



Anacardium occidentale: Stopping Kwashiorkor in Its Tracks One Cashew at a Time



John Cody Howe and Florence Dunkel, Plant Sciences and Plant Pathology, Montana State University - Bozeman, MT
 Keriba Coulibaly, Junior Vegetable Breeder, AVRDC World Vegetable Center, Sub-regional Office for West Africa, BP. 320 Bamako, Mali

Introduction

People of Sanambele are subsistence farmers of the Bambara ethnic group who embrace cultural traditions and embrace their environment. Using the holistic process in 11 villages in the Arrondissement Diallakoroba and Bougoula (Kante et al. 2009), we learned the main constraints to Sanambeleans' quality of life was first cerebral malaria in their children and secondly "hunger" which we later learned meant kwashiorkor or protein energy malnutrition. To better understand the disease of Kwashiorkor we have taken a look at a few different sources of protein (Turley 2011, Wedlake 2010). Cashews were reviewed from past research and was considered very viable. Suggesting this as an alternative protein source is an example of using the holistic process since it is information that is already in existence in this village community.



Fig. 1 Healthy and smart boys of Sanambele. Bourama Samake (left) was 7 years old in this photo.



Figure 2. Cashew tree



Fig. 3 Children with Kwashiorkor

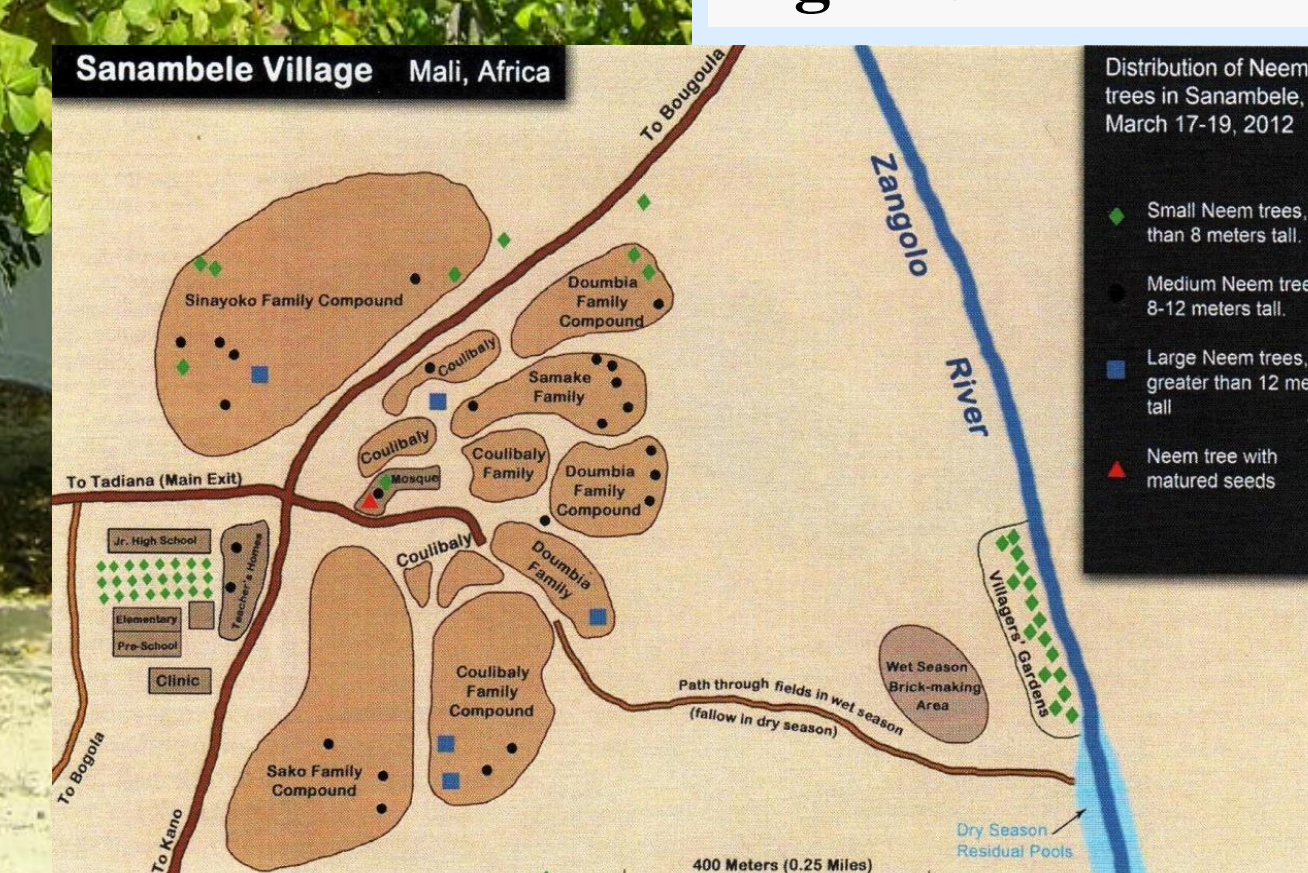


Fig. 5. Map of village showing women's gardens where cashews for children could be grown (Luong et al. 2012)



Fig. 4 Cashew fruit and nut of Sanambele

Table 2. Cashew nut Amino acid content (+Aremu et al. 2007, Institute of Medicine, National Academies 2002/2005 The National Academies Press, Washington D.C. pp. 589-678).

Amino Acids+ (* = essential for children)	Mg amino acid per 10 g cashew	Estimated daily requirements for children ages 1-3 years mg/kg/day ¹	Estimated daily requirements for children ages 4-8 years mg/kg/day ¹
*Lysine	550	45	37
*Histidine	220	16	13
Arginine	520		
Aspartic Acid	1020		
*Threonine	320	24	19
Glutamic Acid	1360		
Proline	230		
Glycine	280		
Alanine	350		
Cystine	140		
*Valine	350	28	23
*Methionine	170	22	18
*Isoleucine	350	22	18
*Leucine	620	48	40
*Tryptophan	320	41	33
*Phenylalanine	430	41	33
Isoelectric point	425		
*Tryptophan	372	6	5

http://www.fao.org /DOCREP/ 005/AC 854T18.htm

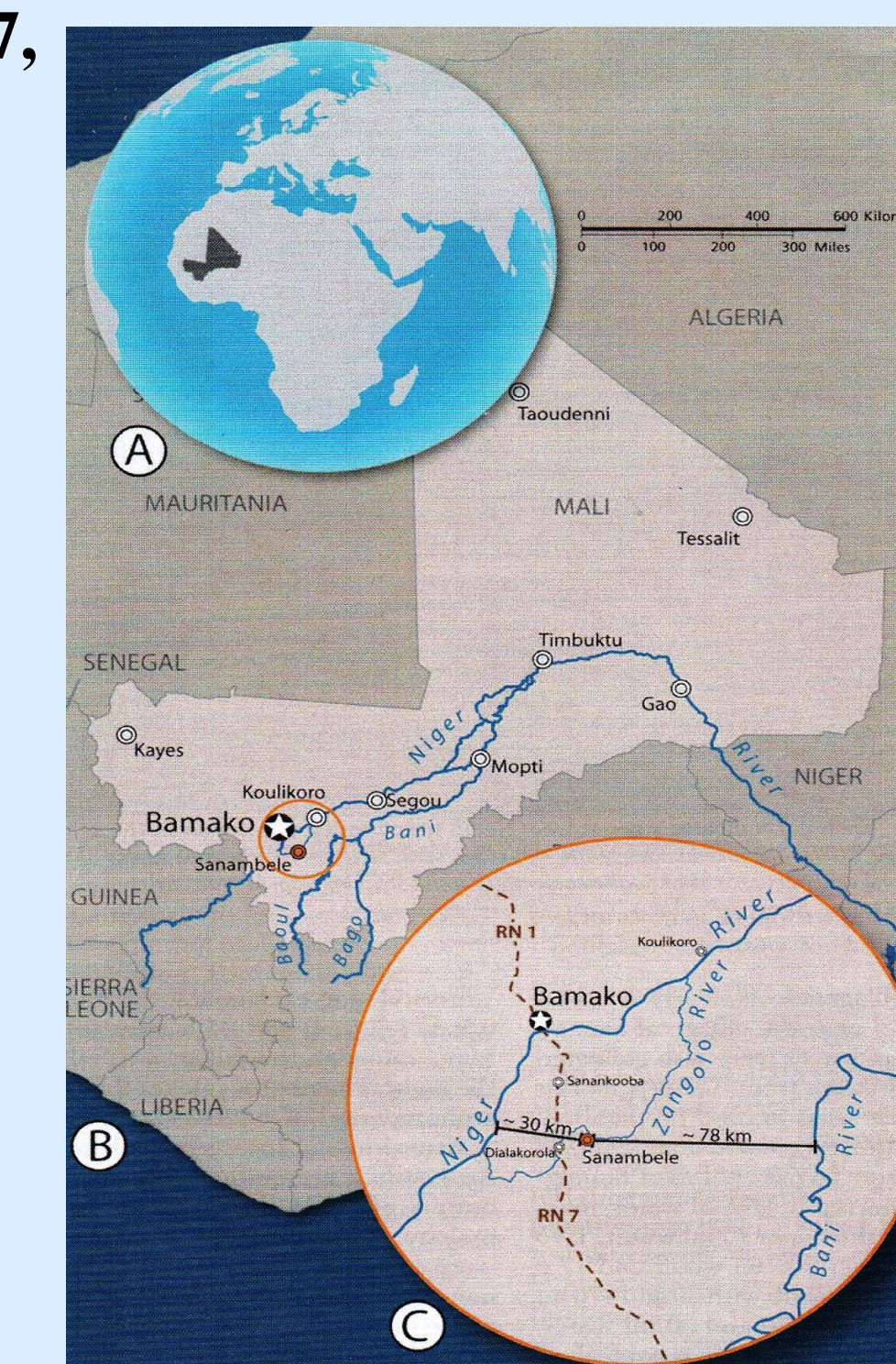


Fig. 6. Geographic location of Sanambele in Mali (Luong et al. 2012)

% Estimated Average Daily Requirements per 100g serving for young children		
	Lysine	Tryptophan
Tou		
Maize	29.6%	58.3%
Millet	33.8%	144.0%
Sorghum	25.7%	116.0%

Amino acid content of Turley et al 2011

Hypothesis Tested

Cashews are a viable alternative protein supplement to fill the gap of protein energy malnutrition and health in young children in Sanambele.

Materials and Methods

In-depth interviews with:

- Regional Agronomist, Keriba Coulibaly (via internet)
- Elder wisdom and knowledge conveyed through Keriba
- Entomologist Dr. Florence Dunkel (via interviews in person and weekly meetings)

Peer-refereed Literature Search. Through Cab Direct, Google Scholar, Crop Science Society of America.

Table 1. Peer Referred journal search for cashew information

Index or Data Base	Key Word Phrase	Number of Hits
Google Scholar	Cashews	13500
	Cashew Production	20400
	Cashew Production in Africa	13600
	Cashew Production in Mali	2010
	Cashew Pathology	2720
	Cashew Amino Acid Complex	7770
	Cashew Agronomics	3950
CAB Direct	Cashew	4201
	Cashew Production	1366
	Cashew Production in Africa	318
	Cashew Production in Mali	6
	Cashew Pathology	180
	Cashew Amino Acid Complex	4
	Cashew Agronomics	47
Crop Science Society of America	Cashews	11
	Cashews	0

Questions used in depth interviews:

- What is the number of children in Sanambele?
- What is the age group of children at risk for kwashiorkor?
- How many cashew trees are walking distance of village?
- What are the protein requirements for at-risk children?
- What are the insufficient amino acids in Sanambele?
- What are the growing calendar for cashew in Sanambele?
- What is the relative humidity in Sanambele?

Results

We consulted the Sanambele Elder Council via cell phone and Keriba Coulibaly. Elders informed us cashews are a valued food of the past, collected and were roasted by men. Now cashews are not eaten in village, but traded by men for cash in the local market. When they met in the hut of the Elder Council regarding this research, they reminded us cashew is a hardy, fast growing tree in their village, now growing abundantly around the village. Keriba suggested and we are designing a canvas poster with Bambara phrases and photos to reinforce this traditional wisdom and the value of eating cashews, especially for children, plus trading them for money (\$5US /kg).

Discussion

So this information can use traditional ecological knowledge and slightly modify garden growing practices of women and to let the children eat them and potentially beat back Kwashiorkor. Using testing questions with the holistic process we see potential solutions:

- Create information the village of Sanambele can use to further advance their cultures objectives and thrive.
- Combine traditional knowledge with western scientific knowledge of cashew to help reinvent nutritional use of cashews in Sanambele
- Establish alternative protein source for the children not deficient in any essential amino acids for children
- Establish simple growers guide (aimed at women, mainly non-readers) to raise cashew sustainably in their own gardens.

Table 4. Lysine and Tryptophan in cashews compared with other Sanambelean traditional foods (Turley et al. 2011 modified by Howe et al. 2013.)

	Total Protein	Lysine	Tryptophan	Informational Source
	g/100g	g/100g	g/100g	
Tou	9.5	0.254	0.067	http://www.fao.org/DOCREP/005/AC854T18.htm
Maize (CC)	9.7	0.332	0.189	http://www.fao.org/DOCREP/005/AC854T18.htm
Millet (CC)	10.1	0.204	0.123	http://www.fao.org/DOCREP/005/AC854T18.htm
Sorghum (CC)	7.5	0.296	0.098	http://www.fao.org/DOCREP/005/AC854T18.htm
Grain/Legume	5.5	0.372	0.205	Aremu et al. 2007
Rice (CC)	23.4	1.599	0.254	http://www.fao.org/DOCREP/005/AC854T18.htm
Cowpeas (MIL, sub-term)	17.7	1.143	0.192	http://www.fao.org/DOCREP/005/AC854T18.htm
Bambara Ground Nut (CC)	0.6	0.060	0.012	http://www.fao.org/DOCREP/005/AC854T18.htm
Fruit/Nuts	0.8	0.042	0.006	http://www.fao.org/DOCREP/005/AC854T18.htm
Mango	17.4	0.942	0.378	http://www.fao.org/DOCREP/005/AC854T18.htm
Orange	1.3	0.082	0.009	http://www.fao.org/DOCREP/005/AC854T18.htm
Cashew (M)	1.4	0.053	0.020	http://www.fao.org/DOCREP/005/AC854T18.htm
Onion	6.4	0.217	0.000	http://www.fao.org/DOCREP/005/AC854T18.htm
Okra	7.6	0.484	0.750	FAO/WHO/UNU 1990
Grass/Pooper	2.0	1.590	0.205	http://www.fao.org/DOCREP/005/AC854T18.htm
Chicken with a tail	3.5	0.258	0.048	http://www.fao.org/DOCREP/005/AC854T18.htm
Cow (MIL, sub-term)	17.7	1.573	0.198	http://www.fao.org/DOCREP/005/AC854T18.htm
Beef with a tail (CC)	18.8	1.713	0.211	http://www.fao.org/DOCREP/005/AC854T18.htm
Fish (all kinds)				

Recommendations

1. Propagate more cashew trees in women's village gardens
2. Plant beans around cashew trees (beans offer 40 pound nitrogen credit in soil with a grass mixture to mineralize phosphor)
3. Harvest all nuts
4. Offer fruit to children or livestock for carbohydrate gain
5. Throw shells from nut back under tree
6. Preserve nuts traditionally, by roasting over fire
7. Mix cashew butter in sauce for tou to increase complete protein

Literature Cited

- Aremu M.O., Ogunlade I., and Onlisan A., 2007. Fatty Acid and Amino Acid Composition of Protein Concentrate from Cashew Nut Grown in Nasarawa State, Nigeria, Pakistan Journal of nutrition, Vol 6, p 419-423
- Bennet, J. M., 2004. Becoming Interculturally Competent, Discovering the Sequence of Development, p 62-77
- Miller, P. 2013. AGSC 428 Sustainable Cropping Systems. Personal communication.
- Ferreira-Silva L. S., Silveira A.G. J., Voigt L. E., Soares S.P. L., and Viegas A. Ricardo, 2008. Changes in Physiological Indicators Associated with Salt Tolerance in Two Contrasting Cashew Rootstock, Brazilian J. of Plant Physiology, 216: 1-9
- Kante, A., F.V. Dunkel, A. Williams, S. Magro, H. Sissako, A. Camara, and M. Kieta. 2009. Communicating agricultural and health-related information in low literacy communities: A case study of villagers served by the Bougoula commune in Mali. Proceedings of the annual meetings of the Association for International Agricultural and Extension Education. San Juan, Puerto Rico.
- Luong, Ky-Phuong, F.V. Dunkel, +Keriba Coulibaly, and Nancy Beckage. 2012. Use of neem (*Azadirachta indica* A. Juss.) leaf slurry as a sustainable dry season management strategy to control the malaria vector *Anopheles gambiae* Giles s.s. (Diptera: Culicidae) in West African villages. J. Med. Ento. 49(6): 1361-1369; DOI:http://dx.doi.org/10.1603/ME12075.
- Martin P.J., Kasuga L.J., and Bashiru R.A. 1998. Cashew Farm Upgrading: Agronomic Options For Increasing Cashew Production By Smallholder Farmers In Tanzania, Cambridge Journal, 34> 137-152
- Nathaniels Q.R. N., Sijaona E.R. M., Shoo A.E. J., and Katinila N. 2003. IPM for control of cashew powdery mildew in Tanzania. I: Farmers' crop protection practices, perceptions and sources of information. Internat. J. of Pest Mgt. 49: 25-36
- Savory A., and J. Butterfield. 1999. Holistic Management, A New Framework for Decision Making, Island Press. Washington D.C.
- Seppala P., The recovery of cashew production in Tanzania, The Making of a Periphery, number 32
- Turley R. 2011. Seasonal Availability of Lysine and Tryptophan in a Sanambelean Diet, Research Paper submitted in partial fulfillment of AGSC 465R Health, Agriculture, Poverty: Concepts and Action Research. Montana State University-Bozeman.
- Wedlake, K. 2010. Cows, Culture, and Kwashiorkor. Research Paper submitted in partial fulfillment of AGSC 465R Health, Agriculture, Poverty: Concepts and Action Research. Montana State University-Bozeman.

Acknowledgements

I wanted to give a special thanks to Dr. Florence Dunkel and her service learning class to show the world there is more than throwing money at a problem. She has introduced the holistic process in this class which has made me think about problems in a whole new light. I secondly want to thank Keriba Coulibaly for excellent on sight information to the village and for his personal insight into the people and their important traditions. I thirdly want to thank Rebecca Turley and her research of Kwashiorkor and protein from a previous class.