Flagship Project 4: Nutritious food & value added
OUTLINE

KEY SCIENTIFIC ACHIEVEMENTS 2020 & 2021

GENDER OVERVIEW

PROGRESS TOWARDS OUTCOMES & IMPACT

OPPORTUNITIES, PLANS AND TRANSITIONAL RECOMMENDATIONS
Key scientific achievements 2020-2021
**FP4: Nutritious food & added value**

- **44** Peer-reviewed publications
- **41** ISI and **41** Open Access

**By Cluster**
- CC4.1: **22**
- CC4.2: **13**
- CC4.3: **2**
- SW4.4: **7**

**Highest Altmetric score**
- Prioritising quality traits for gender-responsive breeding for boiled potato in Uganda
  - DOI: 10.1111/j.1464

**Most published crops**
- Banana
- Cassava
- Sweetpotato

**Most published countries**
- Kenya, Nigeria, Uganda

**Effect of storage, processing and postharvest practices on quality of end-product**

*Best packaging material for yam flour* Unlike polypropylene woven sack, PVC can retain sensory attributes of yam flour for 12 weeks

**Improving current methods for monitoring ripening**
- Central diameter and peel color: predictors of quality indicators during ripening (TSS and total starch in pulp)

**Tackling cassava PPD for PHWL reduction**

Complex phenomenon dependent on several factors acting differently in each clone.

- Modifying storage condition (↑RU, ↓T, waxing)
- Tolerant genotypes
- Preconditioning before harvest (pruning, 1-MCP)
- Preventing gene expression (gamma rays?)
Adding value to waste

Sweetpotato silage as nutritious and locally available animal feed ingredient

Lactating Ankole × Friesian crossbred dairy cattle
- Higher dry matter intake (from 6.8 up to 11.9 Kg/d)
- No sig. change in body weight
- Increased milk yield (1.5 - 1.7 kg/d)
- No sig. nutritional change in milk
- High profitability at 10% rate

Cassava peels as low-cost energy-rich feed ingredients for livestock and fish

3 drying technologies: sun-drying, roasting and flash dryer
- Potential for turning 3.6 mln tons of peels into 1.2 mln tons of safe feed
- ...replacing 810,000 tons on maize
- Main opportunities: poultry and fish
- $80-120 mln industry
- Patent for 3 HQCP products
Micro-nutrient bioavailability and safety of biofortified crops

First human study of iron bioavailability in potato

Yellow-fleshed potato: 28% iron absorbed (2-10% most vegetables, 8% pearl millet, <10% beans). 500g: 33% of the daily requirement of a woman of reproductive age

Purple-fleshed potato: 2x iron concentration but lower bioavailability

Biofortified SP: 6% iron absorption but high content: 18% daily requirement

Glycoalkaloid concentrations in tetraploid iron and zinc biofortified potato clones and in late blight heat tolerant (LBHT) potato population: 10 LBHT clones (out of 31) non-safe for consumption
Gender Overview
Assessing end-users’ preferences for developing gendered product profiles

Overview of 5-step methodology for Food Product Profile development

**Step 1: State of Knowledge (SOK)**
- Document review and key informant interviews

**Step 2: Gendered food mapping**
- Key informant group discussion (with village leadership)
- Focus group discussions (with people who grow, process and consume)
- Individual interviews (with community members)
- Market interviews (with traders)

**Step 3: Participatory processing diagnosis**
- Measurements and diagnosis of processing parameters (with processors)
- Crop quality related to low & high quality product (with processors)
- Quality of final product and preferences (with processors)

**Step 4: Consumer testing in rural and urban areas**
- Demographic information and consumption habits (with consumers)
- Hedonic tests
- JAR tests
- CATA terms (with consumers)
- Other views about the product (with consumers)
- Market interviews (with traders)

**Step 5: Food Product Profile**
- Final prioritisation of quality characteristics with interdisciplinary team, using data from Steps 2-4
- Dissemination

Collection of sex-disaggregated (quantitative and qualitative) data to identify differences in preferences for quality characteristics, their prioritization, potential trade-offs and their linkage to gender roles and agency.
Achievements

**Quality traits for gender-responsive breeding for boiled potato in Uganda**

- Red skin and yellow flesh important to both men and women (linked to market preferences)
- Big size and mealiness preferred only by women (linked to processing efficiency and eating quality)
- Limitation of using raw material characteristics to anticipate the quality of cooked product
- Characteristics of the raw material can be compared to sensory profile of the cooked product

**EAH cooking bananas ‘Matooke’ preferences of farmers and traders**

No major gender differences, except for ease of peeling, thin peel and soft peel
Development of a food product profile for boiled and steamed sweetpotato in Uganda for effective breeding

Robert O. M. Mwangba, 1, 2, 6 Sarah Mayanja, 1, 2, 6 Jolien Swanckaert, 1, 6 Mariam Nakitto, 1, 6, 7, 8 Thomas zum Felde, 1, 2, 6 Wolfgang Gruneberg, 1, 2, 6 Netsuyi Mudege, 1, 2, 6 Mukani Moyo, 1, 2, 6 Lindy Banda, 1, 2, 6 Samuel Edgar Tinyo, 1, 2, 6 Sarah Kisakye, 1, 2, 6 David Bamwirire, 1, 2, 6 Beatrice Anena, 1, 2, 6 Alexandre Bonioli, 1, 2, 6 Damalie Babirye Magala, 1, 2, 6 Benard Yada, 1, 2, 6 Edward Carey, 1, 2, 6 Maria Andrade, 1, 2, 6 Suzanne D. Johanningsmeier, 1, 2, 6 Laura Forzythe, 1, 2, 6 Genevieve Fliedel, 1, 2, 6 & Tawanda Mutungi 1, 2

Product profile of preferred/good quality pounded yam

Raw material (tubers)
- Healthy big tuber
- Tuber with low water content
- Brown colour of skin
- Regular shape

Processing
- White flesh colour (except if it is yellow yam (D. cayenensis))
- Easy to peel
- No colour change during peeling
- Short cooking time
- Absorbs less water during cooking and pounding
- Forms smooth dough easily

Final product
- South-east
  - Appearance: White colour dough
  - Textural quality: Stretchable, mouldable, not sticky, smooth, moderately soft/hard
  - Taste: sweet
  - Appealing aroma
- South-west
  - Textural quality: Stretchable, mouldable, not sticky, smooth, moderately soft/hard
  - Appearance: White Colour dough except if it is yellow yam (D. cayenensis)
  - Taste: sweet
  - Appealing aroma

*The preferred traits are in order of preference.
Progress towards outcomes & Impact
Low-cost and energy-efficient small-scale flash dryer for cassava

From Stage 3 to Stage 4:
3 equipment manufacturers and 6 cassava processors in Ghana, DRC, Nigeria and Colombia have built and installed models of improved flash dryers
Outcome 4.2: 20,000 small scale processors reduced water and energy-related production costs by 15-20% in cassava sector with growing spillover in other RTB crops

Commercial operations of 11 dryers in DRC, Nigeria and Ghana
• 23-50% increase in production capacity
• 30-33% reduction in fuel (diesel) consumption
• 8-10% increase in net profitability
• Interest from investors in Uganda, Tanzania, Cameroon, Dominican Republic and Colombia

Construction guide of a small-scale pneumatic dryer to process cassava
Outcome 4.4: Diet quality indices increased by 20% for at least 2,000,000 farmer households and urban/rural consumers

- Expanding in Kenya, Uganda, Malawi, RSA and Rwanda
- Introduced in Bangladesh
- SinnovaTek: continuous flow microwave system for a shelf-stable aseptic puree
- NetBizImpact (NBI): tailor-made BDS to 6 SMEs (3 UG, 2 MA, 1 KE)
- BoP Inc.: market research, marketing/distribution strategy for OFSP in low-income markets of Nairobi

Starch digestibility and β-carotene bioaccessibility in OFSP bread

- Bioaccessibility of βC correlates linearly with OFSP concentration
- Reduction in RDS and increase in SDS and RS fractions
- Functional foods that could address the VAD as well as glycemic issues

Quality and psychosocial factors influencing purchase

- Sensory characteristics as major drivers of purchase for 85% respondents. Gender differences in preference and motivations for purchase
- Levers for the reformulation of the bread and opportunities for segmenting the market
**Outcome 4.4:** Diet quality indices increased by 20% for at least 2,000,000 farmer households and urban/rural consumers

**Up to 50,000 Bangladeshi women and their households adopted better child feeding practices while growing and eating OFSP**

Community Nutrition Scholar (CNS): proven approach combining nutrition education and counseling with nutrition-sensitive agricultural interventions

- CIP and partners trained CNS to share health, hygiene and nutrition information with 5,000 mothers of small children
- Each shared information with an average of 10 people
- HHs planted the OFSP and vegetable seed that was distributed, and ate the OFSP at home
- The training successfully improved child nutrition and care
Looking ahead: opportunities, plans and transitional issues for One CGIAR
Nurturing most-promiseing RTB innovations

Farmer Business School (FBS)

Systematic approach to VCD to strengthen the entrepreneurial mindset and skills of farmer groups and accompany them in establishing profitable micro agri-enterprises.

- Taken to scale in the Philippines, India and Indonesia through partnerships with IFAD investments
- 3,874 farmers (76% women) launched over 140 small enterprises
- Outcomes:
  - Market-driven product innovations
  - Market linkages
  - Additional profits
  - Empowerment of men and women farmers, enhanced trust and collaboration
  - Impact assessment with WUR
- Scaling and institutionalization:
  - Bolivia, Peru and Vietnam
  - Philippine DA-BFAR (ABS)
  - Government of Assam, India
  - e-learning course for FBS facilitators

What opportunities and challenges for building on, promoting, and learning from existing CGIAR VCD approaches and tools in the new OneCGIAR?
Nurturing most-promising RTB innovations

Breeding for end-users’ preference and quality traits

NIRS calibrations (e.g. fresh cassava, boiled cassava, garri, yam flour)

NIRS SOP for fresh cassava and yam tubers
Documenting key FP4 innovations

1. Online portal on key postharvest and nutrition innovations
2. Dedicated online platform to promote small-scale efficient flash dryers, incl. documentation and interactive tools (design, self-diagnosis and business planning) www.flashdryer.cirad.fr

Building on RTB experience on integrated system approaches

**Agri-food system integration**

1. Co-consumption of fish and RTB crops
2. Integrated production systems
3. RTB crop residues for commercial fish feed

**Integration with humanitarian interventions**

Connecting agri-food technologies (OFSP varieties, healthy baby toolkit, shelf-stable puree) with efficient and effective delivery mechanisms

Beyond a single commodity or commodity group focus
**RTB FP4 transitioning to One CGIAR**

**FOOD, LAND & WATER SYSTEMS LEVEL**

- **ST:** Transforming food systems from **net carbon sources to sinks**
- **ST:** Realizing gains across the **water-energy-food-forest-biodiversity** nexus
- **ST:** Agroecology across food, land & water systems
- **ST:** Building systemic resilience to climate extremes

**RAFS:** Climate-resilient dryland crop-tree-livestock systems – dealing with climate variability & risks

**RAFS:** Urban and peri-urban agri-food systems – delivering safe healthy food sustainably

**RAFS:** Protecting human health through a **One Health** approach

**RAFS:** Resilient aquatic foods in food, land & water systems

**RAFS:** Climate smart livestock – policy & practice

**RAFS:** Nature-positive agriculture for agrobiodiversity, water & environment

**RAFS:** Sustainably improving livestock productivity for improved livelihoods

**RAFS:** Excellence in agronomy

**THEMATIC LEVEL (COMPONENTS OF SYSTEMS)**

**RAFS:** Resilient aquatic foods in food, land & water systems

**RAFS:** Sustainably improving livestock productivity for improved livelihoods

**RAFS:** Plant health & rapid response protecting income & food supply

**GI:** Farmer-preferred crop varieties

**GI:** Market intelligence & product profiling

**GI:** Breeding innovation, **modernization** & services

**GI:** Delivering **gene editing** & novel technologies

**GI:** Strategic innovation – gene editing & novel technologies
Thank you
Complementary material
Additional selected journal articles by slide

**Slide 5**

**Original article**
*Post-harvest physiological deterioration in several cassava genotypes over sequential harvests and effect of pruning prior to harvest*

Jorge Luna, Dominique Dufour, Thierry Tran, Mónica Pizarro, Fernando Calle, Moralba García Domínguez, Iván M. Hurtado, Teresa Sánchez & Hernán Ceballos

**Original article**
*Correlation of cooking time with water absorption and changes in relative density during boiling of cassava roots*

Thierry Tran, Xiaofei Zhang, Hernan Ceballos, Jhon L. Moreno, Jorge Luna, Andrés Escobar, Nelson Morante, John Belalcazar, Luis A. Becerra, Dominique Dufour

**Original article**
*Role of dewatering and roasting parameters in the quality of handmade gari*

Layal Dahdouh, Andrés Escobar, Eric Rondet, Julien Ricci, Geneviève Fliedel, Laurent Adinsi, Dominique Dufour, Bernard Cuq, Michèle Delalonde

**Original article**
*Correlation of the sensory attributes of thick yam paste (amala) and the functional and pasting properties of the flour as affected by storage periods and packaging materials*

Wasiu Awoyale, Hakeem A. Oyedele, Busie Maziya-Dixon

**Original article**
*Processing methods affect phytochemical contents in products prepared from orange-fleshed sweetpotato leaves and roots*

George Ooko Abong'o, Tawanda Muzhingi, Michael Wandayi Okoth, Fredrick Ng'ang'a, Phillis Emelda Ochieng, Daniel Mahuga Mboyo, Derrick Malavi, Machael Akhvale, Sita Ghimire

**Original article**
*Physicochemical and physiological changes during the ripening of Banana (Musaceae) fruit grown in Colombia*

Jhon Larry Moreno, Thierry Tran, Borja Cantero-Tubilla, Karina López-López, Luis Augusto Becerra, López Lalave, Dominique Dufour
COVID-19 and extreme weather events
Registered Reports

An interdisciplinary and participatory methodology to improve user acceptability of root, tuber and banana varieties

Lora Forsythe,1* Hale Tufan,2 Alexandre Bouniol,3,4,5 Ulrich Kleih1 & Geneviève Fliedel6,6

Prioritising quality traits for gender-responsive breeding for boiled potato in Uganda

Netsayi Noris Mudege, Sarah Mayanja, John Nyaga, Mariam Nakitto, Samuel Edgar Tinyiro, Damali Babirye Magala, Janet Cox Achora, Sarah Kisakye, David Bamwirre, Thiago Mendes, Tawanda Muzhingi

A review of cassava semolina (gari and eba) end-user preferences and implications for varietal trait evaluation

Wasiu Awoyale, Emmanuel Oladeji Alamu, Ugo Chijioke, Thierry Tran, Hubert Noel Takam Tchuenté, Robert Ndijouenkeu, Ngoualem Kegah, Busie Mazlya-Dixon
Slide 15

**Food Chemistry**

Starch digestibility and β-carotene bioaccessibility in the orange-fleshed sweet potato puree-wheat bread

Daniel Mbogo, Tawanda Muzhingi, Srinivas Janaswamy

Original article | Open Access

Effect of food safety training on behavior change of food handlers: A case of orange-fleshed sweet potato puree processing in Kenya

Derick Nyabera Malavi, George Ooko Abong, Tawanda Muzhingi

Slide 18

**Agricultural Systems**

Enhancing Value Chain Innovation Through Collective Action: Lessons from the Andes, Africa, and Asia

Gordon Prain, Christopher Wheatley, Cameron Odsey, Leonora Verzola, Arma Bertuso, Julieta Roa, Diego Naziri

Research-development partnerships for scaling complex innovation: Lessons from the Farmer Business School in IFAD-supported loan-grant collaborations in Asia

Andre Devaux, Claudio Velasco, Miguel Ordinola, Diego Naziri
Effect of Sample Preparation Methods on the Prediction Performances of Near Infrared Reflectance Spectroscopy for Quality Traits of Fresh Yam (Dioscorea spp.)

Emmanuel Oladeji Alamu 1,2,*, Michael Adesokan 2, Asrat Asfaw 3, and Busie Maziya-Dixon 2

Fish, roots, tubers and bananas: opportunities and constraints for agri-food system integration

Molly Atkins 4, Kendra A. Byrd 5, Lauren Pincus 6, Diego Naziri 7,8, Jeleel Opeyemi Agboola 9 and Rodrigue Yossa 9