The role in agricultural decision making in the upper Citarum watershed, Indonesia

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Abstract. Women as a labor force share a significant role in farming, included in the most degraded Citarum watershed, Steep slopes, soil sensitivity to landslides, erosion, and relatively high rainfall are the limiting factors that are dangerous for farmers, especially for female workers participating in farming activities to support the family economy. However, the role and remuneration system for women in farming, in general, has not received serious attention. This paper aims to analyze the role of women and the factors influencing decision-making in farming activities. The research was conducted in the upstream area of the Citarum watershed in 2 districts, namely Bandung and West Bandung, in 2019. A total of 499 sample farm households were randomly selected. The data were analyzed statistically and descriptively. The results show (1) women participate in almost all agricultural activities except irrigation, but at the same activity and working time get lower wages than men; (2) there are differences of opinion between women and men regarding the roles in the decision-making process of farming activities. According to men, they play a more dominant role, while women prioritize joint roles without being dominant. The results also show that age, education, and experience of women in farming do not directly affect decision-making as long as not impacted to income, but affect women's role and decision-making process in input use. Increasing women's knowledge and skills are the keys to accelerate their participation and role in family decision-making in the agricultural sector.

1. Introduction
The role of women as a labor force shares a significant portion in agricultural business. Around 35.3 percent of the workforce working in West Java are women, of which 37.5 percent out of them work in the agricultural sector [1]. Several studies show that women’s roles in agricultural business occupy almost all activities, from food crops, horticulture to estate crops, and in all aspects of production, marketing to consumption [2-5]. These roles are performed jointly with men or solely by women. This indicates that the roles of women in supporting the household economy and the sustainability of agricultural businesses cannot be ignored.

The Upper Citarum Watershed is an area with a high level of economic development and a relatively well-established and complex agricultural system. The status of the Citarum watershed as one of the most degraded watersheds in Indonesia is caused by agricultural practices that are not environmentally friendly, added with the destruction of forest areas and the expansion of vegetable crops in steep and hilly areas which are very dangerous for farmers. Critical and very critical land in the upstream area of the Citarum watershed reaches 77,037.36 hectare, which is a challenge for farmers in obtaining
agricultural land [6]. Steep slopes, soil sensitivity to landslides, erosion, and relatively high rainfall are the limiting factors that are dangerous for farmers, especially for female workers who participate in agricultural activities in order to support the family economy. Therefore, the role of women requires serious attention, both in terms of knowledge of environmentally friendly farming practices and in terms of income. This is important to achieve optimal and sustainable agricultural production.

The issues and government policies related to gender aspects in Indonesia are still being debated, including the role and remuneration system for women workers. This paper aims to analyze women's participation in agricultural activities, their role in agricultural strategic decision-making and the influencing factors.

2. Materials and methods

2.1. Data, location, and time of research

This research is a part of a more extensive study of Agricultural Policy Research to Support Natural Resource Management in Indonesia's Upland Landscapes (IndoGreen), a collaboration between the Center for Socio-Economic and The University of Adelaide and The University of New England, funded by Agricultural Policy with the Australian Center of International Agriculture Research (ACIAR). Data and information collection was carried out in June-August 2019, located in Bandung and West Bandung Districts. The survey was preceded by extracting information and collecting data in the district and village levels, followed by interviews with 499 farm households in 14 sub-districts and 22 villages. Nine subdistricts within the administrative area of Bandung District, and five subdistricts are in West Bandung District.

Primary data and information for the study were obtained from interviews with 499 farmer households and observations. Gender substantive interviews were conducted to 441 heads of households and their spouses separately. A total of 58 other households were excluded due to the absence of the spouse. Several factors that are indicated to influence women's participation and role in agricultural decision making are age and education [7,8]. Age is a representation of farming experience while knowledge is a representation of skills and mastery of information technology.

The main data and information for the study were sourced from interviews with 499 farm households and observations. Gender substance interviews were conducted with 441 household heads and their spouses separately.

2.2. Data analysis

The data were analyzed descriptively. The study analyzed women's participation in 13 activities, and decision-making processes in 14 agricultural business activities according to men and women responses, by which the responses are divided into three decision-making process categories: male dominant (husband), equal (with male and female equally dominant), and female dominant (wife). The data is processed with simple statistic distributions using frequency, percentage, and data grouping based on dominant decision-making.

3. Results and discussion

3.1. Overview of agriculture in the upper Citarum watershed

This research is focused on the upstream area of the Citarum Watershed, where 77,037 hectares out of the total of 231,465 hectares (33.3%) fell into critical and very critical lands. Of that area, the largest being in Bandung District's administrative area (56.43% or 42,981 hectares), and the second-largest in West Bandung District's administrative area (34.30% or 26,122 hectares), while the rest are within other districts.

The Agricultural sector is the main source of livelihood for the population, including food crops, horticulture, and estate crops. The largest composition is horticulture. Food crop farming is generally intended to meet family needs (subsistence). Rice farmers only sell the surplus of their products after reserving the households’ needs.
Agricultural practices in the upstream Citarum Watershed are categorized as well-established, complex, and less environmentally friendly. Vegetable farming is in slopy areas, while rice fields are located on the feet and the ridges of the hills and are made of terraces. The need for land urges the community to take advantage of steep and hilly lands. State’s forest lands have been cultivated from generation to generation; even land transactions (buying, selling, and leasing) occur without any proof of ownership. As a result, the function of forest as a catchment area is being deteriorated and it is dangerous for the environment. In the dry season, it is difficult to get water.

The household survey results showed 1,286 plots of land managed by farmers with an average plot area of 0.25 hectares. When compared between the two districts, the average area of agricultural land ownership in Bandung is 0.29 hectares, which is larger than in West Bandung (0.19 hectares). The expansion of industrial development, trade, tourism and housing causes the rate of conversion of agricultural land to non-agriculture land to take place rapidly, thus the area of agricultural land is getting smaller. The gap in land ownership is quite high, from 0.006 to 7 hectares. Nevertheless, the average area of land managed by farmers is 0.65 hectares, with a distribution of 1-3 plots per household. Most of the respondents work on non-owned land through mechanisms such as renting, pocket, borrow or pawn.

3.2. The roles of women in agribusiness and influence factors

More than 50% of men and women are within the productive adult age group (41-60 years), followed by the young adult age group (15-40 years). If there is no effort to make millennials interested in agriculture, this proportion has a tendency to lead to aging of farmers [9,10]. Currently, the proportion of men who are over 60 years old has reached 21.77%. The young age group is predominantly female (Table 1).

| Age (year) | Respondent | Household head | Percentage | Spouse | Percentage |
|------------|------------|----------------|------------|--------|------------|
| 15-40      | 109        | 24.72          | 175        | 39.68  |
| 41-60      | 236        | 53.51          | 230        | 52.15  |
| More than 60 | 96        | 21.77          | 36         | 8.16   |

The description of the education group shows that farmers and their spouses are concentrated in the group at the primary school level. Women's education is more spread across levels, with the number of groups not completing primary school are less, and with diploma or bachelor degrees are more than men. This illustrates a relatively good level of women's education and should strengthen their participation and decision-making in farming (Table 2).

Women from the Pasundan area are generally involved in agriculture activities after getting married to help their husbands improve the family economy. Meanwhile men mostly participate in helping their parents since they are single, especially when they are not in school. This means that the farming experience of women in the family is generally lower than men. The higher the experience, the more opportunity to provide input in decision making.
Table 2. Household head and spouse education distribution.

| Education level       | Respondent |
|-----------------------|------------|
|                       | Household head | Percentage | Spouse | Percentage |
| Did not complete      | 104         | 23.58      | 70     | 15.87      |
| Elementary school     | 234         | 53.06      | 269    | 61.00      |
| Completed elementary  |             |            |        |            |
| school                | 63          | 14.28      | 70     | 15.87      |
| Completed junior high |             |            |        |            |
| school                | 38          | 8.62       | 24     | 5.44       |
| Completed senior high |             |            |        |            |
| school                | 2           | 0.45       | 8      | 1.81       |
| Bachelor degree       |             |            |        |            |
| Total                 | 441         | 100        | 441    | 100        |

The majority of Sundanese people in the upper Citarum watershed adhere to a bilateral system, with a clear differentiation of roles in the family. The husband is the head of the family who is responsible as a breadwinner in the family, thus has high mobility in the external space while the wife is responsible for taking care of the children and is more engaged in the domestic space. Women are constructed to carry out activities around the household or commonly known as kasur (bedroom), dapur (kitchen), and sumur (cleanliness), as companions to their husbands, so whatever is done by women in the external space is classified as the task of helping their husbands [11]. Based on the perspective of gender, the main role of women is to play a reproductive role.

The development of external factors and limited resources require women to take responsibility for helping the family economy. Education, farming experience, and the development of information technology encourage women to enter public spaces. Initially, the productive role began with time spent on agriculture activities surrounding the house’s backyard, and gradually expanded to the management of other farming businesses, even being farm-labor for other farmers. This social reality reinforces the household expression that you have to become pious, then you become salogak, which means that in the household there must be harmonious cooperation between husband and wife [12]. The involvement of women in agricultural businesses is a form of attitude-driven role to help husbands improving the household economy which is operationally harmonized with environmental conditions [13].

The survey results show that women are involved in almost all agricultural activities, exclude for irrigation. Watering activities are fully carried out by men because it requires strong physical exertion. Watering activity is carried out during day and night, and are also dangerous. During the dry season, several locations such as Nanggerang, Pasir Halang, Sirnajaya, Pulosari, Cikembang, and Lebakmuncang, require farmers to collect water from sources located far from agricultural land.

For the same type of activity and working hours, the wage rate of female workers is much lower (approximately a half) than how much the men receive (Table 3). Labor participation based on sex indicates the existence of a social construction regarding the division of labor. Seeding, planting, manual weeding, harvesting, and post-harvesting are classified as women's work. This work is considered to require diligence and perseverance and does not require physical strength, and cultural reproduction considers it suitable for women to do [14,15]. Land preparation, planting and staking, herbicide weeding, pesticide spraying, irrigation, and transporting are classified as men's jobs requiring strength and are high risk. The difference in wage rates between men and women is because women's work opportunities are more limited and women's productivity is considered less. This gender inequality has been going on for a long time without causing conflict in the community of local agricultural labor because it is socially accepted in harmony.
Table 3. The participation and average wage level of female workers compared to male workers in farming activities in the upstream area of the Citarum watershed.

| No | Activity                        | Participation rate | Average wage level (IDR/working day) |
|----|---------------------------------|--------------------|--------------------------------------|
|    |                                 | Women (%)          | Men (%)                              | Women     | Men     |
| 1  | Land preparation                | 5                  | 95                                   | 30,667    | 56,47   |
| 2  | Seeding                         | 59                 | 41                                   | 41,2      | 54,8    |
| 3  | Planting                        | 81                 | 19                                   | 38,625    | 52,758  |
| 4  | Hoarding and installation of stakes | 20                | 80                                   | 31,25     | 53,03   |
| 5  | Manual weeding                  | 85                 | 15                                   | 37,851    | 54,06   |
| 6  | Weeding with herbicides         | 4                  | 96                                   | 37,5      | 54,286  |
| 7  | Fertilization                   | 51                 | 49                                   | 36,475    | 53,667  |
| 8  | Pesticide spray                 | 1                  | 99                                   | 50        | 54,828  |
| 9  | Pest control                    | 50                 | 50                                   | -         | 50      |
| 10 | Irrigation                      | 0                  | 100                                  | -         | 52,619  |
| 11 | Harvest                         | 58                 | 42                                   | 44,937    | 61,639  |
| 12 | Freight                         | 3                  | 97                                   | 34        | 66,282  |
| 13 | Post-harvest                    | 53                 | 47                                   | 38,750    | 60,000  |

3.3. Agricultural business decision making

Most countries in the world note that women provide a high contribution toward agriculture. In 1987, IRRI recorded that in Asia, women contributed one-third of the total workforce for farming, even in Nepal, South India, and Sri Lanka, more than half of the workforce was female. Women participate in the activities such as planting, weeding, harvesting, threshing and winnowing, post-harvest handling, and marketing [16]. Furthermore, the activities extend to land cultivation and fertilization. In the case of Asian and South African countries, women are the main contributors in agricultural business and play an important role in ensuring food security and nutritional adequacy of households [17]. The level of women’s participation and involvement in terms of time and number of days spent for agricultural work is quite high [15,17]. Research on six agricultural projects in South Africa where the husbands work outside the farm or village showed that women’s participation exceeds men’s. Women have absolute freedom in decision-making because they have full access and control over resources [17].

The results of this study do not indicate the same direction. Although the evolutionary tendency of men to work outside the village is very strong due to rural driving factors such as climate change and limited land, the study shows that the urban pull factor with easier access is the main drive factor for working outside the village. The transformation of subdistrict capitals to becoming more urban areas opens up opportunities for farmers and agricultural laborers to migrate into urban areas and work in non-agriculture sectors.

The agricultural business process in the upstream Citarum watershed involves women in the decision-making process regarding strategic matters for the success of the farming business, such as labor management and farming practices. Vegetable farming is a commercial commodity, thus there is no separate cultivation pattern that often creates gender stratification in decision making [15]. One of the important variables in the agricultural system is decision-making. Husbands, wives, and other household members in certain age groups are potentially involved in this process. The higher the education of women, the greater the access to technology and information, resulting in stronger influence in the decision-making process. Similarly, for variables age and farming experience [17,18]. Involvement in the decision-making process indicates the strength of women's access to and control over agricultural resources such as labor, credit, and extension services.
There are differences in defining the decision-making between men and women. Women interpret it as involvement in the process (provision of opinion), while the husbands consider it an action (implementation). The Husbands claimed that decision-making was dominantly done by men in all activities with the exception of getting credit for investment activity. This opinion is very strongly based on the stereotype that the head of the family understands more and is the most responsible person for agricultural activities as the main livelihood of the household. This is in line with the opinion of women. The decisions related to commodities choice, harvesting, processing, selling, marketing, negotiating with traders, and requesting credit are mainly carried out by women.

The division of roles that have an impact on decision-making places women in a strong position in harvesting, post-harvest activities, marketing, and accessing credit. The role of men is strong in the process of agricultural production and investment (internal business), women are stronger in harvesting, maintaining, and purchasing inputs and assets, which are decisions that require energy and carry greater risk. Table 4 confirms that in the upstream area of the Citarum watershed, the gender perspective puts forward the issue of fairness because being involved in the decision-making process takes precedence over equality. This is closely related to the socio-cultural perception of society which assumes that conventionally a husband is both the operator and the person in charge of the family farming business, and shares duties and responsibilities with the wife in making decisions [19].

| No | Farm Activity | According to husbands (%) | According to wives (%) |
|----|---------------|---------------------------|------------------------|
|    |               | Men dominance | Equal | Women dominance | Men dominance | Equal | Women dominance |
| 1  | Cultivated agricultural commodities | 59.72 | 36.87 | 3.00 | 42.40 | 43.15 | 14.10 |
| 2  | Variety selection | 65.94 | 28.06 | 5.21 | 47.06 | 41.10 | 9.35 |
| 3  | When and how to prepare land and plant | 67.53 | 36.87 | 2.80 | 48.86 | 41.55 | 9.36 |
| 4  | When and how to apply agrochemicals | 69.34 | 25.45 | 4.00 | 52.74 | 36.07 | 10.72 |
| 5  | When and how to take care of the farm | 64.73 | 25.85 | 8.41 | 40.18 | 38.58 | 20.78 |
| 6  | When and how to harvest | 63.33 | 31.26 | 5.00 | 40.65 | 46.12 | 13.01 |
| 7  | Safety and practice of spraying pesticides/herbicides | 83.97 | 13.03 | 3.01 | 52.10 | 38.08 | 9.82 |
| 8  | Buying agricultural machinery | 65.53 | 28.46 | 5.20 | 52.97 | 36.99 | 9.59 |
| 9  | Buying agricultural inputs that increase yields | 68.62 | 26.85 | 3.80 | 49.32 | 39.04 | 11.65 |
| 10 | Processing (drying, packing) | 61.52 | 29.46 | 9.02 | 37.27 | 49.70 | 13.03 |
| 11 | To whom to sell agricultural products | 59.32 | 33.07 | 7.62 | 35.87 | 51.90 | 12.22 |
| 12 | Marketing | 58.52 | 33.47 | 8.02 | 38.48 | 50.90 | 10.62 |
| 13 | Price negotiation with buyers/traders | 67.54 | 25.65 | 6.81 | 43.09 | 45.49 | 11.42 |
| 14 | Request credit for agricultural investment | 39.28 | 54.51 | 6.21 | 27.25 | 64.93 | 7.82 |

The interviews with the spouses/wives show that women have strong involvement without being dominant in decision making. The rate is above 40% except for the activities such as determining the...
time and method of applying agrochemicals (36.07%), time and method of maintaining the agriculture (38.58%), spraying pesticides (38.08%), decisions in purchasing inputs (39.04%) and agricultural machinery equipment (36.99%). In some cases, women are considered to have more capacity and time [20,21].

When detailed by activity groups, women's opinion shows that joint decision-making is stronger than the men dominance in agricultural business planning. Strengthening joint decisions is influenced by women's recognition of land suitability, farming experience on certain types of commodities, and marketing opportunities of the products. Meanwhile, the husband's dominant role was strengthened in making decisions regarding the selection of commodities and varieties because men have more time managing agriculture. This is consistent with men's opinion that the husband's decision making in planning is very strong (close to 60% and 69%) because they are more experienced and understand the products' market.

Based on women's opinions, involvement in decision-making regarding agricultural business implementation and group activity is quite strong in land preparation, planting, use of fertilizer production facilities, plant maintenance, and harvesting. Both wives and husbands think that male-dominant decision-making is much stronger (more than 40%). The more time spent in agriculture, the stronger the role in decision making [18]. Land preparation is considered a job that requires physical strength, thus mostly done by men. The decision-making regarding the procurement of technology assets is mostly done by men with a rate of more than 40%. Factors that greatly influence the power of decision-making are knowledge, experience, and agricultural income. As a worker and a farmer, men generate more income than women. A longer time and energy spent on laboring results in higher wages and income. This increases men's bargaining power and control over spending on expensive assets. The strength of women’s role in asset procurement is merely on confirmation regarding decisions to be taken.

Horticultural commodities require a fast-selling process, and processing requires patience and speed because the results affect the selling price. This activity is usually done by husband and wife together. Implicitly, there is a division of tasks of which women handle cleaning and sorting, while men do the packing and transportation. According to the wife, the equal roles of women and men in making joint decisions without any dominant are greater than the husband's dominant decision-making. According to the husband, however, the husband's dominant decision-making is greater. It means that even though male dominance is stronger, women's roles and opinions are prominent and influential.

This fact reinforces the statement that the decision-making process and decision-making are two different things. The role of husband and wife in the decision-making process is democratic as women consider that their opinions are sufficiently considered in decision-making. This reality indicates that age, education, experience, and the burden of women on the household economy are the factors that indirectly influence decision-making for household agricultural businesses in rural areas.

4. Conclusions
Women's participation in agricultural and farming activities in the upstream area of Citarum watershed was found in all activities except for irrigation. For the same activities and working hours, women receive lower wages than men. This difference in wage levels results from the local social construction that positions women in external activities as a companion and an assistant to their husbands. This gender inequality has been going on without causing conflict and accepted in harmony. The scarcity of agricultural labor should encourage the government to gradually facilitate the enactment of gender equality in the wage system by referring to the indicators of working time, skills, and performance.

Decision-making on strategic agricultural activities is an integrated part of implementing activities in agricultural and farming practices. Men perceive the strength of men's gender roles in almost all activities, while women see the strengthening of collective decisions without being dominant. The harmonization that occurs indicates that agricultural decision-making prioritizes a sense of justice and respect, not equality.
Age is correlated to farming experience, meanwhile, education is correlated to knowledge and ability to access technology and information. Both do not directly influence women’s participation and role in decision-making because they do not affect income. But, age as the representation of experience and education as the representation of knowledge and insight serve to increase contributions in agricultural and farming business decision-making.

Reference
[1] Badan Pusat Statistik 2019 Statistik Ketenagakerjaan Sektor Pertanian (Agustus 2020) (Jakarta: Vadan Pusat Statistik)
[2] Damatun M, Rantung V V and Memah M Y 2017 Peran tenaga kerja perempuan dalam usaha tani hortikultura di Kelurahan Wailan, Tomohon Utara, Kota Tomohon Agri-SosioEkonomi 13 169–82
[3] Worung V S T, Ngangi C R and Tangkere E G 2016 Partisipasi tenaga kerja perempuan dalam usahatani bunga potong di Kelurahan Kakaskasen II Kecamatan Tomohon Utara Kota Tomohon Agri-SosioEkonomi Unsrat 12 37–46
[4] Philip D, Ngangi C R, Benu O L S and Wangke W M 2014 Curahan kerja perempuan pada usaha tani padi sawah di Desa Beha Kecamatan Tabukan Utara Kabupaten Kepulauan Sangihe COCOS 4 1-23
[5] Tim PSG STAIN Pekalongan 2010 Peran perempuan di sektor pertanian (studi perempuan petani tebu Kec. Sragi Pekalongan MUNAWÂH 2 215-23
[6] BPDASHL Citarum 2020 Hijaukan Citarum Penanganan Lahan Kritis DAS Citarum (Bogor: BPDHASL)
[7] Azizi A and Hikmah H 2008 Identifikasi faktor-faktor yang mempengaruhi pengambilan keputusan dalam pengadopsian paket teknologi budidaya udang di Tanah Laut Kalimantan Selatan J. Sos. Ekon. Perikan. Kelaut. 3 213-31
[8] Marphy T M and Priminingtyas D N 2019 Analisis faktor-faktor yang mempengaruhi tingkat partisipasi petani dalam program Asuransi Usaha Tani Padi (AUTP) di Desa Watugede, Kecamatan Sigosari, Kabupaten Malang Habitat 30 62-70
[9] Arvianti E Y, Masyhuri, Waluyati L R and Darwanto D H 2019 Gambaran krisis petani muda di Indonesia J. Sos. Ekon. Kebijak. Pertan 8 168-80
[10] Susilowati S H 2016 Fenomena penuaan petani dan berkurangnya tenaga kerja muda serta implikasinya bagi kebijakan pembangunan pertanian Forum Penelit. Agro. Ekon. 34 35-55
[11] Kompasiana 2015 Benarkah “Dapur, Sumur, Kasur” Tidak Relevan Lagi? Kompasiana
[12] Komariah S 2019 Perubahan peranan wanita sunda: studi kasus di Kota Bandung J. Pembang. Sos. 2 354-84
[13] Hutajulu J P 2015 Analisis peran perempuan dalam pertanian di Kecamatan Rasau Jaya Kabupaten Kuburaya J. Soc. Econ. Agric. 5 83-90
[14] Sajogyo P 1983 Peranan Wanita Dalam Perkembangan Masyarakat Desa Rajawali (Jakarta: Rajawali)
[15] Chen H 1996 The role of gender in farming household decision-making in Yaan, South-Western China (Wageningen: Agricultural University)
[16] International Rice Research Institute 1987 Women in Rice Farming System: An Operational Research and Training Program (Manila: International Rice Research Institute)
[17] Raidimi 2014 He roles and activities of women in the six selected agricultural projects in thulamela local municipality of vhembre district municipality in the Limpopo Province J. Agric. Ext. 42 10–23
[18] Pal S and Haldar S 2016 Participation and role of rural women in decision making related to farm activities: a study in Burdwan District of West Bengal Econ. Aff. 61 55-63
[19] Suradisastra K 1998 Perspektif keterlibatan wanita di sektor pertanian Forum. Penelit. Agro. Ekon. 16 1-9
[20] Lesmana D 2005 Peranan wanita dalam pengambilan keputusan penerapan teknologi pada usahatani salak pondoh Nglumut EPP 2 29-38
[21] Syarif A and Zainuddin M 2017 Kontribusi ekonomi dan peran perempuan dalam pengambilan keputusan pada usahatani sayuran di Kabupaten Bantaeng Pros. Sem. Hasil Penelit. (Makassar: Politeknik Negeri Ujung Pandang) pp 8-12