CHAPTER

15

Gender-specific spatial perspectives and scenario building approaches for understanding gender equity and sustainability in climate-smart landscapes

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Highlights

- Men and women differ in interests, mechanisms, roles, and strategies for dealing with climate change impacts
- Men and women have different perceptions of space due to their productive and reproductive roles, power relations, and to historical and environmental contexts that shape the local 'theory of place'
- Participatory tools can be used to explore the gender-specific objectives and goals within the locally perceived socio-cultural landscapes
- We feature two methods (role-playing games and agent-based models) using case studies that demonstrate the spatial perception differences between genders
- In this chapter, we share examples of how to perceive the 'landscape' through coupling socio-cultural and ecological systems pertinent in livelihood resilience building

1. Introduction

1.1 Why connect gender and landscapes?

The nexus of gender, land use, landscapes and climate change is very complex and multi-dimensional. However, understanding these interactions may reveal important aspects for achieving food security and improving livelihood resilience to climate change impacts, especially during extreme events. After all, the concept of the landscape does not merely refer to a geographic space, but includes the social construct of a 'theory of place' based on diverse cultural and individual perceptions regarding the livelihood (or everyday life) of individuals and rights of social strata. For many communities in West African countries, the meaning of landscape is rooted in each persons' life history and experiences; and if misread and misunderstood, the landscape is misrepresented (Fairhead & Leach, 1996). Thus, the representation of landscapes should be viewed in combination with an

analysis of livelihood dynamics and individual perceptions (e.g., whether the world is flat or spherical; see Vosniadou, 1994). However, peoples' perceptions vary according to their gender and everyday experiences, with the needs of women and men varying depending on their life phase, social status, income and ethnic origin (Meinzen-Dick et al., 1997). Gender, as defined by Food and Agricultural Organization of the United Nations (FAO), is likewise a social construct reflecting both perceptual and material relations between men and women, including the characteristics and qualities that each society ascribes with each sex (FAO, 1997); the empirical question of how many gender strata[1] are distinguished is answered differently in different parts of the world. There are many facets of gender differentiations in roles, responsibilities, options, and decisions that may affect the delivery of ecosystem services, landscape functionality as well as environmental sustainability. Yet, there have been few in-depth analyses linking land use and gender at the landscape level due to inherent complexities (Colfer & Minarchek, 2013; Villamor et al., 2013*a*).

A growing body of empirical evidence demonstrates that gender-specific roles and choices affect the functionality of landscapes in multifaceted ways (Kiptot & Franzel, 2012; Villamor et al., 2014*a*). For example, in terms of knowledge of the behaviour and functions of socio-ecological systems, Assé and Lassoie (2011) point out that Malian households that combine gender inclusive decision-making with relational agro-ecological knowledge and a mix of intensive and traditional extensive agriculture have greater capacity for creating adaptive soil and tree management strategies. Culturally defined gender specific roles in relation to water (e.g., collecting water for household use, washing clothes and personal hygiene) shape the ways landscapes are perceived and managed. Furthermore, women are often known as key stewards of household agricultural activities who determine agro-biodiversity and the use of location-specific crops, as well as soil restoration activities (Kiptot & Franzel, 2012; Mullaney, 2012).

Given this growing understanding of gender-specific roles and relationships in environmental stewardship, gender equality (i.e., equal access and control over resources) and equity (i.e., fair allocation of resources, participation in programmes and decision-making) have been identified as prerequisites for achieving greater sustainability (Johnsson-Latham, 2007). The realities of everyday life, however, need to be recognized and valued, such as the exclusivity of women's 'reproductive labour' (Rodenstein et al., 1996); they constrain how closely equity or equality is approached in practice. Broadly speaking, gender-differentiated roles fall into three main categories (Peter, 2006): 1) reproductive tasks undertaken to reproduce such as child bearing and rearing, feeding the family, and caring for the sick; 2) productive work that acquires goods or services for subsistence or market purposes and associated payment in cash; and 3) social/community activities performed not only for family welfare, but also for the well-being of the public and community related responsibilities. With the burden of reproductive tasks falling mainly upon women in rural areas in most cultures, women play 'triple' roles, while men typically split attention only across productive and community tasks. Consequently, as shifts in economic, social and environmental structures occur both at local and global levels, reproductive labour associated with childcare needs disproportionately constrain the responses of women to such change. Analysis that stops at the household level misses this, as well as any number of other processes that shape the agricultural landscape

including interactions among women to share labour and pool risk and negotiations among men and women household members to allocate spending across food, education, assets, or leisure, among others. In particular, as patterns of seasonal and long-term labour migration shift in response to climate, development, or other stressors, the responsibilities for many decisions will pass between men and women within households or communities. With such a change in roles and responsibilities between men and women may come shifts in crop systems, production methods, and/or equitable sharing of common property resources.

The importance of gender-specific knowledge of perceptions and priorities within agricultural landscapes highlights the need for tools designed to collect and apply such information. In this chapter, we highlight two tools in particular – experimental games and agent-based models (ABMs) – whose complementarity allow us to elicit gender-specific perceptions and strategic behaviours at the field scale, and analyse implications of these behaviours at the landscape scale. To provide context for the application of such tools, first, gender dynamics in landscapes are described with specific examples. Next, descriptions of the different tools are provided supported by two specific case studies in the following section. Finally, the chapter is summarized highlighting the overall potential of applying the tools discussed to understand gender-specific perspectives within landscapes.

1.2 Gendered landscapes in practice

Typically, the available spatial information we use to research and otherwise understand landscapes is captured in 'maps' derived from a combination of local observations and satellite images. Using such images, the land composition/configurations of geographic landscapes are determined and management plans (e.g., conservation plans) are developed. However, these spaces often embed gender sensitive socio-cultural landscape characteristics that are not well discerned with conventional image processing and analysis techniques (Figure 15.1). In urban areas, particularly in western countries, the gender-orientation of space has been increasingly considered over the last 30 years in the development of settlements and infrastructure (Evers & Hofmeister, 2011). We believe that such consideration of gendered spatial perceptions in rural areas may provide new insights for enhancing adaptive capacity to climate change while improving food security. Under the joint stressors of globalization, climate change, and food insecurity, this gendered understanding of landscapes (and their perceptions) becomes increasingly important to consider in areas where the rights and opportunities differ between men and women or are otherwise limited or contested.

Similar gender-specific spatial patterns have been observed in many rural areas of West Africa such as in Northern Ghana (Figure 15.1a), Mali (Figure 15.1b), and Benin (Figure 15.1c & 15.d). There is also growing evidence of similar patterns in Asia, for example, within many rural areas in the Philippines and Vietnam (e.g., systems similar to the home gardens shown in Figure 15.1c & 15d) (Villamor et al., in prep) and across the matrilineal inheritance system of the Minangkabau tribe in the lowlands of the Jambi Province on Sumatra in Indonesia. Access to surface water (wells, streams, rivers) and gender-specific roles in water acquisition for households' needs adds complexity and leads to gender-specific change when village-level boreholes substitute for surface water sourcing (Makoni et al., 2004).

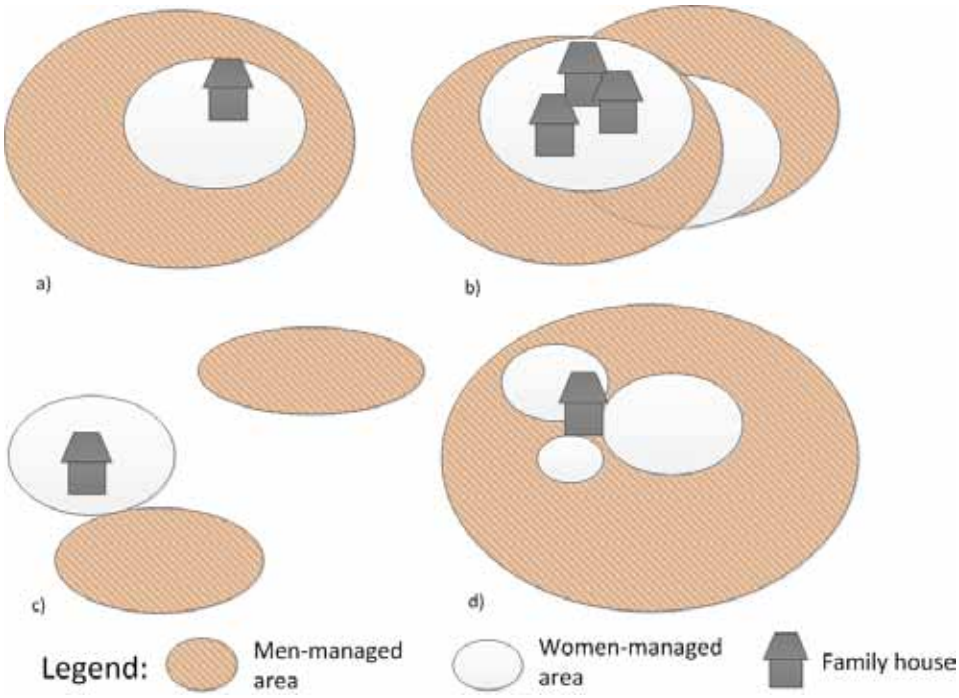

Figure 15.1 Gender specific spatial organization of households' farm management; **a** a typical household farm observed in Bolgatanga, Northern Ghana (Badmos et al., 2014), **b** the Mandé spatial organization observed in Mali (Assé & Lassoie, 2011), and **c** and **d** household farm arrangements in Tangueita, Benin (Dah-gbeto & Villamor, in prep).

These spatial patterns share similar gender specific aspects or characteristics:

1) men and women operate within specific crop production areas (see case study of Indonesia below),
2) women-managed areas are typically located near houses (spatial propinquity), whereas men tend to manage areas at greater distances from houses; and
3) within their respective areas, women tend to cultivate subsistence crops and men typically manage the production of commercially important crops, tree-based products, and/or livestock (see case study boxes 15.1 and 15.2).

Based on these observations it is evident that two factors interact with land use decisions among women: 1) reproductive labour related responsibilities, and 2) proximity to the home[2]. It can be argued that, in general, females manage relatively smaller parcels of land that are relatively closer to their household due to the limited labour availability among females for food production (as consequences of their reproductive roles) (Figure 15.1). Thus, the area used by women for subsistence farming is relatively smaller than areas used by men. For example, in northern Benin, women could only tend their shea (*Vitellaria paradoxa*) trees if they had completed their household responsibilities. Hence, the production of shea butter or oil was limited despite high demand for shea-based products (Dah-gbeto & Villamor, in prep). Distance from households to subsistence plots is also considered in managing farm plots because of time limitations and (perceived) security.

Explanations for how these gendered spatial patterns arise requires an understanding of the landscape as an integrated, socio- cultural and ecological system. Aspects of the physical and natural environment (e.g., topography, climate, volcanic activity, fauna, etc.) interact with aspects of human systems to shape the agricultural landscape, including i) power relations among men and women with inherently different demands, gender-specific values and expectations (e.g., women are required to remain near their houses for safety reasons by village elders), ii) external factors (e.g., global market-oriented policies or trends) and iii) rights and historical experiences (e.g., previous natural resource extraction experience such as timber harvest activities regulated by forestry/natural resource-based governmental bodies). Considering these factors, the spatial pattern perceived within landscapes are products of multiple interactions. Antrop (2005) defines a landscape as the *expression* of the highly dynamic interactions between socio-cultural and natural systems. Thus, it is pertinent to understand current perceptions (between genders), including how these perceptions arise and are shaped by social and cultural norms that affect the sustainability of natural resource use (i.e., success and failure of ecosystem management). Gaining such understanding may also help to provide insights into gender equity issues related to natural resources under climatic uncertainty. Most of our perceived traditional/cultural rural landscapes with distinct identity and character (see Figure 15.1) are rapidly being shaped by modernization (see Box 15.1) and globalization

Box 15.1

Outsourcing, landscapes and gender

If we accept that human roots are that of a 'social ape' living in small bands and groups that provided additional ways of securing individual needs for survival and reproduction, the starting point for most theories of change is a 'subsistence' economy at the local scale. The archaeological record shows that long-distance trade substantively predated agriculture (Diamond, 2012), but most of the products consumed where acquired locally, from various parts of the landscape. Gradual integration into local and global markets offers opportunities to 'outsource' acquisition of goods and services, benefitting from specialization. Outsourcing implies that production factors that were used to self-produce are shifted towards acquisition of externally produced goods and services. While it may be economically efficient under stable conditions, it involves exposure to new types of risks. A major step is taken when staple food is 'outsourced' and income obtained from sale of cash crops becomes the basis of 'food security'. Decisions to resist or use the opportunity to thus engage with markets have been analysed as a 'dual economy' (Dove, 2011), with many consequences for the way landscapes are used. Decisions to partially outsource food production may increase gender-differentiated land use, where men more readily engage in cash crops and women maintain the production of locally consumed goods that are not monetized and tend to be undervalued in economic studies. An example of such a pattern is found in (West) Sumatra where rice paddies are inherited, controlled and operated in a matrilineal (mother-to-daughter) pattern and tree crop lands in a mixed (both sons and daughters inherit) or male-dominated pattern (Quisumbing, 2001). Rural-to-urban migration involves major further steps in 'outsourcing' individual needs, participation in a cash-based economy, and loss of direct (economical) and indirect (emotional) links to landscapes. New gender-specificity of socially accepted roles emerge and interact with norms originally formed in rural societies (Resurreccion & Elmhirst, 2012).

(as well as population growth). What do these spatial patterns mean to gender equity and ways to adapt coping mechanisms for the impacts of climate change? We do not know the exact answers to these questions, but they are significant and need to be better understood. Part of the process of understanding why a landscape appears as it does will involve understanding the socio-cultural influences (Forman & Godron, 1986; Antrop, 2005; Wu, 2010) of which gender is certainly one. Therefore, gender analyses need to be incorporated more broadly into landscape-related research as according to Schiebinger (2014), "…unconscious sex and gender bias can be socially harmful and expensive…on the other hand, including gender analysis in research can save from life-threatening errors and can lead to new discoveries".

2. Understanding gender-specific perceptions of the landscape through participatory approaches

Accounting for gendered spatial patterns and gender relations in rural landscapes could enhance resilience-building capacity through food security policy development in response to external sources of variability (Assé & Lassoie, 2011; Mullaney, 2012; Villamor et al., 2014*a*). For instance, food production for household consumption could be endangered in densely populated rural areas, and in urban areas where most food is imported from rural areas. In terms of coping with climate variability and extreme events, increased seasonal or permanent outmigration (primarily working age men) may be a typical response to decreased food production. Employment related emigration may have negative consequences on household welfare such as child neglect or reduced ability to care for dependent household members as the family members who are left behind have to take on additional work and responsibilities (Brydon & Chant, 1989).

Participatory tools that allow insight into gender-specific decisions related to households' and communities' ability to adapt to change can be used to improve gender equity and foster climate-smart landscapes. These tools enable the identification and exploration of options that account for gender dynamics, which might not otherwise be apparent to researchers or practitioners. Some of the questions that such tools must address include (Colfer & Minarchek, 2013)[3]:

1. How is access to resources gender related? Are there broadly accepted notions that influence land tenure, inheritance, and occupation?
2. What are the behavioural gender norms that affect peoples' interactions with traditional crops, trees, and forests (e.g., masculinity ideals, seclusion of women, witchcraft beliefs)?
3. How do men's and women's daily responsibilities and economic roles differ (e.g., agriculture, forest products, livestock)?
4. What essential or valued domestic roles do men and women have that affect their respective involvement in the agricultural or forest landscapes?

Participatory appraisal techniques are not new – researchers have made use of scenario building exercises, agricultural calendars and ranking techniques for decades. Here, we highlight two techniques that have risen in prominence over the last decade as a means of eliciting behaviours and understanding their consequences – experimental games and agent-based models. These two approaches have a clear complementarity, and when applied jointly provide a powerful technique both to translate behaviours observed in

the field into landscape outcomes, and to involve non-expert stakeholders in modelling and decision process (e.g., Naivinit et al., 2010). In particular, they provide a means of representing the gender-specific decisions and interactions that characterize male and female agricultural behaviour; despite this, save for a few examples (e.g., Villamor, in prep.; Saqalli et al., 2011), these techniques have, to date, been under-utilized in the study of gender in agriculture and landscape approaches.

2.1 Experimental games for eliciting behaviour

Games have a long history of application in anthropology, mainly for educational and pedagogical purposes[4]. A game is a simplified and contrived situation that contains sufficient verisimilitude or illusion of reality to elicit practical responses by those participating in the exercise (Keys & Wolfe, 1990). Games allow the plurality of views and diversity of interests (e.g., due to gender differences) to be explored. During the last decade, however, gaming (especially tabletop board games) has become a tool for examining strategic behaviour under distinct scenarios. Advancements in computer simulation games can sometimes offer more precise measurements (Keys & Wolfe, 1990). Both computer-based simulation and gaming are widely applied in natural resource management (Barreteau et al., 2007). Role-playing games (RPG) in particular are more practical and straightforward for revealing gender relations and their dynamics within landscapes. It can also promote participants' understanding of interrelated physical, spatial and social functions within the landscape.

2.2 Agent-based modelling for integrating gender specific spatial behaviour and perceptions

An ABM is a representation of a system (such as an agricultural landscape) using interacting, decision-making agents (such as farmers) (Bankes, 2002; Brown, 2006). In such a representation, landscape-scale properties such as the rates of land-cover change or population growth emerge from agent-level decisions to plant new fields or to have children, rather than from pre-defined mathematical relationships. Representing farmers as individuals is a significant data challenge, typically requiring primary data collection (Robinson et al., 2007), but offers a payoff. The one-to-one relationship that typically exists between agent behaviour and on-the-ground resource-use decisions (a discrete choice to either deforest a plot or not versus a mathematically determined rate of land-cover change) make ABMs a valuable entry point for engaging non-expert stakeholders (like farmers) in participatory training and resource management exercises.

ABMs are an ideal tool for studying contexts where interactions among individuals are strong drivers of outcomes at the landscape scale. Over the 20 years or so that ABMs have been applied to the study of natural resource management issues they have been used to understand different kinds of dynamics such as information sharing interactions among households (e.g., Ng et al., 2011), labour patterns (Naivinit et al., 2010), competing markets for resources (Schlüter et al., 2009) including focusing on system-level production and input consumption (Saqalli et al., 2011), assessing land cover changes (Bell et al., 2012; Villamor et al., 2014*b*) and determining social outcomes such as wealth distribution (Bell, 2011).

2.3 Integrating games and ABMs – landscape inferences, stakeholder engagement, and social learning

Using the results from the games to inform, structure, and calibrate the decision processes built into ABM enhances the validity of model results (i.e., convergent validity) (Ligtenberg et al., 2010; Villamor et al., 2013*b*). Integration can generate the following insights: 1) the effects of individual desires on beliefs and preferences; 2) the effects of the beliefs and preferences of other actors; and 3) the effects of joint beliefs and preferences on potential solutions to a particular planning problem (Ligtenberg et al., 2010). An ABM structured from the results of field-level behaviours provides a powerful tool for understanding how individual interactions and behaviours shape patterns observed at the landscape scale.

However, both games and ABM double as tools for inference and training. The act of playing a game can in many cases lead participants to confront novel situations and decisions. Coupled with follow-up training programmes games have been applied as means of improving collective action in different resource systems (e.g., Meinzen-Dick et al., 2014). The easily interpreted nature of decision rules in ABMs allows non-modellers to make links between their decisions and the resulting consequences for the landscape (e.g., Naivinit et al., 2010).

3. Case studies: gender-specific spatial perception

The following two case studies are examples of applying board games and ABMs to understand gender-specific land-use decisions at the landscape level.

3.1 Dassari watershed, (Tanguieta) Benin – exploring climate variability scenarios

A game called the 'grazing game' was implemented in the Dassari watershed in northern Benin. This area is a semi-arid ecosystem and its inhabitants are mainly farmers and pastoralists. Rainfall is erratic and it is predicted that drought events will become more frequent and severe with rainfall periods becoming shorter due to effects of climate change. The objective of the game exercise was to identify processes that lead to land degradation while exploring coping strategies under unpredictable rainfall patterns (van Noordwijk, 1984; Villamor & Badmos, submitted)[5]. Household farmers segregated into groups of men and women were the target players. Groups were segregated to be able to assess the gender-specific perceptions of coping strategies and the management of arid landscapes subject to unpredictable precipitation patterns.

One of the main findings resulting from the gaming exercises (Figure 15.2) was that under unpredictable rainfall pattern scenarios the strategies of men and women differed in production yield targets (Figure 15.2.1a & 15.2.2c). During the game, women began producing cattle to sell and used the proceeds to convert blocks of land to production of more profitable cash crops (e.g., cotton) and food crops (e.g., corn and sorghum). The men, who in reality are responsible for livestock production, did not respond to land degradation as long as they were able to maintain cattle throughout the course of the game. This contrasted with the strategy of the women who were careful to avoid creating degraded patches of land while also producing cattle.

Gender-specific spatial relationships became apparent during the course of the gaming exercises when players were asked what was missing from the game to better reflect

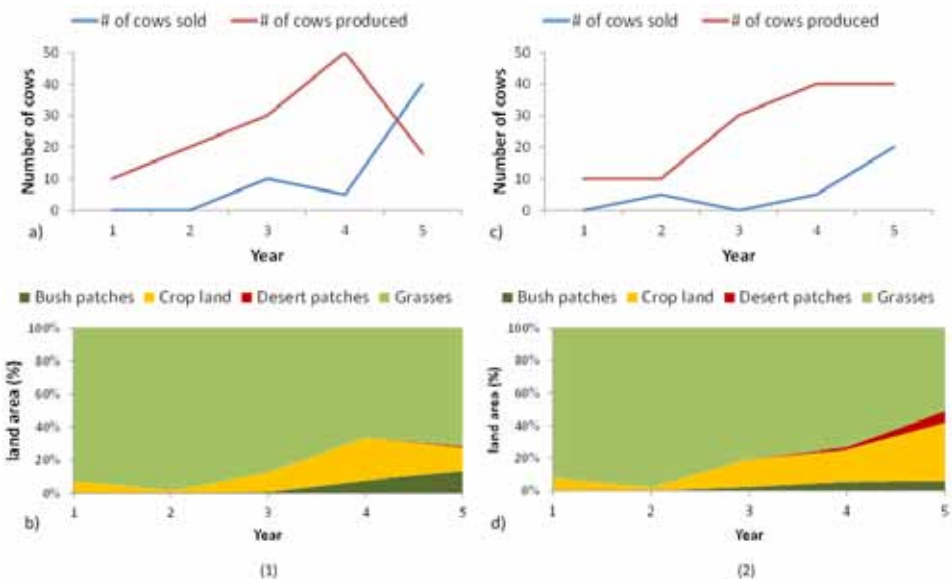

Figure 15.2 Patterns of land-use change under variable precipitation conditions created by the women-only group (1; a and b) and the men-only group (2; c and d).

reality. Men and women responded according to their perceived gender-based work experiences. Women reported pest and disease components of crop production should be included, whereas men suggested including the protected area as a limiting factor for agricultural expansion. This suggests that participating women were more concerned with the immediate issues affecting their role in crop production, while participating men were concerned with the potential for expanding production.

3.2 Indonesia (combined RPG & ABM approach) – predicting the outcome of payments for agro-biodiversity schemes

A traditional matrilineal kinship system continues to be practiced in the Bungo District of the Jambi Province on the island of Sumatra in Indonesia. Under this system women are responsible for rice fields, including both production and proprietorship bequeathed by mothers to daughters or aunts to nieces, whereas men are responsible for the agroforestry systems (e.g., rubber agroforests). The Dutch introduced rubber trees (*Hevea brasiliensis*) to Sumatra from Brazil in the 1900s. Initially rubber trees were inter-cropped with native lowland forest tree species. Rubber agroforests or 'jungle rubber' eventually became the dominant land use on Sumatra (van Noordwijk et al., 2012). However, in the early 1990s oil palm (*Elaeis guineensis*) production was introduced to Sumatra and large areas of forest and rubber agroforest have been converted to converted to oil palm production in response to increasing global demand (Villamor et al., 2014*c*). An ABM called Lubuk Beringin - Land Use DynAmic Simulator (LB-LUDAS) was applied to predict the land-use change trajectories under a payments for agro-biodiversity scheme (Villamor et al., 2014*b*). Autonomous agents (farmers) were parameterized based on gender disaggregated data (collected from samples of 95 men and 96 women). The model was coupled with RPGs to integrate other external actors that could influence gender-specific preferences and as a validation tool for the model (Villamor, 2014).

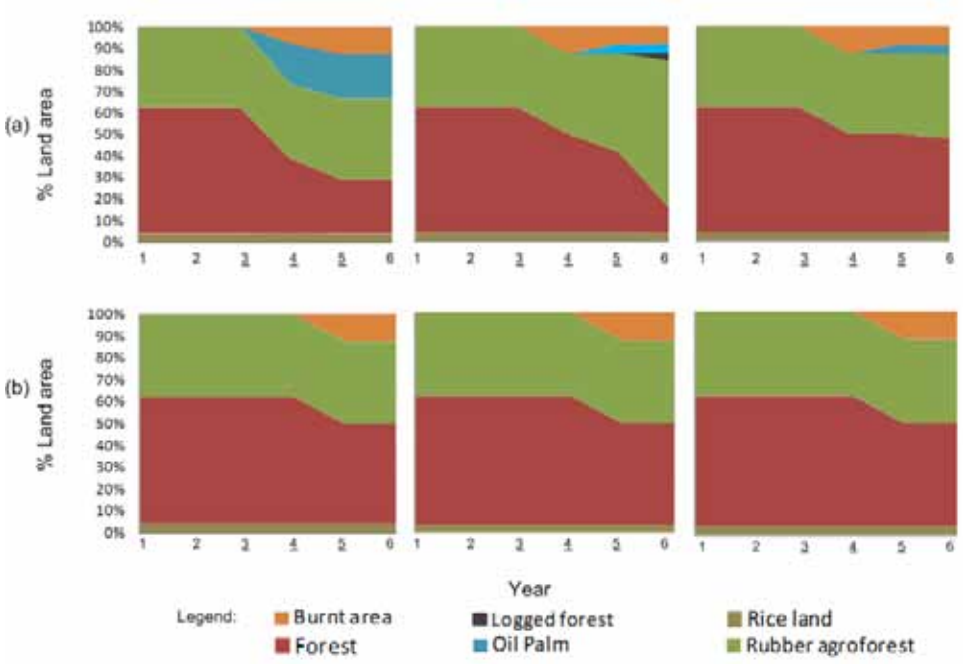

Figure 15.3 Land use change patterns based on the RPGs of women-only (a) and men-only (b) groups (Villamor et al., 2013*a*).

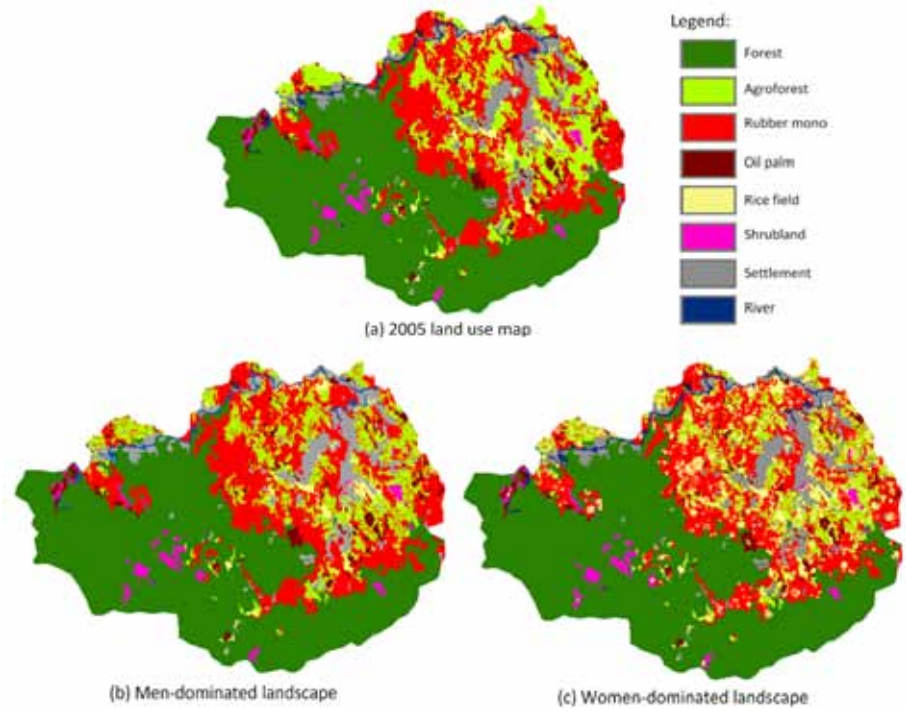

Figure 15.4 Land-use change pattern using a 2005 land use map as a baseline (a), against men-dominated (b) and women-dominated (c) landscapes simulated by the ABM.

One of the main findings from the combined ABM and RPG approach was that even though the participating women expressed a preference (Figure 15.3) for land use changes to improve profitability (e.g., monoculture oil palm and rubber plantations), their reproductive responsibilities, and their skills and labour limitations prevented them from achieving the desired outcomes. After the 20-year ABM simulation women returned to rice production (overall increasing the area under rice production Figure 15.4c). Men, on the other hand, exhibited a greater predilection for rubber agroforestry and monoculture plantations, both of which were more frequently maintained due to the ability of men to meet the labour requirements (Figure 15.4b). The simulation results also revealed that women-dominated landscapes had different spatial patterns (i.e., from clustered to fragmented pattern) than men-dominated landscapes (Figure 15.4; further analysis is presented in Villamor & van Noordwijk, in prep).

4. Gendered landscapes

The two case studies presented provide examples of the capacity for experimental games and ABMs to identify differences in gender-specific perspectives in socio-cultural-ecological landscapes. Wherever there are strong gender-specific roles embedded in agricultural landscapes, inadequate treatment of these roles may lead to major consequences for planning, intervention design, and management by misidentifying sustainability of goals and objectives and limiting their effectiveness. According to Harvey (1993) the very design of the transformed ecosystem (e.g., agricultural landscape) is redolent of prevailing social relations and reflects the social systems that give rise to them.

These are only two very early examples illustrating the potential for games and ABMs to elucidate gender-specific perspectives, behaviours and strategies and their resultant role in shaping landscape outcomes. There remains much untapped potential for this methodological pairing to advance policy and stakeholder-driven science in the area of climate-smart agriculture and climate-smart landscapes. For example, the clear pathway by which stakeholder-specific perspectives and decision processes are elucidated in the games, and expressed clearly in ABM modelling frameworks, allows non-expert stakeholders to have a point of entry into this form of technical knowledge. Beyond this, the technical strength of ABMs to project the kinds of system-level outcomes that emerge from individual decisions and interactions – here the gender-specific sharing of agricultural risks and responsibilities – can aid in designing policy interventions that are tailored to the realities of the everyday agricultural life of both men and women. Interventions designed without considering gender may exacerbate existing inequalities (e.g., increase the burden of women's roles and responsibilities) that could lead to both 'household and ecological crises'; after all, landscapes are holistic systems in which natural and socio-cultural systems co-evolve. To this end, in this chapter we illustrate the potential benefits that the experimental game and ABM toolkit can offer for gender-specific research in the context of climate-smart agriculture, and invite researchers to bring these techniques into mainstream research at the nexus of gender, land use and climate change.

Endnotes

1 While the default perception is two and there is a drive towards eliminating gender-based distinctions, a third, trans-sexual gender is distinguished in several Asian societies; recent fieldwork in south Sulawesi showed five gender strata (Martini, pers. com. 2013).
2 Economic geography traces its roots to the von Thünen model that predicted land use patterns with respect to a settlement based on transport costs; alternative interpretations include the distance-related costs of protecting resource access.
3 The sample questions presented are mainly for meso- and micro-scales. For further information see Colfer and Minarchek (2013).
4 In a way all social science research methods are based on 'role play games', where informant and interviewer roles are played within a social construct that tends to be ignored or forgotten in subsequent data analysis.
5 A full description of the modified game rules and mechanics are presented in Villamor and Badmos (submitted). The complete results of the gaming exercises in Benin are presented in Dah-gbeto and Villamor (in prep).

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Land use conversion at the edge of forest in Tanjung Jabung Barat, Jambi, Indonesia. Photo credit: Putra Agung, World Agroforestry Centre