

# **Energy Management in Agriculture**

## **Status, Issues and the Strategy**

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- **Introduction**
- **Solar Energy and Agriculture**
- **Farm Power and Energy**
- **Energy Use in Agriculture**
- **Energy Issues and Recommendations**

# INTRODUCTION

- **Life is energy**
- **Energy comes from food**
- **Food comes from agriculture**
- **Agriculture depends on solar energy**
- **Solar Energy is natural & renewable**

**Energy is capacity for activity**

**(Physiological and Mechanical)**

**Survival, convenience and comfort of human beings depend on how best the Solar Energy is captured, transformed and utilized.**

# **SOLAR ENERGY & AGRICULTURE**

- **Solar radiation**
- **Photosynthesis**
- **Primary agricultural produces**
- **Processed agricultural products**
- **Food & Feed for humans & animals**

**Human & animal are used as Animate Sources of power for agriculture**

## Percent contribution of different power sources in Indian Agriculture (2005-06)

• <b>Agricultural worker</b>	<b>6</b>	<b>Total power = 1.5 kw./ha</b>
• <b>Draught animals</b>	<b>8</b>	
• <b>Tractor</b>	<b>47</b>	
• <b>Power tiller</b>	<b>01</b>	
• <b>Diesel engine</b>	<b>18</b>	
• <b>Electric motors</b>	<b>20</b>	

## Tractor density in some of the states of India

States	Number of tractors per 1000 ha	Remarks
<ul style="list-style-type: none"> <li>• Punjab</li> <li>• Haryana</li> <li>• Uttar Pradesh</li> <li>• Tamil Nadu</li> <li>• Gujarat</li> <li>• Rajasthan</li> <li>• West Bengal</li> <li>• Orissa</li> </ul>	<p>71.4</p> <p>60.1</p> <p>28.0</p> <p>12.3</p> <p>12.3</p> <p>9.8</p> <p>1.5</p> <p>1.3</p>	<p><b>Tractor density in India</b></p> <p><b>Highest in Punjab: 72</b></p> <p><b>Lowest in Orissa : 01</b></p> <p><b>All India : 13</b></p>
<ul style="list-style-type: none"> <li>• All India</li> </ul>	13	

## Farm power availability and average productivity of Foodgrains in some of the states of India in 2000-01

<b>Name of the State</b>	<b>Farm Power Availability, kW/ha</b>	<b>Food grain productivity, kg/ha</b>
<b>Punjab</b>	<b>3.50</b>	<b>4032</b>
<b>Haryana</b>	<b>2.25</b>	<b>3088</b>
<b>Uttar Pradesh</b>	<b>1.75</b>	<b>2105</b>
<b>Andhra Pradesh</b>	<b>1.60</b>	<b>1995</b>
<b>Bihar</b>	<b>0.80</b>	<b>1622</b>
<b>Madhya Pradesh</b>	<b>0.80</b>	<b>907</b>
<b>Orissa</b>	<b>0.60</b>	<b>799</b>
<b>Chhattisgarh</b>	<b>0.60</b>	<b>799</b>
<b>All India</b>	<b>1.35</b>	<b>1723</b>

# Energy Use in production agriculture

<b>Inputs</b>	<b>Energy input, MJ/ha</b>		<b>Remarks</b>
	<b>1969-70</b>	<b>2001-02</b>	
<b>•Seed</b>	<b>2</b>	<b>9</b>	<b>•Total energy input in 32 years has increased by 6.2 times</b>
<b>•Fertilizer</b>	<b>584</b>	<b>3672</b>	
<b>•Agro-chemicals</b>	<b>10</b>	<b>17</b>	
<b>Total</b>	<b>596</b>	<b>3698</b>	

*Energy use and energy productivity of some of the major crops in India*

	<b>Crop</b>	<b>Productivity, kg/ha</b>	<b>Total energy (MJ/ha)</b>	<b>Energy productivity (kg/MJ)</b>
<b>Cereals</b>	• <b>Paddy</b>	<b>3125</b>	<b>13076</b>	<b>0.239</b>
	• <b>Wheat</b>	<b>2873</b>	<b>14657</b>	<b>0.196</b>
	• <b>Maize</b>	<b>2140</b>	<b>9956</b>	<b>0.215</b>
	• <b>Sorghum</b>	<b>950</b>	<b>4745</b>	<b>0.200</b>
<b>Pulses</b>	• <b>Green Gram</b>	<b>510</b>	<b>4315</b>	<b>0.118</b>
	• <b>Black Gram</b>	<b>406</b>	<b>3870</b>	<b>0.105</b>
	• <b>Bengal Gram</b>	<b>596</b>	<b>5464</b>	<b>0.109</b>
<b>Oilseeds</b>	• <b>Mustard</b>	<b>960</b>	<b>8051</b>	<b>0.119</b>
	• <b>Soybean</b>	<b>1092</b>	<b>6382</b>	<b>0.171</b>
<b>Cash Crops</b>	• <b>Sugarcane</b>	<b>61500</b>	<b>59192</b>	<b>1.039</b>
	• <b>Cotton</b>	<b>938</b>	<b>9972</b>	<b>0.094</b>
	• <b>Potato</b>	<b>15520</b>	<b>31352</b>	<b>0.495</b>

# Energy Issues Involved in Agriculture-1

<b>Source of Energy</b>	<b>Issues Involved</b>
<b>Draught Animal Power</b>	<ul style="list-style-type: none"><li>• Enhancement of DAP utilization efficiency through appropriate harnesses and matching equipment for different breeds <i>(Draughtability, matching equipment and work rest cycle)</i></li><li>• Expanding the annual use of DAP through haulage (carting) and rotary mode of operation for agro-processing and electricity generation <i>(Rotary mode of operation)</i></li><li>• One pair DAP based optimum farm size and other annual usage for economic viability <i>(DAP based optimum farm size)</i></li></ul>

# Energy Issues Involved in Agriculture-2

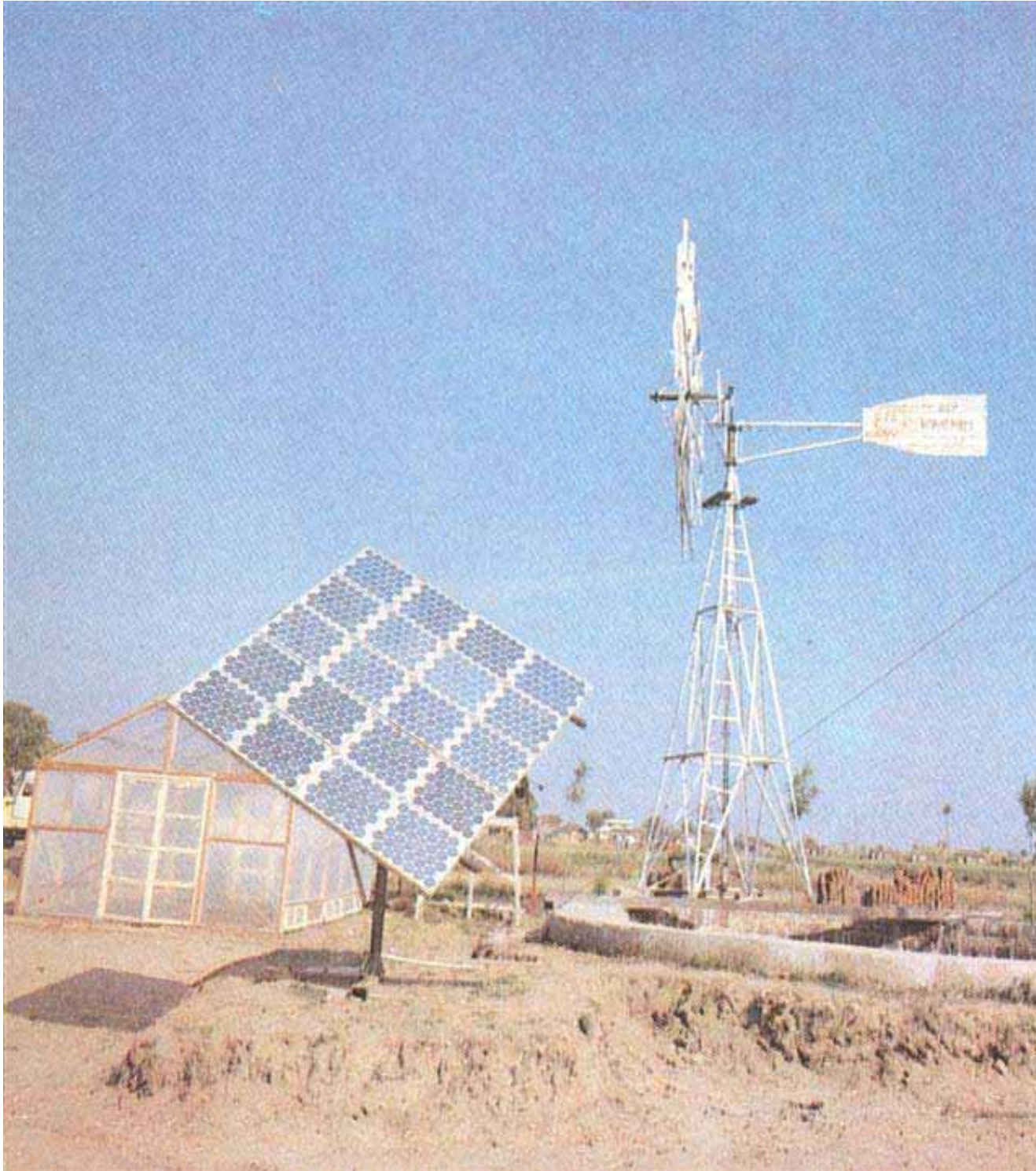
Source of Energy	Issues involved
<b>Renewable Energy Sources</b>	<ul style="list-style-type: none"><li>●Crop residue based decentralized power generation through gasification (flue gases) or anaerobic decomposition (biogas) or fermentation (fuel alcohol). System and gadgets need to be developed tested and upgraded to a pilot plant of an appropriate size. Performance evaluated and management package developed. <i>(Biomass based DPG using thermal or bio-conversion route)</i></li><li>●Promotion of biomass based improved cook stove, solar cooker and biogas &amp; SPV appliances in rural sector. <i>(RES based gadgets and appliances)</i></li><li>●Bio-fuel from Jatropha and Karanj for tractor and diesel pump sets. <i>(Bio-fuel/diesel)</i></li></ul>

# Energy Issues Involved in Agriculture-3

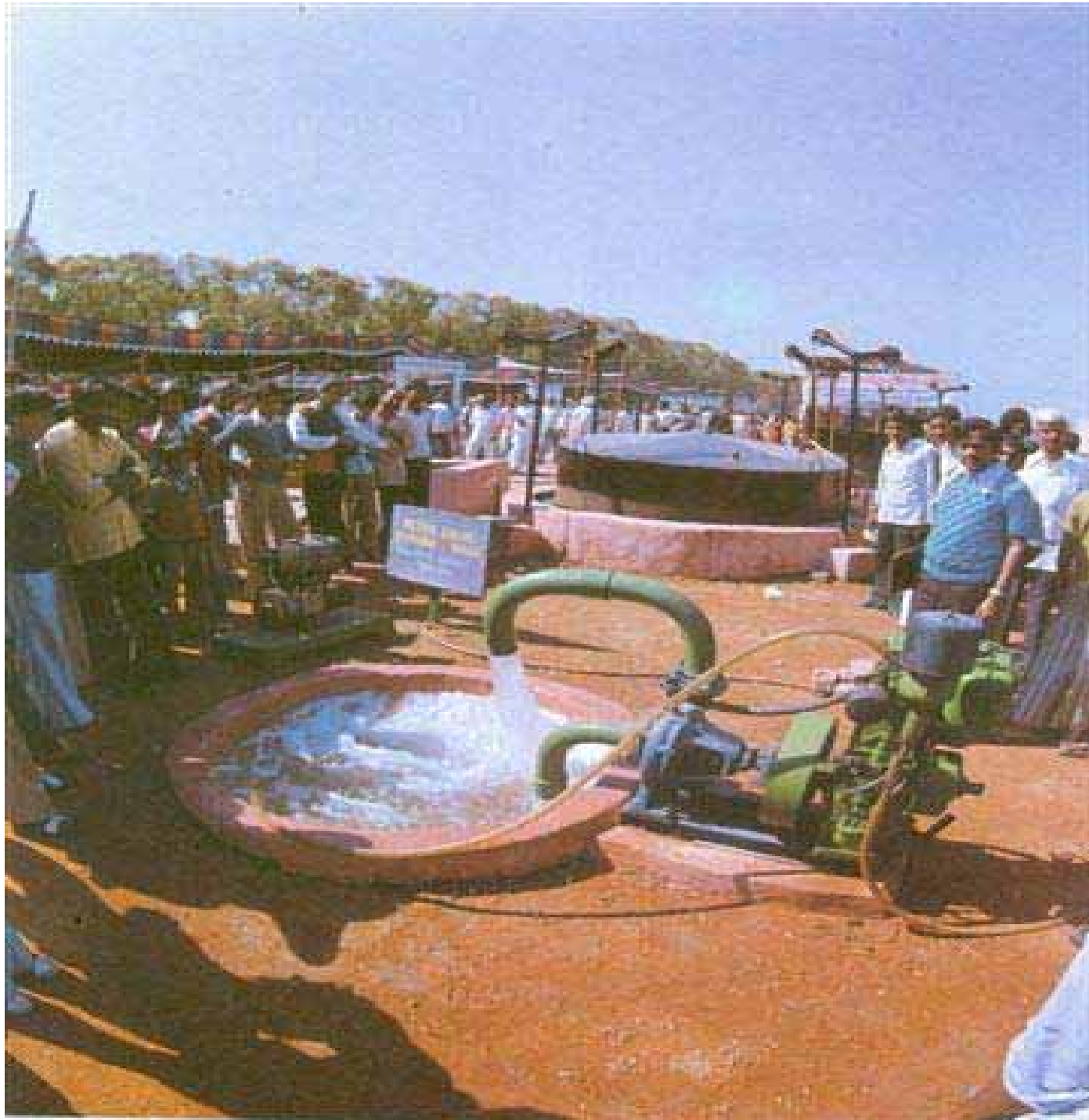
<b>Source of Energy</b>	<b>Issues involved</b>
<b>Conventional Energy Sources (Petroleum)</b>	<b>•Development and promotion of energy conservation technology and maximization of energy use efficiency</b> <i>(Energy saving technology)</i>

## **Role of RES and GOI Programme**

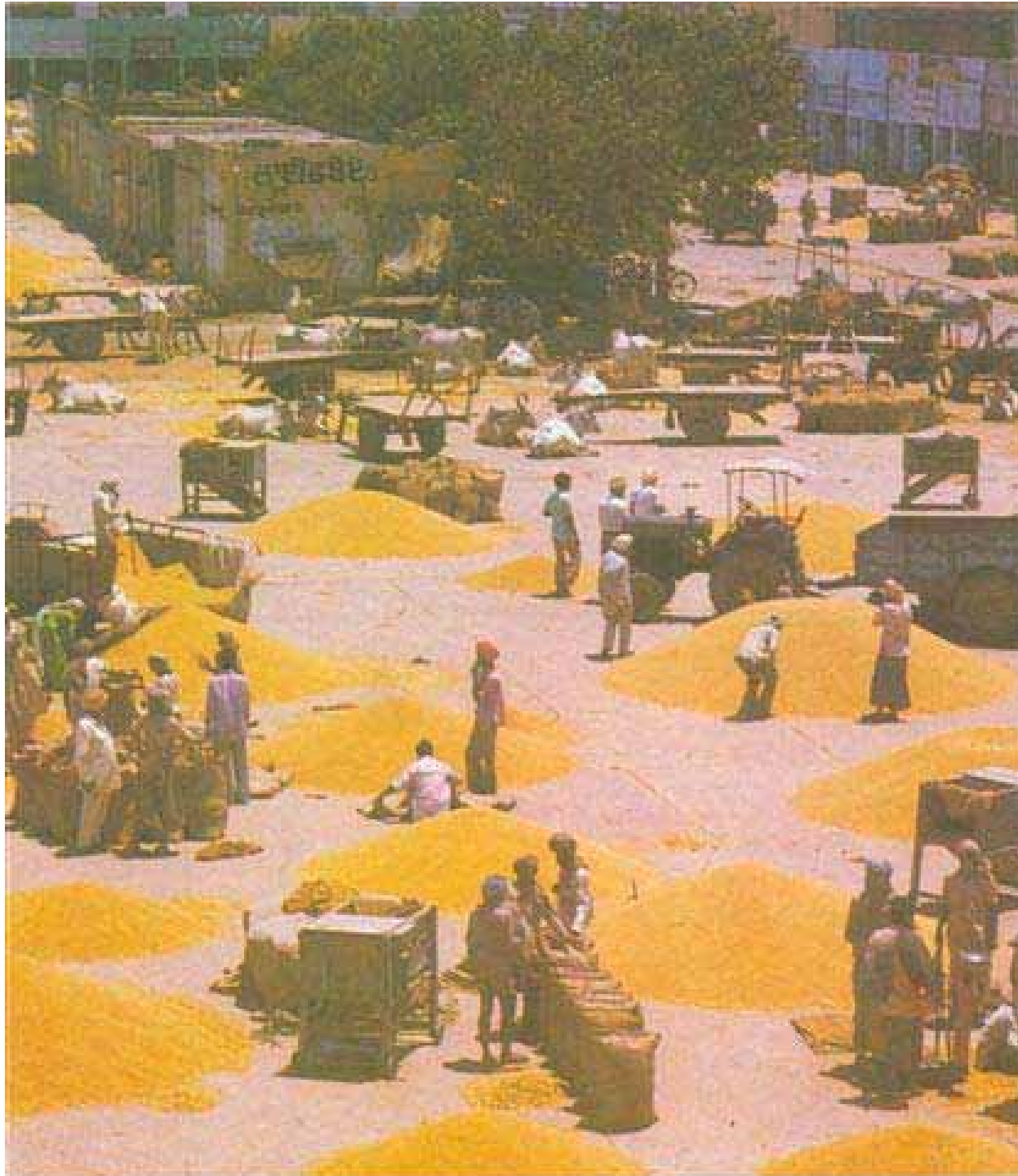
- RES is inexhaustible and Environment friendly. District Advisory Committee on renewable energy has been constituted (532/605).**
  - Energy consumption as an Indicator for Growth & Progress**
  - Electricity consumption per capita in India is 36 kW/h**
- 
- RES like sun, wind, water and biomass are being used from very beginning of human life on the planet earth. It is needed to be modernized and strengthened.**



**Wind Mill for  
Water Lifting and  
Solar Energy for  
Crop Drying**

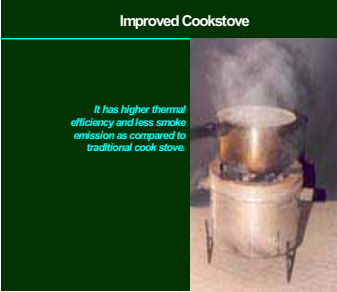


**Biogas run  
Water Pump**



## Solar/Sun Drying and Marketing of Agricultural Produce

# Renewable Energy Technology and Gadgets for Rural Sector

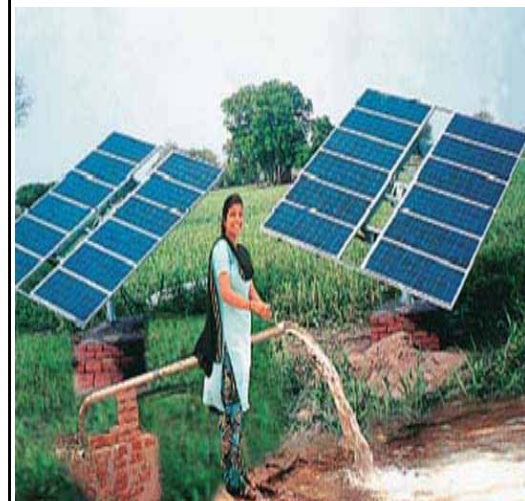
<b>For Domestic Application</b>	<b>For Agro-industrial Application</b>
<ul style="list-style-type: none"><li>•Biogas Plant</li><li>•Biomass Cook Stove</li><li>•Solar Cooker</li><li>•Solar Water Heater</li><li>•Solar Dryer</li></ul>	<ul style="list-style-type: none"><li>•Solar Photovoltaic Pump</li><li>•Solar Tunnel Dryer</li><li>•Biomass gasifier</li><li>•Biogas slurry as manure</li></ul>  <p>Improved Cookstove</p> <p><i>It has higher thermal efficiency and less smoke emission as compared to traditional cook stove.</i></p>



**Biogas Plant**



**Solar Cooker**



**Photovoltaic Pump**

# Thermal and Motive Energy for Agricultural Production and Processing in Rural Sector

- **India produces about 500 Mt of crop residues annually**
- **25% of crop residue (125 Mt) is available for energy generation (12500 MW) in rural sector**
- **Gasification based system/ technology costing Rs. 10-15 million/MW is available**



Producer gas system installed in an industry near Anand (Gujarat) for chicory roasting

# Issues for Discussion

- **Energy autonomy potential through DPG based on biomass need to be explored in terms of technology and management**
- **RES based gadget and appliances such as solar cooker and water heaters; SPV lightening and pumping; biogas stove and engines system need to be promoted on large scale.**
- **Development and promotion of energy conservation technology and maximization of energy use efficiency and the promotion of bio-fuel from Jatropha and Karanj**
- **Enhancement of DAP utilization efficiency through appropriate harnesses and matching equipments for different breeds and optimum farm size for economic viability of DAP need to be established**
- **Statistical data on use and problems of RES based gadget and appliance & biomass potential and present uses need to be collected and analyzed.**

***Thank You***