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Report

Promoting commercial forestry in Uganda

The experience of the Tree Biotechnology Programme

Linda Calabrese

March 2021

GATSBY AFRICA

Cover photo: Rob Beechey for Gatsby Africa

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Acronyms

BGC	blue gum chalcid
FAO	Food and Agriculture Organisation of the United Nations
GA	Gatsby Africa
GC	*Eucalyptus grandis x camaldulensis*
GCF	Gatsby Charitable Foundation
GoU	Government of Uganda
GU	*Eucalyptus grandis x urophylla*
ISAAA	International Service for the Acquisition of Agri-biotech Applications
NaFORRI	National Forestry Resources Research Institute
NARO	National Agricultural Research Organisation
NFA	National Forestry Authority
NRM	National Resistance Movement
R&D	research and development
SPGS	Sawlog Production Grant Scheme
TBP	Tree Biotechnology Programme
TBPT	Tree Biotechnology Programme Trust
UGT	Uganda Gatsby Trust

Executive summary

Forests (natural and planted) are a vital resource in East Africa, providing food, fuel and timber for local communities, maintaining the soil and water balance, and absorbing carbon dioxide. Due to increased population pressure and rapidly growing demand for charcoal, East African forests have been shrinking. Towards the end of the 1990s, the Gatsby Charitable Foundation (GCF) began funding the Tree Biotechnology Programme (TBP), a clonal forestry programme aimed at increasing production of wood for domestic consumption. By focusing on improving tree growers' access to quality planting materials, the programme had a threefold objective: private sector and small grower development, poverty alleviation, and the reduction of negative environmental impact from forestry (contributing to environmental protection).

The TBP began as a technology transfer programme, to introduce faster-growing and more consistent planting material for the forestry sector through clonal technologies, using hybrid eucalyptus species. Mondi Forests, a South African company, provided the eucalyptus clone, and the International Service for the Acquistion of Agri-Biotech Applications (ISAAA) catalysed the relationship between technology donor and funder (the GCF). National forestry research institutes were responsible for identifying the most suitable clones for the various agro-ecological zones in each country, establishing clonal nurseries to produce seedlings and clonal material, and providing training to private sector operators. The activities were funded by the GCF.

The TBP started in Kenya in 1997, and was followed by similar programmes in Uganda and Tanzania. In Uganda, the programme was very successful, contributing to the spread of clonal eucalyptus and the development of commercial forestry activities throughout the country. In addition, an organised scheme, the Sawlog Production Grant Scheme (SPGS), a programme providing technical and financial assistance to commercial tree growers, was well-established, and government reforms and support helped the sector thrive. A tell-tale sign of this success is that, while the GCF's financial support ceased, the commercial tree nursery market in Uganda remains vibrant, with over 60 certified clonal nurseries set up by private operators and many commercial integrated growers, including some large companies, producing sawlogs, transmission poles and other timber products.

The success of the TBP in Uganda is due to a wide range of factors, both internal and external to the programme. In addition to the quality of the clones, and their suitability to the Ugandan climate and planting sites, these included the support of the Uganda Gatsby Trust (UGT) and especially its Gatsby Clubs (private sector clubs formed by small-business owners); its collaboration with the SPGS; and national processes, such as forest sector reform and the rural electrification process that contributed to making land available at scale and to opening up the market for commercial forestry products. As such, the success of the TBP in Uganda was also serendipitous, as the programme found itself in the midst of a prolonged reform effort by the government, and with the ability to draw on the expertise and market dissemination capabilities of the SPGS.

The experience of the TBP in Uganda highlights the importance of sector conditions, such as the availability of land and finance, effective governance structures, dynamism of local firms and availability of targeted business

support services. This understanding has led Gatsby Africa (GA)[1] to focus explicitly on addressing these wider conditions, in conjunction with the introduction of new technologies and other innovations in its programmes to achieve the ambitious goal of transforming sectors.

In Uganda, the programme's broad sector view allowed it to thrive, and take advantage of favourable external conditions. This is one reason why GA has since taken a more holistic systems approach to sector transformation. Being an arms-length funder meant that GCF had limited control over the day-to-day management of the programme and was one step removed from partners. Moving to a direct implementer model, with explicit transformation objectives, has meant that GA has a better picture of what is happening in its programmes, can adapt sooner when challenges arise and can anticipate opportunities for future growth.

1 Gatsby Africa (GA) is a charitable company limited by guarantee, established in order to implement the Africa programmes of the Gatsby Charitable Foundation.

1 Introduction

The GCF has been extensively involved in agricultural programmes across Africa since the 1980s. Its first programme in Africa, supporting the distribution of higher-yielding varieties of cassava to smallholder farmers across Cameroon, was launched in 1985. From 1985 to 2006, the GCF funded non-governmental and research organisations as well as private consultancies to undertake projects in agricultural research and dissemination.

The first projects financed by GCF aimed to bring the results of agricultural research to the field. In 2007, it transitioned from a research funder to a funder–implementer model, and established GA as a subsidiary to manage this work (Gatsby Africa, 2016).[2] The portfolio evolved towards a more holistic approach to support sector development, which remains the main objective of GA's programmes today (ibid).[3] For its work in forestry, this has meant a shift to a clearer focus on promoting the commercial forestry sector.

Forests are a vital resource in East Africa, providing food, fuel and timber for local communities, maintaining the soil and water balance, and absorbing carbon dioxide. Due to increased population pressure and rapidly growing demand for charcoal, these forests have been shrinking. Towards the end of the 1990s, the GCF decided to fund the Tree Biotechnology Programme (TBP) in Kenya, a clonal forestry programme aimed at increasing production of wood for domestic consumption, as well as improving livelihoods for small growers that could grow timber for charcoal production and other uses. The TBP was followed by similar programmes in Uganda and Tanzania under the same umbrella.

This report provides an overview of the clonal forestry activities funded by the GCF in Uganda. It describes the aims and evolution of the programme, as well as the successes achieved and challenges. The Ugandan case is selected as it provides insights into the internal and external factors that contributed to the success of the programme in supporting the commercial forestry sector. For the preparation of this report, the author reviewed the literature (including academic and grey literature, and programme documents) and interviewed a wide range of stakeholders in the UK, South Africa and Uganda between August 2019 and May 2020. The author travelled to Uganda in February 2020 to visit some of the sites described in this study and to conduct interviews.

This report is organised as follows. Chapter 2 provides an overview of the structure of the programme in East Africa; Chapter 3 looks in detail at the Uganda case; and Chapter 4 assesses the strengths and weaknesses of the programme and concludes the report.

2 For more on the history and evolution of Gatsby Africa see: www.gatsby.org.uk/africa/about.

3 GA is no longer funding separate research programmes, but it maintains a legacy of strong agricultural research (Gatsby Africa, 2016).

2 The Tree Biotechnology Programme in East Africa

The TBP began in 1997 as a technology transfer programme, to introduce clonal technologies in the forestry sector in Kenya, and was later replicated in Uganda and Tanzania. Despite some differences in their implementation, the TBP programmes in the three countries aimed to achieve the same main objectives: enhancing the viability of forestry enterprises through increased productivity; creating opportunities for poverty alleviation among resource-poor farmers; and mitigating the pressure on natural forests by meeting demand for fuel-wood and other timber products (Jacovelli, 2014: 6).

In each country, the programmes aimed to:

1. support comprehensive research, led by national forestry research institutes, to identify suitable hybrid clones
2. establish nurseries to produce seedlings and clonal material
3. provide training (and in some cases financial support) to private sector operators.

Research, commercial development and private sector support were, therefore, all essential to the success of the programmes.

The programme started through a partnership initiated by the International Service for the Acquisition of Agri-biotech Applications (ISAAA) and GCF with Mondi Forests, a division of Mondi Ltd, South Africa. A grower and processor of eucalyptus for pure species and hybrids pulp and paper, Mondi provided the eucalyptus clones[4] as part of its Corporate Social Responsibility activities (F. Blakeway, interview, 17 December 2019). In addition to providing genetic material, Mondi supported trials to match clonal varieties to the most appropriate agro-ecological areas in each country (Kilimo Trust, 2011), and provided technical support to establish the clonal production hedges and the clonal nursery at Karura.

The programmes introduced eucalyptus hybrids to East Africa (see Box 1). Eucalyptus hybrids were chosen as they could be selected for desirable characteristics such as increased productivity and improved drought resistance compared with non-hybrid plants. In addition, high-density (and thus reasonably high-calorific-value) clones were chosen. Three main hybrid clone groups were produced: *grandis-camaldulensis* (GC), a cross-breeding between *Eucalyptus grandis* and *Eucalyptus camaldulensis*; *grandis-urophylla* (GU), a cross-breeding of *Eucalyptus grandis* and *Eucalyptus urophylla*; and *grandis-tereticornis* (GT), a cross-breed of *Eucalyptus grandis* and *Eucalyptus tereticornis* (ibid.).

Cuttings of superior quality were then transferred and screened for their suitability in specially designed long-term research trials. The trials provided information on how trees performed in terms of growth and productivity (volume), wood quality, resistance to pests and diseases and other factors. The trials showed that hybrid clones generally perform well across Kenya, Tanzania and Uganda, but that no one hybrid clone was suitable in all situations. Therefore, specific clones were matched to the most appropriate sites (ibid.).

4 The genetic material provided was not Mondi's most recent and advanced, but it was deemed adequate for use in East Africa (F. Blakeway, interview, 17 December 2019).

Box 1 Hybrid eucalyptus and clonal technology

Why eucalyptus?

Eucalyptus is a multipurpose fast-growing tree genus that can provide wood for energy and construction within 6–10 years. A native of Australia, eucalyptus is now successfully planted in Brazil, Portugal, India, South Africa, Zimbabwe, Kenya, Uganda and Tanzania. Eucalyptus is primarily grown for wood chip, firewood, poles, timber and charcoal. In East Africa, *Eucalyptus grandis* is suited to cooler and wetter areas, and E*ucalyptus camaldulensis* grows well in hotter and drier climates (Kilimo Trust, 2011).

Often deemed a 'heavy water consumer', eucalyptus consumes more water than slow-growing plants, but grows faster and converts water into wood more efficiently than other species (ibid.). Different varieties of eucalyptus have different water needs (Albaugh et al., 2013). Moreover, it adjusts its water consumption according to the water available (Kilimo Trust, 2011).

Why hybrids?

Hybrid trees combine the desirable properties from several different species. They are produced through hybrid tree breeding programmes. Eucalyptus hybrids selected for the programme had desirable qualities such as fast and uniform growth, high productivity, resistance to pests and diseases and straight stems (P. Jacovelli, interview, 17 December 2019; Kilimo Trust, 2011). When compared with pure species, eucalyptus hybrids have the potential to produce genotypes with combinations of properties that contribute to the value of the genetic resources. These include pest and disease resistance, wood properties and volume/growth (Hettasch et al., 2005). Hybrids between *Eucalyptus grandis* and *Eucalyptus urophylla* are becoming increasingly important for enhancing yields on some types of sites and for improving disease resistance (White et al., 2007). In South Africa, from the early 1990s eucalyptus clonal hybrid combinations were matched to site (mainly determined by rainfall) with the drought-resistant *E. grandis x E. camaldulensis* and *E. grandis x E. tereticornis* on drier sites, and *E. grandis x E. urophylla* planted on moister sites (Denison and Kietzka, 1992).

Why clonal technology?

Clones are genetically identical plants reproduced from rooted cuttings or tissue culture. Clonal technology produces many genetically identical, disease-free plantlets in a short period of time, ideal for fast development of the sector. It also ensures that the plants remain uniform and maintain the desired characteristics.

In clonal technologies, plantlets are planted in nurseries where they form 'clonal hedges'. Cuttings are taken from these clonal hedges and placed in a rooting medium, before being transplanted for growing out (Gatsby Charitable Foundation, 2003).

The use of clonal technology presents risks. Clones all share the same genetic material, and so there is a greater risk that all will be impacted by specific pests and diseases.

3 The Tree Biotechnology Programme in Uganda

3.1 Background

In recent decades, despite an exceptionally favourable climate for forest growth, Uganda's rich forest resources have been neglected to the point of degradation. In the 1970s, President Idi Amin announced that every Ugandan was free to settle in any part of the country, and many interpreted this statement as permission to clear forest land for agricultural production. After the fall of Amin's government and during the subsequent guerrilla period, the government lacked funds and personnel to monitor the use of forest resources. As a result, by the mid-1980s illegal activities in forest reserves had become almost uncontrollable (Turyahabwe and Banana, 2008). With the end of the civil war in 1986, the newly installed National Resistance Movement (NRM) government made efforts to revise the forestry policy framework, issuing a new forestry policy in 1988. However, this was not enough to protect Uganda's forest reserves (ibid). According to the Ministry of Water, Lands and Environment at the time: 'There is increasing concern about the deteriorating state of forestry in the country. Natural forest cover is receding; ecological services are declining; there is increasing pressure on forest land and increasing demand on forest products; management capacity is limited and institutional weaknesses constrain development' (Ministry of Water, Lands and Environment, 2001: 1).

At the end of the 1990s, Uganda's forests comprised areas classified as natural forest (tropical high forest and savannah woodland), and a small area of man-made plantations, for a total area of 5 million hectares. Of these, 40% was protected as forest reserves, national parks, game reserves or controlled hunting areas. The remaining 2.9 million hectares were not legally protected under the Forestry Act (1988) and were under private, customary or public ownership. This land was the country's main source of fuelwood and timber, and as such it was undergoing major degradation (Jacovelli and Carvalho, 1999).

In the 1990s, Uganda met 95% of its energy requirements from wood. Much of this wood was obtained informally, which makes it difficult to estimate the contribution of this sector to the economy. One report (Sepp and Falkenberg, 1999, quoted in Jacovelli and Carvalho, 1999) estimates this at 6.1% of gross domestic product (GDP). Forests were providing employment to around 850,000 people, with another 250,000 jobs in secondary processing, marketing and distribution of wood and wood products (Impact Associates, 1997; Sepp and Falkenberg, 1999, quoted in Jacovelli and Carvalho, 1999).

Ugandan forests were also a source of government revenues, for both the central government and local authorities. Studies conducted when the Forest Department was still in charge of managing forest reserves show that the organisation was lax in its revenue collection efforts. In the fiscal year 1998/1999, the Forest Department collected USh 825 million, estimated to be only 3% of potential revenue (Sepp and Falkenberg, 1999, quoted in Jacovelli and Carvalho, 1999). Royalties were also considered

too low, and prices were determined haphazardly and without proper market analysis.

At the end of the 1990s, the main private sector groups involved in the Ugandan forestry sector were small tree farmers (non-commercial growers); natural forest owners; commercial woodlot growers and non-government organisations. At that time, the involvement of the private sector was nascent, encouraged by the abundance of natural forest resources but discouraged by the failure of the government to encourage private sector investment in tree planting. Despite incentives for firms (tax incentives, land leases, training etc.), there was limited private sector uptake. Similarly, regulations to promote planting saw limited enforcement. Many tree-planting initiatives were in place, including some run by NGOs. The Government of Uganda (GoU)'s National Tree Planting Programme was launched in 1992 (Jacovelli and Carvalho, 1999).

Given the poor state of Uganda's forests, the NRM government attempted several reforms to improve their management. With the Local Government Statute (1993), some forest management responsibility was transferred from central to local government. However, local governments did not have the technical and financial expertise to back the management of forest reserves. In 1997, some of these functions were moved back from the local authorities to the central government, and finally, in 1998, the Forest Reserves Declaration Order limited the mandate of local government to local forest reserves only (Turyahabwe and Banana, 2008).

These changes were not enough to reverse negative trends in the sector. In the words of the GoU's National Forestry Authority (NFA), '[t]here was a sense of crisis about the state of the country's forests and a particular outcry at the state of the forest reserves' (NFA, n.d.). The government realised that it could not simply rely on natural forests, but instead had to take a more active role in replenishing forest reserves (S. Maniraguha, interview, 5 February 2020).

With the assistance of development partners, the GoU carried out a Forestry Sector Review between 1998 and 2001. In 1999, the GoU launched a Forest Sector Reform Process which resulted in the development of a Forest Policy (Ministry of Water, Lands and Environment, 2001), a National Forest Plan (Ministry of Water, Lands and Environment, 2002), and the National Forestry and Tree Planting Act (Ministry of Water, Lands and Environment, 2003), which established the NFA as an autonomous body under the Ministry of Water, Lands and Environment (Turyahabwe and Banana, 2008; Banana et al., 2014). This comprehensive set of reforms, summarised in Table 1, changed the way Uganda's forestry sector operated.

The pressure on forest reserves was not only perceived as an environmental concern but also an economic one. With Ugandan families relying on forests for fuel, and an increasing population, there were questions about the sustainability of the model. It is in this context that the TBP was set up.

3.2 The Tree Biotechnology Programme in Uganda

Around 2002, National Agricultural Research Organisation (NARO) staff visited the Karura nursery to learn more about the TBP. Following the visit, NARO tasked the National Forestry Resources Research Institute (NaFORRI, instituted under the NARO) to investigate bringing the programme to Uganda. NARO prepared a funding proposal for the GCF, which agreed to fund the project (W. Otim-Nape, interview, 13 January 2020).

The objectives of the Uganda TBP (TBP-U) were economic, social and environmental:

1. promoting sustainable forestry through the distribution of improved varieties of trees at an affordable cost
2. contributing towards poverty alleviation by providing improved access to affordable wood products and creation of wealth at household level
3. making an environmental contribution in the form of increased forest cover.

In 2002, with the funds received from the GCF, NARO set up a nursery on the site of the NaFORRI office in Kifu, Mukono, 25 kilometres outside Kampala. The clones produced in Kifu were used to run trials for site-matching across

Table 1 Key institutional changes in the Ugandan forestry sector

Year	Change	Relevance
1988	Forestry policy framework revised by the NRM government	Based on previous Forest Policy (1947), with more emphasis on environmentally sound forest harvesting, biodiversity conservation and ecosystem approaches to forest management. Encouraged research and promotion of agroforestry. However, lacked incentives for forest conservation and failed to address local people's needs and the links with other sectors and land uses.
1998	Forest Reserves Declaration Order issued	Restricted the role of local government to the management of Local Forest Reserves only.
1999	Forest sector reform process launched	Development of Uganda Forest Policy (Ministry of Water, Lands and Environment, 2001), National Forest Plan (Ministry of Water, Lands and Environment, 2002) and National Forestry and Tree Planting Act (Ministry of Water, Lands and Environment, 2003). Created a new institutional framework with clear roles and responsibilities for stakeholders including central and local government agencies, the private sector, civil society and local communities.
2001	Uganda Forest Policy published	Set out guiding principles for forestry sector development, based on conservation and sustainability, livelihood enhancement and institutional reform. Addressed concerns regarding the management of forests outside gazetted forest reserves; collaborative forest management; private sector involvement in commercial plantations, as investors and managers; urban forestry, the management of forests on private lands; local participation; and gender equity in the use of forest resources. The policy outlined the following principles, among others: • The Permanent Forest Estate under government trusteeship to be protected and managed sustainably; its main functions include conservation of biodiversity, protection of environmental services, and sustainable production of domestic and commercial forest products. • The promotion of sustainable management of natural forests on private land, with the purpose of sustainable production of forest resources. • The promotion of profitable and productive forestry plantation businesses, to be established on private or institutional lands.
2002	National Forest Plan published	Provided the framework for implementing the 2001 Forest Policy; identified forestry as a primary growth sector for the Ugandan economy; described the long-term vision for the forest sector and the reforms needed in its leading institutions; and outlined an investment programme for the sector. The national planning framework changed from a poverty eradication approach to a national enterprise approach, in line with Uganda's first National Development Plan.
2003	National Forestry and Tree Planting Act issued	Legal instruments for the implementation of Uganda's 2001 Forest Policy. Aimed to create an integrated forestry sector to facilitate the achievement of sustainable, socially and environmentally beneficial improvements in livelihoods. Reclassified all forests in Uganda as Central Forest Reserves (about 15% of total forested land); forests under national parks (about 15%); Local Forest Reserves (less than 0.5%); community forests (less than 0.5%); and private forests (70% of total forested land). Provided basis for the establishment of District Forestry Offices.
2004	National Forestry Authority (NFA) started operations	An autonomous body, the NFA replaced the Forest Department as the managing entity for Central Forest Reserves. After its inception, the NFA set aside 150,000 hectares in its central forest reserves to scale up commercial plantations. Of these, the NFA was to plant 50,000 hectares, while 100,000 hectares were reserved for the private sector.

Source: Turyahabwe and Banana (2008); Banana et al. (2014); MWE (2015)

15 different sites in 12 agroecological zones. Out of the 12 imported varieties, six were found to be suitable for Uganda. The trial sites were monitored by the NaFORRI team, with annual visits by a Mondi Forests team. The trials allowed the team to adequately match the clones to sites (J. Epila-Otara, interview, 6 February 2020). During this phase, NaFORRI was supposed to undertake research on domestic species, but this never took place (ibid.). The Kifu nursery was plagued by challenges related to staff skills and infrastructure and failed to produce the required amount of planting material.

The trials identified which hybrids were suitable to the various agro-ecological zones of Uganda. These included GCs, but also several

GU varieties (Drew et al., 2008). GU varieties are more difficult to root and have slower growth rates in the first two years compared to GC varieties, but have been found to be more productive and to grow better in the longer term. The selection of GU varieties was fortuitous in that they were resistant to the damage of a blue gum chalcid pest invasion that hit eucalyptus trees across Africa in the 2000s (FAO, 2012; Bush et al., 2018). GU varieties are found to be more tolerant to this wasp compared to *grandis* and *camaldulensis* varieties (da Silva et al., 2019; R. Mack and J. Steege, interviews, 5 May 2020).

One of the objectives of the programme was the commercialisation of the clones and nurseries. The TBP annual report for 2003 states that '[f]rom conception, TBP-U was tasked with the responsibility to interest local entrepreneurs to take over the production of those clones that would be found to be suitable for various parts of Uganda' (Tree Biotechnology Project Uganda, 2003: 16). However, until 2006 the programme did not have much traction with the private sector, and it remained focused on the research and technical aspects of the programme, especially on trialling the clones (J. Epila-Otara, interview, 6 February 2020).

This is not to say that, during the first phase, the project made no contact with the private sector. Interviews revealed that the trials were strategically placed in areas where the rural population could see the trees and appreciate the performance of the clones compared with non-clonal eucalyptus. This garnered interest, but disseminating results and identifying local entrepreneurs to start nurseries were not clear priorities for the programme in this initial stage, and results in this sense were limited (ibid.).

In 2006, the TBP-U took a more pronounced commercial focus, aiming to crowd in the private sector, both in tree growing and in the nursery business. The programme was split into two parts, technical and commercial. The technical part of the programme remained with NaFORRI. The nursery at Kifu maintained its operations to produce clones and improve their performance in terms of rooting, growth, etc. During this period, the NaFORRI team introduced some innovations to improve the performance of the clones, such as a tunnelling system (building small plastic tunnels to protect the plants). These tunnels were cheaper to set up and easier to maintain, and allowed for experimenting to improve rooting and performance of the clones (S. Ogwal Byenek, interview, 5 February 2020; F. Blakeway, pers. comm., 26 August 2020).

The commercial part of the programme was entrusted to the Gatsby Clubs. These were private sector clubs set up with the support of Uganda's Gatsby Trust, running independently to the TBP-U (see Box 2; Byaruhanga, 2004). In 2006, the clubs took on the task of disseminating clones and promoting private participation in the nursery business. The clubs introduced clonal forestry to small-scale entrepreneurs, generating interest not only in clonal forestry

Box 2 The Gatsby Clubs in Uganda

One of Uganda Gatsby Trust (UGT)'s most notable successes was to tap into the enthusiasm and ability of collectives for the benefit of all through the innovative development of Gatsby Clubs – regional centres through which UGT's services were channelled. The Gatsby Clubs were funded by UGT to bring together small-scale entrepreneurs for income-generating activities such as creating tools for metal fabrication, carpentry and maize milling. Spread across the country, clubs were formed on a voluntary basis, with members paying a joining fee and an annual subscription.

The clubs offered various services to their members, including training courses and workshops, support in creating business plans, access to club savings and credit schemes and student placement.

The clubs also supported the development of technology solutions feasible for small-scale enterprises. Examples included solar water heaters, charcoal briquette cooking machines and bricks for low-cost housing.

Source: Byaruhanga (2004); J. Byaruhanga, interview, 4 February 2020

and in the business of clonal nurseries, but also in the technologies (such as the tunnelling) implemented at the NaFORRI nursery (W. Otim-Nape, interview, 13 January 2020; J. Byaruhanga, interview, 4 February 2020).

The TBP prompted the creation of a large number of commercial eucalyptus nurseries in Uganda. In 2019, the Food and Agriculture Organisation of the United Nations (FAO) listed over 60 certified clonal nurseries in Uganda, with a high concentration in the Central region (FAO, 2019).

3.3 Success factors and achievements of the Uganda TBP

In Uganda, the TBP successfully helped propagate clonal eucalyptus throughout the country and support private entrepreneurs to engage in the nursery business. By 2019, there were 62 certified eucalyptus clonal nurseries across the country (FAO, 2019), as well as other uncertified plantations. The programme in its current form has become self-sustainable and does not involve GCF or Gatsby Africa in any way.

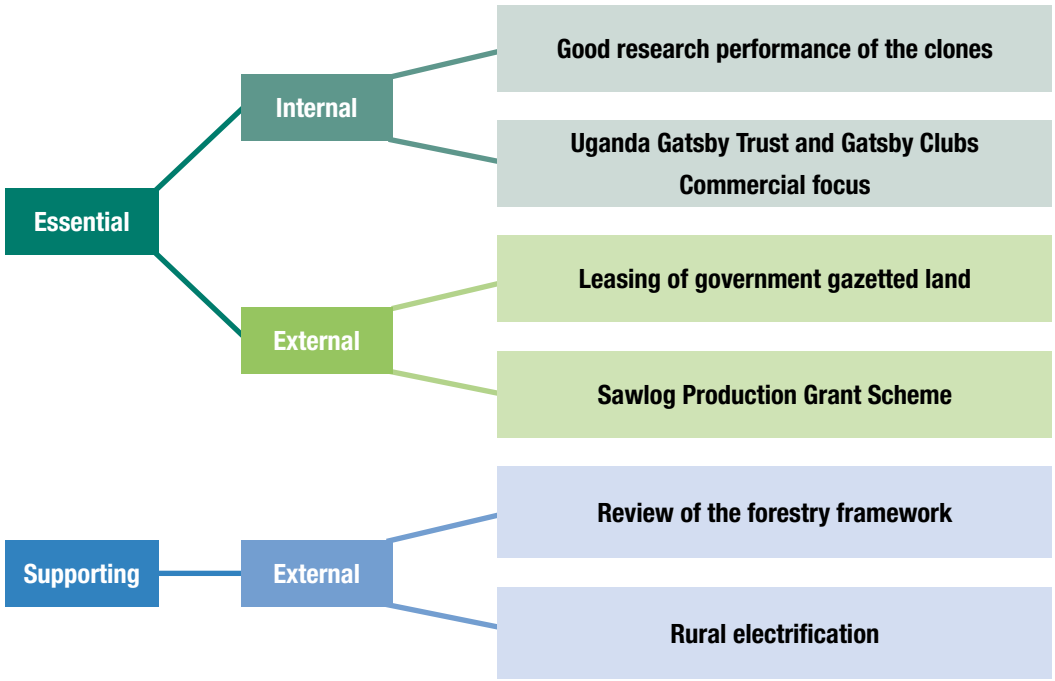
The TBP did not act in isolation but was part of a broader system of institutions and conditions that contributed to the development of commercial forestry in Uganda. The following sub-sections explore the factors that contributed to the programme's success (see Figure 1). We divide these into essential factors, i.e. those crucial to support and shape the programme, and supporting factors, that positively contributed to the programme's performance.

3.3.1 Essential factors

The essential factors were both internal and external to the programme. The first essential factor is the very suitable climate and growing conditions in Uganda, coupled with the effective performance of the clones themselves. The fast and uniform growth of the clones convinced many private growers of the benefits and potential financial gains of planting clonal eucalyptus. Given that the trials were spread across the country, many Ugandans could witness the performance of eucalyptus clones with their own eyes. This was instrumental in fighting the negative perception of eucalyptus (discussed in more detail in Section 3.4) widespread in East Africa.

Here, it is important to highlight that the selection of GU varieties for Uganda contributed to this positive reputation. While GUs grow slower than GCs in the first few years, at rotation

Figure 1 Summary of success factors



Source: Author's data

age they produce more volume per hectare. They are also more resistant to pests such as the blue gum chalcid. Overall, the choice of GUs turned out to be beneficial for the sector, when grown on appropriate sites.

The second essential factor was the role of the Gatsby Clubs. As the clubs already existed before they became part of the TBP, they had an established network from which the programme could benefit. In Uganda, the Gatsby Clubs provided impetus to the commercial operations of the programme, bringing on board small-scale entrepreneurs with capital and interest in new business ventures, supporting the dissemination of clones and related technologies, and hence enabling the establishment of new nurseries, with some business support.

The third essential factor, external to the TBP, was that the government started converting public gazetted land to private use (degazetting), especially for large agricultural operations (Turyahabwe and Banana, 2008), but also for private users. This allowed private growers to lease land for forestry. The degazetting benefitted not only the TBP but also the broader commercial forestry sector. The government set aside 150,000 hectares in its central forest reserves to scale up commercial plantations, 100,000 hectares of which were reserved for the private sector (MWE, 2015). By the end of the second phase of SPGS, around half of the 50,000 hectares they supported were on degazetted land.

The SPGS was the fourth essential success factor, also external to the TBP (see Box 3). The SPGS was a commercial forestry programme offering grants and technical advice to medium-size tree growers. In particular, it was aligned to a government programme of concessions on its gazetted forestry land that was unstocked, providing reimbursement for half of the costs of restocking the planted forests by private actors, but requiring quality practices. The SPGS played a catalytic role in supporting the TBP, popularising clonal eucalyptus among its beneficiaries, directly and through its widely disseminated newsletter. The SPGS also provided a strong stimulus for the establishment of certified nurseries, as it required the beneficiaries of its performance-based grants to source only from these nurseries (J. Steege, pers. comm., 17 February 2020). This ensured strict quality control for clonal eucalyptus. SPGS staff offered extension services and technical support to growers on how to manage planting and maintain a plantation (P. Jacovelli, interview, 17 December 2019).

The Gatsby Clubs and the SPGS not only supported the development of the TBP in Uganda but also contributed to shaping it towards a more commercial direction. As discussed in Section 3.2, the initial aim of the programme was poverty reduction, which would have entailed a focus on smallholders and rural populations. These groups are less able to pay for improved planting material and less willing to try a new product that is less certain. However, the SPGS had a marked commercial orientation, requiring its recipients to have at least 25 hectares of land on which to plant (Jacovelli, 2009). The clubs' members were entrepreneurs rather than smallholder farmers. Therefore, the programme in Uganda was encouraged to move from a poverty

Box 3 The Sawlog Production Grant Scheme

Started in 2004, the Sawlog Production Grant Scheme (SPGS) supported commercial forestry for various tree species, including pine, a species already popular in Uganda, and from the second phase also eucalyptus (P. Jacovelli, interview, 17 December 2019).

SPGS had a marked commercial orientation, requiring its recipients to have at least 25 hectares of land to plant on (and a maximum of 500 hectares; Jacovelli, 2009), in a country where the average farm size was 1.51 hectares in 2012 (FAO, n.d.).

In addition to technical and financial support, SPGS offered other services such as the publication of a newsletter and plantation guidelines; regular field-based client meetings for growers to share their experiences; national commercial forestry seminars to raise the profile of the business; and certification of nurseries (Jacovelli, 2009).

alleviation angle towards a private sector development angle.

3.3.2 Supporting factors

In addition to these three essential factors, two additional factors contributed to TBP's success, though indirectly: the forestry policy framework and rural electrification.

As discussed, the Forest Sector Reform Process was reshaping the forestry sector in Uganda around the time the TBP was launched. In addition to the degazetting of public land, mentioned above, the reform process re-oriented forest management to include a more commercial outlook, which allowed the development of private sector activities (P. Jacovelli, pers. comm., 8 January 2019).

The second factor that supported the TBP was an effort to expand electrification in the country. Towards the end of the 1990s, the GoU launched a reform initiative in the energy sector, with ambitious plans for rural electrification (Mawejje et al., 2013). This increased demand for transmission poles, which at that time were often imported from South Africa at high cost (W. Otim-Nape, interview, 4 February 2020). Clonal technology (and particularly GU over GC) was well placed to produce large quantities of eucalyptus poles, uniform in size and shape and suitable for use as transmission poles, and more quickly than non-clonal local varieties.

3.4 Challenges

Despite its success, the programme faced several challenges. Early technical challenges included inadequate skills and technical capabilities at Kifyu nursery, poor rooting of the clones, and inconsistent performance of the clones. These were addressed over time through experimentation and the introduction of techniques such as tunnelling (S. Ogwal Byenek, interview, 5 February 2020; H. Agaba, interview, 7 February 2020). Moreover, throughout the life of the programme, pests and diseases affected the eucalyptus trees, even threatening their survival in a few instances. One example was the blue gum chalcid wasp to which some of the clones were highly susceptible (Mwima, 2011). Luckily, interviews revealed that this pest disappeared on its own, and to date it has not caused a major problem to eucalyptus planting in Uganda (H. Agaba, interview, 7 February 2020).

The issues with pests relate to one of the bigger challenges of clonal forestry: genetic uniformity. A limited number of varieties were introduced in Uganda. While sharing identical genetic material has benefits in terms of uniformity of the product and sales potential, it also entails lower resistance to pests and diseases. Even when affecting only one or two varieties, one pest can wipe out many trees, causing severe damage to the sector. According to best practices, a clonal programme should be embedded in a robust breeding programme, and introduce new varieties every year, to ensure that the genetic pool is replenished and diversified (F. Blakeway, interview, 17 December 2019). Clonal forestry is also very site-specific, and clones are at greater environmental and disease risk than seedlings. The embedding of clonal programmes in breeding programmes is still in the early stages. While so far this has not posed a major challenge, it remains a threat to the future of clonal forestry in Uganda.

Another issue was associated with the nature of the clones provided by Mondi Forests, a company specialising in pulp and paper. In Uganda, Mondi clones have been used for a variety of products, from scaffolding to timber to transmission poles. While not a challenge as such, the programme may have performed even better with tree varieties bred specifically for these purposes (H. Agaba, interview, 7 February 2020). In practice, the technical solution offered did not meet the long-term needs of the sector or the breadth of desirable uses for the people planting these clonal materials. However, the scale of the East African market, and the fact that the trees are not sold for one specific product but rather for a wide range of uses, suggests that it may be useful to introduce other varieties in Uganda, in particular improved seed from pure species, that may respond better to market needs.

Interestingly, the reputation of the eucalyptus, which greatly affected the programme in Kenya, did not have such resonance in Uganda. In 2017, President Yoweri Museveni encouraged the removal of planted eucalyptus, especially from wetlands (Aine, 2017). However, this did not seem to have any negative repercussions on planting,

and eucalyptus remains very popular, perhaps because growers have been able to see its potential first-hand (H. Agaba, interview, 7 February 2020).

3.5 Current status of the programme and the sector

From a programming perspective, TBP-U showed two main strengths: its long-term approach and its adaptive nature. The long-term approach has enabled the programme to operate in steps. The adaptive quality of the programme, operating within a longer timeframe, has allowed it to try different approaches. For example, the programme initially started under NaFORRI, but later introduced the Gatsby Clubs to support the commercial angle. The adaptive nature of the programme also allowed it to revise and course-correct on its initial objectives. While originally the programme had poverty reduction objectives, the role of the clubs and SPGS meant that the programme took a more commercial approach, and became less focused on smallholders. The Forest Reform Sector Process also accelerated the use of large plots for commercial forestry.

Overall, the clonal deployment programme in Uganda was successful, contributing to the creation of a new sector of the economy, thus supporting economic transformation in Uganda. This success provides a lesson for development programmes and embodies the spirit of GA's more recent work. The key element of this success was that many components had to be in place at the same time. These include changes in the policy framework, land availability and the existence of other programmes creating the right incentives for quality planting such as SPGS. The experience of TBP-U highlights the importance of taking a systems approach, working from different angles to address a number of key constraints or grasp new opportunities affecting a sector. In TBP-U's case, this was largely serendipitous, but has informed how GA operates and structures its newer forestry programmes over the past seven years.

Despite financial support from GCF being discontinued, some parts of the programme remain operational. NaFORRI still runs the nursery at Kifu and finances it with the revenues from its clone sales. A company, Uganda Tree Resources Limited, was formed in 2012 to manage the other nurseries set up under the programme at Mbale, Fort Portal, Kabanyoro and Busiika. In 2017, the company was sold to a private owner who is now improving its processes and management to increase productivity and profitability (J. Byaruhanga and C. W. Nalyaali, interviews, 4 February 2020).

Currently standing at over 60, the number of clonal nurseries throughout the country is likely to increase to satisfy demand. Clonal eucalyptus trees and associated products remain highly popular in Uganda, prompting many copycats selling non-clonal material, or mis-selling tree branches as clonal plantlets (C. W. Nalyaali, interview, 4 February 2020). To date exports have been limited, but South Sudan and Kenya are promising markets for Uganda's eucalyptus.

Some large timber companies operating in Uganda have set up nurseries to produce clones for their own planting needs. Global Woods, one of the top three growers in Uganda, headquartered in Kyankwanzi, has planted over 8,500 hectares, of which 20% is eucalyptus (mostly clonal). Global Woods staff have received training by SPGS at the NaFORRI nursery in Mbale (M. Otim, interview, 6 February 2020).

Gatsby's intervention to support the adoption of clonal forestry planting material in Uganda has been effective in driving the uptake of new improved material. This is primarily due to the strong demand for improved material in Uganda following the government's release of land for forest planting, together with the incentives provided by the SPGS scheme.

4 Conclusions

The TBP allowed Uganda to develop the production capabilities and local markets for clonal eucalyptus. The programme was undoubtedly successful, contributing to the creation of a vibrant commercial forestry sector. In Uganda, the TBP-U promoted the creation of commercial nurseries, which in turn helped spread commercial forestry activities. A combination of internal and external factors allowed the programme to succeed. The programme is regarded positively because of the lasting impact it had. The negative reputation of eucalyptus did not reduce appetite for commercial tree farming, which remains strong.

Chapter 3 shows that the success of the programme in Uganda is due to a wide range of factors, internal and external, essential and supporting. Critically, all these factors had to work concurrently to allow for the transformation of the clonal forestry sector. The TBP-U had control over some (the quality of the trees, the Gatsby Clubs) and influence over others (inviting collaboration with SPGS), but had little to do with other national processes, such as forest sector reform and rural electrification. The fact that the programme was structured to work over a long period of time, and retained flexibility over its operations, allowed it to navigate these changes, and to take advantage of opportunities as they arose.

It is important to note, however, that TBP-U ultimately 'got lucky' in the sense of finding itself amid a prolonged reform effort on the part of the NRM, and with the ability to draw on the expertise and market dissemination capabilities of the SPGS.

The experience of Uganda shows that, for a programme aimed at promoting commercial forestry, the commercial angle is crucial. Similar programmes are often left exclusively in the hands of forestry research institutes, whose mandate is to conduct research and provide public goods, rather than support investment. In Uganda, NaFORRI had the key role of undertaking the research components of the programme, including conducting trials and setting up pilots and nurseries. However, other players with a stronger private sector orientation, such as the Gatsby Clubs, were better placed than NaFORRI to support the commercial aspects of the programme (A. Thomson, interview, 20 December 2019).

The programme did, however, have a weakness: the lack of appropriate research and development (R&D) to replenish and diversify the genetic pool of clonal material or improved seed for commercial forestry. Given the limited genetic variation of clonal eucalyptus found in Uganda and the limited availability of improved seed, one pest could wipe out a large share of eucalyptus forests. Clonal forestry requires constant research to replace genetic material. Interviews with experts indicated that, ideally, two or three clones should be replaced every year by as many new clones. However, this did not happen in Uganda; instead, after the initial matching, research was limited to improving rooting and performance of the existing genetic varieties. None of the three East African countries where the project took place has the capacity to develop new clonal varieties, and Mondi Forests has not provided any new clones after the first batches. Further R&D originally featured in the structure of the programme, but this was not adequately implemented.[5] For now the sector is still thriving, but the lack of appropriate R&D makes it less resilient than it would otherwise be.

5 Blakeway (2013) notes the programme did undertake research in the form of producing journal articles and reports, and testing technologies on indigenous species.

In South Africa, large players like Mondi Forests can run their own independent clonal R&D programmes. In particular, Mondi has specialised in wood for pulp and paper, orienting its research activities towards creating the best products for this market. Replicating a similar model in Uganda would be challenging, not only because the sector has a more limited scale and smaller private sector players, but also because of the wide range of uses for commercial forestry products. It would be difficult for Uganda to run an appropriate R&D system at scale. An East African regional R&D programme could be more feasible and has been discussed, but has yet to find a viable home.

Critical to the long-term future of eucalyptus plantation forestry in Uganda is investment in robust eucalyptus breeding programmes. This should be a key focus in terms of being able to grow the plantation forestry and the forest products sector. Eucalyptus clonal forestry has shown its ability to provide wood quality suitable for several end products and the ability to propagate many eucalypt clones, including hybrids. However, robust and efficient breeding and deployment strategies are essential.

Eucalyptus breeding programmes must have clear aims and characteristics (Rezende et al., 2014). These include:

- increased productivity
- wood density, as it impacts productivity and quality
- adaptation to increasingly harsh climatic conditions
- increased tolerance to pests and diseases, which impacts on productivity
- improved rooting ability (and associated complexities associated with costs and benefits).

The experience of the TBP in Uganda highlights the importance of sector conditions, such as the strength of factor conditions i.e. availability of land, effective governance structures, dynamism of local firms, and availability of business services. This understanding has led GA to focus explicitly on addressing these broad conditions in its programmes to achieve the ambitious goal of transforming sectors.[6]

Gatsby Africa has taken a more holistic view in recent years, focusing on a systems approach to sector transformation. Being an arms-length funder meant that GCF had limited control over the day-to-day management of the programme and was one step removed from partners. Moving to a direct implementer model, with explicit transformation objectives, has meant that Gatsby Africa has a better picture of what is happening in its programmes and can adapt sooner when challenges arise.

6 More on how Gatsby Africa operates can be found at www.gatsby.org.uk/uploads/africa/reports/pdf/2019-gatsby-overview-update.pdf.

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List of interviewees

Name	Title and organisation	Interview date
Hillary Agaba	Director of Research, NaFORRI, Uganda	7 February 2020
Flic Blakeway	Special Projects and Operations Manager, Council for Scientific and Industrial Research (CSIR) (until 30 June 2020)	17 December 2019
Joseph Byaruhanga	Professor, Makerere University, and founder of Gatsby Clubs	4 February 2020
Simon Ogwal Byenek	Former manager of Kifu clonal nursery, National Forestry Research Institute	5 February 2020
Laurence Cockroft	Consultant to the Trustees, Gatsby Charitable Foundation	10 January 2020
James Epila-Otara	Former programme leader, Uganda Tree Biotechnology Project	6 February 2020
Paul Jacovelli	Advisor to the Gatsby Charitable Foundation	17 December 2019
Dennis Kavuma	General Manager, Uganda Tree Growers' Association	7 February 2020
Rory Mack	Head of Technical Forestry Services, Gatsby Africa	8 August 2019 5 December 2019 5 May 2020
Stuart Maniraguha	Director, Plantation Development, National Forestry Authority	5 February 2020
Abubaker Mwima	Former project manager, Uganda Tree Biotechnology Project	5 February 2020
Charles W. Nalyaali	Director, Uganda Tree Resources Limited	4 February 2020
Moses Otim	Senior Forester, Global Woods	6 February 2020
William Otim-Nape	Former Director General, Uganda National Agricultural Research Organisation	13 January 2020 4 February 2020
Ian Powell	Advisor/consultant for the European Union	17 December 2019
Jack Steege	Deputy Director, Gatsby Africa	8 August 2019 5 December 2019 5 May 2020
Abigail Thomson	Former Deputy Director, Gatsby Charitable Foundation	20 December 2019
Michael Underwood	Consultant, Michael Underwood Agroforestry Associates	17 December 2019

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