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Sareth Nhem & Young Jin Lee

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## Women's participation and the gender perspective in sustainable forestry in Cambodia: local perceptions and the context of forestry research

Sareth Nhem<sup>a</sup>  and Young Jin Lee<sup>b</sup> 

<sup>a</sup>Graduate School, National University of Management, St. 96 Christopher Howes, Khan Daun Penh, Phnom Penh, Cambodia;

<sup>b</sup>College of Industrial Science, Graduate School of Natural Sciences, Department of Forest Resources, Konju National University, Yesan-gun, South Korea

### ABSTRACT

We analyzed local stakeholders' perceptions on women's engagement in sustainable forestry and the challenges women face. We additionally examined the publication of scientific papers on women's participation and gender perspectives in forestry research. We employed Kendall's  $W$  to examine the concordance of local peoples' assessment of the knowledge of rural women related to forestry, the major barriers preventing women participating effectively in sustainable forestry and the tasks required to engage women better. The study revealed only very weak agreement regarding the knowledge of rural women about forestry (Kendall's  $W = 0.47$ ,  $p < .000$ ). Local people considered women knew most about sustainable forestry and use of forest for various purposes and less about the trees and forests. The study found moderate agreement (Kendall's  $W = .118$ ,  $p < .000$ ) concerning the major barriers preventing women participating effectively in sustainable forestry, with the most significant barrier being low female participation in decision-making bodies. There was very weak agreement on the highest priority task required to engage women better in forestry management (Kendall's  $W = .035$ ,  $p < .000$ ). Quantitative content analysis was used to analyze the scientific papers. From 1992 to September 2018, 537 scientific papers were published in 171 journals, with study sites in 83 countries, related to women and gender in 1) forest, 2) REDD+ and 3) community-based forestry. The countries most covered by the research were: Indonesia (27 articles), India (39), United States (45) and Nepal (51). There was a significant increase in the number of papers on women's participation and gender mainstreaming in 1) forest ( $n = 482$ ), and 2) community-based forestry ( $n = 20$ ) from 2007, and in 3) REDD+ discourses ( $n = 34$ ) from 2011. This study suggests further scientific research is needed on women's participation and gender perspective in sustainable forestry and environmental concerns if the collective action needed for sustainable forest management is to be effectively addressed.

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Women; gender; forest; Kendall's  $W$ ; Kernel density curve

### Introduction

A number of key events and international frameworks have combined to draw attention to the importance of women's participation and gender mainstreaming in political, economic, social fields, including sustainable forestry (UN 1979). For example, the Convention on the Elimination of All Forms of Discrimination against Women was adopted in 1979 (UN 1979). In subsequent years, further international frameworks were adopted, including the UNFCCC, 1992 (UN 1992b); Earth Summit, 1992 (UN 1992a); UN Millennium Declaration, 2000 (UN 2000). The 2030 agenda for sustainable development (UN 2015d) also, to some extent, concerned women's participation in social forestry management and climate change mitigation.

Alongside this, from the mid-1970s, much attention has been paid to deforestation, natural resource degradation and the impact of climate change (Arnold

1991). However, low-income countries still have limited capacity to protect resources sustainably (FAO 2016, p.17). Gilmour (2016) and Tyagi & Das (2017) reported that South Asia, particularly India and Nepal, has become the hub of community-based resources governance to improve equitable and effective local outcomes since the 1980s. In particular, one-third of the world's forests are under some form of community-based forestry management (Gilmour 2016). Governments alone did not have enough power or manpower to protect forest sustainably and began transferring management rights to local people, especially women, to lead community-based forestry activity (Arnold 2001; Manandhar & Shin 2013; Miah et al. 2014). This has helped to address deforestation and improve local economic, social and environmental outcomes (Arnold 1991; Gilmour 2016). In addition, UN (2015c) pointed out that effective community-based

forestry requires both women and men to become actively involved and be equally represented in decision-making at all levels.

UN (2015b, p.17) emphasized that there has been considerable improvement under MDG's Goal 1: eradicate extreme poverty and hunger Target 2 'achieve full and productive employment and decent work for all, including women and young people' but problems remain with the indicators. FAO (2018) illustrated that 850 million rural poor (83% women) remain reliant on harvesting wood for fuel and collecting medicinal plants and other forest resources for family consumption. This underlines the opportunities for women from greater involvement in forest-based programs; they can secure their access to natural resources (Agarwal 2010; FAO 2018), develop their skills and knowledge concerning forest biodiversity and participatory forestry management and be able to participate in the public policy process (Gurung et al. 2011; Colfer & Minarchek 2013).

Women's informal and subsistence-level involvement can also be turned into economic and political empowerment (UN 2015c; FAO 2018). However, UN (2015c) noted that women's involvement in local and national policy formulation and decision-making in natural resources and environment management remains limited. Despite the global frameworks and national plans concerning women's participation in sustainable forestry (Elias et al. 2017; Asher & Varley 2018; FAO 2018), there are major challenges preventing women participating effectively in sustainable forestry and these remain largely unaddressed (Evans et al. 2017). Women are often excluded from decision-making about sustainable forestry and environmental protection (Aboud et al. 1996; UN 2015a, p.176–178) and Adedayo et al. (2010) showed that unfavorable land tenure for collection of natural resources is a challenge for women across Africa.

FAO (2018) reported that data on the overall contribution of forests to gender equality are still inadequate: more gender-disaggregated data are needed at local, subnational, national, regional and global levels (Agarwal 2009; Gurung et al. 2011; Bradley et al. 2013; Colfer 2013; FAO 2018).

The study of women's participation and gender in sustainable forestry and environmental concerns has become popular since the 1990s (Xiao and Hong 2010; Coleman & Mwangi 2013). For instance, Agarwal (2009) studied gender and forest conservation in India and Nepal; Xiao and McCright (2012) looked at gender differences in environmental concern in the United States; Asfaw et al. (2013) assessed the gender dimension of forest income in Ethiopia; Clair (2016) reviewed gender and fuelwood collection in Nepal; and Ngigi et al. (2017) considered gender differences in climate change in Kenya. Tyagi & Das (2017) analyzed 25 years of research on gender mainstreaming in forest governance and Asher & Varley (2018) assessed gender in forestry research, without specifying the country (a global-comparative study).

Attention to gender disaggregation helps policy makers understand the vulnerability of rural

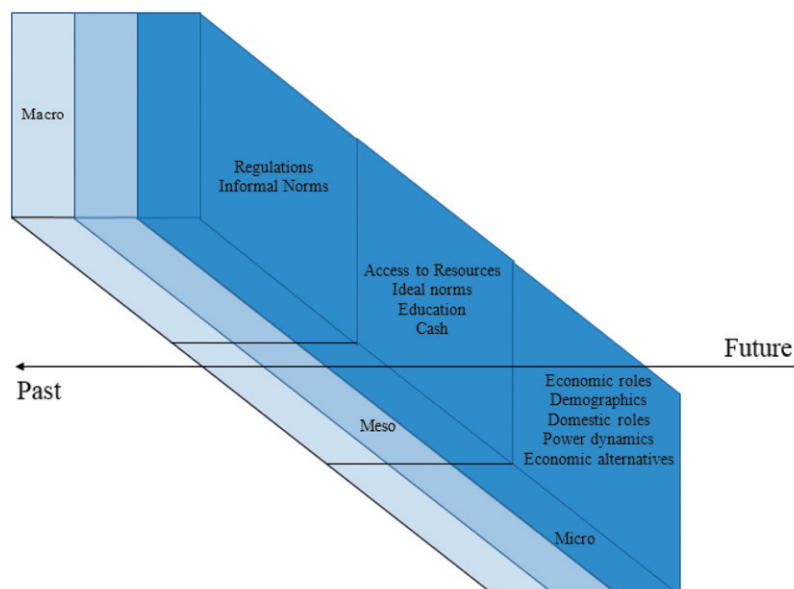
households and their capacity to respond (Agarwal 2009; Vázquez-García & Ortega-Ortega 2017). Leisher et al. (2016) suggested that empowering women in decision-making enables better natural resource governance. Empirical studies have shown that women depend more heavily on immediate access to forest resources as they are responsible for daily housework, including finding food and firewood, while their husbands are focused on work off-farm (Das 2011; Sunderland et al. 2014).

No scientific papers about women's participation and gender mainstreaming in sustainable forestry in Cambodia can yet be found on "Web of Science". However, there are some government reports and project documents, so-called grey literature, on gender and REDD+ or gender assessment in general in Cambodia. We refer readers to UNIFEM et al. (2004); Gurung et al. (2011); Bradley et al. (2013); NCCC (2013); MoWA (2014a) and MoWA (2014b). This study pioneers scientific research into the assessment of the knowledge of rural women related to forestry, the major barriers preventing women participating effectively in sustainable forestry and the tasks required to engage women better in sustainable forestry in Cambodia.

### ***The status of women's participation and gender mainstreaming in sustainable forestry***

Agriculture remains the backbone of the economy in Cambodia, accounting for 75% of the labor force (RGC 2014). At least 80% of the population live in rural areas and their GDP per capita was \$1,036 (\$2.87 per day) in 2013 (RGC 2014, p.6–76). Women were 71.11% of the workforce in agriculture (including forestry and fisheries) in 2009 (MoP 2008, p.82–165). By 2014, this figure had decreased to 63% (MoWA 2014b). MAFF (2010, p.82–165) stated that 75% of Cambodia's rural people depended on forest resources for energy, wood, food and income for daily household consumption but forest coverage in Cambodia decreased from 73.04% in 1970 (MoE 2018) to 48.14% in 2016 (MAFF 2016; MoE 2018, p.15). Continuing deforestation and forest degradation, a sign of poor management of natural resources, will seriously affect the local economy, society as well as the environment, as most rural households depend on natural forest (Dudley 2010; Gilmour 2016; Pouliot et al. 2017; Nhem et al. 2018b).

Recognizing this vast forest decrease, Cambodia has tried to protect forests by combating illegal logging, establishing community forestry and community protected areas, encouraging forest rehabilitation, improving rural farming techniques and reducing dependence on firewood (MAFF 2010; RGC 2011; Nhem et al. 2018b). We observed that Cambodia reformed the forestry program to focus on: 1) monitoring and reporting forest crimes; 2) strengthening forestry law enforcement and governance; 3) transferring power to local people to manage forest through community forestry; 4) continuing to carry out forest demarcation, classification and registration (MAFF 2010; RGC



**Figure 1.** Gender box framework indicating aspects of women's participation and gender perspectives in sustainable forest management. Note: Adapted and modified from Colfer & Minarchek (2013); Colfer (2013) and Evans et al. (2017).

2014); and implement REDD + program (MoE 2015). Despite this, forest loss has continued due to increasing demand for agricultural land, economic land concessions and illegal logging (FAO 2010; ADB 2014).

Cambodia has ratified important international legal frameworks covering women's participation in economic, social and environmental spheres, i.e. CEDAW in 1992 and the Beijing Platform for Action for the Promotion of the Status of Women, in 1995. Domestically, Cambodia developed the Neary Rattanak Strategic Plan for Gender Equality and the Empowerment of Women in 1999 and Gender and Climate Change Action Plan in 2014 (MoWA 2014a). The Technical Working Group on Gender was formed in 2004, followed by establishment of the Cambodian National Council for Women and the Gender and Climate Change Committee in 2011. The Ministry of Women's Affairs (MoWA) reported that 'women and climate change' received attention in a number of national policies including the Rectangular Strategy, National Strategic Development Plan and Cambodia Climate Change Strategic Plan (NCCC 2013; MoWA 2014b).

Women are increasingly represented in political life, making up 14.75% of Senators (MoWA 2014) and 20.33% of National Assembly representatives in 2012 (Bradley et al. 2013; MoWA 2014, p.3–9). In 2013, 37% of civil servants were women (MoWA 2014). Despite this progress, women still face challenges in respect to forestry and climate change in Cambodia, for example, women have limited access to resources for agricultural production, have smaller plots of land and less land tenure than men and are more likely to be landless (UNIFEM et al. 2004; Bradley et al. 2013; Swift 2013; MoWA 2014; Travers et al. 2015; Sotheary 2016). Women rely heavily on local natural resources as they are normally responsible for securing water, food and energy for cooking (UNIFEM et al. 2004; MoWA 2014) and 62% Cambodian households still

depended on firewood in 2015 (RGC 2014, p. 35). Women are more vulnerable than men, according to UNIFEM et al. (2004) and MoWA (2014, p.13) and are further challenged in Cambodia by a lack of understanding their role in community decision-making and the domination of men in forestry activities (Gurung et al. 2011; Bradley et al. 2013; ADB 2015).

### **Framework on women's participation in sustainable forestry**

This study used the gender box framework as a guide to review the literature and develop the survey questionnaires to interview local people exploring their perceptions and understanding concerning women's participation and the challenges women faced in sustainable forestry. To refrain from repetition, we discuss the framework only in the following section. The gender box framework was designed to guide the effective integration of gender in sustainable forest management (Colfer 2013; Evans et al. 2017), based on experience from countries which have integrated women's participation in forestry governance. The gender box framework introduces three scales, called the 3Ms – 'micro, meso and macro'- covering 11 issues affecting women's participation and decision-making in forestry management (Colfer 2013) (Figure 1).

The 'micro scale' focuses on the household level, considering domestic roles and intra-household power dynamics. This scale is the most powerful in highlighting what actually happens and identifying domestic gender roles (Colfer 2013; Evans et al. 2017) and reflects the traditional use and management of forest resources. Colfer (2013) pointed out that the 'micro level' considers behavior at the household to village level, allowing examination of the impact of decline in forest resources on the well-being of forest-dependent communities. The 'meso scale' is the most geographically diverse, ranging from administrative units (the

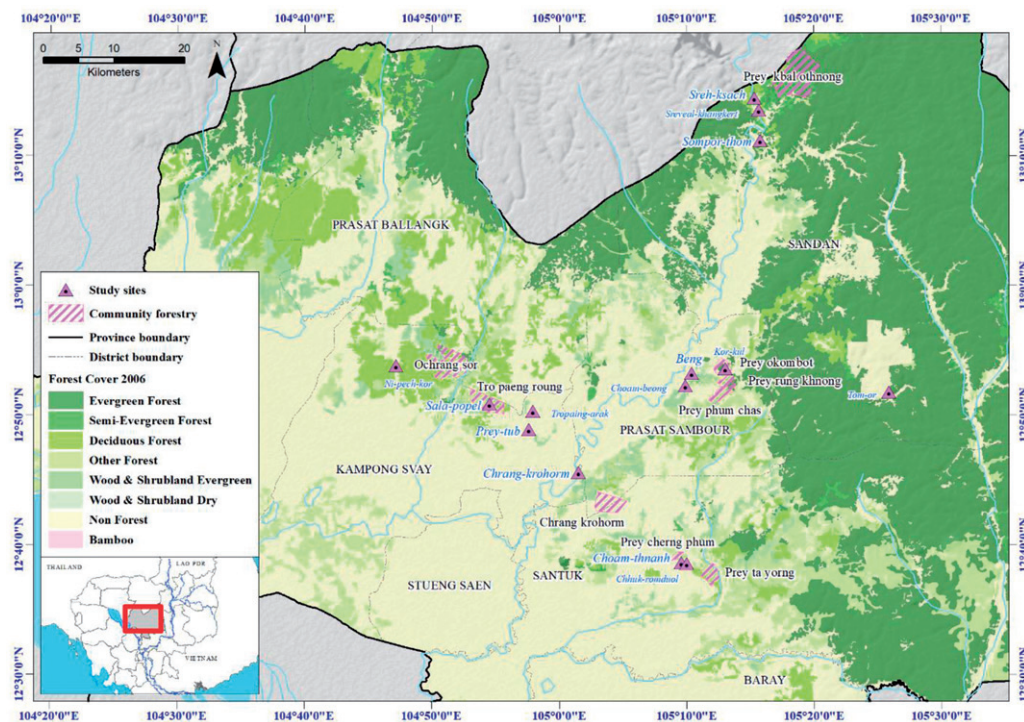


Figure 2. Location of the study sites in Kampong Thom province, Cambodia.

state and below) to the supra-community area of an ethnic, caste/class or religious group (Colfer & Minarchek 2012). It emphasizes gender access to resources and norms or behaviors affecting interaction with trees and forests. The ‘meso scale’ refers to national to village level interactions and changes that influence forestry, such as gender-differentiated aspects of forest tenure, land tenure, customary rights and cash economies (Colfer 2013).

The last is the ‘macro scale’, emphasizing international laws and policies about women’s participation in sustainable forestry (Colfer & Minarchek 2013). This included the principles for the connection of people and environmental issues, including climate change, the international legal framework and agreements to ensure gender equity and equality, and safeguards for the rights of women in decision-making (Colfer 2013). There have been international efforts to promote and safeguard the rights of women in social, economic and environmental spheres (Agarwal 2010; UN 2015c; Elias et al. 2017). There was significant global progress on Millennium Development Goal 3 ‘Promote Gender Equality and Empower Women’ (UN 2015b, p.52) but the indicators were only for gender in education (ADB 2015; UN 2015b; UN 2015c). The UN recognized that women are still disadvantaged in the labor market and that fundamental causes of inequality between women and men must still be addressed (Colfer 2013; UN 2015). The result of ‘MDG 7: Ensure environmental sustainability’ indicates that at least 1.6 billion people still depend on forests for their livelihoods and those forests are under threat around the world (UN 2015b; UN 2015a). The UN set environmental sustainability as a pillar of the post-2015 development agenda, thus women’s participation in forestry

should receive high attention (UN 2015b; UN 2015c; Doss et al. 2018).

## Material and methods

### Study area

The study site was in rural Kampong Thom province, approximately 128 km from Phnom Penh, the capital of Cambodia (Figure 2). Fourteen villages were selected, adjacent to the 11 Community Forestry (CF) sites in the province. Kampong Thom is one of the five provinces bordering the Tonle Sap Lake (Navy et al. 2006; Diepart 2010). This lake is the largest fresh water basin and wetland ecosystem in South East Asia (Arias et al. 2012), with flooded forest, dry forest, grassland, fisheries and shrub (Diepart 2010). Kampong Thom is home to 13,044 of the 48,945 Kuoy indigenous people in the country, (Nhem et al. 2018b). Kampong Thom has one of the highest provincial poverty rates in Cambodia (ADB 2014; Ehara et al. 2016). The study of Nhem et al. (2018a), on forest income and inequality in this province, reported that the annual average indigenous household income from forest resource extraction was \$404.68 in 2015.

Local people rely on forest resource extraction (Pouliot et al. 2017), with 70% of rural households engaged in collection of agricultural or non-timber forest products in 2004 (Ehara et al. 2016). The deforestation rate in Kampong Thom province has been high since 2000 (Ehara et al. 2016), reducing by at least 0.4% from 2002–2006 alone (Sasaki et al. 2016). This province’s land use/cover in 2016 was 1,244,763ha (MoE 2018). Pouliot et al. (2017) identified that land use change and granting of economic land concessions

(ELC) in this province was problematic. The educational attainment of the rural population in this province is also poor, with Nhem et al. (2018a) finding that only one man had received a bachelor degree, among 277 local respondents, and 99 women had no formal education achievement at all.

### Sample villages and sample size

The unit of analysis (Neuman 2007, p. 231; Pouliot et al. 2017) in this study was rural households in 14 villages. We employed 'purposive sampling', a non-probability sampling technique (Walliman 2006; Neuman 2007; Kalof et al. 2008; Merriam & Tisdell 2016; Leavy 2017), to select the villages and respondents. We sampled villages based on the CF book of the Forestry Administration (FA 2015), Cambodia's National Forest Program (MAFF 2010) and recently published articles about Kampong Thom province (Diepart 2010; ADB 2014; Ehara et al. 2016; Sasaki et al. 2016; Pouliot et al. 2017). In addition, our first author visited a local NGO, Action for Development (AFD), who suggested those villages.

'Purposive sampling' is popularly used to identify all possible respondents that fit identified criteria. Following Singh (2007, p.108), we required diversity in age, ethnicity and religion (Neuman 2014). We also used 'snowball sampling' and 'expert sampling' (Singh 2007, p.103) to target respondents. Snowball sampling uses referrals from one or a few cases and onward referrals from those (Singh 2007, p.103; Tracy 2013). After completing interviews, we requested respondents to refer us to local focal points or other suitable interviewees. For experts, we selected a sample of respondents with strong expertise in forestry and agro-forestry, i.e. heads of villages, and heads and members of community forestry. The sample size was 318 respondents, using Taro Yamane's Equation to ensure an appropriate representation of households in villages (Faronbi et al. 2017; Onah & Horton 2018):

$$n = \frac{N}{1 + N(e)^2} \quad (1)$$

where 'n' refers to the sample size of the study, 'N' refers to the population size and 'e' refers to the level of precision or sampling error at 5% (Faronbi et al. 2017) and 95% confidence interval (Onah & Horton 2018). The respondents included 126 men and 192 women.

### Household questionnaires

We designed survey questionnaires based on the studies of UN (1992); UNCED (1992); Tinker (1994); Arnold (2001); Agarwal (2010); RGC (2011); Colfer (2013); Colfer & Minarchek (2013); RECOFTC (2013); ADB (2015); UN (2015b); UN (2015a); UN (2015d) and UN (2015c). We tested the interview and questionnaires with the focal points of AFD, who suggested minor changes to make the questions clearer. The questionnaires were written in Khmer. The focal points

of AFD also helped us to inform the Heads of each village and community forestry site about the interview schedules. We recruited the enumerators from the staff of AFD, travelled to each village to interview the households.

The fieldwork was conducted between June and August 2016. The questionnaire sought the assessment of respondents about; 1) the knowledge of rural women related to sustainable forestry; 2) the major barriers preventing women participating effectively in sustainable forestry; and 3) actions required to engage women better in sustainable forestry. We asked the respondents (judges) to rank the objects or 'variables' using a 3 level Likert scale (1 = Disagree/Low, 2 = Agree/Moderate and 3 = Strongly Agree/High) (Bernard 2006; Fischer et al. 2016) for Kendall's Coefficient of Concordance (W). We also collected socio-economic data from respondents about their income, including from forest resource extraction.

### Kendall's W

The survey results were analyzed using Kendall's Coefficient of Concordance (W), a nonparametric, statistical method of measuring the relationship between rankings of objects to assess agreement (Siegel 1956; Teles 2012; Kraska-Miller 2013; Nhem et al. 2018c). Behavioral science research frequently uses Kendall's W for measurement of the agreement among respondents (Siegel 1956). For example, Nguyen et al. (2018) used Kendall's W to study local communities' adaptation to climate change along heavily damaged coasts in Vietnam. Kimaro et al. (2017) employed Kendall's W to study vector-borne cattle diseases and climate change. Plesch et al. (2010) also employed Kendall's W in their review of testing the behavior for on-farm welfare assessment in dairy cows in Austria and Germany while Bunting (2010) used W to assess sustainable aquaculture development in the UK. The 318 respondents were asked to rate five objects to rate for each of three questions. The equation for Kendall's W can be written in accordance with Siegel (1956); Howell (2010); Gearhart et al. (2013); Kraska-Miller (2013) and Nhem et al. (2018c):

$$W = \frac{S}{\frac{1}{12}k^2(N^3 - N)} \quad (2)$$

where:

W = Kendall's Coefficient of Concordance;

S = sum of squares of the observed deviations from the mean of  $R_j$ , that is,  $S = \sum (R_j - \frac{\sum R_j}{N})^2$ ;

K = number of judges (respondents);

N = objects (variables) to be ranked;  $\frac{1}{12}k^2(N^3 - N)$  = maximum possible sum of the squared deviations, i.e. the sum 'S' which would occur with perfect agreement among 'K' ranking (Siegel 1956; Kraska-Miller 2013; Nhem et al. 2018c). The closer to W is to '1', the stronger the agreement among judges; the closer Kendall's W is to '0', the weaker the agreement (Kraska-Miller 2013).

### Kernel density estimation

Kernel density estimation, a form of non-parametric density estimation (Silverman 1986), is used to estimate the probable distribution of data sets, giving a smoothed ‘curve’ from discrete data (Botev et al. 2010; Dai & Sperlich 2010; Zhou et al. 2018). We employed Kernel density estimation, using Stata 15, to present the annual rural income earned from forest resource extraction, combined with logarithmic transformation to improve the fit for the income density of men and women respondents in the 14 villages (Kohler & Kreuter 2012, p.194).

### Quantitative content analysis

Neuman (2007, p.227) defined content analysis as a ‘technique for gathering and analyzing the content of text’. This author described ‘content’ as ideas, themes, symbols, pictures, meanings, words or messages, which can be communicated. He referred to ‘text’, as ‘anything, i.e. written, spoken, visual and heard’, through communication media including artwork, articles, photographs, speeches, advertisements, magazines, newspapers, books, video, music, films and voice recordings. Other researchers have described the content analysis method as a technique to make replicable and valid inferences from texts to their contexts (Sadath & Rahman 2016; Nhem et al. 2017). Walliman (2006, p.124) specified that ‘content analysis’ was invented in the 1900s while Prof. Klaus Krippendorff, author of the book entitled, *Content Analysis: An Introduction to Its Methodology*, asserted that the content analysis method was introduced in 1980 (Krippendorff 2004; Ekayani et al. 2016).

Researchers have used content analysis to study a range of fields, including sustainable forestry, economic, energy and health care (Neuman 2007; Kalof et al. 2008, p.105; Nhem et al. 2017; Sutterlüty et al. 2018). More specific, empirical and forestry-related study using content analysis method includes studies of forest policy (Sadath & Krott 2012; Sadath & Rahman 2016), media discourse on forest fire (Ekayani et al. 2016), global warming and climate change (Liu et al. 2008; Schmidt et al. 2013) and ecosystem services (Paudyal et al. 2017; Yang et al. 2018).

Content analysis has also been used in the study of media analysis concerning REDD+ context and forest management (Mbatu 2016; Fischer et al. 2016; Nhem et al. 2017; Riedl et al. 2018; Sutterlüty et al. 2018) and the assessment of women and gender in forestry (Mai et al. 2011; Tyagi & Das 2017; Asher & Varley 2018). In addition, the content analysis method has also been used in energy study discourses (D’Agostino et al. 2011); health care (Harris et al. 2016; Farchi & Salge 2017; Webb et al. 2017) and public economics (Larcinese et al. 2011). In this study, we employed ‘quantitative content analysis’, to systematically collect scientific papers, using ‘Web of Science’ (see: Zou et al. 2018) and analyze titles and abstracts using

“VOSviewer Software” (see: van Eck & Waltman 2018). We followed the steps described below:

#### Step 1: Formulation of the research question

Neuman (2007) claimed that the design of the research questions is very important for administering content analysis. A clear example is set out in the study of media attention for climate change in 27 countries by Schmidt et al. (2013). Similarly, Sutterlüty et al. (2018) designed the research questions to guide their study on ‘influence of geographical scope on the research foci of sustainable forest management’. We used ‘content analysis’ to examine the interest, efforts and limitations of scientific research focused on women and gender concerning sustainable forest management, community forestry management and REDD+ activity. We designed three research questions (Sutterlüty et al. 2018) to guide our study:

RQ 1	How many scientific papers were published on women and gender in forestry, from 1992 to 2018?
RQ 2	In how many countries did scientific research focus on women and gender in forestry, from 1992 to 2018?
RQ 3	What is the change, between 1992 and 2018, in the scientific research attention to the study of women and gender in sustainable forestry at the global level?

#### Step 2: Units of analysis

The unit of analysis is the part of text that is assigned to be coded (Neuman 2007, p.231). This study considered the title and abstract of scientific papers published in peer reviewed journals as the unit of analysis, consistent with Paudyal et al. (2017) and Sutterlüty et al. (2018). We selected these because the title is systematically written to attract the interest of readers and address the issue of challenge and the abstract concisely summarizes study the content (Hartley 2014, p.23). This empirical analysis gave accurate data about research concerning the participation and challenges facing women in sustainable forestry (Sutterlüty et al. 2018).

#### Step 3: Sampling and data collection for quantitative content analysis

We have already described the sampling techniques used for the survey. In this section, we explain the sampling and data collection techniques used in the quantitative content analysis. Leavy (2017, p.75–76) discussed ‘sampling’, noting that it commonly describes ‘who is in the study?’ and refers to respondents, participants, subjects or judges. However, for the use of nonliving data, e.g. content analysis of text, images or music, researchers must ask, ‘What is in the study?’, where ‘What?’ refers to ‘nonliving data, objects or animals. Walliman (2006, p.75–76) specified there are two methods of sampling, (a) probability sampling (random selection) and (b) non-probability sampling (non-random selection).

**Table 1.** Database query on Web of Science.

Description	Specification
<ul style="list-style-type: none"> <li>• Searching scientific papers published in peer reviewed journals</li> <li>• Keywords (query text typed in Web of Science)</li> </ul>	<ul style="list-style-type: none"> <li>• 1 September 2018 to 22 September 2018</li> <li>• 1<sup>st</sup>: Forest and women* OR gender</li> <li>• 2<sup>nd</sup>: Community-based forestry and women* OR gender</li> <li>• 3<sup>rd</sup>: REDD + and women* OR gender</li> <li>• 1992–2018 (Sept 22, 2018)</li> <li>• Title and abstract</li> <li>• Total scientific papers = 2,063</li> <li>• Journals = 171</li> <li>• Country = 83</li> <li>• Sampled articles for all three categories of key words = 537</li> <li>• Forest = 482 articles (166 Journals, 80 Countries)</li> <li>• REDD+ = 34 articles (25 Journals, 16 Countries)</li> <li>• Community-based forestry = 20 articles (16 Journals, 9 Countries)</li> </ul>
<ul style="list-style-type: none"> <li>• Timespan</li> </ul>	
<ul style="list-style-type: none"> <li>• Units of analysis</li> <li>• Result of search</li> </ul>	

Researchers are much concerned about sampling and minimum sample size (Neuman 2007), they concerned about statistical significance, time constraints and cost (Walliman 2006). Some researchers have claimed that probability sampling is most commonly used (Neuman 2007); however, Kalof et al. (2008, p.44) argued against this, saying, 'it is not always feasible or necessary to use a random sample'. This author gave the study 'media portrayals of gender roles in the 1950s' as an example where non-probability sampling was the best method. Walliman (2006, p.79) described "Purposive sampling" as researchers' selection of what they think is a typical sample, based on specialist knowledge or selection criteria. Neuman (2007) explained that, using Purposive sampling, researchers can get all possible cases or data from nonliving materials (e.g. books, media) that fit particular criteria, using various methods (Leavy 2017; Ekayani et al. 2016).

We collected scientific articles by Purposive sampling, adapting and modifying from Paudyal et al. (2017) and Sutterlüty et al. (2018) to find papers published in peer-reviewed journals (Kalof et al. 2008; Merriam & Tisdell 2016; Walliman 2006, p.79). We excluded book chapters and grey literature (i.e. case reports, conference abstracts and project reports). We purposively chose 'Web of Science' for the collection of scientific articles, as this platform gives researchers access to an unrivalled breadth of world-class research literature linked to a rigorously selected core of journals and, uniquely, provides information through meticulously captured metadata and citation connections, totaling over 33,000 journals globally. Our data collection was widely discussed with professionals and pre-tested by typing different keywords into the 'Web of Science' portal.

#### Step 4: Coding and analysis

We assigned specific keywords to find and code the papers on women and gender in sustainable forestry, noting which countries they considered and change in publications over the period. We first searched for papers published between 1992 and 2018 (22 September 2018) with title and abstract containing the words: 1) 'forest' and 'women\* OR gender'; 2)

'community-based forestry' and 'women\* OR gender' and 3) 'REDD+' and 'women\* OR gender' (Table 1). There were 2,063 papers published in peer-reviewed journals but we excluded those, which did not match our study objective. We selected a final sample of 537 scientific papers.

We analyzed those papers to identify their geographical scope and the change, between 1992 and 2018, in the research attention to the study of women and gender in sustainable forestry at the global level. We used 'VOSviewer Software' which, according to, van Eck & Waltman (2018) and Zou et al. (2018), "allows literature knowledge unit visualization, computing the contents of the text based on visualization of similarities and map of the knowledge domain", i.e. keywords co-occurrence analysis from the title and abstract. It is used to analyze the large-scale data set and build a complex network concerning the issue of the study (Leydesdorff & Rafols 2012; Mbatu 2016; Zou et al. 2018).

## Results and discussion

### Profile and socio-economics of study participants

The respondents' educational attainment was low: 114 women (59% of female respondents) and 43 men (34%) had no formal education and 54 women (28%) and 45 men (36%) had only completed primary school. Only 18 women (9%) had finished secondary school compared with 28 men (22%). Just 6 women (3%) and 9 men (9%) had completed high school and only 1 man (1%) had achieved a bachelor degree. The majority of respondents were farmers ( $n=280$ , 88%), 8 respondents were employed workers, 11 were Village Head (2 women), 3 were school teachers (1 woman) and 7 were Heads of Community Forestry (no women). In 124 of the 318 households, a household member had migrated abroad, to Phnom Penh or a provincial town for job opportunities. All 318 respondents were members of their Community Forestry.

The female education findings were in line with RGC (2011) who recognized gaps in education. RGC (2014) affirmed that girls' completion rate of lower secondary education was 20.1% lower than boys' (51.7% completed) in 2015 and only 28.4% women and 33.1% men completed upper secondary education.



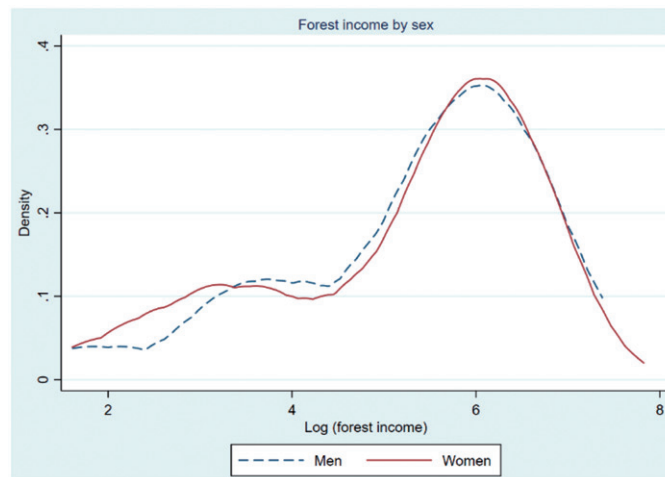


Figure 3. Overlaying density curves comparing distributions of forest income (2016).

The finding of no women Heads of the decision making bodies for Community Forestry in the study sites is strongly consistent with Bradley et al. (2013) who assessed that women have less influence than men in local decision-making concerning sustainable forestry. This grey literature recommended that the Cambodian government should set a quotas of between 20% and 50% of women in recruitment to the civil service and perhaps in local forestry management. It also added that women still had lower membership on elected committees for the local community forestry management, where 80% of seats are held by men.

The grey study on getting REDD+ right for women, by Gurung et al. (2011, p.13), recommended higher levels of women's membership of governing bodies for community forestry and local and national development or administration, including those that make decisions related to the design of REDD+ projects. Some studies reported that women constituting at least 30% of a governing body ensures effective and sustained participation (Gurung et al. 2011; Coleman & Mwangi 2013). Coleman & Mwangi (2013) found that women's participation in, and leadership of, forest councils or management committees is highly correlated with less disruptive conflict.

The findings from Kernel density estimation and logarithmic income density of the income from forest resource extraction in the 14 villages show that men earned \$307.5 (Std. Dev. = \$352.64), more than women \$295.5 (Std. Dev. = 343.57\$) in 2015 (Figure 3). The density curve for men is steeper and higher than for women and the highest density of log income is farther to the right for men than for women. This means that the incomes of women are more uniformly distributed at the lower end of the income scale, whereas the incomes of men are more concentrated around the average (Kohler & Kreuter 2012). At the high end, income was \$1300 at the 75<sup>th</sup> percentile, \$1500 at the 90<sup>th</sup> percentile, \$1600 at the 95<sup>th</sup> percentile and \$2500 at the 99<sup>th</sup> percentile. These results are in line with Diepart (2010), indicating that forest resources generated significant income for rural households. Similarly, Nhem et al. (2018a) found that forest income provided 35% of total rural household income

in Kampong Thom province. This evidence leads us to agree with Diepart (2010) who suggested that agro-forestry programs and sustainable forest management will generate significant value for the livelihoods of rural communities.

#### **Knowledge of rural women related to forestry**

We based our interpretation of Kendall's W on Schmidt (1997); Kraska-Miller (2013) and Nguyen et al. (2018), who explained that if the value of Kendall's  $W = 0.0$  to  $0.1$ , the result is 'very weak',  $0.1$  to  $0.3$  indicates 'weak',  $0.3$  to  $0.5$  indicates 'average',  $0.5$  to  $0.7$  indicates 'strong', and  $0.7$  to  $1.0$  indicate 'very strong'. A small value of Mean Rank of Kendall's W indicates strong agreement, a larger Mean Rank indicates lower agreement among the respondents concerning the variables.

Table 2 presents the Kendall's W mean ranking regarding knowledge of rural women related to sustainable forest management. Respondents' ranking of the five objects gave a Kendall's Coefficient of Concordance of .047, Chi-square = 59,458,  $df = 4$ , showing the result is statistically significant at  $p < .000$ . Local people assessed women as knowing most about 'sustainable management and use of forest for various purposes' (mean rank = 2.81) and 'biological diversity' (mean rank = 2.86). They gave two objects, 'women aware of good and medicinal value of forest products' (mean rank = 2.95) and 'they have lower forest conservation practice' (mean rank = 3.17), lower rankings. They gave their lowest ranking to women 'have knowledge about trees and forests' (mean rank = 3.21). The finding revealed that respondents were in only very weak concordance concerning knowledge of rural women relating to sustainable forest management. Respondents indicated their strongest agreement that women are active in sustainable forestry management and use forest resources for various purposes.

This supports the study of Sunderland et al. (2014) with regard to the difference in perceptions between men and women towards forest product use. These authors found there are distinct gender roles associated

**Table 2.** Perceptions about the knowledge of rural women related to sustainable forest management.

Object/variable	Kendall's <i>W</i> (Mean rank)
Sustainability management and use of forest for various purposes	2.81
Biological diversity	2.86
Aware of food and medicinal value of forest products	2.95
Forest conservation practices	3.17
Have knowledge of trees and forests	3.21

$W = .047$ , Chi-square = 59.458,  $df = 4$ ,  $p < .000$

with the collection of forest products. A contributing factor may be that, as Agarwal (2009) asserted women have more opportunity to use their knowledge of forest products and there is greater cooperation among women. Molnar (1991) described women as key actors in the forestry sectors by saying that they are repositories of knowledge regarding forest product use and growing patterns. This author also added that women often have a better knowledge base than men in the same locality about the qualities, growing patterns, and potential uses of forest species and grasses. However, Asher & Varley (2018) argued that women are more likely to express a lower level of understanding of the forest condition than men. It can be said that respondents viewed women as always active and perhaps more concerned about deforestation and its environmental impact than men. This is similar to (Xiao and Hong 2010), who found that women in China are now as concerned as men about the environment.

### **Barriers preventing women from participating effectively in sustainable forestry**

Table 3 shows the ranks assigned by respondents to five barriers preventing women from effective participation in forestry governance. The finding with regard to the major barriers to preventing women participating effectively in sustainable forestry was  $W = .118$ , Chi-square = 150.370,  $df = 4$ , with the result statistically significant at  $p < .000$ . i.e., respondents agreed about the barriers to women's effective exercise of their communal rights in sustainable forestry management. Respondents strongly agreed that 'low female participation in decision making bodies, committee and councils of any community forestry institutions or forums' was the most significant barrier (mean rank = 2.48). This is consistent with Arora-Jonsson (2011) who claimed that, in developing countries, women's needs are often not taken into consideration, and their participation in the climate change processes and debate is not sufficient at national level. Merchant (1981) revealed that participation of women in programs illustrates their concern and the power of their activism and should influence policy makers more strongly.

In addition, respondents considered 'women continue to be disadvantaged by insecure access to forest resources' as a significant barrier (mean rank of Kendall's  $W$  at 2.78). The study on Nepali women using community forestry as a platform for social change by Giri & Darnhofer (2010), revealed that understanding the process of change is crucial to identifying approaches that could lead to equity in decision

making and transformative participation by women and other disadvantaged group.

Gautier & Van Santen (2014) found that women have very few rights to trees in Cameroon although they are key users of forest products. Respondents in this study ranked lower the barriers of 'women lack formal education and skills and personal networks' (mean rank = 3.19) and 'culture and long distance' (mean rank = 3.25). Responding to this, Kabeer (2005) suggested that education is critical as it can bring about the changes in cognitive ability, which is essential to women's capacity to question, to reflect on, and to act on the condition of their lives and to gain access to knowledge, information, and new ideas that will help them to do so. The lowest ranked barrier was 'women take care of children, prepare meals for family' (mean rank = 3.31).

This study highlights that women feel they have an important understanding of sustainable forest management and potential uses of forest products, perhaps better than men's, but feel a lack of opportunity to attend high level discussions or technical works about forestry. There is little published on how far policy promotes women's participation in sustainable forestry in Cambodia but a recent study indicated that policy-makers either lack the knowledge or attention to create opportunities for women (Allendorf & Allendorf 2013). Evans et al. (2017) and Tadesse et al. (2017) concluded that women face significant obstacles to effective participation in forest decision-making at the community level. Following these, they felt that addressing rights, allocating authority and setting an employment quota for women in the forest sector, would enhance their participation.

### **Actions required engaging women more in forestry**

The Kendall's  $W$  regarding the processes for better engagement of women in sustainable forestry management shows very weak agreement among respondents, indicated by  $W = .035$ , Chi-square = 43.915,  $df = 4$ , statistically significant at  $p < .000$  (Table 4). Respondents felt that 'encourage women to participate in workshop or meetings' (mean rank = 2.83) was the most necessary of the tasks given. This is consistent with Evans et al. (2017), who indicated that supporting change of thoughts or existing forms will require profound cultural sensitivity, long term engagement and greater awareness of gender relation on the part of all actors engaging in community. Respondents also agreed that 'building capacity for women' and 'address

**Table 3.** Barriers preventing women participating effectively in forest management.

Object/variables that are ranked by respondents/judges	Kendall's <i>W</i> (Mean rank)
Low female participation on decision making bodies, committee, councils	2.48
Women continue to be disadvantaged by insecure access to forest resources	2.78
Women lack formal education and skills, and personal networks	3.19
Culture, long distance	3.25
Taking care of children, preparing meal for family	3.31

$W = .118$ , Chi-square = 150.370,  $df = 4$ ,  $p < .000$

**Table 4.** Tasks required engaging women better in sustainable forest management.

Object/variables that ranked by judges	Kendall's <i>W</i> (Mean rank)
Encourage women to participate in workshop and meetings	2.83
Build capacity for women	2.99
Address the rights and power of women in forest sector	2.99
Integrate women in the decision-making process	3.02
Educate women	3.18

$W = .035$ , Chi-square = 43.915,  $df = 4$ ,  $p < .000$

the rights and power of women in forest sector' (mean rank for both = 2.99).

These results are in line with Gurung et al. (2011) who asserted that policymakers should seek ways to increase women's engagement by, for instance, reducing their workload and biases against their participation, increasing their mobility, and instilling the skills and confidence needed for meaningful engagement. This is especially important at the local level, where women's lack of education and or household obligations can restrict effective engagement. Respondents ranked 'integrate women in the decision-making process' (mean rank = 3.02) and 'educate women' (mean rank = 3.18) lower. Tinker (1994) indicated training women is skilled needed for community participation. All of these are great opportunity for women's participation in sustainable forestry; however, Atmiş et al. (2007) noted that women are frequently excluded from decision-making. Agarwal (2010) similarly claimed that women's exclusion from decision-making was widespread, as were their complaints about firewood shortages. Our findings supported the effort of ADB (2015) with regard to specific gender targets in governance and public sector management. ADB earmarked investment to promote women's participation in planning and administration functions in district and municipal structures in order to integrate women's needs and priorities in the development of legislation, policies, and programs related to subnational democratic development.

### **Scientific papers covering women's participation and gender mainstreaming in forestry research**

We identified 2,063 peer reviewed, scientific papers published between 1992 and 2018, from the search of 'Web of Science', using the keyword groups: 1) 'forest' and 'women\* OR gender'; 2) 'community-based forestry' and 'women\* OR gender' and 3) 'REDD+' and 'women\* OR gender'. This is similar to the REDD+ study of Mbatu (2016), who dropped 32 articles from his analysis as they were unrelated to the topic. We found most papers for 1) 'forest and women\* OR gender' ( $n = 482$ ), followed by 2) 'REDD+ and women\* OR gender' ( $n = 34$ ) and 3)

'community-based forestry and women\* OR gender' ( $n = 20$ ). However, 1,526 scientific articles were excluded because these articles were unrelated to our study objectives. This left 537 papers for final analysis, published in 171 journals and covering study sites in 83 countries (Table 5).

The findings revealed that women's participation and gender perspectives in forestry, community-based forestry and REDD+, were most studied in Kenya, Tanzania, Cameroon, Congo, China, Ethiopia, Brazil, Mexico, Canada, Sweden, Indonesia, India, United States and Nepal. Searching on these keywords showed only six papers published with Cambodia study sites, by Shams & Ahmed (2000); Gray & Prum (2012); Boissière et al. (2013); Persson & Prowse (2017); Beauchamp et al. (2018) and Turreira-García et al. (2018). However, these did not refer specifically to women's participation or gender mainstreaming in forestry: they just indicated their female respondents in general (Table 5). Figure 4 shows that the publication rate increased dramatically from 2007. This is consistent with the findings of Asher & Varley (2018) who affirmed that scientific papers assessing women and gender in forestry were increasingly published between 2014 and 2016, with at least 104 articles in that period. We found 49 articles published in 2016, 82 in 2017 and 67 articles in the first 9 months of 2018.

We followed Zou et al. (2018), who explained that that keywords co-occurrence analysis is a common research method in 'Scienmetric'. It is used to analyze the strength of the links between keywords by studying their co-occurrence relationship in a large number of documents. It can be also indicated that the keyword co-occurrence analysis's purpose is to describe the internal composition relationship and structure in a certain academic domain as well as to reveal the research fronts of that disciplines. We used 'VOSviewer co-occurrence analysis' to generate the keywords co-occurrence network of the three keyword groups used in the search. Figure 5 shows the frontier topics form six clusters, and the keywords in each cluster show similarity in respect of the research topic. The analysis shows the greatest word occurrences by cluster: Cluster 1 is composed of 77 keywords, Cluster 2 ( $n = 58$ ), Cluster 3 ( $n = 53$ ), Cluster 4 ( $n = 40$ ),

Table 5. Peer-reviewed scientific papers published by country on the assessment of women's participation and gender perspective in forestry, community-based forestry and REDD+ (1992–2018).

	Austria	Bosnia	Czech	Denmark	Gambia	Guinea	Israel	Jordan	Mozambique	Niger	Poland	Serbia	Solomon Islands	Taiwan
1	Timor Leste	Transkei	Uruguay	Zimbabwe	Australia	Belgium	Bhutan	Colombia	Dominica	France	Gabon	Greece	Haiti	Italy
2	Japan	Malaysia	Myanmar	Namibia	Panama	Rwanda	Spain	Switzerland	UK	Belize	Benin	Bolivia	Costa Rica	Germany
3	Madagascar	Nicaragua	Papua New Guinea	Philippines	Sudan	Thailand	Zambia	Argentina	Chile	Mali	Norway	Senegal	Sri Lanka	South Korea
4	Vietnam	Cambodia	Ecuador	Peru	Turkey	Ghana	Global	Malawi	Uganda	Burkina Faso	Bangladesh	Nigeria	South Africa	Finland
5	Kenya	Tanzania	Cameroon	Congo	China	Ethiopia	Brazil	Mexico	Canada	Sweden	Indonesia	India	United States	Nepal
10		10	11	11	14	14	18	19	20	25	27	39	45	51

Note: 'Global' refers to papers on forestry research which do not specific one country as the site of study.

Cluster 5 ( $n=33$ ) and Cluster 6 ( $n=12$ ). We chose the 20 most frequently appearing words in each cluster (Table 6). This method is in line with Zou et al. (2018), who described the top 30 original keywords burst in 2000–2018. 'REDD+' occurred most frequently, 129 times, in Cluster 1. This finding is consistent with the study of Mbatu (2016), who affirmed a significant increase in REDD+ research since 2007. However, our study found that articles specifically on REDD+ concerning women and the gender perspective began in 2012. The most frequently appearing words in the other clusters were 'attitude' ( $n=108$ ) in Cluster 2, 'household' ( $n=235$ ) in Cluster 3, 'state' ( $n=60$ ) in Cluster 4, 'species' ( $n=165$ ) in Cluster 5 and 'community forest' ( $n=37$  in Cluster 6).

### Forest: Women and gender

There were 482 papers with the keywords 'forest and women\* OR gender' published between 1992 and 2018, in 166 journals and covering 80 countries. The analysis shows that the rate of publication increased significantly 14 years ago (from  $R^2 = 0.5131$  to  $0.7556$ ) (Figure 4). In the 13 years from 1992 to 2004, only 66 articles were published. In the subsequent 14 years, from 2005 to September 2018, 416 articles were published. The top 10 countries covered by the research were China ( $n=12$ ), Ethiopia ( $n=14$ ), Mexico ( $n=17$ ), Brazil ( $n=18$ ), Canada ( $n=19$ ), Indonesia ( $n=20$ ), Sweden ( $n=22$ ), India ( $n=34$ ), Nepal ( $n=37$ ) and United States ( $n=42$ ).

The 10 journals which published the most papers were: 1) International Forestry Review ( $n=31$ ), 2) Forest Policy and Economics ( $n=29$ ), 3) Scandinavian Journal of Forest Research ( $n=19$ ) and 4) Society & Natural Resources ( $n=16$ ), 5) Environmental Conservation ( $n=14$ ), 6) Small-Scale Forestry ( $n=12$ ), 7) Human Ecology ( $n=12$ ), 8) Ecology and Society ( $n=12$ ), 9) World Development ( $n=10$ ) and 10) Ecosystem Services ( $n=10$ ). This finding is consistent with Asher & Varley (2018) who found that International Forestry Review published the most papers focused on the critical assessment of women and gender in forestry research, followed by Journal of Forest Policy and Economics.

The network visualization, Figure 6, presents the keyword co-occurrence for 'forest and women OR gender', resulting five Clusters. Cluster 1 has 61 co-occurrence words, Cluster 2 ( $n=57$ ), Cluster 3 ( $n=52$ ), Cluster 4 ( $n=41$ ) and Cluster 5 ( $n=32$ ). Table 7 shows that the most frequently co-occurring keywords in Cluster 1 were 'Participation' (203), 'Project' (83) and 'Nepal' (75). This finding is in line with Tyagi & Das (2017) who indicated that a majority of the gender studies in forestry were located in Nepal. In Cluster 2, the most frequent co-occurrences were for 'perception' (159), 'attitude' (104) and 'forestry' (98). For Cluster 3, the highlights were 'household' (204), 'income' (135) and 'NTFP' (96). Cluster 4 co-occurred 'farmer', 48, 'type', 53 and 'state' co-occurred 58 while Cluster 5 highly co-occurred 'use', 236, 'knowledge', 183 and

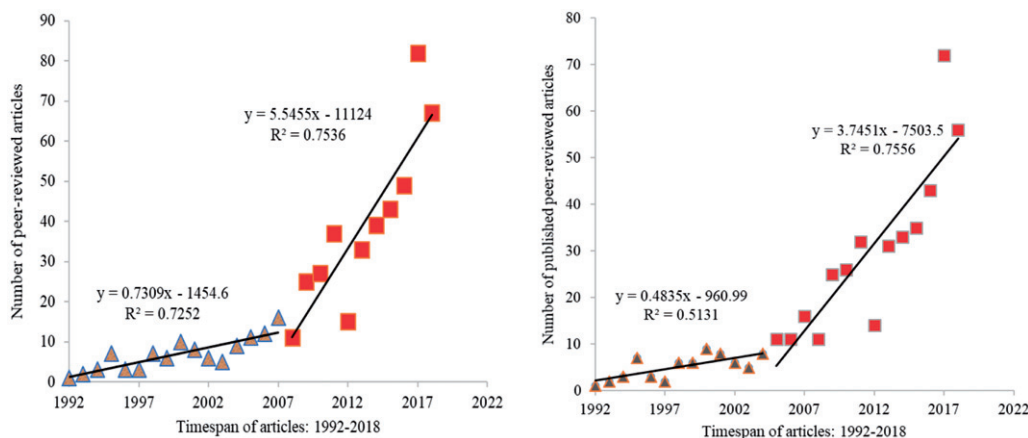


Figure 4. Number of published, peer-reviewed scientific papers on women’s participation and gender perspectives in sustainable forestry.

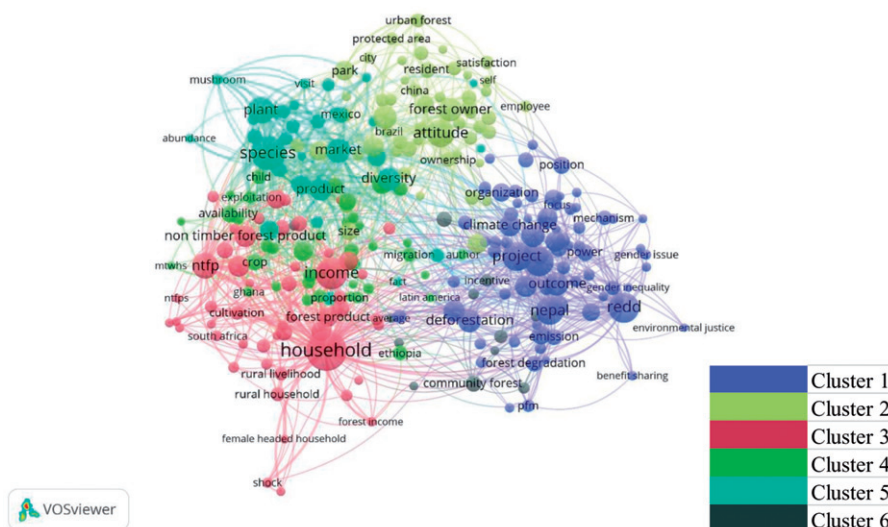
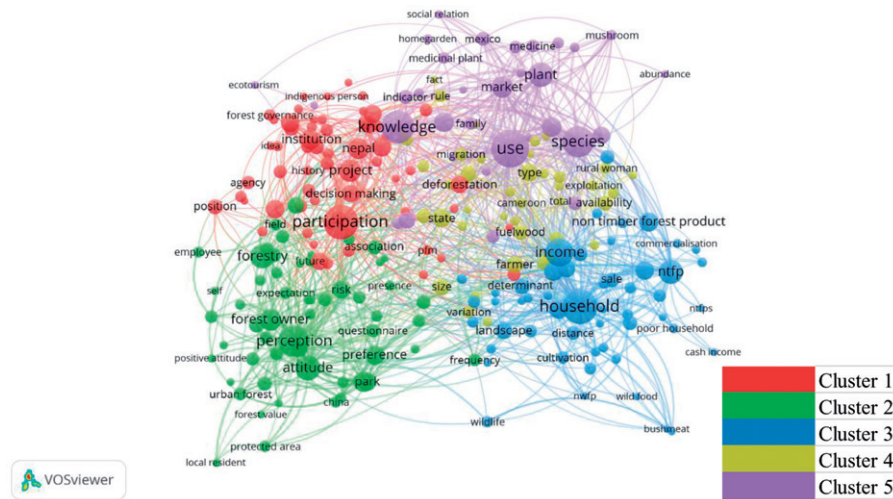


Figure 5. Network visualization showing keyword occurrences from the use of all keywords. Note: All keywords: 1) Forest and women\* OR gender, 2) community-based forestry, women\* OR gender, and 3) REDD+, women\* OR gender. In network visualization of the occurrence of high-frequency and related words, each node represents a word used in the title or abstract of paper found using the keywords indicated and the node size indicates the number of co-occurrences. The distance between nodes indicates the relatedness of the terms and the width of the link represents the strength of the relatedness.

Table 6. All keywords data: Occurrence of the 20 most frequently appearing words in each cluster.

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
39 Stakeholder	29 Belief	25 Rural livelihood	21 Water	18 Mushroom	12 Community forest user group
41 Initiative	29 Health	25 Wealth	22 Exploitation	22 Utilization	12 Key informant interview
42 Position	29 Improvement	28 Cultivation	22 Variety	23 Informant	13 Hectare
43 Attention	29 Willingness	29 Proportion	23 Fodder	23 Medicinal plant	14 Average
44 Implementation	30 View	29 Rural household	23 Rural woman	26 Firewood	15 Community forestry program
48 Organization	31 Ownership	34 Distance	24 Study area	27 Family	17 Amount
53 Community forestry	31 Questionnaire	34 Trade	25 Adoption	27 Medicine	18 Success
56 Equity	32 Space	35 Consumption	28 Network	27 Plant species	20 User group
58 Governance	36 Association	36 Density	29 Farm	27 Rule	21 Incentive
60 Conflict	37 Resident	38 Sale	29 Migration	31 Ecosystem	25 Payment
67 Climate change	37 Student	41 Determinant	30 Agriculture	33 Fruit	34 Indicator
67 Ecosystem service	42 Owner	51 Harvesting	30 Child	35 Mexico	37 Community forest
68 Right	45 Size	53 Landscape	30 Ethiopia	47 Category	
73 Deforestation	52 Reserve	54 Forest product	34 Fuelwood	52 Food	
78 Institution	56 Park	57 Contribution	35 Crop	54 Type	
80 Outcome	57 Programme	61 Collection	36 Increase	68 Product	
111 Nepal	63 Preference	65 Non timber forest product	40 Availability	73 Diversity	
121 Benefit	77 Forest owner	97 NTFP	44 Pressure	81 Market	
122 Project	77 Respondent	144 Income	53 Farmer	101 Plant	
129 REDD+	108 Attitude	235 Household	60 State	165 Species	

Note: Cluster is a focused set of highly associated co-occurrence items (or nodes). Items can only belong to one cluster.

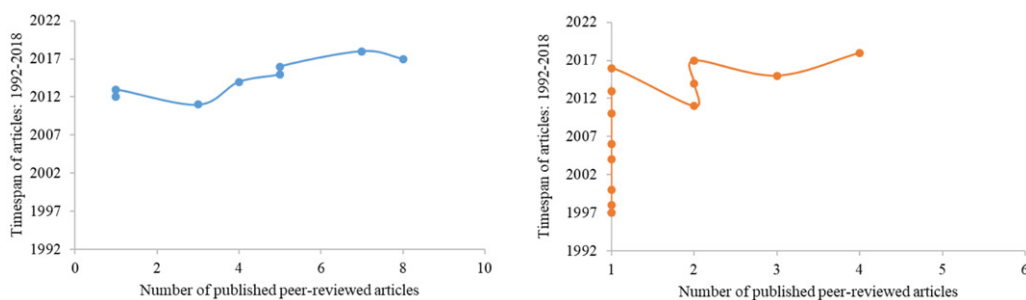


**Figure 6.** Network visualization showing keyword occurrences: Forest and women\* OR gender. Note: In network visualization of the occurrence of high-frequency and related words, each node represents a word used in the title or abstract of paper found using the keywords indicated and the node size indicates the number of co-occurrences. The distance between nodes indicates the relatedness of the terms and the width of the link represents the strength of the relatedness.

**Table 7.** Forest keyword: Occurrence of the 20 most frequently appearing words in each cluster.

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
30 Stakeholder	29 Ownership	24 Wealth	21 Fodder	18 Mushroom
31 Agency	29 Space	26 Rural household	22 Rural woman	22 Brazil
31 Power	29 Willingness	28 Child	23 Study area	23 Informant
33 Initiative	30 Belief	28 Cultivation	24 Land use	23 Medicinal plant
37 Attention	30 Questionnaire	28 Proportion	25 Adoption	27 Family
37 Position	33 Increase	33 Distance	25 Firewood	27 Medicine
38 Community forestry	34 Industry	33 Trade	26 Rule	27 Plant species
42 Equity	36 Association	34 Sale	26 Variation	30 Ecosystem
42 Organization	36 Resident	35 Consumption	28 Farm	32 Fruit
52 Climate change	37 Student	35 Density	28 Network	33 Indicator
52 Decision making	42 Owner	40 Determinant	29 Migration	33 Mexico
52 Deforestation	47 Relation	47 Landscape	32 Crop	47 Category
55 Right	50 Risk	50 Forest product	34 Fuelwood	51 Food
57 Conflict	55 Park	56 Contribution	35 Male	65 Product
59 REDD	62 Preference	59 Collection	38 Availability	67 Diversity
62 Outcome	70 Respondent	62 Non timber forest product	42 Pressure	74 Market
65 Institution	77 Forest owner	64 Source	44 Size	101 Plant
75 Nepal	98 Forestry	96 NTFP	48 Farmer	165 Species
83 Project	104 Attitude	135 Income	53 Type	183 Knowledge
203 Participation	159 Perception	204 Household	58 State	236 Use

Note: Cluster is a focused set of highly associated co-occurrence items (or nodes). Items can only belong to one cluster.



**Figure 7.** Change in number of scientific articles published in each period.

‘species’, was co-occurred, 165. Overall, the analysis indicates the strength of the links to the critical assessment of women’s participation and gender perspectives in forestry research by the co-occurrence relation in a large number of scientific papers.

**REDD+: women and gender**

The search using keywords ‘REDD+, women\* OR gender’ revealed 34 published papers covering 16 countries, in 25 journals between 2011 to 2018 (Figure 7). This later start date reflects that the first adoption

of REDD+ was in Indonesia in 2007 (Nhem et al. 2017). It was not until a few years later that the gender perspective in REDD+ research received attention. The latest empirical study, by Larson et al. (2018), claimed that there have not been many gender analyses of national and sub-national REDD+ readiness and activities to date. Ros-Tonen et al. (2018) noted that ‘attention to gender dynamics is a particular blind spot, poorly addressed in the papers of this special issues and the literature on landscape approaches in general’. This is changing, with international dialogue and resolutions, such as the Paris Agreement, or the 2030 Agenda for Sustainable Development, calling for attention to the inclusion of women in decision-making and the development agenda (UN 2015a; UN 2015c; UN 2015d; FAO 2018; Larson et al. 2018).

Shrestha & Shrestha (2017) asserted that ‘women often either do not participate in forest governance, especially in decision making and benefit-sharing, or their participation is negligible or disregarded despite the important of their contribution to the conservation and management of forest resources’. In Congo, Samndong & Kjosavik (2017) found that women have limited information about REDD+ compared with men. Thus, these authors suggested that REDD+ actors should attempt to bring institutional changes that transform gender relations and thereby increase women’s bargaining power. The 16 countries about which research was conducted were Australia ( $n=1$ ), India ( $n=1$ ), Kenya ( $n=1$ ), Papua New Guinea ( $n=1$ ), Philippines ( $n=1$ ), Senegal ( $n=1$ ), Sudan ( $n=1$ ), United States ( $n=1$ ), Vietnam ( $n=1$ ), Zambia ( $n=1$ ), Peru ( $n=2$ ), Tanzania ( $n=2$ ), Sweden ( $n=3$ ), Congo ( $n=4$ ), Indonesia ( $n=6$ ) and Nepal ( $n=7$ ). The finding of the most relevant research being about Nepal is not surprising as the community forestry program in Nepal is often cited as one of the most successful common pool resources management program in the world, according to Shrestha & Shrestha (2017).

### **Community-based forestry: women and gender**

The search using keywords ‘community-based forestry and women\* OR gender’ revealed 20 published papers with 9 countries as study sites, in 16 journals (Figure 7). Only one paper was published in 1997. However, from 1997 to 2011, there were eight papers, and from 2011 to 2018, this increased to 13 papers. The countries covered were 1) Canada (article =1), 2) Indonesia ( $n=1$ ), 3) Japan ( $n=1$ ), 4) Nicaragua ( $n=1$ ), 5) China ( $n=2$ ), 10) Mexico ( $n=2$ ), 11) United States ( $n=2$ ), 12) India ( $n=4$ ) and 13) Nepal ( $n=7$ ). Arnold (1991) indicated that critical events concerning the rise of community-based forestry started in mid-1970s, due to vast deforestation and degradation of tree cover. The transfer of rights to local people to manage and use the forest resource was believed to be a key foundation to protect the remaining forest coverage. This author claimed that ‘the focus on women has grown to include the analysis of gender as an

important variable in forestry activities’. The author continued that ‘this analysis looks at the different constraint and opportunities facing women and men, and examines the different labor and decision-making patterns of the two sex’. However, we found that scientific papers focused on women or gender in community-based forestry only started to be published in 1997.

The disaggregation of data by gender has become an important tool for involving local people in forestry projects, and in helping to ensure the sustainability of forestry activities beyond the life of any single project. The study of Rout (2017), on gendered participation in community forest governance in India, found that apparently successful participatory forestry programs may become ‘exclusionary’ due to an inadequate engagement of women. This author highlighted a case where women’s names were just included in the Executive Committee without their real participation. Similarly, Mukherjee et al. (2017) found evidence from joint forest management in India that men underestimated women’s considerable knowledge about the local commons and hence gave them less voice in community-based conservation. In contrast, a case study of community forestry and livelihood in Nepal, Dhruva Bijaya et al. (2016) found that women had increased their representative participation in the Executive Committee of Community Forestry meetings and hold positions as head, secretary, treasurer or members in the Executive Committee.

### **Conclusions**

We analyzed gendered, local perceptions of women’s participation, the challenges women face in participatory forestry management and the barriers to increasing women’s participation. To do this, we interviewed 318 local people in 14 villages to rank five objects (variables) for each of three questions concerning; 1) opinions about the knowledge of rural women related to sustainable forest management; 2) major barriers preventing women participating effectively in sustainable forestry; and 3) tasks required to engage women better in sustainable forest management. We set this in the context of an important study of the development of scientific research concerning women’s participation and gender perspective in participatory forestry management at the global level.

The analysis revealed very weak concordance of local perceptions regarding knowledge of rural women related to sustainable forestry, indicated by Kendall’s  $W = W = 0.47$ ,  $p < .000$ . Local people believed that women knew most about the sustainable management and use of forest for various purposes (ranked highest) and less about trees and forests (ranked lowest). Through the ranking, the study can conclude that women are active actors in forestry and environmental concerns. The findings illustrated that women have always been involved in sustainable forest management and are playing important roles in forest protection. We supported the findings of Sunderland et al. (2014), who indicated that women are actively involved in

watershed management and agroforestry, but their voices seem to be forgotten in decision making.

The study found moderate agreement, revealed by Kendall's  $W = .118$ ,  $p < .000$ , on the major barriers preventing women participating effectively in sustainable forestry. The most significant factor was low female participation in decision-making bodies, committees and councils of community forestry institutions or forums. The next most important factor was women's less secure access to forest resources. Acting on these will benefit both rural communities and national institutions by mobilizing the active participation of women in sustainable forest management. There was very weak agreement on the highest priority task required to engage women better in the forestry management indicating by Kendall's  $W = .035$ ,  $p < .000$  ( $W = 0.0$  to  $0.1$  indicates very weak concordance). The highest ranked task, of the five given, was to encourage women to participate in workshop and meetings, followed by capacity building for rural women and addressing the rights and power of women in the forestry sector. The lowest ranked was the need for education, even though there is a clearly lower educational achievement among rural women. We agreed with Ogra (2012), who claimed that gender mainstreaming, or the inclusion of women in forestry, is a robust approach to promote gender equity and the empowerment of women.

The study found that research into women's participation and gender perspectives in sustainable forestry began in 1992: since then, 537 articles have been published in 171 journals, with study sites in 83 countries. There was a significant increase in the number of papers published from 2007 onwards. Scientific papers on women's participation and gender perspective in REDD+ activities started to be published in 2011 and have covered only 16 countries so far, compared with 25 countries for 'forest' research. The study found only 20 papers on women's participation and gender in 1) community-based forestry management (in 16 journals and covering 9 countries), fewer than for 2) REDD+ and 3) forest research.

The top 10 countries covered by research on women's participation and gender in 1) forest, 2) REDD+ and 3) community-based forestry research were, from the least to the highest, China, Ethiopia, Brazil, Mexico, Canada, Sweden, Indonesia (27 articles), India (39 articles), United States (45 articles) and Nepal (51 articles). We suggest more research focusing on women's participation and gender perspective in sustainable forestry and environmental concerns should be conducted if the issues and actions proposed from this study are to be confirmed. If further studies also find weak concordance on the main issues then approaches may need to be changed. Further studies on gender and women's roles in sustainable forestry are important if the collective action needed for sustainable forest management is to be addressed effectively.

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## ORCID

Sareth Nhem  <http://orcid.org/0000-0003-2213-4846>  
Young Jin Lee  <http://orcid.org/0000-0002-9319-1533>

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