Land use in the Amazon

SIR—There have been several recent analyses[1,2] of the actual and potential market values of intact forest in the Peruvian Amazon, in which a future benefit analysis approach to forest valuation is emphasized. But socio-economic reality in the region contradicts assumptions implicit in future benefit and net-present-value analyses. Rural inhabitants of northeast Peru use their land for a variety of subsistence and market-oriented uses: some are based on slash-and-burn conversion of forested land to agriculture and others on extraction of forest products. Slash-and-burn agriculture has exceeded extraction of forest products in economic importance since the 1950s (ref. 3). The hundreds of thousands of shifting cultivators inhabiting the Peruvian Amazon are not misguided recent immigrants, yet their decisions about land use are neither governed nor explained by calculations of perpetually accruing net revenues.

We suggest three reasons for this situation. First, predictions of future benefits rely on estimates of future commodity prices. For such forecasts to be reasonably accurate, prices must be relatively stable or at least relatively predictable; prices for perishable goods with limited markets (forest fruits in Iquitos, Peru, for example) are neither[4]. In the Peruvian Amazon, markets for agricultural staples are more dependable than markets for non-timber forest products, presenting a lower risk for producers. Prices for rice are set by the government, and credit is available for the production of rice, cassava and plantains, providing further incentive for their cultivation (ref. 5 and M. Chibnick, personal communication).

Second, most individuals and rural communities in the Peruvian Amazon lack secure land and resource tenure. As a result, there is little incentive to pursue options for land use with immediate returns lower than those available from slash-and-burn agriculture, regardless of potentially realizable future benefits.

Third, decisions about use of land in the region are based on both subsistence and market-oriented considerations. Net-present-value calculations often neglect the value of subsistence activities because they are difficult to measure.

Economic analyses of alternative uses of land in the Peruvian Amazon must reflect the context of the choices faced by rural populations. Widespread conversion of intact forest to agricultural use is neither ecologically nor, in the long term, socially desirable. Nonetheless, rural populations can be expected to continue converting forested land to slash-and-burn agriculture unless alternative land uses become more attractive in practice as well as in theory.

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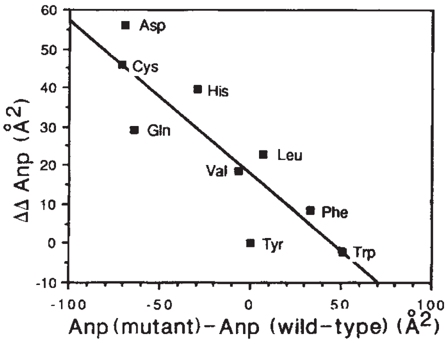
Surface areas of unfolded proteins

SIR—Pakula and R.T.S. have recently investigated[1] the effects of amino-acid substitutions at position 26 in the protein λ Cro. This residue is unusual in that it is more exposed to solvent in the folded than the unfolded states[2,3]. Hence it shows a 'reverse' hydrophobic effect as mutations that increase in hydrophobicity decrease in protein stability. The effect of the mutation on ΔG of unfolding correlated with side-chain hydrophobicity, measured by solvent-transfer experiments[1]. We have used these results to determine the surface area at position 26 in the unfolded Cro protein.

The solvent-accessible surface areas of residues are usually calculated relative to the residue in an Ala-X-Ala tripeptide[1,4]. Hence, a side chain with a fractional solvent accessibility of 1.0 has the same solvent-accessible surface area as the side chain in the tripeptide. The mutation studied (Cro, position 26) has an unusually high fractional solvent accessibility of 1.4 in the folded state. The hydrophobicity of a side chain, measured as a free energy, is directly proportional to the non-polar surface area of the side chain[5], with a constant of proportionality of 24 cal $\AA^{-2}$. The effect of each mutation on ΔG ($\Delta\Delta G$) can therefore give the change in non-polar surface area ($\Delta\Delta$Anp) of unfoldiing between the mutant and wild-type protein, if we assume that the mutations affect ΔG only through the hydrophobic effect.

This assumption is supported by the observed correlation between $\Delta\Delta G$ and hydrophobicity[1]. As λ Cro denatures from a dimer to two unfolded monomers[1], each $\Delta\Delta G$ value includes contributions from two mutant side chains. The change in non-polar surface area per mutant side chain obtained from the experiment is therefore $\Delta\Delta G/48$. The Tyr 26 residue is distant from the dimer interface[2,3] so the folded dimer/folded monomer transition will have no effect on $\Delta\Delta G$. The change in non-polar surface area is equal to ΔAnp between the mutant and wild-type unfolded protein minus ΔAnp between the mutant and wild-type folded protein. The latter is equal to 1.4 multiplied by the difference in non-polar surface area between the mutant and wild-type residues in Ala-X-Ala tripeptides. This assumes that the fractional solvent accessibility of 1.4 for the folded protein is applicable to all the mutations studied. Similarly, ΔAnp between the mutant and wild-type unfolded protein is equal to the fractional accessibility of the unfolded protein multiplied by the difference in non-polar surface area between mutant and wild-type residues in Ala-X-Ala tripeptides.



Relationship between the difference in non-polar surface area of unfolding between mutant and wild-type proteins ($\Delta\Delta$Anp) and the difference in non-polar surface area between the mutant and wild-type residues in Ala-X-Ala tripeptides. The line of best fit is: $\Delta\Delta\mathrm{Anp} = -0.394(\mathrm{Anp[mutant]} - \mathrm{Anp[Willd\text{-}type]}) + 17.7$. Correlation coefficient, 0.87.

If we plot $\Delta\Delta$Anp (calculated as $\Delta\Delta G/48$) against the difference in non-polar surface area between the mutant and wild-type residues in Ala-X-Ala tripeptides (measured using data in ref. 4), we obtain the difference in fractional accessibilities between the unfolded and folded protein as the gradient. The graph obtained has a slope of -0.39, showing that the fractional solvent accessibility of position 26 in unfolded λ Cro is $1.4 - 0.39 = 1.01$, a value very close to that expected based on an Ala-X-Ala tripeptide. This suggests that this tripeptide is a reasonable model for the side chains in an unfolded protein, at least for position 26 of λ Cro.

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