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On the trail of taro: The tale of taro leaf blight

GENEBANK IMPACTS BRIEF No. 6 | December 2019

Fields of tragedy

The prestige aroid, taro – *Colocasia esculenta* – is a staple food crop that has helped to sustain humanity for millennia. Considered an ancestor to the Hawaiian people, a cultural totem given at all major life events throughout the South Pacific and eaten daily amongst subtropical countries globally. What then would happen if this crop was ever lost?

The Tale of Taro Leaf Blight recounts the South Pacific's version of the Irish potato famine and how a cocktail of climatic conditions proliferated a devastating epidemic of taro leaf blight (TLB) (*Phytophthora colocasiae*) on the Independent State of Samoa in 1993. Within a period of around six months, there was an almost 100% crop loss; causing a cultural, food security and economic catastrophe (Figure 1). The disaster cast a poignant light on the dangers of monoculture and relying on narrow allelic diversity. This event provided the global impetus, to estab-

HIGHLIGHTS

- Taro, *Colocasia esculenta*, is one of the main staple food crops of Pacific Island countries.
- Samoa experienced a nearly 100% crop loss of taro due to a devastating taro leaf blight (TLB) outbreak in 1993. This served as a global call to action to support taro diversity conservation.
- Plant genetic materials from CePaCT were used in a 10-year breeding cycle that resulted in viable TLB resistant lines. These were successfully used to replant taro fields in Samoa.

lish several international organizations to conduct botanical expeditions, in order to gather specimens from various centers of origin that expressed natural resistance to the blight.

Through this short narrative, we hope to illustrate the imperative nature of the functions that CePaCT serves for both the Pacific Islands Countries and Territories (PICTs) as well as the global community in providing clean, virus-tested taro plantlets and propagules for use by farmers, breeders and scien-

tists, specifically in respect to their TLB tolerant lines.

You got to fight the blight!

We conducted an ethnobotanical fieldwork, gathering an impact story that showcases the vital importance of the conservation and use of the global genetic diversity of the crop taro. On this journey, we outline the germplasm flow of how, why and by whom the global diversity of taro was gathered by traveling to the Island nations where these key characters live and recording

BOX 1

The Centre for Pacific Crops and Trees Genebank

The tale of this blight is indeed also the origin story of the formalization of the Centre for Pacific Crops and Trees (CePaCT). When the expeditions returned from all over the world including Asia and the Pacific, the scientists, farmers and breeders needed: a safe place to store, multiply and conserve their new germplasm as well as perhaps most importantly virus index the specimens before deploying them to the field and potentially causing more harm than good. Thus, CePaCT, the genebank of The Secretariat of The Pacific Community (SPC) of the Land Resources Division (LRD), was formed with the assistance of the global community to safeguard these accessions. While the taro collection is particularly unique, being the largest collection of taro diversity globally – over 1,000 accessions, CePaCT also conserves other staple crops: yam, sweet potato, banana, cassava, and breadfruit. The aim of CePaCT is to assist Pacific countries to conserve the region's genetic resources, and to provide access to the diversity they need, when they need it.



PHOTO: NEIL PALMER/CROP TRUST

the story firsthand.

By 1994, there was an obvious imperative to collect, analyze and safeguard the *Colocasia* found around the South Pacific region to provide virus-indexed breeders' lines and traditional cultivars. In 1998 Australian Aid (AusAID) funded the five-year long TaroGen Project with Graham Jackson as Technical Director. This provided the support to establish the Regional Germplasm Centre (RGC) at SPC led by Dr. Mary Taylor which would eventually be renamed the CePaCT. This initiative not only established the genebank for the Pacific but also provided funding to revitalize the desperately needed breeding efforts that had been halted in Papua New Guinea and Samoa. Further, TaroGen embarked on a Pacific-wide botanical expedition to collect, characterize and utilize the diversity present in the region.

In 1998 the TANSO was formed with support from the European Union and direct involvement of the governments of Thailand, Philippines, Vietnam, Papua New Guinea, Malaysia and Indonesia. This network's efforts were aimed at gathering, studying, conserving and eventually distributing germplasm diversity to broaden the genetic base and genepool of the crop in the Pacific, as well conduct analysis on the genetic diversity of *Phytophthora colocasiae*. 120 accessions were collected and 16 were used in the taro breeding program at The University of the South Pacific (USP) Alafua Campus; 36 cultivars were from Japan, the Philippines, Malaysia, Indonesia, Thailand and Vietnam.

In July of 1999, the Taro Improvement Project (TIP) was initiated at the USP Alafua Campus in Samoa with the Ministry of Agriculture Research and Extension as a participatory plant breeding program. This platform provided a method and audience to discuss and evaluate the newly bred TLB tolerant lines coming out of the cycles.

Moafanua Tolo Iosefa had recently finished his studies to become a plant breeder just as the blight was blowing through his isle. For the next 22 years he has been coordinating TIP and championing the breeding efforts in Samoa, around the Pacific and around the world. His lines are the most

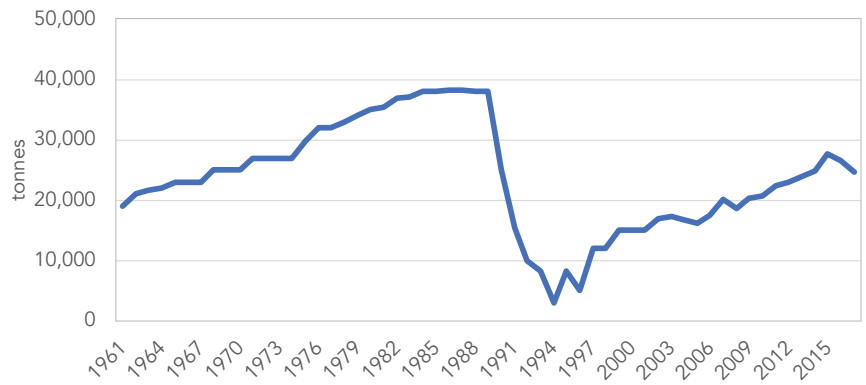


Figure 1. Taro production in Samoa, 1961-2017. Source of data: FAOSTAT

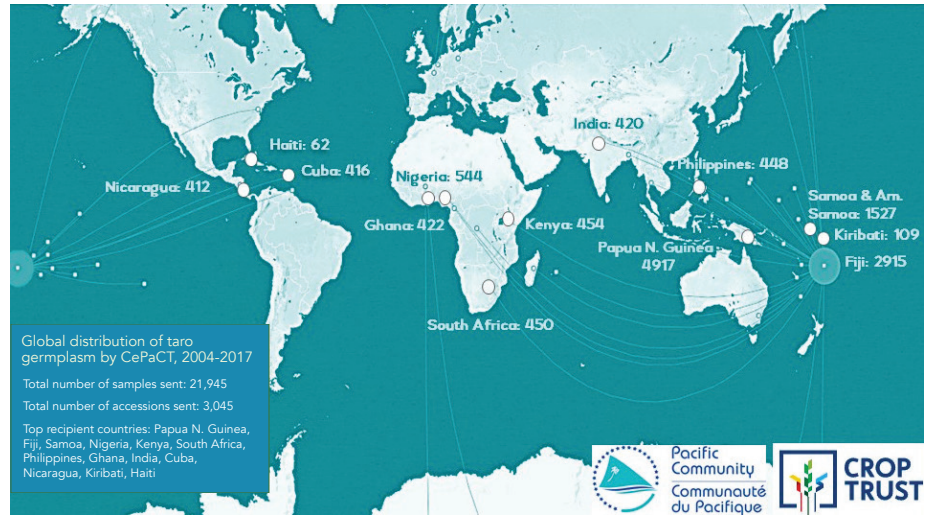
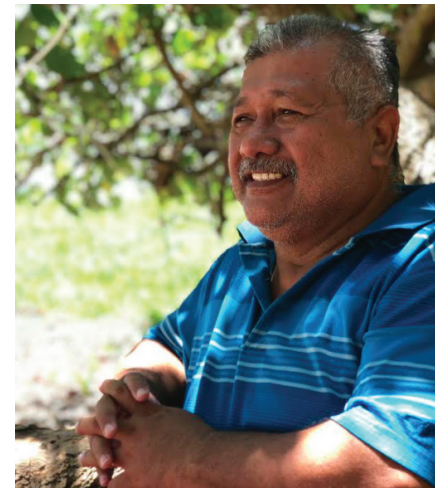


Figure 2. Global distribution of taro plant samples by the CePaCT. Source: Authors

successful and palatable hybrids that arose from the global rebreeding effort. His first seven cycles are illustrated in and currently in 2019 he is on Cycle 9. In 2009, 13 years after he began his ethnobotanical sojourn, his lines (Samoa 1-5) were made widely available to the export market, and household production is now almost back to pre-blight era levels.

The disaster and operations established in the aftermath to create a solution served as a call to action amongst the Pacific region and global aroid community to support the work of CePaCT in order to ensure the future of food security in the face of changing climates. It also highlighted the valuable role of CePaCT in the distribution of taro diversity for research and breeding. Between 2004 and 2017, nearly 22,000 samples of taro were distributed globally (Figure 2). The collection, conservation, multiplication and distribution of taro *in vitro* has a significant impact beyond the regional needs of the South Pacific. Plantlets have been deployed to countries worldwide affected by the blight, aiding in staving off potential famines and economic crises.



Moafanua Tolo Iosefa, taro breeder. Photo: Sefra Alexandra

Conclusion: All together now

This tale showcases the importance of the global partnerships in taro conservation, highlighting the immense humanitarian and ecological benefits derived from genebanks' edict to share virus-indexed germplasm accessions of crop diversity for free with all who request it (Figure 3). Forging regenerative seed pathways fortifies biodiversity resilience in subsistence farming nations and germinates a lifeline to nutrition, earning an income and providing for one's family. The landra-

BOX 2 Fellowship Experience: The Ecology of Resilience

As a Genebank Impacts Fellow, I have learned how vulnerable our global crop diversity truly is and how closely linked our shared planetary agrarian lands are. The success, rapidity and vast reach of our worldwide transportation systems is both a gift and a danger. Coupled with the ever increasing prevalence of unpredictable natural disasters- what exists on one's shores, can rather easily wash up on another's. The knowledge gained around the ecosystems of trade and tragedy, make the necessity to safeguard our shared biodiversity all the more imminent.

Through this Fellowship, I sat with Hawaiian elders on once fertile and fecund lands – proliferated by their ancestor taro, now fallow with the modernization of local diets. I watched new kings be coronated on the Cook Islands with entire villages honored to donate their cultural totem staple to the sacred sustenance of their people in celebration. I rode in Land Rovers along forgotten trial plots in Vanuatu with hero renegade breeders of this vital orphan crop, holding the fraying strings of a once robust global aroid network. I sketched breeding lines with the magnificent hero, Tolo as he wove his tale of the dedicated farmers and wives that participated in decades of planting and tasting to find both palatability and yield to revive their ancestral lands. I watched babies eat taro mash and the market stalls full of families that make their livelihood selling this impeccably nutritious, delicious, medicinal powerful food. I ran my hands along wood carvings of taro's profound morphological architecture, delighted over breakfasts of its sautéed leaves and sipped soups of its stalk. I danced amongst its leaves, listened to songs and read the myths and lore of the canoe people.



The impact of this fellowship was an understanding of the fortitude needed to travel the globe to distant centers of origin to regather germplasm, the endurance and passion necessary to breed and select specimens for decades- the innumerable months and years necessary to establish a genebank to preserve and conserve these irreplaceable accessions...and now the tireless effort of those that keep these vital plant genetic resources; viable, virus indexed and ready to be deployed to any and all who need these plantlets around the planet. Even more profound was the intimate exposure to what it would truly mean if this ancient elder flora was ever to be lost, and the rippling repercussions that would have throughout all facets of life on these lands and sands.

ces must be safeguarded before they are lost to ensure continuity of culture and cuisine in shifting climatic conditions.

Genebanks are not merely preserving seeds – they are preserving culture and future memories – a heritage known through your gut flora and epigenetic lineage. The dignity of all humans, all races in all lands is to share the same tastes and traditions with all future generations yet to be germinated that has been protected and shared since time immemorial.

The ecology of resilience is recognizing that as a global family we share the impeccable duty to safeguard the living embryos of our natural world. Together, we secure our food, forever.

Further reading

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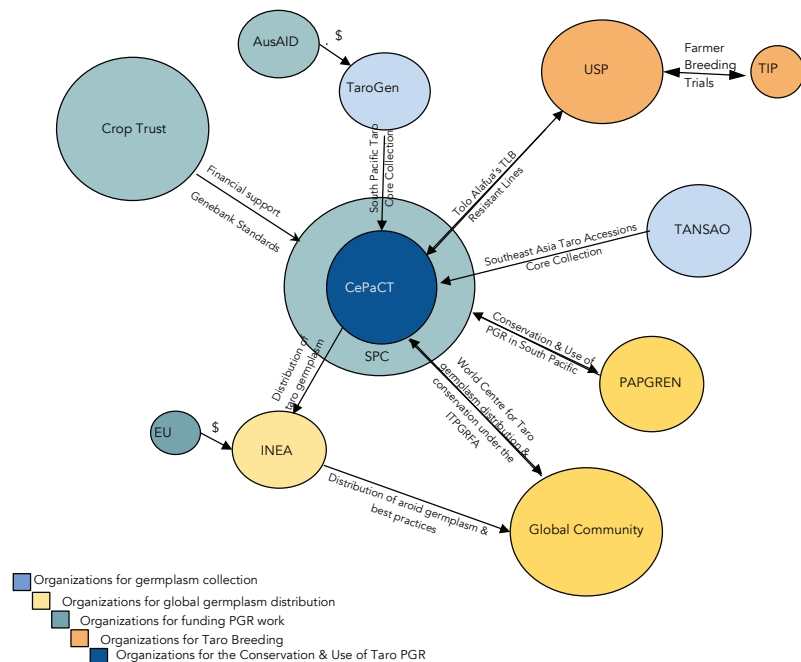


Figure 3. The Global Partnerships in Taro Conservation for Breeding TLB Resistant Lines. Source: Authors

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Suggested citation

Sefra Alexandra, Michel E. Ghanem, Nelissa Jamora and Melinda Smale. 2019. On the trail of taro: The tale of taro leaf blight. Genebank Impacts Impact Brief No. 6. In *Genebank Impacts: Working Papers Series*. 2019. Edited by Nelissa Jamora, Melinda Smale and Michael Major. CGIAR Genebank Platform and the Crop Trust.

Acknowledgements

Title inspired by Peter J. Matthews seminal 2014 book *On the Trail of Taro: An Exploration of Natural and Cultural History*. Funding for this research was provided by the Friends of the Crop Trust, and the Crop Trust as well as through the initiative of the CGIAR Genebank Platform. We acknowledge the following

individuals for the useful discussions and guidance during the fieldwork: Moafanua Tolo Iosefa of the Ministry of Agriculture of Samoa; Audrey Aumua, Deputy Director General of SPC; Jan Helsen, Director of the Land Resources Division of SPC; Savenaca Cuquma, Senior Research Officer of the Ministry of Agriculture of Fiji; William Wigmore, Director of Research and Development at the Ministry of Agriculture of the Government of the Cook Islands; Dr. Vincent Lebot of CIRAD in Vanuatu; Morgan Toledo of Waipi'o Valley Taro Products of Hāwea; and the members of the Pacific Agriculture Plant Genetic Resources Network (PAPGREN).

Additional details can be found in the paper on which this brief is based: Sefra Alexandra, Michel E. Ghanem, Nelissa Jamora and Melinda Smale. 2019. Searching for sources of resistance to taro leaf blight in collections from the Pacific. *Genebank Impacts Working Paper No. 5*. CGIAR Genebank Platform, CePaCT at The Secretariat of The Pacific Community, and the Crop Trust.

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