Annual Report 2016



"If your life's work can be accomplished in your lifetime, you're not thinking big enough."

WES JACKSON





About The Land Institute

The Land Institute, founded in 1976, is a nonprofit 501(c)(3) research and education organization funded by charitable contributions from individuals, families, organizations and private foundations.

Our scientists are developing perennial grain species to be grown in diverse mixtures that will require less fossil fuel, conserve soil and water, and weather the droughts and deluges that will become more frequent with climate change.

2016 marks the 40th anniversary of The Land Institute.

Over the last 40 years Wes Jackson (pictured at left with Wendell Berry in the mid-1980s) and a loyal team of scientists, interns, volunteers, and supporters have proven out "the necessity and possibility of an agriculture where nature is the measure." Based on perennial grain crops grown in ecologically diverse mixtures, Natural Systems Agriculture holds the promise of combining the ecological stability of native ecosystems with the grain and oilseed yield needed to provide ample food for people.

Today, The Land Institute is at the center of a global effort to develop perennial grain agriculture, with research now being undertaken on six continents and 37 countries. We have over 30 people working on the ground in Salina, Kansas including nine PhD scientists. There are an additional 18 post-graduate fellows and graduate students at seven institutions nationally. All are working toward agricultural ecosystems based on diverse perennial grains. Kernza[®] perennial grain, developed at The Land Institute, has found its way into consumer food products at a small scale. In a year of celebration and executive transition, we know one thing: our work is bigger than any one of us.

On October 1, 2016 we welcomed Fred lutzi as our new president and he is proving himself fit to harness the achievements and momentum of the last 40 years to a course for the next 40. As Chief Operating Officer, I have the great pleasure of working closely with Fred and with Director of Research Tim Crews to steward and grow the mission of The Land Institute.

The continuity of our work honors the ongoing support of our established circle of friends, while our progress and successes widen the appeal of our work and engage a new generation of supporters.

In the following report, you'll find highlights from the 2016 fiscal year, which ran July 1, 2015 to June 30, 2016. Our financial outlook remains strong, we carry almost no debt, and we remain confident that we can continue to fund growth opportunities for our work. All of this is made possible by your support. Please accept our deepest gratitude, and our invitation for your continued interest. Reflecting on Wes's quote above, I remain confident that the work of The Land Institute is "big enough" to last my lifetime.

Perennially,

NSER

Rachel Stroer CHIEF OPERATING OFFICER The Land Institute



Summary Statement of Financial Position

	FY 2016	FY 2015
Assets	17,612,949	17,207,224
Liabilities	116,197	256,488
Net Assets	17,496,752	16,950,736

Revenue



TOTAL	4,175,398
Other Revenue 2%	75,698
Foundations 73%	3,070,815
Individuals 25%	1,030,312

Expenses



OTAL	3,629,382
Fundraising 14%	513,303
Management 10%	349,389
Programs 76%	2,766,690

LEADERSHIP AS OF 6/30/16

Wes Jackson PRESIDENT Tim Crews DIRECTOR OF RESEARCH Rachel Stroer CHIEF OPERATING OFFICER Scott Seirer MANAGING DIRECTOR Jayne Norlin DIRECTOR OF INSTITUTIONAL ADVANCEMENT

BOARD OF DIRECTORS AS OF 6/30/16

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Research to transform agriculture



Intermediate Wheatgrass Genome Assembly and Sequence Near Completion

n 2016, the sequencing and assembly of the majority of the intermediate wheatgrass (IWG) genome was begun, a huge task accomplished in partnership with Jesse Poland (Kansas State University), HudsonAlpha Institute for Biotechnology (Huntsville, AL), and the U.S. Department of Energy's Joint Genome Institute. It was paid for in part by the Perennial Agriculture Project. As Land Institute researcher Lee DeHaan notes, having a draft genome sequence for a species has become roughly equivalent to having a dictionary on hand when beginning to learn a new language. Conventional breeding is possible without it, but having a genome sequence as a reference can greatly expedite progress. Our long-term breeding strategy includes sequencing the genomes of promising wild grain, oilseed and legume candidates. The IWG genome constitutes an important benchmark toward that strategic goal.

Perennial Legume Research Begins

A perennial legume breeding program was added to our research lineup. Dr. Brandon Schlautman joined the team as the lead scientist for this program. He is focused on evaluating promising perennial legume candidates and determining corresponding breeding approaches. Integrating a legume crop with other perennial grain species would be major step toward fulfillment of our ecological intensification research objectives.





Post-Harvest Processing Facility Complete

Our 5,000 square foot post-harvest processing facility was completed, allowing our staff to safely complete important seed threshing, dehulling, sample handling, and grain milling tasks in climate-controlled conditions. The building also provides needed office space for technicians, visiting students and researchers.



Kernza[®] Perennial Grain Commercialization Begins

For the first time in the 40-year history of the organization we are engaged in pre-commercialization of a perennial grain crop developed at The Land Institute. Our Kernza perennial grain — from IWG we are domesticating — is increasingly popular in niche markets and with farmers. Commercialization of any new grain requires coordination all the way from the research to the farm to the plate. Farmers must be coached on how to plant, manage and harvest the grain, millers have to understand how to clean and mill the seed, and bakers, and brewers and chefs have to experiment with how to feed the grain to consumers. To ensure our scientists are not overwhelmed by the demands of commercialization we entered into a contract with Plovgh (pronounced Plow) to help us manage the process. The team at Plovgh recruits and coaches farmers, and connects them with buyers nationwide.

Gorrill Farm Research Station Expands Ecological Intensification Research

The Gorrill Farm Research Station came to life in 2016. Located in Lawrence, KS, it is home to a significant expansion of ecological intensification research underwritten by the Perennial Agriculture Project. Ecological intensification focuses on identifying and incorporating ecological processes that can take the place of inputs like fertilizers or pesticides. KU ecology faculty members Jim Bever and Peggy Schultz live on-site and serve as research coordinators. Laura Kemp, former Land Institute ecology technician in Salina has taken on the new role of Research Station manager. The Gorrill Farm Research Station is being used by three post-doc research fellows from the University of Kansas, conducting experiments at this site. A fully-equipped field station laboratory is planned for 2017.

New Leadership Roles at The Land Institute

n 2016 we successfully transitioned our leadership from founder and president Wes Jackson to new president Fred lutzi. Being raised on a farm inspired lutzi to pursue a career focused on the sustainability of agriculture and rural communities. A former Land Institute graduate research fellow, his extensive experience includes research, public outreach and administration, most recently as manager of agriculture, energy and cooperative development programs for Western Illinois University's Illinois Institute for Rural Affairs.

Managing Director Scott Seirer retired October 1st, 2016 after five years with The Land Institute. A newly-created Chief Operating Officer position facilitated this transition by effectively aligning administrative and development management as well as improving coordination with the research team. Filling the position is Rachel Stroer, an existing senior leader at The Land Institute who brings strong experience in project management and strategic planning.



PROGRAM UPDATES

Progress continues toward a Natural Systems Agriculture

Kernza[®] Intermediate Wheatgrass



• We initiated the sixth cycle of Kernza perennial grain breeding at The Land Institute. This involved expanding the breeding population to include about 24,000 individuals. We will be using molecular markers and new breeding techniques to help us accurately make selections out of this huge number of individuals without having to take measurements on every plant.

• We increased the number of plants we believe will produce the first Kernza seed variety released by The Land Institute for general use on farms. Although not yet harvested, we expect to find this variety will not drop its seed prior to harvest (be non-shattering), will thresh freely, and will have a seed size about twice as large as previously available types.

Perennial Wheat



- We used 1,500 plants in the greenhouse to create 200 new hybrids by pairing annual winter durum with perennial IWG. This is a promising method for increasing the longevity of perennial wheat. We also created additional seed for 20 perennial wheat lines for further testing in 7 countries.
- We had many indicators of progress in our perennial wheat plots with several surviving three successive Kansas winters. We hoped to find numerous plots that demonstrated strong regrowth, high grain yield, and free threshability — and we did. In addition, some of the single heads were more similar to annual wheat in their head shape, seed weight, and free threshability. Breeding lines from these plots will be advanced for further selection and evaluation in 2017.

Silphium Oilseed



- We planted major silphium trials in 2 completely new locations: Uruguay and Minnesota. These represented an expansion of the range of our breeding population to both higher and lower latitudes, which corresponds to major differences in growing season length and day-length. We are beginning to develop "races" of silphium that are adapted to different agricultural regions.
- We developed new populations for genetic mapping, population genetics, and allele discovery. We made the crosses in Kansas to provide the starting materials for our collaborators in Minnesota and North Dakota.

Sorghum



- We developed new, unique populations from hybridization between grain sorghum (Sorghum bicolor) and perennial Sorghum halepense collected from near the northern limits of that species' range. The long-term goal is to select from these populations breeding lines with very good cold tolerance and winter survival.
- We identified for the first time DNA markers in Sorghum bicolor X Sorghum halepense crosses linked to genes affecting perenniality, grain size, and grain yield. The goal is to use such markers to improve the efficiency of the breeding work.
- We selected productive breeding lines that produced rhizomes (underground stems) in field trials in Salina, Kansas and College Station, Texas. The goal is to send seed of the best lines for testing in tropical sub-Saharan Africa, including Uganda and Mali, with the eventual goal of developing perennial sorghum for that continent.

Agroecology



- We measured net nitrogen mineralization in 3 year-old plot treatments that included unfertilized Kernza[®] monocultures, fertilized Kernza monocultures, and unfertilized Kernza-alfalfa intercrop arrangements. The expectation was that nitrogen fixation by alfalfa over 3 growing seasons would enhance the rapidly cycling soil nitrogen pool in the intercropped plots. We found the Kernza did respond to the enhanced nitrogen in the intercrop, resulting in a yield between the unfertilized mono-cropped Kernza plots, and those in plots fertilized with synthetic N.
- Nitrous oxide trace gases were measured in fertilized and unfertilized plots of native prairie. We hypothesize that the high soil carbon content will allow microbes to take up soil nitrogen and prevent it from converting to the potent greenhouse gas nitrous oxide.
- We began the first year of a multi-site, multi-year study in which Kernza is mowed during its vegetative states at different times of the year to simulate livestock grazing. Grain production was measured in all mowing treatments to determine whether Kernza yields are influenced by the extent and timing of livestock grazing.

Selected Presentations

SEPTEMBER 2015

Land and Soil Issues in Africa — Disturbance, Succession and the Promise of Ecological Intensification *Presented by Tim Crews* | Perennial Grains for West Africa Meeting, hosted by the FAO and ICRISAT | BAMAKO, MALI

OCTOBER 2015

Rethinking the Future of Food *Presented by Phenoa Nabukalu* | James Beard Conference Panel Discussion | NEW YORK, NY

NOVEMBER 2015

Research in Perennial Grains *Presented by Lee DeHaan* | American Society of Agronomy meeting | MINNEAPOLIS, MN

DECEMBER 2015

Intermediate Wheatgrass and Legume Intercropping

Presented by Tim Crews | Geography and Atmospheric Sciences seminar series | LAWRENCE, KS

JANUARY 2016

Ecological Intensification: Going Where No Grains Have Gone Before *Presented by Tim Crews* | Transitioning to Sustainability Conference. Saskatchewan Soil Conservation Association | SASKATOON, SASKATCHEWAN

FEBRUARY 2016

Research Seminar *Presented by Tim Crews* | St. Louis University | ST. LOUIS, MO

MARCH 2016

Perennial Grain Crops for Sustainable Food Production in the Midwest *Presented by Lee DeHaan* | Global Agriculture Summit | SIOUX CENTER, IA

APRIL 2016

Achieving New Levels of Ecological Intensification Through the Development of Perennial Grain Crops and Intercrops Presented by Tim Crews | Swedish Agricultural University Cropping Systems Ecology Seminar Series | ALNARP, SWEDEN

Selected Publications

Response to Selection in the Initial Stages of a Perennial Sorghum Breeding Program | P. Nabukalu & S. Cox | 2016 | *Euphytica* 209:103-111

A Pipeline Strategy for Grain Crop Domestication | L. DeHaan, D.V. Van Tassel, J.A. Anderson, S. Asselin, R. Barnes, G. Baute, D. Cattani, S. Culman, D. Dorn, B. Hulke, M. Kantar, S. Larson, M. Marks, A. Miller, J. Poland, D. Ravetta, E. Rude, M. Ryan, D. Wyse, X. Zhang | 2015 | *Crop Science* 56:917-930

Nitrogen Limitation Disappears with Succession in Many Lowland Tropical Rainforests—as Expected. Why the Persistence in Temperate Latitudes? | T.E. Crews | 2016 | New Phytologist 209:891-893

The Strong Perennial Vision: A Response | T.E. Crews and L. R. DeHaan | 2015 | *Agroecology and Sustainable Food Systems* 39:500-515

Going Where no Grains Have Gone Before: From Early to Mid-Succession | T.E. Crews, J. Blesh, S.W. Culman, R.C. Hayes, E. Steen Jensen, M.C. Mack, M.B. Peoples, M.E. Schipanski | 2016 | Agriculture Ecosystems and Environment 223:223-238

Toward the Rapid Domestication of Perennial Grains: Developing Genetic and Genomic Resources for Intermediate Wheatgrass | T. Kantarski, L. DeHaan, J. Poland, J. Borevitz | pp. 227-242 in Applied Mathematics and Omics to Assess Crop Genetic Resources for Climate Change Adaptive Traits | 2016 | CRC Press

Genome Evolution of Intermediate Wheatgrass as Revealed by EST-SSR Markers Developed from its Three Progenitor Diploid Species | R.R.C. Wang, S.R. Larson, K.B. Jensen, B.S. Bushman, L.R. DeHaan, S. Wang | 2015 | *Genome* 58:63-70



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