Energy Balance Analysis of Integrated Crop-Livestock Production System in Tianshui Town, Huanxian County of Gansu Province

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Key words: crop-livestock system, energy efficiency, input, output

Introduction Energy balance analysis is a useful approach for assessing the sustainability of farming systems. Energy used on a farm include energy that is used for production inputs (eg. fertiliser, labour, seed) and production outputs (eg. grain from crop, meat and wool from livestock production). Energy balance is measured by energy efficiency-the ratio of energy output to energy input. The higher the value is, the greater the energy efficiency is. This paper presents the results of an energy balance analysis for Tianshui town (37.12°N 和 106.82°E) in Huaxian County, Gansu Province, China.

Materials and methods 40 farms were surveyed in 2006. The information on crop areas, yields, inputs, livestock types, number, production outputs, supplementary feed types and levels, labour inputs, and grazing management such as time of grazing and stocking rates were recorded. Both energy inputs and outputs were identified and calculated in terms of megajoules of energy (MJ). The major energy inputs were nitrogen (77.4 MJ/kg), phosphate (12.96 MJ/kg) and labor (0.679 MJ/hour). The major energy outputs were alfalfa (17.04 MJ/kg DM), wheat straw (15.05 MJ/kg) and wool (20.9 MJ/kg). Energy efficiency (E) is the ratio of energy outputs (E_O) to energy inputs (E_I) (ie. $E = E_O / E_I$).

Results and discussions The results are summarised in Figure 1 and Table 1. Alfalfa (E=51.83) and canola (E=51.51) generated the highest energy efficiency among all the crops identified in the survey. Comparatively, the energy efficiency of broom millet (E=1.83), buckwheat (E=2.58), millet (E=2.60) and potato (E=0.45) were low due to their high energy input. The energy efficiency of alfalfa was more difficult to gauge as it is often used as an input for livestock productions on farms. The greatest energy efficiency in local production systems was associated with the livestock production (E=1.83). The lowest energy efficiency was related to the crop production (E=1.30), reflecting by the high input of purchased fertilisers. The crop production also had a substantial variation in energy inputs compared to the other two systems. The efficiency of the livestock production was higher due mostly to the lower level of energy inputs, reflecting the use of on-farm resources rather than purchased inputs.

Conclusion The results of an energy balance analysis for Tianshui town in Gansu Province, China indicated that the greatest energy balance was associated with livestock production.

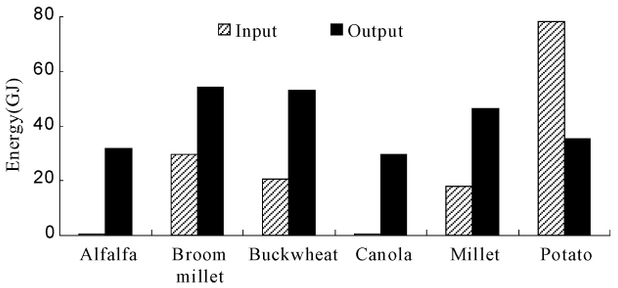

Figure 1 *Energy input and output of main crop.*

Table 1 *Energy analysis of system production.*

	Inputs GJ/ha	Outputs GJ/ha	Efficiency
Crop production	31.7	41.1	1.30
Livestock production	16.3	29.9	1.83
Integrated production	17.9	29.8	1.66

Reference

Pimentel, D., 1980. Handbook of Energy Utilization in Agriculture. *Florida: CRC Press*. 9-169.