

# Increasing Food Security through Renewable Energy Supported Development in Agricultural Sector

Webinar Organised by

RECON

Asad 14, 2077 (June 28, 2020)

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Center for Energy Studies, IOE, TU



Source: Dr.  
Bishnu  
Gautam/News  
Papers

# Thousands People becoming jobless!

- Nepal might face devastating difficulties, due to ongoing COVID 19 related problems as one of the reasons, once we will have more than 2-3 million unemployed young people aged between say 25 to 45 years accumulated in different parts of Nepal.
- The only way to smoothen this problem is to employ these young people having what we have at hand now.
- This is high time to introduce modern agriculture to be implemented in Nepal as soon as possible to reduce trade deficit especially with India.

# Basic Needs for Survival (Maslow's hierarchy of Needs)

- Air
- Water
- **Food ( as per FAO about 180 kg per person per year is required)**
- .....

# SDG 2015/2030

**CLEAN ENERGY**

**ZERO UNGER**



SDG Goal 2: End hunger,  
achieve food security  
improve nutrition,  
promote sustainable agriculture through  
farmer friendly marketing

## Nagrik News Food Deficiency increased from 15 % to 23 % due to COVID 19 impact

Source: <https://nagriknews.nagariknetwork.com/social-affairs/244651-1592359169.html>



# Nepal and Food ?

- **Hunger Status 73 rd out of 117 countries**
- **Malnutrition 68 th out of 117 countries** (source:Naya Patrika dated Asad 6, 2077)

## Food Stuff Imported

Trade Deficit about Rs. 115 Arba every month in current FY 2075/76

Source: Trade Promotion Centre

Vegetables Imported worth more than Rs. 9 Crore /day

Descript ion	FY 71/72	FY 72/73	FY 73/74
Cereals	>Rs. 35 Arab	> Rs. 39 Arab	> Rs. 40 Arab

# Nepalese Context

**It is very hard to believe that Nepal used to export food products to third countries until 1987. It is still there on the FAO website where Nepal has exported 495.4 k tons of rice in 1975 and 250 k tones in 1985.**

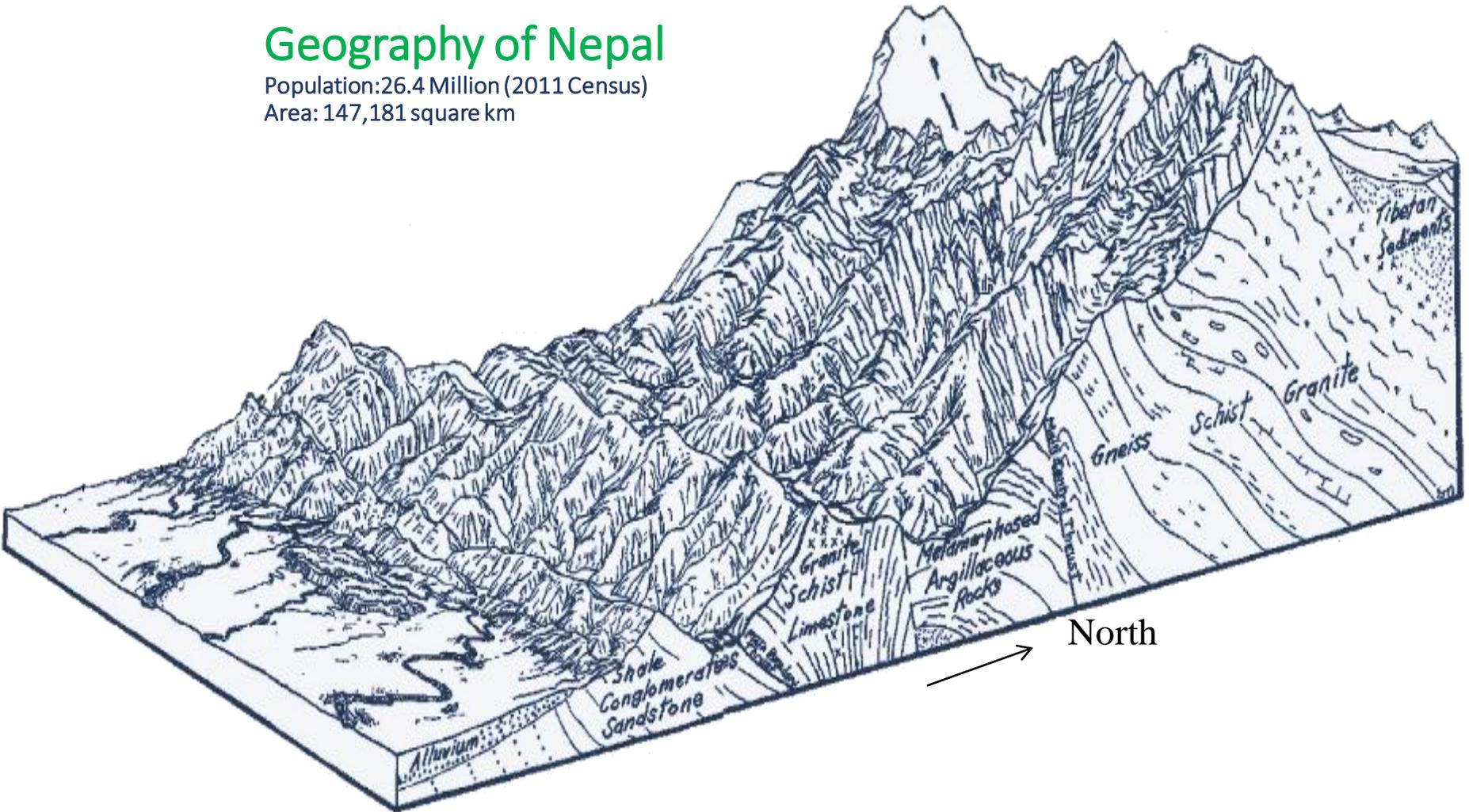
- The glorious history upturned just in 40 years as the country has imported 490 k tons of rice in 2015 and is ever increasing.
- During this period, the population of the country up folded by 2.14 times whereas paddy production is increased by just 1.9 times.

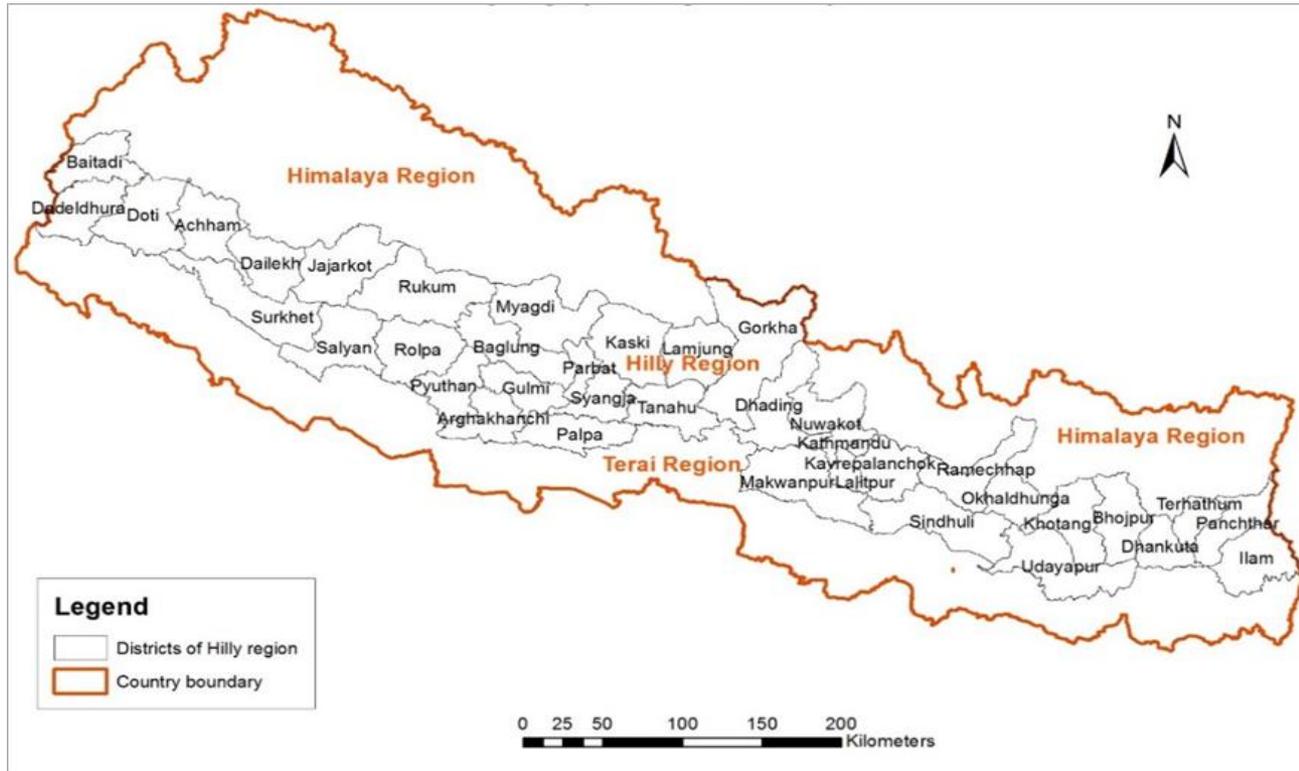
- Although more than 65% Nepalese engage in the agriculture sector as a primary source of income, half of these farmer's agro product is not sufficient to feed their family throughout the year.
- In addition, their contribution to GDP is gradually decreased around 10% in the last 10 years, which accounts for 27% in 2019. (MoF, 2019).

# Geography of Nepal

Population: 26.4 Million (2011 Census)

Area: 147,181 square km

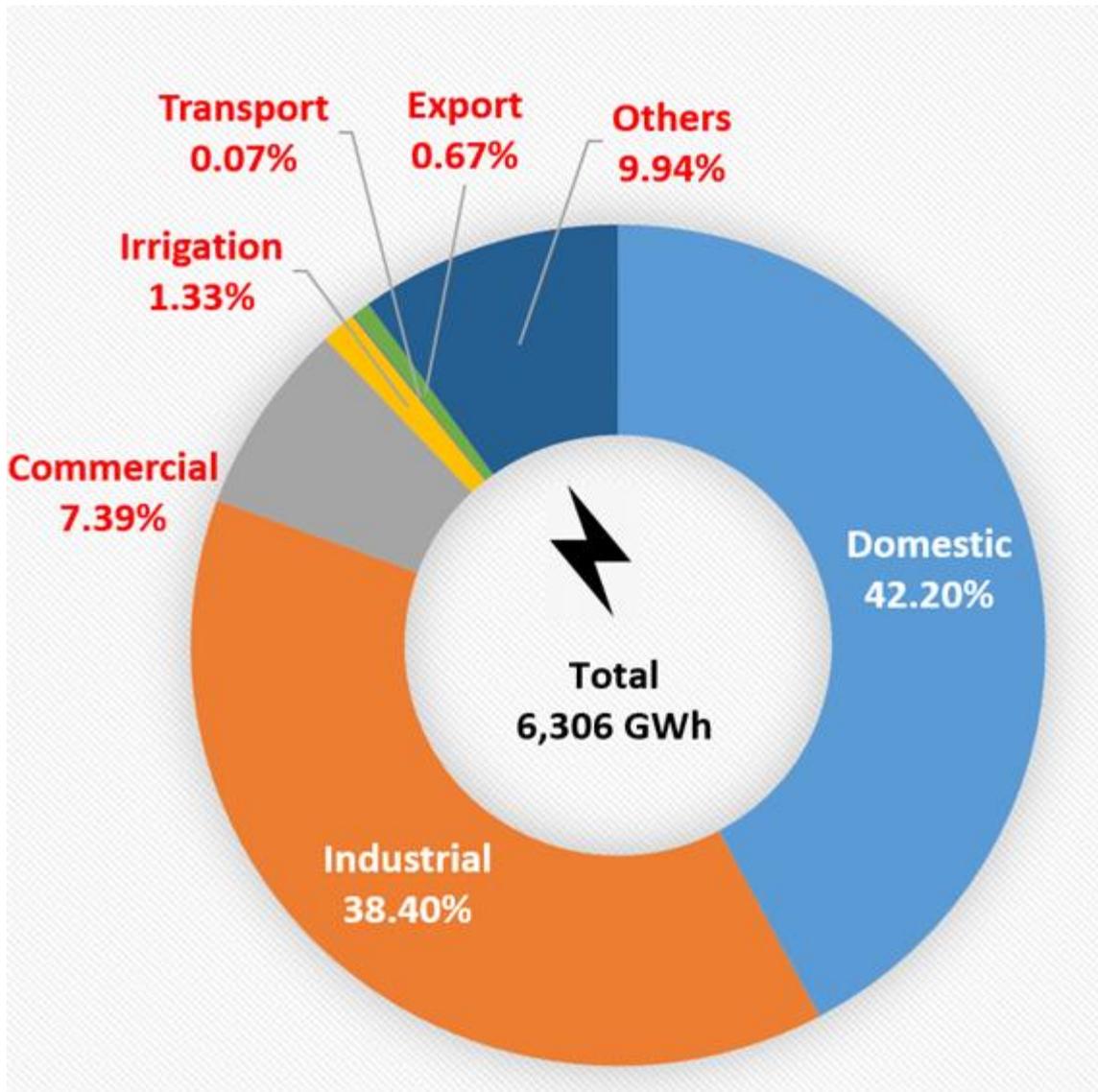




Source: Author, based on Department of Survey data, 1976



Plate 1. Overview of reclamation and demonstration site.



Electricity Consumption by Sector in FY 2018/19

# Natural Energy Resource Base of Nepal

- **About 6,000 rivers (with 23000 rivulets and tributaries, Source: Minister Barsha Man Pun , Budget Response 2077/02/27), with a total length of about 45,000 km with an annual discharge of 220 billion cubic meters of water are available in the country**
- The commercial potential of hydro-power in Nepal are said to be about 83,000 MW and 42,000 MW respectively (?)
- **So far only about 1386 MW have been connected to peak load system, which constitute about 4% of total energy supply**
- Forests supply nearly 55 % of the total energy requirement of the country, and also provide 50% of fodder for livestock purpose.
- **On average Nepal has 6.8 sunshine hours per day, i.e. 2,482 sunshine hours per year with the intensity of solar insolation ranging from 3.9 to 5.1 kWh/m<sup>2</sup>/day. (National average is about 4.7 kWh/m<sup>2</sup>/day)**
- Though significant wind potential is noted to be available in mountainous region (Mustang district, Khumbu region, Palpa, Ramechhap, Karnali Chisapani, Jumla) no proper wind mapping of Nepal has been done so far.

# Global Horizontal Irradiance, kWh/m<sup>2</sup>/day Annual Average

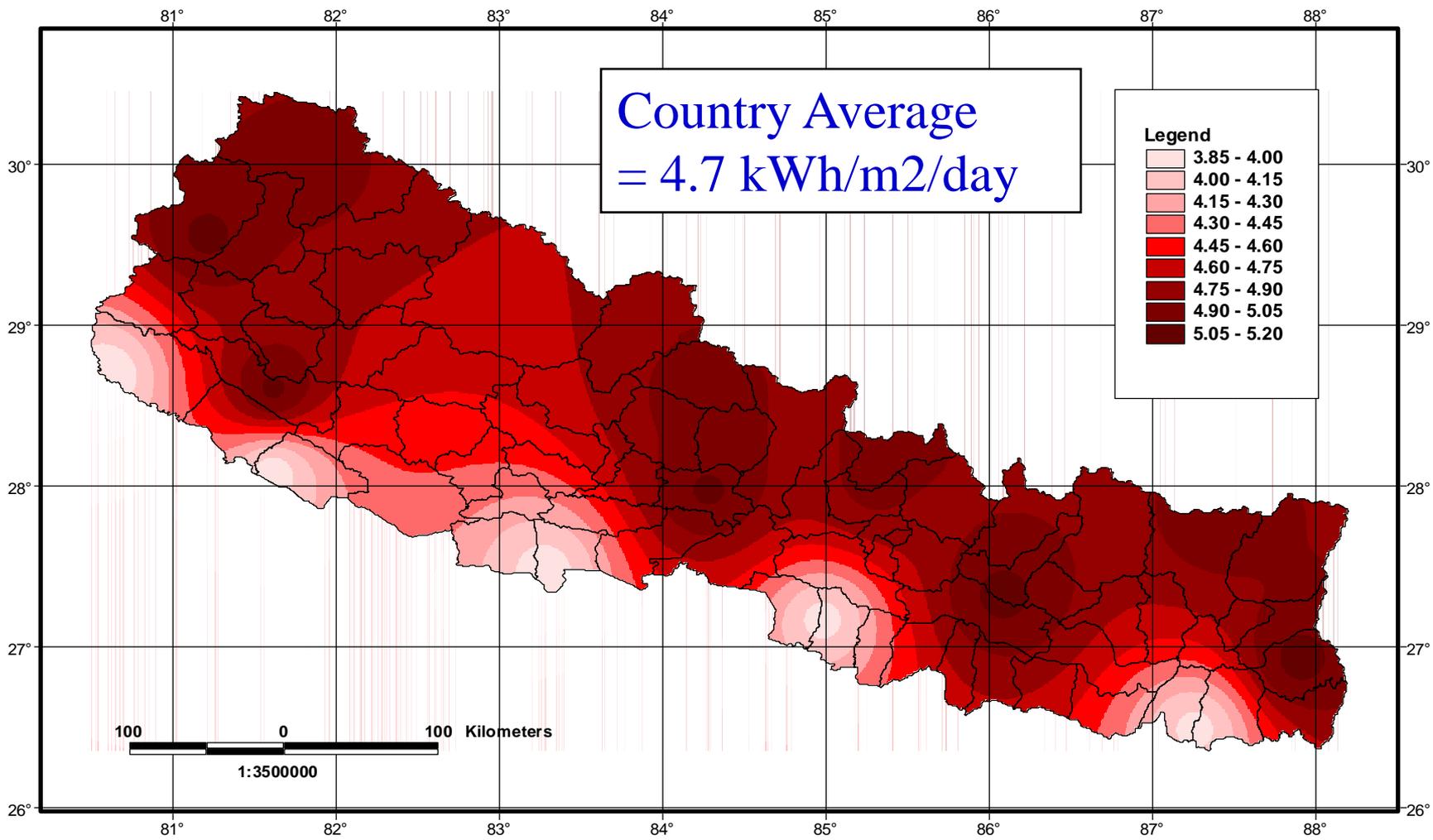


Figure 1

SWERA Project  
Center for Energy Studies  
Institute of Engineering, Tribhuvan University



- <https://www.facebook.com/photo.php?fbid=10207243601038642&set=a.10204719288252400.1073741850.1542522243&type=1&theater>

# Food Security ?

# Agricultural Production is a function of many variables!

Production = f (Policy, Land ,Capital, sunshine, trained farmers, Post Harvest activities (collection/cutting, transportation/ storage) and

- Marketing/entrepreneurship

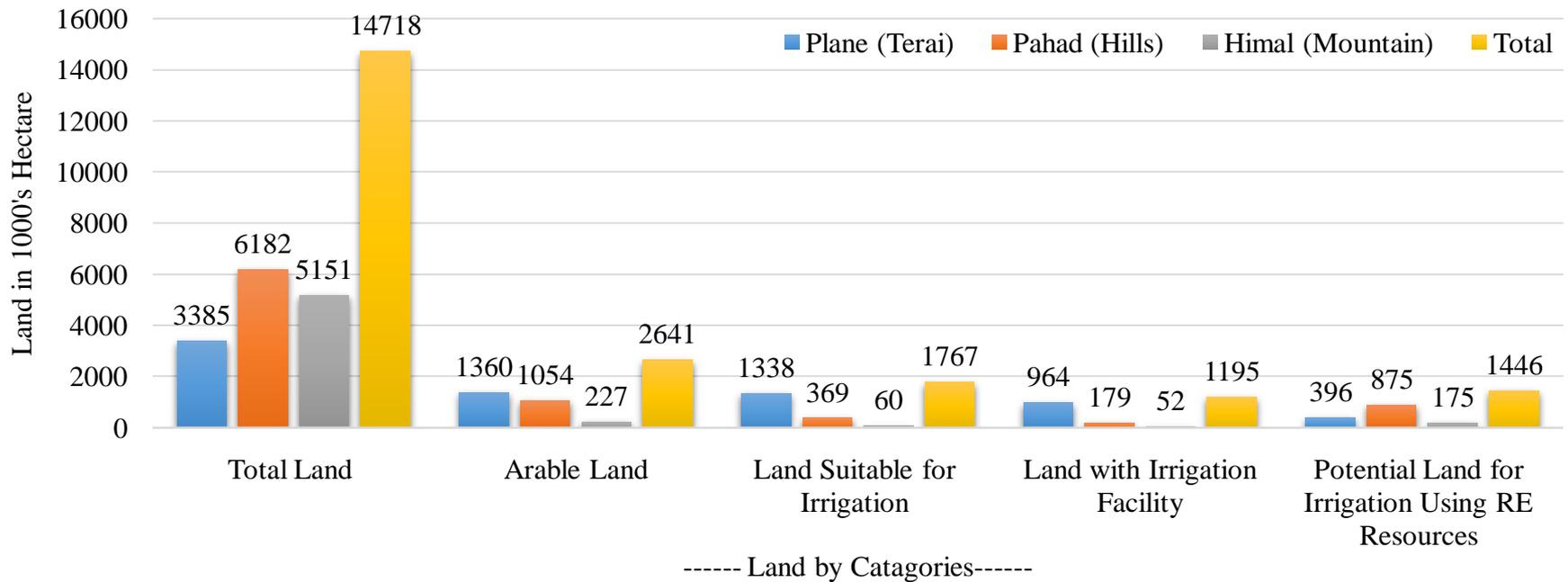
(type of arable land, soil condition, appropriate soil conditioning, **water availability/provision**)

**Experience sharing with countries like The Netherlands and Israel, highly successful countries in agri sector in the world**

(Israel 3100, 2600 returned, BC 70% out of Nepal, now returning)

More people to be sent to The Netherlands for more training

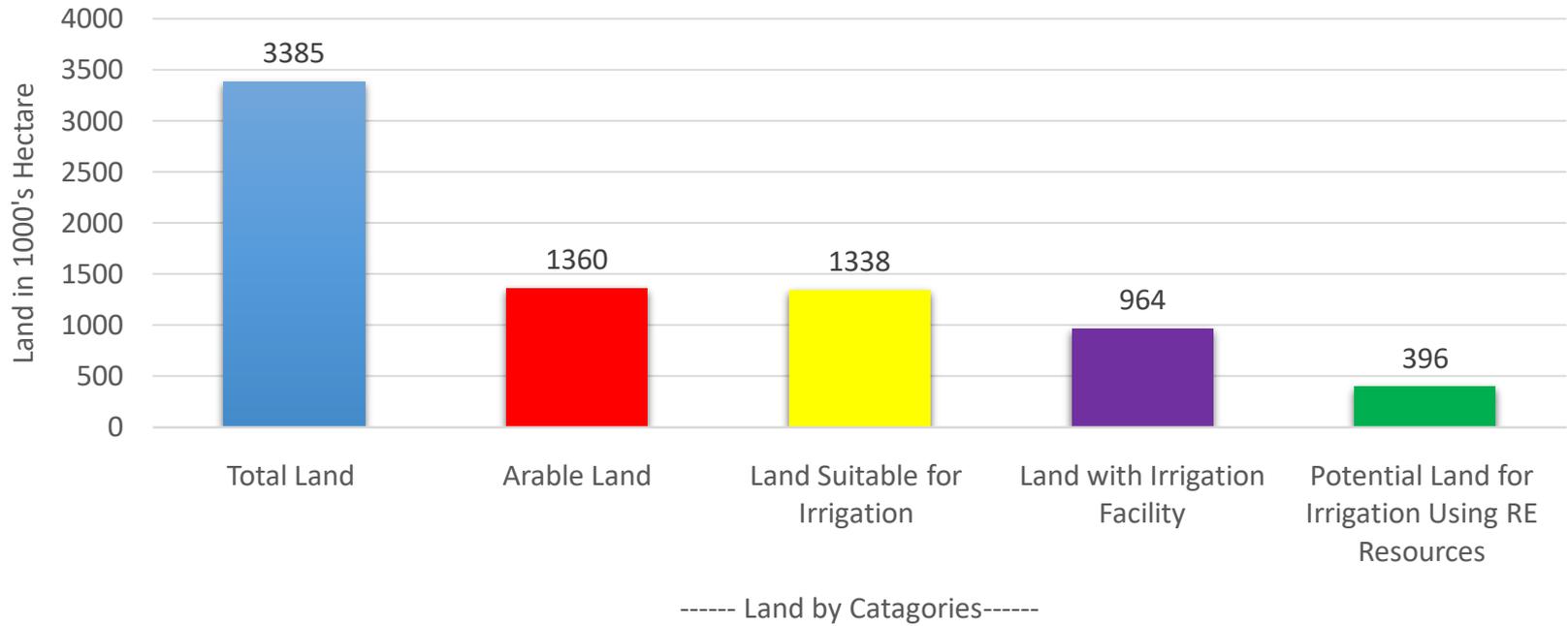
## Irrigation Status of Nepal by Geographic Region



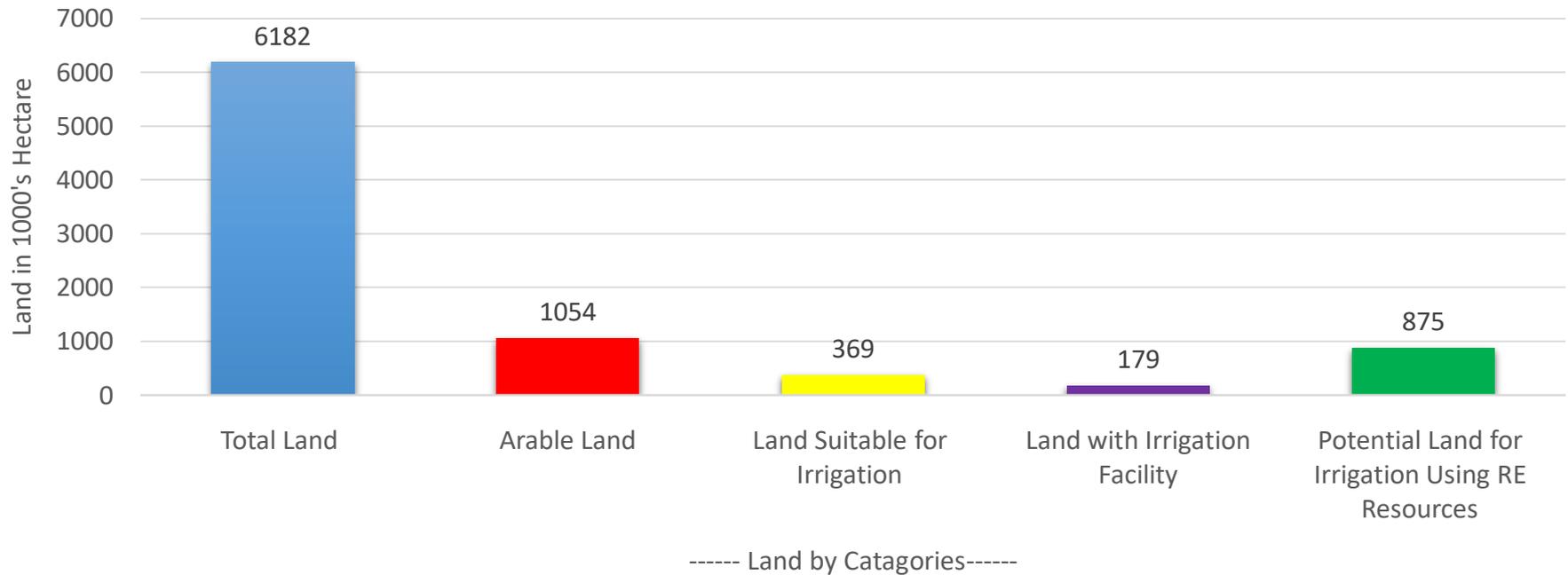
- Food needed per capita at least 180 kg (FAO as quoted in Toni Hagen, 2058 BS)
- Food Production per hectare 2390 kg (in 1984/85-1993/94 as quoted in Toni Hagen, 2058 BS)
- Food Deficiency 40 kg per person  $[((1767000 \text{ ha} \times 2390 \text{ kg/ha}) / 30000000) = 140 \text{ kg}]$
- With improved agricultural initiatives Nepal can be self-sufficient in food!

**Be Good Citizen, Be Scientific Farmer, Contribute in Making Nepal Food Secured and Encourage Nepali People to be Proud”**

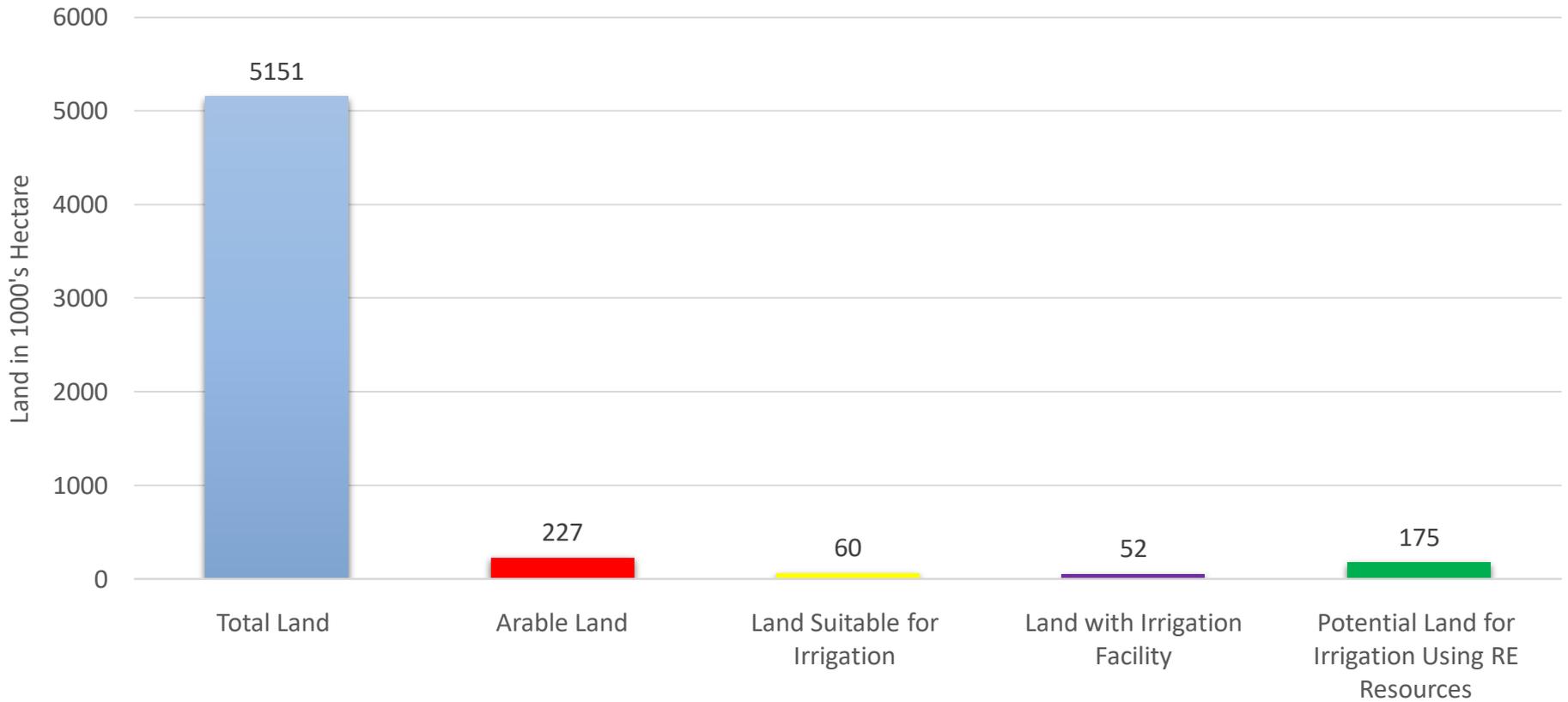
### Irrigation Status in Terai Region of Nepal



### Irrigation Status in Pahad Region of Nepal



## Irrigation Status in Himal Region of Nepal



----- Land by Catagories-----



- Facebook- kedar shrestha

# Types of RET useful for developing agri sector

- **NEA National Grid**
- **Solar Thermal (dryers)**
- **Pico Hydro , Micro Hydro, Mini Hydro (stand alone)**
- **Wind (mechanical, electrical)**
- **Solar Electricity (specially for lift irrigation)**

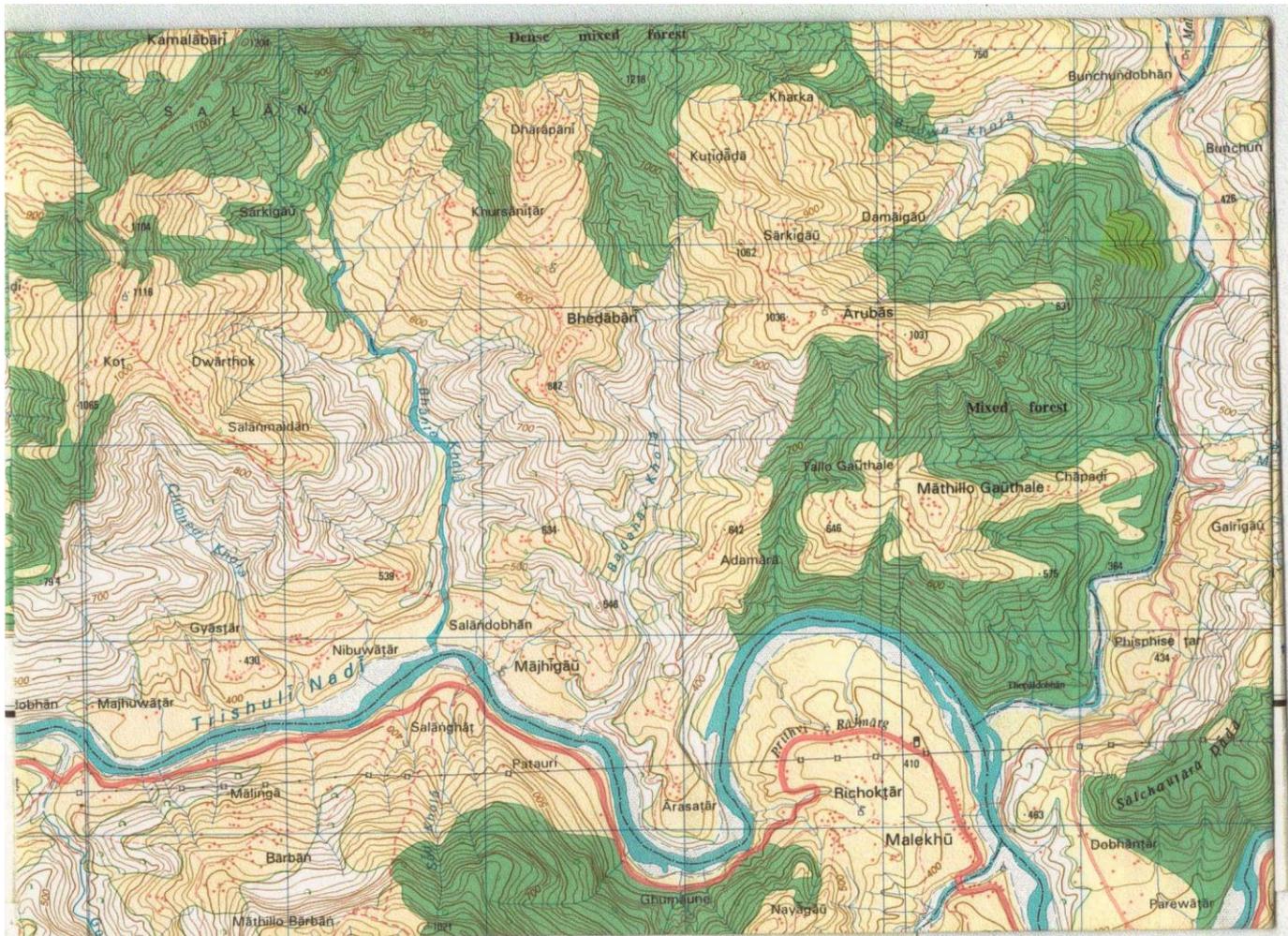
# History of Solar Pumping in Nepal

## Appendix XIII

### Status of PV System Installation through ADB / Nepal

S/N	Site location	System capacity	Purpose of installation	Make of system	Year of Installation	No. of system	Present condition	Remarks
1	Birendranagar, Chitwan	1.4 kWp	Pumping for irrigation	Photowatt, France	1986	1	Not functioning properly	Inappropriate site selection and design.
2	Letang, Morang	1.6 kWp	Pumping for drinking water	Photowatt	1987	1	System with dismantled	Inappropriate site selection.
3	Swargadwari, Pyuthan	1.484 kWp	Pumping for drinking water	Arco solar, Singapur	1987	1	Several repairs done, working at present	Lack of skilled manpower for operation and maintenance.
4	Swargadwari, Pyuthan	0.47 kWp	Electrification	Arco solar, Singapur	1987	1	Batteries were needed to be replaced. Present condition is not known.	Lack of skilled manpower for operation and maintenance.
5	Agyauli, Nawalparasi	1.6 kWp	Pumping for irrigation	Photowatt, France	1987	1	Inverter has broken and need to be replaced.	Site is not so appropriate from the management point of view.
6	Bemekhola, Surkhet	1.6 kWp	Pumping for irrigation	Photowatt, France	1987	1	In running condition but discharge is low due to insufficient recharge in the source.	Due to deforestation in catchment area of water source deminished.
7	ADB/N field offices	40 Wp	Stand - alone Electrification	BP Thai, Thailand	1988/89	40	Mostly in running condition some of them need replacement of batteries.	User's training needed.
8	ADB/N, UNESCO	43 Wp	Stand - alone Electrification	Siemens - Showa	1992	100	Installed at UENCO and UNICEF assisted programmes for adult education, health etc.	User's training needed.
9	ADB/N field offices	43 Wp	Stand - alone Electrification	Arco - Showa	1991	60	Some installed, some needs to be installed	User's training needed.

Source: ADB/Nepal



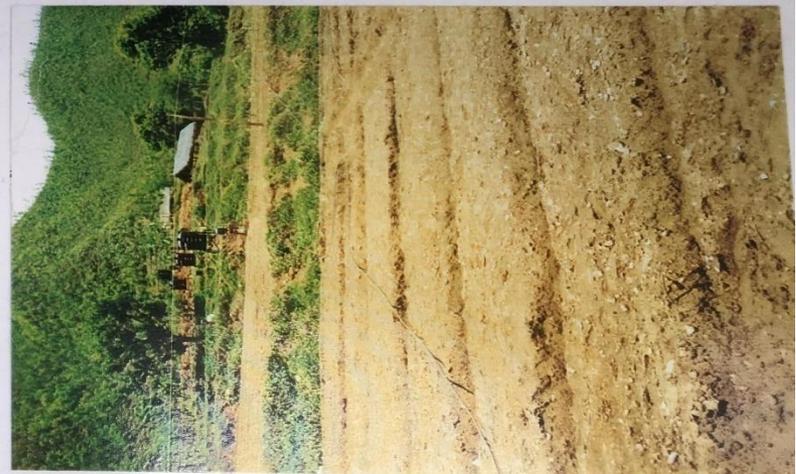
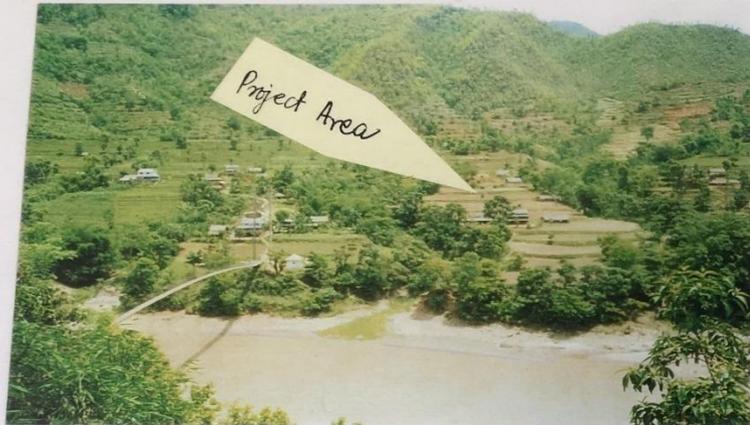
# Salanghat, Malekhu, 2X100 Watt, 24 V DC Pump with two (4X36 Wp PV Modules), Head 70 m,

WECS Funded Project 2003

Salanghat, Salang VDC, Ward no. 7 (Ga), Dhading (P1)

Plate E

①



# Solar PV Pumping for drinking water and drip irrigation (WECS 2003)



# Kavre Village Family supported by 100 Watt SPVWPS 2005 AD



# Solar Irrigation System implemented by AEPC

(Source: AEPC, Santosh Rai)

- FY 2073/74: 85
- FY 2074/75: 221
- FY 2075/76: 861
- Total: 1167
- PVPS for Drinking Water is 207
- **PVPS Irrigation = 2334 kWp = 2.3 MWp (covering 23,000 sq. m.)**
- **PVPS Drinking Water = 621 kWp (covering 6210 sq. m.)**
- **Budget allocated for installing 5000 Shallow Tube wells and 247 Deep Tube wells in FY 2077/78**

***Recommendation: Third party be appointed to evaluate effectiveness SPVWPS installed so far by Government/non-government sectors***

**Rs 131 Crore allocated for lift and solar pumps (262 projects worth 50 Lakh per project has been allocated for FY 2077/78), need more manpower**

# Water needed for total growing period in mm

Source: FAO

<b>Crop</b>	<b>Crop water need in mm for total growing period</b>
Maize	500 - 800
Barley/Oat/Wheat	450 - 650
Onion	350- 550
Tomato	400 - 800

# Description of some SWPS Source: Nabin Bhujel June 23, 2020)

S/N	Discharge in meters	Head in meters	Pump	PV Array	Cost in Rs. Lakh excluding cost of civil works and water distribution network
1	2	70	Surflow	100 Wp @ 24 V DC	1
2	80	15	Grundfos SQF8A-5	270 Wp X 7	5
3	110	240	Grundfos SP 17-40	320 Wp x 105	55
4	400	50	Grundfos SP ?	315 Wp x 90	50

Nepal has sent around 3,000 plus youths for 10 months training to Israel under “LEARN, EARN and RETURN” program which was extremely useful.

- **Around 2600 plus youths have already returned from Israel out of which 70% are not in Nepal and have gone abroad for livelihood earning due to many reasons which could be easily sorted out with proper interventions at federal, state, and local levels.**
- Similar to this program 10,000 plus youths can be sent to **The Netherlands** for mutual benefit so that the most renowned agro-technology can be imported in Nepal.
- As of Paush 2076, NSTB/CTEVT has certified about 4700 Solar Level Technician around 4700 ( 4400 L1 + 300 L2)
- Blending Sociology with Technology is a must for rapid measurable achievements
- Around 200 Solar companies (5 Companies with transactions of at least Rs. 25 Crore ?)
- Around 400 graduates in Agriculture Engineering have been produced since 2005 from Dharan Engineering Campus, IOE/TU.
- AFU (former IAAS) has been producing students in various fields needed for modern farming.
- Recently M.Sc. course in Land and Water Engineering has been introduced at Dharan Campus, IOE/TU.
- There are very important institutions like NARC, NAST related to scientific agriculture.

# Ramechhap Virpani VDC Ward # 7





- [http://www.paulpolak.com/media/rsz\\_drip\\_irrigation\\_in\\_field\\_nepal.jpg](http://www.paulpolak.com/media/rsz_drip_irrigation_in_field_nepal.jpg)

A case study of Nepal where non-conventional irrigation system use renewable energy technology (source; DoI, MoWRI)

- ***A beautiful piece of land on the banks of the Sunkoshi River in Virpani-7 of Ramechhap district was left barren for many years.***
- It was one of the most exposed to the drought area of Nepal.
- Residents Majhi, who belong to one of the most marginalized communities in the country, tried everything they could to change the course of the river and irrigate a few hectares of the barren fields – but had no success.
- In 2016, the department of irrigation has installed solar lift irrigation and implemented a non-conventional irrigation system as a pilot project,
- **Fisherman now earns around USD 1700 per year by selling vegetables. There are altogether 450 households including 45 Majhi communities who were benefited from the project.**
- **A solar array of 10.2 kWp capacity and 10 hp DC pump was installed that can lift the water from riverbank to 72-meter height where 20 ha of land is set with sprinkler irrigation system.**
- The cost of the entire project was USD 66,134.

# Harek Gara - Hara Bhara

Rs. 1.31 Arab for Solar Based Water Lifting for Irrigation/Solar Pumping out Rs. 4.13 Billion for Alternative Energy (Budget Speech FY 2077/78)

**BS 2075 –**

**BS 2085**

**Urja Dashak**

(source: Budget Speech FY 2075/76, 2075/02/15, 2077/02/15)

Let us make the agriculture profession, a respected profession in Nepal!

***Krishi Peshalai***

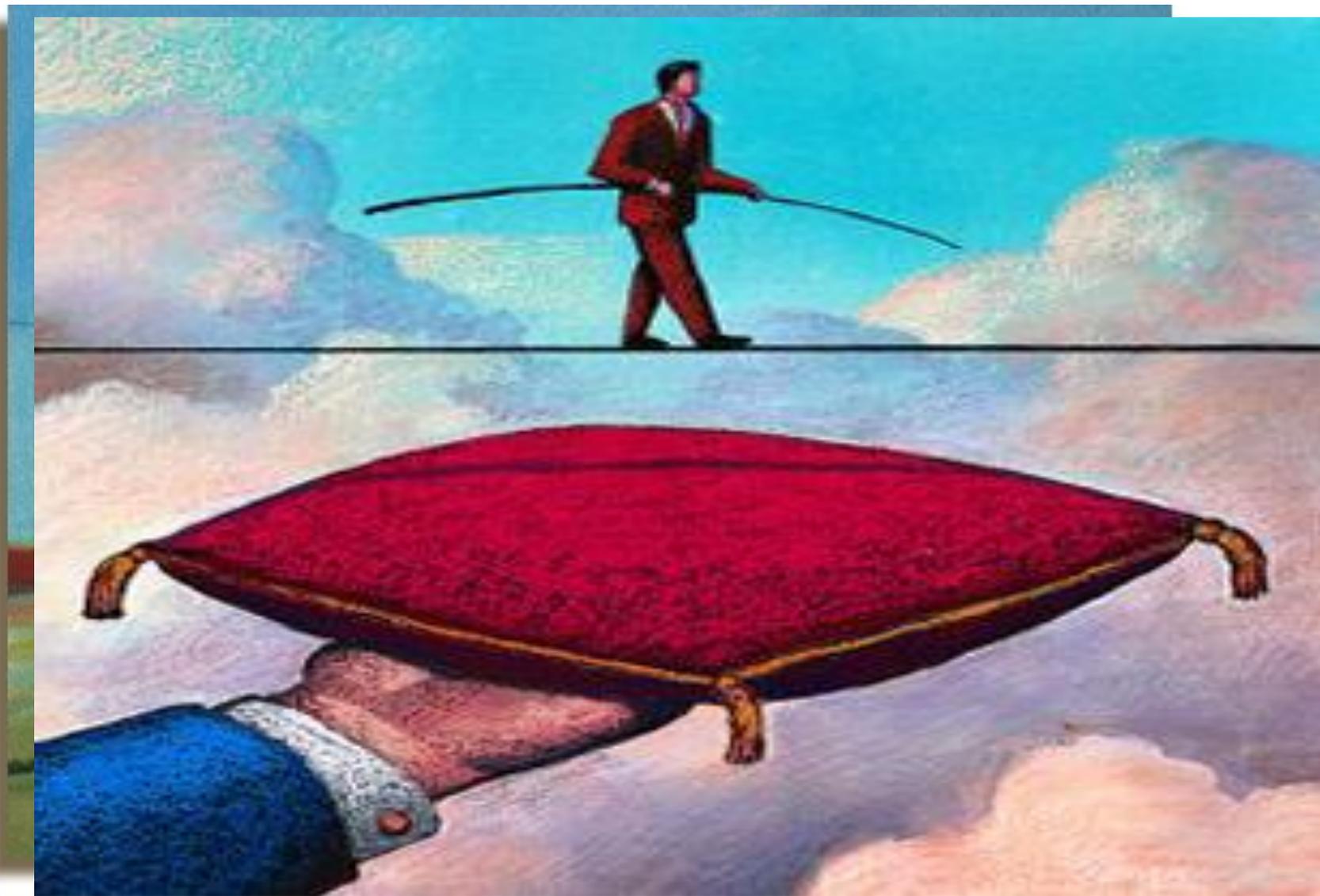
***Sammanit***

***Pesha Banau!***

## युवा तथा साना व्यवसायी स्वरोजगार कोष

### कोषको स्थापना :

- मुलुकभित्रै स्वरोजगारीका अवसर सिर्जना गरी प्रत्येक वर्ष बढ्दै गैरहेको बेराजगार जनशक्तिलाई आर्थिक रूपमा सक्षम, सामाजिक रूपमा जिम्मेवार एवम् सिर्जनशील बनाउन,
- सीप सिकाई स्वरोजगारीमूलक क्रियाकलाप परियोजना सञ्चालन गर्नका लागि सुलभ र सस्तो कर्जा उपलब्ध गराउन (Source: Dr. Bishnu Gautam)



Food and Energy Independence is a key Issue!

There is a close relationship  
between

Samrida Nepal, Sukhi Nepali

and

Food and Energy Security!

# Inspire the people!

- *Generate Green Energy in all arable areas of Nepal and help reduce its trade deficit*
- *No arable land to be left behind in rural and urban areas of Nepal!*
- Producing documents on agriculture is not enough
- Talking on how to modernize agriculture is not enough
- Even demonstration of pilot projects related to modern agriculture may not be enough
- **Inspire people to get involved in modern agricultural activities!**
- **Inspire people to look into current and future prospects of RE supported modern agriculture!!**
- **Demonstration of solar pumping with mobile van at primary, secondary and tertiary level of education.**

# Cold Store Cost: 10 m<sup>3</sup>, 100 m<sup>3</sup>, 1000m<sup>3</sup>

@ Room Temp. 2deg Celsius (24 Hours), Ambient Temp. 35 deg Celsius.

Source: Associate Prof. Vishwa Prasanna Amatya, DoME/PC/IOE/TU June 24, 2020

Volume in m <sup>3</sup>	Storage Capacity, in Ton	Energy Required/day, kWh (effective 16 hours)	Power Required, kW	Cost using local materials, Lakh	Product to be stored
10	2.5	36	2.2	6	Vegetable
100	25	125	8	13	“
1000	250	439	27	115	“

**-15 Deg Celsius is needed for storing Fish, about 50% more energy is required, AC for live fish within the pond is possible**

The energy input-output analysis of maize production in Sundarharaincha Municipality, Morang district, Nepal  
Sandesh Poudel<sup>1</sup>, Saurabh Bhattarai<sup>1</sup>, Tsering Sherpa<sup>1</sup>, Anish Karki<sup>1</sup>, Dae Hyun Kim<sup>2</sup>, and Sagar Kafle<sup>1</sup>,

The study revealed that total **energy input and output for maize production system found about 10,999.61 MJ/ha and 45,501.52 MJ/ha, respectively**, with the highest share by farmyard manure (FYM) about 50%. The energy use efficiency was found 4.14.

**Total CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub> emissions due to chemical inputs were found 163.24 kg/ha, 0.03 kg/ha and 0.33 kg/ha, respectively.**

**The total Global warming potential was found 178.58 CO<sub>2</sub> eq. per ha. The average cost of production were calculated USD 301.35/ha and profit USD 272.26/ha.**

# Yield: Kg/ha

Source: Nepalese Society of Agriculture Energy, May 2020

Major Climatic factors influencing crop water needs as per FAO: Humidity, Sunshine, Ambient Temperature, wind speed, evaporation and transpiration)

Crop	Bagmati Pradesh	All Nepal	
Paddy	3765	3506	<b>*2980 Kg/ha average of paddy, maize and wheat</b>
Maize	3008	2679	80 m3 discharge per day is sufficient to cover minimum of 20 to 40ropanies of land with maize crop (1 to 2 ha) per day for 90 days (planting to harvesting period)(?)
Wheat	2967	<b>2757</b>	
Vegetables	14572	13798	
Fruits		9727	
Potato	17094	<b>14675</b>	

## उपभोग्य खाद्यान्नको स्थिति (Cereal Balance Sheet)

प्रदेश अनुसार आर्थिक वर्ष २०७५/७६ (२०१८/१९)

Source: Krishi Diary 2077

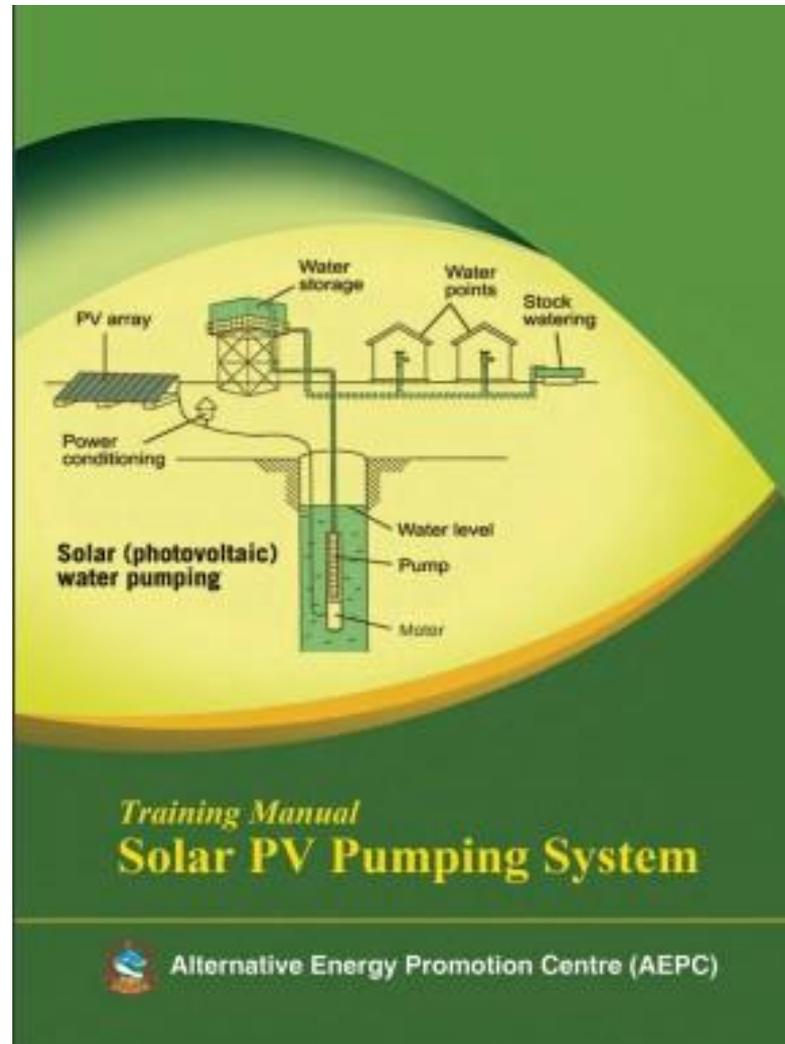
(मे.टन.)

प्रदेश	जनसंख्या	चामल	मकै	कोदो	फापर	गहुँ	जौ	उपभोग्य खाद्यान्न (उत्पादन)	आवश्यक खाद्यान्न	बचत वा न्यून
प्रदेश नं. १	५०४८४९४	६८९२१३	६६३६५९	७५९९९	२१९५	१५१२५७	४५१	१५८२७७४	९५३७९६	६२८९७८
प्रदेश नं. २	६०१६१२७	८३२१७६	१२८९०६	१२७९	०	४८२२०१	५३	१४४४६१४	१०८८९१९	३५५६९५
प्रदेश नं. ३	६१५५६२४	२९०४६८	५१३१४९	५३९४०	२०६४	१३१३४३	६०६	९९१५६९	१२१८६०४	-२२७०३५
प्रदेश नं. ४	२६७५९६६	२३८०८५	३६३१७९	७७७१६	२०४९	७५४८५	६४६	७५७१६१	५३७६४७	२१९५१४
प्रदेश नं. ५	५००८७८४	६६२०६४	३१६९५५	८९००	८५३	४२०००३	८१७	१४०९५९२	९३४३०४	४७५२८७
प्रदेश नं. ६	१७४८२५७	७४२६३	१८५८४५	१६१३१	१७११	१३५१७२	३२२७	४१६३४९	३४७०७२	६९२७६
प्रदेश नं. ७	२८४१५७२	३३६९५८	९६०३७	१३०३५	११८	२६२३७२	१५९५	७१०११४	५३८६८०	१७१४३४
<b>नेपाल</b>	<b>२९४९४८२५</b>	<b>३१२३२२७</b>	<b>२२६७७२८</b>	<b>२४६९९९</b>	<b>८९९०</b>	<b>१६५७८३३</b>	<b>७३९५</b>	<b>७३१२१७२</b>	<b>५६१९०२३</b>	<b>१६९३१४९</b>

प्रदेश अनुसारको खाद्यान्नको माग आपूर्तिको विश्लेषण गर्दा प्रदेश नं. ३ वाहेक सबै प्रदेशहरू खाद्यान्न बचतको अवस्थामा रहेको छ । अत्याधिक जनसंख्या र सहरीकरणको कारण खाद्यान्नको माग बढि हुन गई प्रदेश नं. ३ मा खाद्यान्न न्यून हुन गएको हो ।

स्रोत: कृषि पूर्वाधार विकास तथा कृषि यान्त्रिकरण प्रवर्द्धन केन्द्र, ललितपुर २०७६

# Solar PV Manual Prepared by CES/Grid Nepal for AEPC (Team Leader Prof. Jagan Nath Shrestha, 2018)



What Farmers  
should/and or Need to  
do?

# Farmers are Like a Gold Mine!

- Start small scale, MS and LS businesses related to agriculture (eg cold stores (10, 100, 1000 m<sup>3</sup>), fertilizer plants,
- **Technology Supported Green agriculture (focus vegetables, fruits, medicinal plants, high value cash crops)**
- Engage people returning from Israel after agriculture training with skill and knowledge
- How to achieve SDG DC (during COVID 19) and AC (after COVID 19)
- Start Gravity ropeways, NFF boats, Water Ways

Thank you for  
your kind  
attention!