VOLUNTEER REPORT FORMAT

To be submitted to CRS at the end of volunteer assignment and shared with the Host

1.1 Assignment information

a) Volunteer Name: **Eric Simonne, Professor of Horticulture and District Extension Director, University of Florida**

b) Host Organization: **NOGRA Enterprises Company Ltd**

c) Assignment: **Improved Sweet Pepper (and Tomato) Production Technologies (TZ17)**

d) Dates of Assignment: **October 11 to 27, 2014** (including travel)

e) Number of days worked: **14** (not including preparation or travel)

Summary and recommendations. Fertile soils, available water, potential markets, national food needs, and labor availability naturally give the northern region of Tanzania the potential for establishing a productive and profitable bell pepper and tomato industries within 3 to 5 years. The local/smallholder farmers in the Mkufi Estates (Hai DISRTICT machame, Kilimanjaro region) and from the MEA Group, Ndatu Village (Arusha region) are currently producing bell peppers and tomatoes following empirical methods. They do so with a modest production and profitability level of success (for comparison, local yields are about 1/10thof those of Florida commercial growers). The potential of the region may be realized by (1) increasing local farmers' knowledge in basic soil management, fertilizers, irrigation, field border sanitation, weed control, pest management, adequate harvest time, and proper post-harvest handling techniques; and (2) facilitating local farmers' adoption of these good agricultural practices. Because of similarities in growing environment, the vegetable production recommendations of the University of Florida may be used as the foundation information for tomato and bell pepper production in northern Tanzania. However, most of the inputs needed to adopt these good agricultural practices (seeds of varieties with disease resistance/tolerance, insecticides and pesticides with different modes of action) are currently not available for purchase locally. Hence, the potential of the region may also be realized if/when (3) NOGRA Enterprises - as a regionally established agricultural inputs supplier- expands its product line to fill this demand and provides technical assistance through use of extension officers to link smallholder farmers' field challenges with effective inputs.

The USAID-F2F-CRS TZ17 assignment increased local/smallholder farmers' capacity using three approaches: direct education, establishment of demonstration farms, and increasing NOGRA capacity. First, oral presentations (mostly visuals) were made to both groups (total attendance: 30 approx.) on identification and control of viral, disease and insect pests, selection and application of fertilizers, transplanting, and seed germination of tomato and bell pepper over three days at each site. Attendees brought samples from their own fields and asked critical questions. This made the training focused on their needs. The second approach was to establish demonstrations sites – one in open field (Mkufi Estate) and one under a covered structure (screenhouse donated by NOGRA Enterprises) in Ndatu Village. This second approach is conducive to "teach by example and by doing" as farmers can see for themselves improved cultural practices. Finally, this project helped NOGRA Enterprise management to develop a vision, define its role in this process, and integrate it into the company's strategic plan. Catholic Relief Services in Tanzaia should continue to support this three-prong approach of basic teaching, demonstrations, and technical support. The recommendations of the University of Florida volunteer after the initial assessment during TZ17in October 2014 are to follow and expand current efforts with (1) providing a 6-month internship to a University of Florida Doctor of Plant Medicine

student to provide day-to-day education during the course of an entire tomato and bell pepper growing season, (2) organizing a week-long training for local/smallholder farmers and local technical agents to enable them to facilitate knowledge and good agricultural practices adoption and transfer; and (3) develop a matching scope of work for one or two volunteers to conduct the training. In addition, it is recommended to CRS to (4) consider allocating some funds for the acquisition of essential demonstration supplies. For example, a basic soil test kit is needed to determine soil pH, and N-P-K soil levels; a hand-held soil moisture probe will allow scheduling irrigation and saving water; a pair of petiole sap meters (for NO3-N and K) are necessary to adjust sidedressing to crop nutritional status; sticky traps and pheromone traps are essential in scouting and making early diagnostic of insect populations; and, hand-held lenses allow for field observation of small insects, egg masses and juveniles. Lastly, (5) CRS and NOGRA Enterprises should jointly develop a scope of work and support establishing professional relations and personal connection with international inputs suppliers (seeds, pesticides) seeking to establish or increase their distribution in Tanzania. This could be achieved through NOGRA Enterprises management attending major agricultural or horticultural professional shows in the United States. Overall, the long-term chances of success of this project are real and very encouraging.

Acknowledgment. I wish to sincerely thank Maria Figeroa (USAID Catholic Relief Services Volunteer Support Coordinator), Nyambura Theuri (Deputy Project Director, EA Farmer, Farmer to Program), Mary Kabantange (Catholic Relief Services, Farmer to Farmer Program Country Director), Ufoo Adonikamu Ulotu, (Program Coordinator, Farmer to Farmer, Catholic Relief Services Tanzania), and Noel Felix Nnko (Managing Director NOGRA Enterprises Co. Ltd) for their financial, technical, and logistical support for this volunteer assignment. I also thank Tom Obreza from the University of Florida to allow me to take the time to fulfil this assignment and to cover for me while in Tanzania. Without the contributions of all these dedicated professionals and organizations, this assignment could not have been a success.

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1.2.1 Objective 1: **Facilitate the establishment of demonstration farms for hybrid sweet pepper and tomato production and training of small holder farmers on improved production techniques**

a) Progress with the objective:

-Developed with NOGRA Agricultural Consultant Mr. Felix Urasa "Good agricultural practices for tomato and pepper transplant production" (see Document 1)

-Before this stay, Mr. Urasa had produced enough 'Nowada' F1 tomato and 'Red Gate'F1 bell pepper (disease resistances unknown) transplants for both demonstration sites

-Helped prepare the land, transplant and irrigate at both sites. Plant stand looks good (Pictures 1 and 2; Document 2).

b) Expected impacts/results:

- Mr. Victor (Mkufi Estate Farm Manager) and Mrs. Penina – Farm Manager (Ndatu Village) will be the local "grower".
- Local farmers will get to see and learn a working demonstration
- NOGRA's Agricultural consultant Mr. Urasa will be able to facilitate the learning during the production cycle.

c) Recommendations[1].

-Continue monitor the crops daily; irrigate, fertilizer, scout and apply control measures as needed.

-Organize weekly visits at the sites with the local farmers.

-Use the tomato seeds that were brought from Florida (see Document 3) to follow current trials with a variety trial.

-When appropriate, use and update the enterprise budgets and sensitivity analyses for tomato and bell pepper (see Document 4) and inform small farmers on how to improve their cash-flow when increased input costs and increased yields are needed and achieved.

[1]***Note:***The most useful recommendations for hosts are ones that they can implement themselves with minimal expense. For example, a cooperative might change its financial reporting procedures or hold more regular meetings of its board. Broad recommendations on tax or credit reform, changes in government policy, or investment in large-scale equipment, are usually not within the host organization's reach.

Picture 1. Overview on October 22 (4 days after transplanting) of the 8 raised beds established in open field at the Mkufi Estates on October 18, 2014 with 'Nowada' F1 tomato and 'Red Gate' bell pepper.

Picture 2. Overview on October 22 (0 days after transplanting) of the 5 raised beds established under a covered structure at the Ndatu Village with ‘Nowada’ F1 tomato and ‘Red Gate’bell pepper.

Document 1

Good agricultural practices for tomato and pepper transplant production

(made based on local expertise available, materials available, and best professional judgment. Modify as needed)

For each batch, keep a journal of activities, practices and observations. Record variety and seed lot number.

1- Preparation of growing medium for transplant production:

-3 V of level 2 soil layer (to minimize initial disease inoculum level)

-2 V of forest soil (to provide organic matter and nutrients)

-1 V of sand (to control water holding capacity)

-Sterilize in boiling water for 3 to 5 minutes

(-when large batches of growing medium will be needed, consider investing in a laboratory-size autoclave when practical and economical)

2-Seeding and germination

-fill 160-cell trays (or smaller, depending on the growing system) with growing medium to the top of the cell. Gently compact the cells

-using tweezers, insert 1 whole, not broken seed of the selected varieties in each cell to about 4-mm depth

-water to point of dripping

-favor germination by placing trays at 28c in the dark for 3-4 days

-place the trays in the transplant production screenhouse in full light

3-Growing the transplants:

-equip the screenhouse with double doors opening to the outside; limit the number entries and people into the screenhouse; no smoking inside or around the screenhouse; ensure screen is not broken; if so, repair immediately; insert sticky traps in the screenhouse to trap insects that have entered and monitor number/types.

-water once or twice every day to the point of dripping.

- apply starter solution

- when plants are about 2-3 cm tall, gently brush the plants to make all the seed coats fall and free the young leaves

-scout for pests and diseases and control as possible/needed

-consider hardening the plants by withholding water for 1 day before shipping and keeping in the shade. Tomato transplants kept in the shade for more than 2 days will become leggy and will need to be planted deep.

-take transplants to production field when plants are about 10-15 cm tall (5-6 weeks). Supply 10% more trays than needed to compensate for germination rate.

- Only ship transplants that are green in color, disease-free, insect-free, and actively growing.

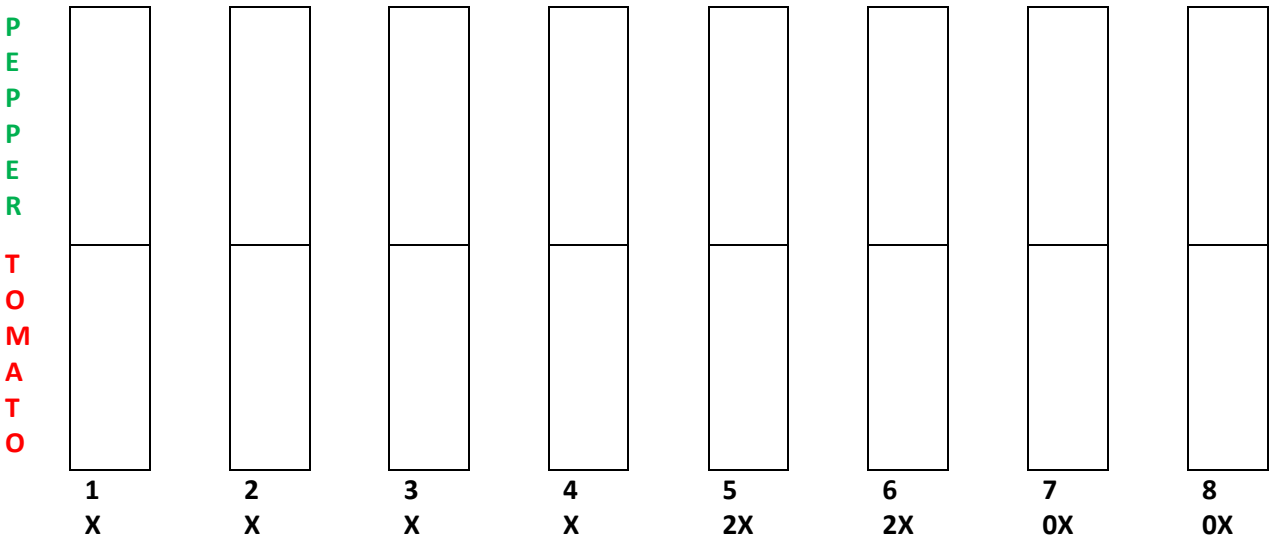
-when volume will require it and when economical, consider investing in or building a rack with shelves 25-cm apart to transport transplants. Rack could be custom-build for a commercial or passenger vehicle, or a stand-alone trailer. Transplants MUST be protected from wind (solid sides to vehicle).

Document 2

Field Map, Cultural Practices Used and Treatments Used

in the Tomato/Pepper Demonstration Plot

Conducted by USAID, CRS and NOGRA at the Mkufi Estate in October, 2014



Preplant Cow Doung rate: X= 1 bag/row

1 row = approx. 15 m; 1 bag = approx. 50 Kg; estimated nutrient content of dung: 1-0.5-1 (based on median value of literature)

1 x 50-kg bag contains 0.5-0.25-0.5 kg N-P2O5-K2O

X = 1 bag applied to 15m = 3-1.5-3 kg N-P2O5-K2O per 100m of row

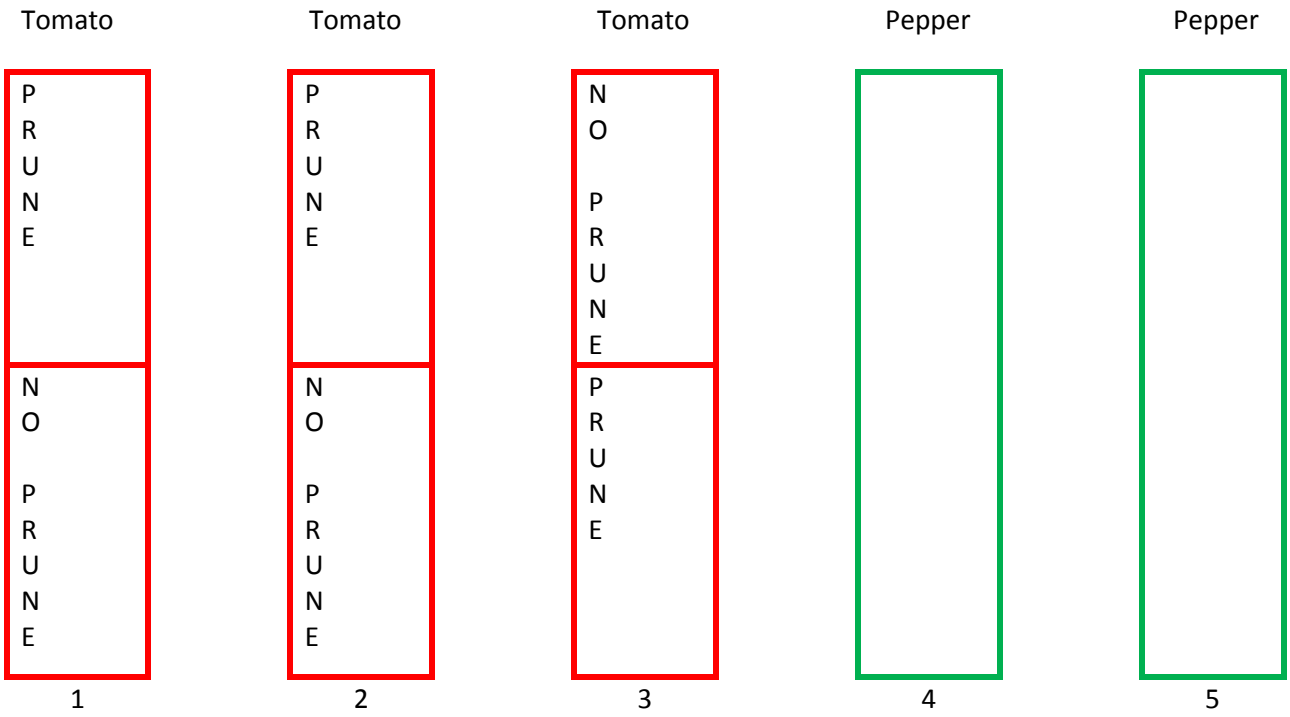
Target plant spacing for tomato: 50 cm or 200 plants/100m of row

(for comparison 200 lbs N/7,260 lbf = 2.75 lbs/100ft = 2.75 x 0.450 x 3.3 = 4 kg/100m)

Field Map, Cultural Practices Used and Treatments Used

in the Tomato/Pepper Demonstration Plot

Conducted by USAID, CRS and NOGRA at the MEA Group, Ndatu Village in October, 2014



Demonstration:

-When ready for first tie, prune 1 or 2 lower leaves from half of the plants in each tomato bed as shown above

Document 3

Entries for a Tomato Variety Trial

Conducted by USAID, CRS and NOGRA

Variety list (Seeds supplied by the University of Florida in October 2014):

Variety (Seed Source)	Type	Disease R/T
Florida 47 (Seminis)	Round	Verticilium Wilt Race 1, Fusarium Wilt Race 1 and 2, Alternaria Stem Canker, Spot and Gray Leaf Spot tolerance
Sanibel (Seminis)	Round	Verticilium Wilt Race 1, Fusarium Wilt Race 1 and 2, Root Knot nematodes, Alternaria Stem Canker, Grey Leaf Spot
HM8845 (Harris Moran)	Round	TYLC
Mariana (Sakata)	Roma	Verticilium Wilt Race 1, Fusarium Wilt Race 1 and 2, Alternaria Stem Canker, Spot and Gray Leaf Spot tolerance
Jolly Elf (SeedWay)	Grape	Verticilium Wilt Race 1, Fusarium Wilt Race 2, cracking
Tami G (Stokes)	Grape	None
Sweet Hearts (Sakata)	Grape	Cladosporum leaf mold, Fusarium Wilt Race 1

Document 4-Tomato

Enterprise Budget and Sensitivity Analysis for Tomato grown in North Tanzania

(from Tanzanian Horticulture Association analyses, 2014)*,**

Tomato Production Cost (Tshs/acre)		
Activity	Cost (Tshs)	Local estimate (Tshs)
Land preparation	130,000	
Planting materials	150,000	
Fertilizers	250,000	
Agrochemicals	200,000	
Labor	400,000	
Trellising	800,000	
Land rent	180,000	
Total Variable Cost	2,110,000	
Yield…	..20 tons	
Price…	..500shs/kg	
Revenue….	10,000,000	
Net Profit	7,890,000	

*the TAHA budget is not accompanied with a specific description of cultural practices. Hence, the comparison between current growers' marketable yields and profit margins above should be made with caution.

**The TAHA budget needs to be updated with specific cultural practices.

Sensitivity Analysis for tomato profitability:

Sensitivity analysis is a technique used to determine how different values of an independent variable (market price) will impact a particular dependent variable (crop value) under a given set of assumptions (crop yield).

Sensitivity analysis for tomato grown in Tanzania* for sales prices ranging from 100 to 700 Fshs/kg and production marketable yields ranging from 5,000 to 30,000 kg/acre assuming a production cost of 2,100,000 Tshs/acre.

Tomato sales price (Tshs/kg)	Tomato Marketable Yield (kg/a)					
	5,000**	10,000	15,000	20,000	25,000	30,000
100	500,000	1,000,000	1,500,000	2,000,000	2,500,000	3,000,000
200	1,000,000	2,000,000	3,000,000	4,000,000	5,000,000	6,000,000
300	1,500,000	3,000,000	4,500,000	6,000,000	7,500,000	9,000,000
400	2,000,000	4,000,000	6,000,000	8,000,000	10,000,000	12,000,000
500	2,500,000	5,000,000	7,500,000	10,000,000	12,500,000	15,000,000

600	**3,000,000**	**6,000,000**	**9,000,000**	**12,000,000**	**15,000,000**	**18,000,000**
700	**3,500,000**	**7,000,000**	**10,500,000**	**14,000,000**	**17,500,000**	**21,000,000**

*Crop gross value numbers in red indicate a loss; Crop gross values in blue indicate a profit less than double the cost of production.

**Tomato marketable yields reported by Mkufi area growers is 3,000 to 5,000 kg/acre.

Document 4 – Bell Pepper

Enterprise Budget and Sensitivity Analysis for Bell Peppers grown in Northern Tanzania

(from Tanzanian Horticulture Association analyses, 2014)*,**:

Pepper Production Cost (Tshs/acre)		
Activity	Cost (Tshs)	Local estimate (Tshs)
Land preparation	130,000	
Planting materials	100,000	
Fertilizers	250,000	
Agrochemicals	200,000	
Labor	400,000	
Trellising	1,100,000	
Land rent*	180,000***	
Total Variable Cost	2,180,000	
Yield…	..21 tons	
Price…	..500shs/kg	
Revenue….	10,500,000	
Net Profit	8,320,000	

*The TAHA budget is not accompanied with a specific description of cultural practices. Hence, the comparison between current growers' marketable yields and profit margins above should be made with caution.

**The TAHA budget needs to be updated with specific cultural practices.

***Not included in TAHA budget for peppers

Sensitivity analysis for bell peppers grown in Tanzania* for sales prices ranging from 100 to 700 Tshs/kg and production marketable yields ranging from 5,000 to 30,000 kg/acre assuming a production cost of 2,400,000Tshs/acre.

Bell Pepper sales price (Tshs/kg)	Bell Pepper Marketable Yield** (kg/a)					
	5,000	10,000	15,000	20,000	25,000	30,000
100	500,000	1,000,000	1,500,000	2,000,000	2,500,000	3,000,000
200	1,000,000	2,000,000	3,000,000	4,000,000	5,000,000	6,000,000
300	1,500,000	3,000,000	4,500,000	6,000,000	7,500,000	9,000,000
400	2,000,000	4,000,000	6,000,000	8,000,000	10,000,000	12,000,000
500	2,500,000	5,000,000	7,500,000	10,000,000	12,500,000	15,000,000
600	3,000,000	6,000,000	9,000,000	12,000,000	15,000,000	18,000,000
700	3,500,000	7,000,000	10,500,000	14,000,000	17,500,000	21,000,000

*Crop gross value numbers in red indicate a loss. Crop gross values in blue indicate a profit less than double the cost of production.

**actual growers' yields are not known to me at this time

1.2.2 Objective 2: **Build the capacity of selected local smallholder farmers in improved production of high quality sweet peppers, so that the smallholder farmers can tap into a lucrative niche market that is already identified.**

a) Progress with the objective:

- Progress with this objective is closely tied with that of objective 1 since the building of the screenhouse and the establishment of the demonstration sites were used as hands-on teaching tools.
- At each site, oral presentations were made by the volunteer and translated by Mr. Felix on insect pests, beneficial insects, diseases, and fertilizers for tomato and bell pepper.
- Hand-outs on identification of insect pests of tomato were distributed.
- Participants had a lot of questions – in particular about insects and fertilizers.
- The most important progress accomplished during this assignment has been building of trust and recognition of NOGRA personnel as competent in their business by the small farmers from Ndatu Village. Trust is the necessary ingredient for small farmers to continue to participate, stay engage, learn and ultimately change their production practices.
- The group dynamics at the Mkufi estates was positive and they showed interest in the project with attention mixed with a moderate amount of skepticism. Body language was revealing. On the first day, 11 farmers attended the presentation on insect pest. Only two sat down on the second day, but all the others stopped by to watch the progress of the demonstration and asked questions. This shows that different teaching methods may work better for each group.

b) Expected impacts/results:

- From a theory of change standpoint, these presentations increased awareness on many topics, mildly increased knowledge, and resulted in one intention to change behavior (several small farmers agreed that they should prune their tomato plants). Two weeks is too short a period to expect behavior change. At this point, this may seem as not much, BUT IT IS A LOT!

c) Recommendations:

- This project needs to continue support the use of demonstrations as a teaching method. The small farmers have a short attention span for technical information that does not directly correspond to their problems. They want answers – on the spot. Giving them the answers they need (to questions such as “how do I kill this insect?”, “how much of this fertilizer do I put” or “why did a pesticide that used to work no longer does?”) is tempting and it is what they need THEN. However, giving them simple answers is NOT the long term solution. Small farmers do not understand that weeds in the field and absence of crop rotations also contribute to insect populations and disease pressure. They do not understand what a fertilizer label is, and that the actual amount to apply depends on the N-P2O5-K2O content of the fertilizer. Finally, they do not understand that failure to rotate mode of action of pesticides builds resistance and decreases product efficacy. The point here is that we need to SHOW farmers a better way to grow tomatoes and bell peppers (and demonstrate the Good Agricultural Practices) rather than TELL them what they should do.

- At the same time, NOGRA needs to translate several of the technical documents relevant to tomato and pepper production so they become grower-friendly (See Document 5).
- Project managers need to be patient, and accept that Good Agricultural Practices adoption will be slow.

Document 5

List of Technical Materials used in Train the Trainer
During the TZ17 Assignment in October 2014

-UF/IFAS Florida Vegetable Production Handbook (hard copies; see www.edis.ufl.edu for on-line chapters)
-UF/IFAS Soil and Fertilizer Management for Vegetable Production in Florida (http://edis.ifas.ufl.edu/cv101)
-UF/IFAS Principles and Practices of Irrigation Management for Vegetables (http://edis.ifas.ufl.edu/cv107)
-UF/IFAS Pepper Diseases (PP12200 and VH05400) (http://edis.ifas.ufl.edu/pdffiles/VH/VH05400.pdf; http://edis.ifas.ufl.edu/pdffiles/PP/PP12200.pdf)
-UF/IFAS Insect Pests of Pepper, Tomato and Eggplant (IN16900) (https://edis.ifas.ufl.edu/pdffiles/IN/IN16900.pdf)
-UF/IFAS Pepper and Tomato IPM (IN73200) (http://ipm.ifas.ufl.edu/resources/success_stories/T&PGuide/)
-UF/IFAS Weed Control in Pepper (WG03400) (http://edis.ifas.ufl.edu/pdffiles/WG/WG03400.pdf)
-Seminis Pepper and Eggplant Disease Guide and Seminis Tomato Disease Guide (http://www.seminis.com/global/us/growerresources/Pages/Disease-Guides.aspx)

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1.2.3 Objective 3: **Build the capacity of NOGRA Enterprises Co. Ltd agriculture extension team**

a) Progress with the objective:

- Made a "Shelf inventory" of agro-chemicals at the NOGRA store in Arusha (on October 14, 2014) and developed a "Proposed Initial List of New Seeds/Agrichemical Sold by NOGRA for Tomato Production in Moshi, Tanzania region" (see Document 6).
- Jointly developed a plan on how to use the existing screenhouse (16m x 8m) for transplant production and distribution (see Document 7).
- Developed a list of Technical Materials Needed by NOGRA to provide product technical assistance to small farmers (See Documents 8 and 9).
- Discussed Good Agricultural Practices for harvest stage of tomato and pepper (see below).

b) Expected impacts/results:

-Through an expanded product line and technical representatives (one will be enough to start with). NOGRA is poised to provide the materials and expertise needed for the small pepper and tomato growers to adopt Good Agricultural Practices.

-Rather than selling seeds of improved varieties and letting each grower grow their own transplants in the open field (where they collect diseases and insect at an early stage), NOGRA could grow transplants in the newly build screenhouse and sell transplants to growers.

c) Recommendations:

-Work with the TROPICAL PESTICIDES RESEARCH INSTITUTE - ARUSHA – TANZANIA, to find the most recent version of "LIST OF PESTICIDES REGISTERED IN TANZANIA", (Made under Section 18 of the Plant Protection Act, 1997 and Plant Protection Regulations GN 401 of 1999). The most recent version accessible on-line dates back from 2007.

-Progressively expand product line based on the TPRI list, pesticide cost and material registrations as presented in the Florida Vegetable Production Handbook (or other similar publication).

Document 6

Shelf inventory of agro-chemicals at the NOGRA store (on October 14, 2014)*

Product type	Product name	Grade/Active Ingredient
Fertilizer	Urea	46-0-0
	Ammonium Sulfate	21-0-0
	Yara Calcium Nitrate	15.5-0-0 + 19% Ca
	"Russian fertilizer"	20-10-10
	YaraMila Winner	15-9-20 w/6.7% Nit; 8.3% Am –SO3 9.5% – MgO 1.8% + B, Zn, Mn
	Synergizer	8-32-4. Looks like a pop up fertilizer
	Booster (foliar)	12-0-8
Herbicide	Oxyfend 24% EC	Labeled for "Grasses and broadleaves of onion"
	Galigan 240 EC	Oxyfluorfen- Labeled for "Grasses and broadleaves in sugar cane" and cabbage
	Round up	Glyphosate
Fungicide	Movil	Systemic
	AGRI-FoS 400	Systemic – K-phosphite for the control of Downy mildew and phytophtora
	Tankopa 50WP	87% Cu-hydrocloride
Surfactant	Super- GRE	
Insecticide	Marshal 250 EC	25% carbosulfan (Group 1A) Labelled for the control of sucking and soil insect pests of cotton
	Dume 40 EC	Dimethoate. Labelled for insect pests of tomato and roses
Seeds	Corn	Unspecified varieties
	Bell pepper	'California Wonder' - TMV resistant
	Roma tomato	'Tanya' - Fusarium Wilt (F) and Verticillium Wilt (V) resistant
	Cucumber	'Ashley' (OP)
	Mihchili-type cabbage	'Chihili' looseleaf Napa type
	Okra	'Clemson Spineless'

*Information provided is from the package of the product. Highlighted in yellow are the products which technical information could not be expanded/verified through an on-line search.

Comments:

-The fertilizer product line is currently adequate for tomato and bell pepper production. Pesticide and fungicide line needs to be expanded to cover all the pests faced by the farmers. Varieties with a more complete disease resistance/tolerance package should be offered for sale

-Tomato and bell pepper growers will be able to afford seeds of improved varieties and "better" pesticides only if their increase their ability to purchase them. This implies an increase of their profit margin (so they do not decrease their revenue) contingent on yield increases and reduction of post-harvest losses.

Document 7

Using the existing screenhouse (16m x 8m) for transplant production

How many trays can be seeded in each batch? How many acres of tomato or pepper can be planted if the house if full? **Greenhouse tray capacity is 396 trays (57,000 plants) that can establish 8.9 acres of tomato or 4.45 acres of bell pepper.**

Assumptions:

-house is 16m x 8m

-field planting pattern is 1 plant /50 cm, single row for tomato and double staggered rows 2 plants/50cm for peppers

- field production is conducted on rows that are 1.5m wide. Since 1 acre is 70m x 70m, there are 4,900/1.5 = 3,200 m of bed in 1 planted acre. This makes a plant need of 6,400 tomato plants/acre and 12,800 bell pepper plants /acre.

-Trays used have 160 cells and are 1 ft x 2ft

-germination rate: 90%

Calculations:

-linear feet of benches that can be built in the greenhouse:

Screen house width = 3m of bench + 2m center alley + 3m of bench.

Because of the position of the door, one usable side is 3m x 16m and the other one is 3m x 14m (average: 15m)

In 15m, there are 15 x 3 = 45 ft or 22 rows (trays are 2ft long).

In 3m, there are 3 x 3 = 9 ft. So, the benches can accommodate 18 trays on both sides.

Answers:

Greenhouse tray capacity: 22 x 18 = 396 trays

With a germination rate of 90%, the screenhouse can produce 396 x 160 x 0.90 = 57,000 plants in each batch.

With plant populations of 6,400 tomato plants/acre, the screenhouse can produce plants for 57,000/6,400 = 8.9 acres of tomato.

With a plant population of 12,800 bell pepper plants /acre, the screenhouse can produce plants for 57,000/12,800 = 4.45 acres of bell pepper.

Comments:

The 160-cell trays will need a solid support as they are not rigid enough to hold their own weight.

Current number of cells per try may need to be adjusted based on the crop.

An enterprise budget needs to be established to determine the cost of production (and the sales price) of the transplants.

A specialized trailer will have to be secured to safely transport the trays.

Document 8

Proposed Initial List of New Seeds/Agrichemical Sold by NOGRA

for Tomato Production in Moshi, Tanzania

1-Tomato Varieties (consult seed companies' websites and the Florida Vegetable Handbook for details):

Roma type: Mariana; BHN 685

Round type: "cool set" (for spring/winter planting): Amelia, Florida 47R, Sanibel, Seebring, Soraya

"hot set" (for summer planting): Florida 91, Phoenix, Solar Fire

2-Insecticdes (MOA class) (consult chemical companies' websites for MSDS sheets and labels and the Florida Vegetable Handbook for formulations; note the MOA class and the REI):

Admire (4A), Asana (3), Asail (7), Dipel or Xentary (11), Fullfil (9B), Lannate (1A), Malathion (1B), Sevin (1A)

3-Fungicides (active ingredient, MOA class) (consult chemical companies' websites for MSDS sheets and labels and the Florida Vegetable Handbook for formulations; note the MOA class and the REI):

Sulfur (S, M2), Kocide (Copper, M1), Bravo (chloratalonil; M5), Manzate (mancozeb, M3), Ridomil (mefurexam + mancozeb; M4+M3)

4-Herbicides:

Hoeing and/or glyphosate (Round up) for fallow weed control.

5-Fertilizers:

In the absence of precise soil characterization and soil test, fertilization is a bit of a guess game.

NOGRA currently offers an adequate line of products:

Product name	**Grade**
Urea	46-0-0
Ammonium Sulfate	21-0-0
Yara Calcium Nitrate	15.5-0-0 + 19% Ca
"Russian fertilizer"	20-10-10
YaraMila Winner	15-9-20 w/6.7% Nit; 8.3% Am –SO3 9.5% – MgO 1.8% + B, Zn, Mn
Synergizer	8-32-4. Looks like a pop up fertilizer

No recommendation made to change this at this time.

Document 9

Proposed List of Technical Materials Needed by NOGRA Enterprises

These documents are needed to order, store and properly sell seeds, insecticides and pesticides.

Core documents for NOGRA management and technical staff (in English):

1- **Variety technical description** (Collected online) including (when available) the number of seeds/kg, variety type, days to maturity, and disease resistance/tolerance. Keep a collection of pdfs and update as needed.

2- **Material Safety Data Sheet** (MSDS; collected online) for each insecticides and fungicides. Keep a collection of pdfs. Keep a collection of pdfs and update as needed.

3- **Pesticide labels** (Collected online) for each insecticides and fungicides. Keep a collection of pdfs. Keep a collection of pdfs and update as needed.

4- **Good Agricultural Cultural practices** for each crop (can be adapted from those of the University of Florida). They should include field sanitation, land preparation, fertilization, irrigation, and weed, disease and pest control, harvest, and post-harvest handling.

5- **Enterprise budgets** and **sensitivity analysis** for each crop.

6- **Guides for insects and diseases scouting, identification and control.**

Educational documents for clients (in Swahili):

1-**Variety information** (picture, type, days to maturity, disease resistance/tolerance)

2-**Insect scouting and identification guide**(frequency of scouting; identification egg masses, juvenile stages and adults, thresholds; control tools)

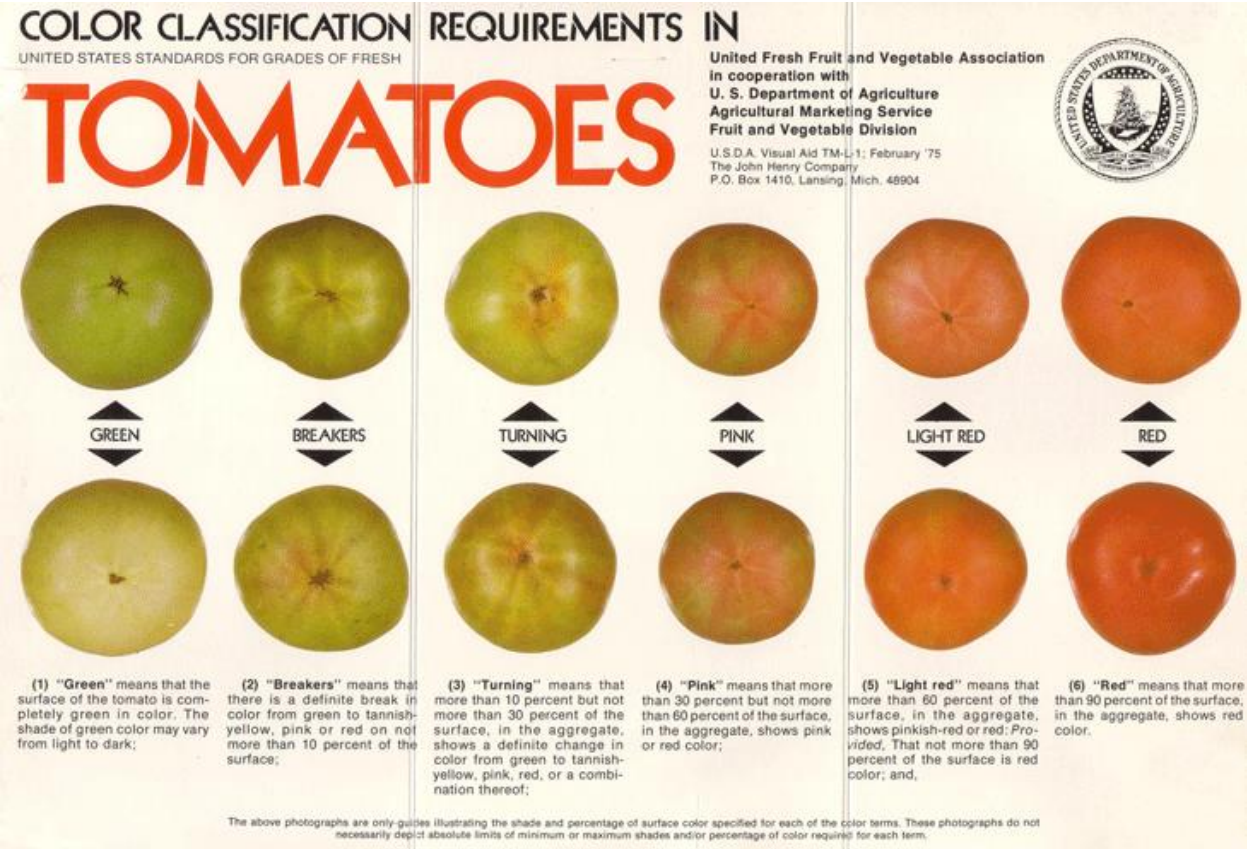
3-**Disease scouting and identification guide**(frequency of scouting; disease symptoms; control tools)

4-**Good AgriculturalCultural practices** for each crop (can be adapted from those of the University of Florida). Should include land preparation, fertilization, irrigation, and weed, disease and pest control, harvest, and post-harvest handling (see Document 5 for source documents).

5-**Enterprise budgets** and **sensitivity analysis** for each crop. This information is needed for NOGRA product pricing determination and farmers to determine pest control program cost and affordability.

Document 10

When should tomatoes be picked for longest shelf-life?



COLOR CLASSIFICATION REQUIREMENTS IN

UNITED STATES STANDARDS FOR GRADES OF FRESH

TOMATOES

United Fresh Fruit and Vegetable Association
in cooperation with
U. S. Department of Agriculture
Agricultural Marketing Service
Fruit and Vegetable Division

U.S.D.A. Visual Aid TM-L-1; February '75
The John Henry Company
P.O. Box 1410, Lansing, Mich. 48904

GREEN | BREAKERS | TURNING | PINK | LIGHT RED | RED

(1) "Green" means that the surface of the tomato is completely green in color. The shade of green color may vary from light to dark;

(2) "Breakers" means that there is a definite break in color from green to tannish-yellow, pink or red on not more than 10 percent of the surface;

(3) "Turning" means that more than 10 percent but not more than 30 percent of the surface, in the aggregate, shows a definite change in color from green to tannish-yellow, pink, red, or a combination thereof;

(4) "Pink" means that more than 30 percent but not more than 60 percent of the surface, in the aggregate, shows pink or red color;

(5) "Light red" means that more than 60 percent of the surface, in the aggregate, shows pinkish-red or red: *Provided*, That not more than 90 percent of the surface is red color; and,

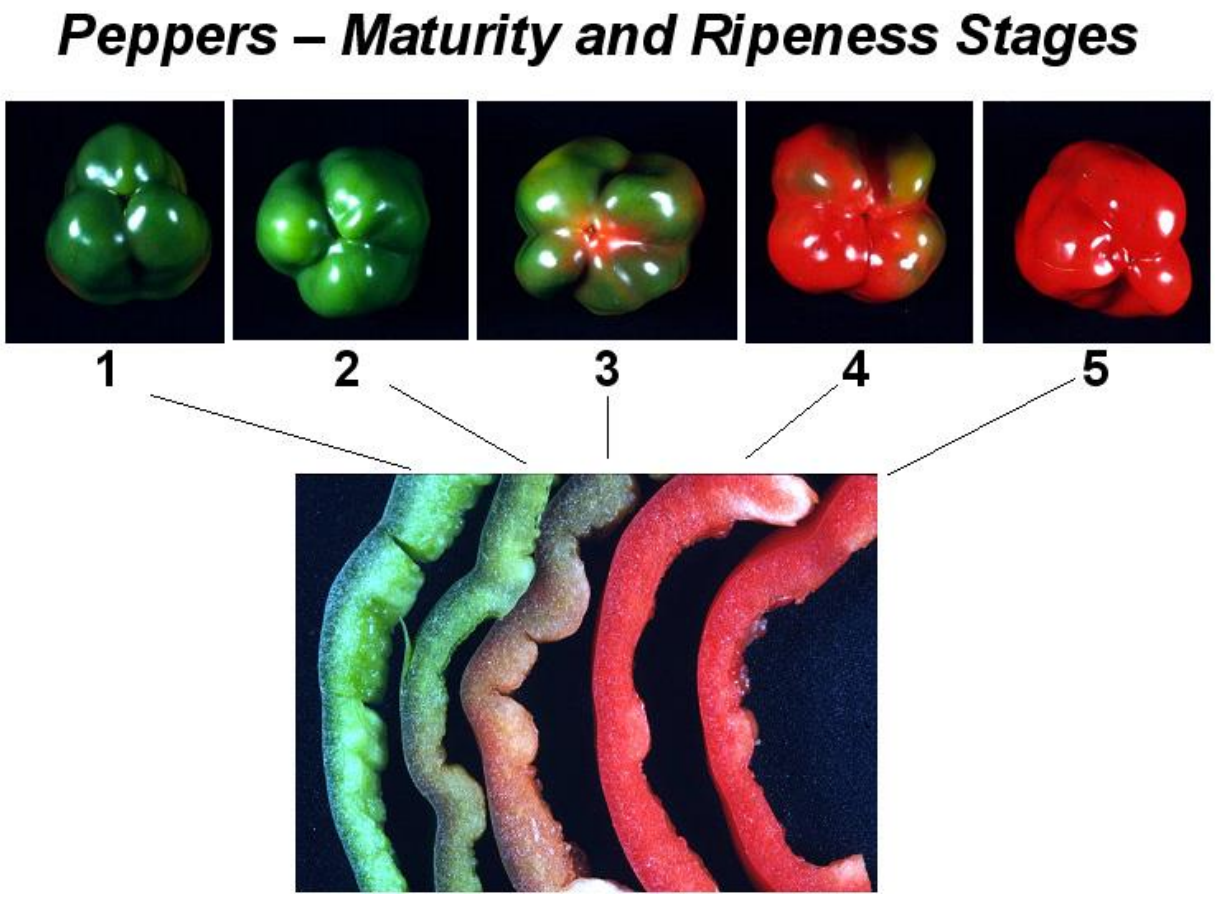
(6) "Red" means that more than 90 percent of the surface, in the aggregate, shows red color.

The above photographs are only guides illustrating the shade and percentage of surface color specified for each of the color terms. These photographs do not necessarily depict absolute limits of minimum or maximum shades and/or percentage of color required for each term.

Document 11

Bell Pepper Maturity Stages

All Bell Pepper varieties go through different color stages. As such, there are no “green varieties”. In the examples below, color stages that are stable and marketable are noticed in CAPITALS. Varieties picked at the green stage are GREEN-to-RED varieties. Other color transitions are green-YELLOW-light orange, green-to-ORANGE, green-to-BROWN-to-red, green-to-BLACK-to red, WHITE-to-yellow, and PURPLE-to yellow.



1.3 Number of People Assisted:

a) Through formal training – **approx. 30**
b) Through direct technical assistance (Do not double count). **Many attendees brought samples of their problems. Also conducted farmer's plot visits in MKufi Estates (8) and Ndatu Village (3)**
c) Out of these above, number of host staffs - **2**
d) Training/assistance by field:

Category	**Total**	**Males**	**Females**
Members/ owners			
Employees			
Clients/ Suppliers			
Family Members			
Total	30	21	9

1.4 Gender:

a) What gender roles did you recognize in your host community? Did these roles play a part in your assignment? How?

Some leaders are men and some are women. Contact time with either was too short to make meaningful observations.

b) How might CRS or the host organization improve opportunities for the women in this host or host community?

CRS and NOGRA should work first with the leaders of the villages who are interested in the project, men or women. If it facilitates the learning, then separate men and women trainings could be offered based on interest.

1.5 Value of volunteer contribution in $:

a. Hours volunteer spent preparing for assignment: **20 hours**
b. Estimated value of all material contributions volunteer contributed to host during assignment
For a + b and volunteer time, the University of Florida contributed an estimated at $5,000 to this assignment.

1.6 Value of hosts' contribution in $ (See Document)

a) Meals: **$0**
b) Transportation:
c) Lodging: **$0**
d) Translation:
e) Other (Specify)

Document 12

Host Contribution to USAID CRS Volunteer Assignment TZ17 (October, 2014)

(i) Building of shed house at Ndatu village (costs 2,212,800/= Tshs equivalent to $ 1,333 USD)

(ii) Supplying Agri inputs to demonstration farm (1,600,000 Tshs = $ 964USD)

(iii) Land Rent (1 acre for five years) 1,000,000/= Tshs = $ 603 USD

(iv) Translation costs (120,000 Tshs) $ 72USD

(v) Drinking water (0.5 liter) 7 bottle @ 600 = 4,200 Tshs = $ 3USD

(vi) Gift to Volunteer for Credible contribution to smallholder farmers Tshs 166,000/= $ 100USD

Total Contribution $ 3,075 USD equivalent to Tshs 5,104,500/=

1.7 Host Profile Data:

Did you obtain any data that supplements or corrects the data in the existing host information as detailed in the SOW? Please list it.

Nothing to add here.

1.8 Recommendations for CRS:
See Document 13

Document 13

TZ17 Volunteer Recommendations to USAID, CRS and NOGRA for follow up:

Recommended to	Topic	Cost	Urgency
CRS	-Continue support the development and expansion of a tomato and bell pepper industry in North Tanzania on the 3-5 year term.	Variable	High
	-Dedicate 10% of overall project funds for OE and demonstrations projects and supplies –such as basic soil test kit, hand-held soil moisture probes, petiole sap meters, sticky traps, field hand lenses, and/or insect pheromone traps. -The supplies may either be purchased locally or brought by the next volunteer	Low – if existing funds are reassigned	High
	-CRS needs to support a volunteer/intern at cropping season-level demonstration project to demonstrate and educate farmers on the following topics: -On the technical stand point, tomato and pepper farmers need to improve their competencies and cultural practices in (1) field sanitation, (2) variety selection, (3) insect management and (4) disease	Low – if funds from short-term-volunteers are reassigned	This is the first next necessary step

	management. - Next will come (5) nutrient management, (6) harvesting, and (7) post-harvest handling. -Consider seeking UF Doctor of Plan Medicine students looking for (and needing for their curriculum) internships		
	-Next assignment could be a short course "Basics of vegetable production in Tanzania" for the training of field technical agents. For a 5-day course, topics could be (1) soil testing, fertilization and irrigation, (2) variety selection and field sanitation; weeds and herbicides, (3) insects and insecticides, (4) diseases and fungicides, (5) harvest and postharvest, (6) field trip. Training could be a combination of lecture, discussions, hands-on applications, exercises. -personnel: 1 or 2 volunteers possibly from the University of Florida	Low – if existing funds are reassigned	This is the second next necessary step
	-Support and organize an annual grower conference in 2 years	High	Low
NOGRA	-Maintain existing line of fertilizer materials	Low	High
	-Make a business plan for new products: varieties, insecticides, fungicides	Low	Medium
	-Make contacts with sale representatives with seed and chemical companies and establish supply into Tanzania.	Medium/High	High
	-Develop an internship announcement for a 6-month DPM internship to assist CRS	Low	High
	-Establish a demonstration site for varieties and cultural practices with CRS	Medium/high	Medium
	-Maintain and operate field supplies Some funds should be allocated to essential demonstration supplies (basic soil test kit, hand-held soil moisture probes, petiole sap meters, sticky traps, field hand lenses, and/or insect pheromone traps) for demonstration and training on nutrient management and pest monitoring	Low if supplied by CRS	High
	-Translate key publications in Swahili with CRS	Medium	Medium
	-Include a grower short course in the scope of work	Low	High
	-Organize with CRS a grower short course	Medium	High
	-Collect online technical descriptions of varieties and make a collection of pdfs	Low	Medium
	-Collect online technical descriptions (MSDS and labels) of insecticides and fungicides and make a collection of pdfs	Low	Medium
	-Conduct an inventory of pesticides available in the Arusha-Moshi region, compare it to the TPRI list of approved pesticides, and determine gaps.	Low-Medium	Medium-High

1.9 Additional Resources:

Soil Fertility Status and Its Determining Factors in Tanzania.http://cdn.intechopen.com/pdfs-wm/25268.pdf

Soils of Tanzania.http://kilimo.go.tz/agricultural%20maps/Tanzania%20Soil%20Maps/Webbased%20Districts%20Agricultural%20maps/Districts%20Soil/Soils%20of%20Tanzania.pdf

Soil pH map of Tanzania.http://www.amitsa.org/CMSPages/GetFile.aspx?guid=b2494bd3-9ba2-48f3-8832-811f296fe793

Grafting Capsicum to Tomato Rootstocks.

http://www.jyi.org/wp-content/uploads//articleimages/3661/Grafting%20Capsicum.pdf

IRAC MOA classification.http://www.irac-online.org/documents/moa-classification/?ext=pdf

FRAC.http://www.frac.info/publication/anhang/FRAC%20Code%20List%202013-final.pdf

TROPICAL PESTICIDES RESEARCH INSTITUTE - ARUSHA – TANZANIA, 15th November,2007, LIST OF PESTICIDES REGISTERED IN TANZANIA, (Made under Section 18 of the Plant Protection Act, 1997 and Plant Protection Regulations GN 401 of 1999)

http://www.kilimo.go.tz/publications/english%20docs/list%20of%20pesticides%20registered%20in%20Tanzania%20by%20Nov%202007.htm

Cattle manure management in East Africa: Review of manure quality and nutrient losses and scenarios for cattle and manure management. 2009. Livestock ReseachWageningen, NL, Report 258.

[End of Report]

Prepared by volunteer.