

Title:	Conservation of Local Crop Genetic Diversity – Unraveling the Dynamics and Challenges at Smallholder farm level: A Case study of Sorghum and Cowpea
PI:	Dr. Thomas Lapaka Odong
Co-Researchers:	<p>Dr. Prossy Isubikalu, Department of Extension and Innovation Studies, School of Agricultural Sciences College of Agriculture and Environmental Sciences, Makerere University, P. O. Box 7062 Kampala (Uganda) 0772 345398 ikalu@agric.mak.ac.ug or isubip@yahoo.com</p> <p>Dr. Michael Hillary Otim National Crop Resources Research Institute, Namulonge P.O Box 7084, Kampala, Uganda. Tel: +256 772 897 040 Email: motim@nacrri.go.ug; motim9405@gmail.com</p>
Purpose	To explore the status (amount and distribution) of genetic diversity of the two crops as well as to document on-farm and off-farm factors that influence maintenance and/or loss of on-farm genetic diversity.
Project Summary	This research project is on understanding the dynamics and challenges of conservation of local sorghum and cowpea genetic diversity on farmers' fields in Uganda. As more and more farmers adopt the growing modern varieties, plant genetic diversity that once characterized agricultural landscape in form of local landraces are being lost at very high rates. The loss of these genetic diversities limit our opportunities to respond constructively to food insecurity (using crops such sorghum and cowpea) as a result of unpredictable weather patterns, epidemics of pests and diseases and the ever-increasing world population will be sufficiently diminished. The ex-situ conservation of plant genetic resources (in genebanks) is an expensive venture requiring large amount of infrastructural and human investment, which is currently limiting. In Uganda and most developing countries, traditionally, farmers have been playing key role in conservation of genetic resources on their fields. However, Over the last three decades, with adoption of free market



	<p>economics in Uganda and deliberate policy to commercialize agriculture, market forces have been playing major roles in shaping both on-farm and off-farm decision made by smallholder farmers with potentially undesirable consequences on the amount of on-farm genetic diversity maintained on-farm. The implication of this that local varieties/landraces are often neglected leading to their loss.</p> <p>This project seeks to clearly understand the status (amount and distribution) of on-farm crop genetic diversity as well as on-farm and off-farm factors that influence the ability of farmers to maintain genetic diversity on their farms in the districts of Agago, Apac and Serere in Uganda. In this study sorghum and cowpea which are key food security crops in marginal environments will be used as case studies. To assess on-farm genetic diversity of Sorghum and Cowpea, randomly selected fields in the study areas will be visited at different stages of crop growth. In addition seeds of the two crops will be sampled from different farming households (including markets) and planted in central field will be used to study. To understand on-farm and off-farm factors influencing on-farm conservation of plant genetic resources, sampling surveys and focus group discussions will be conducted in the study area. The study will use students whose capacities will be built in the process. Two MSc students will be enrolled and each will be periodically assisted with two undergraduate internship students. The knowledge generated from this project is expected to: (i) attract interest of plant breeders and other researchers to conservation and utilization available local crop genetic diversity especially sorghum and cowpeas; (ii) influence policy of plant genetic resource conservation and utilization; and, (iii) create awareness amongst the farmers of the existing local genetic resources and different benefits that can be accrued from them.</p>
Country and Specific Location(s)	Uganda: Agago, Apac and Serere Districts
Participating Institutions	<ol style="list-style-type: none"> 1. Makerere University, 2. National Agricultural Research Organization (NARO)
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Thomas Lapaka Odong (PhD)



Department of Agricultural Production,
School of Agricultural Sciences,
Makerere University,
P. O. Box 7062 Kampala
Email: thomas.l.odong@gmail.com ; odongt2001@caes.mak.ac.ug.com
Mobile +256772986821; Skype name: Thomas.l.Odong

Dr. Thomas Odong's areas of expertise include Biometry (Applied Statistics), Research Methods, Statistical genetics and Bioinformatics. He has over 10 years of extensive experience in Biometry/statistical consulting and lecturing. He has been providing technical backstopping in areas of study design and data analysis to several local and international researchers. Dr. Odong teaches applied statistics, Population and Quantitative Genetics. As a visiting lecturer, Thomas has taught at University of Zimbabwe (2007), University of Kwa-Zulu Natal (2014) and University of Namibia (2014). His research interests include, among others, developing statistical techniques for improving access to genetic resources stored in gene banks/germplasm collections around the world. He is also interested in exploring how Next Generation Sequencing data can be used to understand the genetic structure of germplasm collections which is currently based on neutral molecular markers. Dr. Odong's academic journey started at Makerere University where he graduated in year 2000 with a BSc. Agriculture (First Class). Immediately after graduation, he moved to the University of Kwa-Zulu Natal (South Africa) to pursue an MSc in Biometry (Applied Statistics). He successfully completed the MSc in 2003. In 2005/2006, Dr. Odong was a visiting Scholar at Michigan State University where he did several courses in advanced statistics. Dr. Odong then moved to Wageningen University, the Netherlands in 2007 to pursue a 4-year PhD in Statistical Genetics under the supervision of Prof. Fred van Eeuwijk. From his thesis, "Quantitative Sampling of Germplasm Collections – Getting the best out of molecular markers when creating core collections", five papers were published in peer-reviewed journals. One of these papers won "The 2014 Outstanding Paper in Plant Genetic Resources award" of the American Crop Science Society (<https://www.wageningenur.nl/en/newsarticle/CSSA-award-2014-for-PhD-Thomas-Odong.htm>). From December 2011 to June 2013, Dr. Odong was awarded a Post-doctoral research fellowship under Ecological and Evolutionary Functional Genomic Project at the Laboratory of Bioinformatics at Wageningen University. As a Post-doc, Dr. Odong worked on SNP discovery using Next Generation Sequencing Data. He used the discovered SNPs to explore evidence of evolution along the genome of *Arabis Alpina*, a model plant. For more information check his personal website www.freewebs.com/tlodong



Selected Publications

- Okello, D.K., Akello, L.B., Tukamuhabwa, P., Ocho, S.M., Odong, T.L., Adriko, J., Mwami, C., Deom, C.M. Regeneration Procedure for Three *Arachis hypogaea* L. Botanicals in Uganda through Embryogenesis. *British Biotechnology Journal* 7(3) 122-133 DOI : 10.9734/BBJ/2015/1741
- Okello, D.K., Akello, L.B., Ochwo-Semakula, M., Odong, T.L., Tukamuhabwa, P., (2014). Groundnut rosette disease symptoms types distribution and management of the disease in Uganda. *African Journal of Plant Sciences* 8(3) 153-163. DOI: 10.5897/AJPS2014.1164
- Okii, D., Tukamuhabwa, P., Odong, T.L., Namayanja, A., Mukabaranga, J. (2014). Morphological diversity of tropical common bean germplasm. *African Crop Science Journal* 22(1) 59-68
- Odong, T.L., van Heerwaarden, J., van Hintum, T.h.J.L., van Eeuwijk, F.A., Jansen, J. (2013). Improving hierarchical clustering of genotypic data by Principal components analysis. *Crop Science* 53:1546-1554.
- Odong, T.L., Jansen, J., van Eeuwijk, F.A., van Hintum, T.h.J.L. (2013). Quality of Core Collections for Effective Utilization of Genetic Resources *Review, Discussion and Interpretation. Theoretical and Applied Genetics* (<http://www.ncbi.nlm.nih.gov/pubmed/22983567>)
- Odong, T.L., van Heerwaarden, J., Jansen, J., van Hintum, T.h.J.L., van Eeuwijk, F.A. (2011a). Statistical techniques for defining reference sets of accessions and microsatellite markers. *Crop Science* (abstract: <https://www.crops.org/publications/cs/abstracts/51/6/2401> - I can send you a copy on request!)
- Odong, T.L., van Heerwaarden, J., Jansen, J., van Hintum, T.h.J.L., van Eeuwijk, F.A. (2011b). Determination of genetic structure of germplasm collections: are traditional hierarchical clustering methods appropriate for molecular marker data? *Theoretical Applied Genetics* 123(2):195-205: doi 10.1007/s00122-011-1576-x (<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3114091/>).
- van Heerwaarden, J., Odong, T.L., van Eeuwijk, F.A. (2013). Maximizing genetic differentiation in core collections by PCA-based clustering of molecular marker data. *Theoretical and Applied Genetics* (<http://link.springer.com/article/10.1007%2Fs00122-012-2016-2?LI=true>)
- Odong, T.L., (2013). PhD Thesis: Quantitative Methods for Sampling Germplasm Collections- Getting the best out of molecular markers when creating core collections (<http://edepot.wur.nl/212422>)



Research Projects and Other Responsibilities

- **Assistant Coordinator:** Regional PhD Program in Plant Breeding and Biotechnology
- Assistant Coordinator: INTRA-ACP Academic mobility project for training crop scientists in Africa, coordinated at Makerere University (Partnering Institutions: University of Ghana, Legon (Ghana), Kwame Nkrumah University of Science and Technology (Ghana), University Dakar (Coordinating),)
- **Team leader Bio-Innovate Sorghum project:** “Delivering New Sorghum and Finger Millet Innovations for Food Security and Improving Livelihoods in Eastern Africa”
- **Team leader** McKnight Sorghum project grant No. 10-586 Improving Food and Livelihood Security in the East Africa using Multiple Stress Tolerant Sorghum Cultivars

