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Erratum

Erratum: Mulesa et al. Pluralistic Seed System Development: A Path to Seed Security? *Agronomy* 2021, *11*, 372

Agronomy Editorial Office

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The authors would like to make the following correction to the published paper [1]:

In Table A1 of Appendix A, the second table header should be changed from "Actors (Gindabarat)" to "Actors (Heexosa)," and the last row under the first header Actors (Gindabarat) should be included under the second header Actors (Heexosa).

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Appendix A

Table A1. Roles of seed sector actors in contributing (↑) and/or constraining (↓) smallholder farmers' seed security of the teff-centered and subsistence focused farming system in Gindabarat district, and the wheat-centered and commercially oriented farming system in Heexosa district. Roles that have not yet had the intended effect are denoted with ↔.

Actors (Gindabarat)	**Seed Security Features**				
	Varietal Suitability and/or Adaptability [1]	**Availability** [2]	**Access** [3]	**Quality** [4]	**Gender, Socioeconomic Status, and Age** [5]
Local government decision makers/experts *District bureau of agriculture*	↑ Bring pre-basic/basic seeds or early generation seeds (EGS) of improved varieties from agricultural research located in similar agroecology and conduct participatory variety trials together with farmers under different input packages and agronomic practices at FTC. ↑ Recognize and support participatory variety selection (PVS) of traditional varieties conducted by the community seed bank (CSB) group (see below) ↔ Requested support from regional government for variety testing and research on new technologies (not yet obtained)	↑ Assess farmers' seed demand and determine quantity of certified seeds required ↑ Provide external support (e.g., administrative and financial management) for formally organized farmers for seed production (see below) in collaboration with District Cooperative Promotion Bureau ↔ Requested support from regional government for seed production and distribution to increase supply of improved seeds (not yet obtained) ↓ Did not establish seed reserve for seed system resilience in cases of disaster. ↓Not aware about or did not request the Regional Bureau of Agriculture to provide certificate of competence for interested seed agents [8] and cooperatives for direct marketing of certified seeds to farmers and effective distribution	↑ Determine share of certified seeds for peasant associations, enforce government prices, and support Primary Multipurpose Cooperatives (PMCs) during seed distribution ↑ Conduct field demonstration of new varieties at Farmer Training Centers (FTC) to increase awareness among farmers ↓Despite weak evidence, the extension often promotes improved varieties as better yielding than traditional varieties ↔ Submitted requests for budget from regional government to build physical infrastructure (e.g., access road) to improve access to agricultural inputs and marketing outputs (not yet obtained)	↑ Collect data from farmers and report events of poor performance due to low seed quality of certified seeds to regional bureau of agriculture to enforce commercial guarantee [6] and settle disputes ↑ Recognize the seed quality criteria that most farmers use [7] ↑ Support trainings on quality seed production and storage for members of an NGO-supported community seed bank (CSB) group (see below) ↓ No trainings provided on seed production and storage provided for individual households ↓No technical training and infrastructure support for PMCs to increase their capacity to properly store seeds they receive from public seed enterprises	↓ Extension services, technology promotion, and agronomic trainings prioritize model farmers (often the majority are male household heads), which marginalize women and youth ↔ Established women/youth leagues/federations at the local and district level to increase participation in agriculture development issues, but the structure is mostly utilized for political governance of the district by the leading party
National/regional research *Holeta Agricultural Research Center (HARC) and Debre Zeit Agricultural Research Center (DZARC)*	↔ Send limited EGS samples of new varieties to the district agriculture bureau for use in participatory trials (see above), but most of them failed to adapt to the local environment [9] ↓ Do not conduct variety development and adaptation specific to the district agroecology	↓ Do not produce and distribute early generation seed in the district because commercial seed producers are not present	↓ Do not provide extension and training for DAs and lead farmers to increase awareness on varietal information and agronomic practices	↓ Germination failure of seeds for PVS trials, due to delays in shipments/long shelf life	

Table A1. *Cont.*

Actors (Gindabarat)	Seed Security Features				
	Varietal Suitability and/or Adaptability [1]	**Availability** [2]	**Access** [3]	**Quality** [4]	**Gender, Socioeconomic Status, and Age** [5]
Local traders/markets and seed agents/agrodealers *Traders of grain/seeds including farmers who sell at local markets*	↓ Vendors/traders combine grains from different agroecological areas (lack traceability of source); this sometimes causes crop failure for teff if planted in the wrong agroecology	↑ Bring diversity of grain from different areas to local marketplaces that farmers buy for food grain or seed ↓ Lack of local agrodealers hinders availability of improved seeds	↑ Seeds sold at local markets are easily accessed (close by and timely available) ↓ Wheat seed sold or lent by traders/venders is often expensive due to low availability	↓ Grain/seed sold at local markets generally rated by farmers as poor in terms of germination and purity	↑ Local markets provide poor farmers (e.g., landless youth) access to grain/seeds when they cannot save seeds or consume their saved seeds. This is a last resort, due to poor quality of seed.
Specialized seed producers and farmer organizations/groups *Community Seed Bank (CSB) group, Primary Multipurpose Cooperatives (PMC) and Afoosha* [10]	↑ The CSB group conducts PVS on pools of varieties from the local area, genebank, and other communities to identify varieties suitable for low input farms ↔ Occasionally, the PMCs distribute varieties that are not recommended for the specific local agroecology (e.g., hybrid maize for highland is sold to midland areas)	↑ One CSB group produces limited quantities of local wheat and teff seeds ↔ The PMCs obtain certified seeds from the Ambo Farmers Union, but these often arrive too late and in insufficient quantities ↑ Afoosha maintain grain reserves for local food and seed relief ↓ There are no organized seed producers for improved varieties	↑ The CSB group distributes seeds through a loan system with low interest repaid at harvest (10% in kind/seed) ↑ The PMCs sell certified seeds to users at government price ↑ Afoosha give free seeds to families affected by death or natural calamities	↑ Farmers have positive perception of local seeds produced and communally certified by CSB group ↓ Farmers complain about poor quality of certified seed distributed by PMCs (e.g., hybrid maize and Quncho seeds)	↑ CSB groups and Afoosha offer seeds to poor farmers and households affected by calamities (e.g., widows) ↑ Gender balance in the CSB group allows consideration of women's priorities in seed multiplication (e.g., local barley varieties that were introduced from other areas) ↓ Female household heads have limited access to certified seeds from PMCs that are dominated by men
Non-governmental Organizations/ Development agencies/Inter-governmental organizations *Movement for Ecological Learning and Community Action (MELCA-Ethiopia)* [11]	↑ MELCA trains men and women CSB members on PVS of local varieties to meet diverse environmental and socioeconomic needs	↑ MELCA brings seed/germplasm from the national genebank and other communities for multiplication to increase availability of traditional seeds	↑ MELCA supports seed loan system managed by CSB group (see above) ↓ MELCA's training crop diversification often promote traditional varieties as better varieties than improved varieties	↑ MELCA supports communal seed certification through CSB's seed committee ↑ MELCA supported construction of community seed bank facility for improved seed storage	↑ MELCA supports CSB groups in organizational capacity building including administration, seed, and financial management through balanced representation of different farmer categories (gender, age, and wealth categories)

Table A1. *Cont.*

Actors (Gindabarat)	Seed Security Features				
	Varietal Suitability and/or Adaptability [1]	**Availability** [2]	**Access** [3]	**Quality** [4]	**Gender, Socioeconomic Status, and Age** [5]
Smallholders *Own seed production and social networks*	↑ Farmers verify the varietal suitability of seed provided through social networks (neighbor certification) ↓ Farmers lack sources of new varieties to adapt to declining soil fertility and increasing rust for wheat production	↑ Most farmers produce and save own wheat and teff seeds ↑ Lead farmers save seeds from adaptation trials if they prefer a variety and multiply for their own use and exchange with other farmers ↓ Most landless and poor households do not save enough seeds to meet their needs	↑ Farmers loan (i.e., with interest), sell, or exchange seeds with friends, neighbors, or family ↑ Better-off individuals provide cash loans that are used for seed purchase ↓ The custom of seed gift is abandoned	↑ Farmers perceive quality of own seeds as good ↑ Farmers maintain varietal purity of high-yielding improved teff through appropriate selection and seed handling ↓ Occasionally untimely rain combined with lack of good storage facility cause damages in household seed stocks	↔ Social networks and moneylenders help landless and poor households to access seeds on credit, but interest rates are high, making repayment difficult. ↑ Younger farmers often access an improved teff variety through social networks to increase productivity on small landholdings ↓ Most lead farmers are men, limiting women's access to new varieties
Others not active in Gindabarat	The following seed sector actors are not active in Gindabarat: Regulatory bodies (Ambo seed quality control and certification laboratory of the Oromia Agricultural input regulatory authority); International research (e.g., CIMMYT, ISSD); Public/private seed sector (Ethiopian Seed Enterprise/ESE, Oromia Seed Enterprise/OSE and commercial private farms); and Private sector processors (e.g., private small-scale milling)				
Actors (Heexosa)	**Varietal Suitability and/or Adaptability**	**Availability**	**Access**	**Quality**	**Gender, Socio-Economic Status and Age**
Local government decision makers/experts *District bureau of agriculture*	↑ Conduct participatory variety adaptation trials of new varieties together with farmers under different input packages and agronomic practices at FTC ↑ Recognize and support PVS of traditional varieties in marginal areas (e.g., higher elevations)	↑ Support market-led seed supply to increase availability of certified seeds and locally produced quality declared seeds (QDS) ↓ Supported seed agents and cooperatives to get certificate of competence from the Regional Bureau of Agriculture for direct seed marketing of certified seeds to farmers and effective distribution ↑ Collect demand from farmers and determine quantity of required certified seeds ↑ Support CSB seed production to increase seed supply through farmer training ↓ Did not establish seed reserve for seed system resilience in cases of disaster	↑ Determine share of certified seeds for peasant associations, enforce government prices, and support PMCs during seed distribution ↑ Conduct field demonstration and seed fairs (field days) to increase awareness and information on new seed varieties and their characteristics ↓ Despite weak evidence, the extension often promotes improved varieties as superior varieties for yield and disease resistance and discourage use of traditional varieties	↑ Monitor farmers involved in the production of certified seeds and seeds for the CSB for implementation of good agronomic practices [12] ↑ Collect data from farmers and report events of poor performance due to low seed quality of certified seeds to regional bureau of agriculture to enforce commercial guarantee[13] and settle disputes	↔ Support women's participation in seed producer cooperatives and trainings, but limited to women household heads ↑ Encouraged and recruited women household heads as model farmers

Table A1. *Cont.*

Actors (Heexosa)	Varietal Suitability and/or Adaptability	Availability	Access	Quality	Gender, Socio-Economic Status and Age
Regulatory bodies *Asella seed quality control and certification laboratory of the Oromia Agricultural input regulatory authority*		↓ Strict certification and rejection of seeds produced by contract cluster groups and individual farmers reduced availability of certified seeds to some extent, but limited sales inspection allowed seed sellers to supply rejected seeds though sometimes adulterated		↓ Inadequate human resources to conduct field inspection at all seed production stages and limited laboratory facilities and testing protocols to conduct quality tests of all seeds from producers' plots contributing to ineffective seed certification ↑ Provide training for organized producers on quality seed production and management	↑ Provide technical training on seed production, processing, and storage for internal seed quality control committee of seed producers, including female members
National/regional research *Kulumsa agricultural research center (KARC) and Asella Agricultural Engineering Research Center (AAERC)*	↑ Since its establishment, KARC has produced about 70 wheat varieties [2] with different merits and conducted adaptation trials in collaboration with agriculture bureau at FTCs and on farmers' plots to ensure suitability to farmers' environmental and socioeconomic conditions ↓ Disease-resistant wheat varieties are generally lacking, and production is impossible without pesticides ↓ Variety replacement rate is low due to slow release of new varieties and low seed multiplication of released varieties	↑ KARC produces EGS and makes these available for public seed enterprises, unions, and SPCs ↓ However, not enough quantity EGS are produced and made available for the multiplication of successive generations of seeds (e.g., certified seeds) by seed producers	↑ KARC supports field demonstration and extension to increase awareness of farmers and development agents on varietal information and good agronomic practices ↓ Lack of strong unit in agricultural research is the cause for weak coordination for sustainable EGS access and supply and loose responsibility of EGS multiplication	↑ KARC conducts internal quality control of its EGS before distribution for adaptation trial and multiplication ↓ Poor quality of EGS is sometimes delivered due to limited human resources, equipment, and infrastructure ↑ AAERC provides training in pre-harvest, harvest, and post-harvest technologies (e.g., cleaning combines to avoid varietal mixture)	↑ KARC involves some female household heads in variety testing and adaptation trials
International research *CIMMYT*	↑ CIMMYT brings advanced lines of wheat seed samples from other countries for the testing and identification of adaptable variety ↑ Together with KARC, CIMMYT develops disease-resistant wheat varieties ↓ CIMMYT does not work on teff	↑ CIMMYT provides support to KARC for the multiplication of large quantity of EGS	↑ CIMMYT organizes exposure visits for farmers, development agents, and entrepreneurs to increase awareness about new varieties	↑ CIMMYT ensures the seed samples it imports are free from quarantine pests	↑ CIMMYT provides training of trainers and researchers on gender issues for mainstreaming in crop improvement research

Table A1. *Cont.*

Actors (**Heexosa**)	Varietal Suitability and/or Adaptability	Availability	Access	Quality	Gender, Socio-Economic Status and Age
Local traders/markets *Traders of grain/seeds including farmers who sell at local markets*	↑ Recycled wheat variety from midland areas is perceived by farmers to have better yield and disease resistance in highland agroecological conditions and vice versa	↑ Bring large quantities of grain/recycled or traditional seeds from all agroecological areas and make these available at local markets	↑ Grain/seed sold by traders/vendors is easily accessible (nearby) ↓ Seed sold or lent by traders/vendors is expensive (especially teff)	↓ Seed purchased from traders/venders is not quality controlled and generally perceived by farmers as having poor quality	↑ Local markets provide poor farmers access to grain/seeds when they cannot save seeds or consume their saved seeds. This is a last resort, due to poor quality of seed.
Public/private seed sector *Ethiopian Seed Enterprise/ESE, Oromia Seed Enterprise/OSE and Seed agent/agrodealers*	↓ Sometimes, wrong varieties are distributed in wrong agroecological areas	↔ The seed enterprises produce and supply most of certified seeds via government-controlled distribution channels, but quantities are insufficient (especially teff) and distribution is often delayed ↔ The seed enterprises also produce and supply EGS to other seed producers, but quantities are insufficient ↑ Recent increase in number of seed agents improved availability of certified seeds in wider coverage of agro-ecologies ↑ Prioritize seed supply to severely seed insecure areas when disaster hits	↓ High price discourages farmers from using certified seeds ↑ Recent contract-based direct seed marketing (DSM) through seed agents has increased timely supply within easy reach, but the agents sometimes increase the price against the agreement and make it unaffordable for the poor ↓ The involvement of the private sector that sells seed is generally limited ↓ EOSAs often promote traditional varieties as better varieties than improved varieties	↔ Supply certified seeds but sometimes quality fails to meet the required standards, especially for carryover seeds ↑ Train contract cluster groups and members of seed producer cooperatives in quality seed production and management as well as agronomic practices in wheat production ↓ Seed agents lack good storage facility for temporary stocking until they sell seeds or return leftover seeds, which sometimes affect quality	
Specialized seed producers and farmer organizations/groups *Seed Producer Cooperatives (SPCs), Community Seed Bank (CSB) groups and Individual out-growers*	↑ SPCs produce seeds of many preferred and adapted crops and varieties (e.g., self-pollinated, high-yielding, and marketable cereals and legumes) that were not easily available through the public seed enterprises in the past ↑ CSB groups conduct PVS and produce seeds of locally preferred varieties for low-input farms (especially in high-elevation areas) ↑ SPCs and CSBs are in the center of the farmers' village and know their customers in terms of varietal suitability to the agroecology and availability and affordable price	↑ SPCs and individual out-growers produce large quantities of seeds locally or within easy reach ↔ PMCs receive seeds from Heexosa Farmers Union but in insufficient quantities ↓ No organized group of farmers produce teff seeds	↑ Seed producer farmers/out-growers can keep enough seeds (up to 15%) for own use ↑ Seed price is lower than the prices of public/private companies ↑ SPCs are in the center of the farmers' village and set seed prices that their customers can afford ↑ CSB gives seed loan that is paid with low interest (10% in kind/seed)	↑ Farmers have positive perception of seeds produced by SPCs and communally certified by internal seed quality control Committee of SPCs and CSB ↓ SPCs lack a seed cleaner machine, mini seed laboratory equipment such as moisture testers, and germination Petri dishes for seed quality checks ↓ Experts see farmers' confidence in their long agriculture experience as a guarantee for their capacity to control seed quality, instead of using skilled personnel and establishing laboratory facility, as the cause for sporadic poor seed quality produced by SPCs	↑ Cooperatives support to farmers in provision of basic seed, training, and supervision through linking farmers with research institutions and input, and service providers emphasize women participation ↓ However, the number of women members in SPCs is very low

Table A1. *Cont.*

Actors (**Heexosa**)	Varietal Suitability and/or Adaptability	Availability	Access	Quality	Gender, Socio-Economic Status and Age
Non-governmental Organizations/ Development agencies/Inter-governmental organizations *USAID, FAO, Hunde Oromia and Ethio-organic seed action (EOSA) and ISSD Programme*	↑ EOSA brings seed/germplasm from other communities and the national genebank and conducts PVS of local and improved varieties to meet diverse environmental and socioeconomic needs in marginal areas ↑ ISSD introduced an innovative approach called crowdsourcing and participatory variety selection that aims to outsource multiple improved and farmers' preferred varieties of different crops to many volunteer farmers who are willing to grow and share the selected variety in their locality	↑ FAO, USAID, and Hunde provide seed aid when disaster hits and support seed multiplication ↑ EOSA supports CSB group to multiply traditional seeds/varieties selected through PVS ↑ ISSD provides financial and technical support to agricultural research (mainly regional) and OSE in contract-based multiplication of a large quantity of EGS ↑ ISSD provides financial, technical, and administrative support to increase the number and capacity of SPCs and seed agents for the production and distribution of large quantities of self-pollinating crop varieties that are neglected by public seed enterprises and private companies	↑ USAID, FAO, and Hunde provide vouchers to assist resource-poor households to access seeds according to their needs ↑ EOSA supports the CSB group in administering seed loans (see above) ↑ ISSD supports linkage between SPCs and financial institutions for credit as well as EGS sourcing institutions to increase SPC's access to pre-basic and basic seeds ↑ ISSD promotes small seed pack sizes based on the average land size that smallholders cultivate for each crop to increase access to required quantities of seeds at affordable prices	↑ FAO, USAID, and Hunde distribute certified, and quality declared seeds ↑ EOSA supports communal seed certification through seed farmer committee ↑ EOSA trains CSB members on crop diversification, good quality seed production, and storage ↑ ISSD supports training of SPC members on clustering, isolation, field management, and roughing to remove off types as well as seed value addition (cleaning, grading, treating, packaging, and labeling) to increase quality through technical training, exchange visits, resource mobilization, and linking them with service providers (e.g., credit institution for purchase of processing machines and seed labs for coaching)	↑ EOSA also trains farmers in organizational governance and women participation to ensure sustainability ↑ ISSD promotes gender-sensitive crop and varietal preference for deployment in its crowdsourcing and PVS activities
Private sector processors *Heexosa Multipurpose Union and private small-scale milling factories*	↓ Sometimes, the Union distributes certain varieties to areas for which there is no demand ↓ Sometimes, the Union distributes seeds to the wrong agroecologies	↑ The Union procures certified seeds from SPCs, ESE, OSE, and private seed companies for distribution through its PMCs ↓ PMCs do not participate in seed demand assessment and depend on unrealistic data collected by extension agents and wrong quota allocation, which restricts seed supply/availability	↑ The Union collects seeds and transports to selling points ↑ The Union and private small-scale milling factory purchases grains for milling at a reasonable price from primary cooperatives, allowing farmers to get income to purchase seeds for the upcoming planting season	↓ Sometimes, the Union distributes untraceable poor-quality seeds (including carryover seeds without laboratory seed tests) due to lack of accountability and transparency in the conventional seed distribution system	↑ The Union trains cooperative members including women and youth on business management ↑ Provides benefit for male and female household heads through agro-commodities procurement

Table A1. *Cont.*

Actors (Heexosa)	Varietal Suitability and/or Adaptability	Availability	Access	Quality	Gender, Socio-Economic Status and Age
Smallholder farmers *Own seed production and social networks*	↑ Own produced seed of recycled/traditional varieties is comparable in productivity compared with certified seeds ↓ Farmers lack new disease-resistant wheat varieties ↓ Low productivity/high labor demand of teff varieties causes most farmers to abandon its cultivation	↑ Most farmers produce and save own seeds ↑ Farmers save seeds from adaptation trials organized by district bureau of agriculture or CIMMYT for own use ↓ Some poor and landless households do not save enough seeds to meet their needs ↓ As secondary crop, few farmers grow teff, and its seed is not available in many villages	↑ Seeds sold by trusted farmers (e.g., neighbors) are close and affordable ↑ Farmers loan (i.e., with interest), sell, or exchange seeds with friends, neighbors, or family or provide cash loans for seed purchase ↑ Rich farmers often access new seeds, and they multiply and sell their produce as seeds to other farmers ↓ The custom of seed gift is absent	↑ Farmers perceive quality of own seeds, and those purchased/exchanged from fellow farmers, as good (known quality, neighbor certification) ↑ Most farmers use pesticides and recommended polypropylene bags to store wheat seed for one season	Farmers see high seed insecurity among landless and poor households in lowland areas Farmers who do not save their own seeds mostly depend on local exchange or purchase recycled improved seeds locally

[1] Varietal traits meet farmers' preferences including adaptation to local environment and production conditions, market demand, culinary and cultural needs, livestock feed, construction, and soil fertilization. [2] Physical existence of desired seeds in enough quantity in a reasonable proximity (spatial availability) for critical sowing periods (temporal availability). [3] Means to acquire seeds such as cash, credit, social network, and transportation with affordability and awareness/information. [4] Seed is healthy (free from disease/pest), has good physical qualities (not broken/cracked/shriveled), has good genetic and physiological qualities (good germination, optimum moisture content, genetic purity, and vigor), free from weeds and poses preferred color/size/shape/taste. [5] Impacts on seed security by gender, socioeconomic status, and age (cross-cutting). [6] Commercial guarantee: obtained from purchased seed usually bought locally from known seed dealer and oral, commercial, and often legal assurance is given. [7] Known quality: obtained from on-farm saved seed; 'neighbor certification': obtained from seed saved by family members and neighbors on trust. [8] A seed agent is an individual or institutions who sell seed to farmers on behalf of seed producer/s. They should acquire certificate of competence (CoC) from the government based on the requirements in the 2018 COC directive No.2/2010. The seeds are sold at a fixed producer price and commission is based on the amount sold. [9] In the last decade, only three teff varieties (Quncho, Kora and Guduru) and two wheat varieties (Digelu and Hidase) have been adapted to the environment and are liked by farmers. [10] Afoosha is an indigenous local social institution established in most communities in Ethiopia to provide financial and other types of support when a family member dies. In Gindabarat, we found that Afoosha groups have established grain reserves in most peasant associations to support poor families affected by calamities; these reserves are increasingly used as seed by those affected. [11] MELCA-Ethiopia is a local NGO supported by the Development Fund of Norway. [12] Soil use and fertility management (e.g., fertilizer application), crop rotation, row planting, recommended distance between plots per species, and crop protection. [13] Commercial guarantee: obtained from purchased seed usually bought locally from known seed dealer, and oral, commercial, and often legal assurance is given.

The Agronomy Editorial Office would like to apologize for any inconvenience caused to the readers by these changes. The changes do not affect the scientific results. The published version will be updated on the article webpage with a reference to this Erratum.

References

1. Mulesa, T.H.; Dalle, S.P.; Makate, C.; Haug, R.; Westengen, O.T. Pluralistic Seed System Development: A Path to Seed Security? *Agronomy* **2021**, *11*, 372. [CrossRef]
2. MoA. *Transforming the Ethiopian Seed Sector: Issues and Strategies*; Ministry of Agriculture (MoA): Addis Ababa, Ethiopia, 2019; p. 44.