

Impact case study (REF3b)

Institution: University of Greenwich
Unit of Assessment: (UoA 6) – Agriculture, Veterinary and Food Science
Title of case study: Transforming cassava to improve livelihoods in sub-Saharan Africa
<p>1. Summary of the impact</p> <p>The tropical root crop, cassava, is a food security crop for 450 million people in Africa. This case study describes the impact pathway from strategic research on transformation to make safe, cheap and valued products for food and industrial use, to impact on the ground in Africa benefitting 90,000 smallholder farmers with strong prospects to increase to 250,000 within eight years. The impact pathway involved using:</p> <ol style="list-style-type: none"> strategic research on cyanogen reduction during cassava processing, overcoming problems with mycotoxin contamination, improved processing and sensory evaluation; adaptive research to develop market-based solutions to use cassava as a commercial/industrial commodity; large scale impact on the ground in Africa through Bill and Melinda Gates Foundation funding and take up of the products by the private sector.
<p>2. Underpinning research</p> <p>Cassava production, processing and marketing provides a major source of income for 450 million people, often women and the poorest, in sub-Saharan Africa. Cassava is strategically important as a food source and famine reserve, combining high calorific efficiency with versatile low cost/input and reliable and flexible production; it is also seen as a pro-poor vehicle for economic development. However farmers, particularly from remote areas, have restricted market access because the roots are highly perishable, bulky and expensive to transport. In addition, there are potential food safety issues associated with cyanide-containing compounds and mycotoxins in dried products.</p> <p>Andrew Westby, Professor of Food Technology (1987 to present), and his team at the Natural Resources Institute (NRI), University of Greenwich, have been at the forefront of strategic and adaptive research on the intrinsic properties of cassava and its transformation to make safe, cheap and valued products that bring value to farmers and others in the supply chain.</p> <p>Westby, Bainbridge (1996-2001) and co-workers aimed to produce safe and shelf-stable products. Research (1994-1998) on the breakdown of cyanogenic compounds during processing used methods developed at NRI [3b] and focused on the importance of tissue disruption in cyanogen reduction [3.1, 3.3]. This paved the way for adaptive research for cyanogen reduction during processing (drying and various types of fermentation). Research [3c, 3.6] (1993-1995) by Wareing (1988-2001) and Westby isolated and characterised mycotoxins from cassava products and showed that:</p> <ol style="list-style-type: none"> cassava could support the production of a wide range of mycotoxins, including sterigmatocystin, neosolaniol, cyclopiazonic acid and diacetoxyscirpenol; these could be isolated from traditionally processed products; consumers preferred non-mouldy products. <p>These findings led to research on the development of drying regimes that prevented mould growth and mycotoxin production, which improved product quality and consumers' health and were readily suited to small and medium-scale enterprises.</p> <p>Development of techniques to produce a safer product was crucial in taking forward a cluster of research projects between 1999 and 2006 by Westby, Tomlins (1987 to present) and Graffham (1993 to present). This research had funding from the UK Government and the European Commission to develop and commercialise cassava processing systems and products in order to maximise benefits and sustain rural livelihoods [3a, 3d]. It took holistic approaches and a strong market-demand focus [3.2]. Strategic and adaptive research on processing of cassava was integrated with value chain studies, consumer acceptability [3.5] and systems analysis to determine the institutional arrangements to improve market access and achieve impact at a pilot</p>

level.

In particular, research has created improved processing technologies to produce high quality cassava chips or flour - the flour usually substituting for imported wheat, [3d, 3e, 3f, 3g, 3h] and improved traditional products, e.g. *fufu* [3f, 3h]. Adaptive research was completed to understand and optimise the use of high quality cassava flours in paperboard, plywood adhesives, sugar syrups and other food uses [3g].

In 2007, the Department for International Development's *Research into Use Programme* published case studies summarising the above and its validation. These are:

- "Cassava processors reap benefits from new techniques"
(<http://www.researchintouse.com/nrk/RIUinfo/PF/CPH30.htm>);
- "You name it and cassava can do it"
(<http://www.researchintouse.com/nrk/RIUinfo/PF/CPH21.htm>);
- "Fermentation helps meet growing urban demand for cassava products"
(<http://www.researchintouse.com/nrk/RIUinfo/PF/CPH41.htm>).

3. References to the research (REF1 submitted staff in **bold**, **REF2 Output)

- 3.1 Bainbridge, Z., Harding, S., French, L., Kapinga, R., & **Westby, A.** (1998). A study of the role of tissue disruption in the removal of cyanogens during cassava root processing. *Food chemistry*, 62(3), 291–297. [http://dx.doi.org/10.1016/S0308-8146\(97\)00215-X](http://dx.doi.org/10.1016/S0308-8146(97)00215-X)
- 3.2 Graffham, A. J., Ababio, J. T., Dziedozaove, N., Day, G., Andah, A., Budu, A., Ayernor, G. S., Gallat, S., & **Westby, A.** (1998) Market potential for cassava flours and starches in Africa: A case study in Ghana. *Tropical Agriculture (Trinidad)* 75(2), 267-270
- 3.3 Jones, D. M., Trim, D. S., Bainbridge, Z. A., & French, L. (1994). Influence of selected process variables on the elimination of cyanide from cassava. *Journal of the Science of Food and Agriculture*, 66(4), 535–542. <http://dx.doi.org/10.1002/jsfa.2740660418>
- 3.4 McNeill, M., & **Westby, A.** (1999). Ergonomics evaluation of a manually operated cassava chipping machine. *Applied Ergonomics*, 30(6), 565–570. [http://dx.doi.org/10.1016/S0003-6870\(99\)00013-7](http://dx.doi.org/10.1016/S0003-6870(99)00013-7)
- 3.5 **Tomlins, K.**, Sanni, L., Oyewole, O., Dipeolu, A., Ayinde, I., Adebayo, K., & **Westby, A.** (2007). Consumer acceptability and sensory evaluation of a fermented cassava product (Nigerian fufu). *Journal of the Science of Food and Agriculture*, 87(10), 1949–1956. <http://dx.doi.org/10.1002/jsfa.2941>
- 3.6 Wareing, P. W., **Westby, A.**, Gibbs, J. A., Allotey, L. T., & Halm, M. (2001). Consumer preferences and fungal and mycotoxin contamination of dried cassava products from Ghana. *International Journal of Food Science & Technology*, 36(1), 1–10. <http://dx.doi.org/10.1111/j.1365-2621.2001.00419.x>

Major research grants:

- 3a A. Westby. *Transfer needs assessment methodologies and Post-harvest technologies for non-grain starch staples in sub-Saharan Africa.* (DFID through NR International Limited, code ZN0028): 1992-98; £1,020,000.
- 3b A. Westby. *Influence of cultivation and traditional processing on cyanogens in fresh and processed cassava foods.* (DFID, R5077); 1992-1995.
- 3c A. Westby. *Mycotoxin potential of root crops substrates.* (DFID, R5078). 1992-1995; £181,400.
- 3dA. Westby. *Orientation of cassava chip production in relation to national and international markets.* (DFID contact R6506); 1996-1999; £204,546.
- 3e A. Westby. *Improved cassava chips processing to access urban markets.* (DFID, R7580); 2000 – 2003; £258,671.
- 3f A. Westby. *Commercialization of cassava fufu processing in West Africa that maximises benefits to livelihoods.* (DFID contract R9495), 1999-2003; £231,394.
- 3g A. J. Graffham. *Cassava as an industrial commodity - Approaches for expanding markets.*

(DFID, R8268; R8432): 2005-06; £267,310.

3h A. Westby. *Development of small/medium scale enterprise sector producing cassava based products to meet urban demand W Africa (Cassava-SMEs)*. (EC through NR International Ltd., code ZJ 033): 2000-2006; £661,153.

4. Details of the impact

For many developing countries, smallholder farmers producing staples such as cassava have the potential to drive, and benefit from, economic growth. Lack of competitiveness for fresh roots and cassava-derived products has consigned millions of smallholder cassava farmers, particular women, to continued poverty and food insecurity.

In 2008, the challenge was to develop validated research outputs into significant impact, through uptake by the private sector and root purchases from smallholders. Research outputs and validation pilots undertaken by Professor Westby and team have been widely used. A key example is the pan-African project, *Cassava: Adding Value for Africa (C:AVA)*. Its aim is to develop smallholder-supplied high quality cassava flour (HQCF) and related product value chains, e.g. dried *fufu*. Success has been predicated on adopting a value chain approach and adapting technologies to support intermediary and end user companies; this has created sustainable value chains that have generated social, economic and policy benefits, with significant reach and depth of impact, especially benefitting women and other disadvantaged groups.

C:AVA impacts

Based on monitoring data reported to the Bill and Melinda Gates Foundation, C:AVA has:

- Established value chains for HQCF and related products in Nigeria, Ghana, Uganda, Tanzania and Malawi, with annual increases in HQCF production.
- Supported 51 small-medium scale enterprises, three associations and 89 village processing groups to process HQCF. These include 25 factories in Nigeria including Oamsal, Wahan Food and Walili Mata; six in Ghana including Caltech Ventures, First Door and Amasa Agroprocessing; three associations in Uganda; and seven companies in Malawi including Universal Industries Limited; 20 community processing groups and three enterprises in Tanzania, e.g. Kejo Enterprises.
- Supported local engineering companies (for example, Nobex Technical Company, Nigeria) that have developed improved processing equipment to support the expanding demand for HQCF.
- Generated in excess of 42,616 tonnes of HQCF between April 2008 and March 2013, with 23,695 tonnes produced in 2012/2013 alone.
- Benefitted over 90,000 smallholder farmers; they are estimated to benefit by \$33.0 million as a consequence of project activities by 31/3/2014.
- Increased incomes will be determined in impact surveys in 2014, but are estimated, based on monitoring data, to be in the range of \$310-370 per smallholder.
- Surveys indicate that women involved in C:AVA have:
 - o enhanced technical and management skills;
 - o benefitted from labour saving technologies;
 - o new employment opportunities, increased incomes and greater dietary diversity;
 - o increased independence.
- Promoted the development of instant *fufu* as a commercial product in Ghana and Nigeria, produced by companies such as Sunshine Foods, Ayoola Food and Ubest Industries.
- Supported commercial companies to adopt HQCF. These include:
 - o plywood manufacturers in Ghana, e.g. Western Veneer and Lumbar Company, Kumasi;
 - o paperboard manufacturers in Uganda, e.g. Katon Industries, and Malawi, e.g. Packaging Industries Malawi Limited;
 - o local bakeries and food manufacturing companies in all countries eg Rite Foods, Nigeria; Universal Foods, Malawi, and Britannia Foods, Uganda.

Impact has generated change at the *individual level* beyond direct sales. For example, Zainabu Akol from Uganda used her income from higher cassava production and sales to buy poultry. The poultry manure increased production from her orange garden and cattle were bought from the cassava and orange sales (her story is here at 13:45 minutes: <http://cava.nri.org/multimedia/44-videos/47-video-gallery>). In Malawi, Mrs Melia, a food processor, used HQCF as a wheat flour replacement to produce mandazis which generated more profit that she aims to invest in a start-up clothing business.

At *group level*, technical and management skills have been enhanced, for example in Tanzania by the Ukumbozi village processors' group which has 31 members, 18 of whom are women. After training, the quantity and quality of HQCF production increased, and new processing equipment relieved the drudgery of processing. C:AVA facilitated links to an intermediary and the group now has an assured market with an agri-food processing company, which also provides credit. The lessons learned and success achieved by C:AVA has informed Nigeria's Cassava Transformation Agenda and hence *national policy and strategy*. C:AVA teams have made inputs in the cassava sector in Ghana, Tanzania, Uganda and Malawi.

C:AVA success has generated further interest from the Bill and Melinda Gates Foundation and other donors. The Department for International Development has adopted the C:AVA project approach in its AgriTT pilot project to develop cassava value chains in Uganda, using Chinese technologies. The Gates Foundation is looking to invest a further \$18 million in a second phase of C:AVA under African leadership; the vision is that within eight years, at least 250,000 smallholders will have sold at least \$400 million of roots into value chains.

5. Sources to corroborate the impact

- 5.1 Program Officer responsible for the Cassava Adding Value for Africa Project at the Bill and Melinda Gates Foundation, Agricultural Development, Bill and Melinda Gates Foundation.
- 5.2 The Chief Executive Officer, Nobex Technical Company, Nigeria.
- 5.3 Chairman, African Innovations Institute, Uganda.
- 5.4 Project Manager of Cassava: Adding Value for Africa, and Director Designate of CAVA Phase II, Federal University of Agriculture, Abeokuta, Nigeria.

Website sources

- Cassava Adding Value for Africa Project funded by the Bill and Melinda Gates Foundation through a grant to the Natural Resources Institute, University of Greenwich. 1 April 2008 – 31 March 2014, Grant number 48555. \$16.7 million. Website: <http://cava.nri.org>.
- Manufacturer of instant cassava *fufu* http://www.ayoolafoodsng.com/cassava_flour.php
- BBC Report on High Quality Cassava Flour towards the start of the C:AVA project <http://news.bbc.co.uk/1/hi/world/africa/7674615.stm>
- 2013 News report in Nigeria about the C:AVA project. <http://dailyindependentnig.com/2013/08/cavas-breather-for-nigerian-cassava-processors/>
- Annual Report 2012-2013, Cassava: Adding Value for Africa, Contract 48555, Bill and Melinda Gates Foundation. <http://cava.nri.org/documents/reports/CavaAnnualReport2013.pdf>