2.2 Technologies Contributing to Improvement in Productivity

As demand for milk has increased and markets improved over the last 20 years, there has been an evolution of dairying in Kenya. Dairy breeds have been introduced and used as cross or pure breeds, and improved forage varieties have been introduced. Several management and marketing practices have been made available including improved animal health and the use of fertilizers to enhance forage production. However, the evolution of dairying has not been uniform across the country but has tended to emerge first in peri-urban areas of higher populations. National research and extension programs in KARI and the Ministry of Agriculture, in collaboration with ILRI, have contributed to the development and adoption of improved technology. The following is a partial list of the technologies which have been adopted to varying levels depending on size of operation, location, and market demand:

- Improved animal genetics by introducing dairy breeds, principally Friesan and Aryshire, and crossbreeding them with local zebu cattle, primarily East African Zebu.
- Improved forages, including Napier grass, with multiple fertilizer levels. Application of up to 50 kg N/ha has been recommended.
- Use of feedstuff/minerals, primarily corn bran, and commercial concentrate feeds and mineral sources, primarily phosphorus.
- Improved animal health programs especially for the introduced dairy breeds to minimize the impact of external and internal parasites and disease such as East Coast Fever, through spraying and vaccination.
- Intensification of production system through part time confinement of the animals (semi-zero grazing) or complete confinement (zero-based grazing) with adoption of various stall management technologies (shedding, floor construction, bedding techniques, composting, manure/urine management, etc).
- Rearing of male calves up to 24 months of age for sale, primarily in extensive dairying situations.

2.3 Dairy (Meat and Milk) Production Systems Evaluated in this Assessment

Drawing in these technologies for smallholder dairy production, national experts defined four milk production systems (Table 2.3.1) and two growing animal rearing systems that generate milk and meat within the dairy industry. These systems are described by Stotz (1983) and include:

1. **Zebu cattle - Grazing Only**: Grazing-only environments supporting zebu cattle of improved and unimproved breeding for milk production supported by native forages, introduced species growing on roadsides, and grasses/weeds available in adjacent plantations or woodland clearings. Little or no inputs are made in these systems in terms of supplement, disease control, or fertilizer.
2. Dairy-Zebu Crossbreeds Grazing Only: Grazing-only environments supporting dairy x zebu cross cattle for milk production supported by native forages, introduced species growing on roadsides, and grasses/weeds available in adjacent plantations or woodland clearings. Inputs are generally confined to some minerals and dipping for external parasite control.

3. Dairy Breeds -Semi-zero Grazing: Semi-zero grazing by pure dairy breeds where animals are stall fed and allowed tethered grazing in selected areas. Animals are hand fed harvested forage or provided access to native forages, introduced species growing on roadsides, and grasses/weeds available in adjacent plantations or woodland clearings as well as provided improved forages in stalls primarily from Napiergrass and in some cases Rhodesgrass. Use of minerals and treatment for internal and external parasites is practiced. Limited use is made of concentrates in periods of high need and low forage quality.

4. Dairy Breeds - Zero-Grazing: Grazing by pure dairy breeds where animals are stall fed their entire diet from both forages and concentrates. Animals are hand fed forages that are hand harvested from nearby native forages, introduced species growing on roadsides, grasses/weeds available in adjacent plantations/woodland clearings and purchased fodder as well as provided improved forages in stalls primarily from Napiergrass and in some cases Rhodesgrass. Use of minerals is widely practiced as is treatment for internal and external parasites. Substantial use of concentrates throughout the lactation cycle of the animals is practiced throughout the year.

5. Steer Fattening: Extensive steer fattening with zebu x dairy cross animals up to 24 months of age. Castrated males are retained or in some instances purchased to be fattened on forages and concentrates for added revenue in the dairy operation. Animals are grazed on native forages, introduced species growing on roadsides, and grasses/weeds available in adjacent plantations or woodland clearings. Few inputs are provided to the animals.

6. Intensive Confined Steer Feeding: Intensive confined feeding of castrated dairy calves up to 24 months of age. Animals are hand fed improved forages, primarily Napiergrass, and provided internal/external parasite control, minerals, and strategic use of concentrates.

Table 2.3.1 Brief description of the four major small holder dairy milk production systems in Kenya

<table>
<thead>
<tr>
<th>Component</th>
<th>Zebu Cattle Grazing Native/Roadside/Plantation Forage</th>
<th>Dairy x Zebu Cattle Grazing Native/Roadside/Plantation Forage</th>
<th>Dairy Breed Cattle Grazing in Semi-Zero Grazing</th>
<th>Dairy breed cattle With Zero-Grazing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forage System</td>
<td>Kikuyu, Stargrass, <em>Panicum maximum</em>, Themeda, Other Natives, Weeds, etc</td>
<td>Kikuyu, Stargrass, <em>Panicum maximum</em>, Themeda, Other Natives, Weeds, etc</td>
<td>Kikuyu, Stargrass <em>Panicum maximum</em>, Themeda, Other Natives, Weeds, etc</td>
<td>Napiergrass or Rhodesgrass</td>
</tr>
<tr>
<td>Feeding System</td>
<td>Free or herded grazing</td>
<td>Free or herded grazing</td>
<td>Corral fed with some limited tethered grazing or herded</td>
<td>Hand cut fodder in a corral/shed</td>
</tr>
<tr>
<td>Disease Control</td>
<td>None</td>
<td>Dipping</td>
<td>Dip and Drench</td>
<td>Dip and Drench</td>
</tr>
<tr>
<td>Calf Rearing Method</td>
<td>3-7 month suckling</td>
<td>3-7 month suckling</td>
<td>16 wk whole milk bucket feeding</td>
<td>16 wk whole milk bucket feeding</td>
</tr>
</tbody>
</table>