Agricultural Biodiversity for Better Nutrition, Health and Improved Livelihoods in sub-Saharan Africa

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Definitions

- **Agrobiodiversity** – the variety and variability of animals, plants and micro-organisms used directly or indirectly for food and agriculture

- **Dietary diversity** – the number of unique foods consumed over a given period of time

- **Nutritional status** – the condition of health of a person that is influenced by the intake and utilization of nutrients

- Linkages are often assumed to be automatic

Case studies

- Indigenous and neglected African leafy vegetables in Benin, South Africa and Kenya - 2008-2011

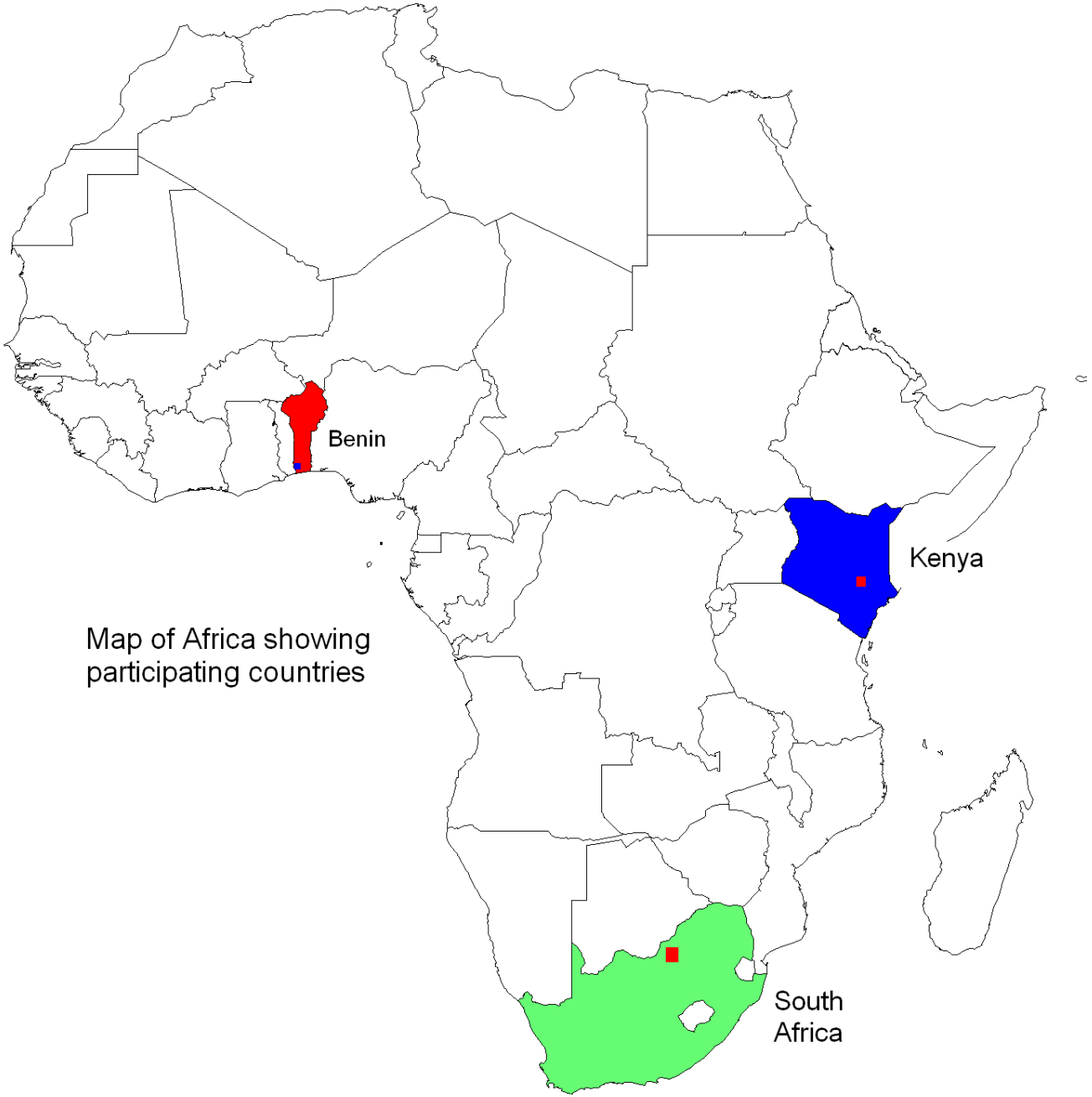
- Forest foods in Cameroon, DR Congo and Gabon- 2010-2015

Neglected or underutilized‘ crops, have been overlooked by research, extension services and policy makers; governments rarely allocate resources for their promotion and development.

Improving Dietary Diversity in African Food Systems: Benin, South Africa and Kenya

- Trans-disciplinarity including researchers, communities and decision makers
- Equity: Gender mainstreaming
- Capacity building along value chain (producers, traders, consumers);
- Monitoring/ research at all levels (farm, household, market, consumer)
- Influence policies supportive of improved health and nutrition

Project countries



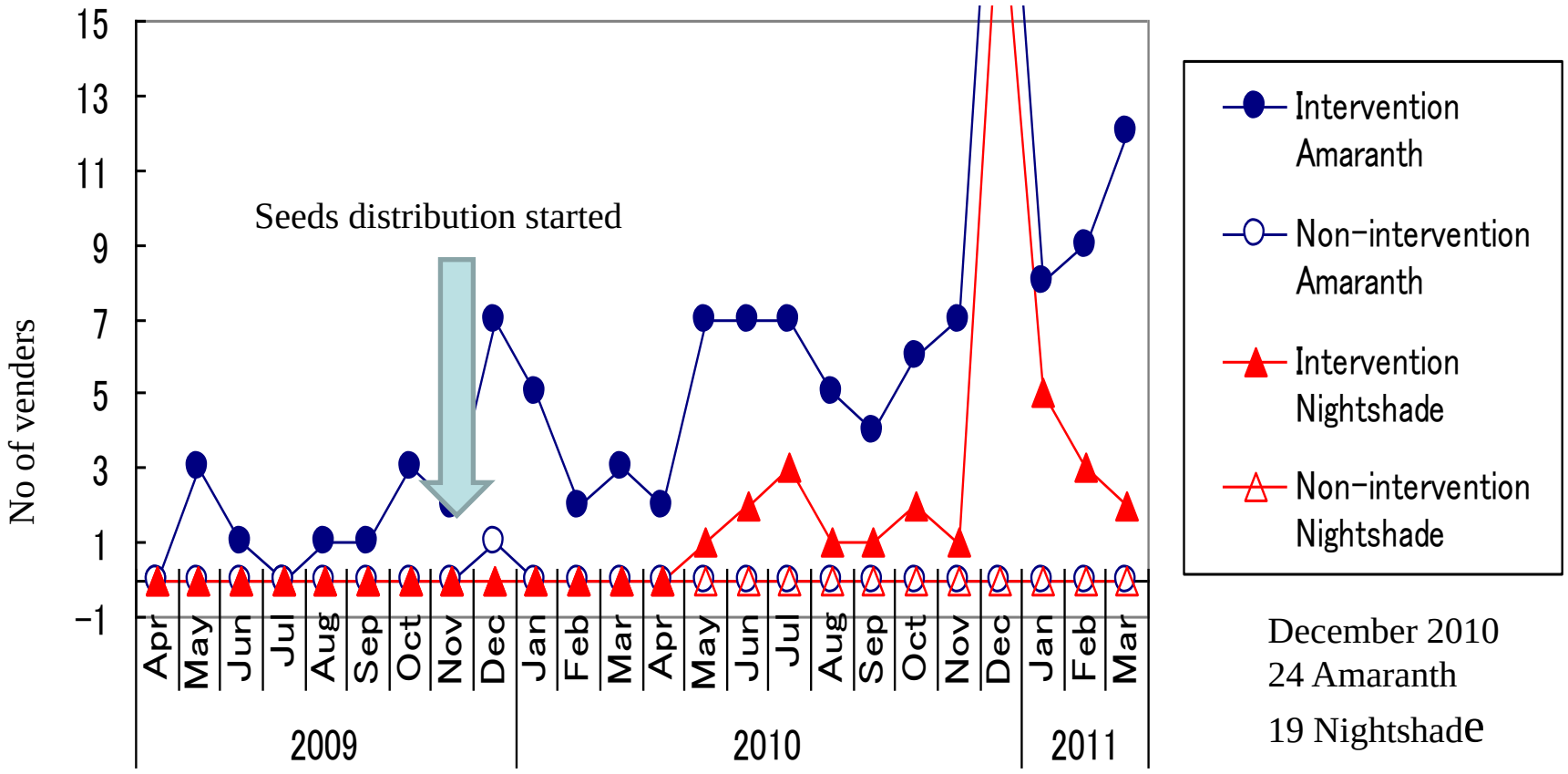
Map of Africa showing participating countries

Adoption of Introduced Neglected Vegetables Farmers

Crops	2009 *n=49* (%)	2010 *n=47* (%)	2010 Intervention *n=29* (%)	2010 Non-intervention *n=18* (%)
Nightshade	0 (0)	17 (36)	16 (55)	1 (6)
Crotalaria	0 (0)	12 (26)	12 (41)	0 (0)
Hibiscus	0 (0)	12 (26)	12 (41)	0 (0)
Cochorus	0 (0)	5 (11)	5 (17)	0 (0)
Spider plant	0 (0)	10 (21)	8 (28)	2 (11)
Bambaranut	0 (0)	3 (6)	3 (10)	0 (0)

In Kenya, we found that farmers adopted the nutritionally rich agrobiodiversity promoted by the project. In the intervention group, there was an increased trend in adoption of nightshade, hibiscus, spider plant and crotalaria as compared to the non-intervention group.

Number of Vendors Selling Amaranth and Nightshade in Kenya



December 2010
24 Amaranth
19 Nightshade

Overall conclusions from the Kenya study on market analyses were:

•There has been a steady increase in marketing of local vegetables such as leafy Amaranth and African Nightshade in intervention sites.

•African nightshade was introduced for the first time in Oct 2009. It is now regularly sold in supermarkets and open markets

Achievements

- Traditional vegetables have found way to supermarket shelves

- Increased sales and increased number of women engaged in the business

Risk factors of cardiovascular disease among consumers and non consumers of indigenous vegetables

Variables	Rural (n=199)		Urban (n=197)	
	Consumers (n=139)	Non-consumers (n=60)	Consumers (n=28)	Non-consumers (n=169)
	#Median (95%CI)	#Median (95%CI)	#Median (95%CI)	#Median (95%CI)
Systolic Blood Pressure (mmHg) Diastolic Blood pressure (mmHg)	129.5 (115.5; 145.5) 87.0 (77.5; 97.0)	129.0 (116.0; 140.0) 87.0 (73.0; 94.0)	135.0 (118.0; 152.0) 91.0 (80.0; 95.0)	137.0 (124; 126) 90.0 (81.0; 99.0)
Total Cholesterol (mmol/L)	4.8 (4.1; 5.8)	4.9 (4.1; 5.8)	4.8 (3.7; 5.4)	5.1 (4.3; 6.2)
HDL Cholesterol (mmol/L)	1.4 (1.1;1.9)	1.3 (1.1; 1.9)	1.3 (1.1;1.9)	1.5 (1.1; 1.9)
Triglycerides (mmol/L)	1.0 (0.8;1.4)	1.2 (0.9; 1.7)	0.9 (0.8; 1.5)	1.2 (0.9;1.7)
Fasting glucose (mmol/L)	4.7 (4.4; 5.2)	4.8 (4.4; 5.1)	4.7 (4.2; 5.5)	4.9 (4.3; 5.5)
Serum iron (mmol/L)	14.4 (10.2; 18.9)	16.4 (11.6; 22.4)	17.3 (11.8; 23.5)	17.6 (12.6; 24.4)
BMI (Kg/m^2)	23.7 (20.3;28.5)	23.0 (19.1; 29.6)	22.1 (19.2; 31.7)	24.3 (20.6; 29.8)
Waist circumference (cm)	78.5 (70.8;88.9)	77.3 (73.1; 91.8)	84.1 (68.3; 95.0)	81.2 (73.9;89.2)

In South Africa, when comparing urban and rural communities, some cardiovascular disease risk factors were higher in urban populations as compared to rural populations. waist circumference and systolic blood pressure were higher.

Food insecurity among forest foods consumers and non-forest foods consumers in Congo Basin Countries

HFIAS [a]	Percentage among consumers of forest foods (n=567)[b]	Percentage among non-consumers of forest foods (n=153)[c]	P* value (significance of difference between the two groups)
Food secure (0)	12	11	P=0.74
Mildly insecure (1-13)	9	6	P=0.03
Moderately insecure (14-16)	20	14	P=0.0001
Severely insecure (17-27)	59	68	P=0.0001

Generally food insecurity was higher among non forest foods consumers (68%), than forest foods consumers (59%)

Source: Fungo et al., (2020). Can forest foods contribute to food security and dietary diversity of rural populations adjoining forest timber concessions? insights from Gabon, DR Congo and Cameroon. Int Forest Rev. Vol.22(2), 2020 1

Spearman's correlation matrix of food security indicators for forest communities of the six concessions in Congo Basin

Household food security	Household dietary diversity score	Forest food consumption score	Food variety score	Household food insecurity access scale score
Household dietary diversity score[a]	1	0.25**	0.46**	-0.13*
Forest food consumption score[b]		1	0.29*	-0.26**
Food variety score			1	-0.11
Household food insecurity access scale score				1

Source: Fungo et al., (2020). Can forest foods contribute to food security and dietary diversity of rural populations adjoining forest timber concessions? insights from Gabon, DR Congo and Cameroon. Int Forest Rev. Vol.22(2), 2020 1

HFIAS was significant and negatively correlated with the FFCS. This implies that households consuming forest foods were less food insecure. Also, there were weak significant positive correlations between FFCS and FVS and FFCS with HDDS. This implies that consumption of forest foods increases dietary diversity and food variety.

Contribution of forest foods and non-forest foods to nutrient intake of non-pregnant, non-lactating women

Nutrient	Forest foods consumed in two non-consecutive 24 hour recalls						
	Yes (n=46)			No (n=233)			
	Nutrient intake	SD	% of women below EAR	Nutrient intake	SD	% of women below EAR	P value
Weight (gms)	1116.9	34.4		1311.3 [b]	131.3		<0.0001
Energy (KJ)	11339.1	20656.8	51.9	7805.3 [b]	3477.7	36.2	<0.0001
Energy (Kcal)	2710.1	4937.1		1865.5	831.2		
Protein (g)	79.1	198.5	47.4	31.9 [b]	127.5	41.3	<0.0001
Fat (g)	77.7	249.8	35.5	20.9 [b]	20.9	40.7	<0.0001
Carbohydrate (g)	141.2	350.2	67.0	320.7 [b]	909.2	41.3	<0.0001
Dietary fiber (g)	35.5	234.9	72	36.2 [b]	126.8	49.1	0.192
Vitamin A (µg)	6155.3	4907.3	7.1	1801.7 [b]	944.3	10.8	0.033
Vitamin E (Eq.)/Mg	8.4	46.9	38.2	4.4 [b]	15.3	48.3	0.041
Vitamin C (Mg)	81.8	255.7	21.3	228.8 [b]	710.3	16.5	0.013
Sodium (Mg)	448.5	161.6	0.00	130.1 [b]	167.5	0.00	<0.0001
Potassium (Mg)	54818.1	32286.2	28.0	14059.9[b]	2341.4	13.2	<0.0001
Calcium (Mg)	1466.4	9313.8	11.2	541.9 [b]	508.2	19.3	<0.0001
Magnesium (Mg)	2110.5	1631.9	11.4	965.8 [b]	740.8	1.1	<0.0001
Phosphorus (Mg)	5681.5	5234.6	44.9	1821.1 [b]	2352.0	41.8	<0.0001
Iron (Mg)	27.8	116.7	15.4	13.1 [b]	32.1	10.2	<0.0001
Zinc (Mg)	55.3	418.6	12.0	42.3 [b]	265.9	2.9	<0.0001

Forest foods contributed high intakes of more than 60% for vitamins A, E and C, iron, zinc, potassium, calcium, magnesium and sodium.

Source: Fungo R, et al., (2016). Contribution of forest foods to dietary intake and their association with household food insecurity: a cross-sectional study in women from rural Cameroon. Public Health Nutrition 2016 (17):3185-3196 doi:10.1017/S1368980016001324

Vitamin A, iron, zinc and energy intake according to food groups, derived from forest foods and non-forest foods

Food groups	Contribution based on two non-consecutive 24 hour recalls							
	Forest foods (n=46)				Non forest foods (n=233)			
	% of total vitamin A in forest foods	% of total iron in forest foods	% of total zinc in forest foods	% of total energy in forest foods	% of total vitamin A in non-forest foods	% of total iron in non-forest foods	% of total zinc in non-forest foods	% of total energy in non-forest foods
Meat	0.7	28.0	40.0	3.8	0	0	0	0
Fish	0	0	0	0	1.9	23.9	16.2	22.9
Non Alcoholic beverages	0	0	0	0	0	3.1	0	0.12
Fruits	0	0	0	0	4.2	8.0	1.4	47.1
Roots and tubers	0	30.6	34.7	93.2	5.8	29.4	24.9	13.8
Cereals and wheat products	0	0	0	0	5.3	21.2	10.6	10.4
Pulses and lentils	0	0	0	0	1.1	1.9	0.5	0.2
Nuts	0	0	0	0	0.1	3.2	2.5	3.7
Oil, fats, milk and dairy products	20.7	0.1	0.01	0.9	0.4	0.1	0.3	1.0
Vegetables	**76.1**	**36.5**	**24.2**	**1.1**	**80.2**	**8.6**	**43.6**	**0.3**
Poultry	0	0	0	0	1.0	0.7	0.3	0.3
Wild forest plant food species	2.5	46.0	1.1	1.0	0	0	0	0

Source: Fungo R, et al., (2016). Contribution of forest foods to dietary intake and their association with household food insecurity: a cross-sectional study in women from rural Cameroon. Public Health Nutrition 2016 (17):3185-3196

Estimated nutrient contribution of the average daily fruit intake to the dietary recommended intakes (DRI) for children aged 1–3 years and women aged 19–60 years.

Nutrients	Unit	*Panda oleosa* Pierre	*Poga oleosa*	*Pseudospondias longifolia*	*Gambeya lacourtiana*	*Afrostyrax lepidophyllus*
Energy (Kcal) [2]	% DRI 1–3 year	99.6	114.7	60.8	61.1	36.0
	% DRI 19–60 year	61.6	70.9	37.6	37.8	22.3
Na	% DRI 1–3 year	12.7	10.2	9.4	18.9	4.4
	% DRI 19–60 year	15.2	12.2	11.2	22.7	5.2
K	% DRI 1–3 year	0.0005	0.0003	0.0008	0.0009	0.0003
	% DRI 19–60 year	0.0006	0.0003	0.0009	0.0011	0.0003
Ca	% DRI 1–3 year	0.0	3.24	16.6	0.00	28.6
	% DRI 19–60 year	0.0	2.4	12.5	0.00	21.5
Mg	% DRI 1–3 year	35.0	36.3	71.0	0.01	295.0
	% DRI 19–60 year	14.3	14.9	29.1	0.00	120.7
Fe	% DRI 1–3 year	294.8	355.2	75.9	41.4	405.2
	% DRI 19–60 year	87.2	105.1	22.5	12.2	119.9
Zn	% DRI 1–3 year	453.3	333.3	8.9	293.3	40.0
	% DRI 19–60 year	255.0	187.5	5.0	165.0	22.5
Se	% DRI 1–3 year	10.3	1.5	0.4	2.9	0.3
	% DRI 19–60 year	11.0	1.6	0.4	3.0	0.3
Vitamin C	% DRI 1–3 year	44.7	30.7	212.0	651.3	14.1
	% DRI 19–60 year	44.6	31.0	242.0	651.3	13.7
Vitamin A RE [3]	% DRI 1–3 year	1.4	1.43	6.4	0.00025	0.5
	% DRI 19–60 year	1.7	1.71	7.7	0.0003	0.6
Vitamin E	% DRI 1–3 year	1160.0	1070.0	0	970.0	25.0
	% DRI 19–60 year	1740.0	1605.0	0	1455.0	37.5

Source: Fungo et al., (2019). Nutrient and Bioactive Composition of Five Gabonese Forest Fruits and Their Potential Contribution to Dietary Reference Intakes of Children Aged 1–3 Years and Women Aged 19–60 Years. Forests, 10, 86.

Conclusions

- Agrobiodiversity is a source of income. It is found in markets, even in urban areas. Income of farmers who are the producers of these crops could be improved in linked into markets in the “right” way.

- As a result of the high incidence of food insecurity (83.5%), food and nutrition insecurity is not alleviated by access to a large number of nutritious indigenous vegetables and forest foods from a highly biodiverse environment.

- However, those who consumed forest foods and fruits obtained substantial amounts of the essential nutrients vitamin A, iron, zinc and sodium from forest foods. Forest foods, if consumed in adequate quantities, have the potential to improve dietary diversity, food security and nutrient adequacy for forest communities in Cameroon.

- Urgent action is required for the promotion, domestication and conservation of these nutrient-rich forest foods and for the preservation of traditional knowledge before these are lost.