14 Marcotting as a good practice for maintaining diversity of citrus in swampy lands of South Kalimantan, Indonesia

Achmad Rafieq, Muhammad Sabran, Susi Lesmayati, M. Winarno and Idha Widi Arsanti

GPD ‘passport’

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<td>Propagation and planting material Production and crop management</td>
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<td>Character:</td>
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<td>Species and varieties involved:</td>
<td>C. reticulata (jeruk siam banjar) C. sinensis (jeruk irisan, jeruk sankis, jeruk cina) C. grandis (jeruk besar antalagi, jeruk bali merah, jeruk bali putih, jeruk besar sasanggan) C. microcarpa (jeruk sambal) C. medica (jeruk nipsis, jeruk kuit) C. hystrix (jeruk purut)</td>
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<td>Name of farmer (data resource):</td>
<td>Mr H. Syukri, Mr H. Kalwiansyah and Mr Kasrah</td>
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Introduction

Citrus cultivation in the swampy lands of Banjar district in South Kalimantan is estimated to have been developed in the 1860s. South Kalimantan is known for diamonds and other precious stones and most probably it was diamond merchants from their trade journeys to Malaysia, China, Indochina and other countries who brought the first seeds or plant material of mandarin (Citrus reticulata), sweet orange (C. sinensis), pomelo (C. grandis) and lesser known species such as kaffir lime (C. hystrix) (Noor et al., 2007). These crops are grown in both the Astambul and Cerbon sites of the project. Citrus cultivation started most likely in the swampy lands along the river Riam Kiwa, from where it spread to the surrounding villages, such as Sungai Tuan, Pingaran and Tambak Anyar. This region is now known as Astambul subdistrict. Farmers in South Kalimantan still grow citrus fruit, mostly mandarin and sweet orange, in these swampy areas. To adapt to the swampy conditions, they use marcotting for propagation instead of grafting techniques. This chapter documents why the marcotting technique is a good practice in the swampy areas of South Kalimantan that helps to maintain diversity, and it is explored whether such a practice can be scaled up in other similar areas.

Local context

Astambul is located about 45 km from Banjarmasin, the capital of South Kalimantan Province, and has a total number of 10,352 households and a total population of 34,013 (Daroini et al., 2013). A total of 12 distinct varieties were found among six citrus species during the baseline survey carried out by the UNEP/GEF Project ‘Conservation and Sustainable Use of Cultivated and Wild Tropical Fruit Diversity: Promoting Sustainable Livelihood, Food Security and Ecosystem Services’. The average farm size is 0.41 ha, with the average home garden being about 0.04 ha, while an orchard is about 0.09 ha. The main cash crops grown in this area are local paddy rice, mandarin, sweet orange, mango, papaya and vegetables. However, rice and fishing are the main sources of livelihoods. The average income per household is low, being Rp7,320,431 (US$790) per annum. Citrus contributes only 3.94 per cent to this but it is important in terms of nutrition and local culture.

Six citrus species are currently found in Astambul: C. reticulata, C. medica, C. hystrix, C. grandis, C. microcarpa and C. sinensis, with 12 varieties among them (see Table 14.1). Mandarin (C. reticulata) and sweet orange (C. sinensis) are commonly grown cash crops in Banjar district. Pomelo (C. grandis), makrut/kaffir lime (C. hystrix) and lemon (C. medica) are less common and found more often in home gardens for cultural use. The most popular species grown is mandarin, of which a unique variety is found in South Kalimantan (jeruk siam banjar) that is well adapted to swampy peatlands and grown at a commercial scale as well as in home gardens. In South Kalimantan fruit trees are traditionally planted on elevated seed beds about 1 m high with paddy
growing in between the rows of trees (see diverse production system in Plates 26–29). Those seedbeds named ‘tukungan’ are located in swampy peatlands surrounded by canals and rivers that are sometimes flooded, particularly in the rainy season. A Four Cell Analysis of locally grown fruit trees (FCA; see Chapter 3 for details) indicated that jeruk siam banjar (C. reticulata), jeruk sankis (C. sinensis), jeruk purut (C. hystrix) and jeruk irisan (C. sinensis) were cultivated extensively as they were found in large numbers and in many households, whereas jeruk bali merah, jeruk bali putih, jeruk besar sasanggan (C. grandis) and jeruk cina (C. sinensis) are rare (in this context, as they are in fact commercial varieties common elsewhere) as few trees are found and only in few households (Figure 14.1).

For the propagation of their citrus species, farmers in South Kalimantan have traditionally used marcotting — a propagation technique invented by the Chinese about 4,000 years ago. This method is still used by most farmers and several nurseries for citrus, but also for other tropical fruits such as mango, rambutan, guava, soursop and many others. In particular, three farmers, Mr Syukri, Mr Kalwiansyah and Mr Kasrah, have perfected this technique and use it extensively as the preferred technique over other propagation methods because of its advantages in the swampy peatlands of South Kalimantan.

The demand for plant material of citrus in South Kalimantan has increased greatly during the last two decades, as many farmers have started cultivating

![Figure 14.1](image-url) Four Cell Analysis on citrus trees in Astambul site, 2013. Cell A indicates common citrus species whereas cell C contains rare and unique varieties. The varieties in cell D are culturally important. Figures in parentheses indicate the number of trees reported.
citrus or have enlarged their area of cultivation. Farmers have planted mostly single species in these newly established orchards, especially mandarin (jeruk siam banjar) or sweet orange (jeruk sankis). To meet this demand, larger nurseries started to use stem and bud grafting techniques to be able to produce large quantities of jeruk siam banjar (*C. reticulata*), jeruk sankis (*C. sinensis*) and jeruk purut (*C. hystrix*). Those grafted saplings are generally cheaper than marcots. The increased demand for saplings has provided several farmers in Astambul with an additional livelihood option – i.e. the production of saplings through marcotting. These marcots and grafts of jeruk siam banjar, jeruk sankis and jeruk purut are mostly sold to meet the demand from other regions such as Central Kalimantan and Java. However, Mr Syukri, Mr Kalwiansyah and Mr Kasrah in Astambul target local demand for marcots of a much broader range of citrus species such as jeruk nipis and jeruk kuit (*C. medica*), jeruk irisan (*C. sinensis*), jeruk bali (*C. grandis*) and jeruk sambal (*C. microcarpa*). Fruits of these species are mostly sold in smaller quantities and mainly for the seasoning of food, use as traditional herbal medicine (jamu) and as an exotic fruit plant in the home garden. For example, jeruk sambal is traditionally used to make sambal and jeruk nipis is a traditional seasoning for fish and soups.

**Methodology**

The question now arises why farmers prefer marcots over grafted plants and how this contributes to the maintenance and conservation of the unique citrus diversity of this region. To answer this question, we conducted a participatory study in the Astambul subdistrict. The study began with focus group discussions involving 12 farmers, both women and men. The discussions were followed by in-depth interviews with the three key male farmers named above who seemed experienced and knowledgeable in citrus cultivation during the focus groups. The interviews with key informants focused on how they were able to maintain the diversity, in particular how they propagate the plant materials and how they pass them from generation to generation and exchange them with other farmers.

**Marcotting as a good practice**

The mandarins grown in Astambul are of a special type with a very thin skin that has significant demand in the local market, where it is sold mostly by women (Plates 30 and 31). This type, named jeruk siam banjar, is very well adapted to the swampy conditions of South Kalimantan. Farmers explained that the marcotting technique (a kind of air layering) has been much more successful than other propagation techniques for these swampy areas (Plate 32). Marcotting is a form of vegetative propagation that consists of inducing branches or twigs to produce roots while still attached to a tree. This is done by selecting a healthy branch (usually about pencil-thick, but thickness is not a limiting factor) and removing the bark up to the cambium tissue around the
portion of stem that is to develop roots. The ring is allowed to dry for two days before it is wrapped with soil, moss or another medium to keep it moist. When sufficient roots have developed, the branch is cut from the mother tree and planted in a nursery bed to develop buds and become an independent plant. After about two months, when the new sapling looks healthy, it is planted in the field or put in polythene bags for sale.

The major advantage of marcots over grafted plants mentioned by the farmers is their longer lifespan in the swampy peat soils of South Kalimantan. Farmers reported that trees from marcots have a lifespan of 10–12 years, whereas trees from grafted saplings tend to die after four or five years. Trees grown from marcots do not have a deep taproot, as when grown naturally from seed, and instead develop many adventitious roots. These give the trees a firmer but shallow rooting in the elevated seedbeds, avoiding inundation of the root system and helping them to more quickly take up nutrients and fertilizers applied on the top soil. Under swampy conditions, a marcotted sapling usually grows faster and fruits earlier compared with a tree grown from seed. In addition, trees from marcots tend to stay smaller and can be planted in a higher density, therefore needing less space and being easier to harvest (NARI, 2004). In these swampy areas trees can also be grafted. The farmers’ experience is that, although grafted trees are often more productive and faster fruiting than marcots, they are less capable of surviving prolonged periods of flooding. Further advantages of using the marcotting technique are:

- Marcotting is relatively simple to perform and requires few additional inputs or facilities to achieve high survival rates.
- Farmers who use marcots often use several genetically distinct mother plants from individual home gardens or orchards, because only a limited number of marcots can be made each time from a preferred mother plant. This leads to the use of several mother plants, which enhances the genetic diversity within the population in the field or in a community of home gardens compared with that derived from grafts taken from a single mother tree. Such a higher genetic variability within the population improves adaptation capacity of the species and lowers the susceptibility to pests and diseases.
- Marcotting can be applied successfully to a wide range of tropical fruit species, including many lesser-known and semi-wild types, whereas grafting techniques are only easily applied for a few domesticated species.

Nurseries, when they have the proper equipment to keep grafted saplings moist, in shade, well fertilized and disease free, can produce very many grafted saplings with a high survival rate from just one mother plant. This makes marcots more expensive than grafted saplings, but grafting, by using only the one mother tree, produces highly uniform progeny. Farmers stated that they buy grafted plants only in times when marcots are not available. Marcotting is an easy technique as it involves simply removing bark around the stem and
packing it with soil. Many farmers find grafting more challenging as they are less familiar with it, and they obtain higher survival rates with marcots.

Citrus growers in Astambul have been practising marcotting techniques for more than a century. An essential aspect is the selection of mother plants used to make the marcots. Farmers such as Mr Syukri, Mr Kalwiansyah and Mr Kasrah have identified and maintained unique mother trees of different species and varieties using their own selection criteria. The selected mother trees are characterized and evaluated on vigorous and healthy growth, high yield and good fruit quality, and are usually free from pests such as citrus greening, foot rot, gummosis and twig blight. Farmers produce marcotted planting materials for their own use as well as for sale to other farmers, which generates additional income. Mr Syukri, Mr Kalwiansyah and Mr Kasrah know the location of the best mother plants in their village and they conduct marcotting for other farmers, sharing half of the profit earned from the sales of the marcots with the owner of the mother plant. People from the nearby city of Banjarmasin, who want to plant non-commercial citrus plants, usually look for saplings from traditional vendors at Astambul market, as the area is known for producing good-quality saplings by marcotting of a wide range of species.

Impact on diversity

Astambul subdistrict is known as the traditional district where farmers grow and produce saplings of citrus species in South Kalimantan. To put its diversity in context, we compare it below with neighbouring Cerbon district, also in South Kalimantan, an area known for its high production volume of mandarins. Though overall citrus tree populations are much higher in Cerbon, we can see that diversity indicators for citrus in Astambul are higher than in Cerbon (Table 14.1).

The larger commercial nurseries in Astambul produce cheap saplings in large quantities using grafting techniques. They focus only on mandarin (jeruk siam banjar), sweet orange (jeruk sankis) and kaffir/makrut lime (jeruk purut), using very few mother trees for scions. This results in a very homogenous population of trees for those three species with limited genetic diversity. Other citrus species or varieties like jeruk sambal, jeruk kuit or jeruk bali merah and jeruk bali putih are produced in limited quantities by farmers using the marcotting technique, for which a much broader range of mother trees are used.

Impact on ecosystem services

Half a century ago, South Kalimantan was still largely covered by lowland rainforest, which has been virtually wiped out for its timber value. Many of these swamp areas have been drained and are left idle without any green cover or are increasingly converted into agricultural land (Hendayana, 2010). South Kalimantan now has 8,109,000 ha of tidal swamp and 3,580,000 ha of lowland
swampy fields. The root system of marcots is more suitable than grafted planting materials for raised-bed cultivation in these marginal swampy lands. Adoption of the marcotting technique can enhance the availability of planting materials and ensure more variability within the population of citrus trees found in these areas, providing the opportunity for further adaptation to new circumstances such as salinization of drained soils. Moreover, the increase in citrus planting in the swampy lands not only makes the land more productive but also increases green cover, thus contributing to ecosystem services such as reduced loss of nutrients, reduced lowering of the water table and reduced erosion of peatlands.

Impact on livelihoods

Farmers such as Mr Syukri, Mr Kalwiansyah and Mr Kasrah, who are highly skilled in the marcotting technique, earn additional income through the sales of marcotted saplings and share the profits with the farmers whose mother plants they use. The marcotting technique has been practised for more than a century in the Astambul area and is now spreading to other parts of South Kalimantan, with several implications for the livelihoods of the region. These include: (i) increased income for marcotting experts such as Mr Syukri, Mr Kalwiansyah and Mr Kasrah through the sales of marcots; (ii) additional income for owners of mother plants from which marcots are taken; (iii) improved performance of orchards and trees leading to better productivity; and (iv) independent multiplication of citrus trees by poor farmers in swampy areas without having to purchase plant materials.

Assessment of the good practice for diversity management

Marcotting makes the traditional selection and propagation of citrus of many domesticated, semi-domesticated and wild species relatively easily. The knowledge can be transferred to new farmers by means of a short training
course conducted by expert farmers. Actions that might strengthen the take-up of this good practice are: (a) conducting training on citrus mother tree management, (b) strengthening the network of mother tree collectors and planting material producers, (c) increasing farmers’ awareness of the availability of elite mother trees, (d) linking to microcredit programmes and to wider markets outside the district and (e) providing marketing outlets. These actions facilitate the maintenance of unique types of citrus diversity in these harsh peat swamps where other agricultural crops are difficult to cultivate because of the high salinity.

Concluding remarks

Citrus cultivation in swampy land areas could have positive impacts on livelihoods and on the environment. It improves swampy peatlands that have been de-forested and could reduce the loss of nutrients, stop the lowering of the water table and avoid further erosion. This chapter outlines a practical case study where, remarkably, the traditional propagation technique of marcotting provides better results compared with modern grafting techniques due to its context-specific advantages that help the species to adapt to the local unique, harsh or adverse environmental conditions. The use of the marcotting technique, as proven by farmers in Astambul, helps maintain the unique mandarin species jeruk siam banjar besides several other citrus species and hence sustains the livelihoods of local communities in swampy areas.

References


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