Gender roles and knowledge in plant species selection and domestication: a case study in South and Southeast Sulawesi

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SUMMARY

Women and men have different sets of knowledge, experiences, and strategies in addressing aspects of plant domestication such as plant propagation, management, utilisation and marketing. Identification of gender roles and knowledge related to tree domestication is important in planning for tree-based livelihood enhancement and sustainable environmental management, however, such identification has not yet been sufficiently researched to date. This study investigated gendered selection of economically priority species and their domestication in South and Southeast Sulawesi. From the focus group discussion, both men and women give priority to tree species with high economic value; the management of those species is a stronger priority for men but is also expressed by women. However, specifically for their livelihoods, women are keen to domesticate vegetables and other annual crops that contribute directly to household food security and nutrition.

Keywords: Tree domestication, women, household decision making, tree prioritization, gender role

Rôle des sexes dans la connaissance de la sélection et dans la domestication des espèces de plantes : une étude-cas dans le sud et le sud-est du Sulawesi

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Les hommes et les femmes possèdent des connaissances, des expériences et des stratégies différentes pour faire face aux aspects de la domestication des plantes, tels que leur propagation, leur gestion, leur utilisation et leur marketing. Une identification du rôle et des connaissances des sexes quant à la domestication des arbres est importante pour planifier une amélioration des revenus basés sur les arbres et une gestion environnementale durable. Cependant, une telle identification n'a été jusqu'à présent que l'objet que d'une recherche insuffisante. Cette étude a opéré une investigation dans la sélection sexuée des espèces à priorité économique et dans leur domestication dans le sud et le sud-est du Sulawesi. Dans les débats en groupes de focus, les hommes et les femmes révèlent leurs espèces d'arbres prioritaires par leur forte valeur économique. La gestion de ces espèces est une priorité plus grande chez les hommes, bien qu'elle soit également exprimée par les femmes. Toutefois, quand il s'agit de leurs moyens d'existence, les femmes ont à cœur de domestiquer légumes et autres récoltes annuelles qui contribuent directement à la sécurité nutritionnelle et alimentaire des foyers.

Los roles del género y del conocimiento en la selección y la domesticación de especies vegetales: estudio de caso en el sur y el sudeste de Célebes

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Las mujeres y los hombres poseen diferentes experiencias, conocimiento y estrategias para abordar los aspectos de la domesticación de especies vegetales como la propagación, gestión, utilización y comercialización de plantas. Aunque la identificación de los roles de género y el conocimiento relacionados con la domesticación de árboles es importante en la planificación de la mejora de los medios de vida basados en los árboles y la gestión sostenible del medio ambiente, tal identificación no se ha investigado lo suficiente hasta la fecha. Este estudio investigó la selección por cada género de especies con prioridad económica y su domesticación en el sur y el sudeste de la isla de Célebes en Indonesia. De la discusión de un grupo focal se desprende que tanto los hombres como las mujeres priorizan las especies de árboles con un alto valor económico, y que la gestión de dichas especies es una prioridad mayor para los hombres, pero también es mencionado por las mujeres. Sin embargo, y específicamente para sus medios de vida, las mujeres mostraron un vivo interés en domesticar hortalizas y otros cultivos anuales que contribuyen directamente a la seguridad alimentaria y la nutrición.

INTRODUCTION

Domestication is an effort to accelerate the evolution of certain species needed by farmers for subsistence to meet food security needs and in response to market opportunities. Domestication of plants includes a series of exploration activities and the collection of genetic natural populations or anthropogenic evaluation and selection of appropriate species and provenances, the development of management techniques, utilisation and (if for marketable goods) marketing of plants and the development and dissemination of technical information (Roshetko and Evans 1999, Roshetko *et al.* 2007, Simons and Leakey 2004). Tree domestication includes activities that bring trees into wider cultivation to provide food, building material, medicine, other tree products, or income from the sales of tree products (Roshetko *et al.* 2008a, Roshetko and Evans 1999, Roshetko and Verbist 2000, Simons and Leakey 2004, Leakey *et al.* 2012). Tree domestication may also positively influence the conservation of endangered species or the provision of environmental services (Leakey and Tchoundjeu 2001, Leakey and Simons 1997, Simons and Leakey 2004). Thus, domestication of trees in agroforestry is a crucial component for ensuring their continued importance in meeting food security needs (subsistence), protecting the environment and as a source of income for farmers. However, low availability of high quality planting material, lack of farmers' knowledge on selecting and producing good planting materials, as well as problems in the market are obstacles in the domestication of tree crops (Degrande *et al.* 2013, van Noordwijk *et al.* 2008).

Farmers as the main actors in the domestication process have unique knowledge to distinguish and select the tree species that best fit with their needs and that are appropriate for local environmental conditions (Leakey and Simons 1997). However, in most parts of the world, farmers' access to scientific information is limited. From this situation, participatory tree domestication with collaboration between researchers and farmers is a viable strategy to enhance livelihoods, address food security and promote sustainable environmental management (Akinnifesi *et al.* 2006, Leakey *et al.* 2012, Tchoundjeu *et al.* 2006).

A broad array of activities are presented as part of the domestication continuum (Gunasena and Roshetko 2000, Roshetko and Evans 1999), ranging from exploration and collection, species evaluation, tree breeding, propagation techniques, germplasm multiplication, germplasm distribution, silviculture techniques, utilization to marketing. This continuum shows the general progression from the wild to a genetically transformed state. However, some steps in the continuum may be by-passed or re-iterated during the process, depending on the stage of the domestication of the species or system.

In most cases, women and men have different sets of knowledge, experiences, and strategies in addressing tree propagation, management, utilization and marketing (Kiptot and Franzel 2012)—and these vary from place to place. The different sets of knowledge may lead to different practices that may lead in turn to different results in tree crop development. Mulyoutami *et al.* (2009) identified the importance of women's role in seed selection and propagation, crucial components (called *Simpukng,* in East Kalimantan) in local agroforestry practices in Borneo. The study of Rice *et al.* (1998) on seed selection of maize in Mexico shows that selection of superior plants in the field is typically men's responsibility, while women have more responsibility in selecting high quality maize for food preparation and marketing. Martini *et al.* (2012) found that for *Aren* (*Arenga pinnata*), men are more responsible for tree maintenance and harvesting, while women focus on post harvest processing, to produce high quality marketable products from this crop. Mulyoutami *et al.* (2009), Rice *et al.* (1998) and Martini *et al.* (2012) all found rather similar patterns in Southern Sulawesi: regarding how women and men contribute and collaborate in management of the agroforestry livelihood systems. Women have more responsibility for work near the house and producing products for sale, while men usually do the field production activity.

This paper examines how gender aspects such as roles, needs, access and control of natural resources affect the gendered tree domestication process. Analysis is intended to fill the gaps of understanding about the importance of gender issues in the domestication process. Focusing on the domestication of prioritised species in Sulawesi, we discuss how women prioritise some important species, are involved in all domestication processes of each priority species, and the advantages for women of such activities. The level of analysis is on the farm, household, and village levels, and see not only the work of women in the productive realm, but also in the domestic/house (Colfer *et al*. 2015a).

Sulawesi is important for the production of high value commodities such as cacao, coffee, and clove. The key producers of those products are smallholder farmers. Mulyoutami *et al.* (2012) have studied gender issues in agroforestry and agricultural development in Sulawesi, concluding that both men and women have specific contributions to the work domain, though sometimes women's contributions remain undervalued. Sulawesi may provide a good context to review gender roles in tree domestication, as the communities differ in levels of gender equity, but are all more egalitarian than most globally (Colfer *et al*. 2015a). Interaction between men and women at the household level is discussed to understand how much this near-equality in gender relations may affect the decision making process in domestication practices. Results from this study are expected to contribute to the global understanding of each gender's roles in tree domestication as well as relevant gendered factors in decision making processes at the household level. Such understanding, which differs from place to place, is important in the process of targeting participants in tree domestication improvement programmes.

MATERIALS AND METHODS

Study area

Research was conducted in South and Southeast Sulawesi, two provinces located on the island of Sulawesi (Figure 1). Sulawesi is situated in the central to eastern part of Indonesia,

FIGURE 1 *Study location in South and Southeast Sulawesi*

between Borneo and the Maluku islands and bordering with the Philippines. Sulawesi is mostly mountainous. Based on the Köppen climate zone system, this island falls in the tropical wet zone.

South Sulawesi consists of 20 districts and three municipalities with a total area of 45 764 km². This province has forest cover (including forestland and smallholder land) of 57%, wetland (swampy area) of 10%, wet paddy land of 9%, and other agriculture land of 10%. The province is famous as the largest producer of food crops including rice, maize, cassava, sweet potato and peanuts in eastern Indonesia. Maize and paddy are the main staple foods in South

Sulawesi. Smallholder tree crops common in South Sulawesi are clove (*Syzygium aromaticum*, syn. *Eugenia aromaticum*), coffee (*Coffea arabica* and *Coffea robusta*), cacao (*Theobroma cacao L.*), and coconut (*Cocos nucifera*). Khususiyah *et al.* (2012) define two main types of farming systems.The first is degraded land which has been cultivated with annual crops for many years. In the 1980s, upland paddy fields were being converted to hybrid maize, leading to the conversion of some forest land to agricultural production. The second type is agroforestry systems of coffee, cacao and cloves, which range from very simple (a few species) to more complex multi-species systems.

South Sulawesi is inhabited by five main ethnic groups: Bugis, Makassar, Toraja, Mandar and Duri. Bugis and Makassar are the largest ethnic communities in our study area. These two ethnic groups have similar cultures, labelled by Errington (1989) as hierarchical and mostly centre-oriented Indic in comparison with other communities in Indonesia. Bugis tend to have a spirit of competitiveness, aiming to achieve the highest status in the community, which strengthens their assertiveness as well as the fluid and equivocal social relations between them (Acciaioli 1998). Millar (1983) argue that Bugis society is hierarchical but it relates to social location as the main, and gender as the second layer.

Southeast Sulawesi is Sulawesi's eastern peninsula and includes a number of small islands such as Buton, Muna, Wowoni and Kabaena. The area of Southeast Sulawesi is 148 140 km^2, land area of 38 140 km^2 and sea area of 114 876 km^2. Our study focused on the Konawe and East Kolaka districts. The agriculture sector contributes 38% of the economy with cacao as the prime commodity, with production of 137 833 ton in 2010. The predominant land use in Southeast Sulawesi is cacao agroforest (Janudianto *et al.* 2012). Sago palm (*Metroxylon sagu*) is a traditionally important staple food cultivated intermittently in some wet areas, however its cultivation has not been identified as a principal land use.

Southeast Sulawesi is inhabited by five main ethnic groups: Tolaki, Buton, Muna, Moronene and Bugis. The Tolaki group is estimated at 16% of Southeast Sulawesi's population (including the sub-ethnic group Mekongga). The Tolaki group is one of the two indigenous groups living primarily on the mainland and the people are forest dependent (Tarimana 1989). Many migrants come from Java, Bali, and South Sulawesi. People from Java and Bali initially came as part of transmigration programmes, followed by spontaneous migration from South Sulawesi. These people came to gain land for cacao cultivation.

The Tolaki have a three tier social stratification: nobles, commoners, and bondsmen (Tarimana 1989:199) that are tightly linked in *Kalo sara*. *Kalo sara* regards the relationship in each strata, where the older (father, mother, and big brother/sister) should protect the young (son, daughter, youth, etc), and young should be respectful. This relationship is important to maintain tranquility within the community. In relation to gender, Salmiah (2008) and Laxmi (2010) discuss one of the Tolaki cultural values, *Tombalaki*. Basically, Salmiah (2008) argues that the concept of *Tombalaki* refers to 'saving or keeping' in the sense of maintaining community and household assets. However, in the context of the household, Laxmi (2010) describes how *tombalaki* is being used to refer to a man who overly interferes with women's responsibility of keeping household assets, and takes over women's right to keep and maintain them. While Salmiah (2008) argues that the Tombalaki reinforces women's role as only domestic, with men in the public sector, Laxmi (2010) contends that such behaviour from men leads to physical, economic, and psychological violence within the family. Though Laxmi (2010) and Salmiah (2008) have different points of view on what *Tombalaki* is, still both see negative influences in gender relations within Tolaki families.

Data collection

Our study was conducted in Bantaeng and Bulukumba districts in South Sulawesi and East Kolaka and Konawe districts in Southeast Sulawesi between early 2012 and 2013. A series of focus group discussions (FGD) were conducted to collect information on: 1) gender roles in species selection and domestication, 2) knowledge of men and women in tree domestication, gender relationships at household level in decision making process, and 3) the perception of each gender on the benefits and challenges they are facing in tree domestication process. In the course of the FGDs in South and Southeast Sulawesi, participants identified ten priority species.

FGDs consisting of 6–10 persons were conducted in four villages each in Bantaeng and Bulukumba districts; and nine villages in East Kolaka and Konawe. FGDs for women and men were conducted separately, using the same set of questions. Pebble methods for a gender equality measure (Mulyoutami *et al.* 2013) were implemented, following the guidelines developed for priority setting (Franzel *et al.* 1996). Franzel (1996) suggested steps in a priority species identification process, one that includes assessment of species used by farmers, which species are prioritised, their valuation and the ranks for each prioritised species. In depth interviews with individual farmers of different gender, 8 women and 8 men involved in nursery group development, were also conducted to document how men and women communicate within the farmer group and their family.

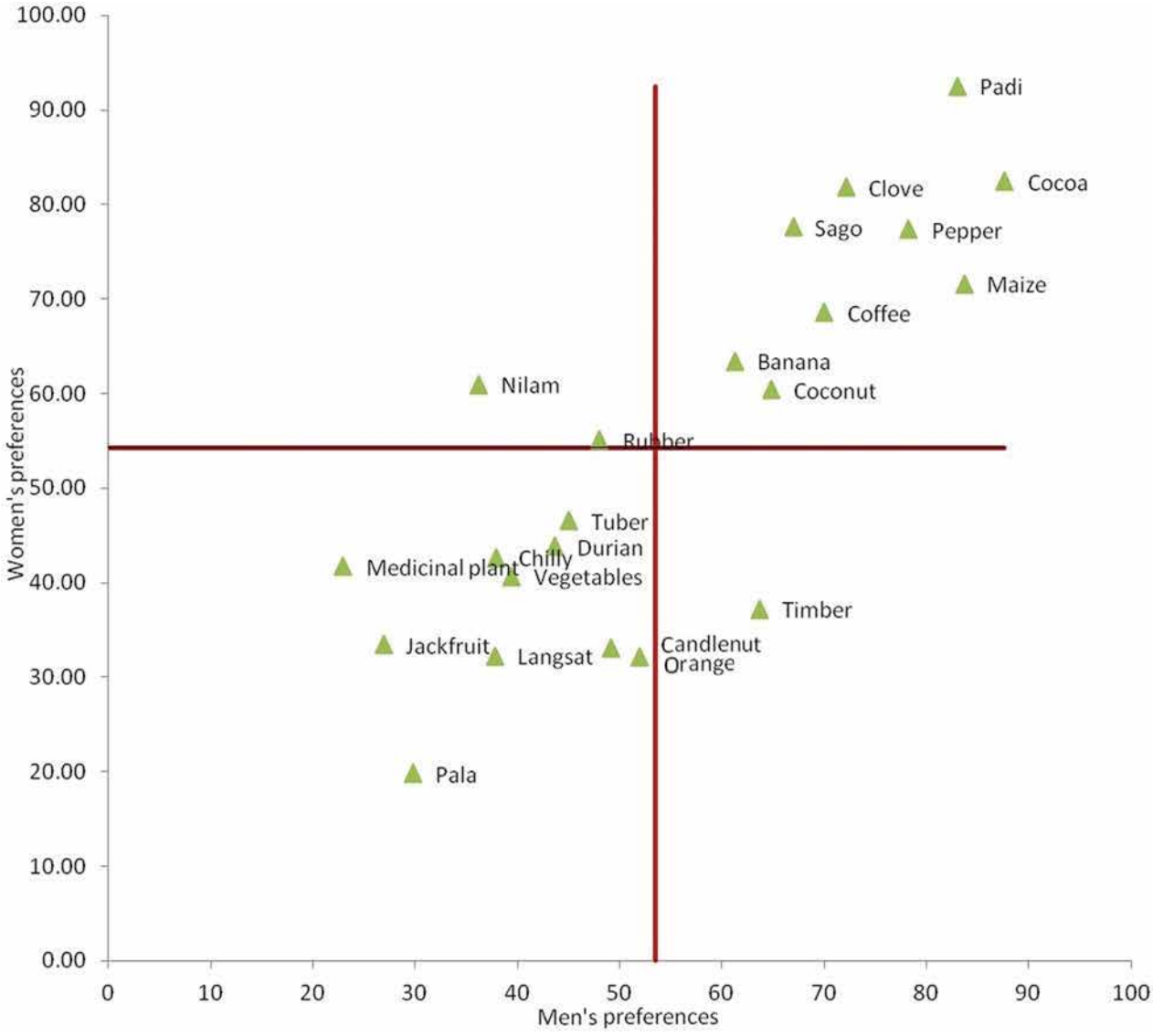
RESULTS AND DISCUSSIONS

Gender roles in species selection and domestication

Tree prioritisation using ranking analysis in the two provinces shows that cacao (*Theobroma cacao L.*), pepper (*Piper nigrum L),* clove (*Syzygium aromaticum*), sago (*Metroxylon sago*) and coffee (*Coffea arabica* and *Coffea robusta*), are the top five tree crops for domestication (Figure 2). Paddy and maize were prioritised by farmers in both provinces for food security. There were no critical differences between men's and women's preferences in either province. Different preferences were due to the main commodity and farming practices implemented in the local area. Detailed information on tree prioritization of men and women in South and Southeast Sulawesi are presented in Table 1.

Cacao (*Theobroma cacao L*) is the main commodity in Southeast Sulawesi, and the province has become the second

FIGURE 2 *Species prioritisation based on men's and women's preferences*



largest cacao producer in Indonesia. Both women and men, consider cacao to be the species of highest priority. Migrant communities of Bugis and Tana Toraja ethnicity from South Sulawesi are the main cultivators of this species as well as some of the transmigrant communities (Ruf and Yoddang 2001, Mulyoutami 2014). Cacao is an attractive commodity that has stimulated several waves of spontaneous migration (Ruf and Yoddang 2001, Hall 2011, Li 2012, Mulyoutami 2014), as well as transmigration schemes for cacao development in the 1980s. The development of commodities in Southeast Sulawesi started with the green revolution of the 1970s (Mulyoutami 2014). The development of irrigated paddy systems in Southeast Sulawesi, was followed by a successful programmes for pepper and cacao development, with resulting rapid expansion of those crops, that led to a boom and bust of cacao (Ruf and Yoddang, 2001). The importance of cacao in the economic sector has also had great impacts on the dynamics of land grabs and land control by migrants/transmigrants over locals as described by Hall (2011) and Li (2012). Also forest encroachment by farmers and non farmers for timber production led to permanent cultivation of cocoa, other commodities or agroforestry models.

Unlike the conditions in Southeast Sulawesi, in South Sulawesi, men and women share a concern that cacao is becoming the third priority rather than the top priority. Cacao is one of several important crops cultivated in mixed gardens, together with coffee, cloves and timber species. Interestingly Bugis and Makassar migrants in Southeast Sulawesi are more interested in cacao, compared to their relatives who remain in South Sulawesi. The Bugis out-migrants more intensively managed their cacao gardens in Southeast Sulawesi, while Bugis/Makassar non-migrants preferred to maintain mixed garden practices. This might be related to the development of the commodity in Southeast Sulawesi that was more pronounced and conducive to cacao adoption. Mulyoutami (2014) shows that in South Sulawesi, land availability and land ownership for each household is more limited compared to Southeast Sulawesi due to high population pressure in the former.

TABLE 1 *Gendered differences in species prioritisation*

Species	South Sulawesi					Southeast Sulawesi					Grand Total	Rank Total
	Men		Women			Men		Women				
	Mean	(Rank)	Mean	(Rank)	N	Mean	(Rank)	Mean	(Rank)	N		
Paddy (*Oryza sativa*)	75.18	**(5)**	91.29	**(1)**	10	93.64	**(2)**	94.87	**(1)**	6	88.37	**1**
Cocoa (*Theobroma cacao*)	73.33	(6)	64.91	(7)	13	96.27	**(1)**	94.67	**(2)**	20	84.96	**2**
Pepper (*Piper nigrum L*)	80.00	**(4)**	76.19	**(5)**	3	78.03	**(3)**	77.57	**(5)**	17	77.74	**3**
Clove (*Syzygium aromaticum*)	87.55	**(1)**	82.58	**(3)**	14	54.15	(9)	79.76	**(3)**	9	76.31	**4**
Maize (*Zea mays*)	83.75	**(2)**	84.51	**(2)**	10	–		45.66	(15)	3	75.31	**5**
Sago (*Metroxylon sago*)	N/A		N/A			66.96	**(4)**	77.58	**(4)**	10	70.14	**6**
Coffee (*Coffee arabica and Coffee robusta*)	82.92	**(3)**	77.77	**(4)**	13	56.96	(8)	46.92	(13)	9	69.29	**7**
Coconut (*Cocos nucifera*)	69.33	(9)	64.81	(8)	4	60.37	(7)	57.06	(10)	12	62.85	8
Banana (*Musa paradisiacal*)	57.86	(11)	63.80	(9)	10	64.71	**(5)**	62.91	(6)	9	62.50	9
Timber species (*Tectona grandis L.f, Gmelina arborea Roxb.*)	70.00	(8)	19.44	(20)	3	61.72	(6)	49.66	(12)	15	52.63	10
Rubber (*Hevea brasiliensis*)	72.38	(7)	65.53	(6)	6	33.40	(18)	44.62	(16)	8	51.04	11
Tuber species (*Manihot esculenta, Solanum tuberosum L.*)	43.33	(12)	29.13	(17)	8	50.00	(11)	57.39	(9)	9	46.16	12
Durian (*Durio zibethinus*)	34.80	(16)	38.20	(15)	10	49.26	(12)	45.67	(14)	20	43.70	13
Nilam (*Pogostemon cablin*)	10.00	(20)		(21)	1	39.15	(16)	60.94	(7)	12	41.93	14
Chilly (*Capsicum annum, Capsicum frutescens*)	38.75	(13)	49.37	(11)	6	36.36	(17)	33.64	(17)	4	41.22	15
Candlenut (*Aleurites moluccanus*)	60.00	(10)	24.07	(18)	4	45.45	(13)	60.00	(8)	4	41.07	16
Citrus (*Citrus reticulata*)	–		50.00	(10)	1	52.00	(10)	26.15	(19)	6	40.64	17
Vegetables (*Brassica oleracea L., Brassica Juncea, Lycopersicum esculentum*)	30.00	(19)	36.05	(16)	7	44.09	(14)	49.75	(11)	5	40.31	18
Langsat (*Lansium domesticum Correa*)	33.33	(17)	42.76	(12)	7	39.98	(15)	27.52	(18)	15	34.48	19
Mango (*Mangifera Indica*)	35.00	(15)	–		2	27.24	(19)	–		3	30.34	20
Jackfruit (*Artocarpus heterophyllus*)	30.00	(18)	41.95	(13)	5	23.82	(20)	7.69	(20)	3	30.15	21
Medicinal plant (*Cymbopogon nardus, Zingiber officinale*)	–		41.67	(14)	1	22.95	(21)	–		4	26.70	22
Nutmeg, mace (*Myristica fragrans*)	36.67	(14)	19.79	(19)	5	9.09	(22)	–		1	26.45	23

Pepper (*Piper nigrum L*) is the second priority in Southeast Sulawesi, while in South Sulawesi, the plant is not included in the top five priorities. Pepper is planted in mixed gardens, sometimes mixed with cacao, coffee, etc. In 2010, pepper production in Southeast Sulawesi was 5 371 tonnes from an area of 11 775 hectares. Almost 99% is produced by smallholder farmers. Konawe accounted for 1 317 tonnes (24.5% of the provincial total) from 3 661 hectares, while Kolaka contributes nearly 40% of the provincial production (DGEC). Pepper was introduced to Southeast Sulawesi by the local government in the 1970–1980s. Before the cacao boom (1985 to the 1990s), pepper was the most important commodity in this area. When the cacao boom started, due to the higher price of cocoa, pepper became a lesser preference.

In South Sulawesi, clove (*Syzigium aromaticum*) is the first priority of tree crops both for men and women. South Sulawesi is known as an important producer of clove, together with Central Sulawesi, North Sulawesi, and Maluku. Clove in South Sulawesi is mostly produced by smallholder farmers in mixed gardens that cover 44 500 hectares. Total production of cloves in South Sulawesi in 2010 was 16 365 tons, Bulukumba contributed 5.2% (850,98 tons) of the total production, and Bantaeng 1.9% (310,93 tons). (http://regionalinvestment.bkpm.go.id/newsipid/id/commodityarea.php?ia=73&ic=85).

In South Sulawesi, men considered coffee to be the third priority while women considered it as the fourth priority. Together with clove, fruit and timber trees, farmers manage coffee in mixed gardens. Coffee production in South

TABLE 2 *Gendered task difference in sago cultivation*

	Level of involvement (%)	
Activities	**Men**	**Women**
Seed collection	65	35
Tree selection	70	30
Cutting the trees	80	20
Beating out the sago pith	80	20
Starch processing	10	90

Sulawesi in 2010 was 36 544 tons. Bulukumba contributes 11.3% of the total coffee production, and Bantaeng 4.4% from the total area of 70 412 hectares (http://regionalinvestment.bkpm.go.id/newsipid/id/commodityarea.php?ic=62&ia=73). In Southeast Sulawesi, due to the massive development of cacao agroforests, few farmers pay attention to coffee production though it is still considered important compared to other species.

Sago, paddy and maize are the main food crops in both provinces. Sago is common in Southeast Sulawesi, while maize is more common in South Sulawesi. Women in both provinces who are responsible for food security and preparation in the household, put higher value on these three crops in comparison to men (Table 1).

Sago is a main staple food in eastern Indonesia, particularly for the Tolaki. Sago is a cultural symbol (Utari 2012). It is important for household consumption and also for agro-industry. Sago production in Southeast Sulawesi covers about 5 607 hectares, producing 119 168 tons of dry starch per year. Sago starch processing is generally done by women using traditional technologies and only for their own family consumption. The study by Wasa and Beribe (2009) in a more eastern part of Indonesia (West and East Nusa Tenggara) shows that sago domestication was preferred by women, due to the high involvement of women in sago production and processing. Women have more responsibility for maintaining the sago trees to meet family subsistence needs. There is some commercial production of sago starch, which is only sold in local markets.

Statistical analysis using the Mann Whitney test was employed to check the significance of differences between men's and women's perceptions in each province. There was no significant difference in gender prioritization of the five selected species. While men have more tendencies to prioritise cacao and coffee, women put slightly higher preference on pepper, sago, and clove. The only significant difference was women put lower preferences on timber. For women, timber is a crop associated with men's realm. Most women said that they have no interest to cultivate timber due to the heavy labor (physical strength) required. Also, timber is usually cultivated far from their houses. Women also argue that they lack experience to estimate timber size and price.

The quadrant analysis presented in Figure 3 shows the criteria that men and women consider important for tree crop domestication and species selection. Quadrant 1 show the criteria that men and women consider important. Quadrant 2 provides the criteria that are important for women, and Quadrant 3 provides the lowest importance criteria for both men and women. The last Quadrant represents the criteria that are important for men.

Both men and women consider external factors that can influence the production of tree crops, i.e., price, land suitability, market channel and planting material availability. Women's criteria also emphasised how to cultivate the tree crops. They preferred tree crops that are easy to cultivate and harvest, cereal crops, vegetables, and tubers. Women also emphasise crops that can fulfil subsistence needs because they have responsibility for providing nutritious food for the family. In Ecuador, Blare *et al.* (2014) indicate that women place significantly stronger preferences for cacao agroforest. They pointed out that cacao agroforestry systems have high value in subsistence which is important for women.

Men consider other criteria as more important: productivity of the crops and pest resistance. The main issues for clove and cacao development are pest and disease control—tasks for which men have primary responsibility. Neither men nor women prioritize ecological functions.

Roles and knowledge in agricultural practices and domestication

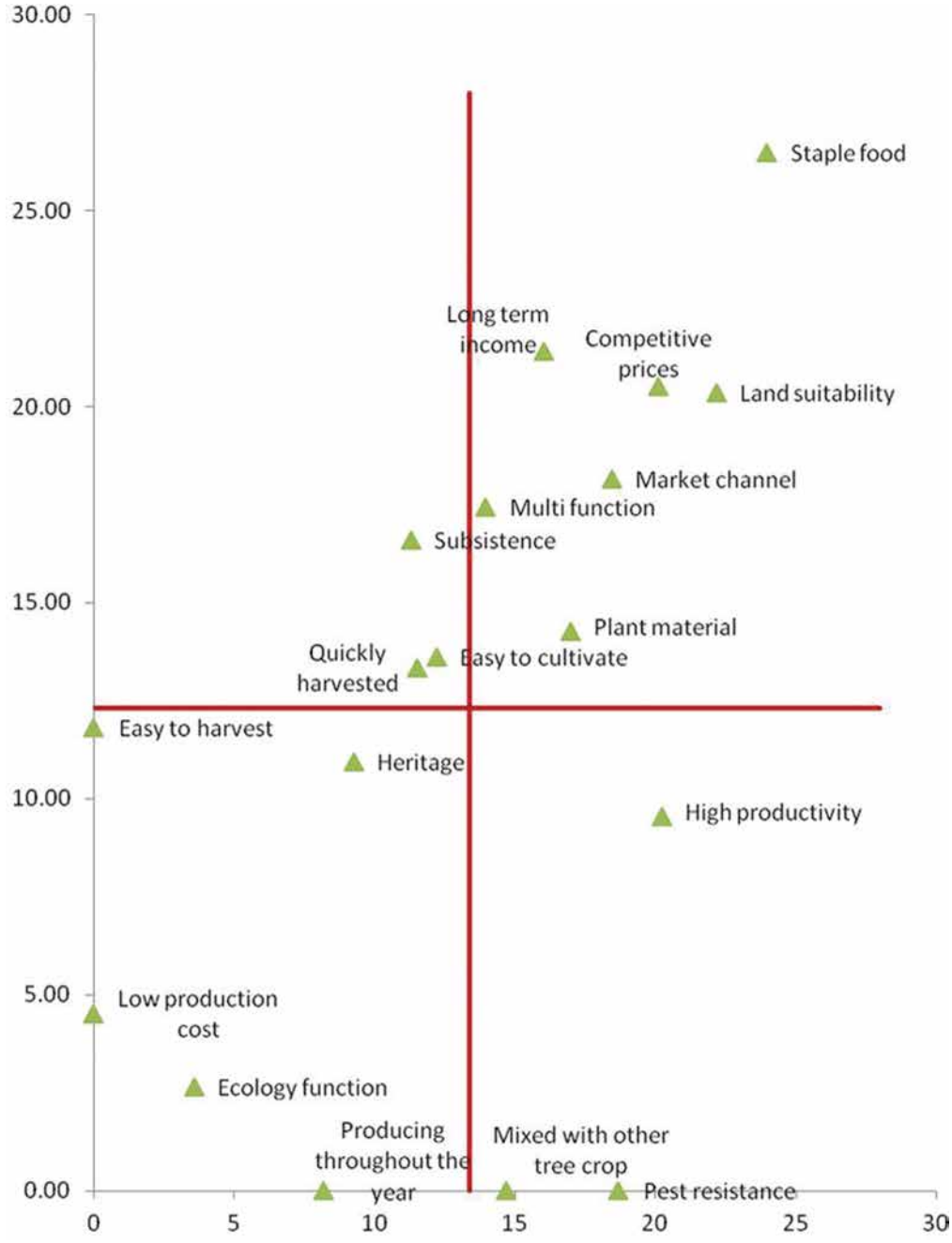
Women are actively involved in agricultural and tree crop harvesting, post-harvesting, marketing and planting. Land preparation and production are by dominated by men (Figure 4). While men prepare the land, clear, slash and hoe, women are usually involved in preparing and bringing food for workers, and sometimes also help in hoeing or slashing small trees.

In nursery work, interestingly, while men have bigger roles in development and general management, women have more responsibility in production of good quality seedlings. Women fill polybags with soil, select high quality seeds, water the seedlings and apply the fertilizer. Both men and women consider that women have a better ability to maintain seedlings compared to men, resulting in better quality seedlings. Another reasons is women have easy access to nurseries which were built in the yard or home garden.

A study in Central Java (Wonogiri and Ponorogo) by Roshetko *et al.* (2008b) shows that seed collection and processing activities were performed predominantly by women: 49% of seed collector respondents were female and 52% were husband and wife. In that study there was a clear division of roles in seed collection activities, with men climbing trees (*L. leucocephala, S. macrophylla, E. cyclocarpum* and *P. falcataria*), and women collecting the seeds from trees that could be reached without climbing (*G. sepium, T. grandis, G. arborea, Albizia* and *Acacia sp*), without men's assistance.

Women in southern Sulawesi also have good understanding of how to select paddy grain, which kinds are good for seed, for consumption, as well as to reserve for use on special occasions. While men are usually focused on selecting seed for re-planting, women are more knowledgeable in selecting paddy grain for their family's consumption. In terms of maize varieties, a small number of farmers still plant the local variety, while others prefer to use hybrid or

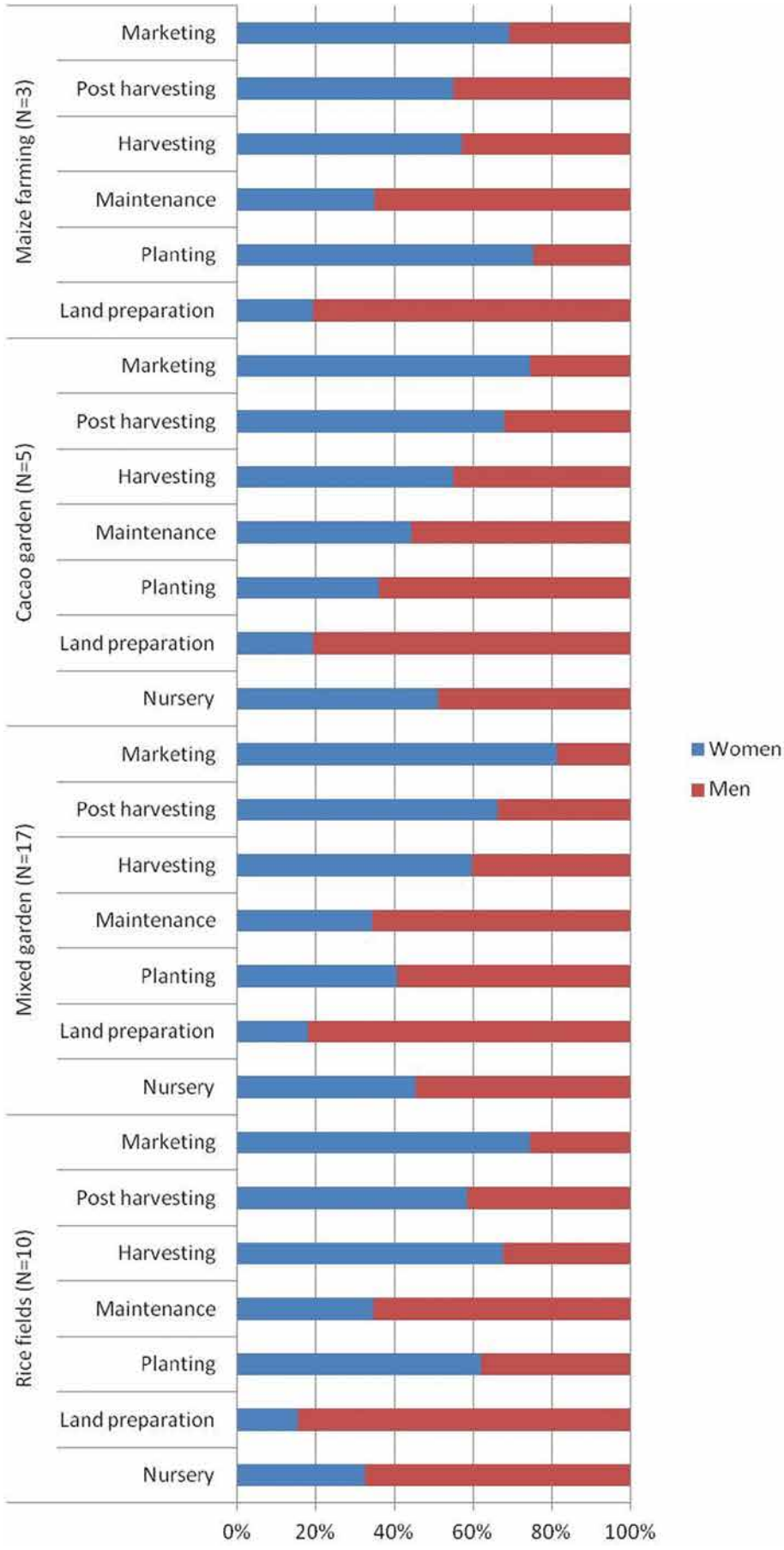
FIGURE 3 *Quadrant analysis of the criteria of tree species prioritisation*



improved planting material. In East Nusa Tenggara, women play important roles in securing the family food. For this reason they take seriously their responsibility to maintain local varieties of maize that they believe produce higher quality food compared to introduced/improved varieties (Beribe 2007, Wasa and Beribe 2009). In South Sulawesi, where the use of improved maize seed varieties is common, women's role in seed selection for household consumption has been reduced. Local maize varieties traditionally used for household consumption have been replaced by improved maize varieties which are the domain of men. Women no longer need to choose a good seed for planting materials and consumption, because improved seed is bought from the market.

Differentiated gendered knowledge results from farming separate plots (Chambers and Momsen 2007). Women in southern Sulawesi are usually more intense in farming homegardens, paddy fields, and maize plots while men tend to work in cacao agroforests and mixed gardens. One important reason that women are more responsible in areas near the house is because they can combine farming with care of their children and house concurrently (Chambers and Momsen 2007, Mulyoutami *et al.* 2012). For women, the home garden and other land near their home can be cultivated productively, while still managing their children, house, and fulfilling the basic needs of household members. This is a confirmation of Fink's (1992) argument that women consider reciprocal interaction to

FIGURE 4 *Gender-based division of labor in different types of agroforestry*



be important when they are farming, while men tend only to focus on production or the work itself. Some of women and men farmers mention that women's safety issues in the forest area are also important. Women usually work in groups or are accompanied by their spouse or other male relatives.

Most land management decisions are made by men, after consultation with women. Women have responsibility in managing the household and farming budget (Colfer *et al.* 2015b). In terms of household expenses, women take the lead, but men usually lead on farming expenses. In terms of land tenure, land titles are usually under men's name. Women may put their name on a land certificate if they inherit the land or buy the land by themselves (Mulyoutami *et al.* 2012). But within the family, there is general agreement that the land certificates are under the men's name.

Gender relationship at household level in decision making process in tree domestication

Data from a household survey shows that men were more dominant in decision making related to tree domestication. Regarding tree planting, 91% of Bugis and Makassar men in South Sulawesi are the main decision maker. Only 4% of women were the main decision maker regarding species selection, all those women were also the heads of the household. In Southeast Sulawesi, men (60%) still dominate decision making regarding tree planting, but the combination of men and women making decisions is higher compared to South Sulawesi, 32% and 4%, respectively. The combination of men and women in decision making indicates that both men and women develop communication regarding tree planting decisions.

In order to see the gender relationship in farmers' households, we sought to understand the communication patterns that men and women have developed. We looked specifically into what happens when one household member attended training and what benefits are obtained by the family members who did not attend. We conducted in-depth interviews with 15 key woman informants, 9 in South Sulawesi and 6 in Southeast Sulawesi. We also interviewed 6 men, the husbands or relatives of the women informants. Observations and interviews from this small sample show three particular patterns that differ markedly in different types of communities and households. Pattern 1 is the case when women and men work together to strengthen their skill and knowledge on farming practices in their household. From our sample, there are four couples who conform to this pattern. Pattern 2 shows the case of women headed households without any support from men in their household. We found four cases of this pattern. Pattern 3 is one in which women have heavy responsibility in the domestic arena, including taking care of children, which causes low prioritization on farming activities. The women representing pattern 3 are mostly women who aren't particularly attracted to farm work, and their husbands have the main responsibility for farming. We found 7 cases for pattern 3.

In a Bugis–Makassar community, one woman farmer said that based on discussions with her husband, it might be decided she would attend the training. After the training, she shared and practiced the knowledge gained at the training with her husband; effectively transferring the knowledge. If the husband went to the training, the same follow-up process would occur. In another family, when the father attended a training, his daughter also benefited from the knowledge he obtained. They practiced together in their homegarden. There was a reciprocal relationship between men and women when they exchanged knowledge. In this kind of household, there was good understanding that enhancing the capacity of both men and women is the best approach to improving family farming practices. Women and men have almost equal access to such knowledge. Tree domestication decision are made together. This pattern occurs when both male and female household members are active in farming.

A similar situation was reported by a Tolaki woman living in a transmigration area of Southeast Sulawesi. Known as a hard working farmer in the community, her husband is less involved in farming due to physical ailments. However, the husband fully supported her in farming activities with his knowledge, and he helped her much as possible. Our observations in that community, indicated that only a small number of Tolaki women worked on the farm, due to the limited availability of land. Tolaki men and women there are mainly involved in off farm work. In traditional Tolaki villages rice cultivation is a shared responsibility between men and women, but women may have a stronger responsibility (Tarimana, 1989).

In the other Bugis–Makassar household types, women face difficulties if male household members do not actively farm. If these women cannot attend training, they will not benefit from secondary information sharing. This is particularly severe in female headed households. Such women have difficulty obtaining training and engaging in other public activities, because of their heavy household responsibilities. One Bugis migrant woman in Southeast Sulawesi who lived in a female headed household developed a solution. The sole 'fighter' in farming activities, this woman was able to be active in farmer groups. She benefited from farmer groups, exchanging knowledge and increased her skills in tree crop management.

Families with school age children face a different condition. Their domestic and child care responsibilities cause a deprioritization of farming practices. Few women with small children are actively involved in farm work, those who are usually have relatives who assist with child care. Our observations indicated that active women farmers who have infants or toddlers are usually very poor.

In pattern 3 households, most of decisions are made by men. There is no communication between husband and wife after they attend training or before embarking on tree planting activities. In some cases, there are no problems. But, in one household the family nursery failed to produce quality seedlings. The husband understood that women generally had better nursery skills, but his wife was not engaged in farm work, so they needed to cooperate with the women's nursery group. This demonstrates that though men have a bigger role in tree domestication, it is still very important to consider the role of women.

Survey results indicate women's constraints related to farming activities are not driven by ethnic difference or type of communities. The discussion above highlight how women and men both contribute and how responsibilities differ

according to people's positions within the household (Howard 2003). Female farmers without any support from their family may receive very low benefit from farming and tree domestication. Further involving women in farming activities and involving them more in marketing will be a benefit, but may also overburden them. The combination of farming and marketing, simultaneous with time consuming household responsibilities may comprise an overwhelming workload. Therefore, shared household work between the genders will have to evolve, as women and men realize that public action for women entails some household help from men. From her study of Tolaki, Bugis, and Makassar people in multiethnic areas, Colfer *et al*. (2015b) suggest that changing attitudes is necessary, particularly men's recognition of the value of women's contribution to agricultural production and the need for their own contribution to household management.

A recommendation from this research is to maintain, as well as to improve the inter-ethnic communication and mutual understanding between men and women, and other marginalized groups as mentioned by Colfer *et al*. (2015b). Better allocation of responsibilities between men and women in the household and also in the community (farmer groups or cooperatives) can be a first step to building a gender-conducive situation within the community that avoids further overburdening women.

CONCLUSIONS AND WAY FORWARD

This study revealed that men and women make important contributions in tree domestication. Both men and women give priority to tree species with high economic value; the management of those species is a priority for men but one that is shared by women. Besides providing cash income, many species make a big contribution in subsistence (e.g., annual crops). In the care of annual crops, women perform a bigger role than men. Women usually focus their domestication activities on land near the home.

Women are keen to domesticate vegetables and other annual crops that contribute directly to household food security and nutrition. Identifying gender roles and knowledge related to tree domestication is important to facilitate effective and successful planning related to tree-based livelihood enhancement and sustainable environmental management. However, there must be changes in the attitudes of men and women regarding shared work both on the farm and in the home. Building good communication in sharing knowledge is also important, both for men and women, so that they can solve their farming problems together. Farmer groups are an important mechanism for women to enhance their agriculture production skills and roles, particularly for women without family support related to agriculture.

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