Results

Socio-economic profile of respondents

Out of 134 respondents, 25% each belonged to Angami and Apatani indigenous ethnic communities, 22% to Nishi and rest to Mizo. Most of the respondents were literate. The age, education status and family size of our respondents are presented in table 1.

Forest biomass extraction and consumption patterns

A Mizo household extracted average 3100 bamboos annually (table 2), whereas bamboo harvest by a Nishi family was the least in the resource use spectrum. An Apatani household harvested more timber (over 400 CFT/annum) as compared to other indigenous communities. Apatani and Angamis did not extract thatch material at all. In contrary, a Nishi household extracted over 100 bundles/annum of thatch. Nishi and Apatani communities as compared to other ethnic groups harvested more fuelwood from the forests. A Nishi household relied heavily on Non Timber Forest Produce (NTFP), whereas dependency of a Mizo household on NTFP was the least.

Sustainability of timber and fuelwood extractions

From earlier studies (Anon 1995 & 1996), the total annual production of growing stock is 1.33 m^3/ha (timber: 0.94 m^3/ha; fuelwood 0.3 tonnes/ha or 0.39 m^3/ha in the forests inhabited by Angamis. The annual average harvest of fuelwood from these forests as per our calculations is 4.9 tonne/ha ± 1.4 CI or 7.39 m^3/ha ± 1.97 CI, whereas of timber is 20.24 m^3/ha ± 15.39 CI Thus, annual extraction of growing stock (27.63 m^3/ha) from these forests is higher than annual production, leaving a gap of 26.3 m^3/ha (fuelwood 6.99 m^3/ha; timber 19.31 m^3/ha) between production and exploitation.

Similarly, annual growing stock extractions of 25.43 m^3/ha (fuelwood: 6.5 tonne/ha ± 2.94 CI. or 9.75 m^3/ha ± 4.29 CI; timber 15.68 m^3/ha ± 9.07 CI) by Apatanis far exceeded annual increment of 2.22 m^3/ha (fuelwood 0.67 m^3/ha; timber 1.55 m^3/ha) of growing stock in their forests, resulting an over-exploitation to the tune of 23.21 m^3/ha/annum.

Socio-economics of forest-based biomass extractions

Non-significant relationship between forest-based biomass extractions and socio-economic factors of the surveyed communities existed in the study area (table 3). The influence of respondents' profession on forest-based biomass extractions was also examined and only significant differences emerged in fuelwood extractions by Mizos ($\chi^2_{\ 2}$ = 8.55, P < 0.01, Kruskal-Wallis). A Mizo farmer (10.9 tonne/family ± 2.3 S.E., n = 21) harvested more fuelwood as compared to businessmen (9.7 tonne/family ± 5.3 S.E., n = 3) and government employees (4.1 tonne/family ± 1.3 S.E., n = 14). Average annual fuelwood extractions by farming, business and service communities of Angamis, Apatanis and Nishis remained statistically non significant (Kruskal-Wallis).

Discussion

The primary source of fuelwood was cutting of regenerating poles and mature trees in the surveyed villages. Apatanis and Nishis were the largest consumers of fuelwood. Both these communities practice space heating where multiple hearths, in addition to cooking food also serve to warm the house specifically during winter. Such heating is not generally prevalent amongst Angamis and Mizos. Further, members of Angamis and Mizos communities have adopted Low Pressure Gas (LPG) for cooking. The impact of LPG accentuated by non-practice of space heating have resulted low consumption of fuelwood and therefore their fuelwood extractions by them were significantly lower as compared to fuelwood harvest by Apatani and Nishi households.