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“Filling gaps and removing traps
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Partial C and N Balances of Small-Scale Farms in a River Oasis of Western Mongolia

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Abstract

During the last decades, Mongolia's national policy fostered the expansion and intensification of crop and forage production. Non-sustainable agricultural management practices, however, may have led to disequilibria in soil surface matter balances of agricultural plots jeopardising the scarce and susceptible agroecological resources of river oases.

The objective of this study therefore was to calculate partial carbon (C) and nitrogen (N) balances in order to assess the bio-physical sustainability of current management strategies for agricultural plots of small-scale farms in the Mongolian river oasis Bulgan sum centre as a representative example. Based on a baseline survey, six small-scale farms were selected. After the quantification of main C and N input and output fluxes, partial balances were calculated for hay, carrot and rye plots in each farm for the growing seasons 2013 and 2014.

All C and N balances were strongly negative ($-1366 \text{ kg C ha}^{-1} \text{ season}^{-1}$ and $-44 \text{ kg N ha}^{-1} \text{ season}^{-1}$ on average). Gaseous emissions accounted for 67% of total C losses for all agricultural products on average, while the removal of biomass through harvest and weeding was a major N output pathway (90% on average). Although fertilisers were an important input flux particularly for N (47% of total N and 12% of total C input on average), the application was with an average of $569 \text{ kg C ha}^{-1} \text{ season}^{-1}$ and $22 \text{ kg N ha}^{-1} \text{ season}^{-1}$ low. C-fixation by plants was the main C input flux for all agricultural products (87% of total C input) whereas N-fixation was only relevant for hay plots (67% of total N input).

Possible measures to lower disequilibria of soil balances include the increase of C and N input through alfalfa cultivation and the intensification of organic fertilisation (sufficient organic manure could be provided by livestock from agropastoral households) whereby fertiliser should be incorporated into the soil to minimise gaseous emissions. Our study underlines the need of corrective measures to sustain soil fertility and thus agro-pastoral livelihoods in the floodplain of the Mongolian river oasis of Bulgan sum centre and similar ones in the (semi)arid areas of East Asia.

Keywords: Altai Mountains, carbon losses, nitrogen turnover, soil fertility