



RTB User Guide

Glossary of Root, Tuber and Banana Seed Systems

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This user guide is intended to disseminate research and practices about production and utilization of roots, tubers and bananas and to encourage debate and exchange of ideas. The views expressed in the papers are those of the author(s) and do not necessarily reflect the official position of RTB, CGIAR or the publishing institution.

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Acronyms

DUS	Distinct, uniform, stable
DM	Decentralized multiplier
EGS	Early generation seed
INA	Impact network analysis
IPM	Integrated pest management
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
ERGM	Exponential random graph model
LSB	Local seed businesses
MDS	Minimum dataset
NWO	Nederlandse Organisatie voor Wetenschappelijk Onderzoek (Netherlands Organization for Scientific Research)
PVS	Participatory varietal selection
QDPM	Quality declared planting material
QDS	Quality declared seed
RTB	CGIAR Research Program on Roots, Tubers and Bananas
SNA	Social network analysis
SSSA	Seed system security assessment
TRIPS	Trade-related aspects of intellectual property rights
UPOV	International union for the protection of new varieties of plants
VBSE	Village-based seed enterprises
WOTRO	Stichting voor Wetenschappelijk Onderzoek van de Tropen en Ontwikkelingslanden (Netherlands Foundation for the Advancement of Tropical Research)
WTA	Willingness to accept
WTP	Willingness to pay
WUR	Wageningen University & Research
YMT	Yam minisett technique

Abstract

The Glossary of Root, Tuber and Banana Seed Systems is a resource for those who work with, study, or simply want to learn more about seed systems. The glossary cites published literature to define and explain important terms that appear in seed systems research, and especially those which are related to the tools in the RTB Toolbox for Working with Root, Tuber and Banana Seed Systems (Andrade-Piedra et al. 2020). Each term is paired with a definition/explanation and the reference from which it is quoted, so readers may follow up for more information.

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Glossary of root, tuber and banana seed systems

INTRODUCTION

Research on root, tuber, and banana seed systems continues to grow rapidly. Seed systems analysis has evolved to include elements from diverse fields, such as consumer marketing, gender studies, botany, virology, network analysis, and economics. This interdisciplinary character is what makes seed systems research (and the RTB Toolbox for Working with Root, Tuber and Banana Seed Systems, Andrade-Piedra et al. 2020) so flexible and powerful for understanding and intervening in complex real-world systems. However, it can also make learning the concepts tricky. While some seed systems publications contain a glossary, they have a tendency to be document- or discipline-specific, making it difficult to find a single source of terms for seed systems.

OBJECTIVES AND USE

This glossary compiles a broad range of definitions which are useful for understanding seed systems in general, and the tools in the Toolbox in particular.

The Glossary of Root, Tuber and Banana Seed Systems is intended to be a living resource, with terms added to it over time. This first version contains over 130 terms, each quoted from a publication cited in the references.

Some terms have multiple meanings, according to context. The context column lists the term's discipline or theme. When terms are defined with two or more meanings, all the matching references are provided.

The definitions included here may change in the future as other authors join the discussion and as science and technology develop. The references cited are good places to start for those interested in further exploring the topics. There are also notes where particular terms link to specific individual Tools, which you can consult for more detailed information.

THE GLOSSARY

Terms (concepts)	Contexts	Definitions and references
Acceptable prices	Methods	"Set of prices that the consumer is ready to pay for a good or service." (Le Gall-Ely 2009)
Access	Seed systems	1) "People produce [their] own seed, or have adequate resources to otherwise obtain seeds – and relevant information." (McGuire & Sperling 2011) 2) "Farmers have money or other resources, e.g., by barter, to obtain seed. Access is divided into delivery channel, affordability, and awareness." (Bentley et al. 2018)
Affordability	Seed	"Farmers can buy the seed at the offered price. As farmers earn more money from a crop, they can afford to buy more seed. An intervention can subsidize seed to make it affordable." (Bentley et al. 2018)
Agrobiodiversity	Seed; Botany	"We consider that agrobiodiversity includes the full diversity of organisms living in agricultural landscapes, including biota for which the precise function, from the human utilitarian point of view, is still unknown (Jackson et al. 2005). Agrobiodiversity has two main components. The first, planned agrobiodiversity, is the diversity of crops and livestock managed by farmers. The second, associated biodiversity, refers to the biota (such as soil microbes and fauna, weeds, herbivores, and carnivores) in the agroecosystem that survive according to local management and environmental conditions (Vandermeer and Perfecto 1995). Croplands and fields are also included, as well as habitats and species outside of farming systems that benefit agriculture and support ecosystem functions (Jackson et al. 2007)." (Kontoleon 2008)
Annual	Botany	"The type of plant that normally starts from seed, produces its flowers, fruits, and seeds, and then dies within one growing season." (Copeland & McDonald 1999)
Asexual propagation	Botany	"Propagation without fertilization, e.g. agamospermy, cuttings, division, meristem culture, and micropropagation." (Brickell et al. 2016)
Availability	Seed	"Sufficient quantity of seed within reasonable proximity to people (spatial availability), and on offer in time for critical sowing periods (temporal availability)." (McGuire & Sperling 2011)
Awareness	Seed	"Information about the benefits of quality seed, where to get it and how (including prices). Agronomic know-how to use seed." (Bentley et al. 2018)
Breeder seed	Seed classes	"This is the seed of a new variety that has the highest purity and is produced, developed, controlled, and provided directly by breeders or their institutions for further multiplication." (IRRI 2017)
Breeders' rights	Policy	"Varietal protection - the legal rights of a breeder, owner, or developer in controlling seed production and marketing of crops." (Copeland & McDonald 1999)

Terms (concepts)	Contexts	Definitions and references
Certified seed	Seed classes	<p>1) "This is the progeny of foundation, registered, or certified seeds, handled to maintain sufficient varietal identity and purity, grown by selected farmers under prescribed conditions of culture and isolation, and subjected to field and seed inspections prior to approval by the certifying agency. Harvest from this class is used for commercial planting." (IRRI 2017)</p> <p>2) "Seed of a known variety produced under strict, formally regulated seed standards to maintain varietal purity and high degrees of seed health. Seed lots must also be free of inert matter and weed seeds (in the case of grains). All certified seed must pass field inspection, be conditioned by an approved seed conditioning plant, and then be sampled and pass laboratory testing before it can be sold as certified seed." (Sperling 2008)</p> <p><i>Note: certification and other regulatory issues are discussed in the 'seed regulatory framework analysis' tool in the RTB seed systems toolbox.</i></p>
Clean seed	Pathology	"A general term for seed that is healthy (free of disease, [or under a predefined threshold]) and from which inert matter (dirt, sand, and twigs) has been removed (in the case of grains)." (Sperling 2008)
Clone	Botany	"Two or more individuals, originally derived from one plant by asexual propagation, which remain genetically identical (ICNCP Art. 2.5)." (Brickell et al. 2016)
Community interviews	Methods	"... in community interviews, the investigator(s) asks questions, raises issues, and seeks responses from the participants. The primary interactions are between the interviewer(s) and the participants rather than among participants. Community interviews take the form of public meetings open to all community members. The date and location of the meeting are announced in advance. The number of participants tends to be large (more than 15 persons)" (Kumar 1993)
Complex adaptive system	Network analysis	"Systems that involve many components that adapt or learn as they interact" (Holland 2006)
Conjoint analysis	Methods	"... a preference elicitation method commonly used to carry out market share simulations. In conjoint analysis, people are asked to rate, rank, or choose between a series of goods described by a set of attributes. These responses are used to estimate an attribute-based utility function, which is in turn used to simulate market shares." (Lusk & Shogren 2007)
Coupled human and natural systems	Network analysis	<p>"Coupled human and natural systems are integrated systems in which people interact with natural components." (Liu et al. 2007)</p> <p><i>Note: these systems usually exhibit non-linear dynamics with thresholds, reciprocal feedback loops, time lags, resilience, heterogeneity, and surprises.</i></p>

Terms (concepts)	Contexts	Definitions and references
Crowdsourcing	Funding	"Crowdsourcing is a type of participative online activity in which an individual, an institution, a non-profit organization, or company proposes to a group of individuals of varying knowledge, heterogeneity, and number, via a flexible open call, the voluntary undertaking of a task. The undertaking of the task, of variable complexity and modularity, and in which the crowd should participate, bringing their work, money, knowledge and/or experience, always entails mutual benefit. The user will receive the satisfaction of a given type of need, be it economic, social recognition, self-esteem, or the development of individual skills, while the crowd sourcer will obtain and utilize to their advantage that what the user has brought to the venture, whose form will depend on the type of activity undertaken." (Estellés-Arolas & González-Ladrón-de-Guevara 2012)
Cultivar	Botany	"An assemblage of plants that has been selected for a particular character or combination of characters and that is clearly distinct, uniform, and stable in these characters and that when propagated by appropriate means retains those characters (ICNCP Art. 2.3)." (Brickell et al. 2016)
CVPO	Seed	"Certification of seed on the basis of varietal purity only, referring to a type of seed certification that certifies seed as to genetic purity without specific criteria for purity, germination, and other aspects of mechanical seed quality." (Copeland & McDonald 1999)
Data poor	Policy	"...refers to situations where the data available cannot provide the needed evidence for decision-making, either because of complete or partial absence of the relevant data, or inadequate quality of the data that are available." (WHO 2020)
Decentralized Multipliers (DMs)	Seed systems	"The model of improving seed availability and access through local, decentralized multipliers (DMs) is widely explored within the context of different seed system approaches. It is seen as a solution for situations where the public sector does not have the capacity or the reach and large-scale private sector companies are not interested or present (e.g. Alemu et al. 2013; Mubangizi et al. 2013; FAO and ICRISAT 2015; AGRA 2016, Van Mele et al. 2011; DeRoo 2016), or not serving farmers' interest (Bezner Kerr 2013). DMs are mostly thought of as farmer groups, cooperatives or individual local entrepreneurs - actors who are seen as potential bridge builders between the formal and farmer systems. Moreover, such local seed production is expected to generate local employment and income, especially for women's groups or young people." (Almekinders et al. 2019)
Degree	Networks	"Number of links of an individual (to others in a network," (Pautasso 2015)
Delivery channel	Seed systems	"The distribution and logistics of getting seed from point A to point B. Delivery may be via markets." (Bentley et al. 2018)
Dormancy	Botany	"A physical or physiological condition of a viable seed that prevents germination even in the presence of otherwise favorable germination conditions." (Copeland & McDonald 1999)

Terms (concepts)	Contexts	Definitions and references
DUS expectation	Policy / programs	Distinct, uniform, stable: " Under the UPOV Convention, the breeder's right is only granted where the variety is (i) new, (ii) distinct, (iii) uniform, (iv) stable and has a suitable denomination (see https://www.upov.int/overview/en/conditions.html)." (UPOV 2020)
Early generation seed (EGS)	Seed classes	"EGS (which encompasses breeder seed, pre-basic and basic seed) is the critical connection between breeding activities and the eventual production and distribution of varieties to farmers." (Cramer 2019) <i>Note: this topic is also discussed in the 'sustainable early generation seed business analysis tool (SEGSBAT)' tool in the RTB seed systems toolbox.</i>
Ecotype	Botany	"A (plant) strain within a given species adapted to a particular environment." (Copeland & McDonald 1999)
Exponential random graph model (ERGM)	Networks	"...commonly called the p* class of models (Frank and Strauss 1986; Pattison and Wasserman 1999; Robins et al. 1999; Wasserman and Pattison 1996). These probability models for networks on a given set of actors allow generalization beyond the restrictive dyadic independence assumption of the earlier p1 model class (Holland and Leinhardt 1981). Accordingly, they permit models to be built from a more realistic construal of the structural foundations of social behavior." (Robins et al. 2007)
Farmer seed system	Seed systems	"Seed and other propagation materials that are produced on-farm and are not part of formal seed sector arrangements, e.g., contract production, is usually associated with farmers' or local seed. All of activities related to farmers' seed production and supply are commonly referred to as traditional (Cromwell et al. 1992), local (Almekinders et al. 1994; Louwaars & van Marrewijk 1996), or farmers' seed systems (Almekinders & Louwaars 1999)." (Almekinders & Louwaars 2002)
Farmers' rights	Genetic resources	"The proprietary rights that local farmers claim over genetic resources in landraces, similar to plant breeders' rights for modern varieties." (Louwaars & van Marrewijk 1996)
Flows	Network analysis	"Flows are relations based on exchanges or transfers between nodes. These may include relations in which resources, information, or influence flow through networks." (Marin & Wellman 2010)
Focus group interviews	Methods	"Focus group interviews are conducted to discuss a specific topic in group sessions. Participants discuss ideas, issues, insights, and experiences among themselves, and each member is free to comment, criticize, or elaborate on the views expressed by other. The premise underlying the focus group method is that free discussions generate fresh ideas and insights because the participants stimulate each other. Focus groups are limited in size to 8 to 12 carefully-selected participants." (Kumar 1993)
Food security	Policy / programs	"All people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life." (FAO 2002)

Terms (concepts)	Contexts	Definitions and references
Formal seed system	Seed systems	"Production and supply of seed of modern varieties and certified seed through an organized chain including specialized plant breeders, regulated seed producers, and specialized commercial outlets or government extension agencies." (Sperling 2008)
Foundation seed	Seed classes	"This is the progeny of the breeder seed, produced by trained officers of an agricultural station in conformity with regulated national standards and handled to maintain genetic purity and identity of the variety." (IRRI 2017)
Four-square / four cell	Methods	1) "The four-square analysis is a method that helps obtain greater detail on agrobiodiversity at the village and farm level." (Sperling et al. 2004) 2) "The Four Cell Approach (Sthapit B. 2006) is a participatory rapid rural appraisal technique that was originally created to assess the abundance (richness) and distribution (evenness) of the production of crops, animal and collected species with in farming communities. The method has been adapted to include market (sale and purchase), diet and production assessment in local livelihoods." (Ranieri et al. 2016) <i>Note: the approach has also been adapted into the 'four square method' tool found in the RTB seed systems toolbox.</i>
Free elicitation	Methods	"In free elicitation, respondents are asked to verbalize the attributes they consider relevant in their perception of different product alternatives in the category under investigation. Memory probes (such as a set of brand names) may be used to assist the respondent in triggering the elicitation process." (Steenkamp et al. 1997)
Fungicide (as seed dressing)	Seed	"A chemical that disinfects the seed and/or protects it from soil-borne fungi during germination." (Copeland & McDonald 1999)
Gender	Policy / program	"Refers to the socially constructed characteristics of women and men – such as norms, roles and relationships of and between groups of women and men." (WHO 2011a)
Gender-blind	Policy / program	" <ul style="list-style-type: none"> • Ignores gender norms, roles and relations • Very often reinforces gender-based discrimination • Ignores differences in opportunities and resource allocation for women and men • Often constructed based on the principle of being 'fair' by treating everyone the same." (WHO 2011b)
Gender-sensitive	Policy / program	" <ul style="list-style-type: none"> • Considers gender norms, roles and relations • Does not address inequality generated by unequal norms, roles or relations • Indicates gender awareness, although often no remedial action is developed." (WHO 2011b)
Gender-specific	Policy / program	" <ul style="list-style-type: none"> • Considers gender norms, roles and relations for women and men and how they affect access to and control over resources • Considers women's and men's specific needs • Intentionally targets and benefits a specific group of women or men to achieve certain policy or programme goals or meet certain needs • Makes it easier for women and men to fulfil duties that are ascribed to them based on their gender roles." (WHO 2011b)

Terms (concepts)	Contexts	Definitions and references
Gender-transformative	Policy / program	" <ul style="list-style-type: none"> • Considers gender norms, roles and relations for women and men and that these affect access to and control over resources • Considers women's and men's specific needs • Addresses the causes of gender-based health inequities • Includes ways to transform harmful gender norms, roles and relations • The objective is often to promote gender equality • Includes strategies to foster progressive changes in power relationships between women and men." (WHO 2011b)
Gender-unequal	Policy / program	" <ul style="list-style-type: none"> • Perpetuates gender inequality by reinforcing unbalanced norms, roles and relations • Privileges men over women (or vice versa) • Often leads to one sex enjoying more rights or opportunities than the other." (WHO 2011b)
Gene bank	Seeds	"A place where genetic material is stored, usually as seed, and/or plant material, and conserved for future use." (Brickell et al. 2016)
Genetic purity	Seed	"Trueness to type or variety, usually referring to seed." (Copeland & McDonald 1999)
Genotype	Botany	"The genetic make-up of an individual or population." (Brickell et al. 2016)
Germplasm	Seed	1) "All living tissues and genetic materials (such as seeds or a piece of stem) from which new plants and organisms can grow." (Wattnem 2016) 2) "An expression used in a broad sense to denote the hereditary properties of an individual plant or plant population that are transmitted from one generation to another." (Copeland & McDonald 1999)
Homophily	Networks	"Homophily is the principle that a contact between similar people occurs at a higher rate than among dissimilar people." (McPherson et al. 2001)
Impact network analysis (INA)	Methods	"Impact network analysis (INA) is a framework for evaluating the likely regional success of interventions before, during, and after projects, for project implementers, policy makers, and funders. INA integrates across three key system components: (a) the quality of a management strategy and the quality of information about it, (b) the socioeconomic networks through which managers learn about the management strategy and decide whether to use it, and (c) the biophysical network that results from those decisions." (Garrett 2012) <i>Note: this approach is described in detail in the 'Impact network analysis (INA)' tool found in the RTB seed systems toolbox.</i>
Indexing	Pathology	"The process used to test vegetatively reproduced planting stock for freedom from virus diseases. Disease evaluations are based on greenhouse or field plot growout tests." (Copeland & McDonald 1999)

Terms (concepts)	Contexts	Definitions and references
Informal, local, traditional seed systems	Seed systems	"Terms sometimes used interchangeably to describe the main ways farmers acquire and disseminate seed: their own harvests; exchanges with relatives, friends, and neighbors; and local markets. These seed systems, which can diffuse local or modern varieties (which are recycled), tend to be governed by local norms of practice rather than official or government standards. Seed is not backed by formal certification. Worldwide, small-scale farmers source about 80% of their seed from these systems (in the case of roots, tubers and bananas this can be up to 100%)." (Sperling 2008)
Informal, traditional, farmer seed systems	Seed systems	"An 'informal', 'traditional' or 'farmer' seed system lacks public sector regulation (Thiele 1999). Farmers frequently exchange seeds among themselves, often for sale (Almekinders et al. 1994; Almekinders and Louwaars 1999; De Schutter 2009). Farmer seed systems also develop new varieties and maintain crop genetic diversity, but they do it as an integrated part of crop production (Almekinders and Louwaars 2002; Brush 2004)." (Bentley et al. 2011)
Inoculum	Pathology	"Any material such as spores, bacteria or fungus bodies that serve as a means of propagating or spreading a pathogenic disease." (Copeland & McDonald 1999)
in-situ preservation	Genetic resources	"Preservation of genetic resources in the area where they occur naturally, i.e. in nature or in farmers' fields." (Louwaars & van Marrewijk 1996)
Integrated pest management (IPM)	Methods	"...a decision-based process involving coordinated use of multiple tactics for optimizing the control of all classes of pests (insects, pathogens, weeds, vertebrates) in an ecologically and economically sound manner." (Prokopy 2003)
Interactions	Network analysis	"Interactions refer to behaviour-based ties such as speaking with, helping, or inviting into one's home. Interactions usually occur in the context of social relations, and interaction-based and affective-based measures are frequently used as proxies for one another." (Marin & Wellman 2010)
Interdependency	Value chains	"Interdependency refers to the fact that the activities performed in a chain (production, processing, distribution, etc.) are related to one another. To operate efficiently and profitably, a chain actor, say a fruit processor, depends on a stable and regular supply of inputs that meet quality criteria and are delivered at an affordable cost. Raw material providers, such as fruit growers, depend on the other hand, on processors to guarantee a regular outlet for their products. Thus, the success of each one of these two actors is very much associated to the fortunes of the other." (Da Silva & de Souza Filho 2007)
Invasion threshold	Pathology	"The boundary between extinction and persistence of an introduced item (e.g. a crop variety) in a network." (Pautasso 2015)
ITPGRFA	Policy	"The International Treaty on Plant Genetic Resources for Food and Agriculture was adopted by the Thirty-First Session of the Conference of the Food and Agriculture Organization of the United Nations on 3 November 2001." (FAO 2001)

Terms (concepts)	Contexts	Definitions and references
Key informant interviews	Methods	"...key informant interviews are essentially qualitative interviews, and are carried out with interview guides that list topics and issues to be covered in a session. The interviewer frames the questions in the course of interviews and subtly probes the informants to elicit more information." (Kumar 1993)
Kinship systems	Methods	"Kinship systems are cultural conceptualizations of relationships between individuals, based on the notion of descent and clan membership... kinship systems structure social networks of exchange between kin (related by descent) and affines (related by marriage)." (Delêtre et al. 2011)
Laddering	Methods	"The interview technique employed to understand the respondents' connections between quality cues, quality attributes and personal values is called laddering. The key of this technique is iterative, non-directive probing from the individual important quality cues into underlying reasons for the quality cues. The laddering interviews follow the wording of the respondent, allowing optimal freedom in response style. This leads to the identification of the implicit quality attributes, perceived benefits, and valued end states." (Urrea-Hernandez et al. 2016)
Landrace	Genetic resources	"The review of the defining characteristics of landraces clearly illustrates that certain characteristics are associated with landraces, and these are historical origin, high local genetic adaptation, recognizable identity, genetic diversity, lack of formal genetic improvement and association with traditional farming systems. These six characteristics are, however, not absolute and cannot all be applied consistently to define a landrace in all crop/agroecosystem situations." (Villa et al. 2005)
Link	Networks	"A connection between two individuals in a network. In the case of seed exchange, links are materialized by the movement of seed between individuals." Outgoing link: "Link directed out of an individual. In the case of seed exchange, an outgoing link implies that seed was given by the individual." Incoming link: "Link directed into an individual. In the case of seed exchange, an incoming link implies that seed was received by the individual." (Pautasso 2015)
Local seed businesses (LSB)	Seed systems	"Local seed businesses (LSBs) fill a gap in quality seed production for crops in which the commercial seed companies are not interested. LSBs may start from the informal sector as farmer groups or entrepreneurial farmers who see business opportunities in the production and marketing of quality seed Farmer groups produce and sell quality seed of locally preferred crops and varieties to local markets and operate as local businesses. They are technically equipped, professionally organized, market oriented and strategically linked to achieve commercial sustainability." (Mastenbroek et al. 2015)

Terms (concepts)	Contexts	Definitions and references
Means-end chain theory	Methods	<p>"In consumer research, the relation between quality cues (product characteristics), quality attributes (abstract benefits) and personal values is modelled in Means-Ends Chain theory. In Means-End Chain theory the quality cues are the means to infer quality attributes. The quality attributes are the means to obtain desired consequences, and the consequences are the means to reach valued end states. Recurring connections between quality cues, quality attributes and personal values across individuals can be summarized in a Hierarchical Value Map. The hierarchical value map explicitly shows the dominant cognitive and motivational structures that usually remain implicit among informal experts." (Urrea-Hernandez et al. 2016)</p> <p><i>Note: this approach is described in detail in the 'means-end chain analysis' tool found in the RTB seed systems toolbox.</i></p>
Minimum dataset (MDS)	Methods	<p>"A compilation of available data focused on selected aspects of demographic, social, economic and health characteristics ... in "data poor" countries ... to create a reliable and timely evidence base to inform policy (i.e. a minimum data set)." (WHO 2020)</p> <p><i>Note: this definition is derived from epidemiological applications in human health. MDS approaches have also been proposed for plant epidemiological research and have been elaborated for agronomy and soil characteristics (e.g. Govaerts et al. 2006; Yemefack et al. 2006)</i></p>
Mixed method studies	Methods	<p>"Mixed method studies are those that combine the qualitative and quantitative approaches into the research methodology of a single study or multi-phased study." (Tashakkori et al. 1998)</p>
Multiplication factor	Seed	<p>"General: the number of seeds produced from one parent seed. In seed production: net seed yield per hectare (i.e. after seed cleaning and quality control), divided by the seed rate." (Louwaars & van Marrewijk 1996)</p>
Multi-stakeholder framework for intervening in root, tuber, and banana seed systems	Methods	<p>"The multi-stakeholder framework for intervening in root, tuber, and banana seed systems allows an analysis of the key seed system functions from the perspectives of all stakeholders, to identify how their different roles mesh together, so that no key functions or players are ignored (Ortiz, Thiele, and Sperling 2013; RTB 2016; Sperling, Ortiz, and Thiele 2013). The elements of the framework are the roles of potential stakeholders, which are systematically compared across the dimensions of availability, access, and quality of seed." (Bentley et al. 2018)</p> <p><i>Note: this approach is the topic of the 'multi-stakeholder framework' tool found in the RTB seed systems toolbox.</i></p>
Network	Network analysis	<p>1) "A set of connected individuals." (Pautasso 2015)</p> <p>2) "Although the term network is often used casually to indicate a set of affiliated entities, here we discuss networks in the more formal sense of a group of nodes and the links between them. Nodes may represent entities ranging from genes to species to individual people to geographic locations (Table 1). Links may represent associations such as the tendency for species to occur together, communication between people, or potential pathogen spread between geographic locations." (Garrett et al. 2018)</p>

Terms (concepts)	Contexts	Definitions and references
Node degree	Network analysis	"The number of links a node has; may be divided into in-degree (the number of links to a node) and out-degree (the number of links from a node)." (Garrett et al. 2018)
Nodes	Network analysis	"Nodes, or network members, are the units that are connected by the relations whose patterns we study." (Marin & Wellman 2010)
Non-exclusivity	Public goods	"Non-exclusivity refers to a situation where once the good is made available to some users or consumers, it is made available to all other consumers whether or not they pay for it." (Jaffee & Srivastava 1992)
Non-rival	Public goods	"Consumption (of a good) by one individual does not limit the consumption by (and benefits to) anyone else." (Jaffee & Srivastava 1992)
Off-type	Genetic resources	"A plant is to be considered an off-type if it can be clearly distinguished from the variety in the expression of any characteristic of the whole or part of the plant that is used in the testing of distinctness, taking into consideration the particular features of its propagation." (UPOV 2002)
Participatory varietal selection (PVS)	Breeding	"In many (participatory plant breeding) initiatives, farmers' participation is limited to the final steps involving evaluation and selecting a few nearly-finished or advanced varieties just before their official release. This is known as participatory varietal selection (PVS)." (Chiffolleau & Desclaux 2006)
Pathogen spillover	Pathology	"Spread of pathogens abundant on one host species (or differentiated population) to another." (Garrett et al. 2018)
Perennial	Botany	"A plant which survives and produces vegetative growth and flowers year after year without being replanted." (Copeland & McDonald 1999)
Pest	Agriculture	"Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products." (FAO 2009)
Phenotype	Botany	"The sum total of all the characteristics of an individual plant; the physical expression of the genotype." (Brickell et al. 2016)
Physiological dormancy	Botany	"Seed dormancy caused by internal physiological conditions that prevent germination. Often referred to as epicotyl or embryo dormancy." (Copeland & McDonald 1999)
Product profile	Breeding	"A Product Profile describes a variety with the necessary characteristics to replace the older varieties that still dominate a particular market. ... The profile also functions as a commitment between breeders, management and their funders, as it should be possible to develop the variety described using available materials and resources within a reasonable timeframe. The goal is to set targets based on your ambitions for breeding program modernization and acceleration." (EiB 2020)
Propagule	Botany	"... 'seeds' (here understood as propagules, i.e., true seeds, tubers, rhizomes, or stem cuttings)." (Delêtre et al. 2011) <i>Note: A unit of plant multiplication, for example true botanical seed, vegetative cuttings, plantlets, or rhizomes.</i>

Terms (concepts)	Contexts	Definitions and references
Pseudo-qualitative characteristics (of a variety)	Seed	"In the case of 'pseudo-qualitative characteristics,' the range of expression is at least partly continuous, but varies in more than one dimension, e.g. shape: ovate (1), elliptic (2), circular (3), obovate (4), and cannot be adequately described by just defining two ends of a linear range. In a similar way to qualitative (discontinuous) characteristics – hence the term "pseudo-qualitative" – each individual state of expression needs to be identified to adequately describe the range of the characteristic." (UPOV 2002)
Pure line variety	Seed	"A variety (cultivar) of a self-pollinated species derived from a single plant." (Copeland & McDonald 1999)
Pure live seed	Seed	"The percentage of pure seeds in a seed lot that have the ability to germinate. The percentage of PLS is determined by multiplying percent germination by percent pure seed and dividing by 100." (Copeland & McDonald 1999)
Qualitative characteristics (of a plant variety)	Botany	"'Qualitative characteristics' are those that are expressed in discontinuous states, e.g. sex of plant: dioecious female (1), dioecious male (2), monoecious unisexual (3), monoecious hermaphrodite (4). These states are self-explanatory and independently meaningful. All states are necessary to describe the full range of the characteristic, and every form of expression can be described by a single state. The order of states is not important. As a rule, the characteristics are not influenced by environment." (UPOV 2002)
Quality	Seed	1) "Seed is of acceptable quality (seed health, physiological quality), and meets farmer needs (is adapted and aligned with farmer preferences)." (McGuire & Sperling 2011) 2) "Based on the concepts of (1) genetic quality (including genetic purity, varieties, and biodiversity, e.g., local crop varieties); (2) health: pests and diseases are below specified threshold levels; (3) physiological quality: at the right physiological age—e.g., properly stored in the case of potato and yam or sourced from vigorous and healthy-looking crops for most other VPC (vegetatively propagated crop) seed; and (4) sound physical quality (size, shape and without mechanical damage). Quality is also shaped by acceptability of the seed to users (the users' perception and intended use)." (Bentley et al. 2018)
Quality declared seed (QDS), quality declared planting material (QDPM)	Seed	"Seed in a quality control system, introduced by FAO, whereby 10% of the seed fields and lots are checked by an autonomous quality control agency and the remainder by the seed production organization." (Louwaars & van Marrewijk 1996) <i>Note:</i> Various other schemes for quality declaration have emerged in different contexts, such that QDS is often used as a more general term for seed which is not resultant from a formal production system, but in which quality is assured through the reputational identity of the producer group.

Terms (concepts)	Contexts	Definitions and references
Quantitative characteristics (of a plant variety)	Botany	"'Quantitative characteristics' are those where the expression covers the full range of variation from one extreme to the other. The expression can be recorded on a one-dimensional, continuous or discrete, linear scale. The range of expression is divided into a number of states for the purpose of description, e.g. length of stem: very short (1), short (3), medium (5), long (7), very long (9). The division seeks to provide, as far as is practical, an even distribution across the scale. The Test Guidelines do not specify the difference needed for distinctness. The states of expression should, however, be meaningful for DUS assessment." (UPOV 2002)
Quarantine (plant)	Pathology	"Rules and regulations promulgated by governments to regulate the introduction of plants, planting materials, plant products, soil, living organisms, etc. with a view to prevent inadvertent introduction of exotic pests, weeds and pathogens harmful to the agriculture or the environment of a country/region, and if introduced, to prevent their establishment and further spread." (Paroda & Arora 1991)
R (statistical software)	Methods	"...a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS." (The R Foundation 2020 "Getting started")
R package	Methods	"Many users think of R as a statistics system. We prefer to think of it as an environment within which statistical techniques are implemented. R can be extended (easily) via <i>packages</i> . There are about eight packages supplied with the R distribution and many more are available through the CRAN family of Internet sites covering a very wide range of modern statistics." (The R Foundation 2020 "What is R?")
Reference price	Methods	"Price or set of prices the consumer uses to compare and evaluate the price of a proposed good or service." (Le Gall-Ely 2009)
Registered seed	Seed classes	1) "This is the progeny of the foundation seed grown by selected farmers, handled to maintain genetic purity and identity, and has undergone field and seed inspections to ensure conformity with standards." (IRRI 2017) 2) "A class of certified (generic sense) seed which is produced from foundation seed and planted to produce certified (blue-tag) seed." (Copeland & McDonald 1999)
Release (variety)	Policy / programs	"A crop variety (or germplasm) that is released and designated to be reproduced, marketed, and made available as seed for public use." (Copeland & McDonald 1999)
Repertory grid	Methods	"The repertory grid task confronts the consumer with triads of product alternatives ... The respondent is asked to indicate which two stimuli are most alike and on which attribute(s) they differ from the third stimulus. This procedure is repeated for different triads until the attributes of the respondent are exhausted or all brands have been included." (Steenkamp & van Trijp 1997)
Resilience	Network analysis	"A system's ability to return to a given state (such as a level of productivity) after perturbation, usually considered in cases where the initial state is desirable." (Garrett et al. 2018)

Terms (concepts)	Contexts	Definitions and references
Revealed preference	Methods	"Revealed preference methods use existing market data to derive implicit values for a good, for example hedonic pricing, travel costs. Revealed preferences work when the good already exists, albeit indirectly, in the market." (Lusk & Shogren 2007)
Reversion/ recovery	Pathology	1) "... when cuttings obtained from diseased plants are propagated, some grow into symptomless virus-free plants (Cours 1951). This phenomenon is referred as 'reversion' (Pacumbaba 1985), 'self-elimination' (Rossel et al. 1988) or 'recovery' (Fargette et al. 1996) in cassava, and similar behaviour has also been reported with other vegetatively propagated crops including potato." (Fondong et al. 2000) 2) "... the ability of plants that are virus-infected to become at least mostly virus-free." (Gibson & Kreuze 2015)
Rhizome	Botany	"A non-fleshy, more or less horizontal, underground stem." (Copeland & McDonald 1999)
Rogue/ Rogueing	Seed	1) "A noun referring to an off-type plant. When used as a verb it refers to the act of removing such plants." (Copeland & McDonald 1999) 2) "Removal of individual plants from a seed field (because they are off-type or diseased)." (Louwaars & van Marrewijk 1996)
Second price auction (also called Vickrey auction)	Methods	"In a second price auction, the person with the highest bid wins the auction and pays a price equal to the second highest amount; the winner either exchanges their typical product for the novel product or obtains the good in the randomly selected auction, depending upon the chosen implementation method. All losing bidders either retain their typical product or obtain nothing. In theory, each bid in this auction reflects a bidder's value or willingness to pay for the good(s). The beauty of a second price auction is that a person cannot be made better off by misrepresenting his or her actual value." (Lusk & Shogren 2007) <i>Note: further discussion is found in the 'experimental auctions' tool in the RTB seed systems toolbox.</i>
Seed	Seed	1) "The term 'seed' is often loosely used to describe planting material for vegetatively propagated crops, including stem and root cuttings of cassava and sweet potato, and suckers of bananas, as well as 'true' seed." (CABI 2014) 2) "In the context of agriculture, seeds can be broadly defined as all living materials used to plant a crop. Seeds are the living organisms which carry the genetic properties of crop plants. For some crops, including wheat, rice, maize, and most vegetables, the genetic information is carried within dry seeds. For other crops, including cassava, sugarcane, bananas, and some cut flowers, the 'seeds' used are actually cuttings of tubers or other vegetative part of the plant which is detached and then replanted to grow another plant." (Jaffee & Srivastava 1992)

Terms (concepts)	Contexts	Definitions and references
Seed degeneration	Seed; pathology	1) "Reduction in yield or quality caused by an accumulation of pathogens and pests in planting material due to successive cycles of vegetative propagation." (Thomas-Sharma et al. 2016) 2) "In vegetatively propagated crops, pathogens tend to accumulate if planting material is drawn from within a crop population over multiple generations, resulting in significant quality and yield losses." (Thomas-Sharma et al. 2017)
Seed enterprise	Seed systems	"A seed enterprise varies from a single farmer who produces seed for local sale, to the international company with many employees and operations in many countries to breed varieties, produce and market many kinds of seed, over wide areas." (van Gastel et al. 2002)
Seed health	Seed	"The extent to which seed is free (or below a predefined threshold) from or carries pests and diseases. The term is sometimes used to refer to the germination rate (proportion of planted seed that begins to grow in a given period) and vigor (how well the plants grow)." (Sperling 2008)
Seed security	Seed systems	1) "Farming households (men and women) (having) access to adequate quantities of quality seeds and plant materials of adapted varieties at all times – good and bad." (FAO 1998) 2) "Farm families are 'seed secure' when they have access to seed of adequate quantity, of acceptable quality, and in time for planting. Here we define seed broadly to include not just grains that are sown, but also cuttings, tubers, and other agricultural planting materials. Helping farmers obtain seed enables them to produce for their own consumption and sale. So, fostering seed security contributes to food and livelihood security more generally." (Sperling 2008)
Seed sovereignty	Policy/ programs	"People's right to save, replant, breed and share seeds, and their right to participate in decision-making processes regarding rules and laws that regulate their access and use." (Wattnem 2016)
Seed storage	Seed	"Seed storage is undertaken for several purposes and takes different forms, including long-term storage of breeder seed of certified varieties', the maintenance of reserve stocks of seeds for staple food crops over several years, carry-over seedstocks between crop harvests and subsequent planting seasons, and seed stocks to meet short-term sales requirements." (Jaffee & Srivastava 1992)
Seed system	Seed systems	"A seed system is the network of stakeholders involved in providing, managing, replacing, and distributing the seed of a particular crop in a certain area. In a formal seed system, these components are regulated by the public sector, e.g., standards are set by government; in an informal seed system, the farmers themselves manage these components." (Bentley et al. 2018)
Seed system (National)	Seed systems	"The interdependent set of seed-related physical activities, the firms and individuals which perform such activities, and the network of trading and other institutional arrangements which facilitate coordination among such activities and participants can be regarded as constituent elements of national seed systems. Each national seed system is normally composed of numerous sub-systems, geared toward different crops and farmer clienteles." (Jaffee & Srivastava 1992)

Terms (concepts)	Contexts	Definitions and references
Seed system security assessment (SSSA)	Methods	“A seed system security assessment – SSSA – determines the security of farmers’ seed systems, considering both acute stress (the emergency) and more chronic, long-term challenges. Such a focus also includes broader analysis of cropping and livelihood systems, with special focus on vulnerability and resilience. The SSSA informs donor, government, and NGO responses in agricultural relief and recovery, identifying whether interventions are needed, and guiding the choice of relief and development actions.” (Sperling & McGuire 2011; Sperling 2008; McGuire & Sperling 2016)
Seed users	Seed systems	"The most important stakeholders, the farmers who demand seed, who accept or reject new crop varieties and who manage most root, tuber, and banana seed on their farms. Women and men often have different needs as users." (Bentley et al. 2018)
Small N surveys	Methods	1) “Small-N designs, such as systematic case studies and single case experiments, are a potentially appealing way of blending science and practice, since they enable clinicians to integrate formal research methods into their everyday work...” (Barker 2002) – definition developed for clinical psychology <i>Note: As applied to seed systems, surveys applied to a small number of interviewees, e.g. farmers. These small N surveys are particularly useful to blend science and practice at a low cost and short time while still understanding the complexity of individuals. This approach is further described in the 'Small-N/exploratory case study' tool found in the RTB seed systems toolbox.</i>
Small-world network	Network analysis	“A network not only with neighbouring connectivity but also with some long-distance connections.” (Pautasso 2015)
Social network	Network analysis	1) “Social networks are formally defined as a set of nodes (or network members) that are tied by one or more types of relations.” (Wasserman & Faust 1994) 2) “A social network is the pattern of friendship, advice, communication or support which exists among the members of a social system.” (Valente 1996)

Terms (concepts)	Contexts	Definitions and references
Social Network Analysis (SNA)	Network analysis	<p>1) "The social network field is an interdisciplinary research programme which seeks to predict the structure of relationships among social entities, as well as the impact of said structure on other social phenomena. The substantive elements of this programme are built around a shared 'core' of concepts and methods for the measurement, representation, and analysis of social structure. These techniques (jointly referred to as the methods of social network analysis) are applicable to a wide range of substantive domains, ranging from the analysis of concepts within mental models (Wegner 1995; Carley 1997) to the study of war between nations (Wimmer & Min 2006)." (Butts 2008)</p> <p>2) "In social science, the structural approach that is based on the study of interaction among social actors ... All four of these features are found in modern social network analysis, and together they define the field:</p> <ol style="list-style-type: none"> 1. Social network analysis is motivated by a structural intuition based on ties linking social actors, 2. It is grounded in systematic empirical data, 3. It draws heavily on graphic imagery, and 4. It relies on the use of mathematical and/or computational models." <p>(Freeman 2004)</p>
Stated preference	Methods	"... stated preference methods use public opinion surveys or comparative choice trials that ask a person, directly or indirectly, to state his or her value for the new good or service. The upside of stated preference methods is that the researcher can create a hypothetical market where a person can, in theory, buy or sell any good or service. The stated preference method is flexible enough to construct alternative potential scenarios such that demand for the good can be understood given changes in market and non-market conditions. A well-known downside of stated preference methods, regardless of how well the survey is designed and executed, is that people know they are valuing a hypothetical change in the good or service." (Lusk & Shogren 2007)
Supply chain management	Value chains	"SCM is primarily concerned with the way firms organize the flow of inputs and production resources from procurement through product manufacturing and distribution. The processes necessary to accomplish this flow effectively, efficiently and profitably are seen as a system, a chain with nodes that can exist both internally and externally to an organization." (Da Silva & de Souza Filho 2007)
Sustainability (network analysis)	Network analysis	"A system's ability to maintain a given state (such as a level of productivity) over time, usually considered in cases where the initial state is desirable." (Garrett et al. 2018)
Synergy	Value chains	"Synergy is a system characteristic that in essence tells us that the whole is greater than the sum of the parts. In agrifood chains there are frequently opportunities for gains which cannot be realized unless all actors work together for mutual benefit." (Da Silva & de Souza Filho 2007)
Synthetic seed	Seed	"Seeds (often a somatic embryo surrounded by a synthetic encapsulation) produced from vegetative tissue (usually by tissue culture) that are clones possessing identical genotypes." (Copeland & McDonald 1999)

Terms (concepts)	Contexts	Definitions and references
Tipping points	Network analysis	"Thresholds for potentially abrupt change in a system." (Garrett et al. 2018)
TRIPS (Agreement on Trade-Related Aspects of Intellectual Property Rights)	Policy / programs	"The TRIPS Agreement, which came into effect on 1 January 1995, is to date the most comprehensive multilateral agreement on intellectual property. The areas of intellectual property that it covers are: copyright and related rights (i.e. the rights of performers, producers of sound recordings and broadcasting organizations); trademarks including service marks; geographical indications including appellations of origin; industrial designs; patents including the protection of new varieties of plants; the layout-designs of integrated circuits; and undisclosed information including trade secrets and test data." (WTO 2020)
Utilization (seed security)	Seed systems	"Seed: -is of acceptable seed quality (seed health, physiological quality) -is of acceptable variety quality (is adapted and aligned with farmers' preferences) -plus produces food of higher quality per se (e. g. better inherent nutrition; or high income value)." (McGuire & Sperling 2011)
Value chain	Value chains	"The value chain describes the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use." (Kaplinsky & Morris 2000)
Varietal protection	Policy / programs	"Legal protection (breeders rights) to developers or owners of crop varieties giving them exclusive right to control seed production and marketing." (Copeland & McDonald 1999)
Variety (Bred)	Policy / programs	"A Bred Variety is one which has been produced by a plant breeder as the result of breeding. Bred varieties can be non-hybrid or hybrid in type." (OECD 2020)
Variety (Local)	Policy / programs	"Local variety (where recognized) derives from a defined region of origin which has been shown by official tests to have sufficient uniformity, stability and distinctness to warrant recognition, but has not been produced as a result of breeding work." (OECD 2020)
Variety (of plant)	Policy / programs	1) "The 1991 Act of the UPOV Convention makes this clear by stating in Article 1 (vi) that a variety is a plant grouping that can be 'defined by the expression of the characteristics resulting from a given genotype or combination of genotypes' and can be 'distinguished from any other plant grouping by the expression of at least one of the said characteristics.'" (UPOV 2002) 2) "The term 'variety' refers to the group of phenotypes identified by farmers under a single name." (Elias et al. 2001)
Vegetative reproduction	Seed	"Referring to asexual (stem, leaf, root) development in plants in contrast to sexual (flower, seed) development." (Copeland & McDonald 1999)

Terms (concepts)	Contexts	Definitions and references
Village-based seed enterprises (VBSE)	Seed systems	1) "Village-based seed enterprises." (Srinivas et al. 2010) 2) "The VBSEs are farmer-based seed production and marketing schemes that undertake seed business with view to make profit (Bishaw et al. 2008; van Gastel et al. 2008)). They are farmer groups or individuals operating at local level to ensure availability and access of varieties and seeds to farmers in the absence of formal sector or in less favorable environments and remote areas. VBSEs tend to compliment the formal sector and focus on crops neither handled by the public sector nor the private sector." (FAO & ICRISAT 2015)
Willingness to accept (WTA)	Methods	"willingness to accept (WTA) compensation to sell a good." (Lusk & Shogren 2007)
Willingness to pay (WTP)	Methods	"Maximum price a consumer accepts to pay for a given quantity of goods or services." (Le Gall-Ely 2009)
Yam minisett technique (YMT)	Seed	"The YMT uses 'mother' yams of 500–1000 g to generate minisetts by careful cutting. The minisett size can vary from 10 to 80 g, but the recommended weight promoted in Nigeria since the early 1980s has been 25 g (Kalu et al.1989). One 500 to 1000 g mother yam should yield about 20–40 minisetts of 25 g." (Morse 2018)

CONCLUSIONS

In a multidisciplinary environment like seed systems research, jargon can become an obstacle. Even specialists are faced with terms from outside of their field of expertise. The Glossary of Root, Tuber and Banana Seed Systems is a resource for those using the Toolbox (Andrade-Piedra et al. 2020), but will also be of value to those interested in seed systems research in general.

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RESEARCH
PROGRAM ON
Roots, Tubers
and Bananas

The CGIAR Research Program on Roots, Tubers and Bananas (RTB) is a partnership collaboration led by the International Potato Center implemented jointly with Bioversity International, the International Center for Tropical Agriculture (CIAT), the International Institute of Tropical Agriculture (IITA), and the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), that includes a growing number of research and development partners. RTB brings together research on its mandate crops: bananas and plantains, cassava, potato, sweetpotato, yams, and minor roots and tubers, to improve nutrition and food security and foster greater gender equity especially among some of the world's poorest and most vulnerable populations.

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