Increasing the resilience of coffee production to leaf rust and other diseases in India and Africa (CFC/ICO/40)

Main achievements Lessons learned

Charles O Agwanda, 9th April 2018, ICO Dissemination workshop, Mexico

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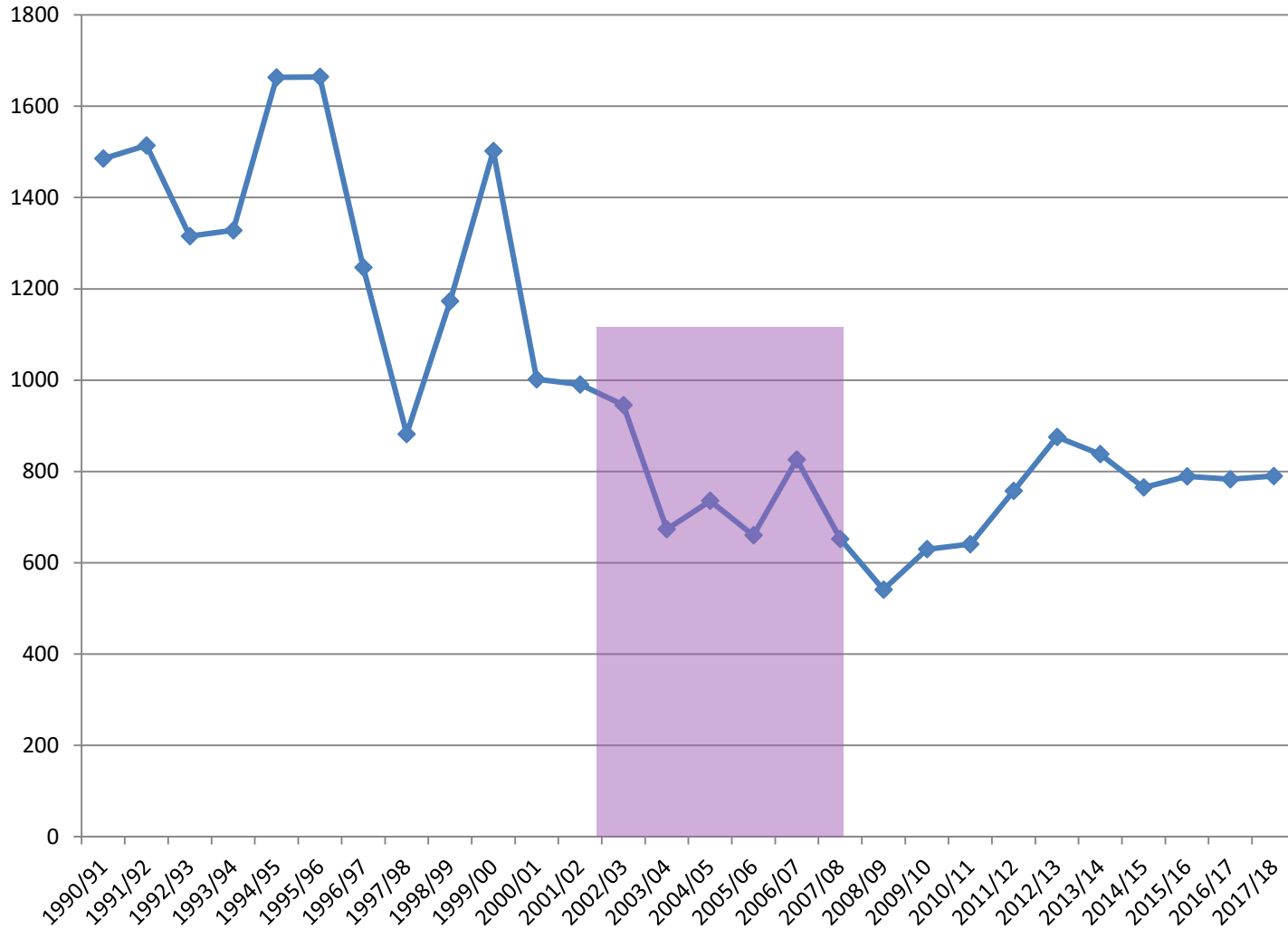# Why increase the resilience of coffee production in India and Africa

- The crop is an important source of foreign exchange earnings for all the five target countries
- Mainly grown by smallholders for whom the commodity is a key coffee for a substantial proportion of their livelihood
- A source of direct employment for 400,000 people in India, accounting for 15% of employment in the agricultural sector
- 600,000 resource-poor farm-families, 3.6 million Kenyans depend directly on coffee for their livelihoods
- Over 2.5 million Ugandans derive their livelihood directly from coffee
- 500,000 households in Rwanda depend on coffee production
- The commodity offered direct employment for about 100,000 people in Zimbabwe
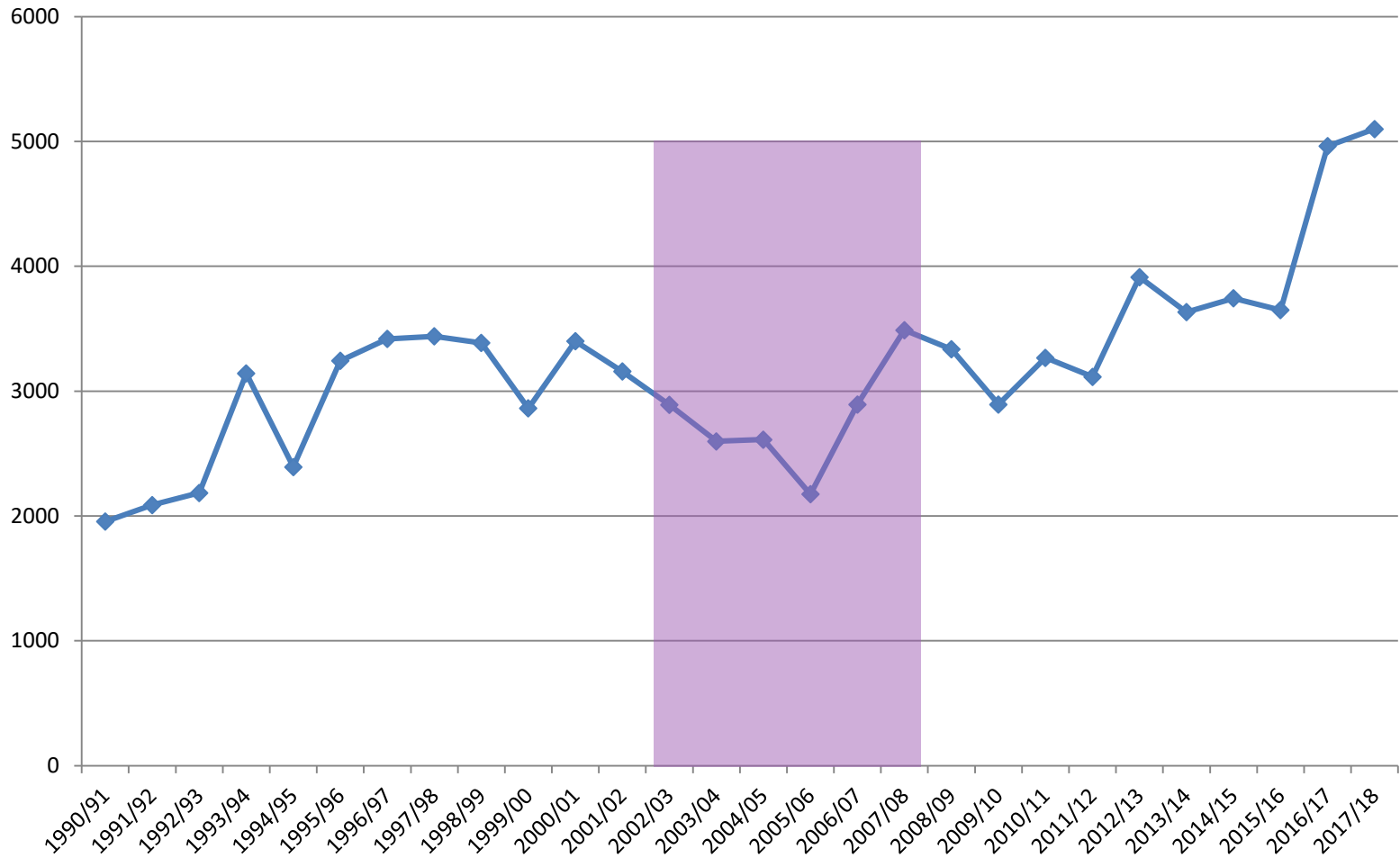
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What was the problem?

- Falling productivity and quality, particularly in Africa
- Poor access to resources, particularly coming from a period of depressed prises witnessed in the between 2000 and 2004
- Increasing disease and insect pest menace at smallholder level coffee leaf rust (CLR) and coffee berry disease (CBD) being the most serious
- Africa and India are the regions most affected by CLR
- Existing control agents, particularly pesticides expensive and out of reach of the smallholders
- Appropriate CLR resistance varieties not available in most of the African countries
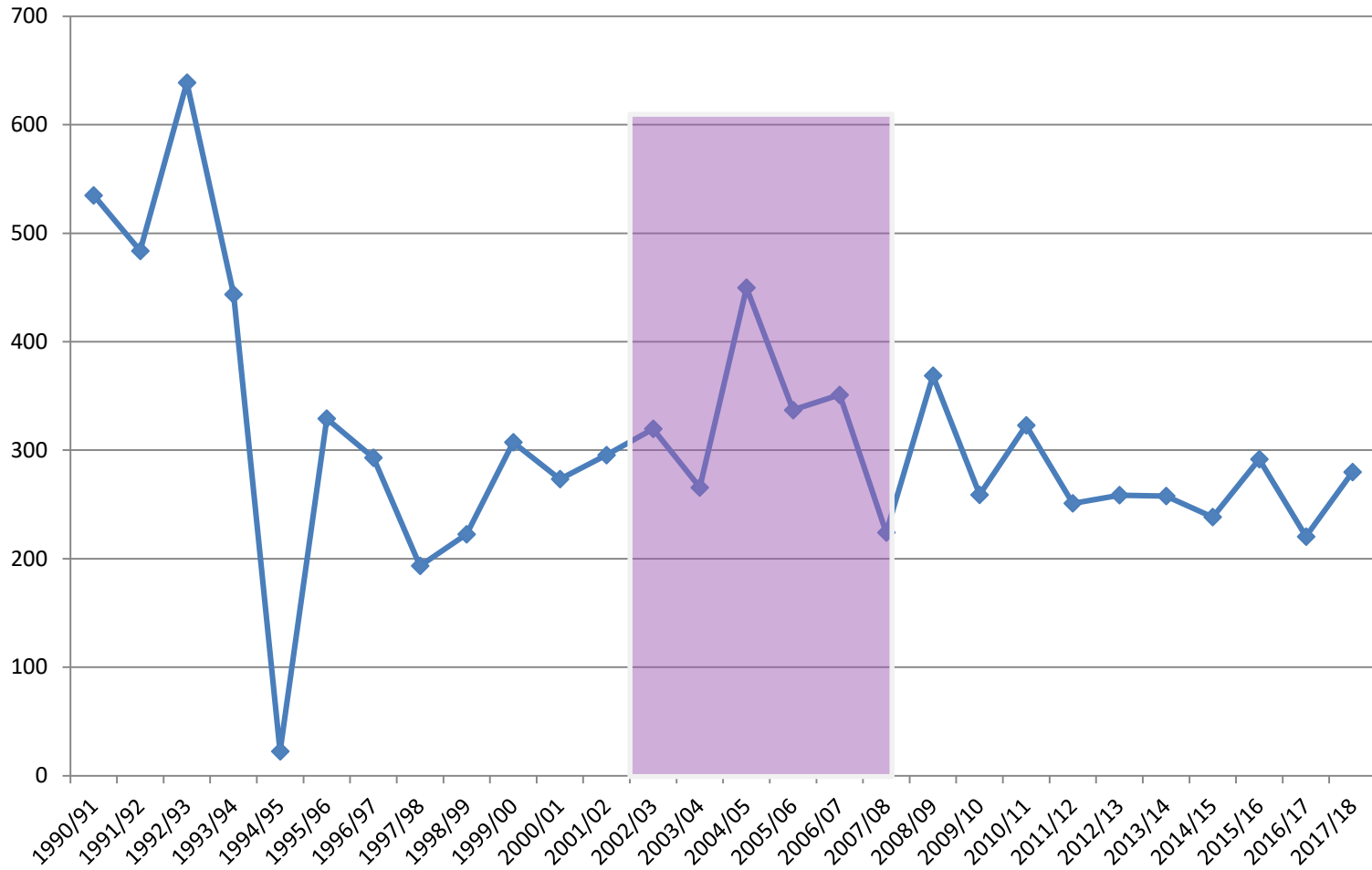- Climatic changes phenomena accentuating the impact of CLR on the prevailing commercial varieties

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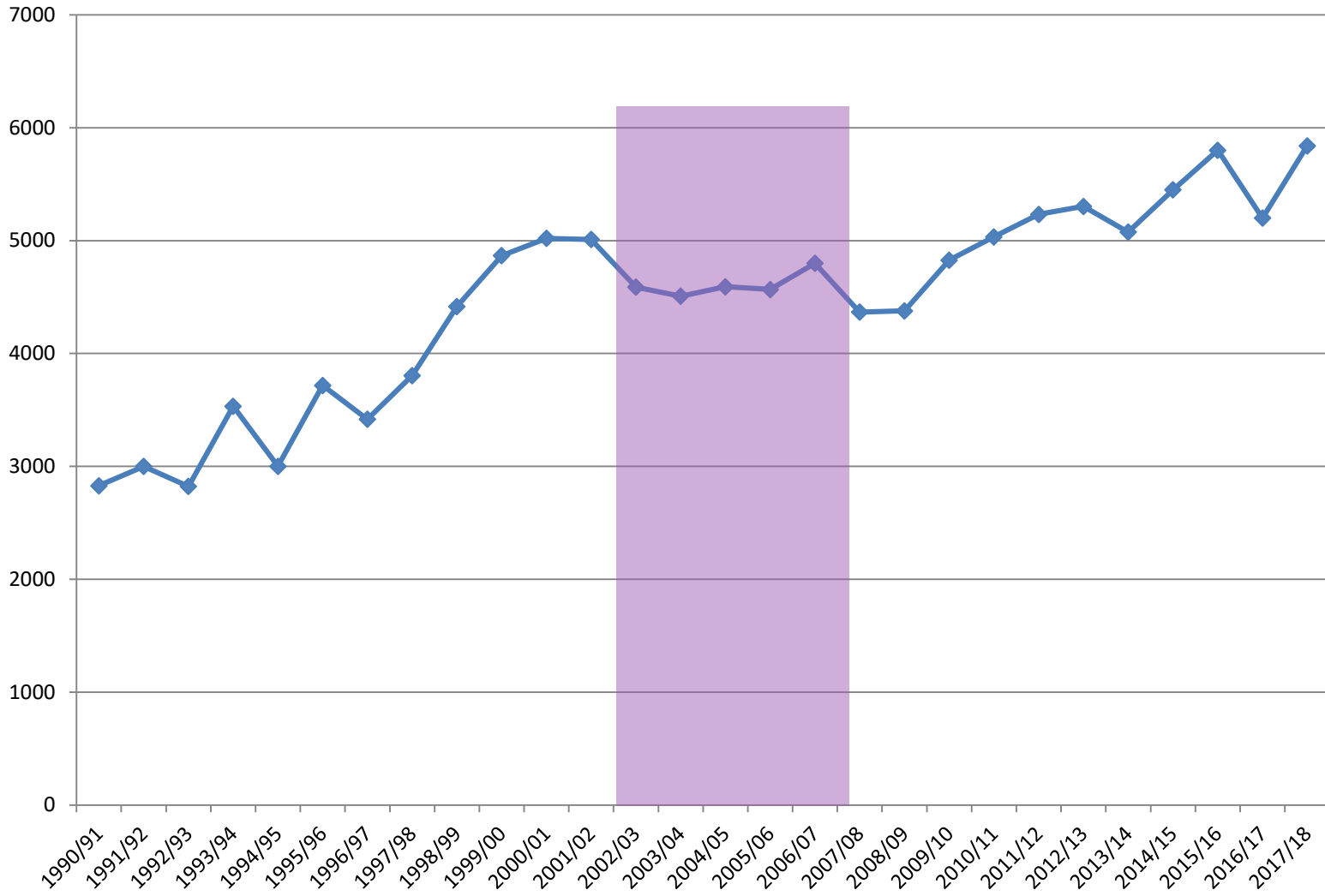Total production from Kenya 1990-2017 (thousand 60 kg bags)

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Total production from Uganda 1990-2017 (thousand 60 kg bags)

Total production for Rwanda 1990-2017 (thousand 60kg bags

Total production from India 1990-2017 (thousand 60 kg bags)

Project objectives

- To build the capacity of partners:
  - To share improved germplasm between participant African countries and India
  - To conduct demand-led research for variety evaluation and that generates alternative methods for control of CLR and other diseases
  - To deliver new knowledge and technologies including CLR resistant germplasm and environmentally friendly chemicals/botanicals to coffee growers.

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Main findings and achievements

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Identification of needs and resources

- At smallholder level, **CLR was one of the most important constraints** to sustainable coffee production.

- Other farm-level constraints such as lack of inputs (fertilizer, pesticides). An impediment to sustainable management

- Sustainable CLR management requires strategies to control other important pests; Coffee Berry Disease (CBD), and insects including White Coffee Stem Borer and Coffee Berry Borer

- Although most smallholder farmers were able to recognize the symptoms of CLR, many lacked the knowledge needed to manage the disease, particularly in Africa. Creation of platforms which facilitate farmer-to-farmer learning is crucial.

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Conservation and identification of coffee varieties and disease races

- Most countries posse a variety of coffee accessions maintained in field collections. The conservation status of coffee genetic collections was poor in all countries.
- Rehabilitation, relocation or maintenance undertaken for:
  - 56 collections in Zimbabwe,
  - 120 accessions in Uganda moved from Kawanda to Bugusege and Kituza due to threat from city expansion.
  - 182 accessions rehabilitated and maintained in Rwanda
  - 250 collections revitalised through clonal propagation consolidated and Arabica accessions characterised in India. India also produced a monograph on their collections
- Prospection for wild germplasm undertaken in Uganda and Kenya and additional germplasm collected and conserved in filed gene banks.

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Conservation and identification cont.

- Other than India, all the other four countries did not undertake regular monitoring of the evolution of rust races in the country.
- Evaluation of the CLR races profiles in the five countries undertaken and an updated list of CLR races compiled
  - **Three new races** which had not yet been named were identified in India on resistant genotypes,
  - **6 not previously recorded** in Kenya
  - **One previously unrecorded** race in Zimbabwe found .
- In-house capacity to undertake race identification was lacking in the African institutions
  - Scientists from Kenya, Rwanda, Uganda and Zimbabwe were trained in Portugal, by the project, in CLR race determination
  - Kenyan coffee breeder trained in India on marker assisted selection

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Modernisation of research capacity

- High quality facilities established at CCRI in India for genetic characterisation of germplasm and Marker Assisted Selection (MAS)

- Two Sequence-characterized amplified regions (SCAR) markers were validated and applied, along with 11 genotype specific Sequence-related amplified polymorphism (SRAP) markers.

- Progenies arising from MAS established in field plots.

- Researchers from Africa trained on molecular techniques for selection and breeding at post graduate levels and through attachments at CCRI and CIFC

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Trials with new and existing materials under a range of field conditions

- Introductions from India [Selection 5A (Sl 5A) and Selection 6 (Sl 6)] formed the basis of international variety trial in this project.
  - Selection 6 was resistant in all participating countries
  - Selection 5A showed segregation for CLR resistance
  - Selection 6 also showed field tolerance to Bacterial Blight of Coffee (BBC) in Kenya. Currently no variety with resistance to BBC exists in Kenya
  - Both Sl 5A and Sl 6 displayed early maturity and high yields and had comparable cup quality Kenya commercial varieties Ruiru 11 and SL28
  - Selection 6 was better in quality than the commercial variety BM 139 in Rwanda
  - Trials with local varieties in each country uncovered varying degrees of resistance to CLR within the national germplasm collections
- Biological and pesticide controls for CLR were tested

Trials with new and existing materials cont.

- Biocontrol agent *Bacillus brevis* showed similar levels of effectiveness against CLR to the recommended fungicide regime of Bordeaux mixture in India

- Cyproconazole was the most effective fungicide for controlling CLR in Rwanda and Zimbabwe, and so was registered for use in Rwanda.

- Tebuconazole was the most effective fungicide in trials in Uganda.

Scientific management, information systems and dissemination

- Innovative telephone helpline service for coffee farmers India **(Café Móvel)** to provide real time advisory information to needy farmers was piloted in India and has been expanded since the project by the Coffee Board.

- Face-to-face dissemination and upscaling activities centred on farmer field schools (FFSs). India established FFSs in non-traditional coffee growing areas where farmers had less knowledge.

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Lessons learned from the project

Identification of needs and resources

- Although CLR was identified as the most important challenge to coffee production by the smallholders, **factors associated to access to resources need to be addressed** in order for the recommended CLR management intervention to be sustainable.
  - Lessons from the project on **Sustainable Credit Guarantee Scheme (CF/ICO/48)** implemented in Ethiopia and Rwanda could be a useful resource in promoting access to finance by the smallholders.
  - Access to planting materials with resistance to CLR was an impediment, particularly for the **improved coffee hybrids** due to difficulties associated with conventional hybrid seed production. Tissue Culture mediated systems as currently practiced in Kenya and Malawi could be adopted in other African countries facing similar challenges

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Identification of needs cont.

- Access to planting materials with resistance to CLR was an impediment, particularly for the **improved coffee hybrids** due to difficulties associated with conventional hybrid seed production. Tissue Culture mediated systems as currently practiced in Kenya and Malawi could be adopted in other African countries facing similar challenges

- Farmer-to farmer learning present a unique opportunity for technology and information dissemination, particularly among smallholder farming communities with low formal literacy levels.
  - Creation of platforms which facilitate farmer-to-farmer learning is crucial. **Farmer Field School** approach provides an ideal platform for facilitating such engagements.

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Conservation and identification of coffee varieties and disease races

- The germplasm collections in the respective countries present an invaluable resource for developing varieties of the future. The accessions were however neglected and largely remain uncharacterised.
    - It is necessary for producer countries to invest in maintaining such germplasm and to undertake comprehensive characterisation for important agronomic traits both at morphological and molecular levels..
- In all countries where CLR race profiling were undertaken, new or additional races hitherto absent in such countries were found.
    - Frequent surveys to update race population in the countries need to be undertaken by the producer countries and the results used to update CLR control strategies including pyramiding of additional resistance genes.

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Scientific management, information systems and dissemination

- Telephone helpline service for coffee farmers India (**Café Móvel**) developed and rolled out in India was effective in providing timely advisory information to needy farmers.
  - Similar information dissemination platforms could be scaled up in other countries where government extension survives are inefficient.

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Café Móvel ('mobile coffee')

- A mobile-enabled extension service that uses the Direct2Farm database to provide information and advisory support to around 150,000 coffee farmers in southern India.

- Designed, deployed and maintained by CABI, with help from the Coffee Board of India, the International Coffee Organization and Common Fund for Commodities.

- Makes the latest research and local information available to farmers in real-time

- Complementary to existing face-to-face coffee extension provision and helping to boost yield and quality.

- Formally launched in India in August 2013 by the Commerce Secretary, Government of India

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Features of Café Móvel service

- Interactive FAQ section accessed by Interactive Voice Response (IVR- a technology that allows computers to interact with humans),
- Private discussion threads between planters and experts,
- Functionality to broadcast voice casts of the discussion threads to a community
- Growers not only get advice and access to market data, auction prices and weather in their local language, but are also be able to create discussion threads on their personal 'voice wall' and receive suggestions from fellow farmers and experts.
- Can further share this knowledge by tweeting these discussion threads to increase community learning and participation

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Scientific management, information systems cont.

- Real time access to pest management information for extension personnel and researchers important for timely design of appropriate CLR control strategies
    - Modernising coffee extension system could be modelled around the **PlantWise** program currently operating in a number of countries
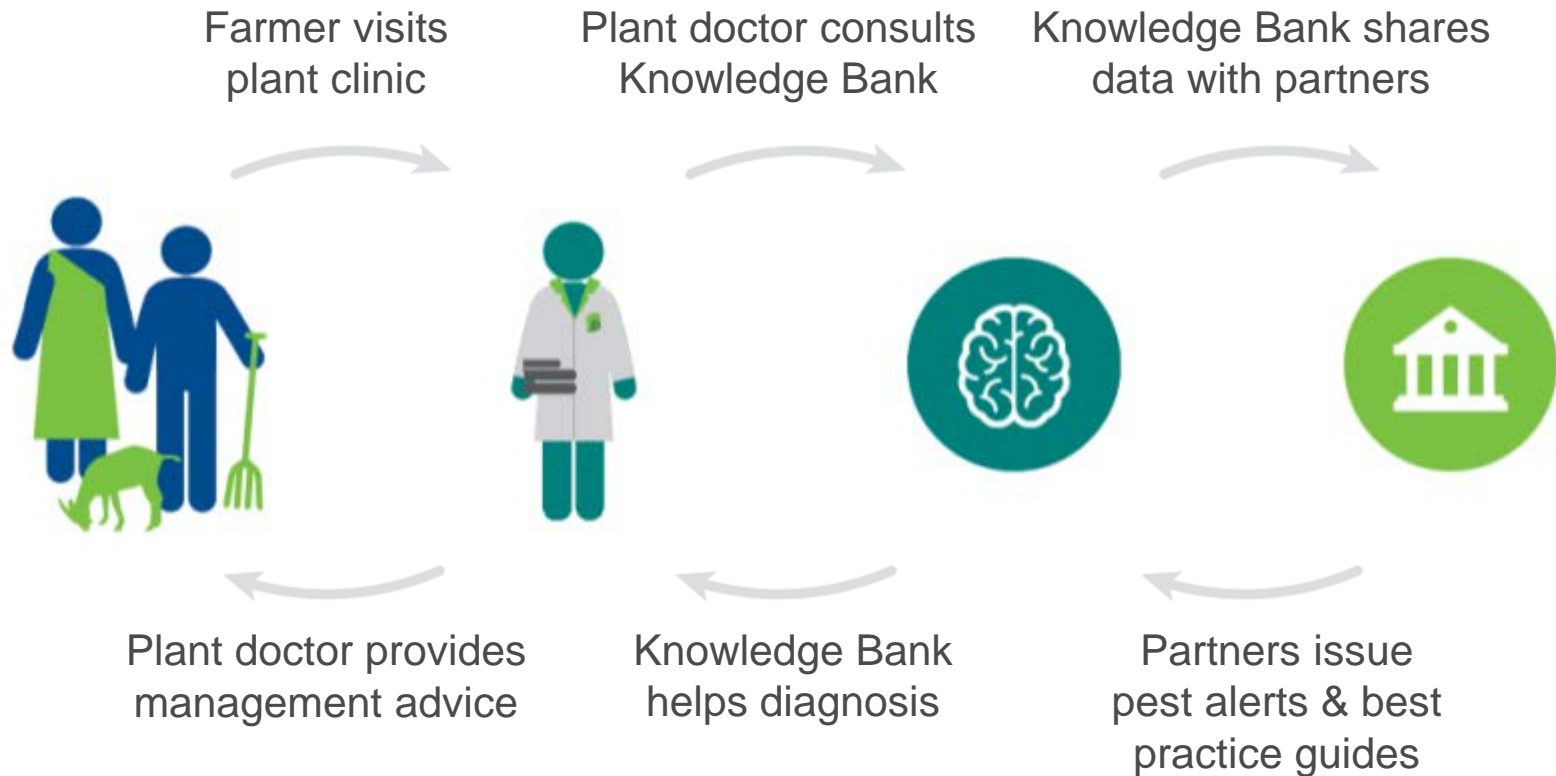
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What is Plantwise?

Plantwise is a global programme, led by **CABI**, to increase food security and improve rural livelihoods by reducing crop losses
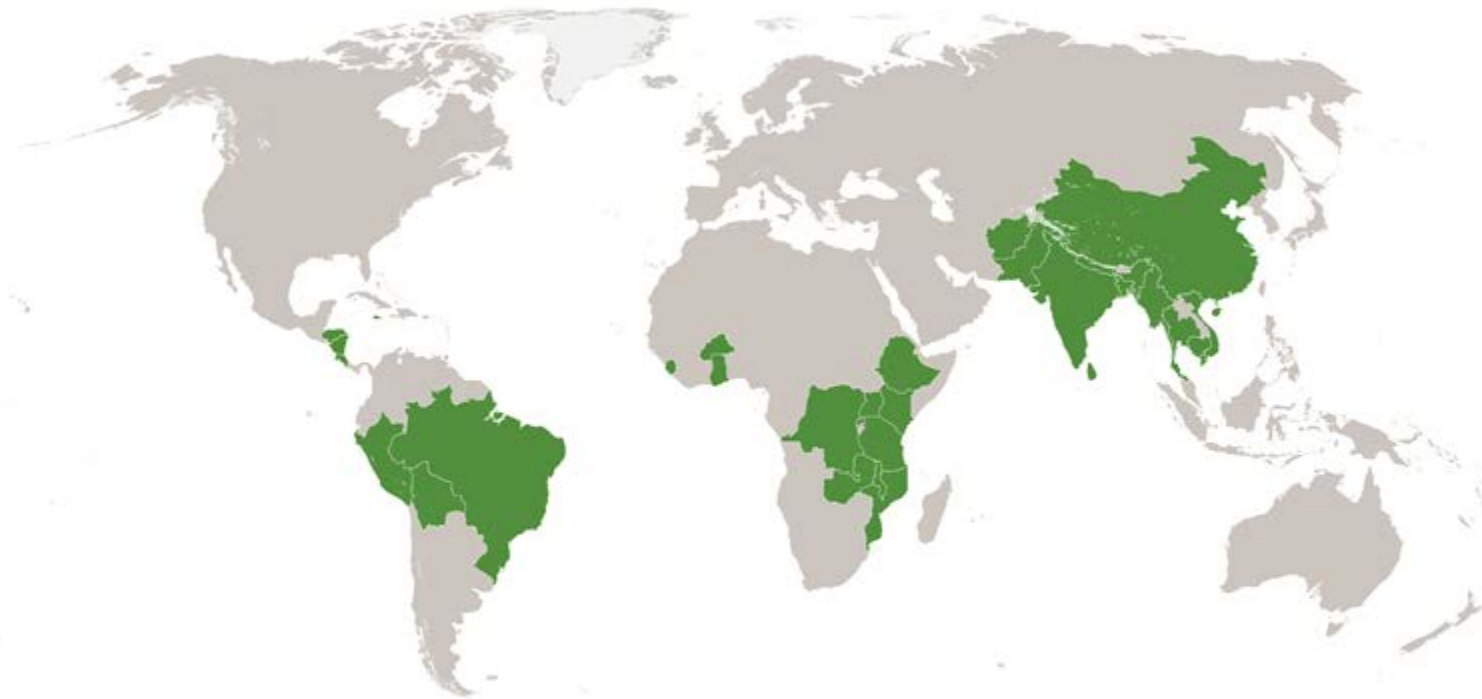
Plant clinics

- **SET UP** in local meeting places
  - e.g. at markets, village squares and near human health clinics

- **PROVIDE** diagnosis and treatment advice
  - for any crop and any problem

- **COLLECT** data about farmers and crops

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Process

Farmer visits plant clinic

Plant doctor consults Knowledge Bank

Knowledge Bank shares data with partners

Plant doctor provides management advice

Knowledge Bank helps diagnosis

Partners issue pest alerts & best practice guides

CABI plantwise

Countries

The Americas

Barbados	Jamaica
Bolivia	Nicaragua
Brazil	Peru
Costa Rica	Trinidad &
Grenada	Tobago
Honduras	

Africa

Burkina Faso	Mozambique
DR Congo	Rwanda
Ethiopia	Sierra Leone
Ghana	Tanzania
Kenya	Uganda
Malawi	Zambia

Asia

Afghanistan	Nepal
Bangladesh	Pakistan
Cambodia	Sri Lanka
China	Thailand
India	Vietnam
Myanmar	

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Knowledge Bank

- an **open access** internet resource

- covering **2,500 crop pests** in 80 languages

- over **12,500 factsheets** to provide practical information on pest management

- **thousands of images** to assist with diagnoses

- **interactive maps** showing pest distribution

- **pest alerts** to inform of new pest outbreaks

- **plant health news** from online sources

- **available offline** and via apps
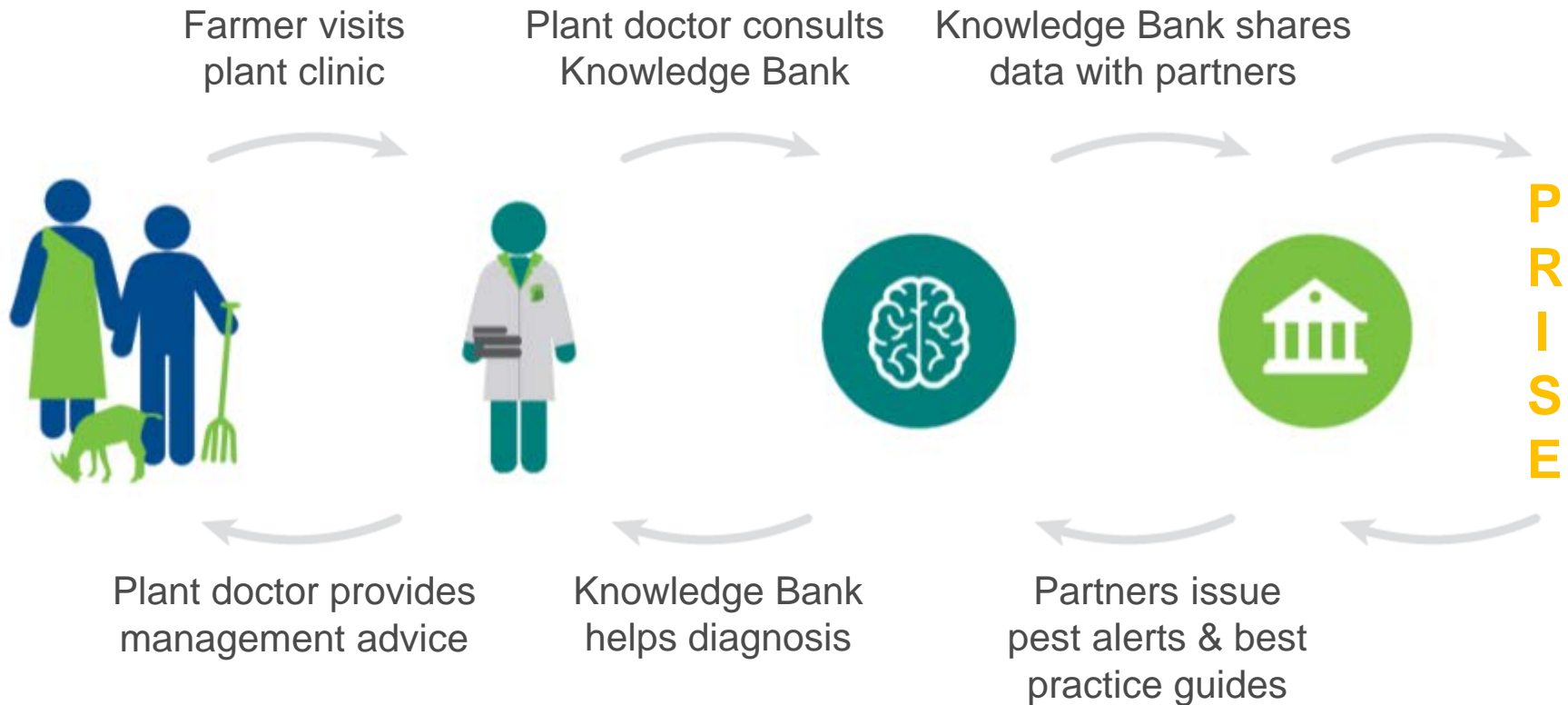
www.plantwise.org/**KnowledgeBank**

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Online knowledge bank

- 10,000 factsheets
- 3,300 maps
- 2,500 pests and
- diseases One million
- page views
- 50% growth in visits per year
- 33% visitors from PW countries
- Android factsheet app
  Memory stick with all content
  available to all plant doctors

Plantwise -PRISE

Farmer visits plant clinic

Plant doctor consults Knowledge Bank

Knowledge Bank shares data with partners

Plant doctor provides management advice

Knowledge Bank helps diagnosis

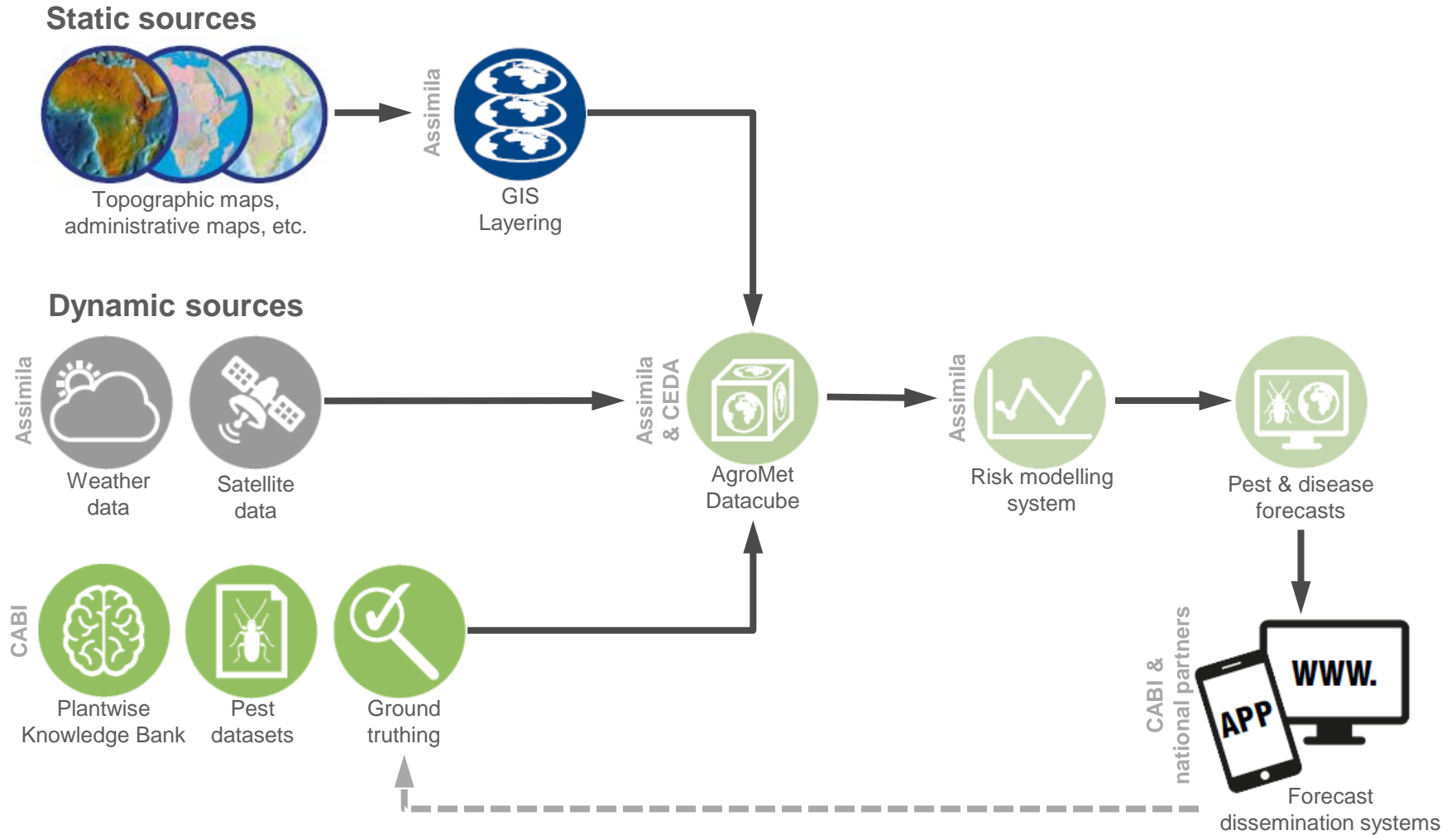Partners issue pest alerts & best practice guides

P R I S E

Scientific management, information systems cont

- Effective control of disease and other pests in coffee require control interventions to be applied in a timely fashion when the pest is vulnerable
    - Predictive pest control strategy modelled in a similar fashion to the Pest Risk Information Service (PRISE)

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PRISE is
the **P**est **R**isk **I**nformation **Se**rvice

a new Plantwise project

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Where the data comes from

Static sources

Topographic maps, administrative maps, etc.

Assimila

GIS Layering

Dynamic sources

Assimila

Weather data

Satellite data

Assimila & CEDA

AgroMet Datacube

Assimila

Risk modelling system

Pest & disease forecasts

CABI

Plantwise Knowledge Bank

Pest datasets

Ground truthing

CABI & national partners

WWW.

APP

Forecast dissemination systems

CABI

Partners

Implementation partners:

National partners:

Concluding remarks

- Resistant varieties key in the management of CLR but frequent emergence of rust races pose a challenge
- Fungicide useful in managing CLR particularly where there is no resistant varieties but are expensive and not good for environment
- Cultural control of CLR is widespread (canopy and fruit load management use of shade trees and adequate tree nutrition) but labour intensive
- Use of botanicals and bio-pesticides have great promise but more work needed to validate their effectiveness and deployment
- Integrated CLR management most effective in all the project countries
    - Regular reporting of abnormal resistance behaviour required
    - where booster sprays on resistant varieties is necessary, need to decide when to use curative or protective sprays or both
    - Surveillance for new races core when CLR control is based on resistant varieties

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Thank you

We wish to acknowledge the support of our donors, as well as our international partners, who make project possible