***Supplementary Material***

**Mainstreaming traditional fruits, vegetables and pulses for nutrition, income, and sustainability in sub-Saharan Africa: the case for Kenya and Ethiopia**

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1. **Supplementary Tables**

**Appendix 1**: Priority ranking of traditional fruit trees with the under-exploited potential in Kenya

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Ranking** | ***Scientific name*** | **Common name** | **Selection criteria** | **Reference** |
| 1 | *Tamarindus indica L.* | Tamarind | Farmers/consumers’ preferences: Food value, market potential, shelf life, other uses, level of occurrence, germplasm availability | Chikamai et al., 2004 |
| 2 | *Adansonia digitata L.* | Baobab |
| 3 | *Sclerocarya birrea (A.Rich.) Hochst* | Marula |
| 4 | *Ziziphus mauritiana Lam.* | Ber |
| 5 | *Balanites aegyptiaca (L.) Delile* | Desert date |
|  |  |  |  |  |
| 1 | *Tamarindus indica L.* | Tamarind | Participatory species priority setting | Teklehaimanot 2005, Wanjira 2017 |
| 2 | *Adansonia digitata L.* | Baobab |
| 3 | *Sclerocarya birrea (A. Rich.) Hochst.* | Marula |
| 4 | *Ziziphus mauritiana Lam.* | Ber |
| 5 | *Balanites aegyptiaca (L.) Delile* | Desert date |
|  |  |  |  |  |
| 1 | *Tamarindus indica L.* | Tamarind | Field appraisal -> Institutional research interest criteria: Research ability, expected adoption, non-financial factors | Tahir and Bashir 2006 |
| 2 | *Adansonia digitata L.* | Baobab |
| 3 | *Balanites aegyptiaca (L.) Delile* | Desert date |
| 4 | *Ziziphus mauritiana Lam.* | Ber |
| 5 | *Vitex doniana Sweet* |  |
| 6 | *Berchemia discolor (Klotzsch) Hemsl.* | Bird plum |
|  |  |  |  |  |
| 1 | *Tamarindus indica L.* | Tamarind | General use, food value, economic value | Muok 2019 |
| 2 | *Adansonia digitata L.* | Baobab |
| 3 | *Ximenia americana L.* |  |
| 4 | *Carissa spinarum L.* |  |
| 5 | *Ancylobothrys tayloris (Stapf) Pichon* |  |
| 6 | *Ziziphus mauritiana Lam.* | Ber |
| 7 | *Dialium orientale Baker.f.* |  |
|  |  |  |  |  |
| 1 | *Tamarindus indica L.* | Tamarind | Potential for production, value addition, marketing and economic contribution | Muga et al., 2016 |
| 2 | *Adansonia digitata L.* | Baobab |
| 3 | *Ximenia americana L.* |  |
| 4 | *Carissa spinarum L.* | Bush plum |
| 5 | *Ancylobothrys tayloris (Stapf) Pichon* |  |
| 6 | *Ziziphus mauritiana Lam.* | Ber |
| 7 | *Dialium orientale Baker.f.* |  |
|  |  |  |  |  |
| 1 | *Tamarindus indica L.* | Tamarind | Community participatory setting: preliminary selection | Teklehaymanot 2010 |
| 2 | *Adansonia digitata L.* | Baobab |
| 3 | *Sclerocarya birrea (A. Rich.) Hochst.* | Marula |
| 4 | *Ziziphus mauritiana Lam.* | Ber |
| 5 | *Balanites aegyptiaca (L.) Delile* | Desert date |
| 6 | *Vitex payos (Lour.) Merr.* | Chocolate Berry |
| 7 | *Berchemia discolor (Klotzsch) Hemsl.* | Bird plum |
| 8 | *Carissa spinarum L.* | Bush plum |
|  |  |  |  |  |
| 1 | *Tamarindus indica L.* | Tamarind | Farmers/consumers’ preferences: Food value, market potential, shelf life, other uses, level of occurrence, germplasm availability | Tahir and Bashir 2006 |
| 2 | *Adansonia digitata L.* | Baobab |
| 3 | *Balanites aegyptiaca (L.) Delile* | Desert date |
| 4 | *Berchemia discolor (Klotzsch) Hemsl.* | Bird plum |
| 5 | *Ziziphus mauritiana Lam.* | Ber |
| 6 | *Vitex doniana Sweet* |  |
| 7 | *Saba comorensis (Bojer ex A.DC.) Pichon* |  |
| 8 | *Lannea alata (Engl.) Engl.* |  |
| 9 | *Sclerocarya birrea (A.Rich.) Hochst* | Marula |
| 10 | *Carissa spinarum L.* | Bush plum |

**Appendix 2**: Priority ranking of traditional fruit trees with their under-exploited potential in Ethiopia

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Ranking** | ***Scientific name*** | **Common name** | **Selection criteria** | **Reference** |
| 1 | *Ziziphus spina-christi (L.) Desf.* | Jujube | Occurrence in quantity, availability during famine, palatability, medicinal, market values | Pauline and Linus 2004, Bhag 2007, Weldekidan et al., 2017 |
| 2 | *Cordia africana Lam.* |  |
| 3 | *Balanites aegyptiaca (L.) Delile* | Desert date |
|  |  |  |  |  |
| 1 | *Balanites aegyptiaca (L.) Delile* | Desert date | Food/nutritional value, socio-economic importance, market potential, value addition potential, other uses | Chikamai et al., 2004, Tahir and Bashir 2006 |
| 2 | *Cordeauxia edulis Hemsl.* | Yeheb |
| 3 | *Mimusops kummel A. DC.* |  |
| 4 | *Sclerocarya birrea (A. Rich.) Hochst.* | Marula |
| 5 | *Vitellaria paradoxa Gaertn.* | Shea |
|  |  |  |  |  |

**Appendix 3**: Big 5 priority traditional fruit trees with their under-exploited potential regions in Africa

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Region** | **Ranking** | ***Scientific name*** | **Common name** | **Selection criteria** | **Reference** |
| East Africa (Ethiopia, Kenya, Sudan, Uganda, Tanzania) | 1 | *Adansonia digitata L.* | Baobab | Priority setting exercises: Field  surveys based on farmers’ preferences and market orientation | Chikamai et al., 2005, Jama et al., 2007, Teklehaimanot 2007, Akinnifesi et al., 2008 |
| 2 | *Tamarindus indica L.* | Tamarind |
| 3 | *Ziziphus mauritiana Lam.* | Ber |
| 4 | *Sclerocarya birrea (A. Rich.) Hochst.* | Marula |
| 5 | *Balanites aegyptiaca (L.) Delile* | Desert date |
|  |  |  |  |  |  |
| Sahelian zone (Seneghal, Mali, Niger, Burkina Faso) | 1 | *Adansonia digitata L.* | Baobab | Priority setting exercises: Field surveys based on quantitative descriptors of variation in indigenous fruit and nut traits - economic importance, visual, organoleptic, and nutritional traits | Franzel et al., 2007, Bounkoungou et al., 1998 |
| 2 | *Tamarindus indica L.* | Tamarind |
| 3 | *Vitellaria paradoxa C.F.Gaertn.* | Shea |
| 4 | *Ziziphus spina-christi (L.) Desf.* | Jujube |
| 5 | *Parkia biglobosa (Jacq.) G.Don* | African locust bean |
|  |  |  |  |  |  |
| West Africa (Ghana, Nigeria, Cameroon) | 1 | *Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill.* | Wild mango | Priority setting exercises: Field surveys based on quantitative descriptors of variation in indigenous fruit and nut traits - economic importance, visual, organoleptic, and nutritional traits | Franzel et al., 2007, |
| 2 | *Dacryodes edulis (G.Don) H.J.Lam* | African plum |
| 3 | *Chrysophyllum albidum G.Don* | Star apple |
| 4 | *Garcinia kola Heckel* | Bitter cola |
| 5 | *Cola nitida (Vent.) Schott & Endl.* |  |
|  |  |  |  |  |  |
| Southern Africa (Malawi, Zambia, Zimbabwe, Tanzania, Mozambique) | 1 | *Uapaca kirkiana Müll.Arg.* | Wild loquat | Priority setting exercises: Field surveys; Participatory Rural Appraisal (PRA) selection; based on market-oriented ideotype products | Maghembe et al., 1998, Akinnifesi et al., 2008 |
| 2 | *Strychnos cocculoides Baker* | Wild orange |
| 3 | *Parinari curatellifolia Planch. ex Benth.* | Maula |
| 4 | *Ziziphus spina-christi (L.) Desf.* | Jujube |
| 5 | *Adansonia digitata L.* | Baobab |
|  |  |  |  |  |  |
| Sahel, South, East Africa | Not ranked | *Adansonia digitata L.* | Baobab | Big five species  based on market extent and preference |  |
| East and West Africa | *Balanites aegyptiaca (L.) Delile* | Desert date |  |
| South and East Africa | *Sclerocarya birrea (A. Rich.) Hochst.* | Marula |  |
| South and East Africa | *Tamarindus indica L.* | Tamarind |  |
| Sahel, South, East Africa | *Ziziphus spina-christi (L.) Desf.* | Jujube |  |
|  |  |  |  |  |  |
| Africa | Not ranked | *Sclerocarya birrea (A. Rich.) Hochst.* | Marula | Well adapted to arid and semi arid areas | Jama et al., 2007 |
| *Tamarindus indica L.* | Tamarind |
| *Adansonia digitata L.* | Baobab |
| *Ziziphus mauritiana Lam.* | Ber |

**Appendix 4**: Nutrition, income, and ecosystem resilience potential of underutilized and neglected priority fruit trees

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Fruit tree** | **\*Multiple uses** | **Nutrient value** | **Market prospects** | **Ecosystem resilience** | **References** |
| *Tamarindus indica L.* (Tamarind) | Food, income, fodder, medicines, food preservatives, wood, fuelwood | proteins, carbohydrates, fibre, vitamin C and B (1, 2, 3), Fe | Fruit pulp is the most valued product | Well adapted to arid and semi-arid areas, drought-tolerant, nitrogen fixing, provides mulch, weed control | Tahir and Bashir 2006, Jama et al., 2007, Van der Stege et al., 2011, Kehlenbeck et al., 2013, Wanjira 2017, Kidaha et al. 2017, Leakey et al., 2022 |
| *Balanites aegyptiaca (L.) Delile* (Desert date) | Food, income, fodder, medicines, insecticide, cosmetics, bio-diesel, wood, fuelwood | protein, fats, vitamin A, minerals | Local market for leaves, fruits, nuts. International market for drugs manufacturing | Found in drylands and very resistant to drought, make very good mulch, nitrogen fixing, highly versatile to Sahelian soil | Tahir and Bashir 2006, Okia 2010, Sagna, et al., 2014, Wanjira 2017, Achaglinkame et al., 2019 |
| *Adansonia digitata L.* (Baobab) | Food, income, fodder, medicines, insecticide, soap making | Vitamin A, C, E, B1, B2, B3, protein, carbohydrate, Fe, Ca, Mg, Zn, P, Kn fiber, ß carotene, amino acids | Every part of the tree is traded and various products approved as ‘novel food’ by European Commission | Drought-tolerant, adaptable to adverse climatic conditions, fertilizer | Jama et al., 2007, Kehlenbeck et al., 2013, Bayala et al. 2014, Boedecker et al. 2014, Chivandi et al. 2015, Wanjira 2017, Vinceti et al. 2018, Akinola et al., 2020, Leakey et al., 2022 |
| *Sclerocarya birrea (A. Rich.) Hochst.* (Marula) | Food, income, fodder, medicines, insecticide, wood, fuelwood | Vitamin A, C, B1, fat, protein, lipids, citric, acid, malic acids, P, Cu, Zn, Ca, Mg, K | Cosmetics industry, biodiesel, food industry | Adapted to arid and semi-arid areas, well adapted to shallow inherently infertile soils | Hall et al., 2002, Tahir and Bashir 2006, Jama et al., 2007, Kehlenbeck et al., 2013, Wanjira 2017, Leakey et al., 2022 |
| *Ziziphus spina-christi (L.) Desf.* (Jujube) | Food, income, fodder, medicines, nematode control, wood, fuelwood | Ca, K, Fe, Cu, Zn | Food industry | Indigenous to dry, low-rainfall and high-temperature areas, drought tolerant and very resistant to heat wave, increase available soil phosphorous | Mokria et al., 2022, Leakey et al., 2022 |

\*The multiple uses list is random and not based on ranking of importance nor is it universal across African regions and countries nor within countries.

**Appendix 5**: Nutrition, income, and ecosystem resilience potential of underutilized and neglected leafy vegetables

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Leafy vegetable** | **\*Multiple uses** | **Nutrient value** | **Market prospects** | **Ecosystem resilience** | **References** |
| *Amaranthus blitum L.* (Amaranthus) | Food, medicines, beer, fonder, laundry starch, cosmetics, paper coatings, films, dye | Leaves: A, C, B1. Ca, Fe, carotene, folate, vitamin C. Seed: protein (lysine and methionine) fiber, K, Ca, P, vitamin A, C | Seed flour for baking industry - gluten free. Seeds malted for beer | Adapted to different agro-climatic conditions; heat, drought, and pest tolerant and grow in nutrient-poor soil | Calzetta et al., 2000, Park et al., 2020, Ogwu 2020 |
| *Cleome gynandra L.* (Spiderplant) | Food, medicines, insecticidal, fodder, insecticidal and anti-tick properties | Vitamin A, C, E, Ca, Fe, Zn, Mg, β-carotene, protein | Grows very fast; ready rural and urban market, only vegetable available during relish-gap period | Tolerates high and low temperatures, drought; pest resistance; requires fertile soils | Chweya and Nameus, 1997, Van den Heever and Venter, 2007, Onyango et al., 2013, Chataika et al., 2022 |
| *Corchorus olitorius L./tricularis L.*  (Jute mallow) | Food, medicines, cosmetic, packaging fibre, soap, waxes, paper making | Vitamin A, C, E, K, Ca, Mg, Fe, β-carotene, protein | High market value, consumers’ preference, and nutritional value | Available when no other foliage crops can grow; resistant to diseases and pests, adapted to various environments | Choudhary et al., 2013, Mukul 2022 |
| *Crotalaria ochroleuca G.Don/brevidens Benth.* (Slenderleaf) | Food, fodder, medicines, green manure, soil fertility, fibre, cover crop, striga and nematode control, insect repellent, ornamental plant | Vitamin C, β-carotene, B1, B2, B3, protein, Fe, Ca | Demand increase in local or regional markets | Tolerate rather dry conditions; planted during short rainy season; nitrogen-fixing abilities; nematode control | Kullaya et al., 1998, Sikuku et al., 2013, Okelo et al., 2021, Muli et al., 2021 |
| *Launaea cornuta (Hochst. ex Oliv. & Hiern) C.Jeffrey.*  (Bitter Lettuce) | Food, medicines, fodder, insecticidal | Protein, crude fibre, vitamin C, Na, K, Ca, Fe, P | Ready urban market; local availability, growing naturally, low input | Prefers sandy soils in relatively dry localities; threatened by genetic erosion | Ndossi and Sreeramulu 1991, Ambajo and Matheka 2016, Onyancha 2015, Fashir 2015, Akimat et al., 2021 |

\*The multiple uses list is random and not based on ranking of importance nor is it universal across African regions and countries nor within countries.

**Appendix 6**: Nutrition, income, and ecosystem resilience potential of underutilized and neglected long-life cycle pulses

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Leafy vegetable** | **\*Multiple uses** | **Nutrient value** | **Market prospects** | **Ecosystem resilience** | **References** |
| *Amaranthus blitum L.* (Amaranthus) | Food, medicines, beer, fonder, laundry starch, cosmetics, paper coatings, films, dye | Leaves: A, C, B1. Ca, Fe, carotene, folate, vitamin C. Seed: protein (lysine and methionine) fiber, K, Ca, P, vitamin A, C | Seed flour for baking industry - gluten free. Seeds malted for beer | Adapted to different agro-climatic conditions; heat, drought, and pest tolerant and grow in nutrient-poor soil | Calzetta et al., 2000, Park et al., 2020, Ogwu 2020 |
| *Cleome gynandra L.* (Spiderplant) | Food, medicines, insecticidal, fodder, insecticidal and anti-tick properties | Vitamin A, C, E, Ca, Fe, Zn, Mg, β-carotene, protein | Grows very fast; ready rural and urban market, only vegetable available during relish-gap period | Tolerates high and low temperatures, drought; pest resistance; requires fertile soils | Chweya and Nameus, 1997, Van den Heever and Venter, 2007, Onyango et al., 2013, Chataika et al., 2022 |
| *Corchorus olitorius L./tricularis L.*  (Jute mallow) | Food, medicines, cosmetic, packaging fibre, soap, waxes, paper making | Vitamin A, C, E, K, Ca, Mg, Fe, β-carotene, protein | High market value, consumers’ preference, and nutritional value | Available when no other foliage crops can grow; resistant to diseases and pests, adapted to various environments | Choudhary et al., 2013, Mukul 2022 |
| *Crotalaria ochroleuca G.Don/brevidens Benth.* (Slenderleaf) | Food, fodder, medicines, green manure, soil fertility, fibre, cover crop, striga and nematode control, insect repellent, ornamental plant | Vitamin C, β-carotene, B1, B2, B3, protein, Fe, Ca | Demand increase in local or regional markets | Tolerate rather dry conditions; planted during short rainy season; nitrogen-fixing abilities; nematode control | Kullaya et al., 1998, Sikuku et al., 2013, Okelo et al., 2021, Muli et al., 2021 |
| *Launaea cornuta (Hochst. ex Oliv. & Hiern) C.Jeffrey.*  (Bitter Lettuce) | Food, medicines, fodder, insecticidal | Protein, crude fibre, vitamin C, Na, K, Ca, Fe, P | Ready urban market; local availability, growing naturally, low input | Prefers sandy soils in relatively dry localities; threatened by genetic erosion | Ndossi and Sreeramulu 1991, Ambajo and Matheka 2016, Onyancha 2015, Fashir 2015, Akimat et al., 2021 |

\*The multiple uses list is random and not based on ranking of importance nor is it universal across African regions and countries nor within countries.

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