



An Electric Two-Wheel Tractor for empowering small-scale farmers in developing regions and economies



In sponsored
collaboration with

Atlas Copco

Background

Master's Thesis Project

To **improve the future of agriculture for small scale farmers** in developing regions and economies.

Context

Predictions for the world in **2050** show us facing the critical issue of **“the Forthcoming Global Crisis in Agriculture”**.

Global Trends and the Future of Agriculture

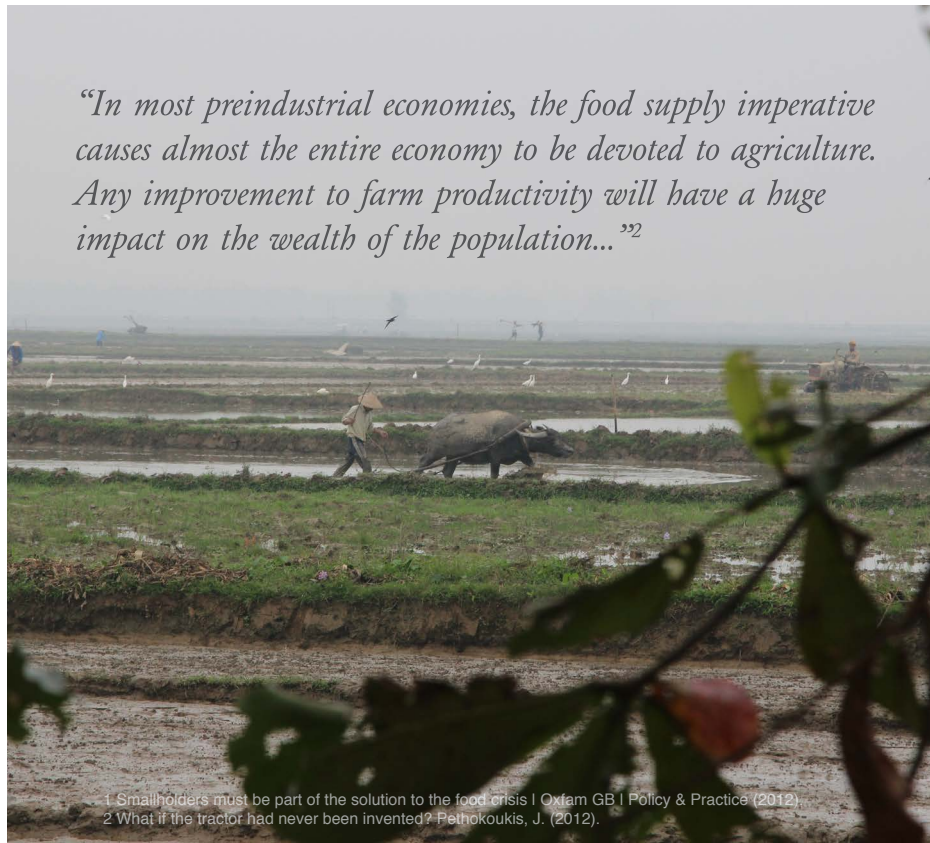
- **Increasing Agricultural Demand:** population growth; rising affluence; conversion of food crops to biofuels.
- **Increasing Production Challenges:** extreme soil erosion; increasing water shortages; rising global temperatures; extreme weather events.
- Production yields in the developed world have started to plateau; in some countries have even started to decline.



Focus and Research

Small Scale Agriculture

- Globally, over 500 million smallholder farmers, fishers, and agro-foresters supply food, fuel, and fibre to almost 2 billion of the poorest and most vulnerable people.¹
- Initial research showed Brazil having great potential for improvements in small scale agriculture.



Research Field Trip to Brazil

- 1 week long research trip with field visits and first hand observations with small scale farmers in rural São Paulo state.
- Planned through *Bonsucro*; organized in collaboration with *WWF USA*.



Identifying a Product Design Opportunity

Failing, Learning, Correcting

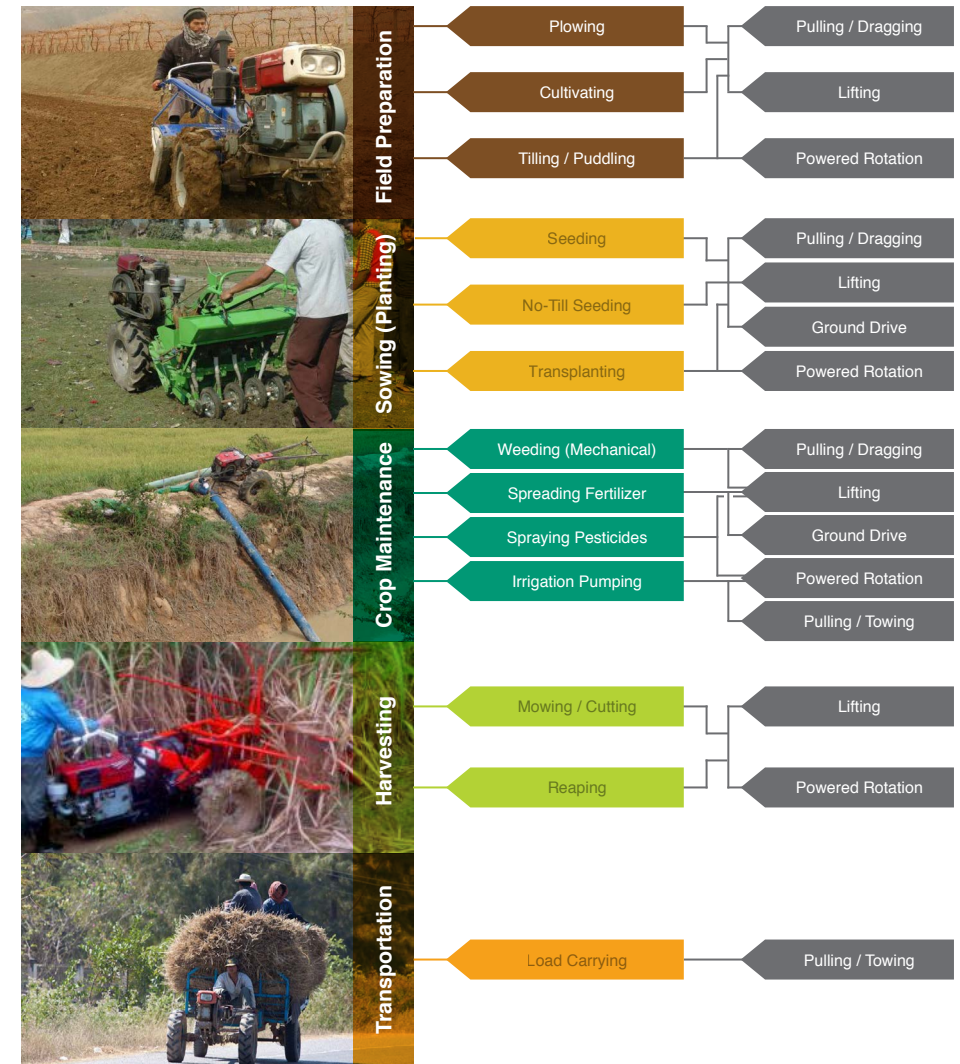
- Visiting primarily sugarcane farms, and not real small scale farms meant not identifying a strong design problem.
- Sponsor feedback helped re-evaluate the project focus.
- Re-examining problems and observations so far quickly revealed a product design opportunity to focus on.



A Better Two-Wheel Tractor for Small-Scale Agriculture

- A prevalent tool with room for improvement; two-wheel tractors are a prime means of bettering productivity and quality of life for small scale farmers.
- No time or budget left for another field trip at this point.
- Analysis, understanding, and evaluation done through tutoring, research, 2nd hand experiences, group brainstorming, scenario mapping, user testing.

Product Analysis: Mapping Critical Apps & Basic Functions



Connecting the Dots

Safety Concerns

- Traffic accidents associated with: braking; steering; nighttime visibility; driver experience level.
- Exposed moving components: flywheels, pulleys, safety shields being removed.



Ergonomic Issues

- RSI from vibrations of single cylinder engines.
- Noise exposure.
- Physical strength required to lift/tilt and operate the tractor.



Going Electric in Commercial Agriculture

- Developments in electric powered implements highlight their benefits.
- Hybrid and electric tractors are being developed and tested.



Countries Shifting to Electric

- Developing regions like South Asia show a strong drive to convert to electrical transportation.

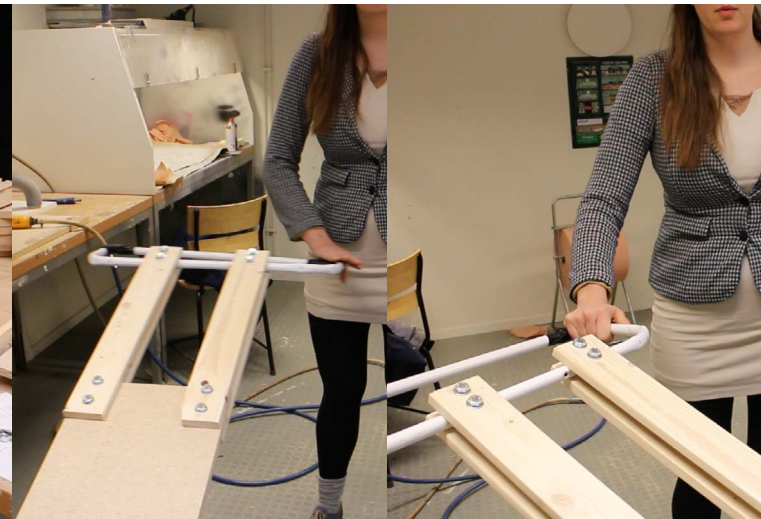


Electricity and Development

- Increased implementation of micro-power generation in decentralized, remote locations in developing regions.
- Increased energy storage capacity could be a boon for residents.



Rough Mock-Up Testing & User Feedback



Final Design

Greater Flexibility/Adaptability

- Farmers adapt the tractor to their needs; rather than adjust to it's limitations.

Safer & More Inclusive

- Height adjustability for different needs.
- Easier and safer wheel changing.
- Reduced physical demands for operation, making it more inclusive for both genders.

Electric Power

- Electric motors reduce noise and vibrations.
- Hub motors place weight where it is needed and allow for skid-steer operation.
- Combined with micro-energy production (solar/wind), allows fuel independence and extra energy storage.



Wheel Changing & Bogies



Road wheels are used to get to fields



Wheels are changed on the side of the road



Paddle wheels are used in muddy fields

Many tractor wheels feature bolt-on split rims; allowing variability.

Snap-on connectors are commonly used for tractor duals.

Simple pump action hydraulic jacks are reliable for lifting heavy objects.



- Height adjustable bogies make wheel changing quicker and safer by lowering the tractor to the ground.
- Wheel hub motors detach quickly from rims.
- Changing to paddle wheels, or other options becomes easier.

Versatility and Adaptability

- Tractor frame with bolt-on joints forms a platform for hacking.
- Adds functionality, flexibility, and adaptability.



