AI in Agriculture
Leveraging technology for smallholder farmers

David Hughes
Penn State University
dph14@psu.edu
www.plantvillage.org
I mean smallholder Agriculture

83% of the 570m farms are <2ha
What is my motivation?
Not much has changed in 170 years

Ireland in 1847

Africa in 2017
Irish Famine was the beginning of Extension

“to supply them [farmers] with sound practical instruction....to raise upon their lands the greatest possible quantity of food, and thus obtain for themselves pecuniary profit, and secure the state from a recurrence of the great calamities through which we just passed”

Lord Clarendon, Dublin, Sept. 23rd 1847
£300 pound = $300,274
Motivation

Leverage technology to help small holder farmers
The goal: grow more

The solution: diagnosis and advice

The problems

1. Knowledge: Not accessible!
2. Experts: We are not training enough
Talk Outline

1. Knowledge: Make available existing knowledge
2. Experts: Use machines and Artificial Intelligence
1. Make available existing knowledge
AFRICAN VS. U.S. MAIZE YIELD
AMERICAN FARMERS GET FIVE TIMES AS MUCH MAIZE FROM THEIR LAND AS AFRICAN FARMERS DO

Knowledge

Source: Food and Agriculture Organization of the United Nations (FAO)
Knowledge is increasingly behind paywalls
“Tragedy of the knowledge commons’ (Ostrom & Hess)

Improving lives by solving problems in agriculture and the environment

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Crop Protection Compendium

"Extensive global coverage of pests, diseases, weeds and their natural enemies, the crops that are their hosts, and the countries in which they occur."

New Crop Protection Compendium site now live!
The CPC has undergone some enhancements and moved to a new platform - to see what's new, go to www.cabi.org/cpc

Code AGRS-045D. The complete publication in PDF format containing an interactive table of contents, hyperlinks, and bookmarks. Orders will be distributed via email.
Best way to add calcium to soil to prevent blossom end rot?

I have a tomato growing question. I have experienced problems with blossom end rot on past tomato crops and I would like to try growing some again this year. If it is caused by...
How much did this cost? And is it sustainable?

- $350,000 internal funds (PSU)
- About $240,000 for next 3 years
- Needs a path to sustainability
- Connections with GGIAR Big Data Platform and FAOSTAT
Part 2: Use machines and Artificial Intelligence

• Artificial Intelligence is now very powerful
Why is AI so good now?

V3 inception model of TensorFlow
Machine Learning Model Example:
99% accuracy in classifying these 38 leaves using Artificial Intelligence (53,000 leaves)
>200,000 images collected
Cassava (ca. 12,000)
AI will help in-field decision making

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<th>CBSD</th>
<th>CMD</th>
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Video of beta app with James Legg of IITA (Tanzania)
Healthy (score = 0.57)
Brown streak disease (score = 0.23)
Brown leaf spot (score = 0.16)
Mosaic disease (score = 0.02)
Green mite damage (score = 0.02)
Mosaic disease (score = 0.98)
Green mite damage (score = 0.01)
Brown streak disease (score = 0.01)
Brown leaf spot (score = 0.0)
Red mite damage (score = 0.0)
Brown streak disease (score = 0.42)
Green mite damage (score = 0.35)
Brown leaf spot (score = 0.13)
Mosaic disease (score = 0.09)
Healthy (score = 0.01)
Red mite damage (score = 0.65)
Green mite damage (score = 0.22)
Brown streak disease (score = 0.08)
Mosaic disease (score = 0.03)
Brown leaf spot (score = 0.03)
Brown leaf spot (score = 0.55)
Green mite damage (score = 0.26)
Red mite damage (score = 0.14)
Brown streak disease (score = 0.04)
Healthy (score = 0.01)
Screen 2: The person chooses cassava and video opens.

2a: Cassava Mosaic Disease

Meter linked to tensor flow probability

Live video

2b: Place square over infected area

Result: 94% likely to be CMD

User takes image and in-phone diagnosis based on image
Use machines to compensate for lack of experts: drones
Drone Flight Over Cassava Field
Height: 66ft
Chambezi, Tanzania
June 2, 2017
AI can do biomass estimation

Drone picture of maize

Machine accurately detects maize

Notice weeds ignored
Fall Armyworm: invasive in 28 countries
Losses between US$2.4m-US$6.1 m/year
(CABI)
Our proposed FCN model for diseased maize image segmentation

- Fully convolutional networks (FCN): A widely used deep learning model for semantic image segmentation
- It takes a raw maize image as input, and produces label maps for the segmentation objects
- It consists of encoding part (multiple convolution and max-pooling layers) and decoding part (up-convolution layers)
- A key challenge: Obtain an effective model using a small amount of labeled ground truth data
Quantify FAW damage
(an advantage of a University)

5,525 m² fall armyworm damage maize took 120 human hours to annotate and 6 machine hours
Talk Outline

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2. Experts: Use machines and Artificial Intelligence
Conclusion

We cannot be here in 10 years!
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Thank You

David Hughes
Penn State University
dph14@psu.edu
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