable farming are higher value harvests and bring in more income. 48 out of the 50 participants had some form of plans for expansion since the installation of SPIP. That is 96% that are seeing such a positive impact on their farms they have the income, and the means to expand in the future. Many

participants are reinvesting this income back into agriculture or putting it towards their family's needs (children's education, living standards, etc.) SPIP is also having a major impact on the empowerment of women through agriculture. SPIP is incredibly easy to operate which is allowing more women to be independently active in agriculture. There are a total of 53 SPIP sites, although only 50 were participants in this experiment. Out of 53 sites 41 have land and the SPIP in a woman's name. Traditional irrigation systems are notorious for requiring hard labor and constant maintenance this limits overall female involvement. However, with SPIP many participants have mentioned how the easy use of the system has impacted how women are involved on the farm. Over 36% of the participants interviewed had mentioned that there has been an increase in at least one woman's involvement in agriculture since the installation of SPIP. SPIP is having positive effects on smallholder farmers in rural Nepal. SPIP is so beneficial that all 50 participants have identified SPIP as their main source of water.

From this research more is able to be learned from this experiment. While speaking with participants many have indicated their optimism towards modern technology and practices. Many farmers want to incorporate these new practices on their farms. They recognize that modern technology in agriculture has the ability to make their lives easier and their farms more successful. Although these participants are eager to adopt these new practices, the limited access to the the information regarding these practices make it difficult. The farmers in these rural areas main source of new farming equipment and practices are from the local markets. Despite their efforts the technology is simply not available in that setting. Modern technology has the ability to revolutionize the lives of these smallholder farmers much like SPIP has. How do we enable access to these modern practices in these rural areas? The participants have expressed a great

deal of interest into adopting this technology but there is a disconnect to what they physically have access too. By improving their access to modern practices an increase in development would follow.

Discussion:

Hypothesis: Solar Powered Irrigation Pumps are having positive impacts on the livelihood of smallholder farmers in rural Nepal.

My hypothesis has been concluded to be true. Livelihood a means of supporting one's existence, especially financially or vocationally; living. (Livelihood, Dictionary.com) SPIP are endabling smallholder farmers to accomplish this easier. There are a variety of necessities that are affected through SPIP. Necessities such as food, water, income, education and many more are now at easy access because of SPIP. SPIP has started a domino affect within the lives of farmers. Reliable access to water has not only given safe water and sustainable food but has lead to an increase in production, which has caused an influx in income, this income can then be invested in children's education, farm expansion, or on the improvement of living standards. All of these are major contributions to improving overall livelihood. Other organizations have recognized the benefit of SPIP and have found many of the same conclusions in the overall benefits of Solar Irrigation. However, there has also been studies into the concern of depleting groundwater resources. (Bureau, 2018) Solar Irrigation poses incredibly easy access to water for irrigation at high capacities. This access to water it having renowned effects on the farmers who need it most, however with it's easy accessibility it is also much easier to over use the resource. With most Solar Irrigation Pumps there has been precautionary measures put into place to limit the overuse of the system. Most Solar Systems do not have rechargeable batteries to pump water at night or

on cloudy days. Limiting the Pumping time to late morning until early evening. There are also flow meters installed on a majority of systems. This allows a credible record of water pumping to monitor usage.

New Questions:

Mentioned earlier smallholder farmers are eager to adopt these new modern practices. The only issue, is how do we effectively get this new technology and information to the rural areas? Not only getting the technology to the farmers but ensuring the proper use and education of the new practices. The introduction of these modern practices correctly could have major impacts on the overall development of the area which is so interconnected to the development of rest of the country. The expedited development of the rural areas and farms that could potentially be responsible for feeding a much larger population, which could have huge impacts on the country as a whole.

In the future to continue this theory of expedited development with the introduction of more modern technology and farming practices. We could potentially take a much similar approach as we had for the introduction of Solar Powered Irrigation. Start with pilot sites and local field offices and work one on one with the individual farmers tracking their progress. Continue to branch out to more farmers and to new technologies, continuing with the practices that farmers are seeing the most overall success and continuously introducing new modern technologies. This would be the best way to be able to ensure farmers are getting access to new practices and are correctly utilizing them. We can then closely monitor how smallholder farmers success is affecting larger populations. Overall there are much broader topics to consider with

smallholder farmers and how modern technology is affecting them and the overall. (Tacoli, 2003)

Supporting Information and Photographs

Completing interviews in Teri.

Sukhari Devi Shah, a fully independent female farmer since the installation of SPIP.

Ram Singhasan Yadav, a political figure in the community and a

subsistence farmer, demonstrating his SPIP.

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