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Land use decisions: By whom and to whose benefit? A serious game to uncover dynamics in farm land allocation at household level in Northern Ghana

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ABSTRACT

Globally, 38% of the land area is agricultural land, of which 45% are located on drylands, mainly in Africa and Asia, constituting the basis for about 60% of the world's food production. Of all farms worldwide, 83% are smallholder farm systems, whose livelihoods depend on effective land management and allocation. While land is often cultivated by the various members of a farm household, land allocation decisions depend on the approval, the ambition and the abilities of influential household members, likely affecting all other household members, too. While intra-household decision-making processes have been described to depend on the interplay of prevailing interests and power positions, so far knowledge on interests and power positions is based on individual reports rather than actual observations. With the aim to explore the process of land allocation in a socially complex smallholder farm system, we invited members of a smallholder community in Northern Ghana to join a closed, experimental serious game, simulating a negotiation process between a male household head (HHH), a wife and the eldest son of a hypothetical local farm household. We observed an integrative negotiation style, resulting into high levels of satisfaction with the negotiation process and outcome by all parties, who reported a high level of similarity between simulated and real-life negotiations. Power was observed to be actively deployed, withheld or passively overruled depending on decision domains and process dynamics. While the HHH was the key decision maker acting as a strategic gatekeeper in a funnel-like process, the wife and the son had a significant influence on 'his decision' i.e. the household-level negotiation outcome. Model-based analysis also showed that the household-level outcome was more profitable as well as agro-biologically and nutritionally more diverse and productive as compared to the HHHs' suggestion. The proposed game proved to be a culturally adequate, simple, cost and time effective tool to capture how household-level land use decisions may come about and whose interests they represent. Our study provides a powerful framework for further research and for policies to foster more equitable land use decisions and therewith more sustainable socio-ecological systems.

1. Introduction

Globally, 38% of the land area is agricultural land (FAO, 2003), of which 45% are located on drylands, mainly in Africa and Asia, providing about 60% of the world's food production (UNDCC, 2017). Climate change (IPCC, 2019), population growth and the increasing land pressure call for more productive yet more sustainable farm systems (Bren d'Amour et al., 2017; Rasmussen et al., 2018; Tilman et al., 2011). Worldwide, 83% of all farms are smallholder farm systems (Herrero et al., 2017), whose livelihoods strongly depend on effective land management and allocation (Bren d'Amour et al., 2017; Rasul and Thapa, 2004; Tittonell et al., 2015). But how do land-use decisions in smallholder farm households come about? And whose interests within the household do they actually represent?

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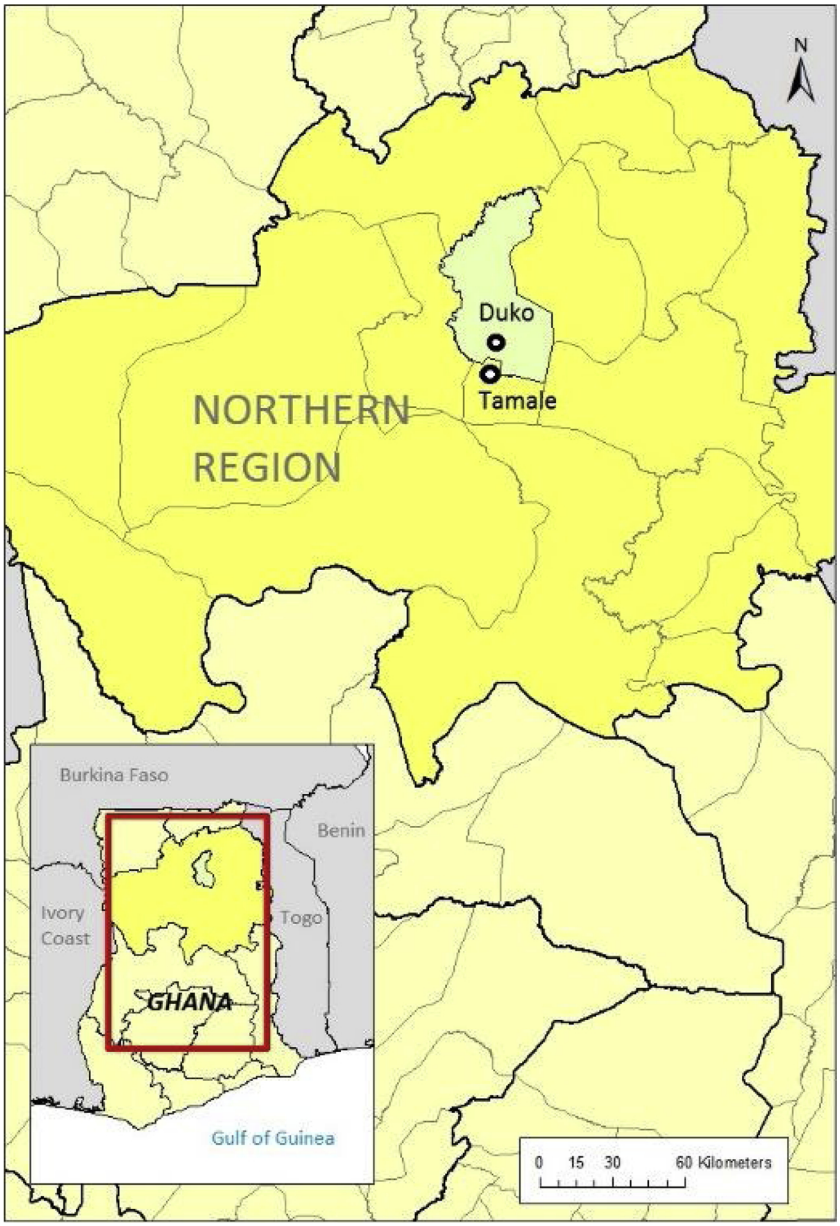

Fig. 1. Map of case-study site location.

In smallholder farm households, functioning much like multi-stakeholder institutions (Haddad et al., 1997; Kabeer, 1994), land allocation decisions often depend on the approval, the ambition and the abilities of influential household members, likely affecting all other household members, too (Agarwal, 1997; Doss, 2001; Michalscheck et al., 2018a). While intra-household decision-making processes have been described to depend on the interplay of prevailing interests and power positions (Haddad et al., 1997; Kusago and Barham, 2001; Michalscheck et al., 2018a; Padmanabhan, 2011; Purnomo et al., 2005; Schwilch et al., 2012), so far knowledge on interests and power positions is based on individual or joint reports by husband and wife (Becker et al., 2006; Browning et al., 2013; Doss, 2013; Elias, 2015a; Mwungu et al., 2017; Ngigi et al., 2017; Prabhu, 2010; Thomas, 1990) rather than observations on the actual interplay.

The actual interplay of interests and power positions on complex decisions in multi-stakeholder settings may be observed by means of serious gaming: in the natural resource management (NRM) context, serious games have mostly been used as an educational tool (Ansoms et al., 2015; Crovato et al., 2016; Gugerell and Zuidema, 2017; Hartig et al., 2010; Heinonen et al., 2017; Mayer et al., 2004; Merlet et al., 2018; Morganti et al., 2017; Onencan et al., 2016; Orland et al., 2014; Ouariachi et al., 2017; Salvini et al., 2016; Schulze et al., 2015; Tanwattana and Toyoda, 2018; Wang and Davies, 2015) or to facilitate consensus among stakeholders with conflicting or ill-defined interests (Craven et al., 2017; Hertzog et al., 2014; Magombeyi et al., 2008; Meinzen-Dick et al., 2018; Pacilly et al., 2019; Speelman et al., 2014). In agricultural systems research, serious games have been employed for education and co-design (Ditzler et al., 2018), but, to our knowledge, only two studies explored intra-household decision-making (Ashraf, 2009; Iversen et al., 2006) using experimental economic games to test investment decisions of spouses in Uganda and the Philippines, respectively.

With the aim to explore the process of land allocation in a socially complex smallholder farm system (Doss, 2001), we invited members of a smallholder community in Northern Ghana to join a serious game, simulating a negotiation process between a male household head, a wife and the eldest son of a hypothetical local farm household. To better understand decision-making dynamics and to compare individual

visions for land allocation with the household-level decision-outcome, we addressed the following five research questions (RQs):

RQ1: How do (a) interests and (b) power positions differ among household members?

RQ2: How do individual interests and power positions shape household-level land allocation decisions?

RQ3: Can we observe trades (since person A gets a land area for crop X, person B gets a land area for crop Y) or power modes *i.e.* power being deployed, withheld or overruled?

RQ4: How does the simulated process compare with real-life negotiations on land allocation?

RQ5: How do the individual preferences on land allocation and the household-level decision-outcome compare in terms of the nutritional yield (food production), their economic (profitability), environmental (soil organic matter) and social (labour input) performance?

After introducing the case-study community and game methodology, we present and discuss the game process and results as well as the implications of our findings for ongoing research projects and land use policies that aim to bring about positive change in smallholder farmers lives.

2. Materials and methods

2.1. Case-study site description

Most smallholder farm systems in Ghana are located on communally owned land, governed by customary laws (Aryeetey et al., 2007; Lambrecht and Asare, 2016). Customary laws in Ghana determine that land decisions are typically 'taken by chiefs or male household-heads on behalf of the community, clan or family '(Apusigah, 2009; FAO, 2019, 2006). In Northern Ghana, the Dagombas are the dominant ethnic group, who perceive land as being spiritually connected to their ancestors (Apusigah, 2009) and who follow a patrilineal inheritance system (Abudulai, 1986). Duko (9.56 °N -0.83 °W) is a Dagomba smallholder farm community located in the Northern Region of Ghana, *see* Fig. 1.

Located in the Guinea Savannah agro-ecological zone (FAO, 2005), Duko is characterized by a unimodal rainfall regime with 1000–1200 mm of precipitation per year, with farmers practicing rainfed agriculture. Duko hosts 54 smallholder households, which are mostly large, male headed and polygamous, adhering to Muslim religion. Farmers in Duko grow cereals (maize, rice, millet), tubers (yam, cassava, sweet potato), legumes (cowpea, soybean, groundnut, bambara bean) and dry season vegetables (tomato, okro, chili pepper, green leafy vegetables). Farmers also own cattle, donkeys, small ruminants and poultry, depending on their resource endowment. According to the locally prevailing patrilineal customary law (Aryeetey et al., 2007; Lambrecht, 2016), household heads (HHHs) are the owners of farm land (Abudulai, 1986). The HHHs' ownership of land, in this context, means the right of access, withdrawal, management and transfer through inheritance or sales (Schlager and Ostrom, 1992). HHHs are often responsible for the households' food security, growing staple crops (maize, yam), while the wives are responsible for providing nutritional diversity, growing soup ingredients like groundnuts and vegetables (Apusigah, 2009; Padmanabhan, 2007). Despite their agricultural activities, women in Duko are described as traders rather than farmers. Being the future heir of land, the eldest son of a household enjoys particular respect (Abudulai, 1986; Apusigah, 2009). Sons are described as being interested in growing cash crops (rice, cowpea) to enable higher education or marriage (Iddrisu Baba Mohammed, 2016: *pers. comm.*). Upon marriage, the sons' wife or wives move into their husbands' compound, becoming part of the existing large household. While the household jointly works on the HHHs fields, wives and sons may cultivate individual fields (Apusigah, 2009; Lambrecht, 2016; Michalscheck et al., 2018a), too. To cultivate an individual field, a household member needs to ask the HHH for permission of use *i.e.* for the right of management and withdrawal. If granted, cultivating an individual field implies autonomy on the crop choice, on the use of crop products and associated revenues from sales.

2.2. The game

A serious game (Abt, 1970) is a structured process, engaging stakeholders to operate in a simulated situation. The simulated situation typically evinces a goal, rules, competitive elements and feedback loops (Ritterveld et al., 2009). While many serious games aim to train or educate participants (Cai et al., 2017; Dörner et al., 2016; Michael and Chen, 2005), we aimed to carefully uncover and learn about household-level decision-making dynamics, namely the interplay of different interests and power positions concerning land allocation. The game set up was derived from narratives of real-life land negotiation processes in Duko (Michalscheck et al., 2018b). While in reality, negotiations on land allocation may be multi-staged and wives, in some households, were reported to only be indirectly consulted, we decided for a compact, one-staged, joint set-up in order to observe possible interactions and negotiation dynamics. Game participants were invited to imagine being part of a well-defined medium resource endowed (MRE) farm household in their own community (Michalscheck et al., 2018a), facing the question which crops to grow on how much of the available farm land. We defined the demographic composition (9 members), the quantity (10 acres) and location (upland, valley and transition zone) of farm land, possible crop choices, animal types and numbers, availability of hired labour, private means of transportation and off-farm income. The household land availability was assumed to be undisputed at this point *i.e.* there were no other customary claims to be expected *e.g.* by the village chief or extended family members. While the household resource-base was well-defined, social rules and norms (institutions) were deliberately left undefined in order to explore these by means of the game. Despite describing a typical polygamous household with several wives, sons and adult daughters, the game was played with only the HHH, one wife and one (eldest) son, leaving it up to the participants to represent all members of their category or merely themselves. The inclusion of a son rather than a daughter in the game set-up, expresses the prevailing patrilineal inheritance system, where daughters reported to have little voice in matters of land allocation (Michalscheck et al., 2018b). In separate groups, male HHHs, wives and sons were asked to develop a suggestion for land allocation. Each groups' interests, based on the group-level suggestions, were then represented by a spokesperson during the simulation of a household-level negotiation, pursuing the general games' goal of reaching household-level decision on land allocation. After observing or experiencing the negotiation, each participant was furthermore invited to provide feedback on the negotiation process and outcome.

Our game may be classified as a closed (Bousquet et al., 2002; Falk and Heckman, 2009; Janssen, 2010), experimental (Redpath et al., 2018) game *i.e.* allowing a finite combination of fixed elements (crop cards) to be allocated on a pre-defined land area. Conducting this experimental game with real stakeholders increased the likelihood of our results being informative about real-life negotiations (Redpath et al., 2018). However, with stakeholders being members of the same community, our first priority in game design was to guarantee a safe sphere for all game participants to fully engage.

2.2.1. The social set-up

According to numerous (n = 58) independent narratives of household members (Michalscheck et al., 2018b) and local elders (Iddrisu Baba Mohammed, 2016: *pers. comm.*), intra-household decision-making processes in Duko are largely kept private. Land allocation decisions were reported to be typically made during a household gathering, organized by the male HHH who summons the (core) household members to inform them about his decision or to discuss possible land allocation options for the upcoming season (Michalscheck et al., 2018b). In order

to diminish biases and conflict potential, we worked with three groups of about five participants of different and differently endowed households. Resource endowment was defined according to the locally validated farm typology of Michalscheck et al. (2018a). While household resource endowment was a selection criterion for participants, during the game, participants were grouped according to their intra-household position, so that each participant joined his or her 'own group' *i.e.* the group of HHHs, wives or sons. We chose these three particular stakeholders since the community had symbolically compared the HHH, the wife and the eldest son or daughter to the three stones under a cooking pot *i.e.* the social fundament of a local farm household (Kuivanen et al., 2016; Michalscheck et al., 2018a).

2.2.2. Game preparation

In preparation of the game, three facilitators were trained, participants were invited, the game scheduled and gaming materials prepared. Before the start of the game, participants were registered with their name, gender and household-level information, to determine their intra-household position and household resource endowment.

2.2.3. The four phases of the game

The game itself was split into four consecutive phases:

1 Game introduction
2 Group discussions
3 Household-level negotiation
4 Debriefing

2.2.3.1. Game introduction. During the introduction, the game's purpose and set-up were explained to all participants (*see* Annex A.1). We then described the farm household that the participants should imagine to be part of (*see* Annex A.2). Furthermore, the groups were briefed on the procedure of the subsequent individual group discussions, *see* Annex A.3.

2.2.3.2. Group discussions. Each group met at a different location with the task to describe their own production orientation and interests, suggesting a farm land configuration that was, in their view, a suitable compromise between the household needs and their own interests. We hence did not obtain isolated individual preferences, but individually shaped suggestions for a household-level solution. Each group was, moreover, asked to elect a spokesperson: the spokesperson was not allowed to participate in the actual discussion within the group, but he or she had the role of a mediator, summarizing the different opinions or joint conclusions and leading the group towards a consensus. The spokesperson was the only group member joining the negotiation, representing the opinion of the group. The election of a spokesperson was meant to hinder individual participants from dominating the discussion and the negotiation, allowing greater wisdom to emerge from the principally diverse groups (Klimoski and Ash, 1974). Each group was accompanied by a facilitator, who was able to re-explain the game elements, ensured that the spokesperson did not participate in the discussion, who recorded the group-level final decision and went through a list of pre-defined questions on the groups' land allocation suggestion. The questions and template for capturing the group-level consensus are provided in Annex A.4.

2.2.3.3. Household-level negotiation. Three household members, each represented by the spokesperson per group, were asked to engage into an actual negotiation in order to reach a household-level consensus. The spokespersons were not informed about each other's group-level discussions or result. There were no rules or restrictions for the negotiation. The sole goal defined was to reach a household-level agreement on the farm land configuration. All other participants were asked to witness the negotiation without interfering. The negotiation was filmed and translated and is provided in Annex B. The household-level result was captured and the three negotiators were asked to explain the functions of the chosen cropping pattern.

2.2.3.4. Debriefing. To capture the participants' satisfaction with and evaluation of the negotiation process as well as the outcome and to understand how the negotiation was different from negotiations in their own household, the three facilitators consulted each participant separately and confidentially. We used the stick-score method proposed by Michalscheck et al. (2018b) to capture the level of satisfaction and the observed power distribution among the negotiators. The debriefing protocol is provided in Annex C.

All qualitative and quantitative results were transcribed and are presented in Annex D.1–D.2.5. To model and calculate the performance of the intermediary and final land allocation decisions, we recombined crop and livestock data of Michalscheck et al. (2018a).

2.3. Data analysis

We answered most research questions by describing the participants' self–reports on interests (RQ1a and RQ5), power shares (RQ1b) and similarity to real-life negotiations (RQ4). To complement the self-reports, we used methods of interaction analysis (Bales and Cohen, 1979; Dabbs and Ruback, 1987; Moritz and Corsten, 2018), analysing the video material in terms of the contentual contributions, body language and interactions including shares and sequence of speech, interruptions and disagreements during the negotiation. In line with the standards of Social Network Analysis (Balkundi and Kilduff, 2006; Durland, 2006), the frequency, direction and the duration of interactions between the three negotiators were interpreted as a snapshot of actor centrality as well as the in- and out-degree of information flow. The results were visualized in a social network diagram (Borgatti et al., 2009). Greater shares of speech as well as strategic and longer speech sequences (Falzon et al., 2018) were taken as an indicator of power (Balkundi and Kilduff, 2006). Interruptions were hypothesized to indicate dominance while being interrupted was interpreted as an external non-recognition of dominance (Okamoto et al., 2002; Weatherall and Edmonds, 2018). We also analysed the deployment of interruptions, recording *e.g.* whether they served to accelerate a clarification or to demonstrate power hierarchies.

Concerning the body language, we analysed the participants' posture, facial expressions, voice and gestures for signs of confidence, comfort or hesitation and discomfort (Metallinou et al., 2013; Van den Stock et al., 2008). We assumed that power positions are partly embodied, with powerful participants being more likely to speak with a strong and clear voice, strict or relaxed facial expressions and an upright or relaxed posture (Thomson, 2017) while less powerful participants are more likely to evince a crouched body posture, to use a less strong voice, to show face or body tension and to avoid direct eye contact. The body language was interpreted with the support of local academics. The contentual contributions during the negotiation were analysed to evaluate how well each spokesperson represented the interests of his or her group. Contentual congruence was assessed by comparing targeted, claimed and obtained amounts of land per crop and per household member. We also asked for an evaluation (0–100% satisfaction) of the spokespersons' performance as part of the debriefing, checking whether the participants felt accurately represented during the negotiation. Based on a mismatch between reported and executed power shares, Michalscheck et al. (2018b) had hypothesized that the execution of power was optional and not necessarily always successful *i.e.* power could be actively deployed, withheld or passively overruled. There may also be trades between household members to each get one's will on at least one domain instead of aiming at compromises in all domains. The interaction analysis was furthermore used to search for evidence on the different power modes and trades (RQ3). The whole-farm performances were modelled based on records of the intermediary and final land allocation decisions (RQ5).

2.4. Whole-farm modelling

We used the whole-farm model FarmDESIGN to determine and compare the intermediary and household-level decisions in terms of the nutritional yield (kcal and nutrients/person/yr), operating profits (GHS/yr), the soil organic matter (SOM) balance (kg/ha/yr) and the required labour inputs (h/yr). Profits, SOM balance and labour inputs represent the economic, environmental and social sustainability dimension of the farm respectively and have been recognized as important farm objectives by farmers in Duko (Michalscheck et al., 2018a). The nutritional yield *i.e.* the raw energetic (kcal) and nutritional output, are novel additions in the whole-farm comparison of Ghanaian farm configurations (Michalscheck et al., 2018a). Nutrition was included since food production for home consumption was independently mentioned as the most important farm objective by all three stakeholder groups during the game. Beyond the farm-household-level performance, we assessed the intra-household implications per land allocation scenario by comparing the profitability of individual fields (wife and son) and gendered (male and female) labour inputs.

FarmDESIGN is a static, bio-economic model, allowing a detailed analysis of the farm performance and resource flows (Groot et al., 2012). The model describes a farm system in terms of its productive resources (land, livestock, crops), inputs (operating costs, labour input, fertilizers, crop protection products, seeds *etc*.) and outputs (income, crop and livestock products). Despite our game being focused on land resources, a typical smallholder farm household in Duko owns animals, too, which have to be fed and whose manure, in turn, serves as fertilizer for the crops. FarmDESIGN integrates crop and livestock components, making it particularly suitable for modelling mixed crop-livestock systems like our case-study farm. The FarmDESIGN models can be downloaded as part of the supplementary materials (Annex D.2.6). All data underlying individual models are explained in the respective FarmDESIGN notes, accessible *via* the model user interface.

3. Results

3.1. Participant demographics

The game was played with six HHHs, five wives and five eldest sons. Fig. 2 illustrates the participants' age structure and household resource endowments. Seven of the sixteen participants were associated with MRE households, being the game's target farm type. The HHH opened the game by introducing himself as the landlord, alluding to his customary bundle of land rights.

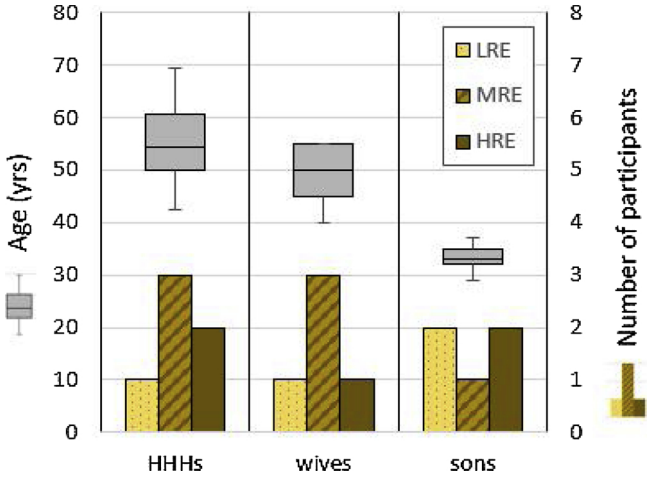

Fig. 2. Age and farm resource endowment of household heads (HHHs), wives and sons participating in the game. The whisker-plots indicate the age distribution of participants. The bar charts indicate the number of participants per farm type as defined by low, medium and high resource endowment (LRE, MRE and HRE).

3.2. Individual interests (RQ1a)

Individual interests are embedded in overall production objectives, translating into crop choices and associated crop areas. HHHs, wives and sons independently mentioned the same two main production objectives: food provisioning for home consumption and income generation to cover school fees as well as health expenses. Wives and sons, however, envisioned a farm configuration that was agro-biologically much more diverse than the HHHs suggestion, with nine instead of five different crops, *see* Fig. 3.

The HHHs chose the largest maize area and the wives the largest groundnut area, both crops being central food and cash crops. HHHs, wives and sons envisioned the same amount of land for soybean (cash and food), rice (cash) and yam (food and ceremonies). Sons and wives also had congruent suggestions concerning the areas for vegetables and sweet potatoes (food and cash) and they were the only members interested in growing cowpea (food and cash) or millet (food and rituals) respectively. The wives envisioned the largest area of individual land (3.5 acres), followed by HHHs (2.5 acres) and sons (1.5 acres). While the wives and HHHs allocated individual fields to wives and sons, the sons only allocated individual land to themselves, not to the wives. The sons assumed the wife's needs to be satisfied from 'household production' rather than from own fields.

While our notes do not suffice to judge the level of intra-group disagreement, all participants reported high levels of satisfaction with the spokespersons, seemingly indicating shared convictions at group level.

While individual interests were captured before the negotiation, the power evaluation was performed afterwards. Therefore, we first present a basic description of the negotiation process and results (RQ2) before reflecting on power shares (RQ1b).

3.3. Household-level negotiation (RQ2)

The negotiation process was characterized by a high level of mutual respect, support, active listening and curiosity about each other's perspectives. Individual suggestions were put forward in a concise, transparent, well-structured and determined manner, albeit the wife and the son showing reservations particularly in the beginning of the negotiation process. The three negotiators seemed to take the game seriously, being emotionally involved and displaying a high level of identification with their roles.

Concerning the outcome, the household-level land allocation decision comprised 4 acres of maize, 1.5 acres of rice, 1.5 acres of groundnuts, 1 acre of soybean, 1 acre of cassava, 0.75 acres of yam and 0.25 acres of vegetables. The son would receive 1 acre to grow groundnuts and 0.5 acres to grow rice. The wife would obtain 0.5 acres of groundnuts and maize each. All three spokespersons argued in line with their respective groups' mandate but had to make compromises (Table 1)

The wives made the largest compromise in terms of deviations between targeted and obtained areas, with a sum of deviations of 6.0 acres, while the summed deviations for HHHs and sons were 2.5 and 3.0 acres, respectively. The comparison between targeted and obtained areas reveals that

- the HHH largely got his will on the area of maize and sweet potato,
- the son got his will on the area of cassava,
- both, the HHH and the son got their will on the millet and
- both the HHH and the wife got their will on the cowpea area.

The crops of sweet potato and cowpea were not discussed during the negotiation, while millet was designated to be grown as an intercrop.

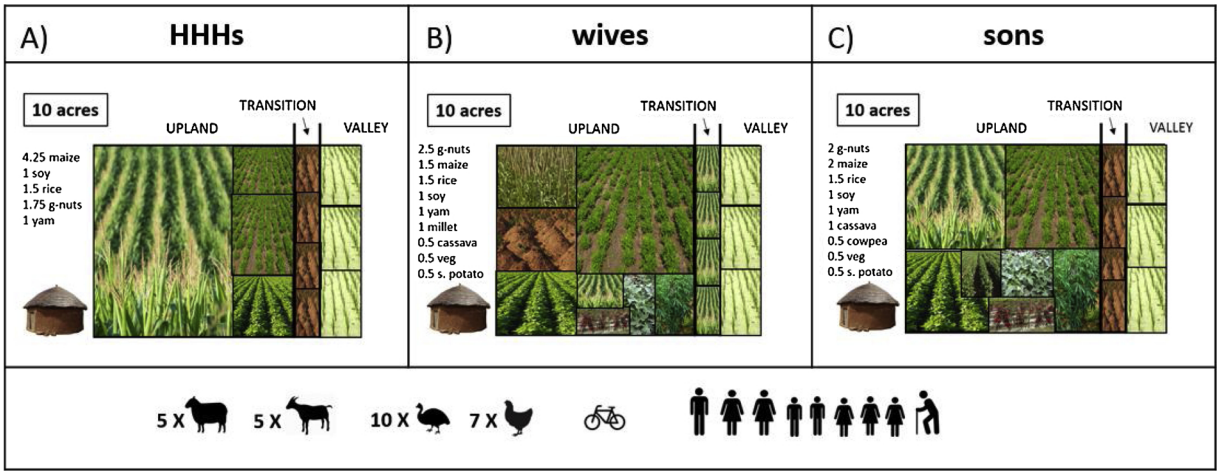

Fig. 3. Suggested land allocation per stakeholder group of A) HHHs, B) wives and C) sons, based on shared assumptions on household composition and resource endowment.

Game participants reported to be highly satisfied with the decision-outcome as well as the performance of the spokesperson. Concerning the decision-outcome, HHHs indicated a satisfaction level of 83%, the wives of 94% and the sons of 90%, resulting into a total average satisfaction of 88%. For the performance of the spokesperson, the HHHs indicated a satisfaction level of 78%, the wives of 98% and the sons of 90%, resulting into a total average satisfaction of 88%.

3.4. Power shares (RQ1b)

Game participants evaluated the HHH to be most influential with 74% of the total power, followed by the wife (14%) and the son (12%), based on the intersectionality of his age, sex and birth rank. The power shares in the game were similar to those reported for real-life negotiations (Fig. 4). For both, simulated and the real-life negotiations, each group provided the highest mean evaluation of their own power share among all groups. For real life negotiations, HHHs and sons both thought that the wife and the son had equal power shares.

We analysed the video material to detect additional clues on power distribution among the negotiators.

The sequence and shares of speech (*see* Figs. 5A and 5B) revealed that the HHH held a dominant role, leading the process and holding a speaking share of 50%.

Concerning the interaction of the spokespersons, the HHH evinced a high betweenness centrality, being the centre of communication: the HHH spoke most and most frequently (Fig. 6). The wife and the son addressed their interests to the HHH, not to each other, except towards the end of the game. Concerning the in-degree frequency of 'being addressed', the negotiators evinced almost equal counts, but the HHH received most (time and frequency) individual information.

Concerning interruptions (N = 11), the son interrupted least and was most interrupted. The HHH interrupted most and was interrupted thrice. The wife interrupted the HHH once and the son twice, but was interrupted only twice by the HHH. Five interruptions served to clarify a situation, while the other interruptions were interpreted as competition for process leadership, overruling a speaker to bring forward one's own point of view earlier or louder, not necessarily expressing conflicting interests or contrasting views.

Concerning disagreements, in three out of six cases the HHH got his will, the son and the wife each got their will once, and the remaining case was abandoned since the negotiators realized that they did not need to decide on the allocation of intercrops in the game. In addition to open disagreements we observed instances of conscious disregard *e.g.* several propositions of the son directed to the HHH were ignored or overruled by a suggestion from the HHH. We interpret conscious disregard as an attempt to limit or lower the claimed power standing of the opponent.

When analysing the negotiator's contentual contributions we, furthermore, observed the HHH to invent circumstances ('*Last year we grew…*'), favouring his position.

The invented arguments fit into the general storyline of the game and were difficult to challenge since contesting them would have questioned the players' authority in and possibly beyond the game. Not questioning an argument, however, strengthened the players' authority through the ability to shape the game elements and boundaries.

The body language of the HHH was perceived as relaxed, confident

Table 1
Crop-specific land allocation suggestions (targets) of household members and the deviation (Δ) from the household-level result.

	HHHs		Wives		Sons		Household-level result (acres)
Crop	Target (acres)	Δ	Target (acres)	Δ	Target (acres)	Δ	
Maize	4.5	−0.5	1.5	2.5	3	1	4
Millet	0	0	1	−1	0	0	0
Soybean	1	0	1	0	1	0	1
Cowpea	0	0	0	0	0.5	−0.5	0
Rice	1.5	0	1.5	0	1.5	0	1.5
Yam	1	−0.25	1	−0.25	1	−0.25	0.75
Cassava	0	1	0.5	0.5	1	0	1
Vegetables	0	0.25	0.5	−0.25	0.5	−0.25	0.25
Groundnuts	2	−0.5	2.5	−1	1	0.5	1.5
Sweet potato	0	0	0.5	−0.5	0.5	−0.5	0
Total deviation		2.5		6.0		3.0	

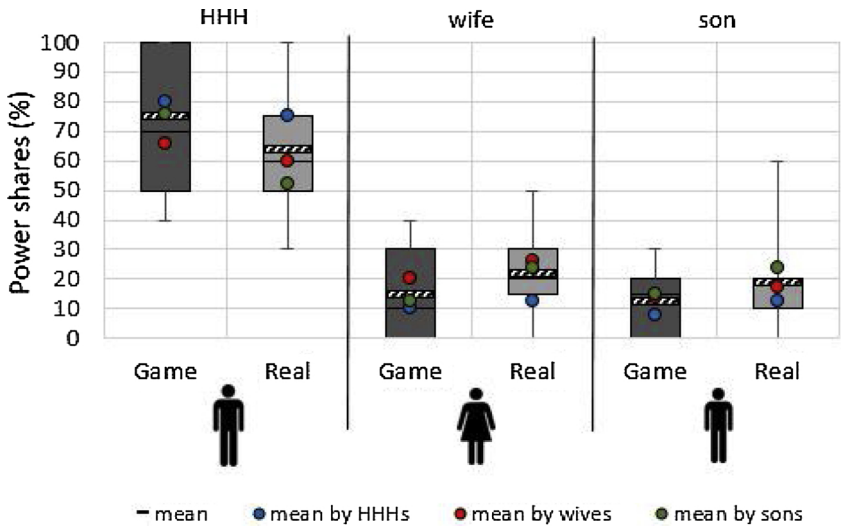

Fig. 4. Estimated power shares for the HHH, the wife and the son as observed during the game ('Game') and as reported for real-life ('Real') negotiations by the participants (N = 16), referring to their own households.

and attentive. However, at times, it seemed as if he had difficulties to simultaneously act in his two roles: the self-assigned role as a mediator gave him authority but seemed to weaken his capacity to react to game dynamics as a HHH, putting forward his individual interests. The son started the game in a submissive posture, avoiding direct eye contact with the HHH while searching his protective proximity, imitating his behaviour and acting as his extended arm. The HHH seemingly rewarded the son by allowing him to take over procedural tasks such as placing the crop cards and summarizing preliminary results. The son consequentially gained confidence, embodied in an upright torso posture, a stronger voice and intonation. Throughout the game, the wife pressed her lips together as if retaining or controlling herself. When prompted to speak the wife was fast and confident to respond, indicating attentiveness but also tension, possibly torn between the aim to be a strong negotiator and the objective to safeguard her reputation as a 'good (submissive) wife' (Apusigah, 2009; Kabeer, 1999). The wife did not compete for procedural tasks during the negotiation.

In line with power reports of the game participants, the speech sequence, speech shares, interruptions as well as the body language point to the HHH as being the most influential negotiator. However, comparing the HHHs suggestion with the household-level decision-outcome, the wife and the son had a substantial influence on the land allocation decision, too.

3.5. Power modes and trades (RQ3)

The interaction analysis of the negotiation did not provide evidence on direct trades, but on the three power modes: while the HHH and the son deployed power in their competition for procedural leadership, the HHH withheld power at content-level by inviting the son and the wife to express their interests. Depending on the context and decision domain, the son or the wife seemed to stay in the background, withholding power, too. While the wife abstained from the discussion about the HHH's maize field, the son explicitly reported to compromise his own interest in soybean cultivation to respect the interests of the HHH and the wife. Moreover, power was actively deployed for mutual support *e.g.* the wife supported the son's claim for individual land, the son suggested to grow vegetables for the wife and the HHH backed up the son's need for additional individual fields. Besides serving the promotion of individual interests, power was hence actively deployed as a social instrument, creating trust and bonds among household members. Despite the high level of cooperative behaviour, the negotiators were, at times, involuntarily overruled as expressed by speech interruptions, disagreements or the conscious disregard of new or opposing suggestions. It seemed as if the wife and the son competed for the position of the 'second most influential household member'. A noteworthy incidence during the negotiation was the open disagreement of the wife with the HHH: just before concluding the game, the HHH was doubting whether he should not grow groundnuts on his own fields, but the wife insisted that she could grow it instead and provide him with groundnuts if needed. The wife hence tried to secure her access to land *via* a provisioning rule and the HHH agreed.

3.6. Comparison to 'real-life negotiations' (RQ4)

Most (14/16) game participants described real-life negotiations to be literally 'the same' as in the game. One participant reported the HHH to be the sole decision maker in his household and another participant reported that there were no adult children so that the HHH and the wife were the sole decision makers. The reported power shares for the

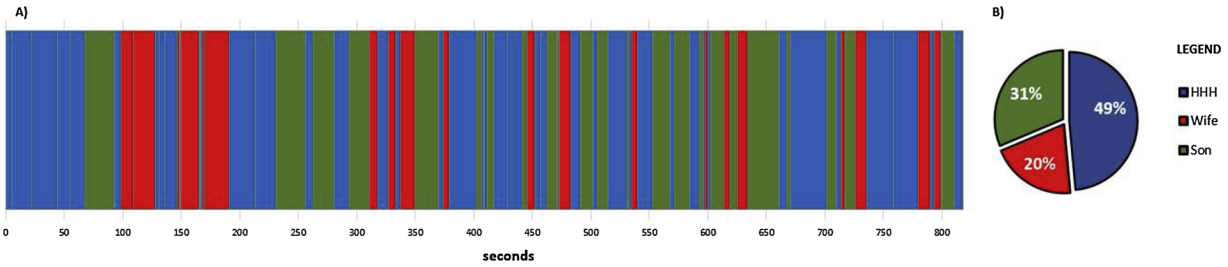

Fig. 5. Speech A) sequence and B) percentage of time per negotiator.While the wife, upon direct invitation of the HHH, put forward her interests at the beginning of the negotiation, her later interventions were rather short and targeted. The son seemed to restrain himself at the beginning of the game, getting more active with suggestions and competing with the HHH for the moderators' role as the game proceeded.

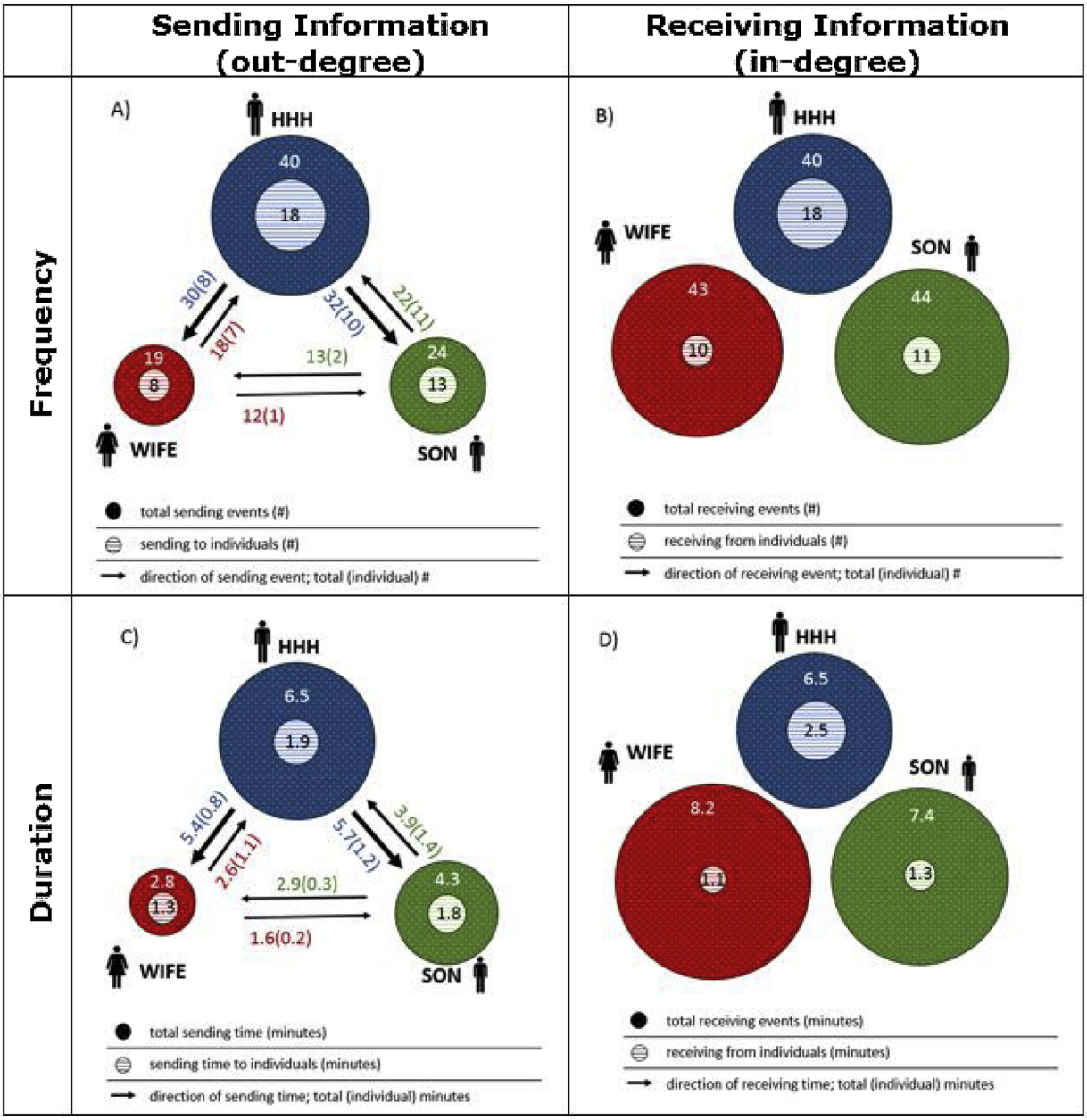

Fig. 6. Socio-gram showing the frequency (A, B) and duration (C, D) of interactions between the HHH (blue node), the wife (red node) and the son (green node) during the negotiation. The node sizes are proportional to the in- or out-degree of information flows, with node-numbers expressing the frequency or duration (in minutes) of sending (A and C) or receiving (B and D) events. The arrows in A) and C) indicate the direction of the total (and individual) sending events (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

simulated and real-life negotiations (Fig. 4) were similar, too. Farm modelling results (RQ5)

We modelled the intermediary and final decision-outcomes in the whole-farm model FarmDESIGN. At household level, the model results revealed similar SOM balances and labour inputs, but significant differences in nutritional outcomes and profitability of the four land allocation decisions (Fig. 7). While the suggestion of the male HHHs attained annual operating profits of about 2200 GHS/yr (USD 464), the wives' and sons' propositions attained more than double the profits, with about 5220 GHS/yr (USD 1160) and 6200 GHS/yr (USD 1302) respectively. The sons' and the wives' suggestions also had slightly lower SOM losses and labour requirements. The sons' suggestion was more profitable but also slightly more labour intensive than the wives' suggestion. When considering the profitability of the individual fields per scenario (Fig. 7B), the profitability for the son was always the same (1176 GHC/yr) while the profitability for the wife was highest in the wives' own suggestion (772 GHC/yr), followed by the household decision, the HHHs'- (both: 497 GHS/yr) and the sons' suggestion (0 GHC/yr). When differentiating between male and female labour contributions (Fig. 7C), the wives' suggestion evinced the highest share of female labour on both, individual and household-fields, while all other scenarios entailed substantially lower female labour shares. Concerning the nutritional performance, the more diverse cropping pattern of the son and the wife translated into a greater nutritional diversity as compared to the HHHs' configuration (Fig. 7D-F).The sons' land allocation proposition performed best in terms of dietary energy and all nutritional values including micro-nutrients and vitamins. Compared to the household-level result, the sons' suggestion would deliver *i.a.* 2% more calories, 12% more proteins, 18% more fat, 18% more niacin and 41% more folate. The HHHs' and the wives' suggestion only provided

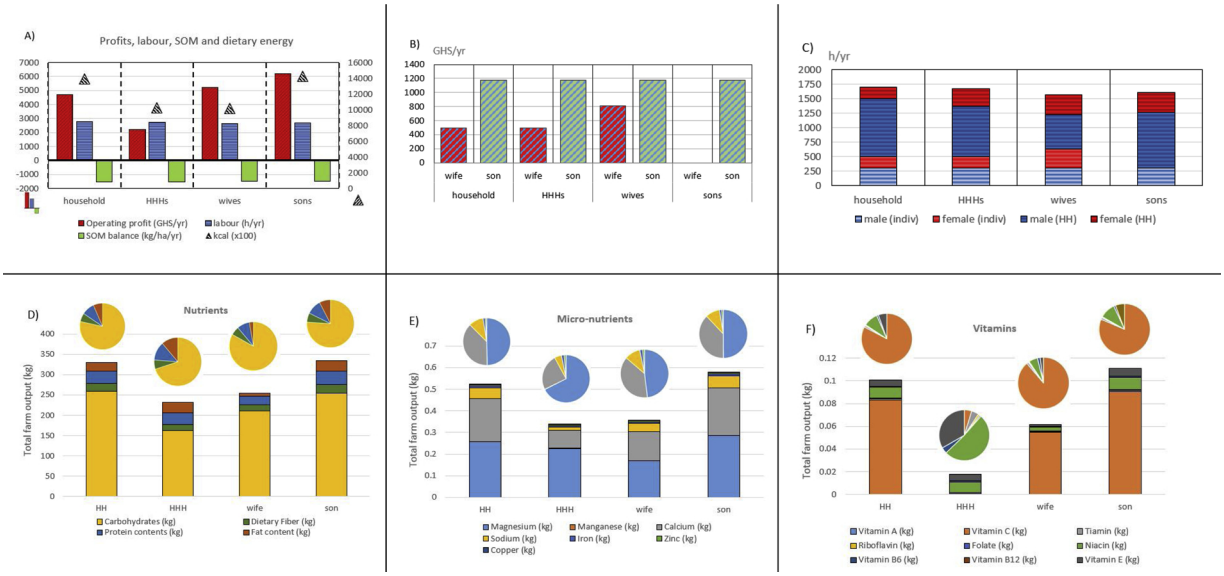

Fig. 7. Performance of land allocation scenarios. Household-level performance in terms of A) profits, labour inputs, SOM and dietary energy, D) nutrients E) micro-nutrients and F) vitamins. Profitability in B) of crops on individual fields for the wife and the son respectively and in C) male and female crop labour inputs per scenario for individual (indiv) and household (HH) fields.

about 70% of the calories of the household-level result and significantly less nutrients, micro-nutrients and vitamins. The wives' configuration would provide more carbohydrates, fibre, calcium, sodium and vitamin C than the HHHs' suggestion, which in turn provided more proteins and fat, magnesium, niacin and vitamin A than the wives' configuration. The HHHs' suggestion provided significantly less vitamins than all other configurations, actually causing a deficit in vitamin C when comparing the (cooked) food supply with the household food needs, *see* Annex D.2.5.

It seems as if through the influence of the son and the wife the household-level decision-outcome became more diverse and much more profitable as compared to the HHHs suggestion.

4. Discussion

The serious game provided novel insights into land allocation processes within smallholder farm households in Northern Ghana: wives and sons envisioned a more diverse cropping pattern than the HHHs, significantly influencing the household-level decision-outcome despite their power shares being evaluated as relatively small (12–14%). The wives' suggestion was substantially more ambitious in terms of 'own profits' and female labour contributions than the vision of the HHHs and the sons, possibly indicating a desire for additional responsibilities and liberties in agricultural tasks. While the HHH, as the patrilineal land owner, held the strongest power position, he gave substantial room to the wife and the son to bring forward their individual interests, possibly due to a dependency on their labour and financial support, as typical for MRE households in Duko (Michalscheck et al., 2018a). Occasionally, the wife and son abstained from power, too, depending on process dynamics and decision domain. The choice or eventuation of power modes by an actor likely depended on his or her fall-back position (Agarwal, 1997; Apusigah, 2009; Doss, 2001; Padmanabhan, 2011), the prospective nature and amount of gains or losses (Ashraf, 2009; Iversen et al., 2006) as well as the prevailing divergence of interests among the negotiators. Deliberate power abstention has been described in previous studies (Anderson et al., 2017; Becker et al., 2006; Colfer et al., 2015; Jha, 2004). In line with observations by Agarwal (1997), household members were found to actively deploy power to support one another and to build coalitions. The strong mutual support among household members is consistent with the social security system in most of rural Africa, with people relying on each other's support, hoping for a return of favours when in need of help (Binswanger and Rosenzweig, 1986; Ligon et al., 2018; Ng'ang'a et al., 2016; van Rijn et al., 2012).

Despite the reported congruence between simulated and real-life negotiations, we think that the remarkably cooperative behaviour during the game might have been shaped by a desirability bias: the representative role, the audience and video recording possibly let the participants assume a more controlled, fair and formal behaviour than in real-life negotiations. Previous studies *e.g.* in Burkina Faso (Kevane, 2012; Kevane and Gray, 1999) report that negotiations do not take place in a direct plenum, as simulated in our game, but rather through implicit contracts and informal sharing rules (Doss and Meinzen-Dick, 2018; Lambrecht, 2016). Participatory observations might be needed to capture and analyse the more subtle cues of negotiation dynamics. Furthermore, despite observing a high level of mutual responsiveness and support among the negotiators, we did not discern direct trades during the negotiation. The final decision-outcome suggests, however, that each negotiator got his or her will on decision domains that were deemed personally important and/or congruent with gender norms, which may be interpreted as indirect trade outcomes. The pathway of indirect instead of direct trades may express local norms of conflict resolution. The integrative negotiation style (Hames, 2012; Moran and Ritov, 2007; Walters et al., 1998), marked by a high level of cooperativeness, led to a win-win situation where each group over-estimated their own influence on decision-outcomes: on average, the HHHs assigned their spokesperson 80% of the power, the wives 20% and the sons 15%, which would add up to more than 100%, possibly explaining the high level of satisfaction with the household-level decision-outcome by all parties despite the multilateral compromises (Agarwal, 1997). The balance between joint and conflicting interests as well as intra-household dependencies may be described as a cooperative conflict (Sen, 1987).

We recommend adoption studies to explore patterns in power shares and power modes to better understand household-level decision dynamics and to inform debates on gender relations, particularly on women empowerment in agriculture (Alkire et al., 2013; Kabeer, 1999; Malapit and Quisumbing, 2015; O'Hara and Clement, 2018). Serious games should be played with additional household members to better represent the possible complexity including cooperation or conflicts between wives or sons. While we viewed household members to be the decisive executing agents in (land) resource allocation, we recommend

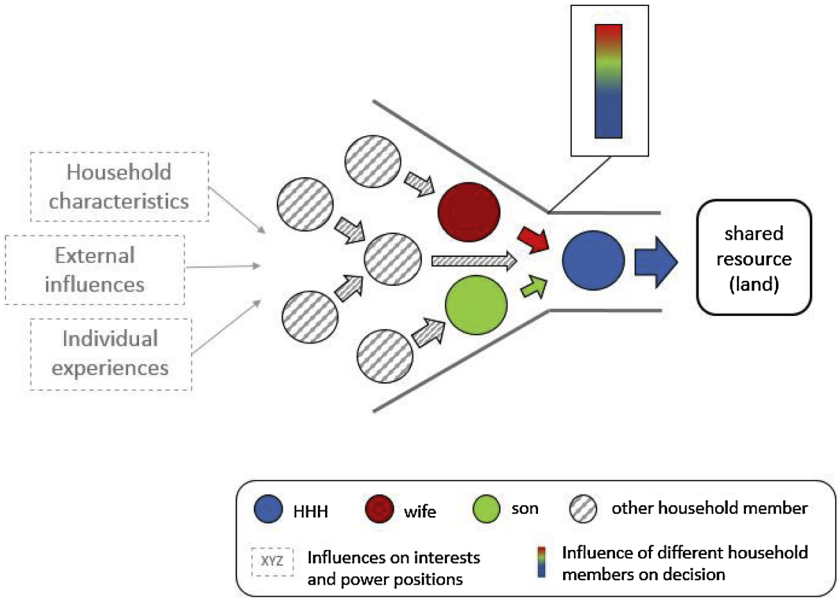

Fig. 8. Funnel model, conceptualizing how various household members influence the household head's decision over the jointly managed (land) resources. Depending on the decision domain, other household members may take up position at the funnel stem, holding the power of ultimate decision.

putting household-decision-making into a larger context (Agarwal, 1997; Singh et al., 2016) by investigating how external factors, institutions (Abudulai, 1986; Lambrecht, 2016) and shocks, such as price fluctuations, credit constraints (Porgo et al., 2018), policy changes, extreme weather events (Tambo and Wünscher, 2017) or personal losses (Valbuena et al., 2015), shape the individual interests and power positions and therewith household-level decision-outcomes. Furthermore, based on the described similarity between the game and real-life negotiations, HHHs do not hold the sole decision-making power but the contentual and procedural lead in land allocation decisions. Whenever decisions fall into the domain of a particular household member, we can imagine a funnel-like process with the key decision maker acting as a strategic gatekeeper at the funnel stem, *see* Fig. 8.

The prevailing local gender norm 'the HHH decides' (Lambrecht, 2016) hence expresses HHHs being the 'central nodes' in intra-household land allocation decisions, holding formal decision-making power as opposed to the informal agency (Abudulai, 1986; Kabeer, 1999) of other household members, who nevertheless influence the HHH's decision. The importance of informal influence on natural resource management decisions was also reported by Elias (2015a), b and El Tayeb Muneer and Mukhtar Mohamed (2003) and may be verified on a large scale by systematically reviewing data of ongoing research initiatives such as GENNOVATE (2018). Awareness on the systemic set-up of decision-structures, including who acts as the central node and who as peripheral nodes in relevant decision domains, may explain why certain changes or adoption decisions come about or not, bearing in mind that gender norms and relations and therewith power positions are in constant evolution (Doss and Morris, 2001; Elias, 2015a; Saito et al., 1994). While, with our research, we aimed to play a careful observer's role, our findings are of high practical relevance for projects working with and policy makers targeting smallholder farmers.

- Firstly, the current land use policy-literature of Ghana suggests that men are the sole decision-makers on land-related decisions in Ghana (FAO, 2019, 2006; MoFA, 2003; Sutz, 2019). Our findings, however, reveal that land use decisions at household level may also be the result of the interplay and integration of various individual perspectives. The multiple influences made the household-level decision on land allocation in our serious game more profitable, agro-biologically and nutritionally more diverse and likely more resilient, seemingly setting the farm household on a better track towards sustainable intensification as compared to *e.g.* the individual land allocation suggestion of the HHH. Similar findings are reported in Elias (2015a); Jones et al. (2014); Lecoutere and Jassogne (2017) and Šūmane et al. (2018). We hence postulate that project work and related research, including participatory modelling efforts, are likely to produce more sound and sustainable results when taking a gender transformative approach, engaging with different household members or stakeholders to each contribute their diverse perspectives.
- Secondly, diversity is only likely to be expressed when participants feel safe. This is achieved when the game is realistic while being non-binding and explorative (Gugerell and Zuidema, 2017). We believe that a culturally-sensitive game design is a prerequisite for a sustainable cooperation with smallholder communities.
- Thirdly, we experienced our serious game as a cost- and time effective tool to explore intra-household dynamics and perspectives on local resource allocation. A serious game could be played to assess prevailing gender norms around particular resources or to obtain multilateral and interdependent feedback on a concrete suggestion for change. Interdependent feedback is the particular strength of games, going beyond the assessment of isolated opinions (Jean et al., 2018b). Serious games may also be used directly to formulate land use policies (Jean et al., 2018a; Olejniczak et al., 2018; SIM4NEXUS, 2019).
- Fourthly, a game or discussion is not just a learning opportunity for project researchers but first and foremost for participants. Games and discussions could, in fact, be primarily designed as learning events for the participants, promoting a local knowledge exchange and a reflection on local gender norms before providing any external knowledge and viewpoints, strengthening the local self-determination potential of communities (Ryan and Deci, 2000; Stobbelaar et al., 2009). Games and discussions are opportunities for 're-framing' *i.e.* learning about the paradigms, problems and interests of 'the other' (Sterk et al., 2006). In terms of affordances, as described by Ditzler et al. (2018), we may describe games like ours as having a framing, visualization and integration role.
- Last but not least, new knowledge and skills are likely to impact the interests and power positions of household members (Agarwal, 1997; Doss, 2001). We recommend trainings to be as inclusive as possible, so that all household members have access to them, not missing out on information or skills needed to play an active and respected role in intra-household decision-making processes. Like

Haider et al. (2018) and Johnson et al. (2015), we expect that wives and 'the youth' would disproportionately benefit from capacity building, eventually experiencing an empowerment in household-level decision-making. We therefore think that any policy which empowers women and the youth, *e.g.* through education or agricultural trainings, is likely to have a strong and positive impact on land use decisions that concern them. However, to allow for inclusive and socially sustainable change, policies geared towards women and youth empowerment, need to consider sensitization of men, too.

The real-life interplay of interests and power positions may vary from the ones observed during our game *e.g.* within low or high resource endowed households in Duko or within households in other communities, depending on the context and prevailing circumstances (Agarwal, 1997). Our study, nevertheless, certainly provided rare insights into possible negotiation dynamics as well as novel insights into the prevalence and circumstances of different power modes shaping household-level decision-outcomes on land allocation.

5. Conclusion

Our serious game provided valuable new insights into negotiation processes around land allocation: the encountered integrative negotiation style led to the coalescence of the different intra-household perspectives into a household-level compromise rather than a unilateral decision-outcome. We observed a funnel-like process, where the HHH was the key decision maker acting as a strategic gatekeeper at the funnel stem but with the wife and the son having a significant influence on 'his decision'. We find evidence and first explanations for the prevalence of different power modes *i.e.* for power being deployed, withheld or overruled. According to our whole-farm model results, the wife's and the son's influence led to a more sustainable and more intensive farm configuration as compared to the HHHs preference. We think that any policy that empowers women and the youth, be it through education or agricultural trainings, is likely to lead to more equitable decision-making and possibly more diverse and sustainable land use decisions at household level. We furthermore conclude that serious gaming has served well to uncover dynamics in farm land allocation decisions at household-level in Northern Ghana.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.landusepol.2019.104325.

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