PART 1

TAPPING AND CREATING GENETIC RESOURCES

The foundations of our global food supply are built from the crop species our ancestors domesticated millennia ago. Plant breeders today aim to systematically understand and use the genetic diversity available in our crops to further adapt them to a wider range of environments and a changing climate, as well as to improve their yields, productivity, nutritional value and expand their uses beyond simple food. This flows from the largely unconscious acts by early farmers to select those materials from their fields that best suited their needs, but relying only on obvious performance characteristics and with no knowledge of genetics. Both ancient farmers and modern plant breeders required a diverse population from which to select and create new varieties of crops. It was not until a little more than a century ago when Russian botanist Nikolai Vavilov systematically began collecting representatives of major crop species that the diversity of crops was appreciated, catalogued and then made available to breeders to develop new crop varieties.

Today there are many national and international collections of most of our crops, albeit of widely varying coverage and sophistication. These 'gene banks', or *ex situ* collections, typically contain true seed, but for some crops only vegetative materials can be preserved. The first two chapters of this section summarise the complexities of establishing, maintaining and using these collections. Chapter 1 summarises the status of global collections and the massive data management challenges that confront collection curators as the information available for each accession grows exponentially with advances in our genetic technologies. Seed and other propagule collections help preserve what has been achieved by farmers and breeders in the past. Preservation of the original crop habitats – *in situ* conservation – is described as a means to maintain the process that gave rise to our current crop-based food systems.

Chapter 2 takes the reader on a deep dive into the exquisite diversity of some of our most important crops: bread wheat and it allies. Domestication of a wild species for human purposes necessarily involves the elimination of many traits that are of little use, or are actually detrimental, to human needs. Many potentially beneficial traits were lost along

the way as well. The heretofore intractable complexities created by the multi-species hybridisations that eventually yielded today's wheat are now amenable to manipulation by wheat breeders and molecular biologists.

Chapter 3 guides the reader through the history and daunting complexity of the international community's effort to monitor and manage use of genetic resources. Of particular interest are the attempts via international agreements to assure that monetary benefits flow to segments of society historically excluded from these. The thorough examination of the ramifications of these well-intentioned efforts on today's flow of genetic resources is a sobering reminder of the impact of unintended consequences.

The challenges of converting collections of genetic resources from essentially museums of genetic diversity to active collections that are well characterised from the genetic to field level are not to be underestimated. Using rice as an example, Chapter 4 presents readers a clear view of how the latest tools in genomics allow us to appreciate in fine detail the relationships among rice and its many wild relatives. This appreciation allows far more precise selection of candidates – both rice and its relatives – for in depth study and ultimate use by breeders.

The myriad of treaties, agreements, protocols and conventions were created to establish a semblance of order in our treatment of genetic resources. Yet there remains a set of overarching questions around how the global community manages them: Who will have access to these resources? Who will benefit from them? Who will profit from them? And who will preserve them for our descendants? Finally, what are the implications of the major philosophical shift from treating genetic resources as a 'heritage of all mankind' to being treated as a sovereign natural resource? Although not providing simple answers to these questions, each chapter offers the reader insights into the varying perspectives of different stakeholders as well as helping the reader to unravel the complexities that attempts to answer these questions reveal.