

# The Physics of Threshing Pearl Millet: Finding a Revolutionary\* Solution to an Ancient Problem



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## The meta-problem

- The base of the “economic pyramid” (BoP) consists of ~4 billion people earning <\$2/day.
- The BoP is the largest emerging market.
- Growing numbers of students are eager to learn about and work in this sector.
- Conventional education focuses on the ToP.
- New programs like MIT’s IDDS and D-Lab, Caltech’s E105, and others are starting to address this educational opportunity.



## The pearl millet challenge



75% of pearl millet grown in Namibia is threshed manually.

Pearl millet is a staple grain for millions of poor Africans and Indians.



Manual threshing is painful, tedious, and produces dirty grain.

**Problem statement:** How do we design and develop a \$20, 10kg/hr millet thresher suitable for local manufacture and sale in Africa and India?

## The Revolutionary Solution

- We discovered that 1-10 m/s impact on the grains, directed toward the panicle tip, knock off grains, and leave the florets on the stalk.
- Spoke nuts on a flattened bicycle wheel can make a simple & efficient pearl millet thresher.
- Our thresher is being tested in Africa, and will be displayed in the National Design Museum of the Smithsonian Institution.



\* literally



# Pearl Millet: Technical Highlights

## The challenge



Stalk

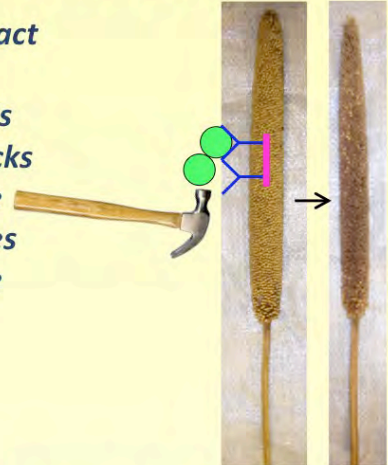
Florets

Grain

*Pearl millet has a complex structure that is more difficult to thresh than other grains.*

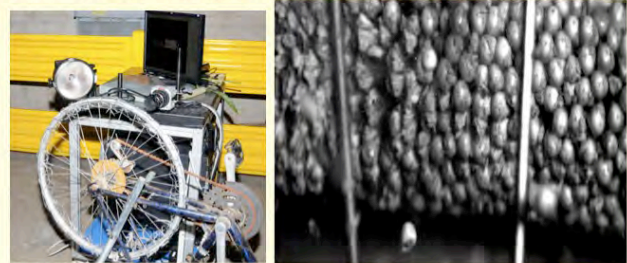
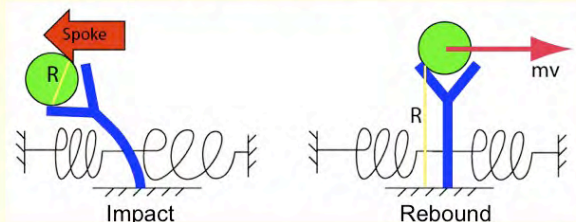
## The breakthrough

*High-speed impact on each grain, directed towards panicle tip, knocks the grain off the floret and leaves the floret on the stalk.*



## Work at C.S.U. Channel Islands

- Improved thresher design: we designed a simpler bike support using just 4 hose clamps and two bent pipes.
- Understand threshing physics: filming threshing with a 2000 frame/second video camera and 1/8000 sec exposure revealed:
  - the millet's motion is highly damped (no resonances or accumulated energy)
  - grain often flies off on the rebound from impact, suggesting the dynamics below:



Video at [www.millet.wetpaint.com](http://www.millet.wetpaint.com) & youtube

## Next steps

- The bike thresher is being tested in Mali.
- Explore new designs of the grain collector and a multi-user thresher.
- Expand field studies, with stronger social science emphasis.

## Acknowledgements

- Samuel Hewatt & Luis Contreras, CSUCI
- Mike Johnson & Chuck Li, Amgen
- Donna Cohn, Hampshire College
- Francisco Rodriguez, Mali Biocarcurant
- Amy Smith, MIT
- Michelle Marincel (USA), George Yaw Obeng (Ghana), Thalia Konaris (Cyprus)



First field trial in Oankoro, Mopti, Mali ("Dogon Country").