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Farmers' Perception on On-farm Conservation of Mango and *Citrus* Diversity in Indonesia

Dian Kurniasih*, IW Arsanti, Nurmalinda, AM Kiloes[1] and Hugo AH Lamers[2]
[1]*Indonesian Centre for Horticulture Research and Development, Pasarminggu, South Jakarta, Indonesia-12540*
[2]*Bioversity International, Office for South Asia, National Agricultural Science Centre, Pusa Campus, New Delhi-110012 India*

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A study was conducted in 2014 to measure Indonesian farmers' perception of mango and *Citrus* conservation, to analyse which non-behavioural factors affect the farmers' perceptions and to analyse the impact of farmers' participation in project activities based on their perception. Eighty respondents were selected randomly from two sub districts in South Kalimantan and two sub-districts in East Java, and a questionnaire was administered. Simple linear regression showed that farmers' participation in *on-farm* conservation programs positively affect their perceptions about *on-farm* conservation. Multivariate regression analysis indicated furthermore that the following non-behavioural factors do affect farmers' perceptions significantly a) the accessibility of mango and *Citrus* planting materials, b) farmers' knowledge about conservation benefits, c) the level of government support, and d) farmers' knowledge about conservation purposes. Farmers suggest that the Indonesian government should focus on creating access to qualitative saplings, access to farm inputs and assistance to improve their skills in bio-fertilizer and bio-pesticide production. The community biodiversity management approach, as used in the project, seems an appropriate approach to influence farmers' perceptions and behaviour related to conservation activities, especially when incentives and needs of farmers are recognised and addressed.

Key Words: Agricultural biodiversity, Behaviour, *On-farm* conservation, Perception, Tropical fruit trees

Introduction

As an archipelagic country, with its thousands of islands scattered between two continents (Asia and Australia) and two oceans (Pacific and Indian), Indonesia is endowed with very rich and unique biological resources. More than 329 native and introduced fruit species have been documented and described in Indonesia as potential sources of food, nutrition and medicine (Uji, 2007). The Indonesian Ministry of Agriculture (2010) has prioritized mango and *Citrus* as commodities and has targeted production of some 2.5 million tonnes of mango and 2.3 million tonnes of *Citrus*. However, the programmes are threatened by farm land conversions. The rate of farm land conversions in Indonesia is around 100.000 hectares per year and caused by the rapid population growth in the last 15 years that increased around 1.49% per year (Indonesian Statistic Agency, 2014).

Diversifying the agricultural sector has become now an important strategic interest for the Indonesian Government, which requires also a conservation strategy to maintain a viable population of species and the intra-specific diversity within species as the fundamental source for improved planting material. To diversify and improve the agricultural sector, the conservation of fruit trees is urgently needed by the Indonesian government (Hanani *et al.*, 2009), especially for fruit trees which have recalcitrant seeds and can not be conserved in cold storage. The prevention of erosion of native fruit genetic resources should be highlighted as a national priority. Loosing plant genetic resources means that Indonesia will lose national assets to develop new products or compete in the global market, whereas the competitiveness level of Indonesian fruits in Asia is already low.

On-farm conservation entails the active participation of local communities in the documentation, multiplication, utilization and safeguarding of unique species and varieties found on their farms. *In situ* and *on-farm* conservation is ineffective without local community participation (Isager *et al.*, 2001). Community-based Biodiversity Management (CBM), is an example of a conservation approach that empowers the community through participation so that their access to and control over genetic resources are secured (Rechlin *et al.*, 2008). Sthapit *et al.* (2008) described CBM method entails several steps and type of interventions. Firstly sites and

**Author for Correspondence: E-mail: dee_tribe@yahoo.com*

communities are selected with high level of unique inter or intra-specific diversity, followed by full understanding of the local context to determine if *on-farm* conservation is appropriate and feasible. The next steps are: raising awareness, set-up institutional modalities, strengthen capacities and skills, development and implementation of action plans for utilization and conservation, mobilize CBM funds, and facilitating social learning in which local stakeholders lead and drive the CBM process (Sthapit *et al.*, 2008).

On-farm conservation activities and interventions include the organization of diversity fairs, the documentation and description of local species and varieties in a catalogue or register, establishment of nurseries for multiplication and distribution of unique plant or seed material, the promotion of nutritional values and traditional recipes, the development of enterprises and market linkages for the sales of products or services based on local unique crop diversity and the protection/ conservation of most important source trees or seed material (Arsanti, 2013). The successful implementation of *on-farm* conservation projects or interventions is dependent on many inter-related endogenous and exogenous factors. Results are often considered context specific and thus attributed to external factors, providing little recognition for the effectiveness of specific or several associated interventions. This study strives to provide insights which factors do contribute most to the successful participation of farming households in *on-farm* conservation activities, using the model of Green (1994) which evaluates factors that influence behavioural change.

Behaviour and perception are connected with causal relationship (Riding *et al.*, 2001). Perception is a part of human's cognitive and affective area, while behaviour is a part of psychometrics area. Farmers' perceptions on conservation could be affected by *n*on-behavioural factors such as farmers' age, gender, education level, knowledge on conservation purposes and benefits, and external factors such as availability of mango and *Citrus* seed material and also government endorsement and support. Our hypothesis is that the more positive the farmers' perception on mango and *Citrus* conservation activities are, the more chance they will adopt and continue *on-farm* conservation practises within their communities and on their farms. These insights might help to improve the implementation and planning of *on-farm* conservation projects and programmes and also to identify the type of assistance programmes that the government should prioritize to raise the farmers' participation and influence their perceptions ensure the sustainability of existing conservation efforts.

Methodology

Green (1994) developed a model or framework to better understand how to improve health education and treatment programmes (for asthma) that take into account additional factors such as lifestyle, behavioural factors and social or environmental factors besides the medical treatment. The model strives to understand how to facilitate and achieve behavioural change of the patient to adopt the suggested therapy. The model has been applied and adapted in former studies to assess which factors influence the implementation of land conservation and soil degradation programs (Ratnada 2002; Kurniasih 2007). Model was used to analyse the factors crucial for the adoption of *on-farm* conservation programmes (Green, 1994). The model describes that the sustainable adoption of therapies (or programs) entails the facilitation of behavioural change of the target individual or group which is strongly affected by people's perceptions. In this study we identified 7 non-behavioural factors which influence perceptions related to *on-farm* conservation which are grouped as follow: (a) predisposing factors (farmers' age, gender, farmers' educational level, farmers' knowledge on conservation purposes and benefits), (b) enabling factor (mango and *Citrus* planting materials availability), (c) reinforcing factors (government support).

Key Variables or Concepts Used in the Model

On-farm conservation entails the implementation of a range of activities involving community members in the documentation, dissemination, utilization and safeguarding of mango and *Citrus* species and varieties. In this study *on-farm* conservation means the development of a community biodiversity register (fruit catalogue), establishment of community nurseries, conducting diversity fairs, establishment of a diversity block, producing and popularizing informative flyers about good practices in conservation and other publications, training on grafting, fruits processing and marketing.

Farmers' perception regarding *on-farm* conservation was determined by the opinion of farmers about the importance of a range of activities for *on-farm* conservation. Respondents were asked about the

importance of the following activities; *i.e.* community biodiversity register, community nursery, conducting diversity fair, diversity block, producing fruit catalogues and other publications, training on grafting, fruits processing and marketing). Respondents could choose between 5 options ranging from 1. Strongly Disagree, 2. Disagree, 3. Doubt, 4. Agree, 5. Strongly agree. Subsequently the sum of all scores for each respondents were categorized in three equal groups, those with high score (38-50), medium score (24-37) and low score (10-23). High scores were interpreted as a positive perception towards *on-farm* conservation and low scores with a negative perception towards *on-farm* conservation.

Farmers' participation was determined by the frequency of participation in each of the seven listed *on-farm* conservation activities. Respondents could choose between 5 options ranging from (1. Never, 2. Very rarely, 3. Rarely, 4. Often, 5. Always). Similarly, the sum of all scores determined the frequency of participation, which was clustered in three categories; low, medium and high participation.

Predisposing factors in this study were described as the factors that facilitate or predispose the farmers' perception on *on-farm* conservation of *Citrus* and mango. The predisposing factors determinated in this study were farmers' age, gender, farmers' educational level, farmers' knowledge on conservation purposes and farmers' knowledge on conservation benefits. The last two variables were calculated based on the sum of scores from several questions asking them to confirm their awareness about several purposes and benefits related to conservation of mango and Citrus diversity in a Likert scale of five options. This study used those factors as they have been proven to affect farmers' perception and behaviour (Kurniasih, 2007).

Enabling factors described as the external factor that enable or facilitate the farmers' perception on *on-farm* conservation of *Citrus* and mango. The enabling factor determined in this study is mango and *Citrus* planting materials availability. The variable was calculated based on the sum of scores for several questions asking about the distance, number and type of nurseries and the number of varieties that are available to them.

Reinforcing factors in this study described as the factors that encourage and reinforce the farmers' perception on *on-farm* conservation of *Citrus* and mango. The reinforcing factor selected in this study was government support.

Study Site and Sampling Method

The study was carried out in four districts: Sukomoro and Tiron sub-district in East Java province, Pembantanan and Kandangan sub district in South Kalimantan province. The locations were selected out of six sites which have been part of the UNEP/GEF funded project 'sustainable use of wild and cultivated tropical fruit tree diversity, improving livelihoods, ecosystem services and food security', which used the CBM approach to strengthen local *on-farm* conservation practises for mango and *Citrus* species and varieties in selected villages. South Kalimantan and East Java are major production regions of mango and *Citrus* respectively in Indonesia and harbouring a wide range of inter- and intra-specific diversity. Based on baseline survey was reported by Winarno *et al.* (2013), Tiron had 4 species of mango, Pembantanan and Telaga Langsat had 11 species of mango, and Sukomoro had 6 different species of *Citrus*. The details of varieties for each species can be seen in Table 1.

Data were collected by enumerators using pen and paper questionnaire including multiple choice questions and few open questions regarding their participation and perceptions of project interventions. Respondents were selected by simple random sampling, selecting 20 people from each of the four locations. Heads of households were selected for interview and if not available the person available that could represent the household, ensuring equal representation of male and female respondents. In total 80 respondents consisting of 47 male farmers and 33 female farmers were interviewed. Interviews were conducted at the end of the UNEP/GEF project for *on-farm* conservation after completion of all field activities.

Data Analysis

Descriptive statistics was used to describe the basic features of the variables used in the study (See Table 2). To categorize the variables in respondents with high, medium and low scores proportions where calculated as described in Dajan (1986) for the following variables; i.e. farmers' knowledge on conservation purposes, farmers' knowledge on conservation benefits, mango and *Citrus* planting materials availability, government support, farmers' perception and participationon mango and *Citrus on-farm* conservation Subsequently the study used simple linear regression analysis to study the relationship between participation and perceptions.

Table 1. The species and varieties identified at the study location

Location	Scientific name	Varieties (local name)
Tiron	*M. indica*	Podang Urang, Golek, Gadung, Madu, Lanang, Santok Buto, Kopyor, Santok Kapur, Bader, Jempol, Manalagi, Dodonilo, Beruk, Sengir Empok, Apel, Gajih, Gurih, Ireng, Dasa Muko, Cantek, Lulang, Cantrik
	M. foetida	Jaran
	M. odorata	Pakel, Kweni
	M. lalijiwo	Lalijiwo
Pembantanan and Telaga Langsat	*M. indica*	Hampalam Nagara, Mangga Golek, Mangga Gadung, Hampalam Hambuku, Hampalam Biasa, Apel
	M. foetida	Hambawang Biasa, Hambawang Kalambuai, Hambawang Tapah
	M. odorata	Kuini
	M. torquenda	Hambawang Pulasan
	M. griffthii	Rawa-Rawa Humbut, Rawa-Rawa Biasa
	M. applanata	Palipisan Sak Hirang, Palipisan Sak Hijau
	M. havilandii	Hampalam Damar
	M. rufocostata	Tandui
	M. casturi	Kasturi
	M. caesia	Binjai Manis, Binjai Asam
	M. pentandra	Asam Pauh
Bibis	*C. grandis*	Adas, Adas Duku, Nambangan, Sri Nyonya, Bali Merah, Bali Putih, Jeruk Gulung, Jeruk Jowo, Pamelo Magetan
	C. sinensis	Sunkis
	C. hystrix:	Jeruk Purut
	C. reticulata	Keprok Gulung Keprok Siem
	C. aurantifolia	Jeruk Pecel
	C. limon	Sitrun

Table 2. Descriptive table

Variables	Mean	Standard deviation	Score max	Score min
Farmers' age	44.68	12.04	80	20
Farmers' educational level	8.68	4.11	0	17
Knowledge of conservation purposes	47.78	5.10	63	37
Knowledge of conservation benefits	20.72	3.38	25	5
Mango and *Citrus* richness within the village	15.50	3.03	21	5
Government support	24.13	3.04	31	16
Farmers' participation	37.96	4.37	47	27
Farmers' perception	20.43	2.95	25	10

Besides, the study used multiple linear regression analysis to assess which non-behaviour factors do influence perceptions of farmers.

A simple linear regression analysis was used to analyse the impact of farmers' participation in project activities on their perceptions on mango and *Citrus* conservation.

$Y = a_0 + b\ X + e$

Where:

Y : Farmers' perception on mango and *Citrus* conservation;
a_0 : constant;
b : regression coefficient;
X : farmers' participation on mango and *Citrus* conservation.

Whereas a multiple linear regression analysis was used to analyse non-behavioural causes that dominantly affecting the Indonesian farmers' perception on mango and *Citrus* conservation.

$Y = a_0 + a_1\ Di + b_1X_1 + b_2X_2 + b_3X_3 + ...+ b_6X_6 + e$

Where:

Y : Farmers' perception on mango and Citrus conservation (Z score);
a0 : constant;
a1 : regression coefficient of dummy variable;
b1–b13 : regression coefficients;
Di : Gender (dummy variable);
X1 : Farmers' age;
X2 : Farmers' education level;
X3 : Knowledge of conservation purposes;

X4 : Knowledge of conservation benefits;
X5 : Mango and Citrus richness within the village;
X6 : Government support; and
e : Error.

X_1 was determined by asking of farmers' age, X_2 was determined based on number of years of farmers' education, X_3 was determined by asking about the farmers' knowledge about conservation purposes (i.e. ecological purposes, economical purposes, and social purposes). Variable X_4 was based on farmers' respons about conservation benefits (i.e. ecological benefits, economical benefits, and social benefits). Whereas X_5 was determined by several questions about the availability of saplings in the village. X_6 was determined by asking the farmers' about the number of government programs they participated that contribute to the *Citrus* and mango *on-farm* conservation such as technical assistance programs for fruit tree cultivation. This was converted into a number by calculating a total score (interval score 1, 2, 3, 4, 5) from each question in each variable.

Results

People's perception is influenced by participation (in the program activities) and non-behavioural factors (Fig. 1). Green (1994) differentiated non-behavioural factors into three categories, (a) predisposing factors include knowledge, attitudes, beliefs, personal preferences, existing skills, and self-efficacy towards the desired behaviour change, (b) enabling factors are skills or physical factors such as availability and accessibility of resources, or services that facilitate achievement of motivation to change behaviour, (c) reinforcing factors include factors that reward or reinforce the desired behaviour change, including social support, economic rewards, and changing social norms.

Ratnada (2002) reported that non-behavioural causes that consist of predisposing factors (*i.e.* farmers' motivation to reach success, farmers' knowledge on land conservation, and farmers' initiatives to get information), enabling factor (*i.e.* farmers' income), and reinforcing factor (extension intensity), influenced farmers' behaviour in land conservation. Kurniasih (2007) also reported that predisposing factors (*e.g.* farmers' age, conservation knowledge, motivation, activity in group), enabling factors (*e.g.* non-agricultural income and availability of organic input), and reinforcing factors (e.g. government endorsement and policy support) affected farmers' perceptions and behaviour regarding wetland conservation.

The variables used for this analysis are presented in Fig. 2. The results indicated that 53% of the farmers fall into non-productive age group (*i.e.* 60 years and older) while 47% into productive age group (*i.e.* between 16 and 60 years). Farmers interviewed included just as much young as older farmers, showcasing equal distribution of age. This is interesting as often it is assumed that farmers are generally getting older as less and less young farmers take up farming. Most of them have more than six years of formal education, which means they have

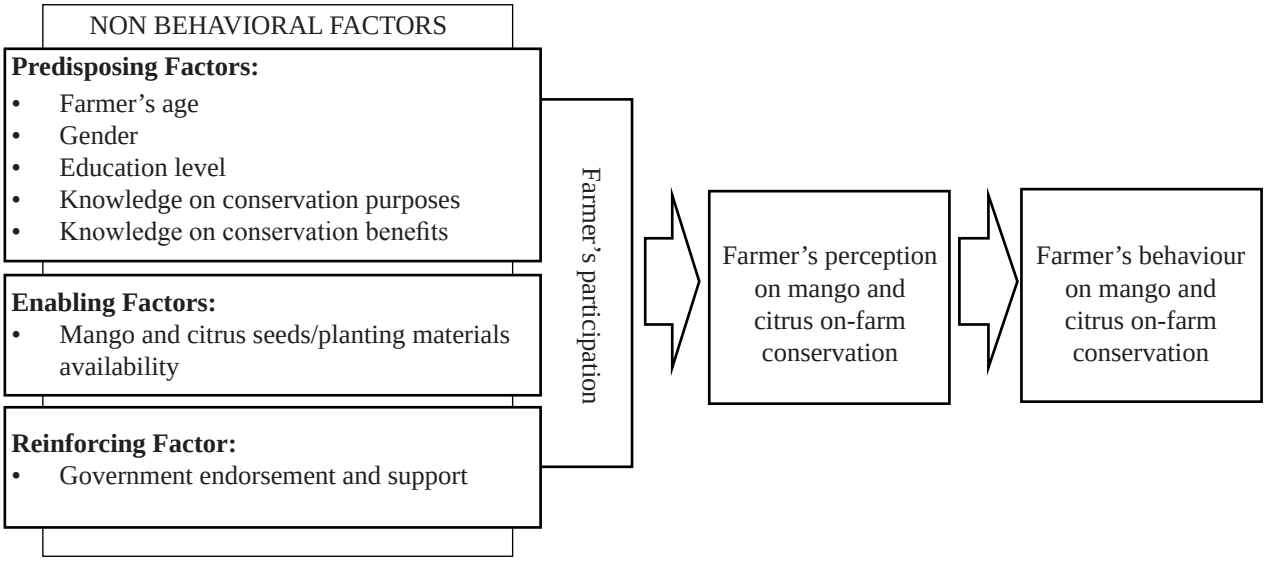

Fig. 1. Logical frame of the study

Table 3. Regression analysis result of causal relationship between farmers' participation and farmers' perception about *on-farm* conservation activities by SPSS.16 operation

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.575[a]	0.331	0.322	2.43614	1.289

a. Predictors: (Constant), Farmer participation
b. Dependent Variable: Farmer_perception

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.675	2.393		2.371	0.020
	Farmer participation	0.389	0.063	0.575	6.209	0.000

a. Dependent Variable: Farmer participation

finished secondary school, which will influence the ability to understand concepts of *on-farm* conservation. The respondents were having high knowledge about social, ecological and economic benefits of conservation activities (88% of respondents fall in highest tertile), and substantial knowledge on the purpose of conservation activities (56% of respondents fall in highest tertile). While government support and access to saplings is medium (respectively 83% and 74% respondents fall in middle tertile), the participation in activities and perception about conservation activities is very high (87% and 89% respectively in highest tertile).

Farmers participated most in diversity fair (32.5% farmers participated always), training on grafting (15%), training on processing fruits (12.5%), community nursery (10%), training on marketing (10%), diversity block and producing fruit catalogue (7.5%) and community biodiversity register (5%). Based on their participation, farmers gave highest importance to the following activities as part of *on-farm* conservation activities; conducting diversity fair (36.25% farmers were agree), training on grafting (17.5%), training on processing fruits (16.25%), and establishing community nursery (11.25%). Other activities were considered less important such as producing fruit catalogue and other publication (6.25%), training on marketing (5%), community biodiversity register and diversity block (3.75%). Results show that activities in which respondents participated most are evaluated sequentially also as most important for *on-farm* conservation with diversity fairs as clearly most mentioned activity as stated by Arsanti and Kurniasih (2013).

The results of the simple regression equation showed that farmers' participation in activities does affect farmers' perceptions with an R^2 of 0.322, which means 32.2% of the change in perceptions is explained by their participation in project activities (see Table 3). This means a larger share is explained by other factors; however frequent participation in project activities does play a major role in influencing perceptions about the importance of activities for *on-farm* conservation. The regressor is estimated to be 0.389 (significant at the 0.01 level) showcasing a substantial effect on perception when the frequency of participation changes.

The results of multiple linear regression analysis presented on Table 4 showed that R^2 value is high (0.901). This means that 90.1% variation in the farmers' perception on mango and *Citrus* conservation activities could be explained by the independent variables observed. The regression equation is:

$$Y = a_0 + a_1 Di + b_1X_1 + b_2X_2 + b_3X_3 + ...+ b_6X_6 + e$$

$Y = 0.338 - 0.003Di - 0{,}044\ X_1$ (Farmers' age) $+ 0.031X_2$ (Farmers' education) $+ 0.084X_3$ (Farmers' knowledge on conservation purpose)** $+ 0.163X_4$ (Farmers' knowledge on conservation benefits)** $+ 0.753X_5$ (Farmers' access of mango and *Citrus* planting materials)** $+ 0.160X_6$ (Government support)** + error

Checking the model on heteroskedasticity (scatter plot), autocorrelation (Durban-Watson test) and multicollinearity (Variance Inflation Factor test) shows no pattern in residuals (model seems fit) or disturbing correlations between error terms or independent variables. Variables (significant at 0.01 level) with largest (standardized) effect on a change in perceptions are respectively seed availability (0.753), knowledge about conservation benefits (0.163), government support (0.160) and knowledge about purpose of *on-farm*

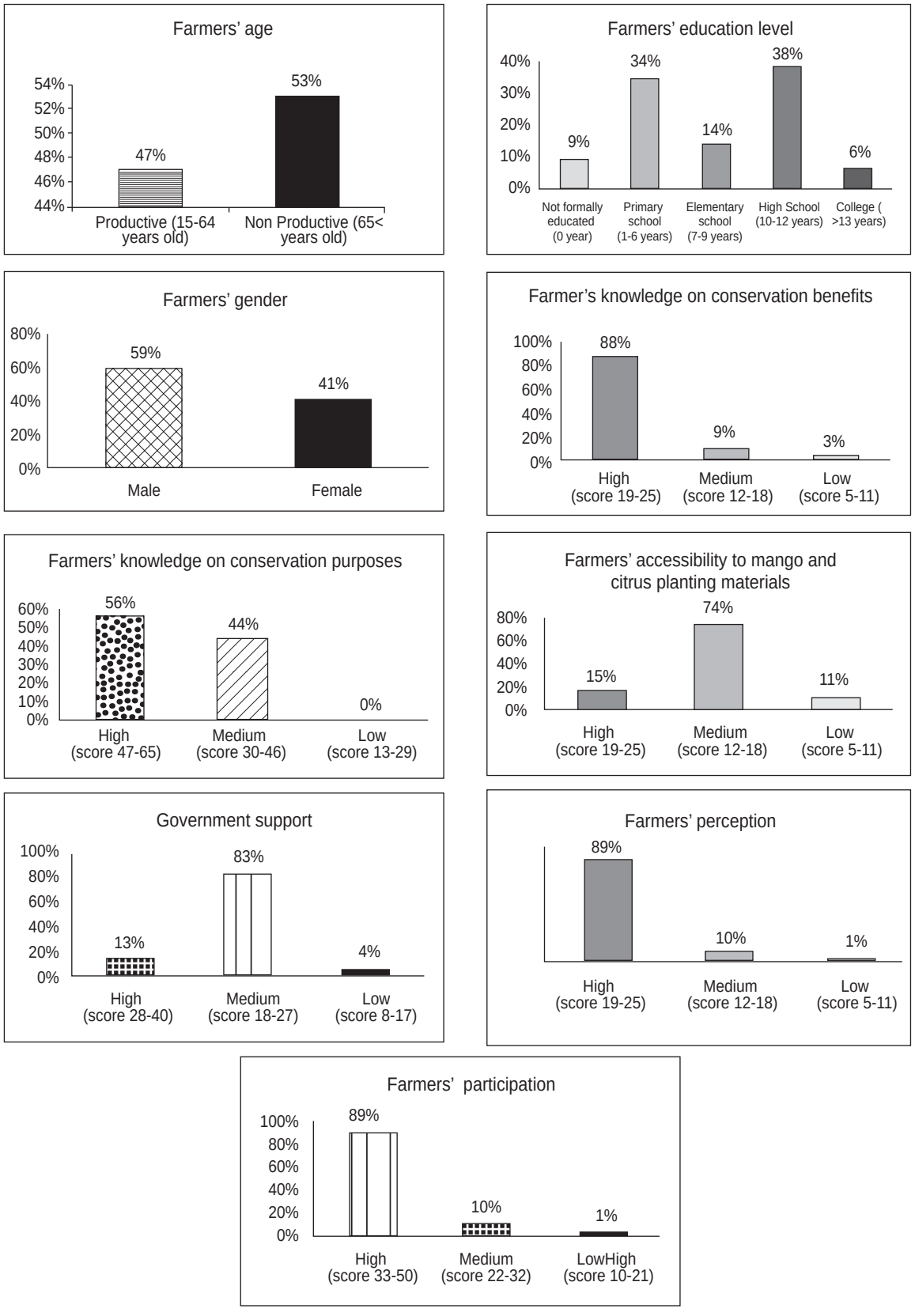

Fig. 2. Distribution of non-behavioural factors, farmers' participation and perception (Primary data, 2014)

conservation (0.084). Gender, age and education years were not significant. The results show that improving the availability of saplings has a major positive effect on perceptions, and thus subsequently ismost likely to facilitate a change in behaviour and the successful adoption of *on-farm* conservation practices. Knowledge about the purpose and benefits of conservation and government support, have a significant but smaller effect.

Discussion

The Influence of Predisposing, Enabling, and Reinforcing Factors

Age is an intrinsic factor that is believed to affect the acceptance and adoption of new information (Jogiyanto, 2007). The result of this study showed that, farmers' perception was not affected by farmers' age. This study identified that 53% of the farmers are more than 65 years old. Nevertheless, they still actively worked in their farm to cultivate paddy, vegetable, fruit, and also raised cattle. They also still involved in the farmers group activities. By interacting with the other farmers they benefitted from the information related to their mango and *Citrus* farming. Therefore, despite the fact that they are included in non-productive age group, their level of perception is still high.

Gender is an important issue and involving woman farmers in conservation programmes is necessary as they have significant knowledge on conservation issues and hence should have the same right as men to be involved in any decision making process regarding *on-farm* conservation activities (Kurniasih, 2007). Unfortunately, often traditional and culturally embedded taboos prevent them to play an active role in such processes. The result of this study showed that, gender did not affect the farmers' perception. In total, 59% of respondents are male and 41% female farmers. In this case, the woman farmers were also actively involved in the farmer group activities, conservation activities and the training workshops provided by government agencies or Non-Government Organizations (NGOs). Women also got involved through a woman farmer group that established a business unit for the processing of mango and *Citrus* fruits.

Education strengthens capacities and gives knowledge and ideas to the participants to access more information and technologies that are useful to improve their farming system. The result of this study showed that educational level did not affect the farmers' perception. Most of the respondents did not have higher level education such as pursuing a bachelor or master's degree. About 57% of the respondents were formally educated (up to 9 years), meaning they finished high school or a vocational school after secondary school. However, even farmers with limited formal education have a high perception on conservation activities. It is possible that they may be getting information about mango and *Citrus* conservation from informal institution like farmer groups. Conservation is usually a long term effort and may not always be a profitable activity. Often, farmers were not interested in conservation programmes because they did not directly benefit from it. Government has to change the farmers'

Table 4. Regression analysis result of causal relationship between non behavioural factors and farmers' perception by SPSS.16 operation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.954[a]	0.910	0.901	0.92868	1.413

Coefficients[a]

Model	Unstandardized coef.		Standardized coef.	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	0.338	1.407		0.240	0.811		
Age	-0.011	0.010	-0.044	-1.145	0.256	0.828	1.208
Gender	-0.016	0.227	-0.003	-0.070	0.944	0.866	1.155
Year_of_Education	0.022	0.027	0.031	0.823	0.413	0.876	1.142
Seed_availability	0.733	0.047	0.753	15.659	0.000	0.539	1.854
Knowl_conserv_ purposes	0.049	0.023	0.084	2.116	0.038	0.783	1.278
Knowl_conserv_ benefits	0.143	0.042	0.163	3.414	0.001	0.546	1.832
Government_support	0.155	0.037	0.160	4.243	0.000	0.880	1.136

Dependent Variable:Farmer_perception

mind set about conservation and its purposes. In this study, the farmers' knowledge about the different uses and purposes of mango and *Citrus* conservation significantly affected the farmers' perception. The study suggested that the project activities have been effective to increase the knowledge of farmers regarding the purpose of conservation and its benefits. The study also suggests that targeted activities regarding these topics are important to influence opinions and perceptions regarding the importance of *on-farm* conservation activities.

Conservation of mango and *Citrus* depend on planting materials availability as enabling factor, especially for wild species that recently have been difficult to find. Mostly, only commercial varieties are available. In this study, 85% of farmers indicated to have difficulties to access mango and *Citrus* planting materials, especially for wild varieties. The result of this study showed that farmers' access to mango and *Citrus* planting materials has a large influence on their perception on conservation. The farmers got the mango and *Citrus* planting materials from community nursery that were established by the project. Unfortunately, community nurseries have not been able to fulfill the planting materials demand because of its limitation of rootstocks. This issue should be taken by the government and it should develop faculties so that the access to seedlings of species/varieties by farmers is improved. This may be done through establishing nurseries by formal sector or by promoting community nurseries.

This study also indicated that the support by the government to conservation programmes influenced the farmers' perception on mango and *Citrus* on farm conservation. This reinforcing factor already proven affected the farmers' behaviour on conservation (Ratnada, 2002; Kurniasih, 2007). About 89% farmers' stated that the role of government in *on-farm* conservation is crucial. The role of the government, to empowering communities in the management of genetic resources, is critical. In the case of the mango and *Citrus* conservation project, the government was responsible to educate, facilitate, and empower the communities by providing information, technology, and assist them to secure economic benefits from conservation activities. However, such interventions need to be cost efficient, effective and sustainable, as a dominant role of the government can also disempower communities. Farmers identified that the government should help the community by providing mango and *Citrus* seed and seedling production technology, farm inputs such as fertilizers and pesticides, harvesting and post-harvest technologies (fruits processing : pure, juice, dodol, manisan), and market linkages (see Table 5).

Conclusions

This study conducted in the final phase of a community-based *on-farm* conservation project showed that farmers' participation in project activities had a major positive effect on their perceptions about *on-farm* conservation, and thus increased the likelihood that practises are adopted and continued within their farming system. Multivariate regression analysis indicated furthermore that the following non-behavioural factors do affect farmers' perceptions significantly a) the accessibility of mango and *Citrus* planting materials, b) farmers' knowledge about conservation benefits, c) the level of government support, and d) farmers' knowledge about conservation purposes. The organization of diversity fairs was considered most important and most often attended by the farmers among all activities. Furthermore, farmer suggested that the Indonesian government should provide assistance in the creation of access to qualitative saplings, access to farm inputs and assistance to improve their skills in production of bio-fertilizer and bio-pesticide, as part of *on-farm* conservation activities.

The community biodiversity management approach and its activities, as used in the project, seems an appropriate approach to influence farmers' perceptions related to conservation activities, especially when incentives and needs of farmers are recognised and addressed. Creating access to planting material of unique fruit species and varieties, the provision of additional agronomic and technical support and the creation of benefits through income generation seem all important aspects for a community-based biodiversity management approach.

With efficient and effective government assistance, farming communities in high diversity areas may be able to position themselves as agent of change to ensure the sustainable utilization and conservation of fruit tree diversity. Some outcome that emerge from this study that could be implemented by stakeholders are:

The importance of identifying and working through custodian households within the community as entry point for interventions and agents of change to document and spread knowledge, practises and saplings across the community.

Table 5. The rank of community needs for the following government programmes

Community needs	Positive confirmations (%)	Rank
Providing the mango and *Citrus* planting materials	90	1
Providing the production input (fertilizer and pesticide)	86	2
Assistance on cultivation and pest control technology	83	3
Providing a micro finance	80	4
Assistance on harvest and post-harvest assistance	75	5
Assistance to build marketing linkage	71	6
Training on seedling technology	60	7

The importance of having a long timeframe of 5-8 years of *on-farm* conservation projects to understand the context, identify key stakeholders, plan interventions to be able to influence and change perceptions and behaviours regarding the utilization and safeguarding of local fruit tree species.

The existing conservation activities that are part of the CBM approach, such as biodiversity block or garden, community biodiversity register or fruit catalogue, community nursery, diversity fair, processing product of mango and *Citrus*, and marketing training, are effective to encourage farmers' participation and perception on conservation of mango and *Citrus*. Therefore, these activities should be continued to get increased participation not only in the project location but also in the other places in Indonesia.

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