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Motivation for On-farm Conservation of Mango (*Mangifera indica*) Diversity in India – A Case Study

TM Gajanana[1*], MR Dinesh[1], S Rajan[2], R Vasudeva[3], Sanjay Kumar Singh[4], Hugo AH Lamers[5], VA Parthasarathy[6], Bhuwon Sthapit[7] and V Ramanatha Rao[8]

[1]*ICAR-Indian Institute of Horticultural Research, Hesaraghatta Lake Post, Bengaluru-560089, Karnataka, India*
[2]*ICAR–Central Institute for Subtropical Horticulture, Rehmankhera, Lucknow-227107, Uttar Pradesh, India*
[3]*Department of Forest Biology and Tree Improvement, College of Forestry, Sirsi, University of Agricultural Sciences, Dharwad-580005, Karnataka, India*
[4]*ICAR-National Research Centre for Litchi, Mushahari, P.O. Ramna, Muzaffarpur-842002, Bihar*
[5]*Bioversity International, New Delhi-110012, India*
[6]*UNEP-GEF/TFT Project, ICAR-Indian Institute of Horticultural Research, Bengaluru-560089, Karnataka, India*
[7]*Bioversity International, Bioversity-Nepal Office, 93.4 Dharahara, Ward # 11, Pokhara, Nepal*
[8]*Bioversity International, Rome, Italy*

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Studies were carried out to investigate the reasons underlying farmers' motivation to conserve mango diversity particularly of indigenous varieties. At four project sites, *viz*., Chittoor, Malihabad, Pusa and Sirsi, 48 custodian farmers were identified. The results of the analysis indicated that it is not only the economic factors (market value, 79%), but also other factors such as personal (63%), social (52%), cultural/religious (14%), natural (48%) factors and biological traits (52%) which motivate farmers to conserve specific varieties while maintaining mango diversity. Further, while all the custodians maintained the diversity, some others (34%) also promoted and adapted the diversity. For promotion of mango diversity conservation, value addition to diversity and linking mango diversity to markets through diversity fairs, stakeholders' meeting, and roadside stalls will have to be given priority. National policy support in the form of establishing a network of custodian farmers and skill up gradation (grafting, management of genetic resources) and registration of farmers' varieties will go a long way in ensuring conservation of mango diversity on sustainable basis.

Key Words: Custodian farmer, Mango diversity, Motivation, On-farm conservation, Tropical fruit tree resources

Introduction

Many farmers maintain a large number of fruit tree species or varieties on their farms and a wide variability in intra and interspecific richness can be found between households. Despite the availability of preferred commercial fruit varieties, farmers around the world have been maintaining, promoting and adapting a wide range of indigenous fruit tree varieties on their farms and homesteads (Bhag Mal *et al*., 2010). Such male and female farmers, 'who actively maintain, adapt and promote agricultural biodiversity and related knowledge over time and space at farms and community level and are locally recognised for these efforts', have been defined as custodian farmers (Sthapit *et al*., 2013). The factors that motivate farmers to maintain indigenous varieties in their farm lands have been subjected to recent scientific scrutiny (Subedi *et al*., 2003; Jarvis *et al.*, 2011). Earlier studies have indicated that farmers benefit from conserving crop diversity and several factors have been shown to motivate them (Perrings and Gadgil, 2003; Bellon, 2004; De Boef *et al.*, 2012). Brush and Meng (1998) and Brush (2000) identified three different types of values of crop varieties: direct, indirect and option value. Direct or use value refers to harvest and uses of crop varieties. Indirect value refers to environmental services or ecological health to which crop varieties contribute though farmers may not observe or notice the relationship. Option value refers to the future use of crop varieties. These values accrue to fruit tree diversity based on personal, social, economical, cultural and biological source of motivation (Sthapit *et al.*, 2013). It would be useful to understand the underlying reasons for the farmer's motivation and to know how the farmers benefit from such a decision. In order to gain such insights, the present study was carried out to get an answer to a few key questions such as: (i) what varieties such farmers maintain? (ii) who

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

maintains them and what is their socio-economic context? (iii) what factors motivate the farmers to conserve diversity? (iv) what are the commercial implications of diversity conserved by them?

A clear understanding of the type of farmers who maintain diversity on their farms and of the relative importance of motivational factors shaping such on-farm conservation practices, is fundamental to guide conservation interventions and to create an enabling policy environment. This study has the following objectives:

- To understand the socio-economic profile of custodian farmers and assess if they had a distinct profile compared with other fruit farmers
- To identify different factors that motivated the farmers to conserve mango diversity
- To assess the relative importance of these motivational factors and their association with the level of diversity
- To examine whether there existed variety-specific motivation

Materials and Methods

The present study was conducted at four ecologically diverse sites (Chittoor, Malihabad, Pusa and Sirsi) across India (Table 1 and Fig. 1), where community management of tropical fruit tree (TFT) resources is being addressed under the GEF-UNEP project entitled "Conservation and sustainable use of cultivated and wild tropical fruit diversity: promoting sustainable livelihood, food security and ecosystem services". Being implemented amongst 18 communities of India along with six communities each in Indonesia, Malaysia and Thailand, the immediate objective of the project was to conserve TFT genetic resources *in situ* and on- farm through strengthening capacity of farmers, user groups, local communities and institutions to sustainably apply good practices and secure benefits (Sthapit *et al*., 2013). Based on the focus group discussion especially, Four Cell Analysis, the mango-richness of the communities at each site was ascertained. Later, baseline data that was collected at the beginning of the TFT project, was used to identify farmers who typically maintained higher number of varieties of TFT than those who maintained the average (4-5) in that community. Further, the farmers who maintained more than 10 varieties of mango were included in the initial list of Custodian Farmers (CF) in the present study. Additional custodians were identified based on the recommendations from TFT project field staff and fellow farmers based on the aforementioned description of custodian farmers. A total of 48 custodian farmers who conserved more than 10 varieties of mango and also maintained 'un-named' seedling types, were identified at the respective sites – Chittoor (17), Malihabad and Pusa (10 each), and Sirsi (11). Subsequently, data were collected from these custodian farmers based on a questionnaire and or semi-structured interview with respect to personal characteristics like age, education, farm characteristics and motivational factors for analysing the reasons for conservation of mango diversity.

The following typology of motivational factors driving the custodian farmers to maintain agro-biodiversity, provided earlier by Sthapit *et al*. (2013), was adopted in this study.

1. Personal (hobby, personal interest to collect)
2. Social value (heritage value and legacy-respect for parents/forefathers, for exchange with relatives/ friends)
3. Economic considerations (good income, risk management)
4. Cultural significance (traditions, customs, beliefs or because of its use in cultural or religious functions)
5. Natural / virtues of a variety (disease-or pest-resistant or adapted to local climate and soil conditions, provision of eco-system services, regular bearer)
6. Biological (taste, varietal preference)

Results and Discussion

Profile of Custodian Farmers

As shown in Table 2, there were no significant differences in the profiles of custodian farmers and the average

Table 1. Study sites, their geographic details and number of custodian farmers at each site

Site	State	Broad agro-ecological region	Farming system	Latitude	Longitude	Altitude	No. of custodian farmers
Chittoor	Andhra Pradesh	Hot, arid eco-region	Orchard	13°13	79°08	183 m	17
Malihabad	Uttar Pradesh	Hot, moist semi-arid region	Orchard	26°55	80°43	127 m	10
Pusa	Bihar	Hot, sub- humid eco-region	Orchard and home garden	25°46	86°10	53 m	10
Sirsi	Karnataka	Humid hill zone	Home garden and orchard	14°37	74°50	605 m	11

Fig. 1. Study sites in India

farmers except their education and the farm size. This suggested that factors other than the age and family size of the farmers motivate farmers to conserve the mango diversity, on-farm (Table 3). Clearly, all custodian farmers possessed significantly larger farm size (thrice as that of other farmers) and higher education than the non-custodian farmers.

Table 2. Socio-economic profile of custodians and general mango farmers

Characteristics	Custodian farmers (n=48)	Average mango grower (n=824)
Farm size (ha)	6.43* (±9.01)	1.83* (±3.09)
Age (years)	52.35 (±12.12)	53.25 (±13.24)
Education (%, > high school)	54.16	18.12
Family size (No.)	6.18 (±3.41)	5.33 (±2.70)

*Significant @1% level of probability; Figures in parentheses are SD

Motivational Factors

As shown in Table 3, farmers conserve mango diversity for a variety of reasons. Though economic benefit (79%) is the major driver of conservation, other non-economic factors like prestige for being the owner of diversity (63%), exchange of specific varieties and their products with neighbours, relatives and family friends (52%), biological traits (52%) like taste, colour and/or specific use (pickling) also motivate farmers to maintain and promote conservation of mango diversity. Further, adaptability of certain seedling types (*Naati/Bijju/Tukmi*) to adverse climatic conditions including other abiotic and biotic stresses, regular and heavy bearing also contributed to on-farm conservation of rich mango diversity (48%). The motivational factors differed across sites clearly implying the importance of these factors while making efforts to support conservation.

Choice of Varieties

Specific varieties chosen by the farmers for conservation

were driven by the motivational factors (Table 4). It is evident from the table that choice of varieties by farmers varied with respect to sites and also the motivating factors. It was also observed that the same variety was conserved for different reasons at a particular site. For example, *Imam Pasand* is conserved due to its good marketability as well as for being a pollinator attractant thus helping in better fruit-set in the mango orchards. Similarly, some *Appe* varieties are conserved for their biological traits (specific aroma) and also for the economic considerations. Varieties such as *Royal Special* and *Atimadhuram* are conserved mainly for their rarity in the region and also for social reasons like exchange among the friends and relatives. Besides, the *Naati* varieties are mostly regular bearers and thus contribute to tide over the economic risk associated with other commercial varieties. The farmers have also identified the superior biological traits of certain varieties like *Chakkaraguttulu, Ali Pasand, Gaddemar, Reddy Pasand* and *Sukul* (pickling types); *Lalbaba* and *Manoranjitam* being suitable for long distance transport due to their better keeping quality besides having attractive colour. Choicest varieties conserved by custodian farmers have been described by Rajan *et al.* (2014).

Type of Custodians

Custodian farmers, apart from playing a critical role in conserving the rare varieties, act as local guides to disseminate the good practices and also as providers of scions of local varieties and traditional knowledge associated with TFT. Such roles have been earlier reported

Table 3. Relative importance of economic and non-economic motivational factors for the conservation of local mango varieties across four study sites in India

Site and number of respondents	Motivating factors						No. of varieties (Range)
	Economic (%)	Non-economic (%)					
		Personal	Social	Cultural	Natural	Biological	
Chittoor (n=17)	82.36	47.06	58.82	11.76	64.75	64.75	10-28
Malihabad (n=10)	80.00	70.00	80.00	–	40.00	40.00	25-135
Pusa (n=10)	80.00	90.00	60.00	20.00	50.00	40.00	10-36
Sirsi (n=11)	72.72	45.45	9.09	9.09	36.36	63.64	18-72
India (n=48)	78.77	63.12	51.98	13.62	47.77	52.09	

The percentages do not add up to 100 because of multiple responses

Table 4. Motivating factors and specific varieties conserved across sites

Motivating factors	Chittoor	Malihabad	Pusa	Sirsi
Economic	*Kalepadu, Imam Pasand*	*Dashehari, Gulab Khas, Husnara, Fakira, Mohan Bhog, Rangeen Gola, Jard-Amin*	*Calcuttia Malda Bathua Safeda Malda Lal Malda, Sukul Sipia*	*Varate Guduga, Malanji, Nandagara, Adderi jeerige*
Personal	*Kudadut, Royal Special*	*Surkhi, Sundari, Pauda Gaj, Deshi Bombaiya, Machhli, Pan,*	*Calcuttia Malda Safeda Malda Lal Malda Sukul*	*Genesina kuli*
Social	*Royal Special, Atimadhuram*	*Surkhi, Amin, Taimuriya, Fakira, Mohan Bhog, Rangeen Gola, Jard-Amin*	*Bathua, Belwa, Sipia, Hajipur Mithui, Sukul*	*Manadur Katte*
Cultural	*Chakkaraguttulu* – Pickle served during functions	–	*Bijju* – traditional belief not to cut mango trees of seedling origin	*Appe varieties* for a sweet sour drink *(Appehuli)* to be served during functions
Natural	*Imam Pasand, Mittigeri, Naati-3, Nauzak Pasand, Bogum Rangasani, Gadiyaram, Poonsa* (bears twice a year), *Royal Special* (bears twice a year)	*Biju Tukmi, Deshi Chausa, Tukmi Chausa, Gulab Jamun*	*Sukul, Bathua*	*Chouti Appe* because of late bearing
Biological	*Lalbaba* (attractive colour), *Peddarasam, Atimadhuram* (taste), *Manoranjitam* (shelf life), *Gaddemar* and *Ali Pasand* (pickle), *Thorappadu* and *Kudadat* (large fruits), *Kuddus, Gadiyaram, Seeri* (juicy)	*Acharwala, Peela Gola, Khubsurat Lamboi, Thuhuru* (pickle)	*Bijju* (colour), *Belwa, Shukulia*	All *Appe* varieties (aroma)

Table 5. Description of custodian farmers by their roles (%)

Type of custodian farmer	Chittoor	Malihabad	Pusa	Sirsi	India
Maintain	100.00	100.00	100.00	100.00	100.00
Maintain + Adapt	35.29	60.00	60.00	54.55	52.46
Maintain + Promote	41.17	50.00	100.00	63.64	63.70
Maintain + Adapt + Promote	29.41	30.00	60.00	18.18	34.40

The total does not add up to 100 as there are multiple responses

by Sthapit *et al*. (2013). However, not all the custodians play all the roles. In this study, attempts were made to identify the roles of custodians and typify each of them. The results of the analysis are presented in Table 5. It may be observed that all the farmers maintain diversity for one reason or the other (100%). However, about 64% of them maintain and also promote specific varieties by giving scions to nursery men or other interested farmers in the community, *Royal Special* and *Lalbaba* being the notable ones. *Royal Special* is a locally appreciated variety in Chittoor which flowers twice a year. About 52 % of the farmers maintain as well as adapt certain varieties of their choice. For example, *Atimadhuram* and *Lalbaba* are adapted by the Chittoor farmers. Interestingly, about 34 % of the farmers play all the roles of a custodian i.e. maintain, adapt and promote the diversity. It means that about a third of the custodian farmers identified in the study had the highest impact on conservation and use of TFT. Hence, it may be possible to move the two thirds of CF who only maintain and/or adapt, into the most effective group (those who maintain, adapt and promote) through active support and suitable education

Conclusions

One of the strategies of conserving diversity, on-farm, is identification of custodians and extending support to them as these farmers have maintained the diversity without any formal support. The results of the study indicated that it is not only the economic factors (market value) which motivated the farmers to conserve mango diversity but also personal, social and cultural/religious factors. Biological traits with reference to specific varieties played an equally important role. The farmers also chose varieties for conservation depending upon the type of motivation. Further, while all custodians just maintained the diversity, a good number of them (50-60%) also promoted and adapted the diversity. The latter role is important for sustainability of conservation efforts made by the farmers. The custodian farmers are *de facto* the primary actors in *in situ* conservation, on-farm, for which they deserve full recognition and appreciation from the community. Further, for continuation of mango diversity conservation on a sustainable basis, farmers need to be made aware of the value of their rich diversity by linking them to R&D sector for characterization and evaluation of the elite types, grafting of superior types in their farm and by distribution of plants. Value addition to diversity and linking mango diversity to markets through diversity fairs, stakeholders' meet and roadside stalls, will have to be given priority. The demonstration (valuation), capturing and sharing the benefits of biodiversity conservation as proposed by Pascual and Perrings (2007) may be of interest in sustainable conservation of mango diversity. National policy support in the form of establishing a network of custodian farmers and skill up gradation (grafting, management of genetic resources) and registration of farmers' varieties will go a long way in ensuring conservation of mango diversity on a sustainable basis.

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