Low Cost Soil Diagnostics

Providing farmers with actionable soil health data

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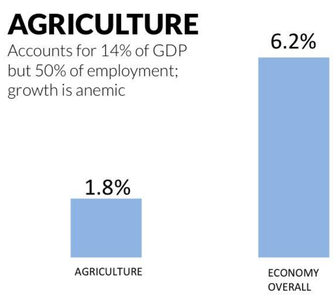
Opportunity

Rural Indian farmers suffer from **critically low crop yields**, resulting in low growth in the agriculture sector respectively to the rest of the economy.
There exists a need for **actionable, affordable, usable, and available** information on soil health.



We foresee a number of **potential avenues** to provide value to the end user.
Corporate farming groups employ upwards of 20,000 farmers and have a higher risk carrying capacity.
Local entrepreneurs and **NGOs** have lower barriers to adoption of new technology.

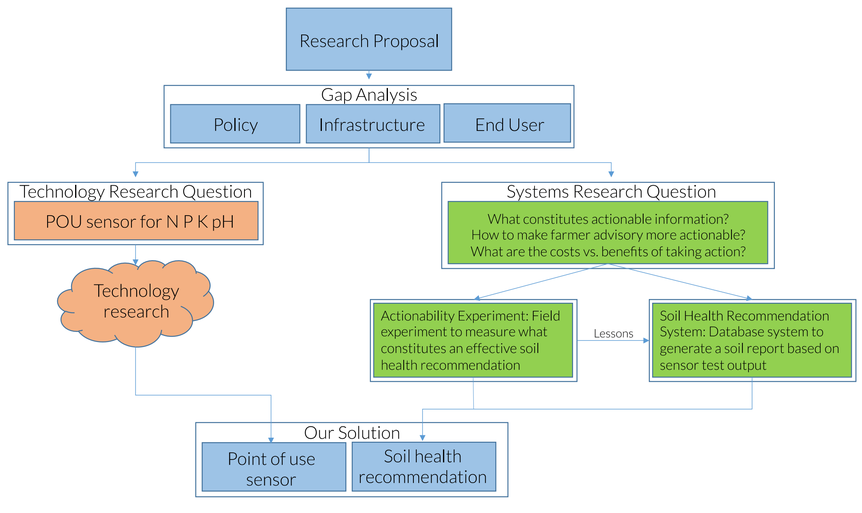
SMALL HOLDING FARMER	CORPORATE FARM
Get actionable information on soil health Requires low MSRP and high distribution cost	Improve aggregate yield across member farmers Needs to make large scale investment

Proposed Solution

Proposal: soil diagnostic sensor that uses planar ion selective electrodes to detect N, P, K, and pH contents in a soil sample; combined with recommendation service that returns an actionable fertilization recommendation to the farmer.

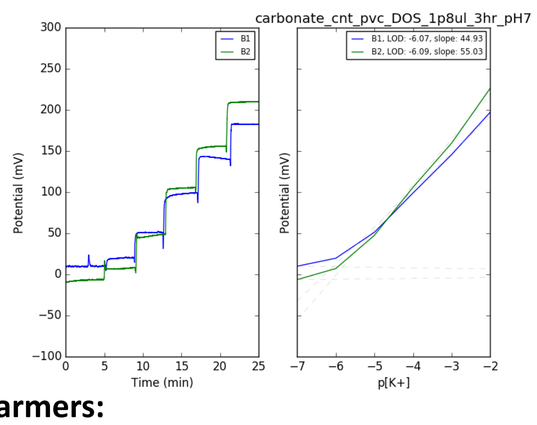
Existing Solutions on the Market:
KVK soil testing laboratories, Mobile soil testing kits, Private soil testing agencies

Existing Solutions in Research Labs:
Colorimetric testing strips (Whitesides et al, 2010)
All plastic ion selective electrode (Michalska et al, 2009)
Origami based ion electrophoresis (Crooks et al, 2014)



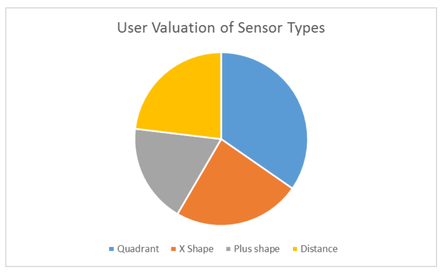
Research Methodology

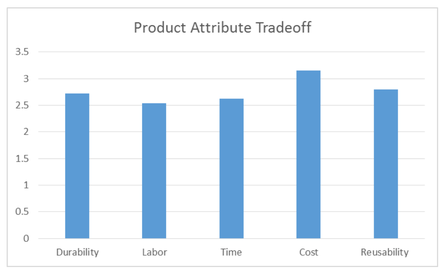
Our research methodology includes a combination of **interviews**, interactive design **workshops**, and prototype **demonstrations** to gauge user preferences. From there we gauge desired product attributes and design our research activities to realize those.

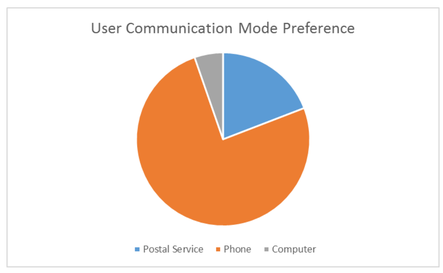


Results from interactions with farmers:

- Farmers would value a point of use device
- Colorimetry is an infeasible and confusing method of result interpretation
- Information interpretation always happens in groups as opposed to individually
- Farmers face very different problems depending on which area they are from; water, pests, disease, and wildlife can supersede soil health concerns
- Soil health recommendations must include significant level of detail on fertilizer, as well as options for availability, cost, etc.







Next Steps

Technology

- Achieve a minimal viable product (MVP) which can measure N, P, K, pH at ppm sensitivity and within 10% accuracy
- Create a theoretical model which predicts ion selective electrode parameters based off different experimental conditions; and suggests different device architecture to achieve optimal sensing
- Design and manufacture a low cost voltmeter in house which can display different ion concentrations based off output of ion selective electrodes
- Scale up design for small-scale 30 farmer pilot in the March-June timeframe

Systems

- Full scale randomized controlled trial with approximately 400 farmers in the Hubli region in Karnataka. Three test groups will be measured against a control group to quantitatively measure effects of various factors contributing to actionability of the system.
- Optimize MATLAB model to determine the predictive value of factors such as rainfall, irrigation, and fertilization on crop yield outcomes.
- Analysis of national and state level policy effects on the fertilizer industry in India.

Acknowledgments

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