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Cold Chain Assessment for Iraq

FINAL REPORT



Inma
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Table of Contents

EXECUTIVE SUMMARY.....	6
SCOPE OF REPORT.....	9
BACKGROUND.....	10
DEFINITION OF KEY TERMS.....	11
THE INTEGRATED COLD CHAIN	12
POST HARVEST HANDLING.....	12
PROCESSING AND PACKAGING.....	12
COLD STORAGE AND DISTRIBUTION	12
REFRIGERATED TRANSPORTATION	13
SALES	13
COLD CHAIN STRATIGIC OBJECTIVES	14
CONSTRAINTS TO COLD CHAIN DEVELOPMENT IN IRAQ	15
AWARENESS.....	15
SECTARIAN AND TRIBAL ISSUES.....	16
INFRASTRUCTURE AND LOGISTICS	16
ACCESS TO CAPITAL OR CREDIT.	16
ACCESS TO MODERN TECHNOLOGY	16
INADEQUATE RAW MATERIAL SUPPLY	17
TRAINING AND TECHNOLOGY TRANSFER	17
COST OF INPUTS AND ENERGY	17
ENVIRONMENTAL RULES AND REGULATIONS	18
INADEQUATE COLD CHAIN CAPACITY	18
FRUIT & VEGETABLE SECTOR ASSESSMENT	19
POST HARVEST HANDLING.....	19
PROCESSING & PACKAGING	21
COLD STORAGE & DISTRIBUTION	22
Cold Storage Facility.....	22

Assessment	22
Specific Recommendations	22
Commercial Cold Storage Facility	23
Assessment	23
Structure	23
Operation	23
Requested Assistance	24
Specific Recommendations	24
REFRIGERATED TRANSPORTATION	25
SALES	26
Wholesale Markets	26
Al Hilla Governorate Wholesale Market.....	28
Karbala Wholesale Market.....	29
Al Taji Wholesale Market	29
Sulaymaniyah Wholesale Market.....	29
Erbil Wholesale Market.....	30
Najaf Wholesale Market.....	31
Al Hillah Wholesale Market.....	31
Baghdad Al Alwa Wholesale Market.....	32
Rasheed Wholesale Market.....	32
Diwaniyah Wholesale Market	33
Retail Markets.....	33
Taji Gypsy Market.....	33
Sulaymaniyah Retail Market	33
Diwaniyah Retail Market	34
POTENTIAL SITES FOR COMMERCIAL PACKING HOUSES	35
CENTRAL EUPHRATES FARMER'S MARKET	35
Assessment.....	35
Specific Recommendations	35
FALLUJAH INDUSTRIAL PARK.....	35
Assessment	35
Specific Recommendations	38
MEAT & POULTRY SECTOR ASSESSMENT.....	39

FISH SECTOR ASSESSMENT.....	40
DAIRY PRODUCTS SECTOR ASSESSMENT	41
STRATEGIC PLAN FOR COLD CHAIN IMPROVEMENT	42
FRUIT & VEGETABLE SECTOR.....	42
Fruit & Vegetable Market Basket Focus Group	42
Retail Marketing Study	42
Training, Education and Extension Outreach	42
Refrigerated Transportation	42
Retail Ready Marketing Concept	42
Training At the Central Euphrates Farmer's Market	47
Cold Chain Demonstration Project	47
Regional Research & Review	47
Expansion of Cold Chain Activities	47
Improve Post Harvest Handling Systems	47
Potential Impact of Fruit & Vegetable Recommendations	48
MEAT & POULTRY SECTOR	48
FISH SECTOR	48
Effective Use of Clean Ice	48
Skip Generation Fish Marketing	48
Dairy Products Sector	49

Executive Summary

The following is a summary of key findings and recommendations addressed in the Cold Chain Assessment report:

KEY FINDINGS

- The existing cold chain for fresh fruits and vegetables is dysfunctional. The integrated cold chain includes the movement of perishable products from harvest to market, including post harvest handling, processing, packaging, storage, refrigerated transportation, as well as sales and marketing. In Iraq, there are significant elements of the cold chain that are either missing or dysfunctional. Most specifically, the absence of proper post harvest handling, packaging, refrigerated storage and refrigerated transportation are significantly impacting cold chain movement. It is estimated that at the present time the majority, perhaps 90 percent or more, of the local perishable fruits and vegetables are moving from farm to market without the benefit of any refrigeration. This is in stark contrast to many of the imported produce items that arrive and are sometimes stored in refrigerated trucks at wholesale markets.
- At the present time, imports dominate the Iraqi marketplace for fresh fruits and vegetables. Iraqi produce is in short supply during most of the year, and imported produce has filled the vacuum created by the absence of farm level production in Iraq. However, as production efficiency increases, improved security allow for more farmers to farm, and transport to the market improves, the volume and availability of Iraqi produce has the potential to skyrocket. This increase in marketable goods is desirable from a volumetric standpoint, but it also has the capability to flood the market with local produce and subsequently severely depress market price during peak harvest seasons.
- Traditional wholesale markets are inherently destructive to product quality, and represent the lowest value point for Iraqi produce in the marketplace. The markets are antiquated and primitive, and result in lower quality produce and farm gate prices for local farmers. It is unlikely that these markets can be substantially improved to the level that would support cold chain activities, including refrigerated storage, display and transportation adequate to preserve the value of high quality local produce.
- Existing cold storage facilities or sites, such as the newly renovated facility in Al Hillah and the Cold Storage Trailer Park in Erbil, are limited in number and capacity. Those that do exist are not appropriate for the type of storage necessary given the present evolution of the cold chain in Iraq. Cold storage in Iraq, for the time being, should be focused on smaller capacity units with a short term storage emphasis. Long term storage is not feasible at the present time, and large capacity facilities are inefficient and costly to run with the current level and cost of energy.

- There is a gross lack of awareness of and appreciation for cold chain systems at all levels of the industry. Farmers are not aware of the beneficial impact of removing field heat and getting fresh products into refrigeration; wholesale markets lack the awareness to utilize cold storage to improve product shelf life, and the basic belief that fruits and vegetables will be consumed within a few days limits the creative thinking and desire to integrate products into cold chain systems.
- There is a lack of refrigerated infrastructure and capacity necessary to support the cold chain. Value added packing facilities, short term storage, refrigerated transportation, and refrigerated display at the point of sale are all inadequate to support the existing fresh fruit and vegetable production base in Iraq, and are not developing at a rate quickly enough to create capacity as the farming industry recovers in Iraq.
- Packaging systems currently used in the fruit and vegetable sector are having a negative and exasperating affect on product quality. The recent introduction of polyethylene and other plastic bags for bulk storage of fresh products has severely hindered product quality, shelf life and food safety. The poly bags are transparent, which allows sunlight and damaging UV rays to penetrate and impact the products; the poly bag does not “breathe” to allow natural product respiration to escape the bag, leading to condensation and a incubation effect; the high humidity environment combined with damaged fruit and vegetables provides a breeding ground for microorganisms; and the packaging is not rigid enough to support the product weight, resulting in considerable compression and physical damage to products under their own weight.

KEY RECOMMENDATIONS

- Training & Education: Post harvest handling, including harvest maturity, sorting, grading, packing, food safety, storage, distribution and transportation are necessary. Creating awareness and providing compelling information for cold chain handling will help drive the demand for cold chain systems.
- Retail ready marketing.
 - Supply side: Provide grants for complete small-scale mobile field packing units with the capacity to pack 30 to 50 MT of product from a 2 km radius over a few days time. The units would include shade, produce handling equipment, sorting & grading equipment, packaging lines, pre-cooling and short term refrigerated storage. A concept paper has been developed for consideration. The estimated cost of each unit is around \$75,000.00.
 - Packing House: Integrate the mobile field packing units with Fresh Fruit & Vegetable Packing Houses (FFV PH) currently being developed as part of the *Inma* project and expected to come on line in mid-2009. The FFV PH would serve as the collection point for field packed produce, and would be the distribution center (DC) for direct to retail marketing efforts. *No additional cost to the project.*

- Demand Side:
 - Refrigerated Transportation: Establish a refrigerated distribution network to alternative marketing channels for fresh fruits and vegetables packed at either the mobile field level units or FFV PH in order to market fresh products within the cold chain directly to retail end points. This would involve leasing or finding an entrepreneur to lease or provide small (up to 10 MT) trucks for delivery of chilled produce to retail end points. *No additional cost to the project.*
 - Distribution Center: Utilize a part of the FFV PH as a short term DC for retail ready marketing. The FFV PH would receive products from the mobile field packing centers as well as produce value added products as part of day-to-day operations. *No additional cost to the project.*
 - Develop Alternative Market Channels: The *Inma* project would provide a full time support person to manage the DC, develop marketing channels, and market products through new marketing channels. *Annual salary to be determined.*
- Project expansion outside of Baghdad: With rapid growth in the areas south of Baghdad, including Diwaniyah and Najif, the opportunity exists to build a larger consumption base for value added fruits and vegetables in the cold chain, including tourist and retail centers. In addition, the recent renovation of the areas to the north, including Erbil, are prime locations for cold chain improvements. These areas are excellent candidates for retail ready marketing activities.

Scope of Report

This final report encompasses the initial assessment tour of the *Inma* Cold Chain Technical Specialist, Dr. Stephen Neel, from December 3 to 21, 2008, and the follow-up assessment tour from January 25 to February 28, 2009.

The assessment report will discuss the status of the existing cold chain for perishable foods in Iraq, as well as the known constraints to expansion of the cold chain in the short term. Recommendations for tactical operations and programs to improve the integrated cold chain in Iraq are provided for consideration and discussion. It should be noted that some of the recommendations have already been implemented or acted upon, and summary documents provided as part of this final report. Support documentation, including conceptual diagrams and resource information is provided in the appendices.

Recommendations are provided under the context of short term impact, presuming a project completion date of May 2010, and longer term impact, presuming a project extension through May of 2012.

Background

Staple foods such as grains and root crops form the basis of most diets in under-developed areas of the world, whereas horticultural crops are important sources of vital nutrients, vitamins and minerals that are essential for human health and well being, particularly for children, pregnant and nursing women. Field studies have shown that 40 - 60% of perishable products produced in under-developed areas are lost before they can be consumed, mainly due to high rates of bruising, rancidity, spoilage, water loss and subsequent decay during post harvest handling. The post harvest chain includes all the steps between harvesting and consumption, including sorting, cleaning, packing, storage, transport and processing.

Most farmers sell their product through brokers or at traditional wholesale markets, whereby they sell on consignment and pay a commission to the vendor, and any product spoilage or loss that occurs during the sales window is borne by them. This significant amount of product waste makes the lives of farmers very difficult, as they often receive low prices for their foods, since marketing intermediaries know that the foods they handle will lose a considerable amount of value before they can be sold to consumers. Most small farmers use a “price taker” marketing strategy whereby they grow a commodity and offer it for sale to the highest wholesale bidder in the marketplace. In the case of horticulture or seasonal crops, this marketing strategy usually means that farmers receive low prices because when they have product for sale, so does every other farmer and there is a glut of particular produce commodities in the marketplace.

Implementing simple post harvest technologies can help small farmers store products and enable them to potentially get better prices by selling during off peak production times or extend usable shelf life beyond the day of harvest. Use of post harvest technologies to reduce fruit and vegetable losses enhances farming sustainability by reducing demands on natural resources, including energy, fuel, water, fertilizers and labor used to grow horticultural crops. In addition, improvements in post harvest handling and storage can effectively increase the distribution radius and marketing potential associated with cool chain initiatives, whereby farmers in rural areas can move more products to urban areas, with fewer losses, by using simple cold chain principles and practices.

Historically, the majority of attention and funding in global development projects has focused on increasing yields or growing new crops in production agriculture. While this aspect of agriculture is important, much of these investments are largely wasted when a crop is lost due to poor post harvest handling before it can be eaten or sold. More emphasis is needed on improving post harvest handling practices to improve the health and welfare of persons living in under-developed areas of the world.

Assuring the quality, safety and marketability of perishable products requires that everyone involved in the post harvest handling chain handle product appropriately. There is no one technology that can substitute for proper post harvest handling all along the distribution chain, as quality is the result of doing each handling step correctly.

Definition of Key Terms

Throughout the body of this report the terms “elements” and “sectors” of the integrated cold chain are used, as defined below:

ELEMENTS

The five key elements of the integrated cold chain are defined as Post Harvest Handling, Processing & Packing, Cold Storage & Distribution, Refrigerated Transportation, and Sales.

SECTORS

The four key sectors of emphasis within the agricultural complex are defined as Fruits & Vegetables, Meat & Poultry, Fish, and Dairy Products.

The Integrated Cold Chain

The integrated cold chain is a linked supply chain or value chain that transfers perishable foods from the point of harvest or sacrifice, in the case of animals, to the final point of consumption. Whereas each commodity and region of the world may have a slightly different perishable supply chain, the primary links of the integrated cold chain include the following five elements:

POST HARVEST HANDLING

Post harvest handling involves the procedures or techniques that happen immediately after harvest or sacrifice. In the case of horticulture crops, effective post harvest handling should occur at the field level, and can include effective pre-cooling and field heat removal systems as well as effective harvest packaging, including the proper use of crates and bins. Effective pre-cooling systems facilitate the rapid entry of perishable products into the cold chain, which will help reduce post harvest losses, decay and spoilage. With regard to sacrifice or slaughter of animals, time and temperature management, along with sound contamination or bacterial control measures, represent the key components of extending shelf life and producing a high quality meat product for human consumption. When considering post harvest treatments, temperature management should be considered the most important component of effective cold chain management, and begins immediately after harvest or slaughter. Poor post harvest or slaughter techniques may not be immediately evident, but will result in poor product performance and storage capability down the value chain.

PROCESSING AND PACKAGING

Processing and packaging are means to add value to products, while using the handling process to sort, size, grade and select products for consistency and quality. Processing should preserve inherent product quality and value, while adding value wherever possible through selection or technology that provides consumer appeal or value. It is important to note that products in the cold chain do not normally improve in quality, only maintain the inherent quality of the products produced. Packaging systems serve multiple roles, including preservation of the products by controlling the atmosphere or exposure to elements of spoilage. Packaging also provides an opportunity to attract consumers and promote the positive attributes of a product, and thus should not be taken lightly by companies attempting to add value to commodity products.

COLD STORAGE AND DISTRIBUTION

Cold storage and distribution services represent the next basic link in the integrated cold chain. The importance of cold storage and product distribution is often overlooked, yet

represents a significant area of emphasis in extending the usable and functional shelf life of perishable foods. Since most farmers or producers of commodity goods are “price takers”, they are victims of the supply and demand cycles associated with crop production. During the harvest season, when the volume of commodities is high, the prices are very low. By extending the storage life of products through effective cold storage management, farmers can sell their products “off peak” and capture more revenue during times of less supply and more demand. This fundamental nature of supply and demand is, in large part, influenced by proper cold chain management, including but not limited to the quality of post harvest handling, processing, packaging and storage of perishable products. Temperature management and operational efficiency are the key components to effective cold storage and distribution, and will result in longer shelf life, reductions in damage or losses, and an improved distribution radius of high quality perishable products outside of the production season.

REFRIGERATED TRANSPORTATION

Refrigerated transportation is often overlooked when evaluating the overall efficacy of the integrated cold chain. Once products are placed under refrigeration, it is imperative that they remain refrigerated until consumption in order to preserve the inherent quality of the product and validate the investment in processing, packaging and storage of the products. It is very common, especially in underdeveloped regions of the world, to transport refrigerated products in non-refrigerated or insulated transport vehicles, thereby exposing the products, even packaged products, to extreme temperatures and exposure to the elements. While this transportation component may be short in time and/or distance, the impact on the quality, safety and shelf life of the perishable product is significant, and can result in rapid decay or destruction from bacterial that may have already been on the product, but was inhibited by low temperatures provided by storage or refrigeration. Improper transportation can also diminish the appearance and perception of the product through damage during loading and unloading, or destruction of packaging equipment resulting from condensation or exposure to ambient elements. It is a shame to see high quality products that have received proper post harvest handling; processing, packaging and storage diminish in quality due to poor transportation or handling during the distribution process.

SALES

Sales to the end user, including retail, wholesale, institutional or food service, represent the ultimate goal of cold chain systems. Our mandate is to provide the highest quality products to consumers in the best possible fashion and with the highest perceived value. It is often said that the majority of cold chain damage to products results during the “last 30 meters” of distribution, or at the point of sale to end users. Improper receiving, storage and display of perishable foods results in considerable spoilage, decay, destruction or discounts. While it is understood that a great percentage of perishable foods are purchased at traditional wholesale markets, “wet markets”, “green markets”, bazaars or wholesale centers in underdeveloped countries, it is imperative that efforts to improve refrigerated storage and display at end point centers continue in order to drive more products into refrigeration.

Cold Chain Strategic Objectives

The strategic objectives of a fully functional cold chain, particularly with regard to cold chain improvement in Iraq include:

- 1) Improve the baseline quality standards associated with Iraqi produce,
- 2) Reduce the marginal cost to process and pack Iraqi produce relative to quality standards,
- 3) Extend the usable sales window for Iraqi produce beyond existing parameters,
- 4) Increase the volume of edible, high quality Iraqi produce for sale, thereby increasing gross revenue for farmers,
- 5) Generate measurable results during the 2009 and 2010 harvest seasons, and
- 6) Improve the image, perception and marketability of Iraqi produce.

It is important to note that efforts to reduce post harvest spoilage of perishable foods occur on two basic levels. A significant percentage of perishable products produced are transported and sold to end users without the benefit of refrigeration. These products travel from farm to fork without the benefit of refrigeration, and must be consumed very quickly to avoid excessive spoilage, loss or potential disease due to contamination. *Within this context, our cold chain efforts continue to be focused on getting more of these products into the integrated cold chain, by providing access to modern handling, storage and distribution facilities and encouraging the use of cold chain technologies.* Another primary area of emphasis is on improving cold chain handling and storage practices to improve the level of competency of those members of the integrated cold chain. In this case, the basic elements of the integrated cold chain may exist, but products are not being properly managed through the supply chain, resulting in damage, decay, or destruction prior to final sale to the end user. *Within this context, our efforts are focused on improving awareness of cold chain principles, improving operational efficiency and upgrading cold chain systems for maximum impact on product quality and safety.*

Constraints to Cold Chain Development in Iraq

While the integrated cold chain is really several independent links working in harmony to deliver high quality and safe perishable foods to end users, the constraints to improvement are quite similar, although they may be manifested in different ways. The following cross-cutting constraints to cold chain improvement exist in the Iraqi agricultural industry:

AWARENESS

Across all elements of the integrated cold chain there is a general lack of awareness of the financial benefits of the integrated cold chain, and the magnitude of impact “downstream” associated with breaches in the cold chain. Farmers focus, for good reason, on the production and harvest of their crops, often not taking into consideration their use of pesticides or herbicides and the resulting impact on post harvest life of the crop. At the time of harvest, little thought is given to the type of harvest equipment and harvest practices that will enhance cold chain handling of products throughout the value chain. Bacteria, bruises, damage and temperature abuse at the point of harvest has an additive effect during the later stages of processing, packaging, storage, distribution and sale of the perishable products. Field-level removal of heat, proper harvest procedures, proper use of containers and crates, and proper transportation to consolidation or packing sheds will pay huge dividends at later stages of production and storage of horticulture crops. In the animal world, proper post mortem procedures significantly impact shelf life potential and ultimate product quality, and begin at the moment of sacrifice. Companies that process, package or add value to perishable foods share an equal responsibility for preserving the innate quality of the products. Unfortunately, many in this sector of the business fail to appreciate the “cause and effect” of poor product handling and packaging, and suffer the losses associated with poor cold chain management. The storage sector, while seemingly simple, plays a critical role in temperature management, product handling and rotation for optimum shelf life and quality. Many in this industry fail to appreciate the impact of proper temperature, airflow and humidity requirements for fresh perishable foods as well as the importance of maintaining proper and consistent cooler and freezer temperatures for optimum product preservation during the storage period. Furthermore, the handling and distribution of perishable products post-storage often results in excessive damage, decay and destruction due to lack of knowledge and awareness of proper handling procedures. Finally, the sales sector, which is responsible for the final presentation to the end user, often times fails to properly receive, store and display the products on the basis of inadequate information pertaining to proper methods or the impact of poor procedures on end-point quality and marketability.

SECTARIAN AND TRIBAL ISSUES

Residual conflicts and hostility between Shiite, Sunni and Kurdish tribes continue to hamper integrated and cooperative cold chain development efforts. Unwillingness or inability to communicate and work across tribal and sectarian lines slows the potential for improvement in integrated cold chain development, training efforts, communication and cooperation amongst Iraqi businessmen.

INFRASTRUCTURE AND LOGISTICS

Iraq is still a war zone, and many years of war and sectarian violence have created significant problems with regard to basic infrastructure and logistics. Roads are in very poor condition, power supply and water are intermittent and unreliable. Furthermore, there are many checkpoints, both official and unofficial, that further delay the effective and timely movement of perishable products from farm to market without significant delay and destruction.

ACCESS TO CAPITAL OR CREDIT

Rural and agricultural companies have traditionally had a tough time gaining access to credit, loans or financing for improvements or investments. The commodity and “low value” nature of many agricultural products exasperates this circumstance, with low value end products produced at the peak of harvest providing little incentive for banks and credit institutions to take a position on providing credit. This is especially impact on small and medium sized enterprises (SME’s), which represent the backbone of the agricultural sector. As a result, many improvements in the integrated cold chain must be achieved with “low cost” and “no cost” interventions, providing ways to reduce spoilage, improve quality and safety while increasing processing efficiency without major capital inputs. This, of course, remains a challenge to all sectors of the industry.

ACCESS TO MODERN TECHNOLOGY

As integrated cold chain systems evolve they gradually, although sometimes dramatically, improve the level of technology used to produce, transport, process and store perishable products. Modern equipment and supplies are a key component to improving quality, safety and processing efficiency of cold chain systems, and evolve at a pace consistent with availability to credit and financing. All sectors of the industry experience constraints in their ability to purchase and install modern farming, harvest, packaging, processing, storage, distribution and display equipment and technology. Outdated systems result in outdated end products, many times lacking the inherent quality and safety to survive the distribution cycles required of modern day networks. Technology and equipment, of course, require investment and maintenance, which can be a limiting factor in the evolution of cold chain systems in underdeveloped markets.

INADEQUATE RAW MATERIAL SUPPLY

Agricultural crops, while necessary for human existence, are demand driven. Consumers purchase the products, for the most part, that they desire and perceive to be of high quality. Unfortunately, many underdeveloped markets and emerging markets have failed to improve crop varieties that keep pace with consumer demand. Further to that, farmers have failed to provide consistent volumes and products with consistent quality necessary to support cold chain improvement programs. This supply side problem is one of the few constraints to cold chain development that rest primarily with the production sector, but results in constraints to the other sectors of the industry when they can not source adequate quantities of high quality products that satisfy the consumer demand in the marketplace.

In Iraq, the desire for local products remains strong, with a specific and significant preference for locally produced items over that of imported goods, in spite of the fact that many of the imported items are cheaper and of higher quality. This “National Consumerism” provides hope for growth and success of the local production sector, provided farmers are able to adopt technologies that improve the volume and availability of items outside of normal production seasons. The effective use of new varieties, inputs and greenhouse technology will allow local producers to compete with imports more favorably.

TRAINING AND TECHNOLOGY TRANSFER

Human resources, in the way of training and technology transfer, remain a critical constraint to effective cold chain development in underdeveloped and emerging markets. Every sector is faced with this problem, with farmers needing access to information and training on modern farming methods, new varieties and inputs, and proper handling and harvesting systems. The packing and processing sector is in need of information on new handling and storage techniques, packaging technology and management programs to maximize quality, yield and safety systems. Cold storage and distribution systems, including advanced systems to modify atmospheres during storage, are constantly changing, thereby necessitating the transfer of new technology and training of warehouse personnel. And finally, sales sectors are in a constant need of new trends and marketing programs designed to entice consumer purchases and return visits. Training and technology transfer are driven by human interaction and sharing, with qualified personnel from developed industries spending time and energy sharing information and techniques with their professional counterparts in underdeveloped or emerging markets. This constraint represents a huge outreach possibility, but one that is often overlooked by development groups.

COST OF INPUTS AND ENERGY

The cost of conducting business is always on the rise, with skyrocketing input costs, including but not limited to fuel, energy, water, and refrigeration costs. All sectors continue to experience increasing costs for inputs, necessitating reductions in the cost to product end products through efficiency and management. Inputs, for the most part, can not be stockpiled but must be purchased on an ongoing basis, thereby increasing the need for effective management and control systems to keep costs down to reasonable levels.

In Iraq, access to “The Grid” is perhaps the primary constraint to cold chain development. Farmers are unable to secure reliable electrical power to run pumps and other equipment, processors are forced to utilize expensive generator power to run equipment and refrigeration, and businesses throughout the integrated cold chain suffer when public power supplies are available for only hours per day. Potable water, while available in most areas of Iraq, is generally provided at low pressure and must be pumped with limited power availability. Fuel for running local generators is generally available, but not cheap. It is estimated that generator power is ten times more expensive than “Grid” power, limiting or eliminating competitiveness when compared to imported items of the same variety.

ENVIRONMENTAL RULES AND REGULATIONS

Our world is changing, and the focus on “going green” has significantly impacted all sectors of the integrated cold chain. Waste management, chemical use, pollution and environmental impact laws are placing significant constraints on a business’s ability to operate. Farmers are especially prone to regulations and rules that limit farming inputs and practices, both in the crop and animal areas. The use of energy and refrigerants, especially ammonia and Freon, are under increasingly tight regulation, and procedures to manage waste produced from industry are becoming more stringent, presenting a constraint to traditional business development and growth.

INADEQUATE COLD CHAIN CAPACITY

As more and more perishable products are integrated in to the cold chain, issues of capacity and infrastructure will continue to constrain business growth. Cold storage capacity is of greatest concern, with severely inadequate supply to meet the growing demand for modern cold storage and modified atmosphere facilities. Further to that, the availability of refrigerated transportation trucks and improved roads from farm centers to storage facilities will continue to hamper the necessary growth of the cold chain in certain underdeveloped and emerging areas of the world.

Fruit & Vegetable Sector Assessment

POST HARVEST HANDLING

Figure 1 provides a visual summary of the existing flow of perishable fruits and vegetables harvested from local Iraqi farms through retail marketing. During the course of the cold chain assessment it was observed that virtually all, if not all, local Iraqi produce was distributed from farm to market without the benefit of refrigeration. This observation was supported by interviews and site visits throughout the country. There did not appear to be, nor was there any evidence of, any post harvest refrigeration, pre-cooling or cold storage usage during the transportation from farm to wholesale market, and the subsequent transport from wholesale market to retail sales outlet.

In comparison, imported products are much more likely to utilize, at least in part, refrigerated storage and transportation during the sales cycle. Some, although not all, produce is imported via refrigerated semi-truck trailers, and at several of the larger wholesale markets there was evidence of overnight or short-term refrigerated storage of imported products.

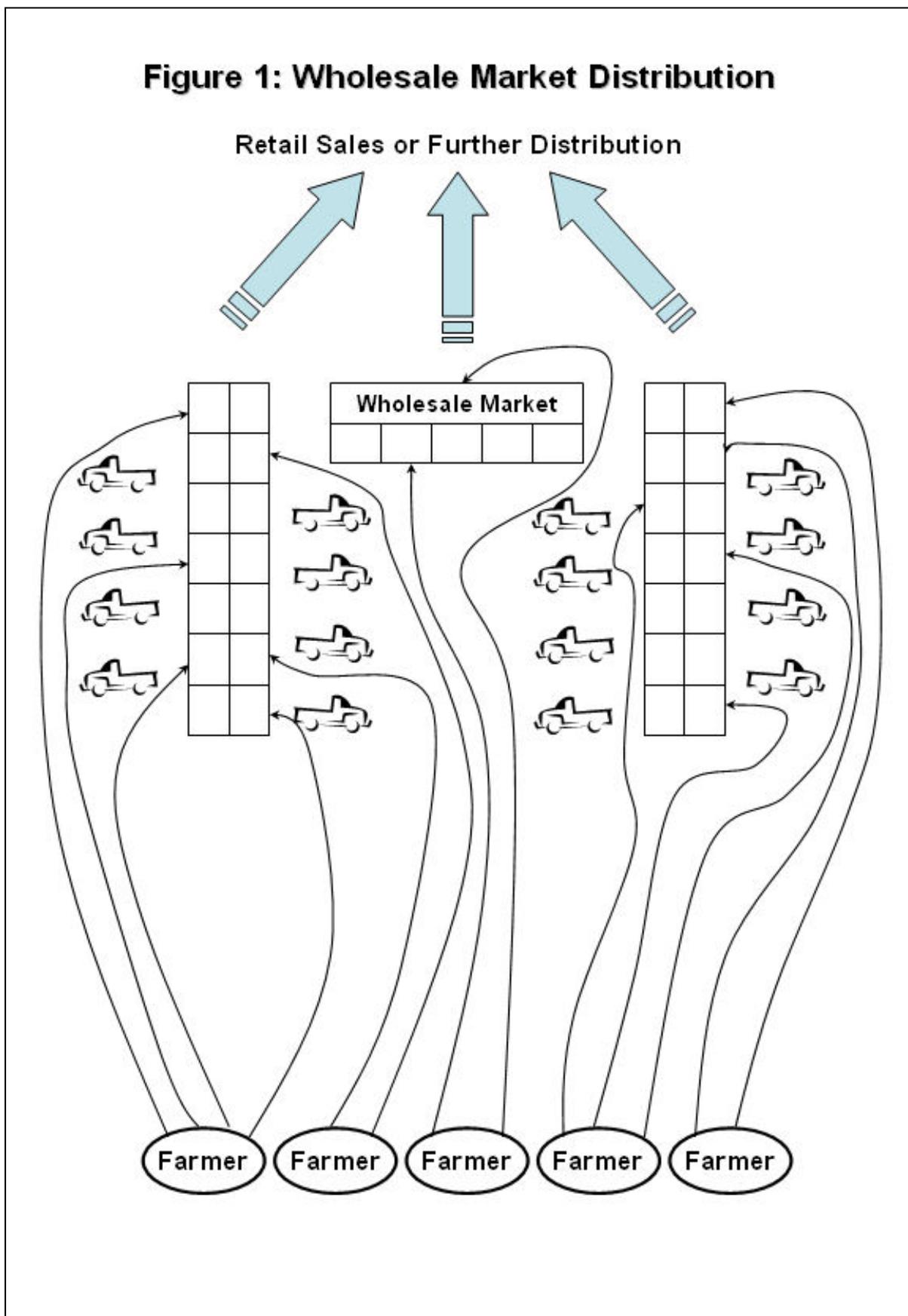
Post harvest handling of Iraqi produce was very poor, resulting in considerable damage due to dehydration, bruising, cuts, decay and subsequent devaluation. Photos one and two provide examples of post harvest damage commonly seen with local products. Note the severe damage and product dehydration due to low humidity storage and temperature abuse. Iraqi products have an estimated maximum shelf life of three days, during which time the products suffer from extreme exposure to environmental conditions of heat and low humidity. During the first day post harvest an estimated ten (10) to twenty (20) percent of the product is lost or severely discounted due to destruction and decay, whereas the percentage of losses increases over days two and three to an estimated 30 and 60 percent, respectively.

Improper handling practices, absence of proper storage and transport equipment (boxes & bins) and the use of polyethylene storage bags exasperate the problems seen at the wholesale point of sale.



Photos: 1 & 2: Post Harvest Damage to Iraqi Produce

Figure 1: Wholesale Market Distribution



PROCESSING & PACKAGING

Value added processing, including sizing, sorting, cleaning, grading and packaging is not commonly performed on Iraqi produce. In contrast to some imported products, which are properly sized, cleaned, packed and marketed, Iraqi produce is generally packed in bulk and sold without the benefit of value added handling. In comparing local and imported produce of the same type and variety, it is evident that the Iraqi produce is of inferior consistency, size and quality. However, in spite of these negative attributes, the Iraqi consumer seems to prefer the flavor and image of Iraqi produce, although volumes are insufficient to satisfy demand. Photos 3 and 4 compare Iraqi product and imported products of the same type. Note the difference in size, consistency and uniformity. In both photos the imported products are displayed on the left side, with the Iraqi products on the right. The green pepper is an example of undersized products being sold in competition with uniformly larger imported peppers, whereas the tomato photo displays uniform shape of imported products with misshapen Iraqi tomatoes.



Photos 3 & 4: Size, Consistency & Uniformity Differences between Imported and Iraqi Produce

Packaging systems currently used in the fruit and vegetable sector are having a negative and exasperating affect on product quality. The recent introduction of polyethylene and other plastic bags for bulk storage of fresh products has severely hindered product quality, shelf life and food safety. Photo 5 shows the negative effect of polyethylene bags on product quality and safety. Note that the products are stored in direct sunlight, and the evidence of condensation and compression damage due to excessive weight. The poly bags are



Photo 5: Polyethylene Packaging

transparent, which allows sunlight and damaging UV rays to penetrate and impact the products; the poly bag does not “breathe” to allow natural product respiration to escape the bag, leading to condensation and a incubation effect; the high humidity environment combined with damaged fruit and vegetables provides a breeding ground for microorganisms; and the packaging is not rigid enough to support the product weight, resulting in considerable compression and physical damage to products under their own weight.

COLD STORAGE & DISTRIBUTION

Cold storage systems for temporary (short term) storage of fresh fruits and vegetables is virtually nonexistent. As mentioned above, there are some portable storage units, long haul refrigerated trailers, used for short term storage of some imported products (mostly citrus) available, but the vast majority of local produce is not exposed to refrigeration during the post harvest to consumption cycle.

During the course of the assessment, several cold storage sites were identified and evaluated, including a trailer park in Erbil and a cold storage facility under renovation in Al Hillah. Those that do exist are not appropriate for the type of storage necessary given the present evolution of the cold chain in Iraq. Cold storage in Iraq, for the time being, should be focused on smaller capacity units with a short term storage emphasis. Long term storage is not feasible at the present time, and large capacity facilities are inefficient and costly to run with the current level and cost of energy.

COLD STORAGE FACILITY

SITE SUMMARY: ERBIL, FEBRUARY 11, 2009

Assessment

There is a moderate sized cold storage facility located adjacent to the Erbil wholesale market. This facility is new, and has a large asphalt pad for truck parking and turning, a large shade station for unloading trucks, an elevated dock, and 28 individual reefer containers for chilled storage. The 28 units are raised and placed on elevated blocks, although the containers are not covered or nested together. All containers are painted silver to reduce heat absorption, and are run with a combination of Gensets and back up generators.

According to facility managers, the cost for storing products in the cold storage area 500 USD per month. It is assumed that cold storage capacity is being used for imported products being held for sale at the wholesale market rather than for local products. At the time of our tour, which was winter, the facility was mostly empty, with only 2 containers having products in storage.

Specific Recommendations

The physical site is excellent, and requires no modification to be effective and functional. The pricing for the use of units appears to be prohibitive to local producers and marketers, and as a result the units will mostly be used for imported goods.

COMMERCIAL COLD STORAGE FACILITY

SITE SUMMARY: AL HILLAH FEBRUARY 20, 2009

Assessment

There is a large commercial cold storage facility under construction, and nearing completion, in the Al Hillah area. This facility, which was damaged during the 2003 invasion, is currently being renovated and reconstructed using Civil Emergency Response Program (CERP) funds from the U.S. Military as well as private investments from local businessmen.

Structure

The facility, located on 50 donum¹ of land, is extremely large. The structure includes a large, open air, elevated receiving dock with four adjustable ramps for large trucks. The receiving dock is ambient with a shade roof. Adjacent to the receiving dock is the ante-room, or airlock, which separates the dock from the storage chambers. The ante-room is refrigerated to 10C, and is an effective barrier between the external and internal environments. The doors appear to be of adequate quality to minimize temperature breach. There are four large chambers for frozen or refrigerated storage, located off of a central alleyway. The chambers are very large, approximately 38m x 25m, with a 6m high ceiling. Estimated size of 950 m² or 5,700 m³ per chamber makes this one of the largest known cold storage facilities in Iraq. The estimated storage capacity is 500 MT per chamber, or 2000 MT total. However, it should be noted that these estimates are based on floor level storage and not using advanced racking systems.

Cooling is provided using Freon, with a dedicated compressor for each cold room. The facility currently does not have back up compressors. There is a large cooling tower and water filtration system. The facility is designed to operate on electrical power, but current circumstances only provide for between 6 and 8 hours of available power per day. There are two large 1000 KW generators on site for back up and stand by power.

Chambers are capable of maintaining frozen and refrigerated temperatures. Frozen capability is to -35C.

Lighting and doors are modern, and adequate for the size and scope of the facility.

There are four (4) battery powered lift trucks for moving product in and out of the facility. However, the lift trucks are not capable of lifting and stacking pallets more than three high.

Operations

The facility is owned and will be operated by the Ministry of Trade (MoT). It was initially assumed that the facility was owned by the MoT, but would be sub-contracted or leased to businessmen for day-to-day operations, but this does not appear to be the case. The site should employ approximately 20 technical staff (engineers, upper management) and up to

¹ Donum – Arabic unit of area: one metric donum is equal to 2,500 square meters.

200 laborers. MoT representatives indicate that the facility will be used for both government purchases as well as private industry, with public space being available for rent to local businessmen and entrepreneurs.

Requested Assistance

Representatives from the MoT requested assistance from Inma in the following ways:

- **Compressors:** While the site has four compressors for the four chambers, a request for assistance in purchasing the two additional back up compressors to support the system was made. The piping is already in existence.
- **Product Scales:** A request was made for assistance with the purchase of a 100 ton scale for weighing inbound and outbound products.
- **Lift Truck Batteries:** While lift trucks are on site, the battery packs to operate the trucks are spent, and need to be replaced. Evidently, the charging equipment is still operational.
- **Security System:** A request was made for assistance in purchasing the closed-circuit security monitoring system for the internal and perimeter of the facility.
- **Racks:** The chamber rooms lack any racking systems. When the facility was operational in the past, there was no racking systems used, and products were only stacked one pallet high. New management understands the need for modern pallet racking systems, which would significantly increase the storage capacity of the facility and facilitate product movement, rotation and worker efficiency.
- **Cold Gear:** The request was made for assistance in purchasing cold-weather operational equipment, including cooler coats, gloves, boots and headgear for employees working in the cold rooms.
- **Operational Equipment:** Facility management have requested assistance in purchasing monitoring and management tools for operating a refrigerated warehouse, including sensors, leak detection equipment and other emergency aids.
- **Transformer Maintenance:** The existing electrical transformer is over 30 years old and in need of maintenance. The MoT requested Inma assistance with this function.
- **Welfare Trailer:** Evidently, there is no available space for offices for the engineers, and the request was made for assistance in purchasing a mobile trailer for the engineering staff.

Specific Recommendations

It appears that this facility was originally designed for storing large quantities of imported frozen products, perhaps meat. The renovations are excellent, and of a first-class nature. However, the functionality of the facility, as configured, is limited by the nature of the materials in the marketplace and the internal structures of the facility.

The rooms are too large for the volume of product currently in the marketplace, and seem much more conducive to large volumes of imported products. If proper racking is procured and installed, and if the rooms are sub-divided, they may be more functional for use by local vendors and small-scale entrepreneurs. One option is to create a Public Refrigerated Warehouse (PRW) facility, whereby the management receives, puts away, stores, picks, and ships products, sometimes on a case-by-case basis, for clients. Another strategy would be to sub-divide the existing chambers such that local entrepreneurs and businesses can rent smaller space for short and long term storage of perishable goods.

Unless the MoT is involved in large-scale purchasing and storage of commodities, the facility will struggle to operate efficiently with multiple storage clients. It appears unlikely that the facility will be a useful storage area for local refrigerated produce, or frozen commodities, unless the site and storage chambers are reconfigured to allow for multiple small-scale users. This would, of course, entail a much more comprehensive and complicated management structure. Furthermore, if the MoT continues to manage the facility it will be impossible for Inma to effectively work, train and interact with the local management, due to USAID restraints.

As the need for additional cold storage capacity grows in the Al Hillah area, the facility, if properly configured and managed, could play a significant role in the development of a functional distribution center for fresh and frozen products, including fish, meat, dairy, and produce. However, effective racking, configuration, and management are necessary to convert this large-scale commodity freezer to a modern PRW.

REFRIGERATED TRANSPORTATION

Refrigerated transportation of Iraqi fresh fruits and vegetables from the farm to the wholesale market was nonexistent. The primary means of transport of products from the field to market was via ambient truck, sometimes with a cover and sometimes exposed to the full impact of the elements. Photos 6 and 7 show typical transport vehicles for local products. Note the absence of a protective cover to protect against direct sunlight and heat. Imported products, on the other hand, were commonly transported from farm to wholesale market using refrigerated long-haul truck and trailer units. Photos 8 and 9 show typical transport vehicles for imported products. Note the use of shipping crates.

Products leaving the wholesale market, which is the primary collection and sales point for local products, were most often transported in ambient trucks. There are limited numbers of small three to five ton refrigerated delivery trucks, called “bongos” for local deliveries, although the number and use is under the capacity of need. Refrigerated transportation of products to retail and end-user markets appears to be an area of growth, and the assessment team observed several new trucks in the country, although not in use at the time of the assessment.



Photos 6 & 7: Local Transport Vehicles



Photos 8 & 9: Imported Transport Vehicles

SALES

WHOLESALE MARKETS

Traditional wholesale markets represent the primary outlet for fruits and vegetables leaving the farm sector and entering into commercial trade. However, these marketplaces are inherently destructive to product quality, and represent the lowest value point for Iraqi produce in the marketplace. The markets are antiquated and primitive, and result in lower quality produce and farm gate prices for local farmers. It is unlikely that these markets can be substantially improved to the level that would support cold chain activities, including refrigerated storage, display and transportation adequate to preserve the value of high quality local produce.

As part of the assessment project, a comprehensive evaluation and study of the existing wholesale market network was conducted. As part of the initial market survey, Inma identified a total of 136 functioning wholesale markets in Iraq, and gathered volumetric and geographical information for each. [Copies of the wholesale market initial survey questionnaire as well as results and discussion are provided in Appendix III of this report.](#)

In order to identify the primary wholesale markets for further study, the list was reviewed using the following criteria for selection:

- Volumetric: After an initial review of the Inma survey data and on the basis of discussions with Inma staff and consultants, it was determined that the largest facilities, those handling over 70,000 kg (70 tons) per day should be the focal point of the assessment.

- **Geographical:** Geographical location of the market, including the proximity to other markets and the physical location in relation to export or import areas would be considered. This selection criterion is important when considering sites located around Baghdad, where there are many smaller markets that may potentially benefit from a centralized cold storage facility. Likewise, larger markets that are located in isolated areas but near borders with other trading partners are important locations to consider.
- **Intangibles:** Aside from volume and geography, there are several other considerations that make a market ideal for consideration, including but not limited to:
- **Security risk:** Ability to travel to and work in the area is an important consideration for the Inma project. Areas that have been, and may remain, unstable are not good choices for future efforts.
- **Diversity of products:** Markets that handle a wide range of perishable products, including fruit, vegetable, meat, poultry, seafood and dairy products may provide more benefit to the cross-cutting sectors of the project, and may be of more value than isolated markets that only handle a limited variety of products.
- **Investment opportunities:** If markets or areas where influential investors or businessmen are eager to expand cold storage capacity are identified, these areas should be targeted for future work.
- **Territorial issues:** We must consider religious sects, tribal conflicts, or other territorial issues when making selections of sites to review.

The following sites were identified as primary and major wholesale markets, and were targeted for in-depth study as part of the assessment:

MARKET NAME	AREA NAME	REGION	MARKET SIZE
Governorate Market	Al Hillah	South	100 tons
Al Karbala Wholesale Market	Karbala	South	250 tons
Najif Wholesale	Najif	South	250 tons
Wholesale Hilla	Al Hillah	South	125 tons
Diwaniyah Wholesale	Diwaniyah	South	100 tons
Al Taji Wholesale Market	Baghdad	Central	150 tons
Al Alwa Market	Baghdad	Central	250 tons
Al Rasheed Wholesale Market	Baghdad	Central	350 tons
Al Shula Market	Baghdad	Central	250 tons
Sulaymaniyah Wholesale Market	Sulaymaniyah	North	200 tons
Erbil Wholesale Market	Erbil	North	250 tons
Kirkuk Wholesale Market	Kirkuk	North	100 tons

It should be noted that this list of markets includes all of the largest markets in Iraq with the exception of several markets eliminated from consideration due to various reasons, listed below:

- Al Ramlya Wholesale market in Baghdad due to unsafe travel conditions
- Jamela Wholesale market in Baghdad due to unsafe travel conditions
- Wholesale markets in Basrah due to limited project activity in the region

It should also be noted that site visits to Al Shula and Kirkuk were impossible due to security situations at the time(s) of the assessment.

Additional information about the wholesale markets is provided below. Markets are listed in the order toured:

Wholesale Market Summary: Al Hillah Governorate Wholesale Market, February 6, 2009

There are two wholesale markets in the Al Hillah area, one that is older and traditional and another that is newer, but with fewer infrastructures. There is considerable confusion as to which market is which. The market we visited was outside of town, and was large but underdeveloped. Both markets seem to be owned by the state, with stalls rented by vendors on an annual basis. It appears that one of the markets, perhaps the one closer to downtown, is not properly licensed by the government.

The market we visited was newer, and seems to have become established since there were no more available stalls at the other market. This market was large, with perhaps 200 stalls, although very lightly occupied. Only about 20 percent of the stalls were in use, with very limited traffic and products. Some of the stall owners were operating without licenses. Rents at this facility were estimated to be considerably higher than the other facility, and the traffic, both truck and visitor was much lighter. Vendors at this market complained that the lower rents and higher traffic at the other market were the primary competitive factors of concern. During the summer season it is understood that the market is more active and busy, but during the winter season it experiences very low volume and traffic. It is estimated that the market moves about 100 tons per day on average (throughout the year).

Products were a mix of imported (Jordan, Turkey, Saudi Arabia, Syria, Egypt and Iran) and local. There was not cold storage available, except for a reefer truck that was available for rent to store product overnight or for up to two or three days. The cost for the truck was about \$200 for three days. There were two small generators for power, presumably for lights and fans but not for cooling.

Products were severely distressed, with high moisture loss, shrink and damage. Even imported products were suffering from poor handling and display conditions. Condensation was evident in the bags of stored products, and dehydration of products was clearly evident.

Comparisons of local and imported products of like types, such as tomatoes, indicated that local products were misshapen, and lacked uniformity when compared to imported products. However, all products were poorly handled and showed signs of damage and decay.

Wholesale Market Summary: Karbala Wholesale Market, February 6, 2009

The Karbala wholesale market is centrally located in the southern town of Karbala. There are approximately 50 wholesale stalls in the market, which is owned and operated by the municipality of Karbala. Approximately 250 tons of imported and local fruits and vegetables are moved daily, with imported goods from the region (Egypt, Jordan, Syria, Iran & Turkey) and further abroad (South Africa & China) on display.

The market has limited access to power, with grid power for about 6 hours per day, as well as limited access to fresh water from municipal sources. Vendors each have a small generator in the stall area for power supply when the grid is down.

Vendors complain about severe delays in receiving products from imported and local sources due to the complexity of local check points and inspection delays. There are 16 refrigerated trucks servicing the market, one owned locally, five from the Anbar province and the remainder owned by Syrian importers. Refrigerated trucks appear to be used only for import and storage of foreign products.

Wholesale Market Summary: Al Taji Wholesale Market, February 7, 2009

The Taji wholesale market is made up of 8 large stalls, arranged in a semi-circle facing the main road into Taji. A local Sheikh owns and operates 5 of the 8 stalls. The majority of the products are local, although some imported citrus and bananas were observed. The market is owned by the state, with the stalls being licensed to wholesale brokers. All stalls are properly licensed.

Volume at the market is approximately 150 MT per day, up from about 75 MT last year. The increase in volume is attributed to improved security in the area, higher crop yields, more availability of water for irrigation, and more farmers farming crops.

Each wholesale stall has a small cinder block store room to the rear, equipped with a small wall AC unit. The units do not appear to be functional.

Products at the market were similar to other wholesale markets, and showed significant signs of post harvest abuse, including damage, decay, dehydration and extensive respiration. There is not central storage available for products, although a reefer truck was located nearby, presumably under rent from a wholesaler.

There is a small “gypsy” retail market across the street from the wholesale market, with similar products. The retail price was twice the price of wholesale.

Wholesale Market Summary: Sulaymaniyah Wholesale Market, February 10, 2009

The Sulaymaniyah wholesale market is located in the central part of Sulaymaniyah, in Kurdistan. The wholesale market is very large, and contains approximately 120 wholesale stalls. The market is surrounded by a block retainer wall, and has three entrance/exit areas, all manned by market employees who collect paperwork and track product volumes. The facility is owned by the municipality of Sulaymaniyah, but each stall is privately rented on an annual basis. All vendors are licensed, and the municipality does not allow “gypsy” stalls outside of the gate of the market. The market is located on sloped ground, and is congested and difficult to move around in. During the winter, the ground is very muddy and slippery.

It is estimated that the market moves about 200 MT of product per day. During winter hours the market operates from about 07:00 until mid-afternoon, but during the summer season, when temperatures can reach 45 C in the afternoon, the market starts around 05:00 and is closed down by noon.

Products during the winter are a mix of Iraqi and imported goods, although the mix favors Iraqi produce during the summer harvest season. Products from neighboring countries of Iran, Syria, Jordan and Turkey are received via large over-the-road trucks. Products are held in the market for up to three days, with losses mounting as the days pass. It is estimated, on the basis of interviews with vendors, that spoilage and losses due to damage are low on the first day, about 20%, but increase to 30 and 60% on days two and three, respectively.

Farmers bring local produce to the market daily, and work from vendor to vendor to determine which vendor to leave produce with. There does not appear to be an established relationship with vendors, unless a farmer believes that a particular vendor can do a better job moving the products during the day. Farmers leaving produce with the vendors allow the vendor to sell their products on consignment, with the vendor taking 5% commission on the sale. Any losses due to damage, decay, spoilage are the responsibility of the farmer, not the vendor. It should be noted that moderate thermal and post harvest abuse was noted, with visible signs of damage, bruising, rust, mold, and moisture loss. However, some products were in excellent condition. In fact, some of the onion products that had been transported from south of Baghdad were in better shape than similar products seen in local Baghdad markets. This may be attributed to night harvest and overnight delivery, during cooler hours.

Products are not graded, sized, sorted or inspected upon arrival at the market. The wholesale vendor will make some efforts to display the products in an attractive manner, and at times do some simple sorting for color, but size and physical damage is quite evident, with good products mixed with bad on a regular basis. It should be noted that vendors do not appear to support the farmers with loans, seeds, harvest bins or other assistance.

Retail and other buyers who visit the wholesale market shop among vendors to find the best price and quality. It does not appear that buyers develop strong relationships or alliances with vendors, but rather shop around for the best prices and quality of the day.

Wholesale Market Summary: Erbil Wholesale Market, February 11, 2009

The Erbil wholesale market is located on a large, open, flat piece of land approximately 10 donum in size (2.25 Hectares). The facility is not surrounded by a wall, but the wholesale stalls form an external barrier and the primary entrance areas are manned, thereby restricting and controlling access. There are approximately 100 large wholesale stalls, with a total estimated daily volume of 250 MT. The market is very well run, with ample space to move around and plenty of parking for vehicles and storage trailers.

The stalls of the market are located on the perimeter of the area, with the central part of the market reserved for truck parking. It is estimated that about 50 large (40') refrigerated trucks are kept in this area on a permanent basis for refrigerated storage. Vendors are able to rent storage as needed, although only imported products were observed in short-term storage trucks.

Product quality was similar to Sulaymaniyah, with a strong mix of import and domestic products during the winter and more local products during the summer. Product volume was higher than Sulaymaniyah, but quality seemed a bit lower.

Sales commissions for farmers are 5%, with farmer's selling through vendors on a consignment basis. All losses of products, which can stay on the premise for up to three days, are borne by the farmer.

Wholesale Market Summary: Najaf Wholesale Market, February 11, 2009

The Najaf wholesale market is a large market owned by the municipality of the city of Najaf. Wholesale stalls are leased to individuals on an annual basis, and there are currently 120 stalls available. Estimated daily volume is about 250 MT per day of fresh fruit and vegetables. The market has a wide variety of products, including imported and domestic products. Imported products were seen from Iran, Jordan, Syria, Lebanon, United States, Kuwait, Turkey, China, Pakistan, Chili, Ecuador, and Egypt.

Most products are sold the same day of receipt at the market, although some imported products stand in refrigerated trucks between 4 and 6 days. It is estimated that there are 30 Syrian-owned trucks on the site for storage purposes. These products appear to retain their price structure, whereas other products have a shelf life of three (3) days, with prices dropping each day in correlation to the destruction of quality and yield. It is estimated that losses to local products during the first day are minimal, perhaps 10 to 20 percent, whereas losses on day two and three mount to significant levels, perhaps 50 and 60 percent, respectively.

Sales commissions for farmers are 5%, with farmer's selling through vendors on a consignment basis. All losses of products, which can stay on the premise for up to three days, are borne by the farmer.

Wholesale Market Summary: Al Hillah Wholesale Market, February 20, 2009

The Al Hillah wholesale market is located in downtown Hillah, and appears to be the more active of the two markets in the area. The market is owned by the state, but may not be properly licensed to do business. Nonetheless, the market was very active and productive. It is estimated that between 100 and 125 MT of produce is sold through the market daily, with approximately 170 wholesale stalls for rent on an annual basis.

Products at the market were a mix of domestic and imported products, with limited cold storage available, using reefer trucks, for rent or use by vendors. Market conditions were consistent with other large wholesale markets, with moderate to extreme product damage, destruction and cold chain temperature abuse. Similar marketing arrangements between vendors and farmers existed, with commissions being charged, 5%, to farmers.

Shelf life for products is approximately 3 days, without the benefit of refrigeration, with losses mounting each day the products are held over.

Wholesale Market Summary: Baghdad Al Alwa Wholesale Market (Central Baghdad), February 23, 2009

The Al Alwa wholesale market is located directly adjacent to the Rasheed wholesale market in the south Baghdad area. To the best of our knowledge, the market is owned and operated by a cooperative of businessmen. The ownership status has yet to be verified with property deeds or other documentation, although market managers promise to deliver the documents forthwith. If the market is privately held it would represent the only known market that is not physically owned and then subsequently leased by the government. It is important to note that the retail stalls directly outside of the wholesale market area are owned by the Ministry of Trade (the management said it was the Ministry of Tourism, but we believe there was some information lost due to translation), but that the market property was privately held. This will need to be verified.

Market management indicated that there were 80 vendor stalls on the facility, 50 of which are currently occupied and 30 that were currently vacant. 16 of the 30 vacant stalls are in an unused area of the market that is currently being cleared of trash and debris, and should be available for occupation within the next month. According to management, all vendors are properly licensed to operate at the market. Market occupancy has doubled in the past year, and perhaps tripled in the last 18 months. It appears that the market is growing rapidly.

Although cooperative management stated that the market trades about 150 MT per day, it is estimated that the market is moving approximately 200 to 250 MT of product per day, even with less than full occupancy. There is not permanent cold storage on the facility, and portable reefer trucks were limited in number, and traditionally reserved for imported products.

The mix of products was both imported and domestic, with a higher percentage of imported products during the winter months when local products are not generally available. The percentage of local products has dramatically increased over the past year, as the security situation has allowed for more farmers to farm and products to move easier to market.

Market management indicated that local products are preferred to imported, but that pricing for imported products was more competitive.

Wholesale Market Summary: Rasheed Wholesale Market, February 23, 2009

The Rasheed wholesale market is located directly adjacent to the Cooperative Baghdad Central wholesale market. The market is very large; perhaps the second largest wholesale market in Iraq next to the Jameela market.

The market contains approximately 125 vendor stalls, and trades perhaps 350 to 400 MT of products per day. The market is owned and operated by the government, and trades a mix of imported and domestic products. Imported products are from neighboring countries, and many are stored in reefer trucks until sold. There is no permanent cold storage available on the property, although several stalls have rooms that were once fitted with cooling equipment, but are now used for overnight storage of products with household air conditioning units.

It is important to note that the two markets combined are moving a tremendous amount of fresh product, perhaps over 500 MT daily. With the rapid and sustainable growth of the Al Alwa wholesale market, the area may become a major center of fruit and vegetable wholesale sales.

Wholesale Market Summary: Diwaniyah Wholesale Market, February 25, 2009

The Diwaniyah wholesale market is owned by the municipality of Diwaniyah, and is located in the central part of the city, with the retail street market and bazaar in close proximity.

The market area is along a city block, and is very congested, with limited access by vehicles. There are an estimated 80 stalls, with approximately 100 MT of product moved daily. At the time of the visit, the market had very few Iraqi products, primarily potatoes, tomatoes and onions. The majority of the products, perhaps 80%, were from import sources.

RETAIL MARKETS

Efforts to tour retail markets were hampered by security and the ability to move around large crowds. However, several retail market tours were accomplished in conjunction with wholesale market visits. Additional retail marketing information is needed.

Information about specific retail market tours is provided below. Markets are listed in the order toured:

Retail Market Summary: Taji Gypsy Market, February 7, 2009

A small retail market area is in operation adjacent to the Taji wholesale market. The market is not licensed, and operates alongside the main road. Commonly called a “gypsy market”, the market conditions are poor and unsanitary, with roadside stands offering fresh fruit and vegetables. The retail price is twice that of wholesale products being sold just across the road.

Retail Market Summary: Sulaymaniyah Retail Market Center, February 10, 2009

The Sulaymaniyah retail market area contains over 100 individual stalls, each selling a variety of produce, with some being much diversified and others being exclusive to a particular crop (i.e. potato stall). Product quality was similar to the wholesale market, although consistency and uniformity was much improved. The retail vendors make extra efforts to sort, clean, and display the produce for sale. It is assumed that the retailers factor in these losses when purchasing products, since the losses appeared to be significant, sometimes up to 30 or 40%, with some products.

It is important to note that there were some significant differences in values between varieties within the same crops. Green peppers are an excellent example. Peppers at the wholesale market were from three sources: Iraq, Syria, and Iran. The Iraqi peppers were very small, misshapen and of variable size. However, they are widely perceived as the best tasting. The Syrian peppers were a different variety, and they were very uniform, although of a much more elongated shape. The Iranian peppers were very large, uniform and looked like a typical green pepper. In fact, they were so perfect in appearance that they looked artificial. When the peppers were seen at the retail center, we found how the consumer perceived the

quality and value. The Iraqi peppers were in greatest demand, and were first to sell out in spite of the negative attributes. The local peppers were the most expensive, valued about 20% higher than the Syrian peppers. It is perhaps a combination of nationalism and taste that drives this factor. The Syrian peppers were next in demand, and commanded twice the price as the Iranian peppers. Uniformity, appearance and price are important, but evidently not the primary driving factors in sales.

Retail Market Summary: Diwaniyah Retail Market Street, February 25, 2009

The main retail market area for Diwaniyah, a city of around 600,000, is a series of streets in the central part of town. The retail market is very similar to Sulaymaniyah, with the exception of fresh meat and fish sales. Market conditions, especially sanitation and trash, are very poor, with significant product damage evident during the tour.

Potential Sites for Commercial Packing Houses

As part of the assessment, several potential sites for commercial Fresh Fruit and Vegetable Packing Houses (FFV PH) were reviewed. Detailed assessments and recommendations are provided below:

CENTRAL EUPHRATES FARMER’S MARKET (CEFM) SITE SUMMARY, FEBRUARY 6, 2009

ASSESSMENT

The CEFM is a nice facility currently under construction and nearing completion. It is anticipated to open in March of 2009. The market has a large fenced perimeter, with several features in the interior, including an office suite, retail stalls, wholesale collection point, and trailer parking area.

The main receiving gate is on the east side of the complex, and allows trucks to enter towards the wholesale receiving area. The wholesale receiving area is comprised of two long pole buildings on concrete to provide shade. Each pole building is divided into 10 stalls, large enough to accommodate two small delivery trucks, with estimated capacities of 1 to 2 tons each. Large ground scales are located at the end of each wholesale receiving area.

Farmers are expected to deliver fruits and vegetables to the wholesale area, where they will be graded and weighed before the daily auction begins. The auction takes place early in the morning, and sets the base price for each commodity. Farmers would receive the base price for all like products sold during the day. Farmers are given paper certificates or receipts indicating the exact weight and grade of their products, which they can cash out at the stalls during the day as they sell their produce.

Once graded and received, the produce is either transported off of the grounds to sales locations elsewhere, or sold in the retail stalls inside the market’s retail sales center. This sales center has approximately 30 retail stalls, or offices, along with a restaurant and small cool room (4m x 8m x 3m). Wholesale integrators or agents rent stalls from the market, and can sell products and conduct cash purchases of products inside the market.

There is a moderate size plot of land to the east of the CEFM that could be used for additional cold storage, presumably for overnight storage of excess goods that were not sold during the day. Conceptual designs have been created by CEFM. It is unlikely that PRW storage or value added storage would work here, since products would have to move “counter flow”, and value added products would not have a solid sales opportunity at this location. More likely, this extra storage would be used for left over products, which would begin the next day of sale at a competitive disadvantage to fresh product being brought in.

SPECIFIC RECOMMENDATIONS

It appears that too much emphasis and expenditure has been placed on the retail component and not enough on the wholesale component where true “price discovery” and market intelligence can be gathered. The technology associated with the wholesale receiving area is limited and primitive. Furthermore, little information is available pertaining to the amount or percent of products that will be sold on site vs. shipped to other sales locations.

It is recommended that Inma support the CEFM with training activities and through technical assistance. However, this site does not appear to be a good candidate for a commercial FFV PH or cold storage facility.

However, if *Inma* is responsible for the operational success of the CEFM, there are some additional steps that could be taken to mitigate some of the aforementioned issues with regard to design, counter flow and logistics, thereby enhancing the functionality of the site, including:

Implement the Retail Ready Marketing concept, utilizing the space next to the CEFM as a collection center for value added processing. The site could be used for the mobile packing shed, thereby allowing for some value added merchandise to be packed and shipped from the CEFM location. Some of the sorted, graded and wholesale packed products could be distributed to the CEFM and sold via that outlet.

- Expand temporary cold storage capacity at the CEFM site, using leased reefer units. Storage would be for products packed at Inma mobile field packing centers in the area, and transported to the CEFM site for temporary storage prior to shipment to retail centers or wholesale markets.
- Reconfigure the CEFM site to incorporate more pre-cooling, sorting and grading of products prior to wholesale price discovery (auction) and distribution. This would involve utilizing the wholesale areas (shade tents) outside the retail building as a sorting, grading and pre-cooling area, then re-packing and marketing the products prior to distribution.

FALLUJAH INDUSTRIAL PARK, SITE SUMMARY: FEBRUARY 8, 2009

ASSESSMENT

Sheikh Al-Abid from Fallujah recently submitted a project proposal to *Inma* for development of a FFV PH and cold storage facility in the Fallujah area. A site review was conducted to assess the potential for success and opportunities for operating cold chain facilities at the Sheikh's industrial park.

The industrial park is located in close proximity to the city of Fallujah, where there are three established wholesale markets of moderate size. It is estimated that the combined capacity of the wholesale markets, located within 3 km of the industrial park, is about 100 tons per day.

The Sheikh's family is in close contact with local farmers, and has a history of working with local farmers to provide seed potatoes and technical assistance, including transportation from farm to plant, in the past. It is foreseeable that the family could work with local farmers with other crops. In addition, the family appears to have a solid network of retail and wholesale contacts, although they do not operate stalls at the local wholesale markets.

The industrial park is located adjacent to his personal residence, along the banks of the Euphrates River. The walled compound is very secure, and is located on 15 donum (3.75 Hectares), and contains many buildings suitable for cold chain operations, including:

Cold Storage Complex The site has four (4) cold storage cells, each measuring 14m x 11m x 4m, or 616 m³. It is estimated that each unit could hold approximately 250 MT of palletized product. The loading dock for receiving and shipping is elevated concrete, although not enclosed. The physical structure (rooms) is constructed of insulated material approximately 60 cm thick. The roof is insulated with refrigerated "sandwich" panels, although may need to be reinforced with additional insulation. It does not appear that the rooms have been used for refrigerated products in over 4 years, and the refrigeration units are in poor repair.

Refrigeration is accomplished using super-chilled glycol water, delivered to the units for circulation at -30C. Glycol water is a by product of an adjacent ice manufacturing plant, which is operated with ammonia gas. Glycol leaving the refrigeration units at the cold storage cells is re-circulated to the compressors via evaporative cooling towers.

The doors of the refrigeration cells are in poor repair. Floors seem to be in decent shape, and the room has the capability for lights. The ammonia compressors and room units are operated using generator power. The facility has access to "The Grid" for approximately 4 hours per day, but has several back up generators on the premise for continual power. Of late, the price and availability of diesel for generators has been favorable.

Ice Manufacturing Plant The facility has a functional ice manufacturing facility, capable of making up to 2,200 25 kg blocks of ice per 12 hours. The facility utilizes glycol for freezing, charged by ammonia compressors operating under generator power. The plant has, in the past, had the capability to crush or flake ice, although the equipment is not currently on the site.

Freezer Facility The industrial park has a large 1000 MT freezer facility under construction and nearing completion. The freezing facility is equipped with compressors capable of maintaining temperatures of -30 C, using Freon technology. The facility is new, and has at least 50 cm of insulated sandwich panels.

Dry Storage Buildings The industrial park has two large insulated buildings for general storage. The buildings are 54m x 18m, with a pitched roof averaging 6m. The storage capacity is at least 970 m², or approximately 5,800 m³. The storage areas do not have concrete floors.

Bulk Cold Storage Buildings In addition to the four cold commercial cold chambers, the industrial park has two large cold storage buildings. The buildings will store approximately

700 and 1000 MT of product. Each room has 8 cooling units, using the same glycol system as the commercial cold storage rooms.

Multi-Purpose Building The industrial park has a building under construction that could be utilized for any number of purposes, including a Fresh Fruit & Vegetable Packing House (FFV PH). The building is near completion, and is approximately 60m x 20m, for a total of 1,200 m². This building is adjacent to a large open area, which may be ideal for truck parking or receiving in to the building.

Trucking The Sheikh owns and operates 10 large trucks, which could be used to deliver produce from the farm to the industrial park. The trucks are not refrigerated, but properly retrofitted they could be used to transport fresh produce without undue damage. Each truck is capable of hauling approximately 10 MT of product. Additionally, the Sheikh has recently purchased two large refrigerated trucks. These trucks are new, and measure 3m x 9m x 3.5m, and have an estimated capacity of 10 to 15 MT of finished products.

SPECIFIC RECOMMENDATIONS

This site is under consideration as a location for a FFV PH and/or a commercial cold storage unit as part of the Inma agribusiness development program. It would appear that the site has excellent potential for both activities, provided some additional inputs and renovations were provided.

It appears that the location is ideal, with close proximity to local wholesale markets, adequate supply of fresh fruits and vegetables, and close proximity to major metropolitan areas. The location is easy to reach for potential wholesale and retail buyers, yet is close enough to major farming areas. It is estimated that over 1,000 farmers are working within a 5 km radius of the industrial park.

The potential partners, the Family of Sheikh Al-Abid, are already invested into the community, and have existing relationships with farmers, wholesalers, and retailers.

Cold Storage The commercial cold storage area is in need of repair and renovation, although the structure appears to be suitable and secure. It is recommended that the facility be cleaned and retrofitted with new compressors, condensers, lights, doors and fans. Additional equipment, including fork lifts, lift trucks, racks and other operational equipment would be needed as well.

This facility would be an ideal location for a combination of cold storage opportunities, including public refrigerated warehousing (PRW), and “Direct to Retail” distribution services. The latter would involve utilizing excess value added production from the FFV PH facility in close proximity to the cold storage complex.

Fresh Fruit & Vegetable Packing House It appears that there are several potential locations for the FFV PH inside the industrial complex. The most ideal site is perhaps the 1,200 m² building under construction, since the building has available land for receiving and parking, and is in close proximity to a main entry & exit gate. The geographical and strategic location of the complex is ideal, and the organizational structure of the family is conducive to a successful FFV PH concept. It is, however, recommended that consideration be given to

expanding the FFV PH concept to include value added “retail ready” packaging for distribution outside of traditional wholesale market channels. The availability of refrigerated trucks for distribution is an added bonus.

Meat & Poultry Sector Assessment

The meat sector, including beef, lamb and goat meat, is currently being developed via efforts to improve animal genetics and feeding in modern feedlots. It appears that efforts to create and/or improve the integrated cold chain from sacrifice (slaughter) to end use are premature. As a result, limited efforts to assess the post mortem movement of meat were attempted.

At the present time, meat and meat products are sold at open air (ambient) markets or butcheries. These facilities have limited cooler space for short term storage (overnight), and tend to sacrifice and sell products on the same day. Photos 10 and 11 show typical meat sales outlets, including a butchery and street market.



Photos 10 & 11: Traditional Meat Butcheries

The poultry sector, like meat, is currently being rebuilt from the production end with efforts to renovate and reopen hatcheries and broiler farms. Slaughter and processing systems are not being evaluated for improvement at the present time.

Fish Sector Assessment

The cold chain for fresh fish products is nonexistent at the present time. Given consumer concerns with regard to fish meat quality and safety, most consumers attempt to purchase live fish rather than local fish that have been killed. Consumers fear fish that have been killed with chemicals, explosives, electricity or by other means that may render the meat unsafe, and therefore attempt to purchase live fish from the marketplace. As a result, there do not appear to be any cold chain systems in place to transport, store or display fish under refrigerated conditions, and the use of ice is very limited. Photo 12 shows a typical retail sales outlet for live fish. Note that the fish arrived at the market alive, but are in varying states of dying from exposure to the sun and inadequate aeration of the water.

However, imported fish that are sold from the frozen state are acceptable to consumers. The imported fish are sold intact, without the benefit of gutting, de-heading or de-scaling. While the Iraqi consumer does not prefer this method of sale, they seem to perceive that the frozen fish are safer than the local fresh fish that have been killed prior to sale. The consumer does not particularly like to de-head, de-scale and gut the fish, but price and food safety seem to be the drivers in this market.



Photo 12: Traditional Fresh Fish Sales Outlet

Dairy Products Sector Assessment

The dairy sector lacks the fundamental components of a cold chain. Pre-cooling of milk, which is critical for proper processing, sanitation and quality, is absent. The lack of integrated refrigeration systems to move milk from collection centers to processing areas, and processing areas to retail centers prohibits the ability to sustain a commercial dairy products sector at the present time. It was observed that most milk products are imported as Ultra High Temperature (UHT) milk, which is shelf stable until opened.

As a result, the dairy sector has not been a priority for development work, and assessment efforts were limited.

Strategic Plan for Cold Chain Improvement

The following specific and targeted projects, activities or programs are recommended, on a sector specific basis, to improve the integrated cold chain in Iraq. It should be noted that some of these activities have been implemented or initiated prior to release of the final report. A brief description of the proposed activity is provided in the text of this report, and in some cases a more complete description and justification provided as part of Appendix I.

FRUIT & VEGETABLE SECTOR

As a result of the cold chain assessment the following specific activities, programs, concepts and/or projects are recommended for the fresh fruit and vegetable sector:

FRUIT & VEGETABLE MARKET BASKET FOCUS GROUP

The integrated cold chain encompasses the movement of perishable products from farm to market, including post harvest handling, processing, packaging, cold storage, distribution, transportation and sales. The Inma project has made considerable impact in the “supply side” components of the cold chain, including improving crop varieties, post harvest handling and cold chain awareness. However, the “demand side” of the cold chain remains largely under developed in Iraq, and presents a significant constraint to growth of the agricultural sector. Retail purchases of fresh produce are largely misunderstood and poorly documented. The Iraqi consumer, while traditional in many ways, is forced to shop in unconventional ways due to security and logistical issues.

It was determined early into the assessment process that efforts to improve the demand for Iraqi produce were being hampered by a general lack of understanding pertaining to the shopping habits and purchase strategies of local Iraqi consumers. It was generally accepted by the research team that Iraqi consumers desire local products, but the other demand drivers for purchases were unknown. As a result, it was recommended that a Fresh Fruit and Vegetable Focus Group be organized and conducted as soon as possible.

A copy of the concept paper for the focus group is provided in Appendix I of this report. Two focus group sessions were conducted on Saturday, February 21, 2009 for local Inma professional staff and Sallyport housekeeping personnel, representing different levels of consumer purchasing power. Results and discussion from the focus group sessions are provided in Appendix I of this report.

RETAIL MARKETING STUDY

Information gathered during market tours and during the course of the cold chain assessment, including focus group sessions, revealed that little is known about the retail purchasing sector of the integrated cold chain. *It is recommended that additional work, including comprehensive study of the retail sector, be initiated as soon as possible.*

TRAINING, EDUCATION AND EXTENSION OUTREACH

Cold chain awareness and training is needed at all levels of the industry, from the farm level through processing, packaging, storage, distribution and sales. Inma is currently developing comprehensive post harvest training programs, which are encouraged. *Additional training in cold chain handling, storage, distribution and sales is necessary, and recommended as part of a comprehensive training effort.* Training modules should be created and replicated throughout the country as part of a comprehensive extension outreach program.

REFRIGERATED TRANSPORTATION

Refrigerated transport of local fruits and vegetables is virtually nonexistent, although there appears to be some commercial interest and capability to introduce refrigerated transportation of products for local use. *It is recommended that awareness of, and support for local refrigerated transport of fresh products be initiated, such that local entrepreneurs can appreciate the benefits of refrigerated transportation of high value local products.*

RETAIL READY MARKETING CONCEPT

For the purpose of strengthening and building the integrated cold chain for fresh fruits and vegetables, a comprehensive Retail Ready Marketing concept has been developed and proposed. In order to compete with imported products, Iraqi produce must be more durable and differentiated to the Iraqi consumer. Durability includes proper harvest selection, sorting, cleaning, packaging and grading. Properly packaged products that enter into the cold chain will have extended shelf life (durability) and be attractively differentiated to the consumer, thereby presenting a purchase opportunity that currently does not exist in adequate levels. The concept integrates ongoing Inma activities, including but not limited to field level improvement programs and packing house projects, with other necessary elements of the integrated cold chain, including:

- Harvest Training & Tools: Awareness, training and education efforts to improve harvest techniques and post harvest handling are part of the program. Efforts to harvest at the proper maturity, reduce damage, destruction, bruising and injury are critical components of the integrated Retail Ready Marketing program, along with the proper use of harvest tools, including equipment, tubs, bins and transport tools.
- Field Packing of Selected Items: Value added sizing, sorting, cleaning, grading and packaging is limited for Iraqi produce. While the Inma project is actively working to

increase the availability of value added packaging through the construction of several commercial Fresh Fruit & Vegetable Packing Houses (FFV PH), there still remains a need for additional value added packing. A conceptual design for field level packing of selected products with integration into commercial processing facilities or movement direct to retail is provided in the concept paper.

- **Establish a Distribution Center for Fresh Fruits & Vegetables:** The Iraqi market for fresh fruits and vegetables is small, with retail sales predominantly through small neighborhood retail outlets or traditional street vendors. The western-style large-scale retail grocery store is not popular or established in this market at the present time. With a large number of small retail outlets, it is important to provide small quantities of multiple items as part of a refrigerated distribution network of fresh fruits and vegetables. Field level packing of commodity items will allow for some direct to retail delivery. However, a centralized distribution center for collecting produce packed at the field level along with packing house production is needed. It is recommended that the distribution center (DC) be affiliated with a modern FFV PH, as proposed in the concept paper. This DC would serve as the hub for a refrigerated transportation network of fresh produce to retail buyers, thereby eliminating the need for retail buyers to purchase lower quality produce at traditional wholesale markets.
- **Develop Alternative Marketing Channels:** As retail marketing re-emerges, evolves and develops in Iraq, the need for creative alternative marketing channels will grow. The concept paper discusses the need to develop short- and long-term strategies for marketing Iraqi products through creative channels, thereby eliminating the need and popularity of traditional wholesale markets.

Figure 2 represents a visual conceptual design of the integrated cold chain under the Retail Ready Marketing concept. Figure 3 represents a visual conceptual design for the Commercial Fresh Fruit & Vegetable Packing House (FFV PH). Figure 4 represents a visual conceptual design of the field level packing systems proposed in the Retail Ready Marketing concept.

A copy of the concept paper for the Retail Ready Marketing program is provided in Appendix I of this report.

Figure 2: Retail Ready Marketing

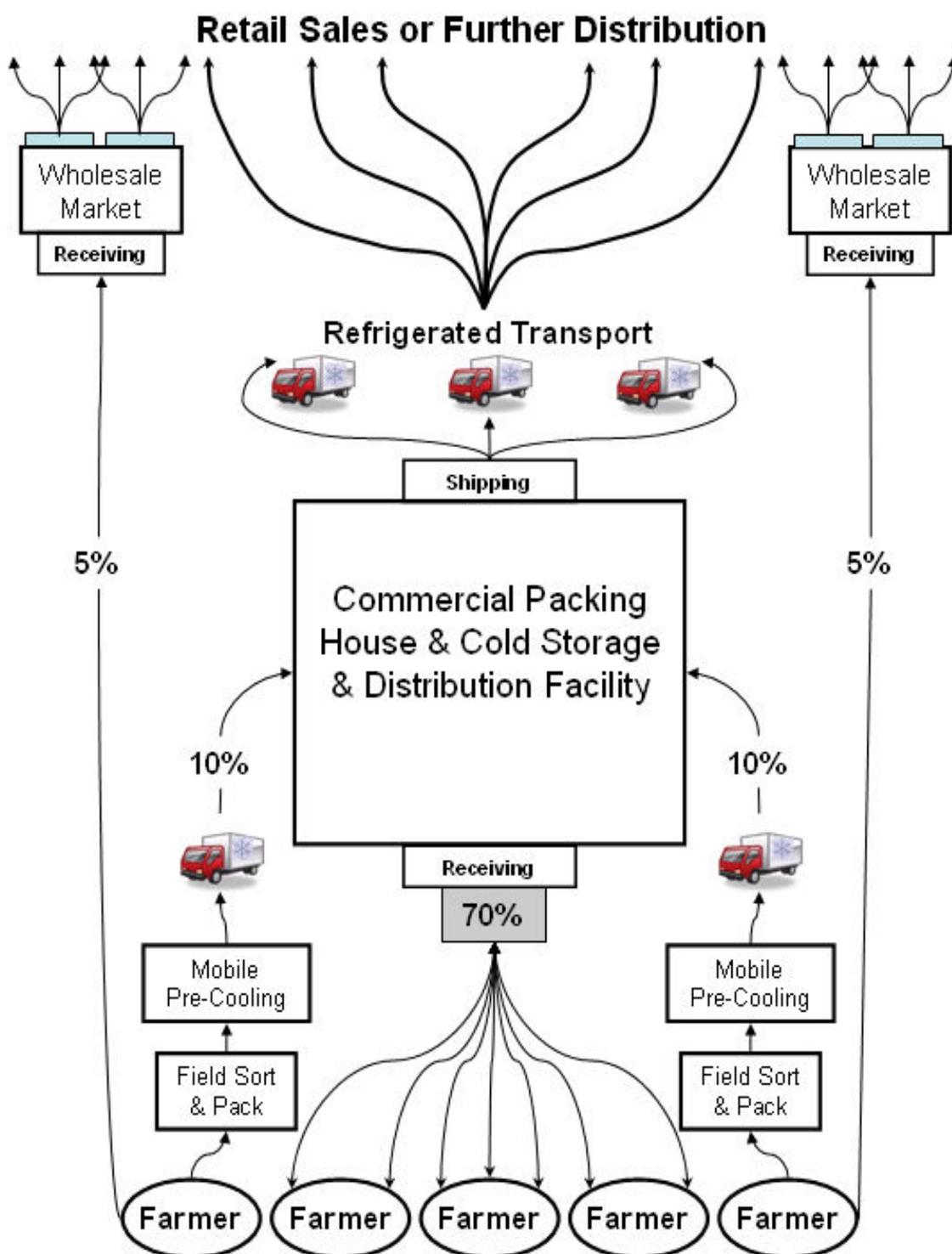


Figure 3: Commercial Packing House

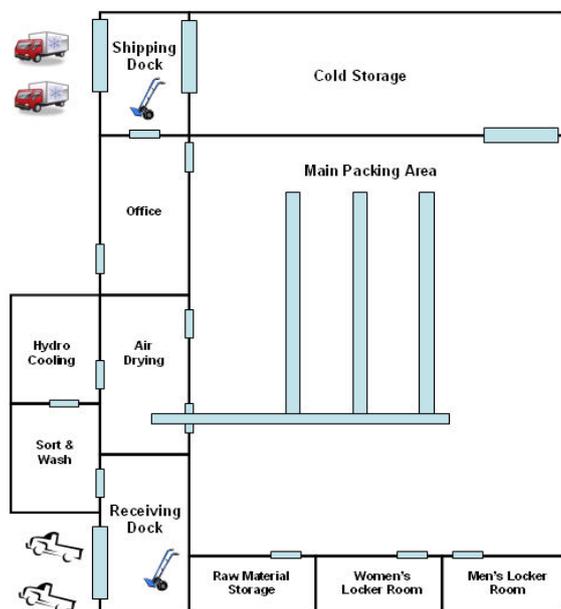
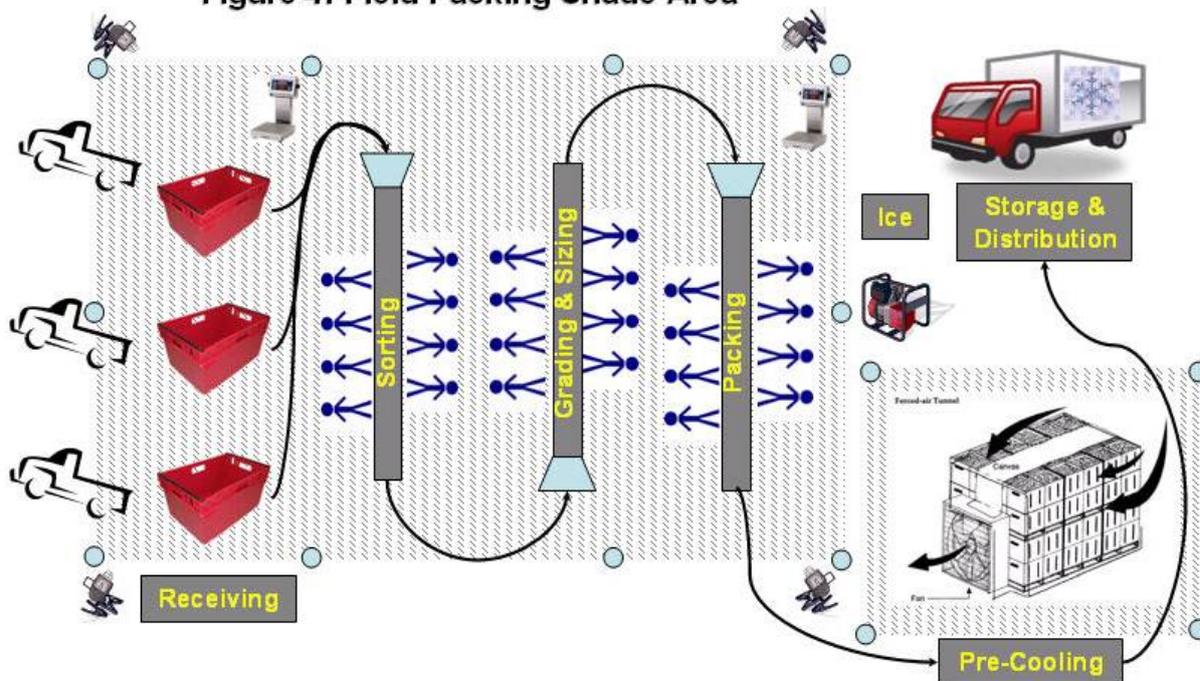


Figure 4: Field Packing Shade Area



TRAINING AT THE CENTRAL EUPHRATES FARMER'S MARKET (CEFM)

CEFM is a USAID sponsored project nearing completion, and is in need of additional training and support. A site analysis was performed as part of the cold chain assessment. It is recommended that additional training and support be provided to CEFM in order to facilitate the success of the project. A site summary with recommendations was provided earlier in this document, and a concept paper developed prior to the assessment. *A copy of the concept paper is provided in Appendix I of this final report.*

COLD CHAIN DEMONSTRATION PROJECT

Integrated cold chain systems do not exist in Iraq, and are therefore unproven with regard to actual savings and success. In answer to questions about the potential impact of an integrated system and the means to measure success, a concept paper for a demonstration project was created. The concept would compare traditional movement of products from farm to market, and the corresponding losses in quality and discounts in price, with products moving through a controlled and integrated cold chain system created and monitored. Savings and efficiencies could be measured. *A copy of the concept paper is provided in Appendix I of this report.*

REGIONAL RESEARCH & REVIEW

While Iraq is a unique and independent country, it will ultimately model cold chain systems in neighboring countries. *It is therefore recommended that Inma staff and selected stakeholders seize opportunities to tour and review cold chains systems in the neighboring countries of Jordan and Turkey.* This review and study will allow stakeholders and staff to see post harvest handling, processing, packaging, distribution and retail sales networks that have been developed and are functional in the adverse environmental conditions of the Middle East.

EXPANSION OF COLD CHAIN ACTIVITIES

Outside of the Baghdad area there are several areas ripe for expansion of recommended cold chain activities, particularly in the areas south and north of Baghdad. Erbil, in the north, is rapidly developing as a center of trade and commerce, with extensive infrastructure building and enhanced stability and security. Erbil has the potential for dramatic cold chain improvement through retail ready marketing and field level packing systems. Likewise, the growth areas in the Babil province, including Najif and Al Hillah, are excellent areas for testing cold chain systems such as field packing and retail ready marketing systems in conjunction with greenhouse projects underway.

IMPROVE POST HARVEST HANDLING SYSTEMS

Efforts to promote pre-cooling of products, effective use of harvest equipment and proper product delivery systems will provide low-cost solutions to product damage, destruction,

decay and discounts. *Awareness programs and simple systems, including forced air cooling, effective use of shade, and proper handling systems at the field level will provide tangible short term benefits to innovative farmers and farm groups.*

POTENTIAL IMPACT OF FRUIT & VEGETABLE RECOMMENDATIONS

There are many tangible and intangible impacts of improving the integrated cold chain in Iraq. A few measurable impacts from cold chain improvement programs worth noting include, but are not limited to:

- Reductions in post harvest waste resulting from spoilage & damage by 50%
- Increase in value for selected items by 20%
- Increase in the volume of saleable products by 39 to 40%
- Extension in usable shelf life from 3 to 6 days
- Improved product durability
- Improved product differentiation from imports

MEAT & POULTRY SECTOR

No recommendations for cold chain improvement programs are provided at the present time and within the lifecycle of the Inma project.

FISH SECTOR

As a result of the cold chain assessment the following specific activities, programs, concepts and/or projects are recommended for the fish sector:

EFFECTIVE USE OF CLEAN ICE

Cold chain systems for fresh fish harvested for human consumption (not sold live) are virtually nonexistent. Fish harvested and sold to consumers dead are not shipped, stored or displayed with the benefit of clean ice. *Therefore, it is recommended that efforts to integrate the production and use of clean ice, made with potable water, for the transport, short term storage and display of fresh fish be initiated.* Centralized location of ice making equipment at wholesale markets and the proper use of transport containers will enhance cold chain efforts and provide a safer and more attractive product for sale to consumers.

SKIP GENERATION FISH MARKETING

If the short term potential for cold chain development of fresh fish marketing, including ice and sanitary controls, is not possible, an alternative method would be to create a skip generation marketing plan to provide Iraqi consumers with a frozen product of higher quality and convenience than existing imported fish. *By processing fish locally, including de-heading, de-scaling, gutting and freezing the fish, the Iraqi processors could offer a frozen*

product of higher quality to compete with imported frozen fish. The cost for processing should be competitive with the cost of importation, thereby providing a similar product at a comparable price, but with higher convenience and quality than imported fish.

DAIRY PRODUCTS SECTOR

No recommendations for cold chain improvement programs are provided at the present time and within the lifecycle of the *Inma* project.