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To cite this article: Ashari *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **892** 012086

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Impact of area-wide management for fruit flies on the role of women in mango farming

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Abstract. Studies on women's roles in Indonesian mango farming were rarely conducted. This paper examines the changes made to women's roles in mango production and its benefit distribution for household (HH) needs due to Area Wide Management (AWM) implementation for fruit flies. Data were collected at two villages in Indramayu, West Java, during July and August 2019. The respondents were cooperator farmers who had taken part during the 2010–2015 AWM project implementation. This study applied a survey method for data collecting using structured questionnaires. The data were descriptively analyzed with a focus on gender perspectives. The study showed that the primary activity of most cooperators was for mango farming. Women had minor roles in pre-harvest and harvest mango farming activities. However, almost all accesses and participations of pre-harvest activities had increased after the implementation of AWM. Women's controls have increased for all activities except for processing and sorting, which had been already high. Adult females took control of financial decision-making on how the mango farming benefit was allocated. There was a higher allocation expense on savings, education and vehicle following the implementation of AWM. The increased women's role in the production and financial decision-making had given promising results in children's education improvements. This study suggested that the agricultural program should involve women as the actors as well as the beneficiaries. The women's involvement in the project was expected to optimize the benefits of the project, and further will ensure its sustainability.

1. Introduction

In the global position, Indonesia's mango production ranks fifth, following Brazil, India, China, and Thailand. Mango production growth during the 2017–2018 period had also been considerably high. Mango commodity achieved the most significant increase in fruit production during the mentioned period, where production increased sharply by 420,998 tons or 19.1% [1].

One of the constraints of getting a high mango yield was significant pests and diseases attacks. Generally, the problem with mangoes in Indonesia was fruit fly infestation. In mango farming, fruit flies were still the primary pest that could cause high yield losses [2]. Fruit damage due to fruit fly



attacks reached 30–40%, reducing farmers' income significantly [3]. Fruit fly control efforts could be made through fruit wrapping and the use of traps with attractants such as methyl eugenol. This method was quite effective and safe for the environment because this substance was not directly related to the fruit, so the residual impact could be considered non-existent [4].

In terms of fruit fly control efforts, during the 2010–2015 period, ACIAR had carried out a project of Area-Wide Management (AWM) for fruit flies. The AWM was a low insecticide system approach to reduce fruit fly infestations to near zero. Briefly, the objectives of this project are to (1) reduce fruit losses, increasing the number of marketable fruit, (2) improve the mango quality, and (3) reduce overall chemical use. By implementing this program, it is expected that the mango growers will increase their returns significantly.

The first AWM project was implemented in Indramayu District during the 2010–2015 period. It focused on Gedong Gincu mango farming. The Gedong Gincu mango was selected due to its exotic nature and potentially very profitable because of its high price. The problem was that Gedong Gincu mango attracted fruit fly infestation. Gedong Gincu, which was grown in particular districts of West Java Province, owned the prospect of being exported commodity because of its several comparative advantages [5].

Another aspect that was also one of the ACIAR project focuses was gender dimensions in mango farming. It was expected that the project would improve women's roles in mango farming, both in upstream and downstream business nodes. The project could increase women's participation in mango farming. Focusing on gender dimensions, in this case, gender analysis application would improve decision-makers to launch proper strategies to give a better base for women farmers to appreciate their unrecognized potential in bringing sustainability to the production system [6]. The role of women in agriculture has often been discussed. However, studies on women's roles in mango farming were rarely conducted. Various studies of gender aspect in agricultural activity showed a different result among studies.

Woman's involvement nature and intensity varied from one area to another [7]. In Karnal region, Haryana, India, woman agricultural laborers had lower participation than man agricultural laborers. So did the wage rate. Women laborers got a lower wage rate than men. A study carried out in mango farming in Tamil Nadu, India, demonstrated that women's participation in farm decision-making and post-harvest operations were discouraging. Women only control less than 10% of the land, while non-farm assets were more than 95% on behalf of men. The women merely dominated in terms of decisions on livestock maintenance and sale [8].

A study on intra-household bargaining, gender consideration in decision making on food security of farm households in Nigeria revealed that there was gender-based decision making within the farm households [9]. Households whose women did not participate in decision-making and food provision were more vulnerable to food insecurity because men did not pay much attention to family needs for food. Although the study mostly on food security, it showed an effect of intra-households decision making on family food security. Therefore, to get food security within the farm households, it was important to encourage balanced gender-based decision-making and conduct woman empowerment.

In general, woman's role in farming activities alienated into two activities. First, pre-harvesting activities such as land processing, seed/fertilizer/infrastructure preparation, weeding, pest and disease prevention, and watering. Second, harvesting and post-harvesting activities, namely, crop threshing, harvesting, cleaning, transport, sorting, and marketing [10]. Women in Karo District worked in the field from early morning up to evening to fulfill family needs. Women should work to ease the burden on their husbands. Farmers (corn commodity) in the district were very dynamic and independent [11].

The position of women in agriculture was unique, and it depended on the kind of farming system. The results of gender analysis showed that in the aspect of the activity, the role of women was more dominant than that of men in organic vegetable farming. However, women's participation in organic vegetable farming was not in line with the authority (control) and opportunity (access) because men occupied dominant authority and opportunity [12].

The objective of the research was to (1) assess the characteristics of mango farmers, (2) analyze women's access and participation in mango farming, and (3) comprehend the women's role in decision-making on the benefit allocation of mango farming. These last two aspects would be measured before and after implementing Area-Wide Management (AWM) technology of mango farming.

2. Materials and methods

2.1 Materials

The study was conducted in two villages: Krasak and Sliyeg Lor, Indramayu District, West Java Province, Indonesia, from July to August 2019. The villages were the research sites of the ACIAR Project No. HORT/2008/041 "Area-wide management of pest fruit flies in an Indonesian mango production system" (AWM Project), conducted during 2010–2015 period. Indramayu District was also known as the production center of Gedong Gincu mango. Samples consisted of 56 mango farmers (households) who were selected purposively. The respondents were the farmers who had participated (cooperator) in above-mentioned project. A survey method was applied for data collecting using structured questionnaires.

2.2 Methods

This study focuses on the gender aspects mainly elaborated the female role in mango farming based on farmers' perception. The parts covered the access and participation of women in mango farming, the role of the female in decision-making, and the allocation of the benefit obtained from mango farming for particular items/expenditures. The term of access implied the degree of ease achieved by farmers and their family members on farming resources and activities. In this study, it was related to how women got access to mango farming activities. Meanwhile, participation was defined as a person's mental and emotional goals and taking responsibility for them. In reality, someone who has access to a farming resource might not always participate in farming activities.

Data were descriptively analyzed using frequency or percentage. However, for objective 3, we applied the chi-square test to examine the allocation of benefits generated from mango farming for some expenditure types. A chi-square statistic is a single number that reveals how much difference exists between the observed value and the expected value if there were no relationship in the population. The formula of chi-square is as follows.

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

The subscript "c" is the degrees of freedom, "O" is the observed value, and "E" is the expected value.

3. Results and Discussion

3.1. Characteristics of mango farmer households

Table 1 demonstrates that, on average, the mango growers in the Indramayu District belonged to productive age, namely of 50 years for Krasak village and 51 years for Sliyeg Lor village. The average number of household members was relatively small, less than four persons. The size number of household members of Krasak village was higher than that of Sliyeg Lor's. Educational attainment for the head of household and the wife belonged to the low category (junior high school/elementary school). In terms of mango farming practices, farmers have experienced more than 13 years.

Most cooperator farmers admitted that mango farming was the primary job, followed by food crops farming as the other dominant job. The majority of the spouses served only as homemakers (85% of Krasak village dan 78% of Sliyeg Lor village). There were only 7% of spouses in Krasak village and 17% in Sliyeg Lor village, Indramayu District, who had mango farming as their main occupation. Mango growers, both in Krasak village and Sliyeg Lor village, had more than 13 years of experience in mango farming.

Table 1. Characteristics of respondents in Indramayu District, 2019

No.	Variable	Village	
		Krasak	Sliyeg Lor
1.	Head of HH age (years)	50	51
2.	Spouse age (years)	45	47
3.	Number of HH members (persons)	3.66	3.31
4.	Head of HH education (years)	8	6
5.	Spouse education (years)	9	7
6.	Mango farming experience (years)	13.88	13.58
7.	Mango farming as main job (%)	70	84

3.2. Impact of the AWM project on women's role in mango farming

The role of women in mango farming could be reflected by their access and participation in farming activities. Table 2 presents how the farmers perceived the change in the role of women in mango farming due to the AWM project. The perception was represented by respondents who answered "yes" for particular activities. It shows, in general, that farmers perceived that women's access has increased in almost all activities, as shown by the positive signs of change. Greater improvement occurred in sorting, grading, processing, and training activities. Meanwhile, credit access activities had decreased.

Regarding the participation or involvement of women in mango farming, this study results showed that farmers perceived a reasonably high increase in women's involvement in harvesting, grading, marketing, processing, credit, and transportation activities. On the contrary, the participation decreased in sortation and technology-related activities.

Table 2. Access and participation of women in mango farming activities before and after the AWM project.

Activities	Access (%)			Participation (%)		
	Before	After	Change	Before	After	Change
Pre-harvest	6.42	8.05	1.63	5.33	6.26	0.93
Harvest	35.80	37.20	1.40	28.30	30.20	1.90
Sortation	13.20	16.30	3.10	7.55	6.98	-0.57
Grading	5.66	9.30	3.64	1.89	4.65	2.76
Marketing	15.10	16.30	1.20	9.43	11.60	2.17
Processing	7.55	11.60	4.05	5.66	9.30	3.64
Training	3.77	9.30	5.53	3.77	4.65	0.88
Extension	3.77	6.98	3.21	3.77	4.65	0.88
Technology	3.77	6.98	3.21	3.77	2.33	-1.44
Credit	3.77	2.38	-1.39	3.77	4.76	0.99
Transportation	3.77	4.65	0.88	3.77	4.65	0.88

The subordinate role of women in agriculture could be in line with their involvement in the decision-making process. In this study site, women were primarily involved in household affairs and did not engage in mango farming. This situation, in turn, will affect the role of women related to decision-making in mango farming. A study in India revealed that the involvement of farm women in the decision-making process in agriculture was shallow. Because most farm women were uneducated and possessed a limited understanding of the latest farming technologies, they encountered males' domination and limited mobilities due to various cultural prohibitions [13].

The extent of women's involvement in farming covered operations such as transplanting, weeding, harvesting, and storing. The farm women encountered restrictions like non-availability of inputs on time, low price, and less involvement in decision-making. Farm women also reported a heavy drudgery level in operations like field preparation, threshing, and marketing [14].

The other study found that women's engagement in the household's decision-making process remained in a shallow position as the head of the family/male members made all crucial decisions. It was because the majority of the females did not get enough chances to receive proper educational attainment. It was probably a kinship system (in the case of Indonesia, it was mostly a patriarchal system) of discrimination towards female family members [15]. In order to counter the condition, woman farmers must have access to appropriate technologies, and they must apply the technologies to improve farm productivity and empowerment [16].

3.3. Impact of the AWM project on women's role in decision-making on benefit allocation

Table 3 depicts how the women took control of decision-making regarding how the benefit of mango farming was allocated. The benefit gained from mango farming was mostly decided to spending on food, saving, electricity, and clothing. The majority of respondents still distributed the gained benefit for those items both before and after the project. The dominant proportion for allocation was relatively similar before and after the AWM project. In terms of the average allocated benefit, the percentage of food was still very dominant. However, the proportion decreased after the project, from 31.63% to 29.19%.

Interestingly, there was a higher allocation of funds towards savings, education, and vehicle following the implementation of the AWM project. It was also a good sign that the farmer had a reasonable concern about their standard of living, and they could be more aware of the education of children. The chi-square analysis shows no significant results for decision-making in allocating gained benefit before and after the project, except for other items that decreased significantly. However, such a phenomenon provides fruitful information about the impact of the AWM. Based on these findings, the effort should be enhanced to increase women's role in decision-making.

Table 3. The decision-making for benefit allocation generated from mango farming before and after the AWM project.

Decision item	Gained benefit (%)			Avrg. of allocate benefit (%)		
	Before	After	Change	Before	After	Change
Food	93.00	97.40	4.40	31.63	29.19	-2.44
Housing	51.20	45.90	-5.30	10.24	10.63	0.39
Electricity	88.40	89.70	1.30	6.08	6.53	0.45
Water	72.10	74.40	2.30	5.90	5.93	0.03
LPG	81.40	82.10	0.70	5.74	5.55	-0.19
Tax	81.40	79.50	-1.90	5.00	5.14	0.14
Education	64.30	66.70	2.40	10.38	14.00	3.62
Health	83.70	82.10	-1.60	7.71	7.74	0.03
Vehicle	30.20	41.00	10.80	7.08	10.13	3.05
Jewelry	53.50	53.80	0.30	9.00	12.65	3.65
Clothing	88.40	79.50	-8.90	6.84	6.47	-0.37
Insurance	2.78	6.25	3.47	5.00	5.00	0.00
Social gathering	37.20	34.20	-3.00	6.81	7.08	0.27
Savings	90.70	92.30	1.60	15.53	16.09	0.56
Others	32.10	11.50	-20.60	28.38	8.33	-20.05

4. Conclusions

Mango farmers in Indramayu District were still of productive age. In addition to cultivated mango plants, they also cultivated food crops such as rice and horticultural crops. Meanwhile, the majority of

farmers' spouses are housewives. However, women in Indramayu had access and could participate in mango farming activities, whether in the upstream and/or downstream business nodes. The existence of the AWM project has had an impact in the form of increasing women's access and participation in mango farming. In general, the increase occurred in post-harvest activities such as sorting, grading, and processing. In terms of participation, there had also been an increase in the mentioned aspects. Meanwhile, in the decision of income allocation gained from mango farming, the percentage was still dominant for food. Moreover, the increased expenses on education, savings, and vehicle also had occurred following the AWM implementation.

The study suggested that the agricultural program should involve women as the actors as well as the beneficiaries. The role of women for on-farm activities seems rather strenuous because they have to handle domestic works. Women should be asked, in the first place, whether they were able or willing to do the pre-harvest work in the fields. Because if they are forced to do such things, it would be drudgeries for them, while drudgery was one of the domestic violence forms. It might be better if the women could involve in post-harvest and marketing activities. Women's involvement would be driven in order to increase mango's added value. Not to mention, women could optimize the benefits of the program and further ensure its sustainability.

Acknowledgement

This paper is a part of the ACIAR Project No. HORT/2015/042 "Development of area-wide management approaches for fruit flies in mango for Indonesia, the Philippines, Australia and the Asia-Pacific Region (IndoAWM)." Therefore, the authors extend the gratitude and appreciation to ACIAR for collaborating and financing the project. ACIAR also allows us to write up this paper for the international conference in ICASEPS.

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