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SLIDES: Draft Power in Developing Country Agriculture--South Asia

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Draft power in developing country agriculture – South Asia

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Old and new draft power



Overview of energy, 1985

Energy Use Per Person in South Asia, Gigajoules per year, 1985¹

Country	Modern	Traditional ²	Draft animals ³	Total (rounded)
Bangladesh	2	5	1.5 to 3	9 to 10
India	8	6	2.3 to 4.6	16 to 19
Nepal	1	12	3.5 to 7	17 to 20
Pakistan	7	6	1.9 to 3.8	14 to 16

Notes for Table 4:

Rural per capital energy use, South Asia, 1985 - direct draft animal intakes only. Non-working animals add 20 to 60%.

Energy Use Per Person in Rural South Asia, Gigajoules per year, 1985¹

Country	Modern	Traditional	Draft animals	Total (rounded)
Bangladesh	0.3	5	2 to 4	7 to 9
India	1	7	3 to 7	11 to 15
Nepal	0.2	8	5 to 10	13 to 18
Pakistan	1	7	3 to 5	11 to 13

Total and per hectare draft power - about 0.5 hp per animal is typical

Draft Animal Power in South Asian Agriculture

Country	Cultivated Area, 10^6 ha.	Draft animal power, 10^6 kW	Specific power draft animals, kW/ha. ⁴
Bangladesh	9.2	3.0	0.36
India	169	33.9	0.22
Nepal	2.3	1.2	0.57
Pakistan	20.8	3.8	0.2
U.S.A. (machines)	190	266	1.4

Draft animals for agriculture - pluses

1. They reproduce themselves and do not require large capital outlays *if* an appropriate stock of animals is maintained.
2. They provide cow-dung as fuel (or return nutrients to the soil), milk, meat, and leather.
3. They are flexible in that they can be used for many different purposes such as ploughing, threshing, irrigation, and transportation.
4. They can be obtained in small unit sizes (in terms of power per unit), a big consideration for small farmers.
5. They are not dependent on external supplies of fuel, so that the element of risk in fuel cost is minimized.
6. They largely involve non-monetized energy sources, and use non-monetized labor which is available especially in the off-season.
7. They can provide peak power at several times the average power over short periods.

Draft animals - minuses

- Low efficiency – energy consumption continues for non-working animals and non-working periods.
- Large land requirements
- Insufficient power availability – large deficits
- High cost if the farmer does not own breeding stock
- Land shortage slows population growth
- Increases peak labor requirements
- Poor farmers have to borrow money and cattle and are last in line in the peak season when they have power deficits
- Draft power shortages at harvest can cause large crop losses.

Efficiency comparison – modern versus traditional (including non-working animals)

Comparison of Energy Inputs and Outputs for Modern Energy Sources and Draft Animals

Energy Source	Energy Input, petajoules	Efficiency, %	Energy Output, petajoules
Modern Sources (oil, electricity)	560	15 to 20	84 to 110
Draft animals (system basis)	2700 to 4500	1 to 3	45 to 90

Grazing land requirements

TABLE IV
Pasture Available and Land Areas Needed for Grazing

Country	Cattle Energy, petajoules	Grazing Land requirements, 10^6 ha.	Permanent Pasture available, 10^6 ha.
Bangladesh	300 to 600	3 to 6	0.6
India	3,600 to 7,200	35 to 70	12
Nepal	120 to 240	1 to 2	2.0
Pakistan	400 to 800	4 to 8	5.0

Effect of power availability

Annual Energy Input for a Two-Crop Irrigated System, GJ/ha/year

1. Draft animals	34 to 56
2. Diesel irrigation	20
3. Fertilizer input: 200 kg urea/ha/year:	30
Total energy input	84 to 106
Energy outputs	GJ/ha./year
1. Food: 5 tons/ha/year @ 14 GJ/ ton	70
2. Crop residues: 10 tons/ha/year @ 13 GJ/ton	130
Total energy output	200

Annual Energy Input for a One-Crop Unirrigated System, GJ/ha/year

1. Draft animals	11 to 19
2. Total energy input	11 to 19
Energy outputs	GJ/ha./year
1. Food: 0.5 tons/ha/year @ 14 GJ/ ton	7
2. Crop residues: 1.25 tons/ha/year @ 13 GJ/ton	16
Total energy output	23

Approaches to solutions

- Deficit of power in agriculture is large in South Asia. In the mid-1980s, it may be on the order of 100 GW. This cannot be met by increasing animal population.
- Marginal draft animal efficiency to increased feed of poorly nourished animals is high – up to 18 percent, which is comparable to petroleum power machines. High productivity feed production.
- Small petroleum machines for those who don't have draft animals
- Direct mechanical power from wind for irrigation.

Critical requirements for progress

- No solutions will be forthcoming until the energy inputs and outputs of draft animals are included in energy data.
- Data need refining. At present they are sparse and very rough. Regional field measurements are needed both to define needs, to measure available power, inputs, and outputs.
- Methodology needs to be developed and standardized: counting non-working animals other outputs like manure and milk and cow dung, for instance.
- The question of draft power needs to be joined to the broader issues of rural energy: cooking, electricity for lighting, irrigation, and other uses, skip-the-grid approaches for areas remote from the grid
- Institutional issues – local utilities for energy and water, including leasing of farm machines?

URL for report

- <http://ieer.org/resource/reports/draft-power-south-asian-food-grain-production/>