TOOL BOX FOR WORKING WITH ROOT, TUBER AND BANANA SEED SYSTEMS

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Tools4SeedSystems: working towards resilience through root, tuber and banana crops in humanitarian settings

Contribution of root, tuber and banana (RTB) crops to humanitarian response

Sweetpotato is an excellent recovery crop for post disaster interventions. It is already an important component of the cropping systems in Africa, south Asia and parts of Latin America and the Caribbean (LAC) because of its robustness and ability to produce under difficult conditions. It will become more important in the face of a changing climate. In some settings, especially in Africa, it is also considered a "women's crop," reflecting the relatively strong control women have in decision making in production and marketing. It has short maturity (3-4 months), flexible planting dates, and can produce a harvest with only 2 months rainfall, with 2-3 crop cycles per year. It can be grown in sole stands, intercropped with maize, cassava or tree crops, and is an excellent rotation crop with rice. Varieties with spreading growth habit establish good ground cover to reduce soil erosion and reduce labor requirement for weeding. Early food availability fills the hunger gap before cereal crops can be harvested. Piecemeal harvesting allows for a longer harvesting period. Sweetpotato has high calorie and vitamin A output per unit area/unit time compared to cereal crops. For nutrient enriched varieties, just one small root (125 grams) meets the daily vitamin A needs of a young child and supplies good levels of vitamins C, K, and E, several B vitamins and the minerals manganese and potassium[1] [Low and Thiele, 2020]. There is a wide portfolio of varieties to meet preferences of adults for dry mouth feel or soft, easier consumption by young children and elderly. It has a short cooking time: can be eaten uncooked, boiled, roasted as a staple or snack food. Sweetpotato leaves are also widely consumed as vegetable and are an excellent source of lutein, which like beta-carotene, prevents eye degeneration. The roots can be chipped and dried for future use. Dual purpose varieties can be used as a fodder crop for pigs, dairy, goats. Triple S (Storage in Sand and Sprouting) technology allow for longer storage of fresh roots for consumption or for sprouting as planting material for then next season. Sweetpotato benefits from a large network of African NARIs conducting modernized, state of the art breeding approaches in close partnership with CIP main breeding hubs (Mozambique and Uganda). In addition to agronomic characteristics, the said breeding efforts are focusing on increasing the crop's climate resilience and cooking/organoleptic quality.

Potato is a nutrient-dense staple crop for food and economic security from household to national levels in many countries in Africa. Unlike other important staple crops (such as rice or maize), potato matures quickly in 3-4 months, breaking the hunger gap faster and produces more edible dry matter per unit of time, area, and water compared to cereals. Having a greater harvest index of 0.75 compared to 0.4 to 0.6 for cereals, a greater portion of all dry matter produced is distributed to edible parts of the potato plant

[1] Low, J.W. and G. Thiele, Understanding innovation: The development and scaling of orange-fleshed sweetpotato in major African food systems. Agricultural Systems, 2020. 179 (102770): p. 1-17.

than for cereal crops implying better resource use efficiency.[2] Further, potato produces 5,626 kcal per m^3 water, compared to maize, wheat, and rice which range from 1,989 to 2,279 kcal per m^3 water[3], critical during times of drought or water stress (insufficient water) which can plague humanitarian situations. Other important traits available in CIP's varieties for resource-poor conditions include resistance to biotic constraints, such as late blight and viruses; tolerance to abiotic constraints, such as salinity; and nutritional characteristics, such as high Iron and Zinc content. The crop is thus an excellent weaning food for children and reduces anemia in young mothers. Its short cooking time saves precious time and fuel especially for women who struggle the most to access food for their families in humanitarian conditions (Mueller et al,, 2018). Potato attracts high market value and farmers into potato farming. At a marketable yield of 14 tons per hectare (t/ha) and minimal market price of 0.15 USD/kg, potato can be profitable with gross margins of 1,000 USD/ha.

Cassava has a longer cropping cycle but is vital in the annual cycle of food availability due to its broader agro-ecological adaptation including to drought, diverse maturity period and in-ground storage capability, permitting piecemeal harvesting for sustained food availability. The cassava cropping cycle is typically 8 to 15 months mostly depending on moisture availability. Ninety percent of cassava produced in Africa is a staple food for human consumption, providing calories for 500 million people and constituting 37% of the population's dietary energy requirements[4]. When cassava is processed into a dry product like gari, it can be stored for 6 months or more and easily transported. In Africa with a yield potential of 20-30 tons per ha[5], cassava provides food security for local consumption and income potential for selling processed cassava. The leaves are edible and high in protein and iron. This means that a farmer can harvest leaves, roots, and seed/stem without choosing between them. This reduces the risk of farmers 'eating the seed' which is a typical consequence of hunger for grain crops. Given its significant contribution to the livelihoods of African farmers, and its potential for transforming African economies, cassava is among the six commodities defined by the African Heads of States as strategic crops for Africa. In addition, cassava has been identified from among the major African food staples as having one of the highest levels of resilience under predicted climate change scenarios[6].

Recent investments in cassava breeding have modernized variety development and are producing new high yielding farmer preferred varieties with resistance to important cassava diseases including cassava mosaic disease (CMD) and cassava brown streak disease (CBSD). Particular attention has been devoted ensuring that cassava varieties are gender responsive address and address traits that are important for vulnerable populations. Additional investments in developing of the cassava seed systems particularly in Nigeria and Tanzania, have produced methods for rapid commercial production of high-quality planting material. These systems have been developed in collaboration with national programs, seed regulatory authorities and commercial seed entrepreneurs to provide reliable models for sustainable production of cassava seed. These seed system innovations are being scaled to other countries under the BASICS-II project (Building Economically Sustainable Seed Systems for Cassava) and the TAAT cassava compact (Technologies for African Agriculture Transformation). The proposed project would facilitate further scaling of cassava seed system innovations in food insecure locations and strengthen sustainable cassava seed production in these critical locations. The Central African countries of Democratic Republic of Congo (DRC), Cameroon, and Central African Republic are particularly critical for scaling cassava seed innovations because they are also the locations where the continuing spread of the CBSD pandemic is most active which will likely compound already existing food insecurity challenges.

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[2] Haverkort and Struik. 2015. Yield levels of potato crops. Field Crops Research 182:76–85.

[3] Renault et al, 2000. Nutritional water productivity and diets. Agricultural Water Management 45: 275-296.

[4] Sanginga, N. and Mbabu, A. (2015) RTC Background paper. Feeding Africa: an action plan for agricultural transformation. AfDB, Dakar 21-23 October 2015.

[5] In Asia yields are up to 50 t/ha

[6] Jarvis A, Ramirez-Villegas J, Campo BVH, Navarro-Racines C. 2012. Tropical Plant Biology 5(1), 9-29.

Banana (including plantain) is often grown as a perennial crop with infrequent planting but harvested annually. Hence, it is important for household food security all year round. It is a low maintenance crop grown in diverse farming systems, from perennial plantations to shorter cycle bush fallow and backyard gardens. Given the multiple consumption options, various cultivar types exist including cooking, dessert, processing types, and lowland plantains. As such there is a variety for most of the ecological systems in Africa. Banana has gained prominence more recently as a source of micronutrients (in particular rich in potassium, magnesium and phosporus), leading to the recent promotion of Provitamin A rich varieties, many of them adapted landraces. Humanitarian crises affect household food security in different ways, depending on the nature of the crisis. Banana as a food security crop has low maintenance and a low planting rate. It is a multiple use food crop and so should be a priority in humanitarian agricultural support programs. Even with the recent outbreak of key pests and diseases of banana, the crop is still relatively pest free compared to many true seeded staples like maize or beans. It is therefore suitable as a medium-term food security crop in settling populations (in case of human movement). Indeed, the spread of varieties and emerging diseases (such as the bunchy top disease, fusarium wilt and bacterial wilt) have been associated with populations migrating after conflict in the Great Lakes region. Banana is very drought sensitive. Adverse weather conditions are likely to reduce production but not eliminate plant regeneration through underground plant structures, making it very hardy against short term drought and weather instability.

In humanitarian crises, different power relations and changes in access to resources emerge, influence the capacity to recover, and can result in the marginalization of subgroups in society by gender, ethnicity or by age. Banana seed systems are largely informal and linked to community power structures (Nkengla et al., 2020). Access to seed systems is one arena in which such relations play or could be observed and discussed. The sourcing, production, and distribution of clean seed for expansion and to replace deteriorating fields and plants is therefore very important. Banana seed systems are mixed. Modern hybrids (such as FHIAs, NARITA, and PITA hybrids) are widely grown alongside well-adapted farmer landraces, mostly in multiple production systems. FHIA hybrids have been widely released and adopted in Africa, often adapted to multiple local uses, such as fresh consumption, cooking and juice processing.

Banana breeding is long-term. Several initiatives for breeding improved varieties exist, as are the opportunities for multilocational trials. Several catalogues and databases document the varietal diversity of banana and plantain worldwide. These include improved varieties and farmer landraces. The catalog for Congo includes dessert and cooking banana varieties and plantain types mostly found in the Great Lakes region. The largest Plantain Database to date is managed by CARBAP in Cameroon, while a worldwide catalogue (Musalogue) includes worldwide diversity and would be useful for germplasm exchange. Banana is a very diverse crop. The classification of subtypes of banana varieties is available and could guide non-experts in the local understanding of variety needs or possible replacement types.

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