Trade-offs between agroecological principles in sub-saharian Africa

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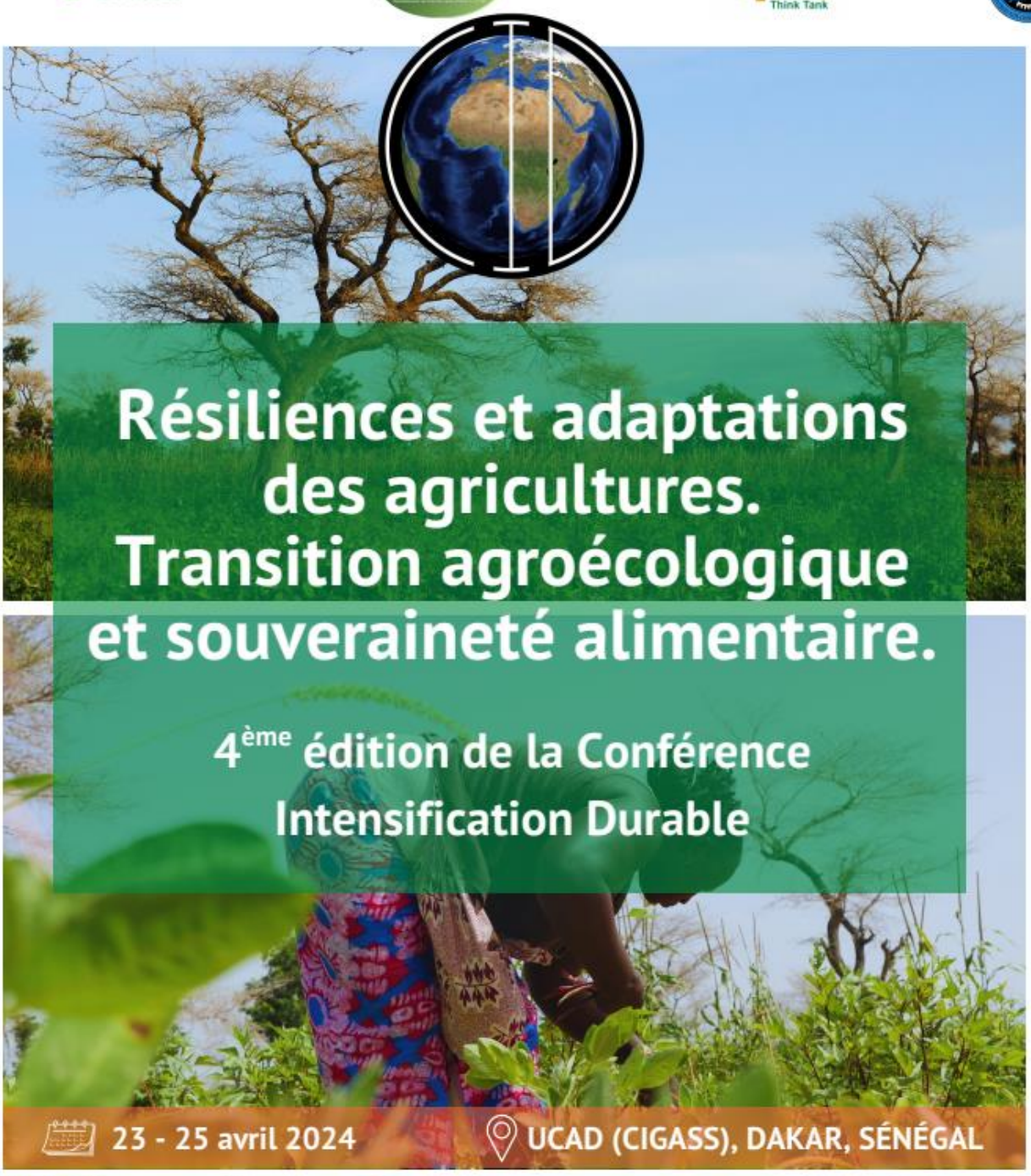

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Even if the concept of agroecology as the application of ecology in agriculture first appeared in the literature long time ago (1928), it has been recently widely promoted as agricultural practices enhancing ecosystems functions, and moving beyond the field level towards the whole food system (Wezel et al., 2009; Gliessman et al., 2007). Agroecology was first defined through 10 principles (FAO, 2019), but this definition was later extended to 13 principles (Wezel, 2020). However, synergies and trade-offs between these principles remain overlooked. Analyzing several case studies on integrated soil fertility management based on crop-livestock integration using diverse methods (board game, farm and landscape-scale modelling, field trials), we illustrated how farms management constraints of poor farmers generate trade-offs among certain of these principles. Crop-livestock integration is a typical example that matches several principles of agroecology in west Africa. The use of manure and crop residues as fodder are expected to directly contribute to soil health, input reduction, recycling, animal health and combining food, feed, and animal productions contribute to economic diversification of farms. Nonetheless, poor soil fertility, and climate-related risks highly limit the cropping system productivity, its capacity to sustain herd feed requirement, and finally the possibility for farmers to invest labour or money in leeway to increase the productivity and escape their poverty trap. Assogba (2022) showed that crop residues solely covered between 11% and 60% of current herd protein requirement in northern Burkina Faso. In southern Burkina Faso, where the relatively humid climate makes lower the biomass availability constraint, the predominance of cotton-based cropping system restraints the potential of recycling crop residues by cattle, compared to cereal-legume cropping systems, because cotton residues are low quality feed. Zoungrana et al. (2023) showed that up to 60% of crop residues produced by the farm are not directly used in these farming systems. Both studies revealed that crop-livestock systems in Western Africa still highly rely on communal grazing and free-grazing of crop residues. Agro-pastoralism is a way to cope with biomass scarcity and to optimize unsuitable land for crop production. However, it can also generate some conflicts on land use when herds graze in protected forest or other communities' land (Oroundlaji et al., 2024). To foster biomass production at farm scale, cereal-legumes intercropping is also an "agroecological" practice that allows both nitrogen fixation and production of fodder. Recent studies (Bagagnan et al., 2024) revealed that row intercropping systems are labor- and knowledge-intensive at field-farm scale, and do not allow to feed both livestock and people at village scale. Legume could both improve soil fertility and food security; but only at a higher fertilization rate (Assogba et al., to be submitted). These case studies focused on agroecology principles linked to nutrient cycles (inputs reduction, soil health, recycling, synergy) and demonstrated that trade-offs between principles can be overcome only with external inputs to increase biomass production at farm scale. More interdisciplinary research is needed to consider other agroecology principles and assess their capacity to foster synergies between all principles.

Mots clés : agroecology; Sub-Saharan Africa; crop-livestock integration; intercropping; fertilizer