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Community and Social Forestry

***Aren* (*Arenga pinnata* (Wurmb) Merr.) Traditional Management System
in Batang Toru, North Sumatra and Tomohon, North Sulawesi,
Indonesia**

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ABSTRACT

Aren or sugarpalm (*Arenga pinnata* (Wurmb) Merr.) is a multipurpose palm species found across tropical Asia which is traditionally utilized as source of livelihoods in Indonesia such as in Batang Toru landscape, North Sumatra and Tomohon district, North Sulawesi. Interestingly, despite of *aren* sustainable contribution to local livelihoods, indigenous domestication efforts have been limited. Thus, traditional *aren* management systems were studied to understand the regeneration and management practices of *aren* trees in the landscape. Data on *aren* tree management across the landscape, *aren*'s role to local livelihood, and local ecological knowledge of *aren* management were collected through interviews with key farmers, focus group discussion, and direct observations (transect walk). Results show no significant difference in *aren* traditional tree management between sites, however farmers in Batang Toru harvest more diverse *aren* products than in Tomohon because of the better market opportunities. In the study sites, two types of *aren* tree regeneration were identified, i.e. a) natural regeneration, b) transplanted regeneration. Under current conditions, natural regeneration is most practiced by farmers. Farmers perceive *aren* as an abundant natural asset that is best regenerated by wildlife. Potential improvements in smallholder *aren* productivity are best by managing *aren* trees density and selecting superior germplasm. This paper provides best options for domesticating the non timber forest product (NTFP) species for community-based reforestation and livelihood enhancement in Indonesia.

Keywords: natural regeneration, transplanted regeneration, livelihood, tree management.

1. INTRODUCTION

Aren or sugarpalm (*Arenga pinnata* (Wurmb) Merr.) is a multipurpose palm species belongs to Arecaceae family. The trunk is single and covered with a black fibrous hessian like material. *Aren* often found in tropical Asian landscape with ample sun, lots of water (usually occur near the river), and in a well drained position. The species grows best at high altitude area (500-800 m asl) with precipitation above 1200 mm/year, 7-10 rainy months and average temperature around 25°C (Soeseno, 2000). Animals such as palm civets (*Paradoxurus hermaphroditus* Pallas) play an important role in *aren* natural regeneration. In many areas, farmers believe that the best *aren* planters are the palm civets (Mogea *et al.*, 1991).

Traditionally, *aren* multiple non timber products (such as flower sap, thatch and fruits) has been harvested for home consumption and to supply the local market demand. Thus, *aren* has become a major contributor to the livelihoods in Indonesia (Mogea *et al.*, 1991, Smits and Widawati, 1999). Extractive harvesting with limited indigenous domestication efforts has become the traditional management of *aren* in many parts in Indonesia. The perception that *aren* trees are still abundant in the landscape may be a reason of farmer's reluctance in cultivating and proactively managing *aren*. In the future, intense utilization of *aren* without improvement of its domestication efforts would have negative impact on *aren* resource and natural ecosystem.

In Indonesia, Batang Toru in North Sumatra and Tomohon in North Sulawesi are the two sites that received attention from scientists for *aren* study. Mogeia *et al.* (1991) study has summarized the *aren* utilization in those two sites, thus it would be useful to reconfirm the information that was collected 20 years ago. Batang Toru and Tomohon have similar *aren*'s management practices, but only in Batang Toru is the fruit harvested and utilized. Fruit harvesting is suspected to decrease the production of *aren* flower sap and potentially have a negative effect on genetic variation, as fruit is harvested from superior trees and thus do not regenerate. Raebild *et al.* (2001) study in Southern Burkina Faso showed that intensive seed harvest of *Parkia biglobosa* has limited the natural regeneration of the species.

Utilization of non timber forest product (NTFP) is an alternative to optimize forest value with limited impact on forest degradation when compared with timber extraction (Belcher *et al.*, 2005). NTFPs are generally used to supplement diets and household income, notably during particular seasons in the year, and as economic buffer in hard times. However, NTFP harvesting can affect the genetic diversity of the population being exploited, especially when harvesting flowers or fruits (Peters, 1994). As NTFPs utilization is intensified (commercialization), NTFP harvesting can alter and degraded the forest resource (Arnold and Perez, 2001). Traditional low intensity harvesting of NTFP is expected can contribute to the sustainable forest management. The traditional production systems are in harmony with the environment prior to exposure to various forces of pressure (Kang and Akinnifesi, 2000). Knowledge on traditional species management can be used as starting point to identify the actions necessary to sustain the productivity of NTFPs species. Thus, in regards to maintain the sustainability of *aren*'s contribution to local livelihood and environment, traditional *aren* management systems are studied to understand the regeneration and management practices of *aren* trees in the landscape. As *aren* has been using as species for land rehabilitation, information from this study can be used to foster community-based reforestation and livelihood enhancement in Indonesia.

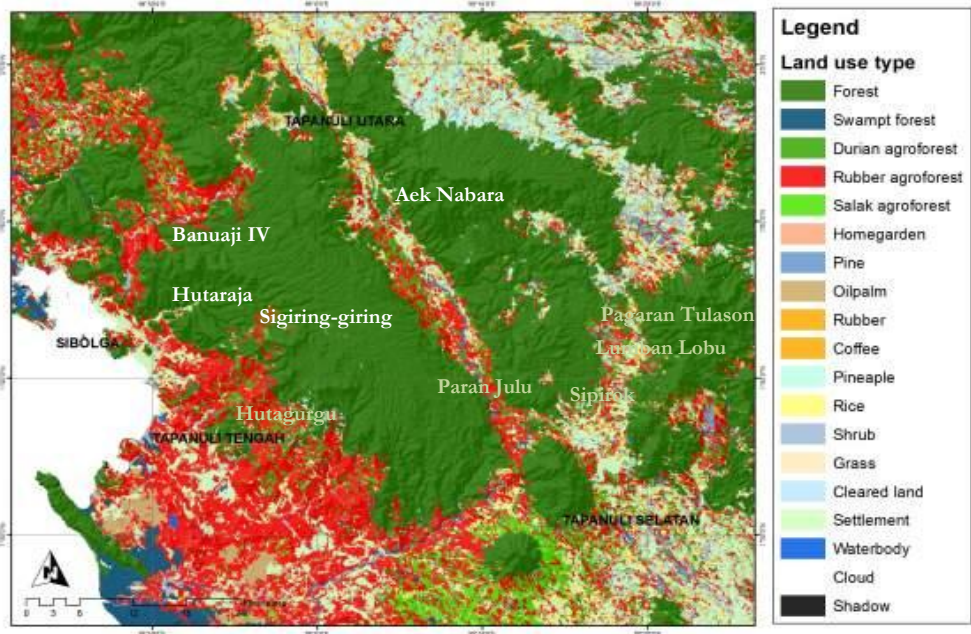
2. METHODS

2.1 Location of Study

The Batang Toru landscape is located in North Sumatra, Indonesia and is a habitat of Sumatran orangutan (Wich *et al.*, 2003). It covers approximately 105,000 ha in 3 districts - North Tapanuli, South Tapanuli and Central Tapanuli. Elevation in Batang Toru ranges from 200-1500 masl and annual precipitation of 1500-3000 mm, with dominant land cover types are primary rainforest, rubber agroforests, agroforests/homegarden and paddy ricefield (Figure 1). *Aren* can be encountered everywhere in the Batang Toru landscape particularly in riparian zone, from forest to the agricultural areas near settlements. The cultivation of *aren* in Batang Toru is primarily based on natural regeneration and extractive management, and efforts to domesticate *aren* remain rare (Martini *et al.*, 2011). Based on statistic data in 2008, there were 1,431 ha of *aren*-based agricultural system in Batang Toru, and only 30-40% of the area was productive (BPS Sumatra Utara, 2008). *Aren*'s contribution to local livelihood in Batang Toru is from its four main products, i.e. sugar, thatch, alcoholic beverage and *aren* fruits (Martini *et al.*, 2011).

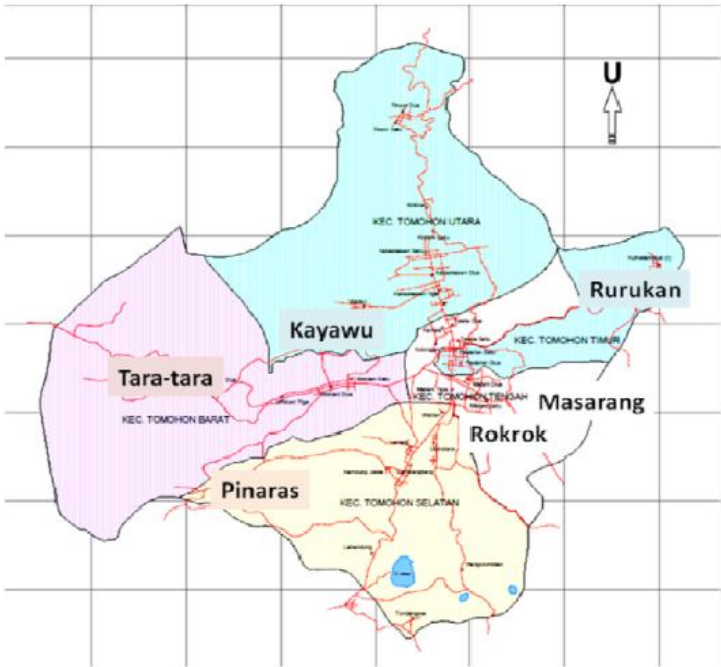
Tomohon district is located in North Sulawesi, Indonesia and consists of around 14,000 ha of land (Figure 2). Elevation ranges of 500-1500 masl and annual precipitation of 1500-2000 mm, with the dominant land cover types are agroforests (with coconut, clove, vanilla, coffee and cacao as its main products) and horticultural garden (with vegetables and flowers as its main products). Forest occurs in the landscape with an area of 1,615 ha (ca. 10% of the total area of Tomohon). Same as in Batang Toru, in Tomohon, *aren* can be encountered in many places in the landscape from forest to agricultural areas near settlements. Based on statistic data in 2009, there was a 980 ha of *aren*-based agricultural system in Tomohon, and only 30% of the area was

productive (BPS Tomohon, 2009). *Aren* contribution to local livelihood in Tomohon is from its 3 main products, i.e. sugar, alcoholic beverage and thatch (Mogea *et al.*, 1991).



Source: ICRAF Spatial Analysis Unit, 2010

Figure 1: Batang Toru land cover map from image analysis of LANDSAT satellite image in 2006



Source: BPS Tomohon, 2009

Figure 2: Administrative boundary of Tomohon district, North Sulawesi, Indonesia

2.2 Data Collection

Primary data was collected in June to July 2010. General information on *aren* tree management across the landscape, *aren*'s contribution to local livelihood, and local ecological knowledge on *aren* management were collected through interviews with key farmers, focus group discussion, and direct observations (transect walk). The semi-structured interviews collected quantitative data on empirical yield and qualitative data on tree regeneration strategy and harvesting techniques. Interviews were conducted in 4 villages in Batang Toru (i.e. Aek Nabara, Sigiring-giring, Hutaraja and Banuaji IV) and 5 villages in Tomohon (i.e. Tara-tara, Pinaras, Kayawu, Rokrok and Rurukan). In total, 45 farmers were selected randomly for interview, with at least 5 farmers per village. Markets issues were identified through discussion with farmers and local traders. Secondary information from previous studies (Martini *et al.*, 2011 and Mogeia *et al.*, 1991) was used as supplement of the primary data.

2.3 Data Analysis

Rapid Assessment of Agroforestry Practices and Technology (RAFT) analytical framework (Joshi and van Noordwijk, 2009) was modified to analyze information collected on *aren* tree management systems in both sites. Quantitative data on *aren* productivity were compared by t-test and descriptive statistics.

3. RESULTS AND DISCUSSION

3.1 Aren's Tree Regeneration, Management and Productivity

Aren trees occur scattered across both Batang Toru and Tomohon landscapes. In Batang Toru, farmers harvested productive *aren* trees in their rubber agroforest garden (at elevation of 0-800 m asl) and abandoned agroforest garden (above 800 m asl). *Aren* trees are also occurred in the Batang Toru forest, however farmers are reluctant to harvest product from those trees due to the long distances between forests and road or settlements. In Tomohon, farmers harvested productive *aren* trees that occur in their agroforest garden (where clove and coconut as the dominant species). Based on direct observation (transect walk), at the landscape scale *aren* tree density in Tomohon is higher than in Batang Toru (Figure 3). *Aren* tree maintenance is rarely practiced by farmers at either study sites, however thatch removal is belief to enhance tree diameter growth.



Figure 3: *Aren* occurrence in Batang Toru (left) and Tomohon (right)

In the landscapes studied, two types of *aren* tree regeneration were identified, i.e. a) natural regeneration, b) transplanted regeneration (Figure 4). Natural regeneration is depending on the role of civets and other biota that disperse *aren* seed, there is no farmer intervention to enhance seed germination seedling establishment or early growth (0-5 years). Transplanted regeneration is practiced by trans-locating *aren* seedlings that regenerate naturally to farmer's tree garden, there is no farmer intervention to enhance seed germination but farmers stimulate initial growth of the seedlings by clearing areas in radius of 0.5 meter from the seedlings. Under current conditions, at both sites, natural regeneration practice is preferred by farmers. Transplanted regeneration is still rare. It is only practiced by ca. 10% of farmers in Batang Toru and not at all in Tomohon.

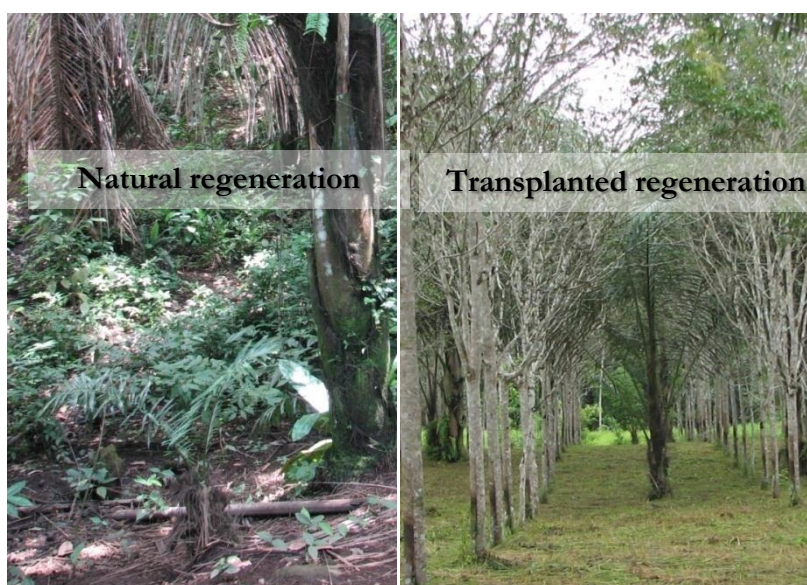


Figure 4: Type of *aren* tree regeneration in Batang Toru and Tomohon

(left: natural regeneration; right: transplanted between rows of rubber trees)

Although *aren* tree density is higher in Tomohon than Batang Toru, on average, number of *aren* trees that are tapped by farmers in both sites is relatively similar, mainly due to the capability of a person in tapping and processing the sap. One farmer usually taps 5-6 *aren* trees/day, with a maximum 12 *aren* trees/day.

Statistical analysis indicates there is no significant difference of *aren* sap productivity in Batang Toru and Tomohon. However, Tomohon tends to have higher *aren* productivity than Batang Toru (Figure 5). Also in Tomohon the *aren* trees have better performance, i.e. bigger size (height and diameter) and lengthy leaves with horizontal orientation, which are the characteristics of superior trees based on farmers knowledge at both study sites.

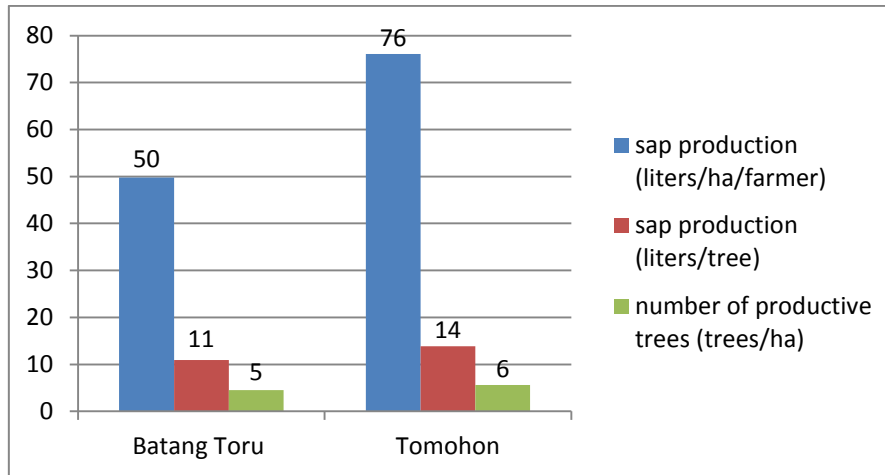


Figure 5: Average value of sap production and number of productive trees in Batang Toru and Tomohon

Sugar content of the flower sap is not different at the two sites. Based on the standard farmers practice, of dividing number of liters sap per kilogram of sugar that is produced, the sugar content of the flower sap both in Batang Toru and Tomohon is 15-18%.

Variation in are tree productivity is high at both sites, this due to the high dependency to natural regeneration and no selection for superior *aren* trees considered by farmers. Most farmers know the characteristic of superior *aren* trees, however they are not yet use the knowledge in practice. Up until now, there is no scientific knowledge that can describe the characteristic of superior *aren* trees. Based on farmers knowledge, the characteristic of superior *aren* trees are:

4. Trees with longer and wider leaves yield more sap and sugar;
5. Trees with green leaves is better for sap production, and trees with grayish leaves is better for starch production;
6. Trees with horizontal leaf orientation are better for sap production;
7. Trees with greater diameter and height yield more sap and sugar;
8. Trees with thick leaves yield more sap and sugar;
9. Trees with more female flower/inflorescences yield more sap and sugar (a minimum of 7 bunches of female inflorescence).

A paucity of *aren* trees in the accesible landscape deny farmers the confidence to effectively utilize that knowledge.

3.2 *Aren's* Traditional Product Harvesting Management

At both sites, flower sap is the most valuable products for *aren* farmers. *Aren* male flower can be tapped after trees are 10 to 15 years old and can be tapped for another 10 to 15 years, depending on the continued presence of productive flowers. However, in Tomohon farmers said 10 years is the effective productive period of an *aren* tree. After 10 years, Tomohon farmers shift tapping to other new productive trees. While in Batang Toru, farmers stated that 15 years is the general productive period of an *aren* tree. The differences may because by the fact that more *aren* trees in Tomohon than Batang Toru, thus farmers will have more trees to be selected for tapping.

In general, both in Tomohon and Batang Toru farmers tap *aren* flower sap daily throughout the year, with individula flower can be tapped consecutively for 6 months. Depending on the purpose (e.g. sugar or alcoholic beverage), in one day farmers tap *aren* flower twice for sugar production and once for alcoholic beverage (*tuak* with 5% alcohol content).

Tapping techniques are similar in both sites. However, post-harvest processing techniques are a different.

Besides *aren* flower sap, Batang Toru farmers also harvested the fruits for sweetmeat (*kolang-kaling*). Because the fruit bunches are considered as source for sugar, thus out of 3-12 fruit bunches only 1-2 fruit bunches per tree that are harvested per year. Total weight of one fruit bunch is around 60 kg which can be processed into 180 kg *kolang kaling*. The *kolang-kaling* is sold to Medan, Jakarta, Riau with the price at farmer level Rp 2500/kg. The demand for *kolang-kaling* is greatest during the Ramadhan (Moslem fasting month). Farmers in Tomohon didn't produce *kolang-kaling* due to lack of market channel and local demand for *kolang-kaling* in Tomohon.

Aren thatch is more intensively harvested in Batang Toru than in Tomohon, again this is due to the presence of stronger market demand. In Batang Toru, thatch is sold for road foundation material. While in Tomohon thatch is harvested for broom production. Poor families, who do not have *aren* trees, harvested thatch of other farmer's *aren* tree and made it into brooms. From 5 *aren* trees, usually at least 4 sheets of thatch can be harvested per year, with at least 2 kg/sheet and the price Rp 3,000/kg of thatch. Thatch production per trees are variative, depend on the growth of the trees. Annually, thatch usually harvested twice every 6 months.

3.3. *Aren's* Contribution in Local Livelihood

Aren's contribution to local livelihood both in Batang Toru and Tomohon can be classified into its four main products, i.e. sugar, alcoholic beverage (5% and 30-40% alcohol content), fruits (*kolang-kaling*) and thatch (*ijuk*) (Table 1.). However, farmers at the two sites have different income strategy from *aren* products which are affected by the availability of productive *aren* trees and market access.

Table 1. *Aren's* contribution to local livelihood in Batang Toru and Tomohon

Products	Batang Toru		Tomohon	
	Income strategy	Gross revenues (per farmer)	Income strategy	Gross revenues (per farmer)
Sugar	Weekly	12-20 USD/week	Daily	13 USD/day
Alcoholic beverage (<i>Tuak</i> 5% alcohol content)	Weekly	2-10 USD/week	Daily	18 USD/day
Alcoholic beverage (<i>Tuak</i> 30-40% alcohol content)	None	None	Daily	14 USD/day
<i>Kolang-kaling</i>	Annually	450 USD/year	None	None
<i>Ijuk</i>	Annually	2 USD/year	Weekly	7 USD/week

3.4 Discussion

Despite *aren's* importance to local livelihoods, in the past two decades there has been little effort by farmers to cultivate *aren* in either Batang Toru or Tomohon. This trend is valid for most

palms in the tropics (Byg and Balslev, 2006). Based on discussion with farmers, main reason for limited *aren* domestication is because *aren* trees are still abundant in the natural landscape, and that wildlife is perceived to be the appropriate and efficient mode for *aren* regeneration.

Based on analysis of Net Present Value and Return to Labour in Batang Toru Martini *et al.* (2011) determined that *aren* management systems that depend on natural regeneration were more profitable where *aren* trees are still abundant and the wildlife are still active in pollination and seed dispersal. However, in areas where natural vegetation has been converted to other land uses, cultivating *aren* by transplanted regeneration was a better option for supporting the sustainability of *aren* utilization as a source of local livelihood systems. Byg and Balslev (2006) also showed that perceptions of declining palm availability in combination with heavy reliance on palm products were positively related to palm cultivation (domestication).

Currently, farmers in Batang Toru have begun to cultivate *aren* at regular spacing, while in Tomohon farmers do not yet have strong motivation to do so. This is because natural regeneration in Tomohon maintains *aren* tree density that is sufficient for farmer needs and greater than in Batang Toru. The lack of fruit harvesting in Tomohon is suspected to facilitate higher *aren* tree density as more fruit/seed are present to produce natural regeneration.

Aren fruit harvesting is also thought to have an indirect negative effect on sap productivity. In Tomohon where fruit is not harvesting, the trees are larger and the flower sap production is greater. Moge *et al.* (1991) reported that the sizes of *aren* trees in Tomohon are larger than those described in other places. They suspected that the positive selection by Tomohon farmers has resulted in *aren* populations with high sap production, as well as the fertile dark andosols soil occurring in the area. For NTFP species which depend on natural regeneration not only may deplete the species stocking in the area, but also deplete the genetic diversity which is essential for selecting superior variants. This phenomenon was also observed with *Parkia biglobosa* in Southern Burkina Faso (Raebild *et al.*, 2001). Further genetic study need to be conducted to collect more evidence of negative linkage between reduced natural regeneration and fruit harvesting of *aren*.

Aren's value to local livelihood can also be enhanced by improving market access and share of end-user value received by farmers. Sugar and *tuak* are primarily sold in local markets, which is an advantage as price are relative stable compare to international market. On the other hand, *aren*'s thatch and fruits are exported mainly to Singapore. With the current global economic crisis, international market prices of export product may reduce the economic benefit of the exported products, in that context local market may be more secure.

In Indonesia, *aren* has been used to support ecological restoration and land rehabilitation, because *aren* root systems contribute to the soil and water conservation, its contribution to local livelihood and its compatibility with other plant species. Recent study by Martini *et al.* (2011) concluded that to optimize the role of *aren* for local livelihoods and conservation, the number of *aren* trees per hectare needs to be considered. A density of 12 *aren* trees/ha seems to be the minimum for an *aren* agroforest to significantly contribute to a family livelihood. Thus, *aren* has the potential to be used as species in community based forest restoration in Indonesia. Furthermore, supported activities in enhancing *aren*'s productivity under community based reforestation scheme, needs to be identified.

4. CONCLUSION

In Batang Toru and Tomohon, *aren* is a source of livelihood for local communities. In both landscape, *aren* trees are primarily encountered in degraded forests and farmers' tree gardens. In this study, two types of *aren* tree regeneration were identified, i.e. a) natural regeneration, b) transplanted regeneration. Currently, natural regeneration is preferred by farmers. Farmers perceived wildlife as an appropriate and efficient mode of *aren* regeneration. Under natural regeneration management, *aren* fruit harvesting may deplete the species stocking in

the area and the *aren* genetic diversity which is essential for selecting superior variants. However, further genetic studies are required to collect evidence of negative linkage between reduced natural regeneration and fruit harvesting of *aren*. Furthermore, supported activities in enhancing *aren*'s productivity under community based forest restoration scheme, also need to be identified.

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