Modelling Sustainability of Agropastoral Systems in Bolivian Arid Highlands

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Key words : sustainability model ,agropastoral systems ,*Chenopodium quinoa* ,*Lama glama*

Introduction In arid regions , agropastoralists must anticipate losses caused by drought . Herd-management practices , crop diversification , and the relative importance given to both types of production are the most important strategies . In Andean agriculture , risks exist not only for agriculture but for food availability and commerce (Morlon , 1989 ; Sautier , 1989 *in* Eldin , 1998) . Increasing international demand for quinoa (*Chenopodium quinoa*) , the principal crop of this region , has multiplied the price by a factor of 15 in 10 years . In consequence , its production has grown , upsetting the balance between crops and livestock in the traditional system . Our main aim was to identify variables needed to model a sustainable production system under new circumstances .

Materials and methods The study area was located on the southern Bolivian highlands in the departments of Bolivia Potosi and Oruro , the most important quinoa-producing area in the country . The research concerned six villages located around the Uyuni salt lake . The climate is tropical arid with a mean annual temperature of 7 .6°C and more than 270 frost-free days per year . Elevation ranges from 3600-4100 m , with three topographic units : plains , mountains , and piedmont (slopes between plains and mountains) . The native plant communities are well adapted to the adverse climate and are generally intact thus constituting the major forage source in the region . Under these arid conditions agricultural production is problematic and only well-adapted crop and livestock species are viable here . The main agricultural crop is quinoa , and herds are composed of llamas (*Lama glama*) and sheep (*Ovis aries*) . Lands are managed as collectives with use regulated by village authorities . Surveys and interviews of producers , their families , and experts in the field were conducted in May-August 2007 . These data were used to identify crucial factors for modeling sustainable scenarios of this agropastoral system .

Results and discussion Different models have been proposed to understand choices of pastoral and agropastoral groups (Hervé *et al* , 2002 ; Milner-Gulland *et al* , 1996 ; Thornton *et al* ., 2001) . Livestock and crop performances , technical parameters , and cash income have been identified as key factors to establish scenarios and assess sustainability of pastoral systems . But as Tichit and Genin (1997) noted , *...other factors , such as historical transformations of communities , economic opportunities and socio-cultural aspects also influence herd structure .*" Our findings confirm this previous work not only are the herds affected , but the whole production system as well . Therefore , key factors were included in our conceptual model as interactive entities belonging to decisional , production , and economic subsystems (Figure 1) . These factors should be added to future models , especially when studying the sustainability of traditional systems , which are culturally and socially complex and influence agricultural activities .

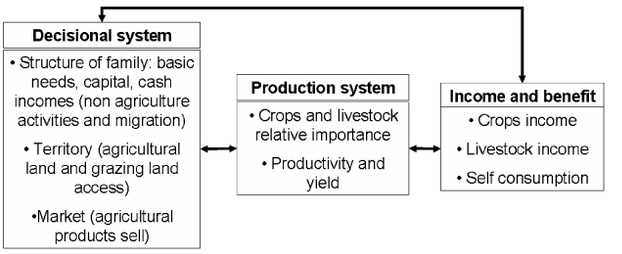

Figure 1 *Key factors represented in subsystems for the conceptual model of a sustainable agropastoral system .*

Conclusions In tropical , arid environments , mixed farming allows diversification of products and a protection against climate variability . Nowadays , traditional agropastoralist societies have to face new sources of risk because they are no longer isolated . Markets , NGOs , research and development institutes , and governments generate links that are pressures but also sources of innovative information that induce changes in management practices , changes that usually go unnoticed . Thus , studying agropastoral systems requires looking beyond the agricultural production system . The sustainability of livestock production systems should be considered as a whole by including socio-economic factors in multi-criteria analyses .

References

Eldin , P . , 1989 . *Le risque en agriculture* . Paris , ORSTOM : 187-224 .
Hervé ,D . ,Genin ,D . ,Migueis ,J . ,2002 . A modelling approach for analysis of agro pastoral activity at the one-farm level . *Agricultural Systems* 71(3) , 187-206 .
Milner-Gulland , E . J . , Mace , R . , Scoones , I . , 1996 . A model of household decisions in dryland agropastoral systems . *Agricultural Systems* 51(4) , 407-430 .
Thornton , P . K . , Galvin , K . A . , Boone , R . B . , 2003 . An agro-pastoral household model for the rangelands of East Africa . *Agricultural Systems* 76(2) , 601-622 .
Tichit , M . , Genin , D . , 1997 . Factors affecting herd structure in a mixed camelid-sheep pastoral system in the arid Puna of Bolivia . *Journal of Arid Environments* 36(1) , 167-180 .