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Sustainability of semi-arid extensive livestock systems in Senegal : elements for modelling animal-plant interactions

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Introduction In the Sahel cattle often graze free during the dry season (8 months) . This system allows feeding cattle on rangelands and crop residues and recycling manure to maintain crop field fertility . The matter recycling depends on animals daily circuit which depends on localisation of the well , the night park , and fenced areas . To evaluate long-term sustainability of such a system both animal performances and matter transfers are approached by modelling animal behaviours .

Materials and methods A 3 years survey on cattle feeding systems and performances was done in Kolda (Senegal) . Daily variables measured were circuit durations and distances , faecal excretion and intake rates , diurnal activities (grazing , walking without grazing and standing) , feeding behaviour , milk production ; a total of 78 full days observations per herd , on 3 herds are available . A multi-agent modelling process that was initiated by Cambier et al . (2005) , and that has proved to be of interest , was presently developed with Cormas with an individual-based logic (Bousquet et al . ,2004) .

Results and discussion Cow s daily circuit duration appeared to be highly predictable according to season , independent of herd (Figure 1-a) . Measured diurnal activities tended to evolve with season and herd size but not by years . In simulated circuits one of the major processes of cow driven movements is rather well represented by a time dependant function ("driving force" DF , Figure 1-b) . DF has an exponential time dependant shape that drives cows to move toward the attractive points (well/watering and night park/suckling calves) . Daily time duration is then an input parameter . The village territory has been divided in scored patches according to available biomass and its nutritive value . Hence patch to patch movements of cow are driven by a combination of scores and the DF values (black arrows on Figure 1-b) .

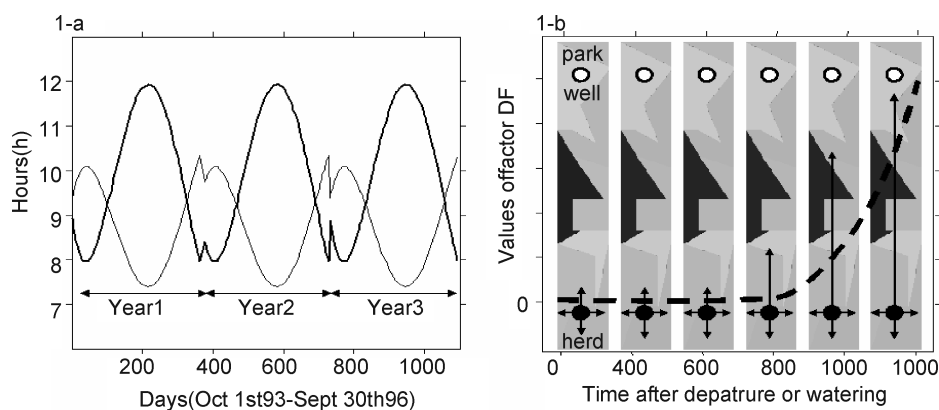


Figure 1 (1-a) Circuit durations (thick) and starts (thin) function of the season , and (1-b) exponential tendency of DF .

Conclusions Model is stepwise validated comparing results of simulation with observations (circuit duration and length , exploited areas) . Next steps will consider daily visits of different areas and associated activities (walking , eating , and resting) , diet selection . We plan to develop the global validation on animal energy balance , i .e . estimated energy intake minus energy requirements (maintenance , production , movements , and body energy changes) , at the whole dry season scale .

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