

ALLANBLACKIA SPECIES: A MODEL FOR THE DOMESTICATION OF HIGH POTENTIAL TREE CROPS IN AFRICA

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Abstract

Allanblackia is a dioecious multipurpose tree genus of the family *Clusiaceae* occurring in the equatorial rainforests of Africa extending from Tanzania to Sierra Leone. Besides its traditional main use for producing edible oil from its seeds, local communities use *Allanblackia* species as medicine and timber. A few years ago, the food processing industry discovered *Allanblackia* oil with its specific exceptional characteristics as a new ingredient in the sustainable manufacture of products such as margarine. Currently the potential market demand for *Allanblackia* oil (estimated as over 100,000 tons/year) cannot be met by harvesting fruits of wild *Allanblackia* species (*A. floribunda* in Nigeria, *A. parviflora* in Ghana and *A. stuhlmannii* in Tanzania), which yields only 200 tons/year. To address this and the challenges of over-exploitation and decreasing *Allanblackia* abundance in the forests, ICRAF and its partners from the public and private sector are domesticating the species since 2002 using participatory tree domestication approach. The program includes community sensitization, exploration, participatory selections of superior mother trees, conservation in field genebanks, development of agroforestry systems with *Allanblackia* and market development. Secondly, the program consists of developing asexual and sexual propagation protocols, which are necessary to overcome challenges in multiplication such as seed dormancy, long juvenile phase and high variability of desired traits. Experiments are mainly performed in ‘Rural Resource Centres’ (RRCs), which serve as diffusion hubs for new technologies, germplasm and knowledge. RRCs have their own tree nurseries, motherblocks and demonstration plots, and train farmers in *Allanblackia* propagation and cultivation techniques. In addition, RRCs support private satellite nurseries in the villages nearby to reach remote farmers. The domestication programme of *Allanblackia* through public-private partnership and participatory tree domestication could serve as a model for domestication of other underutilized African tree species of high economic potential.

Keywords: Agroforestry, conservation, propagation, rural resource centre, vegetable oil

INTRODUCTION

Allanblackia is a dioecious multipurpose tree genus of the family *Clusiaceae* found in the equatorial rainforests of West, East and Central African regions extending from Tanzania to Sierra Leone. It has several uses including shade, timber, and medicine, but the main use is the production of edible oil from its seeds. The dry seeds contain about 67-73% of solid white fat (Sefa, 2006) and has been used traditionally for cooking and soap making. Recently, new uses of *Allanblackia* seed oil at industrial scale have been discovered by Unilever for the manufacture of margarine and cosmetic products, thus raising the international demand on a commercial scale. The moderately high melting point of the *Allanblackia* seed oil among other properties makes it superior to other alternative oils like palm oil. The oil has recently received the approval of the European Union (EU) Novel Food Regulations that certify its safe usage in food products (Hermann, 2009). Since the demand for *Allanblackia* oil is higher than the supply from the natural forest and remnants on farms, there is the danger that wild harvesting of *Allanblackia* seeds may result in over-exploitation of this resource in such a manner that will impair natural regeneration as well as biodiversity conservation. Invariably, there is a need for extensive on-farm cultivation of *Allanblackia* which will also contribute to improving the livelihoods of rural communities. If current limitations to cultivation are addressed, the foreseen returns from planting *Allanblackia* will compare well with other perennial crops such as cocoa and oil palm (Shrestha et al., 2007). In view of these, a planting initiative supported by research is underway, where ICRAF and its partners from the public and private sectors are assisting local communities to domesticate and cultivate *Allanblackia* primarily for extraction of oil.

ICRAF's experiences over the last 15 years demonstrate that different activities are needed for the promotion of a new tree crop, which includes the development of a coordinated strategy for market development, propagation, cultivation, and conservation elements (Leakey et al., 2003; Tchoundjeu et al., 2006).

THE NEED FOR DOMESTICATION OF *ALLANBLACKIA* SPECIES

Unilever, which currently is the major buyer of *Allanblackia* oil, estimates that the potential market for oil is more than 100,000 tons annually. However, the basic minimum requirement of 240 tons of oil to sustain the *Allanblackia* oil business of Unilever is somehow difficult to achieve by the three countries (Ghana, Nigeria and Tanzania) currently participating in the supply chain development. Tanzania, Ghana and Nigeria produce a mean of about 450, 110 and 60 tons of seeds, respectively, which will result in about 150, 40 and 20 tons of oil per annum (Kattah, 2010). Most of the harvested seeds are collected from natural forest stands and remnant trees on farmlands. It has however been realized that wild collection cannot sustain the *Allanblackia* business. The huge potential demand of *Allanblackia* oil can only be achieved if *Allanblackia* is domesticated and extensively planted on farms, involving millions of trees. These efforts will increase both the efficiency of the *Allanblackia* supply chain as well as quantity and quality of the product.

THE NOVELLA PARTNERSHIP AS A DRIVING FORCE

The term 'public-private partnership' (PPP) refers to joint activities of governments, research institutions or NGOs with the private sector. The advantages of PPPs are numerous; including bringing together stakeholders with different interests and organisational capacities, sharing of resources for increasing cost-efficiency, avoiding duplications and directly responding

to consumers' needs. The 2002 World Summit on Sustainable Development highlighted the importance of PPPs in achieving global goals of sustainable and equitable development.

The Novella partnership is a corporate multi-country PPP with strong development, extension and conservation components that was established in 2002. Its main aim is to develop domestication techniques, tree management practices and conservation strategies for *Allanblackia* species in Africa. The partnership composed of Unilever, World Agroforestry Centre (ICRAF), World Conservation Union (IUCN), Netherlands Development Organization (SNV) and a number of governmental organizations and NGOs in Africa, who are running joint pilot sites in Cameroon, Ghana, Nigeria and Tanzania (Shrestha and Akangaamkum, 2008). The main actions of the partners centres around:

- Sensitization and encouragement of farmers to participate in *Allanblackia* domestication
- Range-wide germplasm collection, development of propagation methods (sexual and asexual) and gene conservation
- Studies on the ecology, abundance, sustainable harvesting and biodiversity conservation
- Integration of *Allanblackia* in agroforestry farming systems
- Facilitation and development of marketing networks and supply chains
- Development of poverty alleviation options in the rural areas through promotion of *Allanblackia*.

The success of the Novella Partnership is firmly grounded on national partners who provide local context and expertise. The National Agricultural Research Institutes and Stations (NARS) and local NGOs collaborate with leading international institutions to undertake domestication research, sensitization and mobilizations of rural communities. Community-run Rural Resource Centres (RRCs) were jointly established, which serve as diffusion hubs for new technologies, materials and knowledge.

DEVELOPMENT OF MARKET SUPPLY CHAINS

Novella Africa began to develop market supply chains for *Allanblackia* oil in 2002. Seed harvesting operations are underway in three countries namely, Ghana, Nigeria and Tanzania (Attipoe et al., 2006), where Novel Development Companies act as buyers. Through verbal presentations, radio broadcasts, posters and video resources, local people are informed about the value of *Allanblackia* and from where and how it can be harvested (SECO, 2008). Local associations are formed to mobilize communities and 'focal persons' are trained in business skills and record-keeping. Collectors send the dried seeds to buying centres where seed quality such as seed moisture content is checked before the seeds are paid for at \$0.25/kg (Fig. 1). Seeds bought are sent to central oil extraction facilities for extraction under the supervision of Novel companies. On average, oil yield is about one-third of total seed weight (Attipoe et al., 2006). Most of the oil produced by Novel Development Companies is to date being purchased by Unilever and has guaranteed market for the oil set at a premium to other food oils. Their policy is to encourage other food processing companies as buyers and to join them in their initiative for responsible and sustainable investment into the development of an international market for *Allanblackia* oil (Grootveld, 2009).

FARMERS' PERSPECTIVES ON ALLANBLACKIA CULTIVATION

Allanblackia fruit collection activities are carried out during the lean season and its opportunity cost is nil in financial terms. *Allanblackia* domestication and cultivation seem to be embraced by the majority of the farming communities if certain challenges are addressed. The

species is dioecious (Peprah et al., 2009), resulting in uncertainties on the proportion of males and females in planted seedlings until their first flowering. Although a lot of efforts have been made to enhance seed germination, it still takes about three months to obtain 50% seed germination and 10 months to obtain 75% seed germination (Fig. 2; Ofori et al., 2011). Furthermore, the seedling's first flowering occurs after six years (Ofori and Peprah, 2011). Because of these constraints, farmers were initially skeptical about the profitability in planting *Allanblackia* but they got convinced after seeing flowers on one to two years old grafts (Ofori et al., 2008). In Ghana and Tanzania, 650 farmers have been involved in planting thousands of *Allanblackia* propagules (Table 1).

GENETIC DIVERSITY, SELECTION AND CONSERVATION

Analysis of genetic diversity is very important in any tree domestication programme for identification of superior genotypes and also for proper clonal deployment. Both molecular (Atangana et al., 2010; Russell et al., 2009) and morphological (Peprah et al., 2009) variation among *Allanblackia* trees indicate large genetic diversity within the species. The pattern suggests a high potential for genetic gain through individual selection. Hence, targeted selection based on fruit size and seed yield has been adopted in sampling (Peprah et al., 2009). Seeds and vegetative propagules collected from the selected trees are not only being distributed directly to farmers, but also used for establishment of mother blocks for further propagation (vegetative), and also for the establishment of living 'gene banks' for conservation purposes (Munjuga et al., 2008). In Ghana, two mother blocks have been established with 20 superior clones. In addition to the clonal materials in the mother blocks, a 3 ha genebank planted with seedlings from 120 mother trees has been established. Similarly in Tanzania, 16 accessions have been cloned and used to establish a mother block. Furthermore, two genebanks have also been established with seedlings from 20 trees.

PROPAGATION OF ALLANBLACKIA

Allanblackia seeds can take more than a year to germinate at success rates lower than 20%. Using sand or a mixture of sand and soil has been reported to be a more effective seed germination medium than soil alone (Munjuga et al., 2008). Farmers in Tanzania have experimented with a variety of approaches to accelerate germination, including burying whole fruits for several months to allow for post-harvest maturation before extracting and sowing the seeds. Such 'local research' is providing promising avenues for formal testing of different techniques at the research stations (Munjuga et al., 2008). In Ghana, removal of the seed coat and incubating the seeds in polythene bags at a temperature range of 23-31°C has enhanced seed germination, with seed germination starting from week two and reaching a rate of 75% at week 10 (Ofori et al., 2011).

However, sexual propagation of *Allanblackia* has disadvantages such as producing either male or female seedlings and the time needed until germination and first flowering. Thus, vegetative propagation was adopted to produce quality planting materials with known genetic quality and sex as well as reduced gestation period when ontogenetically matured parts are used. Rooting of leafy stem cuttings, grafting and air layering were used (Anegbeh et al., 2006; Atangana et al., 2006; Ofori et al., 2008), resulting in first flowering on one to two years old grafts (Ofori et al., 2008, Asaah et al., 2011a). Problems faced with vegetative propagation are the slow rooting rate of cuttings and the poor quality of the roots resulting in low number of roots

per cutting. Plagiotropism has also been observed on cuttings but this has already been overcome by the use of orthotropic shoots.

ESTABLISHMENT OF RURAL RESOURCE CENTRES (RRCs)

Distribution pathways for *Allanblackia* planting materials were decentralized through the establishment of RRCs and satellite nurseries within the project area. The RRCs are equipped with propagation units, nursery facilities, mother blocks and demonstration plots. Farmers, technicians and other stakeholders are trained at the RRCs on nursery establishment and management as well as tree propagation and cultivation techniques. Finally, RRCs support innovative trainees in the establishment of private satellite nurseries in their villages to enable the supply of remote farmers with knowledge on *Allanblackia* cultivation and quality planting stock (Asaah *et al.*, 2011b). So far there are two and three very active RRCs in Ghana and Tanzania respectively. These RRCs together have produced 48,000 thousand planting materials and distributed to 650 farmers (Table 1).

DISCUSSIONS AND CONCLUSIONS

The World Agroforestry Centre (ICRAF) and Unilever, together with a number of local and regional organizations such as NGOs, research institutes and governments as well as different donors have been putting together their efforts to bring *Allanblackia* under commercial scale production. This Novella partnership is unique in that it is being set up with local communities and small scale businesses, in cooperation with non-profit development partners and local governments. Through the adoption of the participatory tree domestication and RRC approaches developed by ICRAF and partners, farmers could improve their livelihoods. Earlier initiatives to domesticate other tree species often had failed, but the combination of participatory domestication and RRCs were proven to be successful not only for *Allanblackia*, but also some Cameroonian fruit and nut species (Asaah *et al.* 2011). The model for *Allanblackia* showed that challenges such as lack of propagation techniques, poor access of farmers to quality planting materials, lack of knowledge on tree management on-farm and a non-existing value chains can all be addressed by science in partnership with public, private and grassroots institutions. In addition to the economic benefits for small-scale farmers and a higher resilience of the agro-ecosystem by diversification, the *Allanblackia* project has a positive impact on the environment by decreasing the pressure on remaining stands, conserving the genetic resources of the species and increasing its abundance through planting incentives. The domestication programme of *Allanblackia* through public-private partnership and participatory tree domestication could serve as a model for domestication of other underutilized African tree species of high economic potential. Currently, the most important activities of the project are mass-production of selected superior genotypes, the development of a sound agroforestry system for extensive integration of *Allanblackia* on-farm.

References

Anegbeh, P.O., Tchoundjeu, Z., Simons, A.J. and Roy-Macauley, H. 2006. Domestication of *Allanblackia floribunda*: vegetative propagation by leafy stem cuttings in the Niger Delta region of Nigeria. *Acta Agronomica Nigeriana* 7: 11–16.

- Asaah, E.K., Tchoundjeu, Z., Leakey, R.R.B., Takouasting, B., Njong, J. and Edang I. 2011b. Trees, agroforestry and multifunctional agriculture in Cameroon, *International Journal of Agricultural Sustainability* 9: 110-119.
- Asaah E., Tchoundjeu Z., Ngahane W., Tsobeng A., Kouodiekong L., Jamnadass R., Simons AJ. 2011a. *Allanblackia floribunda*: a new oil tree crop for Africa: amenability to grafting. *New Forests* 41:389-398
- Atangana A.R., Beaulieu J. and Khasa D.P. 2010. Wild genetic diversity preservation in a small-sized first generation breeding population of *Allanblackia floribunda* (Clusiaceae). *Tree Genetics and Genomes* 6: 127–136.
- Atangana A.R., Tchoundjeu Z., Asaah E.K., Simons A.J. and Khasa D.P. 2006. Domestication of *Allanblackia floribunda*: amenability to vegetative propagation. *Forest Ecology and Management* 237: 246–251.
- Attipoe, L., van Andel A. and Nyame S.K. 2006. The Novella project: developing a sustainable supply chain for *Allanblackia* oil. Pp. 179–189 in Ruben R., Slingerland M. and Nijhoff H. (eds) *Agro-food chains and networks for development*. Springer, Amsterdam, The Netherlands.
- Grootveld, P. 2009. Becoming trusted at the Base-of-the-Pyramid. MSc thesis. Tilburg University, Tilburg, The Netherlands.
- Hermann, M. 2009. The impact of the European Novel Food Regulation on trade and food innovation based on traditional plant foods from developing countries. *Food Policy* 34: 499–507.
- Kattah, C. 2010. Developing a Sustainable *Allanblackia* Business in Africa. First *Allanblackia* Conference, Thinkers Village Hotel, Monrovia, Liberia 2-3 February 2010.
- Leakey, R.R.B., Schreckenber, K. and Tchoundjeu, Z. 2003. The participatory domestication of West African indigenous fruits. *International Forestry Review* 5: 338–347.
- Munjuga, M., Ofori, D., Sawe, C., Asaah, E., Anegebeh, P., Peprah, T., Mpanda, M., Mwaura L., Mtui, E., Sirito, C., Atangana, A., Henneh, S., Tchoundjeu, Z., Jamnadass, R. and Simons, A.J. 2008. *Allanblackia* propagation protocol. (ed. Dawson, I.). World agroforestry Centre, Nairobi, Kenya, 39pp. ISBN978-92-9059-231-0
- Ofori, D. A. and Peprah, T. 2011. Domestication of *Allanblackia parviflora* in Ghana. Report to ICRAF – January 2010-March 2011, Pp10.
- Ofori, D.A., Peprah, T., Cobbinah, J.R., Atchwerebour, H.A., Osabutey, F., Tchoundjeu, Z., Simons, A.J., Jamnadass, R. 2011. Germination requirements of *Allanblackia parviflora* seeds and early growth of seedlings. *New Forests*, 41:337-348
- Ofori, D.A., Peprah, T., Henneh, S., Von Berg, J.B., Tchoundjeu, Z., Jamnadass, R. and Simons, A.J. 2008. Utility of grafting in tree domestication programmes with special reference to *Allanblackia parviflora* A . Chev. *Ghana Journal of Forestry* 23 and 24: 42–48.
- Peprah, T., Ofori, D.A., Siaw, D.E.K.A., Addo-Danso, S.D., Cobbinah, J.R., Simons, A.J. and Jamnadass, R. 2009. Reproductive biology and characterization of *Allanblackia parviflora* A. Chev. in Ghana. *Genetic Resources and Crop Evolution* 56: 1037–1044.
- Russell, J.R., Kadu, C.A.C., Jamnadass, R., Booth, A., Cordeiro, N.J., Woodhead, M. and Dawson, I.K. 2009. AFLP and SSR diversity in the African fruit tree *Allanblackia*: implications for management of a genus newly subject to domestication for the edible oil industry. *Tree Genetics and Genomes* 5: 517–527.

- SECO. 2008. *Allanblackia*: standard setting and sustainable supply chain management. Final technical report. The Swiss State Secretariat for Economic Affairs, The Swiss Embassy, Accra, Ghana.
- Sefah, W. 2006. Extraction and characterisation of vegetable fat from *Allanblackia floribunda*. Thesis submitted to the department of Biochemistry and Biotechnology in partial fulfilment of the requirement for the award of the Master of Science (M.Sc.) degree in food science and technology. Kwame Nkumah University of Science and Technology, p 146
- Shrestha, R.B., Akangaamkum, A.D., Agyare, E., Torpey, K., Fordjor, M.M. and Hinneh, K.O. 2007. Relative attractiveness of *Allanblackia* cultivation in Ghana: farmer's perceptions and willingness. Novella Partnership Ghana. The Netherlands Development Organisation (SNV) Ghana, Accra, Ghana.
- Shrestha, R.B. and Akangaamkum, A.D. 2008. Novella partnership, a partnership for poverty reduction through sustainable enterprise development based on *Allanblackia*. SNV Ghana, Pp 20.
- Tchoundjeu, Z., Asaah, E.K., Anebeh, P., Degrande, A., Mbile, P., Facheux, C., Tsobeng, A., Atangana, A.R., Ngo-Mpeck, M-L. and Simons, A.J. 2006. Putting participatory domestication into practice in West and Central Africa. *Forests, Trees and Livelihoods* 16: 53–69.

Table 1. Number of planting materials produced and number of farmers planting *Allanblackia* in Ghana and Tanzania

	Ghana	Tanzania	Total
Planting materials produced and distributed	18,000	30,000	48,000
Farmers planting <i>Allanblackia</i>	200	450	650



Fig. 1. *Allanblackia* seeds being sold in Tanzania at Mvomero District Muhonda buying centre

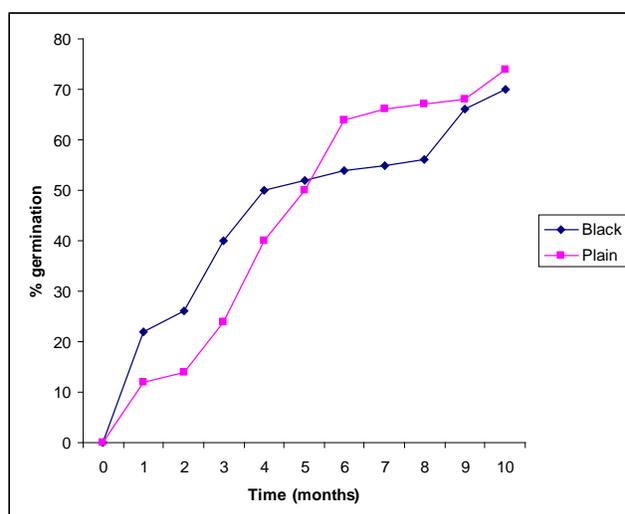


Fig. 2 Germination rates of seeds of *A. parviflora* incubated in black and plane polythene bags in Ghana. Source: Ofori *et al* 2011