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Land use and energy optimization in the Himalayas: case study of a watershed

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The paper proposes to analyze the problem of choice of technology for a pattern of land use such that there is minimum adverse impact on the ecosystem. As the problem of such choice of technology would depend upon the local characteristic of the ecosystem we propose to take up a case study through developing a model of analysis at the watershed level economies in the Himalayan Mountains. The issue of choice, which is involved in the analysis of the particular case study, is supposed to yield valuable analytical and policy insights, which can be generalized for rural situations with similar geomorphic, eco-regional and agro-climatic conditions.

This work develops a quantitative optimization framework of analysis using the mathematical tool of linear programming for structuring and articulating the problem of choice. The modeling framework essentially focuses on optimal use of land and energy resources in an exercise of net revenue optimization. The range of options that the model would attempt to articulate through the case study would cover the following aspects:

1. Use of land for agriculture, pasture and forestry including conversion from one use to the other.
2. Choice of technology as determined by (i) seed (ii) water (iii) fertilizer (iv) animal energy and (vi) human labor.
3. Choices in commercial and non commercial fuel use for household and agricul-

ture in the rural system taking account of the nexus between food and energy linked with the pattern of land use.

The scope of analysis also covers the implication of choice in terms of the following impact on the global and local ecosystem.

1. Emissions in the form of carbon di oxide and methane from agricultural process and fuel use.
2. Soil erosion.

While the model based case study work out the total water requirement for any land use pattern it has not considered any choice of source of water use, as there was no effective choice for the case study considered. The constraint of water availability has been taken into account to show how it drives the choice of technology and land use. A dynamic analysis of the problem would have been insightful however due to paucity of time series data on certain variables dynamic analysis wouldn't be possible. Instead, the attempt here is to determine an alternate combination of inputs, including energy inputs and land use pattern in an optimization exercise for a given year under different technologies (including renewable technologies like micro hydro power plants). The attempt is to identify cost effective technologies, optimal land use pattern, input combinations and prescribe policies for adopting these technologies and help in attaining the optimal land use and input combinations for various outputs such that the impact on ecosystem is minimal.