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Gender differences in land-use decisions: shaping multifunctional landscapes?

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While decision-making processes of land managers drive land-use change and affect the provision of ecosystems services, there is no concrete understanding of whether gender specificity in decision-making influences the multifunctionality of landscapes. We distinguish eleven elements in a typical management cycle. In reviewing the literature, we found apparent gaps on gendered knowledge, preferences, risk taking and access to innovation in land-use decision making. Male and female responses in the adoption of agroforestry practices and other investment opportunities reflect differing exposure to and perceptions of risk. Innovative approaches such as agent-based models and role-playing games are currently applied to study gendered behavior in land-use decisions. These approaches can assist researchers to explicitly and empirically compare potentially self-reinforcing behaviors or feedback loops with local impacts on ecosystem services.

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Introduction

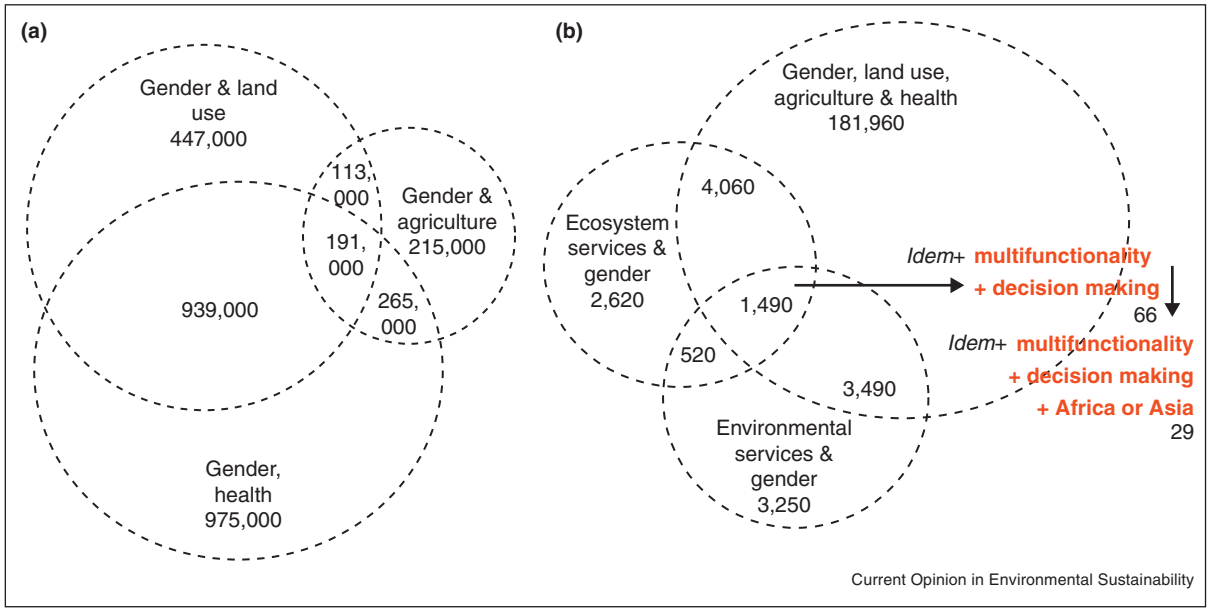
Landscape multifunctionality is widely recognized as a crucial aspect of sustainable land development, including agriculture, agroforestry and forests, with particular emphasis on the wide range of goods and services provided by rural landscape systems for social needs beyond being part of 'the agricultural sector' [1]. Rather than from planning, multifunctionality emerges from the complex interactions of multiple actors with various objectives and means of influencing the system and the norms, rules and regulations that modify human behavior [2,3]. This is responding to the various roles and decision-making processes of both males and females, which are influenced by wealth, age, ethnicity, religion and formal education. However, current literature is scarce concerning the way gender differentiation contributes to multifunctional landscapes.

Understanding landscape multifunctionality requires a better conceptual grasp of decision making that incorporates the process of choosing between alternative options and processing information concerning the expected outcomes of different options that are all gender specific. Yet, feedback between the highly interlinked, underlying, ecological and socio-economic drivers and constraints are often poorly understood [4]. This is particularly true of gender disparities and their effects on demand for ecosystem services, including land rights [5]. Indeed, current approaches to land-use science based on the characterization and analysis of biophysical parameters are insufficient to develop a comprehensive understanding of changes in socio-economic land functions [4].

We reviewed literature detailing how men and women process information differently on the goods and services derived from the landscapes where they live, and how they use it (particularly in Africa and/or Asia). Only a small part (4.7%) of the literature that combines gender, land use, agriculture and health in the title and text, also includes environmental and/or ecosystem services (Figure 1); while only 4.4% discusses multifunctionality and decision making.

While certain case studies exist, these have not been rigorously compared across cultural, geographic, economic and political circumstances. The lack of a generic framework, for making such comparisons, may reflect part of the problem. Acknowledging that gender is only one of several characteristics for individuals that make up households and communities interacting with the landscape, markets and governance systems, we started with a general perspective on decision making that can be used for comparison across situations and actors.

Figure 1



Number of references in Google Scholar for various combinations of keywords; the 191.000 references in **(A)** at the intersection of the three circles is further analyzed in **(B)** for its intersections with environmental and ecosystem services (accessed 28/2/2013).

Decision making

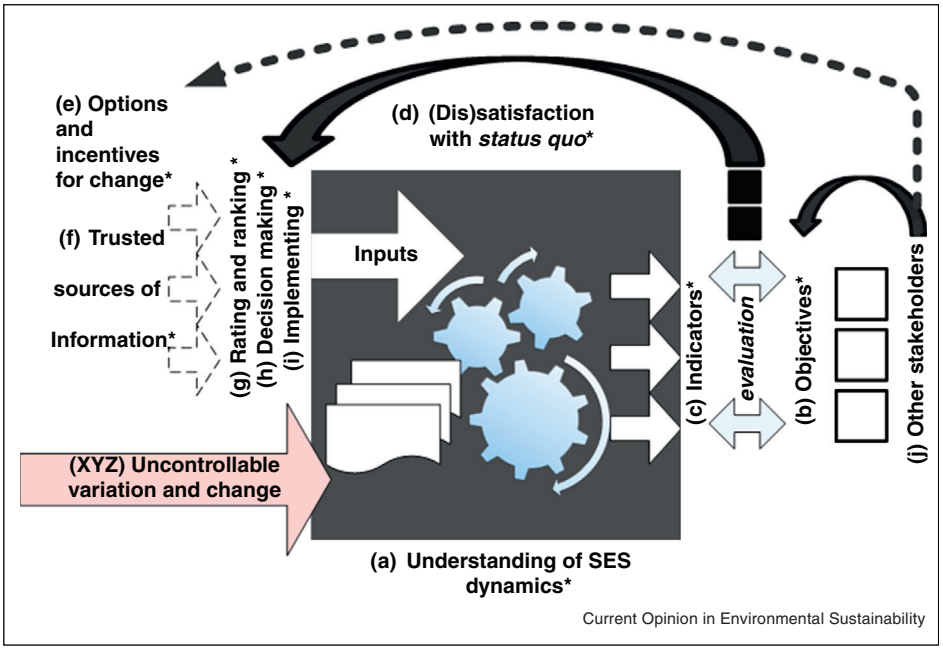
Decision making in natural resource management can be analyzed using the steps of a general management or feedback learning cycle (Figure 2) [6]. While land managers control inputs, they only have partial understanding of how the managed system translates inputs into outputs (A). The outputs are captured through indicators that can be evaluated against objectives for the system's performance (B and C), leading to a level of (dis)satisfaction with the status quo and a potential drive to change, innovate and learn about the use of different or new inputs (D). Decisions concerning change require the availability of options (E), potentially with incentives attached to them, and trustable sources of external information (F). Together with the managers' understanding of the system, these lead to rating and ranking of options (G) with respect to objectives, feeding into a decision-making process (H), which results in implementation (I). Economic analysis uses a subset of this scheme with a single currency for the different steps and with associated efficiency concepts, while broader perspectives on decision making (e.g., irrationality, cognitive and intuitive) further contribute to our understanding [7,8••].

We may deal with nested natural resource management systems [6] where the management cycle of farmers is part of the governance systems that strive to achieve their landscape, economic and development objectives by changing input and output values for farmers. While all steps in such a management feedback loop might be differentiated by gender and other social characteristics, empirical information is generally lacking concerning aspects that are strongly varied, and where external interventions are relevant if gender inequality is to be reduced.

Gendered decision making: beyond the stereotypes

Table 1 provides examples from the literature with empirical evidence of gender differentiation across most steps of the management cycle. Despite national and international efforts of mainstreaming gender equality, gender specificity in response to land-use options and agents that offer new investment opportunities has received little attention to date [9•]. The analytical framework of a 'dual economy' at the household level, balancing participation in global markets and subsistence needs [10], tends to suggest gender differentiated roles in implementation (I) and preferences (B) as stereotypes, linked to knowledge (A) and indicators of success (C). Gender studies related to land-use are predominantly focused on the varied roles of males and females in implementing (I) agricultural production (e.g., land preparation, cultivation, harvesting, processing and marketing), the technology adopted to improve practices (H) and the organizational and institutional interventions that increase access to agricultural research and development programs (E, F, and G) for women [11–13]. On the other hand, empirical studies on different gender behavior in terms of trusting sources of information (F) are very scant

Figure 2



Analytical scheme for understanding land-use as a part of natural resource management decisions. Asterisk (*) is where diversity in gender, wealth and ethnicity play a role in: **(A)** knowledge and understanding of the dynamics of socio-ecological systems (SES); **(B)** objectives for operating SES; **(C)** indicators of current performance relative to objectives; **(D)** the overall level of (dis)satisfaction with the status quo; **(E)** access to knowledge of options for change; **(F)** trusted sources of information; **(G)** the rating and ranking of options relative to the status quo as a basis for decision making **(H)** and implementation **(I)**. The level of other stakeholders' (dis)satisfaction **(J)** with current SES performance may result from the negative or positive spillover effects these stakeholders experience and how they perceive varied social, economic or policy contexts. Moreover, uncontrollable variation and change **(XYZ)** affect all.

Table 1

Empirical evidence of gender differentiation linking with different aspects of the management cycle

Steps in management cycle	Empirical evidence of gender differentiation
A. Knowledge and concepts of SES behavior and function	In Mali, households that combine gender inclusive decision making with relational agro-ecological knowledge and a mix of intensive and traditional extensive agriculture have the highest capacity for constructing adaptive soil and tree management strategies [48•] Women are key stewards in the enhancement of agro-biodiversity and location-specific crops [31••]. In Kenya, females have the right to harvest a specific tree species to provide green manure for soil restoration [11]
B and C. Performance metrics of farm or SES	In West Africa, where a typical spatial-landscape arrangement with different soil-tree dynamics exists, cropping fields with undomesticated trees further from village centers are commonly managed by men, while fields with domesticated trees are typically managed by women [48•]
D. (Dis)satisfaction with status quo	Women tend to first satisfy the need for household consumption, while males are inclined to meet the income security [9•]
E. Array of known alternate options	Women's choices are less individually oriented and more socially oriented [31••], thus reducing the incidence of conflicts [47,49]. They decide for the welfare of the entire household and/or community, in which choices are more oriented towards achieving multiple goals rather than a single aim [24•] While men prefer high-value commodities for income security, women prefer low-value commodities that meet the household's dietary food requirements [23•,50]
F. Dealing with external agents	Depending on the cultural and educational background, women tend to approach external agents offering new land-use options more positively than men [9•,51•]
XYZ. Dealing with external sources of variability and change	Men commonly engage in seasonal migration for jobs, particularly in Africa and Asia. For instance, because of the male out-migration in Uzbekistan, women's participation in farming activities is growing [23•,52]. Women are left to cope with subsistence farming and contribute to household food security

with mixed results [14,15]. Among factors associated with these differences include family structure, socio-economic circumstances, personal interests, and credibility and reputation of the people they are dealing with [15,16]. From an economic viewpoint, a study that shows the relationship between expected returns and trusting behavior is stronger among men than women, suggesting that men view the interaction more strategically than women [14]. Equally important in shaping multifunctionality of landscape, we further discuss two critical aspects: the risk evaluation of new technologies (H), and the land-use decision making and implementation (G and I).

Risk behavior and adoption of new technologies (step H)

Risk preferences significantly differ based on gender [17], with growing evidence that women are individually more risk-averse and less prone to competition than men [17–20,21••]. However, culture and context in gender specific roles and resource access provide significant variation in terms of gender stereotypes concerning subsistence versus market orientation. Particularly when resources are limited or lacking, gender differences in risk aversion become relevant for decision making. Moreover, cultural beliefs and norms including the gender-biased traditions have constrained the participation of women in various activities in some parts of Asia and Africa [22,23•]. By contrast, women in western countries perceive farming as a lifestyle choice that includes the flexibility (i.e., in managing time) and working more together with family members [24•].

Gender-specific risk behavior differs according to male and female opportunities (i.e., commercialization and mobile livelihood strategies versus subsistence farming) [25–27]. For instance, commodities from subsistence farming or 'crops for consumptions' are more likely to be controlled by women, while commodities generating high income or 'lucrative crops' are controlled by men [27–29]. In Indonesia for instance, male household heads prefer to convert their traditional rubber agroforests to higher value crops (i.e., oil palm) [30], while older females maintain upland-rice cultivation under a matrilineal system [9•].

As economic globalization transforms traditional mixed-crops or agroforestry systems to commercial agriculture with new marketing and technological opportunities, farm production is often centralized under men's control [27,28]. Adapting to new farming technologies requires training and experimentation, in which female households lack sufficient time to get involved. In Africa and Southeast Asia, studies show that agricultural restructuring poses negative consequences for women [31••,32]. Furthermore, along with this trend of agricultural commercialization is the formalization of land rights. For instance, the once customary land-tenure rights, at least in some situations in Sub-Saharan Africa, are transferred to legal rights under the ownership of household males [33].

Despite the important role of risk behavior of male and female households in land-use decision-making, other pertinent factors also affect their decisions. These may include gender specific choices of commodities, resource access and control, knowledge, skills, perceptions related to natural resources, and institutional settings (step E of Figure 2). These gender-specific factors may contribute explicitly or implicitly to the pattern of multifunctionality of landscapes.

Land-use decision making (steps G and I)

While complex gender, land-use and multifunctionality intersects may not be obvious, research has revealed that women's participation in decision making is crucial and straight forward, particularly in terms of food security. In Africa, male motivation to incorporate trees on farms is largely conditioned by financial factors, whereas females are concerned with soil conservation and household food consumption [11,23•,27,29,34]. However, there is a dearth of empirical data on gender differences in the provision of ecosystem services beyond agriculture.

To identify the effect of gender variation in land-use decision making, agent-based modeling (ABM) has been used as a research approach for the integration of various knowledge systems. This model can incorporate detailed and multi-layered empirical data on human behavior and the socio-ecological environment [35•,36–39]. Furthermore, it allows us to analyze the interactions among a significant number of demographic characteristics between male and female decision making, and its loop effect with the landscape's biophysical components. ABM is not new to sociological research [40–42]. The earliest example was Schelling's simple model of segregation [43]. Coupling with various anthropological and sociological approaches [44], the model could better describe SES interactions spatially and temporally. While in land change science, numerous efforts have been made to apply ABM to understand SES and forecast future land-use/land-cover change and livelihood strategies [30,35•,39,45], private profitability maximization in terms of human agent decision making has been the primary objective function tested to date [8••,35•]. Such models in land-use decisions could be inappropriate for achieving multifunctional goals, considering the specific role of gender in farming practices [24•].

Consequently, social learning styles and values need to be embedded in the ABM before the construction of gender-specific decision algorithms. To address this, an empirical study combining this model with household surveys and role-play simulations could validate evidence while

increasing the understanding between individual and group dynamics [9•,46]. Within such studies, men and women can be segregated to elicit both individual and group behaviors and decisions in response to external agents offering new land-use practices. These behaviors can subsequently be simulated, projecting the potential trade-offs from such decisions [46]. The results of an empirical study using these methods suggest that contrary to expectations and gender stereotypes, females are more active and dynamic than men in responding to external opportunities shaping landscapes [9•]. Global comparative studies of this type could provide rich learning opportunities. Evidence so far suggests that a mixed-gender or joint decision making leads to better outcomes for environmental sustainability and food security [47], managing the multiple tradeoffs in landscape multifunctionality.

Conclusions

While the existing literature describes many contexts and various outcomes of land-use mosaics, there is a lack of clarity concerning possible generic mechanisms or frameworks that account for the decision making of agents shaping landscape multifunctionality.

A decision analysis scheme based on learning loops offers opportunities to compare case studies and to identify which elements of decision-making processes differ between contexts, and with which landscape outcomes they are associated.

The two most salient steps to be clarified by further research on the gender-specific decision cycle on land-use change appear to relate to the dynamics of trusted sources of information on new options for land-use change, and the ways in which risks are assessed for new options relative to what is already familiar and has a local track record.

If greater gender equity is the goal, points of intervention along the decision loop can benefit from the analysis of locally weak parts of the learning cycles.

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