

# Cropdynamics

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# Outline

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## Background

Responded to a public call, for participation by Karnataka coffee growers, by CABI – South Asia, to channel participants to a phone extension pilot with Central Coffee Research Institute (CCRI).

Proposed in situ quantitative evidence gathering, as phone extension inadequate.

Proposing to collect quantitative farm and plantation data for remote diagnoses and monitoring, with potential for improvement and replication across crops & geographies in India and abroad.

### Proposer & key stakeholders

Rahul Bhargava, 34, Computer Science, Economics research, Australia-India, initially responded to a gap in an **Indian Coffee Board & CABI – South Asia** pilot. Ongoing research recommendations (earlier review under bilateral project) and prototyping. Proposals shared with **IARI**.

**Coffee Arabica** in Karnataka, the more economically valuable species is under attack by **white stem borer**. Infested plants show **yellowing and wilting of leaves**, ridges on stem, wilting branches and drying<sup>1</sup>. Young plants **die** and older

plants are **damaged**. Five years to re-grow. Arabica being replaced by Robusta.

Canopy and ecology monitoring will generate quantitative evidence.

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<sup>1</sup><http://www.thehindu.com/sci-tech/management-of-white-stem-borer-in-coffee/article4739884.ece>

### From gap to impact

- Phone extension is limited by what a farmer can describe over the phone and how many qualified scientists and extension providers are available in the field.
- Current conditions on the field are inadequately described to a remote scientist for diagnosis.
- Soil ecology is involved; Soil Health Cards inadequate
- Coffee and spices, grown and maintained as agro-forestry systems and management is holistic rather than plant specific

### **Example: White stem borer, control and prevention**

Female beetles lay eggs in crevices of bark of main stem or primary branches. Grubs first feed on bark, then bore into woody tissue and burrow to the roots.

- Two tier canopy – adults prefer coffee plants exposed to sunlight for egg laying
- Ridges on the main stem & thick primaries. Trace infested plants & flight period of the beetles to contain further spread of the infestation
- Scrub, prune, uproot infected plants to destroy eggs under bark, uproot and drown larvae or controlled burn preventing flight
- Spray, once in April-May and end-October – chlorpyrifos or swab stems with carbaryl

### Data

Leaf Area Index (LAI) is commonly used for monitoring forests, it has not been used for commercial agroforestry decision making in India, widely. This physical data coupled with sampling for soil chemistry analysis, in situ, should result in reasonably illustrative pathology models and potentially yield models.

A Minimum Data Set (MDS) of a standing crop will allow development of a computer simulated crop model.

### **Ecology – agroecology affected agriculture**

Several ecological factors are not observable to the naked eye, even if an inkling of their importance is known, for example shade and root fungi (or, fungus root). Consequently, current conditions on the field are inadequately described to a remote scientist for diagnosis.

Soil ecology is more involved than elemental soil testing suggests with fungi and bacteria playing key symbiotic roles. Several crops, for example coffee and spices, are grown and maintained as agro-forestry systems and their management is holistic rather than plant specific.



### Capture

Rapid field-crop-ecology monitoring and assessment for diagnosis

- high resolution ground-based, and regulation-permitting low-altitude Unmanned Aerial Systems (UAS) imaging, including NDVI
- and destructive sampling of soil
  - all Nitrogen forms, oxidised, organic, ammonium, total
  - Phosphate forms, orthophosphates and organic
  - oxidisable Carbon content
  - non-metals, B, Cl, and metals, Mg, Zn, Co, Cu, Fe
- and leaves, disease & stress indications, chlorophyll a & b

## Figure



Figure 1: Borer infected



Figure 2: Canopy

### Market

Market size is proportional to field evidence collected. The relationship between sampling and utilisation of analytics is expected to be exponential, as statistically significant quantitative data will impact pest propagation and yield models. Improved insurance and similar economics-investment risk models may be developed.

- To work with Coffee Research Institute (CCRI), necessary to partner with established research institutes with substantial technical expertise
- Feedback on technical considerations positive from CABI – South Asia
- Scientists at IARI willing to field test in controlled research-field trials

- For specific crops and regions, KVK (Agriculture Science Centres) through ATMAs for district-wide monitoring, including transfer
- Where successful at district-scale, insurers will be interested

### **Example: Economic reality**

- Canopy is lost due to felling of trees for income, even at risk of infestation
- Decision making heavily influenced by labour availability and cost
- Community preventive measures, infected plant disposal, relevant to pest propagation
- Farm cluster sampling addresses this to an extent
- Respecting the law and privacy of individual farmers, farmer associations and Government agencies advise farmers of observed risks & enforce (as yet poorly enforced) required legislated action for the common good.

# Questions?

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