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PILOT PROJECT FOR FRUIT AND VEGETABLE MARKETING IN CHAD

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1. INTERACTION WITH COOPERATORS/CONSULTATIVE CONTACTS

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TOUR OF FACILITIES/MARKETS AND MEETINGS HELD:

During the tour of duty no produce was being harvested from the project sites, however, produce from other regions were being merchandised in N'Djamena markets. As familiarization to products, containerization, and modes of transport, visits were made to the Central, Cholera, and Millet wholesale/retail markets. Tomatoes, melons, watermelons, and okra have been targeted for emphasis in this current project and all but watermelons were available for observation in the city markets. Containers and transport being used were similar to those available in the project area.

Four meetings were held with growers within the project area. Attendance at each meeting ranged from 21 to 35 growers. Meeting locations were Baltram, Djani, Gredaya, and Sidje. Depending on recession of lake water, start of planting is anticipated about December 15.

Seed is a major concern among growers. The supply ranges from inconsistent to unavailable. Frequently, seeds are purchased by "type", not specific variety. Some growers save their own seed but without regard for genetic purity; seeds and the resulting vegetables produced are extremely variable and heterogeneous.

There are two major types of tomatoes produced in Chad. The Roma is an elongate type with a high solids content. This tomato is well suited for processing because of the solids content but having thick walls it is well adapted to rigors of handling and marketing. This tomato serves well as dual purpose tomato and for this reason is recommended for emphasis in the current project. The round types of tomatoes have thinner walls, a greater pro- portion of jell surrounding the seed and are more susceptible to physical damage and bruising. The round types are generally superior in flavor. In general, the round types are

more sensitive to high night temperatures and therefore have more problems in fertilization and fruit-set. "Hot Set" is a new variety of a round tomato that has been developed to set fruit under conditions of higher night temperatures; possibly this variety would be well adapted to conditions existing in Chad.

2. ENHANCEMENT OF MARKET QUALITY PRODUCE THROUGH IMPROVED SEED

GOAL: The goal is to make high quality vegetable seed available to farmers of the groupement federation.

OBJECTIVE: The objective of the seed program is to:

- Increase the distribution of high quality, open pollinated seed to growers.

- Develop a program for systematic field selection of seed plants with market preferred genetic characteristics.

- Train farmers in selection of seed plants and procedures for processing the mature fruit for seed.

Background: There is no reliable supply of high quality vegetable seed available to the farmers in the Karal area. In the past, farmers have depended on supplies of seed from, ONDR, SECADEV, and private sources, primarily from Nigeria. The problems have been:

- Obtaining preferred types and varieties
- Poor quality of seed:
  - germination rate
  - genetic characteristics

- Late availability
- Inadequate quantities of seed
- Use of hybrid varieties that cannot be used for seed the next season.

Program Summary: In the coming season the project proposes to supply a limited amount of high quality open pollinated seed of one of the preferred market varieties for tomatoes, cantaloupes and watermelons to selected groupement farmers to be grown for seed and sold to groupement farmers. The project will train farmers in identifying plants with preferred genetic characteristics and processing the seed. Groupement farmers will be encouraged to share seed.

Evaluation Indicators: The success of this program can be evaluated based on:

- Approximately one hectare of seed tomatoes harvested and seed processed and stored.

- Approximately one half hectare each of cantaloupe and watermelons harvested and seed processed and stored.

- Farmers use seed next season.

Implementation: The seeds will be selected by Dr. Sal J. Loscascio of the Horticultural Department of the University of Florida and supplied by a commercial seed company. The seeds will be sent from the seed company by courier (Federal Express) directly to ACDI Chad. Arrival date of the seeds is expected to be about December 15.

Tomatoes: 1 pound of Roma/ San Morzono type tomato seed. This quantity of seed will sow about 1 hectare and the expected yield in seeds at an 80% germination rate will sow about 200 hectares.

Cantaloupe: 2 pounds of a good netted type, orange flesh cantaloupe. This quantity of seed will sow about half a hectare and the expected yield in seeds at an 80% germination rate will sow about 100 hectares.

watermelon: One pound of the Charleston Grey type. This quantity of seed will sow about half a hectare and the expected yield in seeds at an 80% germination rate will sow about 100 hectares.

The project team will identify progressive Federation farmers to grow the plants and harvest the fruit for seed. The procedures from planting, transplanting, harvesting and processing for seed will be supervised by the project team. Participating farmers will receive a portion of the seeds from their field as their payment for the use of their resources. Remaining seed will be packaged and stored at the Federation Building to be sold to farmers in the next season.

The project team will be meeting the major growers in the first and second weeks of December to identify participating seed growers and explain the program to them.

Criteria for Selection of Seed Growers

- Active/prominent member of groupement participating in the Federation.
- Major producer in the area.
- Willingness to hold field days at the production site.
- Seed cultivation field located so that it is available for field days.

Seed Cultivation Requirements:

Sidje/Djani:

- Tomatoes: Six farmers cultivating an average of 50 meters square. Improved seed variety not interplanted with other varieties.

- Cantaloupes: One farmers cultivating about 50 meters square. Improved seed cantaloupe should be 2 kilometers isolated from other melon growing areas.

- Watermelons: One farmers cultivating about 50 meters square. Improved seed watermelon should be 2 kilometers isolated from other melon growing areas.

Karal/Baltram:

- Tomatoes: Six farmers cultivating an average of 50 meters square. Improved seed variety not interplanted with other varieties.

- Cantaloupes: One farmers cultivating about 50 meters square. Improved seed cantaloupe should be 2 kilometers isolated from other melon growing areas.

- Watermelons: One farmers cultivating about 50 meters square. Improved seed watermelon should be 2 kilometers isolated from other melon growing areas.

Guitte:

- Tomatoes: Six farmers cultivating an average of 50 meters square. Improved seed variety not interplanted with other varieties.

- Cantaloupes: One farmers cultivating about 50 meters square. Improved seed cantaloupe should be 2 kilometers isolated from other melon growing areas.

- Watermelons: One farmers cultivating about 50 meters square. Improved seed watermelon should be 2 kilometers isolated from other melon growing areas.

Field Days:

Field days are to be scheduled in at least one of the plots in each of the areas for each of the crops at a harvest session and the mashing and canting for fermentation step of seed processing and at the washing and drying and storage stage.

Procedures for Processing Tomatoes for seed:

1. Harvest fruits at the ripe stage. This can be at any ripe stage from early red to overripe.

2. Cut fruits crosswise and squeeze out jell & seed into a container (pail or sack). The pulp can be discarded.

3. Let seed/jell ferment for about 48 hours and stir once or twice. The purpose of this is to induce fermentation which will help separate the jell from the seeds and destroy seed borne disease organisms.

4. Decant seeds, washing with clean water. Pour off residue (the seeds will stay at the bottom.

5. When seeds are clean, spread them out to dry.

6. Store dried seed in a dry place (cool if possible). Ideally seeds may be kept in air tight container (glass or plastic) so they don't pick up moisture.

Procedures for Processing Cantaloupe and Watermelon for seed:

1. Harvest fruits at the ripe stage. This can be at any stage from half-slip to overripe.

2. Scoop out seed cavity or seeds & adjacent pulp into a container (pail or sack) and save seeds and the pulp.

3. Let seed sit for about 48 hours and stir once or twice. The purpose of this is to induce fermentation which will help separate the pulp from the seeds.

4. Decant seeds, washing with clean water. Pour off residue (the seeds will stay at the bottom.

5. When seeds are clean, spread them out to dry.

6. Store dried seed in a dry, cool place. Ideally seeds may be kept in air tight container (glass or plastic) so they don't pick up moisture.

3. HARVEST MATURITY

Tomatoes -

Tomato fruits mature on the plant and then ripen on or off the plant. Mature fruits have attained the normal size and have developed sugar and acid potential for desirable flavor. Ripening consists of cell wall softening by proteolytic enzymes, appearance of carotenoid pigment (yellow/orange color) which mask chlorophyll (green pigments) and then development of anthocyanin or red pigment. Color designations for ripening tomatoes are: green, breaker, turning, pink, light red, and red.

The breaker stage is the first visible category that can be identified, as green fruits may be either mature or immature. Fruits harvested at the breaker stage will ripen normally and attain edible quality equivalent to those harvested at a more advanced ripening stage.

Harvesting should begin when the majority of ripening fruits are in the breaker to turning stages but before about 10% of the fruits have ripened to the light red or red stage. Fruits of these advanced stages of ripeness are too soft for normal transport and will become badly bruised, split and a source of decay contamination to other fruits in the container.

Melons -

There are three major types of melons and they have different maturity indexes, therefore they will be considered individually.

Muskmelons ("cantaloupe") - These melons should be harvested at the "full-slip" stage. When melons are harvested less than "full-slip", they have not achieved their full potential for sugar content, flavor, texture, or aroma. Also, the netting on immature melons is easily damaged and, therefore, the melon surface is more susceptible to moisture loss and decay.

Indexes of proper harvest maturity include fruit color and appearance of the net. Skin color changes from dark green or gray to light gray and then to light or pale yellow, depending on the particular cultivar. When fruits are mature, the net becomes raised, broader, and covers more of the surface than on immature fruits.

Honey Dew - For local market use, the most desirable harvest maturity is when fruit color is white to a pale cream, surface is slightly waxy, small areas of the blossom end are springy, and there is a slight aroma, mainly at the blossom end.

Persian, casaba, other types - Proper harvest maturity is reached when the blossom end yields slightly to applied thumb pressure. Also, fruits should have some definite yellow color, although in the case of crenshaws they may be fully dark green

with only slight patches of yellow. The casaba melon is hard and the internal flesh is white, graduating to light green next to the rind. Mature persian melons are hard and have a yellowish mottling showing between the grayish netting. The ground spot is well defined and is ivory to yellow.

Watermelons

Living and functioning vines are essential to produce high quality melons and the vines should be kept healthy as long as harvesting is continued. High quality melons for local markets should be harvested fully ripe.

There are several characteristics that indicate fruit maturity including: color or bloom (a very delicate powdery coating on the melon); changes in tendril color from green to brown and drying; when thumped, the sound changes from a metallic ring when immature to a soft, hollow sound when mature; and the yellow color of the ground spot. The best test of ripeness is experience, and to cut and taste a few melons taken at random from various parts of the field. Watermelons will not sweeten after harvest. For high quality melons, the soluble solids content should be at least 10%, determined by refractometer, measured near the center of the fruit.

A knife should be used to cut the ripe melons from the vine, leaving not more than a one inch stem. Pulling the vine from the melon may cause the fruit to crack. Melons should not be stacked or shipped standing on end because of increased susceptibility to cracking in that position.

4. SORTING, GRADING, AND HANDLING PRACTICES

All edible fruits and vegetables are living products and therefore respire, utilizing stored carbohydrates with the accompanying formation of energy in the form of heat. The rate of respiration is best controlled by reducing product temperature. Tomatoes, melons, and watermelons all have relatively low rates of respiration, therefore, under normal conditions the rate of respiration is not of major consequence.

When these vegetable products are exposed to direct solar radiation prior to harvest, fruit temperature can be 15 - 20 degrees higher than ambient. Therefore, these vegetables should be harvested in the cooler part of the day to minimize product temperature. Additionally, these freshly harvested fruits should be carefully handled to avoid mechanical damage, shaded to protect from solar radiation, and exposed to air movement to dissipate respired heat. Any mechanical damage to the products will result in additional generation of heat.

Harvested tomatoes should be sorted in the field before being containerized. Cull fruits are being co-mingled with

marketable fruits and sent to market. These cull fruits have little or no value and contribute to increased transportation charges. In the final analysis, growers are paid on the basis of marketable produce. Additionally, cull and damaged fruits are a source of contamination (bacterial soft rot) to normal tomatoes.

Currently, it is not recommended that grade standards be established for tomatoes. Enforcement would be futile, furthermore, theirs is a wide range in consumer acceptance of size and condition of fruits.

Knowledge concerning product temperature after harvest, during transport and marketing could aid handlers in taking proper action to dissipate product heat and thus prolong the shelf-life of the vegetables.

5. CONTAINERIZATION OF PRODUCT

The standard tea crate is readily available in this country and is the preferred container for fresh vegetables. This container is roughly 50 cm square and holds about 75 to 80 pounds of tomatoes. The tea crate is non-vented and therefore does not permit ventilation within the crate. Excessive volume and lack of ventilation renders this crate a poor container for fresh tomatoes. Durability of the crate is about 2 years depending on careful handling and minor repairs.

Modification of the standard tea crate is planned. Crate volume will be reduced by 1/2 by reducing height and adding a bottom to the top 1/2-section.

Regardless of tea crate volume (full or 1/2 size) major benefit could be realized by restricting harvest to tomato fruit maturity at the "breaker" or "turning" stage. These tomatoes are much more firm and capable of withstanding fruit pressure within the crate. This earlier maturity of fruit should ripen to a red color in about 48 hours. Adjustment in "frequency of harvest" would have to be made to obtain a high proportion of "breaker" or "turning" fruits.

Fruits that have ripened to the "pink" or "ripe" stage have soft wall tissue and therefore are very susceptible to bruise or splits. These tomatoes should not be packed in the same container with less ripe fruits. Also, to maintain quality of these softer tomatoes they should be packed in containers holding only small quantities (less than 15 pounds) or diverted to processing, depending on supply demand in the fresh market.

Tomato containers made from molded plastic, or other durable materials should be evaluated. These containers would be more expensive initially, but would have greater durability and therefore may be cost competitive. Plastic containers would also be much easier to decontaminate between uses and therefore reduce

the incidence of pathogenic microorganisms. Pilferage of plastic containers would be high without adequate control.

Tea crates are relatively well suited for melons. Watermelons should not be stored on their ends, therefore, the larger types such as Charleston Grey, should not be containerized; bulk loading would be preferred.

6. VEGETABLE STORAGE (TEMPORARY HOLDING)

Under normal conditions existing in this country, storage of vegetables would not be anticipated. Proximity of production areas to markets in the N'Djamena area are such to favor a rapid distribution of fresh vegetables. However, a pilot storage facility, consisting of an evaporative cooler, should be constructed in the marketing area. This storage facility could extend the period of marketability of tomatoes harvested at the breaker to turning stage, and reduce product temperature for normal ripening to the red stage.

Normal tomato ripening occurs with the development of carotenoid pigments followed by anthocyanin which is the red pigmentation. At high temperatures, generally above 80 degrees F, the anthocyanins fail to develop and therefore tomato fruits remain yellow/orange in color. Some growers have experienced this poor color development, but have blamed the condition on poor genetic material instead of pigment physiology. Under proper storage conditions and the utilization of an evaporative cooler, it is anticipated that the proper tomato temperature could be attained, permitting normal ripening to the full red color.

Preliminary tests with a sling psychrometer in the N'Djamena area, November 15, 16, 1991, resulted in the following data:

Temperature F		
Dry bulb	Wet bulb	Relative Humidity (%)
94	65	18
89	63	20
79	59	30
70	55	23
92	64	19
86	61	20

The wet bulb temperature averaged 24 degrees F below the dry bulb temperature, indicating a substantial cooling effect could be attained by proper operation of an evaporative cooler. The feasibility of storage with evaporative cooling will be determined after the initial pilot study has been completed.

It is suggested that simplified tests be conducted to ascertain the extent to which high fruit temperature may be a problem with red color formation. A suggested test is:

A. Determine fruit temperature at time of harvest.
B. Attach thermocouples (micro temperature sensors) to specific fruit and position these tomatoes at various levels in the shipping container (tea crate).
C. Determine temperature of those specific fruits in "B" at time of packing, at time when transport to market begins, upon arrival at N'Djamena market, and then just before crate is to be unpacked.
D. Determine color of ripened fruit and establish whether fruit temperature adversely effects color development.

7. ALTERNATE USE OF TOMATOES

Milled tomato powder, obtained from dried fruits, is readily available in the market. Tomato powder has inconsistent quality as to color and storability. Improved powder could be obtained by being more selective of the ripe tomatoes used, thorough drying and then milling of the product before rehydration takes place. Dried tomatoes, or the powder therefrom, can readily absorb available moisture from the atmosphere. Packaging of freshly milled tomato powder in plastic bags, or other moisture-proof containers, would prevent rehydration and should improve color retention of the powder.

Other forms of tomato processing should be investigated. The plastic "pouch" could be a viable alternative to canning. In strategic rural areas, small-scale "processing kitchens" could be established and thus provide an additional food source, while at the same time stabilize price of fresh market tomatoes in the N'Djamena area by reducing the supply of these fruits. Glass bottles that could be repeatedly reused, could also be an economic processing container for these rural areas.

A number of canned tomato products, imported into Chad and offered for sale at retail markets, show signs of content spoilage. The extent of such spoilage is unknown. These spoiled cans of tomatoes don't have value, and furthermore possess a health hazard if eaten. Canning of Chad tomatoes (the over-supply from fresh market) could be a viable alternative. These canned tomatoes would be from fresh stock and therefore have an extended shelf-life. A pilot canning facility could be established to determine feasibility and economic potential.

8. TECHNOLOGY TRANSFER

In order to attain ACDI project goals, a few select growers within the project area should be identified. Grower selection should be on the basis of desire to participate, ability to function, and agreement to share technology with neighboring growers. ACDI staff would work directly with these selected growers to establish production, harvest, and postharvest technology to maximize product quality.

Periodically, neighboring growers would be invited to view demonstration plots and field days to observe techniques being practiced by the selected growers. SECDEV Rural Development personnel would also be urged to attend these training sessions and then take relevant information to other growers in their assigned areas.

During the first year, select growers should be kept at a minimum to assure that ACDI staff have sufficient time and capabilities for adequate supervision and training. During the second year, the number of selected growers could be enlarged because of experienced gained and the increased grower training received during the first year. Growers should receive additional training through scheduled meetings and discussion groups.

Scope of the project could be enlarged the second year by bringing TDY Specialists in and focusing on processing technology which would enhance project goals.

FINAL RECOMMENDATIONS

1. MARKET INFORMATION TO GROWERS

   A. Develop marketing information service so growers can have an understanding of market supply and demand.
   B. Relay quantity/price information to growers so they can adjust quantity of product for fresh market and diversion to processing.
   C. Assist growers in planting decisions based on previous year's market and anticipated production for current year.

2. ENHANCEMENT OF MARKET QUALITY PRODUCE THROUGH IMPROVED SEED

   A. Obtain pure lines of open pollinated seed. Tomato should be restricted to Roma type and possibly "Hot Set" for observation/evaluation.
   B. Increase seed for distribution to growers. Actual seed increase would be by selected growers which received the original pure lines.
   C. Train growers to produce/save their own seed.
   D. Maintain a minimum supply of foundation seed for future increase as needed.
   E. Encourage Chadian Agency to produce & distribute seed: The first step would be to bring seed in from outside of the country, increase seed of promising varieties and then make these seeds available to local growers

3. HARVEST MATURITY

   A. Tomatoes -
      (1) Harvest at the "breaker" to "turning" stages in tea crates for fresh market distribution.
      (2) Harvest "pink" to "ripe" stages in mini crates for fresh market distribution.
      (3) Harvest "pink" to "ripe" stage for processing.
   B. Melons -
      (1) Harvest at "modified-" to "full-slip" stage
   C. Watermelons -
      (1) Harvest at full ripe stage only

4. SORTING AND GRADING

   A. Remove overmature produce
   B. Eliminate produce that is badly misshapen, damaged or in any stage of decay
   C. Separate minimum maturity vegetables from advanced stages of maturity
   D. Protect harvested vegetables from direct rays of sunlight and provide cooling when possible

5. PRODUCE CONTAINER EVALUATION

Optimum containers for produce handling are not available in Chad. Existing containers will be evaluated for effectiveness and protection. Use of existing containers may be a viable alternative if modifications can be made to produce stacking patterns and harvest maturity. Comparative evaluations will be made between:

A. Standard tea crates & current range in product maturity
B. Standard tea crate holding only early stages of tomatoes ("breaker" and "turning")
C. 1/2 size tea crate vs tomato maturity
D. Plastic container fabricated outside of Chad

Evaluations will consist of durability of container, longevity, cost, and protection to product.

6. STORAGE (TEMPORARY HOLDING)

Storage at Karal is not a viable alternative to N'Djamena due to the remoteness from markets, the short duration for handling, the need to off-load, then re-load, and availability of trucks. An evaporative cooler will be installed in N'Djamena and evaluated for tomato holding. Variables to be considered:

A. Tomato ripening rate
B. Longevity of product
C. Color enhancement of ripe tomatoes
D. Stability of supply
E. Economic benefits to growers & consumers

7. ALTERNATE USES FOR TOMATOES

Overmature and over supply will be processed and economically evaluated. SODI facilities at Karal could play an important role in this evaluation. The processed product would need to meet standards of quality equivalent to imported products. Variables to be considered:

A. Improved drying for milling into powder
B. A bottle-pack for primary use in the rural areas
C. Evaluation of "pouch-pak"
D. Paste or concentrate targeted for the metropolitan areas

8. TECHNOLOGY TRANSFER

A. Work directly with select growers within the project area to model production techniques and postharvest technology
B. Establish demonstration plots and conduct field days at select grower sites, for other growers in the area
C. Assist SECEDEV Rural Development technicians to learn relevant postharvest technology and encourage them to transfer such information to other growers within their assigned areas.

9. TECHNICAL SUPPORT

A. TDY personnel - A processing specialist should be brought in about January, to further enhance the project and improve the economic impact upon growers, shippers, and handlers. A production/postharvest specialist should be brought in late January or early February, when crops are being harvested and shipped.

B. Equipment and instrumentation needs for postharvest -
   1. Digital thermometer/thermocouple - for determining fruit temperature in remote areas of a container or holding room.
   2. Dial thermometer - for determinations of product temperature, storage temperature (general use).
   3. Refractometer - to determine the soluble solids content (degree of sweetness) of horticultural products. Is an aid in variety evaluation, quality retention during shipping and marketing, and general condition of the vegetable.
   4. pH meter - indicates the degree of tartness of products such as tomatoes. Best measure of tomato flavor is the combination of sugars/acids (can be determined by refractometer & pH meter).
   5. Sling psychrometer - determines the relative humidity of the air and indicated the effectiveness of an evaporative cooler.
   6. Chlorine test kit - chlorine is an effective disinfectant of surface decay microorganism, particularly on tomatoes.