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## Summary

Nepal is a hilly land locked country having 65.6% Population engaged in agriculture and is divided in to three regions namely mountain region, hill region and the terai region which occupy 35%, 42% and 23% of the total line area of 147, 181 sq.km. The country has diverse climatic variation from sub tropical in south to alpine in north. Rainfall is the major determining factor for the success or failure of agricultural crops as 65% of the total arable land is rain fed. Major crops are rice, maize, wheat and potato and their productivity are 2.717 Mt/ha; 2.03 Mt/ha.; 2.07 /Mt.ha and 13.16 Mt./Ha respectively.

Agricultural mechanization is at infant stage. However, mechanization by tractor is increasing and the total number of 2 & 4 has reached 34336 by 2005/06. And the estimated mechanical power increase to 37.3 % of the total agricultural power. Land preparation is mostly done in terai and combine harvester have been recently introduced.

Small land holdings, high cost of production increasing scarcity of irrigation water, low irrigation efficiency, high transportation losses, women drudgery, shortage of young working manpower in the villages, attraction for young people towards foreign jobs are some of the agricultural and social challenges. Likewise climatic change, increasing soil, air and water pollution, under utilization of agricultural waste. overuse of pesticides/insecticides etc. are some of the environmental challenges/issues for agricultural production.

Poverty alleviation is the core goal of the tenth plan of the country. In the agricultural policy it is mentioned that for increasing productivity rate and protecting & promoting natural resources should be utilized in the interest of the farmers.

Water Induced Disaster Mitigation Policy, 2004 was issued by Government of Nepal. There are working policy issued by Ministry of Science and Technology, related to bio-gas , solar energy, improved cooker technology, improved water mill technology and micro and small hydropower.

There is great potential of Agricultural Engineering and Technology as there are 3915 villages and most of them are without the basic infrastructures such as drinking water, electricity, rural roads, health center etc. Agricultural Engineers could play significant role in the development of rural area by harvesting available natural resources such as sloping hills /terraces, snow fed rivers, long duration of sunshine hours ,high rainfall etc. Rise in temperature, melting of glaciers, untimely rainfall, and rise of the river beds in terai are some of the effects brought by climate change due to global warming.

Institutions involved in mitigation of climate change effects are public organizations, NGOs and INGOs. Public institutions are under Nepal Agriculture Research Council, Ministry of Science and Technology, Minister of Water Resources, Minister of Agricultural and Co-operatives, universities. Some of the measures for mitigation of climate change effects include promotion of renewable energy program, conservation tillage, program, water saving technology including rain water harvesting and water shed management. Strategies for mitigation of climate effect and sustainable agriculture development could be research and promotional activities

on renewable energy; soil water and nutrient management program, natural resources conservation program, soil and water conservation, land and water shed management. Bio and sulfatic fertilizers, management of domestic and urban agricultural waste, waste water re use for agriculture etc.

With a view to strengthening the APCAEM National Institute the support of APCAEM is expected in: technology transfer, exchange of commercially available equipment, establishment of farm machinery testing centre at AED/NARC, skill development training for existing manpower. Joint action R & D projects could be on programs to mitigate climate change effects including conservation tillage, rain water harvesting, mechanization of hill agriculture, value addition of fruits and vegetable products, bio-fuel (bio ethanol and bio diesel, cottage scale processing of high value crops (herbs and medicines plan.)

Programs on proper water management of rice field to save water and to mitigate methane gas emission. Conservation tillage, biotic and sulfatic fertilizer, rain water harvesting, macro and micro hydro plants, transport vehicles run by chargeable batteries, gravity ropeway, degraded forest land improvement program, water saving technologies for irrigation of agricultural crops should be encouraged and further upscaled by the respective district offices.

## Country Profile 2005/2006

### General

Location:	Latitude (26 22' N to 30 27' N) Longitude (80 4' E to 88 12' E)
Climate:	Sub-tropical to temperate
Annual rainfall :	2,000 mm (East) to 1,000 mm (West)
Average rainfall	16,00 mm
Rainfall duration:	60-80% in monsoon season

<b>Population Estimates (millions)</b>	25.8 (2006), male : 12.9, Female: 12.9
a) Total rural population	85.8 %
b) Farming population	65.6% (2001)
c) Literacy rate	53.7 (2006)
d) Life expectancy at birth	63.3 (2006)

<b>Total Land Area (sq.km.)</b>	147,181, (~14.7 million ha)
a) Himalayan region	35 %
b) Hilly region	42 %
c) Terai region	23 %

<b>Land Holding size</b>	
Average size of farm holding:	0.80 ha
Average no. of parcels/holding	3.3
Average parcel size (2006/07)	0.24 ha

<b>Land Use pattern (000 ha)</b>		
a) Agriculture cultivated land	3091	(21%)
b) Agriculture Uncultivated land	1030	(7%)
c) Forest	4268	(29 %)
d) Shrubland	1560	(10.6%)
e) Grassland and Pasture	1766	(12%)
f) Water	383	(2.6 %)
g) Others	2620	(17.8 %)

Irrigated Land (Million Ha)	1.031	33.35%
	(2005/2006)	

GDP (Million Rs.) 2006/07	719477
a) Agriculture Sector	
b) Non-agriculture sector	
Per Capita GDP (2006/07)	US \$ 383
Per Capita GNP (2006/07)	US \$ 456

### **Major Cereals 2005/2006**

S.N.	Cereal Crop	Area (000 HA)	Production (000 M.T.)	Productivity (MT/ha)
a.	Rice	1549	4209	2.71
b.	Maize	850	1734	2.04
c.	Wheat	672	1394	2.07
d.	Millet	261	290	1.11
e.	Barley	26	27	1.03
Total		3358	7654	

### **Cash Crop**

Sugarcane	62	2462	39.70
Potato	150	1974	13.16

Others: Oil seeds, Tobacco, Jute, Vegetable, Fruits, Tea, Coffee, Honey

Source: MOA, Agri. Business, Promotion and Statistics Division 2005/2006

### **Population of Livestock & Other Animals for Cultivation/Transport (in Million, 2004/2005)**

a. Cattle	6.99
b. Buffaloes	4.08
c. Sheep	0.82
d. Goat	7.15

### **Agricultural Power**

No. of 2 - & 4 - wheel tractor (2005/06)	34336 *
Animal Power (%)	27.3
Human Power (%)	35.4
Mechanical Power (%)	37.3

\* Total number is up to 2005/06 first eight months.

Source : CBS, 2006

## **Introduction**

Nepal is a hilly country with its 65.6% population engaged in agriculture (census 2001). Ecologically, Nepal is divided into three regions called the mountain region, hill region and terai the terai region which occupy 35%, 42% and 23% of the total land areas of 147,181 sq.km. The elevation of the country rises from 60 meter at Terai (Jhapa) to 8848 meter at Mt. Everest in the north within a short horizontal distance of 90 to 120 km. Such a sharp verticality renders the country with diverse climatic variation from sub tropical in south to alpine in north. The rainfall variation ranges from less than 300 mm. in the dry rain shadow regions to more than 5000 millimeter in wet region like Lumle, Kaski district. The average annual precipitation is around 1600 mm.

Rainfall is the major determining factor for the success or failure of agricultural crops such as rice, maize, wheat, potato and other vegetable as more than 65% of the total arable land is grown under rainfed condition. The productivity of agricultural crops is very low in comparison to SAARC countries. The area and productivity of rice, maize, wheat and potato are 1.540 million ha. and 2.717 metric ton/ha; 0.850 million ha. and 2.038 metric ton/ha; 0.672 million ha. and 2.074 metric ton/ha; 0.15 million hector and 13.16 metric ton/ha respectively. (2005/2006 MOAC). Major reasons behind low productivity are fragmented small land holdings, low use of improved seed, low fertilizer input with Nitrogen use 17kg/ha only (FAO 2000), low use of agricultural machinery and equipment, lack of round the year irrigation facility, low irrigation efficiency (less than 35%) in the irrigated field (WECS 2005), high post harvest losses ranging from 10% to 37 % (FAO 2001), low up scaling of generated technology.

## **Organization Structure**

## **Agricultural Mechanization Scenario**

The status of agricultural mechanization is in its infancy stage. Human power followed by animal power are the major sources of farm power in Nepalese agriculture especially in hills where as mechanical power is increasing in terai replacing animal power.

The trend of agricultural mechanization is increasing as the use of 2 and 4 wheel tractor is increasing totaling to 34336 (2005/06 first 8 months). In terai land preparation is mostly done by tractors on contract hiring. Wheat sowing by minimum tillage /zero tillage cultivation and direct seeding of rice using power tiller operated seed drills and four wheel tractors is getting popularity among farmers. Threshers are used for threshing rice and wheat. Combine harvesters have also been introduced and farmers are showing interest as there is shortage of labor during transplanting of rice and harvesting season of rice and wheat.

Total estimated mechanical power is only about 0.23 Kw/ha which is 37.3% of total farm power available. (Appendix 1)

## **Challenges Constraints for Agricultural Production**

### **A) Agricultural challenges/issues:**

**Following are the agricultural pre harvest challenges:**

#### **Agricultural Issues**

- Small land holdings
- Fragmented parcels
- Low agricultural mechanization status
- High cost of production
- Low fertilizer efficiency
- Overdose of insecticide/pesticide use
- High cost of keeping draft animals
- Poor water management practices
- Increasing scarcity of irrigation water
- Low irrigation efficiency
- Under exploitation of ground water in Terai region
- Over mining (Exploitation) of ground water in Kathmandu valley
- Lack of suitable equipment and machinery for crops, pasture and livestock production.

- Climate change/Global warming
- Erratic monsoon
- Change in cropping pattern
- Soil erosion/losses from the hilly area
- High transportation cost
- Under exploration of renewable energy
- Insufficient utilization of Agricultural waste (Rice husk, rice husk gasifier for electricity generation).
- Insufficient utilization of animal waste (cow dung and urine).

### **Post Harvest Challenges**

- High transportation losses
- Lack of packaging techniques
- Low market price of the product value addition needed
- Lack of grain and vegetable dryers

### **Social Challenges**

- Women drudgery
- Shortage of young working manpower in the village
- Migration of young people towards cities.
- Attraction of young people towards foreign jobs.

### **Environmental Challenges**

- Climatic change/global warming
- Increasing soil, air and water pollution
- Over use of pesticides/insecticides in vegetables
- Arsenic problem in ground water in few districts in Terai
- Over mining of ground water in Kathmandu valley
- Under utilization of Agricultural waste
- Under exploration of commodities for bio fuel (Jatrofa and sugarcane)
- Under exploration of commodities for fibers (Banana stem, Ketaki)
- Under exploration of commodities for medicinal plants
- Under exploration of ground water in Terai region
- Lack of promotion of fire wood saving and efficient stoves

- Increasing fuel shortage (non-renewable)
- Under exploration of renewable energy

## **Policies Related to Climate Change**

The core goal of the tenth plan is poverty alleviation. The object of increasing agricultural production, productivity and incomes both to reduce poverty of rural farmers and increase food security cannot be achieved without mitigation of climate change and mechanization. It was also mentioned that the growth strategies for agriculture are to modernize, diversify and commercialize crop and livestock production by expanding the case of technology and increasing the access of farmers to modern agricultural input and credit. In the agricultural policy, it is mentioned that for increasing productivity rate and protecting & promoting natural resources should be utilized in the interest of the farmers.

Water Induced Disaster Mitigation policy, 2062 Government of Nepal issued "Water Induced Disaster Mitigation policy 2062." In this policy following are subjects are included:

- a) Emergency protection
- b) Water Induced Disaster Mitigation
- c) Natural Resource Conservation
- d) Utilization of flood plains
- e) Institutional Management and Development

## **Working policy**

1. **Micro & Small Hydro Power:** Electricity generated by Micro Hydro Projects developed by private sectors or communities can be leased out.

2. **Biogas :**

**Necessary Research** - study will be emphasized for curtailing cost of Domestic Biogas Production Technologies, efficiency enhancement and promotion even in the high hills.

Biogas Research Development and Extension Community and Organizations will be emphasized.

Usage of dung cakes as domestic cooking fuels will be discouraged.

3. Fire-wood, Charcoal, Briquette, Bio-fuel and Biomass Gasification.

Scientific management of charcoal production distribution and utilization and its supply systems will be effectively managed.

The possible locations will identified, development and up scaled for the production of briquettes, bio fuels and biomass gasification on the basis of availability of fire-wood, rice-hull, saw-dist and other agricultural substances.

Emphasis will be led on Research to identify different materials used for briquette production and reduce the production cost.

Programs for enhancing the social awareness will be implemented on the use of local resources for production of briquettes, bio fuels and biomass gasification etc.

Technology on the improved cock stones and gasification will be developed for the use of minimum fire-wood and thereby minimizing its consumption.

4. Solar Energy : Development of solar energy will be encouraged for drying and cooking foods, heating and purifying electricity and linking up with communication technologies.
5. Wind Energy : Technology transfer activity will be promoted by involving the private sector for the development of wind energy.
6. Improved Cooker Technology: Social awareness will be enhanced for smokeless and firewood saving improved cookers.
7. Improved Water Mill Technology:
  - 7.1 Milling and grinding service will be made available improving traditional water mill in the rural areas.
  - 7.2 Private sectors will be encouraged for local development of machineries used in improved water mills.
  - 7.3 Electricity production through improved water mills will be encouraged.

Source: Gramin Urja Nile, 2063.

### **Potential of agricultural engineering and technology**

Nepal is a country of villages. Currently there are 3,915 Village Development Committees (VDC) and 58 Municipalities in the country. Most of the villages do not have infrastructure such as rural roads, drinking water facility, electricity, go down and other agricultural structures. Besides, Nepal is bestowed with natural resources such as snow fed rivers, sloping terraces, forests, long duration of sunshine hours, high rainfall during monsoon etc. The above resources should be harvested economically, without disturbing environment in a sustainable manner for agricultural development. Agricultural engineers could play very significant role for the development of basic infrastructure in the rural areas.

### **Opportunities**

There are vast opportunities/potentials that can be harvested or explored for building new Nepal.

<b><u>Opportunities / resources</u></b>	<b><u>Possible scope for best harvesting</u></b>
<ul style="list-style-type: none"> <li>• Sloping hills/terraces</li> </ul>	<ul style="list-style-type: none"> <li>• Production of off season crops special vegetables.</li> <li>• Promotion of gravity rope way</li> </ul>

		transportation of agricultural products (already existing in Dhading districts)
<ul style="list-style-type: none"> <li>• Snowfed Rivers / Streams in the hills</li> </ul>		<ul style="list-style-type: none"> <li>• Utilize for river transportation wherever feasible</li> <li>• Rotary pups, Micro turbines, peltricsets, River transportation (Successful exploration from Melamchi to Bay of Bengal)</li> </ul>
<ul style="list-style-type: none"> <li>• Sunshine hours</li> </ul>		<ul style="list-style-type: none"> <li>• Solar dryers for fruits, vegetables, egg hatchery</li> <li>• Cultivation of chaite early rice as it is yielding high</li> </ul>
<ul style="list-style-type: none"> <li>• High Rainfal</li> </ul>		<ul style="list-style-type: none"> <li>• Water harvesting and ground water recharging</li> </ul>
<ul style="list-style-type: none"> <li>• Under explored ground water potential in Terai region</li> </ul>		<ul style="list-style-type: none"> <li>• Further utilization of ground water in potential area in Terai</li> </ul>
<ul style="list-style-type: none"> <li>• Big neighboring countries</li> </ul>		<ul style="list-style-type: none"> <li>• Big scope for exporting off-season agricultural commodities specially vegetables</li> </ul>
<ul style="list-style-type: none"> <li>• Labour shortage during peak season (transplanting of rice and harvesting of rice and wheat)</li> </ul>		<ul style="list-style-type: none"> <li>• Possible expansion of zero tillage seed drill, tran planters, reapers harvesters</li> </ul>
<ul style="list-style-type: none"> <li>• Zero tillage cultivation awareness among farmers increasing</li> </ul>		<ul style="list-style-type: none"> <li>• Possible expansion of zero tillage equipment</li> </ul>
<ul style="list-style-type: none"> <li>• Maize crop growing almost the year in Chitwan and Terai</li> </ul>		<ul style="list-style-type: none"> <li>• Good opportunity for machinery manufactures, dealers and workshop operations production of maize planters, ridgers, feed grinders, feed mills</li> </ul>
<ul style="list-style-type: none"> <li>• Growing areas under citrus plantation in mid hills</li> <li>• Increasing agricultural waste in the urban areas</li> </ul>		<ul style="list-style-type: none"> <li>• Production of pit makers fruit graders, juice extractor</li> <li>• Production of compost</li> <li>• Recycling of the waste products</li> </ul>
<ul style="list-style-type: none"> <li>• Increasing demand of organic</li> </ul>		<ul style="list-style-type: none"> <li>• Production and promotion of</li> </ul>

product specially vegetable, tea, coffee		suitable agricultural equipment, coffee pulper, vegetable dryers • Production and promotion of vermin compost
• Increasing demand for cold water fish		• Fish dryers, production and promotion of feed mills
• Increasing farmers for milk (cow/buffalo) production		• Production of appropriate grass mowers, hay rake, chaff cutters
• Increasing milk holiday		• Value addition of milk product, production of powder milk

### **Institutions involved in mitigation of climate change effects**

Nepal is experiencing global warming and climate change effect in the following way:

- Rise in temperature has caused change in planting and seeding time, harvesting time in agricultural operations.
- Melting of glaciers - It has caused flooding and landslides.
- Untimely rainfall - It has caused flooding landslides, soil erosion, and damage of agriculture crops.
- High rainfall - It has caused flooding landslides, soil erosion and loss of forest area.
- Low rainfall - It has affected agricultural crops and electricity power generation.
- Drought - It has affected agricultural crops, animal population and natural vegetation. .
- Siltation problem - Due to high rainfall siltation of lake and water reservoirs.
- Rise of river beds causing frequent flooding in terai.

Following public organizations, Non Government Organization and International Non Government Organization have been playing significant role towards mitigation of climate change effects.

Agricultural Engineering Division , NARC

### **Background**

Agricultural Engineering Division was established in 2010 BS as Agricultural Engineering Unit under the Ministry of Agriculture at Singh Durbar Complex to develop physical infrastructures in agriculture. The unit was later promoted to section and then to

Division. After the establishment of Nepal Agricultural Research Council (NARC) in 1991 AD, Agricultural Engineering Division (AED) has been continuously concentrating its effort on research in order to develop appropriate technology in Agricultural Engineering. Agricultural Engineering Division is also a National Institute (NI) and Focal Point of Asian and Pacific Centre for Agricultural Engineering and Machinery (APCAEM).

### **Goal**

To enhance the livelihood/socioeconomic status and ensure equity among the farming community and support agriculture related entrepreneurs in Nepal with the increase in production and productivity in agriculture through the adoption of environment friendly, cost effective, efficient and appropriate agricultural engineering technologies.

### **Objectives**

The broad objective is to develop appropriate agricultural engineering technologies for various agro-technological zones of the country. The specific objectives are the followings:

### **Areas of Work**

AED has focused its research activities in following are

- Farm power and machinery
- On farm water management
- Irrigation and drainage engineering
- Post harvest engineering
- Agricultural structures
- Energy in agriculture
- Soil and water conservation engineering

### **Ongoing Projects of FY 2005/06**

- Drying, storage and milling of major cereal crops.
- Testing & Modification of farm machinery & equipment for mid hills of Nepal.
- Estimation of crop water requirement of rice and wheat based on 30 years meteorological data of hills and Terai districts of Nepal.
- Study on plastic house environment/system for off season vegetable farming.
- Irrigation scheduling in low drip system (LCDS) for cauliflower and tomato for mid hills of Nepal and adaptation of fertigation in LCDS.

- Onfarm water management and water requirement of rice based cropping system.
- Study on pulping, drying and storage of coffee and lapsi.
- Design development of commercial scale solar dryer for dehydration of perishable commodities.

### **Agriculture Implement Research Centre (AIRC), NARC.**

The main activities of the centre include

- Design and development of agricultural implement.
- Testing and modification of agricultural implement.
- Conduct research on agricultural mechanization.
- Conduct on station and on farm research related to research conservation.
- The centre is carrying out programmes on resource conservation technology specially on minimum tillage cultivation, zero tillage cultivation, bed and furrow planting methods in farmers field.
- Other institutions in NARC which are supporting resource conservation programme specially on minimum tillage cultivation are National Wheat Program, rice and wheat project supported by CIMMYT and Regional Agricultural Research Stations.

### **Agriculture Environment unit, NARC,**

Agriculture Environment unit was established in the FY 2000 in Khumaltar, Lalitpur under the directorate of planning and co-ordination of Nepal Agriculture Research Council. The main function of the unit is to carry out all the related agriculture environment research work and also unit support various agricultural research station with the environment related research works. The unit has been focusing its activities on current important environment issues such as.

1. Global warming or climate change
2. Natural Resource Management
3. Chemical pollution
4. System analysis
5. Greenhouse effects in agriculture
6. Climate variability and agriculture

### **Current Research Activities**

- Regional Collaborative research on the application of CO<sub>2</sub> enrichment technology in rice and wheat.
- Methane research on rice at Khumaltar.

- To prepare the inventory of meteorological database of different ecological belts of Nepal and analyze in relation to agriculture production system.
- System approach to address the rice wheat production system using simulation mode.
- Climate change studies.

### **Department of Agricultural (DOA)**

Department of agriculture disseminates technology generated from Nepal Agriculture Research Council through district extension offices. Directorate of Agricultural Engineering has initiated programs on minimum tillage technology.

### **Department of Irrigation**

Department of irrigation has also started conducting integrated soil water and nutrient management programs involving various stakeholders (NARC and DOA).

### **Department of Water Induced Disaster Prevention (DWIDP)**

Department of Water Induced Disaster Prevention (DWIDP) was established in 2000 under the Ministry of Water Resources. The main goal of the Department is to minimize the human casualties and damages of infrastructure caused by water induced disaster by appropriate water induced disaster management and mitigation .

### **Different Programmes and Projects Implemented Under the DWIDP**

#### a. Disaster Mitigation Support Programme (DMSP)

Following are the main activities of the DMSP under the DWIDP.

### **Community Disaster Mitigation Works**

- Disaster Mitigation Education and WID awareness raising activities.
- Promotion of appropriate and low cost technology.
- Peoples' participation works in disaster mitigation.
- Disaster rehabilitation works.
- Institutionalizations works.
- Survey and estimation of disaster effects.
- Emergency rehabilitation model constricts on works.
- Development and dissemination of information system.
- Conduction of WID Training and Seminars.
- Development of Disaster Information System .

- Preparation of WID Hazard Maps using GIS.
- Assist for the development of WID mitigation curriculum.
- To promote the technical assistance in the affected communities.

### **Department of Soil Conservation and Watershed Management (DSCWM)**

DSCWM has developed environmental action plans on sustainable management of water sheds and aquatic ecosystems to minimize the environmental programs.

### **Action Program**

- Improve Environmental data base system
- Map important critical and priority water sheds and aquatic system.
- Develop water quality / standards , guided lines and regulations implement water conservation program implement nationally important water sheds and aquatic eco system, protection, rehabilitation .
- Develop strategic environmental assessment in water resource management.
- Insure compliance with environment impact assessment.
- Promote community participation in the management of water sheds, aquatic eco system.
- Enhance institutional capacity and co-ordination

### **Universities:**

Few related departments do also conduct studies on climate change affect

### **NGO/INGO Involved in Climate Change Mitigation Activities**

Biogas support programme (BSP), started in July 1992, with funding from national and international donors is implementing BSP phase IV (July 2003 June 2009) after successful completion of the first 3 phases. Despite all the difficulties in the country in recent years, (BSP - Nepal has been lately working on promotion of Rainwater Harvesting System (RHS) to help promote biogas plants in water scarce areas as well as to address the problem of safe drinking water in such areas. So far, BSP - Nepal has supported to construct 3 Rainwater Harvesting tanks (together with rainwater collection and filtration systems) of 60,000 litres and 2 tanks of 25,000 litres in schools in Kaski and Syngja districts with financial support from the RAIN Foundation, the Netherlands. Over 140549 biogas plants up to December 2005 have been constructed under BSP in 66 district and over 2500 Village Development Committees of Nepal. Out of total biogas plant constructed, 66.05 % of plants are connected with toilets.

BSP - Nepal received the prestigious 1st prize of the "Orerseas Award fo Welfare 2005" from the Ashden Awards for Sustainable Energy of the UK for recognition of

"outstan, ding achievement in using sustainable energy to improve quality of life and protect the environment."

### **Centre for Rural Technology**

Nepal (CRT/N) is a professional non-governmental organization engaged in developing and promoting appropriate/rural technologies effective in meeting the basis needs of the rural mass and improving their life support system. The organization is actively engaged in up-grading traditional technologies and also developing new technologies to make it more diversified and versatile to meet rural needs.

### **Areas of Operation**

- Renewable Energy Technology Development.
- Environment and Natural Resource Management.
- Small Scale Irrigation management.
- Technology for Women and Micro - enterprise Development.
- Local Water Harvesting Systems and Rural Transport System.

### **Improved Water Mill Support Programme**

The Improved Water Mill Support Programme has been honoured by the prestigious; Ashden Award 2007 in recognition of upgrading over 2,400 traditional water mills in the Himalayas of Nepal and improving livelihood, for millers and mill users and stemming the rise in diesel mills. The Ashden Awards is presented by The Ashden Awards for Sustainable Energy based in London following an annual competition to identify and reward organizations which have carried out truly excellent, practical, yet innovative schemes, demonstrating sustainable energy in action at a local level.

The Programme is being implemented in 16 hill districts of Nepal. At local level, the programme activities are implemented through 16 service centres and eight Ghatta Owner's Associations (GDA). By end of June 2007, the programme has helped to install 7,767 improved water mills in 16 districts. Among them ... 2,473 are of short shaft, used for efficient grinding and 294 units are of long shaft, used also for other end uses such as paddy hulling and dehusking, rice polishing, saw-milling, oil expelling, lokta beating, chiura making. Replacement of diesel run mills has occurred after installation of IWM. Thus, IWM has directly helped to contributed in reduction of carbon dioxide emissions and hence global warming to some extent.

### **Table Installation of IWM by District (June 2007)**

SN	District	Short Shaft	Long Shaft	Total
1.	Baglung	35	2	37
2.	Baitadi	30	-	30
3.	Dadeldhura	58	1	59
4.	Dolakha	207	77	284
5.	Ilam	18	10	28
6.	Kabrepalanchowk	467	44	511
7.	Lalitpur	203	17	220
8.	Makawanpur	696	16	712
9.	Myagdi	16	2	18
10.	Nuwakot	381	55	436
11.	Pachathar	-	11	11
12.	Ramechhap	152	36	188
13.	Sindhupalchowk	187	13	200
14.	Surkhet	22	8	30
15.	Tanahun	1	-	1
16.	Taplejung	-	2	2
	Total	2,479	294	2,767
	Percentage	89.4%	10.6%	100 %

**Source:** CRT/N newsletter Centre for Rural Technology, Nepal

E-mail: [info@crtnepa.org](mailto:info@crtnepa.org), [www.crtnepal.org](http://www.crtnepal.org)

## **Smallholder Irrigation Market Initiative (SIMI)**

Smallholders Irrigation Market Initiative (SIMI) project, by International Development Enterprises (DE) and Winrock International with support from USAID and in partnership with centre for Economic Policy, Research, Extension and Development (CEPREAD), Support Activities for Poor Producers of Nepal (SAPROS, Nepal) and Agriculture Enterprise Centre (AEC), has promoted multiple use systems through its implementation in the mid-hill of Nepal. These projects have developed a multiple use water supply schemes that supply water both for the household used and irrigation. All of these schemes are community - based and community - managed with substantial community participation.

The preliminary works done under these projects show that these small-scale water supply systems have several advantages as follows:

- Cost effectiveness in supplying water to remote areas.
- Flexibility in its adoption in different location.
- Water supply both for household use and for micro irrigation of high value crops.
- Adopted technologies are suitable for the difficult terrain of hilly regions.
- Low construction and maintenance costs.
- Reduced need for expensive storage tanks.
- Significant financial incentives for farmers to install and maintain such schemes due to micro-irrigation for high value cash crops.

### **Treadle Pump :**

- Can irrigate 5 - 10 Katha
- This technology tested in Terai Region of Nepal.
- Initially developed in Bangladesh.
- Can lift water up to 22 ft.

B.S. 2050-51 (... 1993/94 Ad) after that its Fabrication and market promotion started. Now it has office held in large area. To date 1,00,000 farmers have been benefited by the use of treadle pump in irrigating various crops and have become successful in income generation.

### **Special Features:**

1. Can delivered big volume of water.	4. 1 year warranty.
2. Easy to operate.	5. Can recover the investment on short duration.
3. Can be fabricated locally.	6. Less cost.

- Pump fabrication and marketing and installation with the technical support of IDE. Six private companies are fabricating through distributing local dealers.

1.	Shree Krishna Grilland Engineering, Biratnagar, Morang	021-525492
2.	Shree Sharma foot pump, Lahan, Sirahah	033-560557
3.	Shree Sihainshor Metal Udyog, Janakpur, Dhanusa	041-520212
4.	Shree New Thapa Engineering , Bhairawa, Rupendehi	071-521598
5.	Shree Dangi Engineering Workshop, Kohalpur, Banke	081-554221
6.	Shree Yadav Engineering Workshop, Gulariya, Bardiya	084-420064

### **Drip Irrigation technology:**

- The system of irrigating each plant by drips of water at the root of the crop is called drip irrigation .
- IDE, Nepal through research and development has developed easy and low cost drip irrigation technology. It is also known as easy drip irrigation. To date by this technology, more than 5000 farmers have been successful to raise vegetable production and to generate income.
- As the field can be irrigated with less water this drip irrigation technology is more affective in the areas having scarcity of water. Therefore, this technology has been very successful in hilly region and north belt of terai region.

### **Practical Action Nepal**

Practical Action Nepal, an INGO, formally established in Nepal in 1998 and diversified its activities from the micro-hydro sector to the development and promotion of other farms of renewable energy and to the two new programme areas : agro processing and rural part. Now, Practical Action Nepal is working in seven broad priority areas.

- Disaster management
- Food security
- Improving market access
- Integrated infrastructure services (alternative transport and renewable energy)
- Clean air initiatives and
- Waste management and sanitation for a sustainable urban environment.

## **Programme priority areas in Nepal**

- Reducing vulnerability \* Market livelihoods
- Improving access to useful services, system and structures.

## **Reducing Vulnerability**

The programme areas include

- Reducing risk from disaster \* Securing food for the poor
- Adaptation to climate change

## **Transport Programme**

Practical Action Nepal commenced its transport programme in 1998. It improved and promoted innovative transportation systems such as cable river crossing bridges known as tulin gravity rope way for hilly and mountains regions and bicycle ambulance/trailer for the terai region.

Gravity ropeway technology was transferred from Northern India to Nepal by practical Action Nepal in collaboration with ICIMOD and private manufacturer/supplier. Practical Action Nepal installed a couple of demonstration ropeways in Marpha and Tukche VDCs of Mustang district to facilitate the transportation of apples from orchards to the road heads.

After a successful intervention in Mustang practical Action Nepal installed Janagaon/Bishaltar Ropeway in Benighat VDC, Hadikhola - Chiraudi ropeway in Kalleri VDC of Dhading district, and Torisawara - Bishaltar ropeway in Jori Sawara VDC of Gorkha district with financial support from the European Union, and UK Trusts and Foundations.

The initial study showed that the transportation cost of agro based products decreased by at least 50% after being served by gravity ropeway system. Such encouraging statistics provided confidence to the villagers to supply, their products in larger amounts and to enter the competitive market of the cities. Access to transportation system and market linkage improved their socio economic status in terms of income, health, education and community awareness. Promotion of this technology also helped local economy by creating employment opportunities and supporting the business of the local manufacturers and service providers.

## **ICIMOD**

ICIMOD, the international centre for Integrated Mountain Development was established in 1983 to promote the development of an economically and environmentally sound mountain ecosystem in the extended Himalayan region, and to improve the living standards of its mountain communities. The region covers around all or parts of Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan.

ICIMOD has shared various effective options for managing soil fertility, soil conservation and farm management, watershed specific income generating methods, and water harvesting.

Activities and initiatives with ICIMOD partners program mentioned in the medium term action plan 2003-2007.

- Some of the activities related to climate change effect mitigation are mentioned below.
- Regional flood forecasting and information sharing .
- Capacity building in watershed management
- Flash flood management in the Himalayas.

### **Natural Resources Management (NRM)**

Programme focus: Institutional, technological, and policy innovation for community - based management to increase mountain productivity, food security and biological sustainability.

#### **Action initiatives**

- Watershed management
- Range land, pasture and livestock management
- Transponder Bio diversity management

Water, Hazards and Environmental Management (WHEM)

Programme focus: Decreasing the physical vulnerability and increasing the environmental security of mountain people and the down stream poor.

#### **Action Initiatives**

- Water and floods \* Climate change and response
- Environment services

### **Measures for Mitigation of Climate Change Effect**

Measures which are useful for mitigation of climatic change effect are mentioned below:

- Promotion of renewable energy programs (solar energy, wind energy, macro and micro hydro plants, bio gas etc.
- Land leveling for increasing water use efficiency

- Minimum tillage cultivation
- Direct seeding of rice.
- Bed and furrow system of planting
- Sprouted seedling of rice
- Surface seedling of wheat
- Rice seedling broad casting
- Use water saving technologies
- Sprinkler irrigation (macro and micro)
- Drip irrigation
- Treadle pump/rower pumps.
- Water shed management.
- Moisture conservation
- Soil mulching
- Bio mulching
- Plastic mulching rain water harvesting
- Increase use of ground water
- Poly house farming
- Relay cropping (Board casting lentil & berseem in the field before harvesting rice)
- Cultivation of crops having low water requirements (Vegetables specially tomato utilization of agriculture waste for making compost. )
- Increase use of compost Farm yard manure, (increases water holding capacity of the soil).
- Adjustment in cropping pattern by introducing short duration varieties.
- Identification of low water requiring varieties.
- Avoid irrigation at non-critical stages of crops.
- Recycling of waste water for agricultural use.
- Recycling of agro industrial waste water for agricultural use
- Rain water harvesting
- Conservation of seeds and germ plasm.
- Promotion of varieties which can tolerate continuous flooding and water stress
- Increasing water use efficiency
- Terrace cultivation with inward slope
- Draining the field at less sensitive stages of crop when there is constant supply of irrigation

## **Strategies for Mitigation of Climate Change Effect and Sustainable Agriculture Development**

Strategies for promoting ecological and sustainable agriculture development are mentioned below:

- Alternate water saving irrigation practices/technologies for agricultural crops specially rice should be upscaled or promoted.
- Waste water reuse for agriculture should be given major focus on research agenda.
- Moisture conservation technologies/practices including plastic mulching should be disseminated specially in the rainfed areas.
- Water harvesting technologies/practices should be upscaled wherever feasible through out the country.
- In the areas where there is low water table, ground water should be explored to its potential and heavy investment on other irrigation structures should be discouraged.
- Zero tillage/minimum tillage cultivation for rice and wheat should be scaled wherever possible and support from related stakeholders would be provided.
- Low cost water lifting devices/technologies should be promoted in the feasible areas.
- Research priorities should be focused for estimation for crop water requirement for various crops and crops having low water requirement should be identified and included in the cropping system specially for areas having scarcity of water for irrigation.
- Research priorities should be given on soil-water nutrient management issues to increase their use efficiency for various crops.
- Activities towards management of urban agricultural waste for converting into agricultural compost should be encouraged with necessary facilities and the successful practice should be replicated in other areas.
- Water saved management technology/practices should be further upscaled.
- Poly house farming should be further disseminated in other feasible areas to save crops from climate change negative effect specially heavy rains and micro size hail stone.
- Forage and fodder cultivation on degraded land should be encouraged.
- Measures towards soil conservation and terrace riser improvement should be encouraged and disseminated.
- Renewable energy technologies specially water mill, micro hydro plant, wind mill, bio gas plants should be further upscaled wherever feasible.

- Environment friendly transport systems including gravity ropeway chargeable battery operated three wheeler (safa temp) should be further promoted.
- Measures to wards proper management of rice field should be encouraged towards mitigation of methane gas emission.
- Use of biotic and sulfatic fertilizers should be encouraged. Inclusion of legumes in the cropping system should be focused and upscaled.
- Community forest approach should be further upscaled or atleast maintained.

## **EXCEPTED SUPPORT from APCAEM**

### **Expected Support from APCAEM**

Strengthening the APCAEM National Institute is networking among the agricultural engineering related institutes in Nepal to the extent possible. However due to the lack of resources, it could not play active role to the expected level. Hence the support from APCAEM is expected in following areas to strengthen networking activities in the country.

- Technology transfer
- Exchange of commercially available equipment.
- Study visits for planners/scientists/technical officers in regional countries
- Exchange of information and publications
- Establishment of Farm machinery testing center at AED/NARC
- Skill development training for existing man power

### **Joint Action Research Project Development**

APCAEM could play facilitating role in the development of joint action research projects in the participating countries and seeking donors for financial support. Some of the possible areas for the joint action research and development projects are listed below:

- Programmes to mitigate climate change effect including
- Conservation tillage
- Rainwater harvesting
- Integrated watershed management
- Water saving technologies
- Rural transport in hilly areas including gravity ropeway
- Mechanization of hill agriculture
- Value addition of fruits and vegetable products

- Cottage scale processing of herbs and medicines
- Bi-fuel (Bio ethanol and bio diesel)
- Documentation of indigenous technologies and successful story/cases related to agricultural engineering and technology

### **Recommendation and Suggestion**

- Conservation tillage program (minimum tillage program) should be upscaled to reduce the cost of cultivation and mitigation environmental pollution trough out the country wherever possible with some incentives for few years.
- Methane gas emission in the country is mainly from the agriculture (rice cultivation and enteric fermentation) Methane gas contributes 15% towards the increase global warming. Proper water management rice field by multiple aeration or drainage should be encouraged to save water and to mitigate methane gas emission.
- Biotic and sulfetic fertilizer should be encouraged for agriculture production.
- Rain water harvesting program should be upscaled through out the country wherever feasible. with some incentives for few years.
- Water saving technologies for irrigation of agricultural crops should be encouraged.
- Transport vehicles run by renewable energy should be encouraged and promoted.
- Technology dissemination program should be targeted in the program of districts development/ extension offices.
- For degraded forestland improvements, amriso or suitable species cultivation should be upscaled to alleviate fodder shortage and poverty reduction. minimum tillage practices with inoculation and starter fertilizer and lime/palliating is recommended and has given 30 times more yield.

**Appendix - I**  
**Farm Power Availability**

<b>Source of Power</b>	<b>Units (No.)</b>	<b>Power rating, Kw/unit</b>	<b>Available Power (Kw)</b>	<b>% of Total</b>
Human Labor (Agriculturally Active Population 15-59 yrs)	12310968 x 081 = 9971884	0.07	698031.88	35.4
Draught Animals				
Cattle Oxen	1496384 *	0.30	448915.20	
He-Buffer	201660 *	0.44	88730.40	
Total Draft Power			537645.60	37.2%
2 and 4 Wheel Tractor 2005/06	34336	14.9	511606.4	
Stationary Engines Estimated 202/03	60000	3.73	223800	
Total Mechanical Power			735406.4	37.3
All totals			1971084	100.00

Mechanical Power = 023 kw/ha = 0.3 hp/ha

- Estimated Value from CBS Publications.

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