Eight
The Future of DAP in Mountain Agriculture

The evidence and discussions presented in the previous chapters suggest mixed prospects for DAP in mountain agriculture. However, despite all the constraining factors and agricultural transformation, DAP will continue to be the main source of animate energy in future.

As we have seen earlier, intra-regional and inter-regional inaccessibility favour the conservation of DAP. Traditionalism also encourages it. Social factors, such as migration, working away in the plains, or paucity of male labour in the households, discourage DAP. The public intervention system in the field of animal husbandry also works against DAP. In future, inaccessibility problems will largely be addressed thanks to the road network covering more and more areas of the mountains. Traditional agriculture will gradually give way to transformed or commercial agriculture. Migration is also likely to intensify in future, creating a greater shortage of male labour at home. The conventional institutional programmes will perhaps also intensify in the region. These arguments suggest that the future of DAP will be gloomy. But, indeed, the future of DAP will depend on a number of complex situations.

8.1 Size of Holdings

The overall population of draught animals appears to be directly proportional to the number of holdings. But it is not. The size of holdings, indeed, is an important factor governing the population of draught animals. Medium and large-sized holdings tend to maintain a pair of bullocks. Marginal and small holders do not always depend on independent DAP use. In future, with the increase in human population, the total number of holdings will increase. It will be followed by holding fragmentation, i.e., the size of holdings will decrease. Medium and large holdings will turn into marginal and small holdings. It should mean that the population of draught animals will decrease. But this might be compensated for by joining together small and marginal holdings and hiring out DAP for economic gain.

The size of holdings, therefore, is likely to keep DAP in balance, nevertheless, making it more remunerative for a large number of small and marginal landholders. In other

words, instead of influencing DAP resources, the landholding size will only influence DAP management.

8.2 Institutional Policies and Programmes

Institutional policies and programmes relating to the animal husbandry sector elaborated upon elsewhere are, in fact, not DAP friendly. If they become successful and lead to a change in draught animals' genetic composition by incorporating exotic genes, the future of DAP will perhaps be grim. But chances of this programme and other complementary ones becoming successful seem slight, because farmers have already rejected the programme 'choosing' buffaloes as a more promising alternative to the high milk-yielding crossbred cows.

8.3 Commercialisation of Agriculture

Commercialisation of agriculture in the mountains basically relies on the cash crop-based cropping systems. As we have seen earlier, vegetable cultivation requires a maximum input of DAP as well as human energy. One assumes that fruit farming (apple orchards, for instance) requires no DAP input. But the fact is that the area under fruit trees is used extensively for vegetable cultivation. As a result, it has been noted that the orchard - vegetable cropping system demands more DAP than a cereal - based system.

Since orchard-vegetable cropping is emerging as a dominant farming system in mountain areas (Banskota and Jodha 1992, Partap 1995), the prospects of DAP appear to be bright. However, as we have noted earlier, the transformed areas prefer buffaloes to cattle; the DAP supply in these areas in future will depend heavily on the hiring-in system. The inter-village hiring system will be dominant perhaps, for transformed village communities will have less time for cattle rearing. The non-transformed villages will hire out DAP to such villages. In the distant future, the villages engaged in cash crop farming may also depend on hired human labour, for, unlike in the traditional villages, community-based cultural activities are losing ground in transformed villages.

Commercialisation in terms of the increased cultivation of non-perishable nuts, timber species, and medicinal and aromatic plants will, of course, lead to a reduced demand for DAP.

8.4 Increased Use of External Inputs

Use of internal inputs (forest leaf litter, farmyard manure), to a certain extent, is complementary to DAP. In a natural farming system (the Fukuoka-type One Straw Revolution farming involving no tillage), the use of DAP might be completely eliminated. This kind of farming requires rice straw as a basic input. No other input, except seeds and occasional human labour, is needed. There was a lot of discussion over this in the

late 1980s, but then it faded away gradually. This farming system has not captured farmers' attention, even in Japan, where it had evolved, because of the complexity it involves. No-tillage farming in the mountains does not seem to be a reality in the foreseeable future. DAP will remain a basic input. Moreover, research findings have shown that no-tillage without residue cover results in more soil erosion than conventional tillage (Benoit and Lindstrom 1987).

The external inputs—improved seeds, chemical fertilizers, etc – have good responses only when other inputs, including DAP, are supplied in adequate measures. High-yielding seed varieties to be sown on irrigated land, for example, require a higher frequency of ploughing, that is, more input of DAP in order to realise potential yields. Reduced tillage, in fact, holds much promise for the development of sustainable dryland (rainfed) agriculture (Singh et al. 1994) but, for certain crops, for example, recently introduced crops, such as soybeans and vegetables, and high-yielding crops, such as lowland rice and wheat, it will be difficult to sustain yield potential without a high amount of DAP and other inputs. We have already elaborated upon these facts.

8.5 Altered Cropping Patterns

Multiple cropping with no fallowing practices, involving high-yielding, high grain-straw ratio crops and photo-period-insensitive, short duration cash crops is likely to be the future scenario of mountain farming. Such crops and crop sequences will be a part of high energy input agriculture. DAP demand will increase substantially. The input use of other energy, particularly external ones, viz., chemical fertilizers and pesticides, will also increase. Notwithstanding, increasing environmental awareness, of which the Central Himalayan region of India is a strong example, will lead to reduced or 'rational' use of external chemical inputs.

The majority of marginal and small farmers will also join the mainstream of mountain farming in future to increase their incomes. Yet they will not be in a position to depend heavily on high pay-off chemical inputs. DAP, in any case, will have a greater share in the overall energy scenario. In the foothills and Shivalik zone, where the transitional farming system is found, such changes in the farming system will perhaps be in favour of the use of fossil fuel-powered machines (e.g., tractors). The farmers in these areas will not possess tractors independently. They will depend largely on hiring them. Nevertheless, even then, DAP will have a substantial share in the power system.

8.6 Environmental Degradation

In mountain agriculture, cattle are vital components of land-use systems. Yet, when they are discussed in relation to the development of sustainable mountain agriculture, they are often accused of environmental degradation in the mountains. Ashish (1982) argues that the primary reason why hill farmers keep cattle is to provide manure for the fields. Many other researchers also look at cattle as having an essentially negative

impact on the environment and call for stall-feeding (GBP University 1982 and 1989, Pandey et al. 1982, Ashish 1982, Jackson 1985, and Banskota and Jodha 1992). But, in fact, neither are the cattle (bullocks and cows) kept to merely provide manure for the fields, nor are they the sole reason for environmental deterioration or a big threat to it.

Are draught animals contributing to overpopulation? If we look at Table 8.1, we find that the total ruminant population in the Central Himalayas shows a marginal increase (6.5%) from 1961 to 1988, i.e., over 27 years. Interestingly, the cattle population has decreased by about six per cent and that of sheep by about nine per cent over this period, while buffaloes and goats have registered an increase of 41 and 20 per cent during the same period, respectively. This trend shows that draught animals are not contributing to overpopulation of livestock, rather buffaloes and goats are doing so. A similar trend in cattle population stagnation has been observed in Himachal Pradesh, the other Himalayan state of India, where the share of male cattle in the bovine population was around 41 per cent during 1982 declining to 37.5 per cent by 1992 (Chand 1995). The declining trend in numbers of draught animals throughout the regions of India and during the inter-census periods is also evident (Pandey 1995).

The grazing of draught animals, therefore, is not to blame for environmental deterioration, nor will draught animals be responsible for environmental deterioration in future. Assuming that there is no increase in the area of land cultivated in the mountains in the future — and it should be a matter of institutional policy to see that there will be no increase at the expense of forest areas, since it would be self-defeating for the mountain people — the number of draught animals per village will decrease (Jackson 1985).

Some environmentalists fear that, in a free-range grazing system, livestock destroy the vegetation, prevent the regeneration of trees, and affect the environment, particularly CPRs, and thus reduce the productive potential of an area (World Bank 1991). These allegations are true to a certain extent. Yet, draught animals (cattle are most often

Table 8.1: **Changing Trend in Numbers of Ruminant Livestock Population (x1000) in the Central Himalayas, India**

Ruminant	1961	1966	1972	1978	1982	1988	Percent
Cattle	2057	2064	2180	2072	1910	1942	- 5.59
Buffaloes	585	633	677	699	768	827	+ 41.37
Sheep	384	413	353	405	408	348	- 9.38
Goats	751	884	737	948	865	904	+ 20.37
Total Population	3777	3994	3947	4124	3951	4021	+ 6.46

Source: Compiled from district statistcal books

Note : Oral history from the study sites also reveals the same trend in livestock population and composition over a period of three decades.
These dynamics suggest important changes in the DAP system in mountain agriculture in the future.

accused) contribute little to this deterioration. Their frequent movement between mountains and plains also eases pressure on CPRs. Bullocks are stall-fed for as many days as they work in the fields, and these are the species that can be kept exclusively stall-fed. But sheep and goats are notoriously difficult to stall-feed.

The preponderance of goats and sheep greatly intensifies the deterioration of grazing lands, making it more difficult to sustain cattle in future (Mann 1997 and Bhagat 1982).

The advantages of moderate grazing are worth noting. Moderate grazing maintains the physical soil characteristics and soil fertility and also helps in the regeneration of CPRs through the seeds passed through the animal's alimentary canal. *In situ* manuring and grazing go side by side. Moreover, through grazing, animal feeding is more balanced as, by using its natural instincts, it will choose the vegetation that is most desirable for its taste and health. Continuous exercise of the limbs through grazing also helps the animal keep fit. Thus, moderate grazing, in addition to being environmentally regenerative, also helps increase an animal's productivity in terms of work and in terms of milk in the case of cattle.

Considering the vital role and attributes of draught animals in mountain agriculture and the possible future livestock population scenarios in the Central Himalayas, draught animals will be regarded as a great asset rather than a burden by environmentalists in future, as do farmers today. Whatever little damage they cause, out of mismanagement of resources, is more than compensated for in terms of their unique services to the agro-ecosystems.