Integrating Agricultural Production, Nutrition and Marketing - Research and Development of the Bean Value Chain in Uganda

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Value Chain Transformations

Traditional Farming System
- Multiple crops, small areas
- Limited inputs & credit
- High post-harvest losses
- Strive for food security
- Little marketable surplus

Value Chain System
- Focus on one/few enterprise
- Use external inputs & credit
- Reduced/low P-H losses
- Maintain food security
- Produce for known market
**Value Chain Transformations**

**Traditional Farming System**
- Little contact/linkages (vertical & horizontal)
- Ltd. knowledge of market req. (quantity & quality)
- No quality differentiation
- Inefficient storage, transport and market infrastructure and logistics
- Low prices

**Value Chain System**
- Continuous contact & linkages with VC actors
- Detailed, direct knowledge of req. of several markets
- Premium prices for quality
- Improved collection and storage (small/large scale), coordinated transportation
- Grading & quality control
**Beans (traditional & improved)**
- USAID Collaborative Research Support Program
- Uganda & Rwanda
- Train farmers in production, seed multiplication, post-harvest management, nutrition, and marketing
- R&D processed products

**Sweet Potato (Vitamin A)**
- CGIAR system HarvestPlus program (multiple crops)
- Uganda & Mozambique
- Train farmers in production, vine multiplication, post-harvest management, nutrition, and marketing
- R&D processed products
Program Context of VC Projects

**Sustainable Rural Livelihoods program**

- Indigenous NGO, NARO, universities (Ugandan, US)
- Train and Support Community Based Trainers
  - Crop Production with low external inputs (current and improved crop varieties, new crops)
  - Nutrition (nutrient dense crops – beans, groundnuts, grain amaranth, vegetables, fruits), sanitation and health
  - Institutional Development (collective marketing, advocacy)
- Applied Research – agronomy, nutrition and food technology, extension and training
- Agroforestry, Microfinance, and Advocacy
Build on & Contribute to SRL

- Sustainable livelihoods approach reflects asset based community development (ABCD)
- Understand and building on strengths to address prioritized local issues (not ‘blueprint’ model)
- Asset building to enhance diversity and resilience, reduce vulnerability and risks assoc. with innovation
- R&D responds to identified needs for increased production; secure storage of harvested crops; improved diet/nutrition; increased income through collective marketing
Bean Value Chain Project Rationale

- Common beans are most important legume crop in Uganda (5th crop overall), and in Rwanda; women manage the crop
- Major source of protein, fiber, complex carbohydrates, and micronutrients; income potential
- Key attributes: taste, texture, appearance, cooking time
- Less than 10% of smallholder farmers’ land (< 5 acres) devoted to cultivation of beans; few were marketing
- Limited access to extension, training, inputs, improved agronomic practices, new technologies, credit, market information, links to domestic and regional markets
- Poor harvest and post-harvest practices and on-farm storage facilities (damage, disease, weevils, foreign matter)
1. Improve Bean Yields and Quality

- Address key production constraints of priority bean varieties (yields < 25% potential)
- Evaluate existing & new production practices
- Strengthen farmers’ collective capabilities to locally produce quality seed & grain (food, income)
Objectives and Activities

2. Enhance Nutritional Value and Appeal

- Address key causes of post-harvest losses
- Evaluate impacts of improved post-harvest management practices & technologies
- Develop bean products with enhanced nutritional and organoleptic properties
3. **Increase Marketing and Consumption of Beans and Bean Products**

- Identify solutions to smallholder farmers’ production and marketing constraints
- Understand consumer demand and preferences for beans and processed products
- Increase consumer awareness of benefits
- Develop value-added products
- Collaborate with private sector businesses to scale up commercialization
Research and Development Design

Practical, Participatory Training

- 10-12 farmers/group (75% women)
- Agronomy: field prep., planting, field pest control, timely harvesting, dry on tarpaulins, threshing, sorting, moisture test, germination test, anaerobic storage, and record keeping
- Nutrition and food preparation
- Seed production and marketing

On-Farm Adaptive Field Experiments

- Randomized design, 2 replications
- 54 plots (3m x 3m) per group (3 varieties x treatments and control)
- Analysis at NARO & ISU
Community-Based Seed Production

- Sustainable access to quality seed of improved varieties that farmers favor after field testing
- Foster viable local agriculture-based enterprises
- Use Certified Seed, producing Quality Approved Seed for reliable dissemination and income
- Mentoring seed producing groups in marketing (price awareness, negotiation, contract adherence)
- Multiplication gardens & project farmers’ fields now are seed source for 300 new farmers
- 500+ additional farmers using improved crop varieties, management practices & technologies
Improved Post-Harvest Practices

Storage in Airtight Containers

- kills live bruchids, preserves quality and quantity of beans, eliminates need for periodic re-sunning (1x/2 weeks)
- Sealed jerrycans (10 & 20 litre) for small quantities, and triple bagging (up to 100 kg) for large quantities.
- Properly stored beans can be kept up to six months.

Solar Treatment (2 hours)

- kills bruchids, larvae & eggs before storage
- eliminates bi-weekly re-sunning
Nutritional Characteristics & Processing Effects

- Screened bean varieties for levels of iron, zinc, protein, phytates and polyphenol and modeled Fe & Zn bio-availability

- Quantifying ferritin content of 22 bean varieties from Uganda and Rwanda. Data will be used for modeling iron bioavailability.

- Determined effects of processing of beans (soaking, malting, roasting, steaming under pressure) on protein digestibility, Fe & Zn extractability

- Assessed effects of thermal processing on the functional properties of common bean flours
Nutritional Analysis

**Nutrient Characteristics** - signif. diff. in polyphenol, phytate, zinc and protein but not iron content (p=0.05)

Protein content ranged from 25.7-31.6 %, polyphenol, 0.07-0.37 mg/100g; phytate, 0.91-2.17 g/100g; iron, 128.5-154.5 µg/g; zinc 27.1-38.7 µg/g, iron bioavailability 4.3-6.8 µg/g and fraction of absorbed Zinc, 9-11.34 µg/g.

**Bioavailability** – correlation btw. ferritin & zinc ($R^2=0.65$, p=0.04), and btw. ferritin & protein ($R^2=0.64$, p=0.04).
Commercialize Nutrient-Enhanced Bean Products

- Optimized protocol for pre-cooked bean flour and acceptable porridge/sauce with increased protein digestibility and Fe & Zn extractability
- Fast-cooking bean-based composite flour suitable for feeding 2-5 year old children
- Blended flours (beans with Vit. A rich sweet potato) as weaning foods for 6-24 mo. children

Commercial partners:
- in Uganda - Nutreal Ltd. with Makerere University’s Food Technology Business Incubation Center
- in Rwanda - Kubumwe Enterprises with Food Science & Tech. at Kigali Institute of Science & Technology
Recipes for Highly Acceptable Bean Products

- Participatory recipe development and evaluation at rural ‘cook day’ event
- Trained farmers in bean preparation, flour development and storage
- Bean recipes - adopted for family meals and snacks (also on sale in villages)
- Cold extruded, deep fried snack from bean-based composite flour
Impact and Implications

- Dietary diversification at community level using a variety of bean recipes → increased opportunities for bean consumption and nutrition/health benefits
- Income for rural women selling bean-based snacks
- Processed bean products in urban supermarkets
- Market for beans farmers (supports value-chain development and scaling up production)
- Improved acceptability and ‘image’ for beans implies higher consumption and better health
Marketing: farmgate (79%) vs. markets (21%)

At farmgate: intermediaries (58%), traveling traders (30%), households (7%), institutions (3%), and wholesalers (2%)
Strengthen Farmers’ Learning & Success

- Conduct exchange visits & field days at research and demonstration sites for other farmers
- Improve farmers’ understanding of market price variation (among traders, markets, seasons), enhance negotiation skills, coordination of collective marketing, and obtain higher prices
Research and Capacity Building

2 Ph.D. students trained at ISU
- Abiotic stress tolerance
- Zinc and Iron Bioavailability

5 M.S. students trained at Makerere University
- Quick-cooking bean flour
- Farmers’ market participation

6 B.S. students at KIST and 1 at Makerere
- Nutrition vis. pre-processing (soaking, germination, fermentation, puffing)
- Causes and extent of post-harvest losses
- Modified storage atmosphere and pests

Link research activities backward and forward to rural development support work of gov’t & NGOs