



Enhancing dairy-based livelihoods in India and Tanzania through feed innovation and value chain development approaches

Assessing the dairy value chain and potential to enhance productivity through improved feeding in Pemba Island of Zanzibar, the United Republic of Tanzania

By Brigitte L. Maass (CIAT) and Ben Lukuyu (ILRI)

In collaboration with Asha Omar Fasih (Ministry of Agriculture and Natural Resources, Chake Chake, Pemba, Tanzania), Hamza Suleiman (Ministry of Agriculture and Natural Resources, Chake Chake, Pemba, Tanzania), Seif Khatib (Ministry of Agriculture and Natural Resources, Chake Chake, Pemba, Tanzania), Fred J. Wassena(CIAT) and Samy Bacigale (CIAT)






Nairobi, Kenya: International Center for Tropical Agriculture (CIAT)
June 2013



© 2013



This publication is licensed for use under the Creative Commons Attribution-Noncommercial-Share Alike 3.0 Unported Licence. To view this licence, visit <http://creativecommons.org/licenses/by-nc-sa/3.0/>. Unless otherwise noted, you are free to copy, duplicate, or reproduce and distribute, display, or transmit any part of this publication or portions thereof without permission, and to make translations, adaptations, or other derivative works under the following conditions:

-  **ATTRIBUTION.** The work must be attributed, but not in any way that suggests endorsement by the publisher or the author(s).
-  **NON-COMMERCIAL.** This work may not be used for commercial purposes.
-  **SHARE ALIKE.** If this work is altered, transformed, or built upon, the resulting work must be distributed only under the same or similar license to this one.

NOTICE:

For any reuse or distribution, the license terms of this work must be made clear to others.
Any of the above conditions can be waived if permission is obtained from the copyright holder.
Nothing in this license impairs or restricts the author's moral rights.
Fair dealing and other rights are in no way affected by the above.
The parts used must not misrepresent the meaning of the publication. ILRI would appreciate being sent a copy of any materials in which text, photos etc. have been used.

Contents

Summary.....	1
Introduction and background.....	2
Agriculture and livestock production in Pemba Island	3
Livestock production projects in Pemba.....	4
Objectives	6
Methodology	7
Results and discussion	9
Producers	9
Agriculture	9
Livestock production systems.....	10
Feed types and sources throughout the year and feeding systems	12
Major income sources	15
Dairy cooperatives	16
Challenges and opportunities	16
Consumers of milk and milk products.....	18
Local population	18
Tourism	18
Processors and traders/vendors	18
Milk processing	18
Quality control	19
Milk markets	19
Payment mechanisms, credit and check-off system.....	21
Main constraints	21
Input and service providers.....	21
Payment mechanisms, credit and check-off system.....	22
Challenges and opportunities	23
Feed suppliers	23
Veterinary drug suppliers	24
Conclusions.....	26
Acknowledgements	27
References	28
Appendix 1: Local measures in Pemba as indicated by FEAST participants	32
Appendix 2: Illustrations.....	33
Applying FEAST in Kisiwani and Chake Chake	33
Feeds and feeding	34
Processing and consumption	35
Local units and transport	36

Summary

Pemba Island is part of the Zanzibar archipelago, forming one of the administrative regions of Tanzania. As compared to mainland Tanzania, a higher proportion of the population in Pemba is rural, basing their livelihoods essentially on agriculture, and considerably higher poverty exists. Since the islands have become tsetse-free in 1997, the cattle population has steadily increased, consisting predominantly of local cattle of the so-called 'Zanzibar Zebu' type. Despite the relatively low productivity of local cows, milk production has also increased in Pemba. In order to identify potential for feed interventions by the IFAD-funded MilkIT project, the dairy value chain has been investigated on Pemba Island in July 2012 by the International Center for Tropical Agriculture (CIAT) and the International Livestock Research Institute (ILRI) in collaboration with local partners. To assess feed availability, the FEAST tool has been applied in two group sessions with producers. In addition, trader/vendors, input and service suppliers, and consumers have been visited and interviewed mostly along semi-structured questionnaires. Most important conclusions from this study are:

- Milk production has increased over the recent past in Pemba, but local consumption of milk and milk products remains low.
- Promotion of consumption of milk and milk products is needed to better match supply and demand in Pemba.
- Improved marketing of milk and milk products both on Pemba Island and to Unguja Island and the Tanzanian mainland currently requires more attention than further increasing milk production in Pemba. This also includes more professional processing and packaging than done at present.
- Because of its focus on using feed interventions to increase milk production, the IFAD-funded MilkIT¹ project should not regard Pemba as a priority intervention area under the current circumstances of dairy development on the island.

¹ The research project 'Enhancing dairy-based livelihoods in India and the United Republic of Tanzania through feed innovation and value chain development approaches'

Introduction and background

In recent decades, livestock and livestock production have become more prominent on Pemba Island, Tanzania, rather known for its spice production, especially that of cloves (*Syzygium aromaticum*). Unguja and Pemba, together with some smaller islands, form the archipelago of Zanzibar. The island of Pemba is about 56 km off the North coast of Tanzania's mainland and has a surface of almost 1000 km² (67 km long and up to 22 km wide). Pemba's current population is about 360,000 predominantly rural inhabitants (Table 1). The island has always been densely populated with an increasing trend from about 164,000 inhabitants in 1967 to 260,000 in 1988 and 360,000 inhabitants in 2002 (Madulu, 2004). With a density of more than 360 persons/km², the current population, hence, represents the most densely populated part in eastern Africa (RGoZ, 2009a). Especially in North Pemba, poverty is high (Table 1), and more so when compared to overall mainland Tanzania (UNDP, 2010). Urbanization is less than in mainland Tanzania.

Administratively, Pemba Island is organized into four districts, Wete, Micheweni in the North and Chake Chake, Mkoani in the South. The three main towns, Wete, Chake Chake and Mkoani host the island's administration, the airport and the port, respectively. A number of major roads are tarmacked providing relatively good infrastructure across the island (Daily News, 2012).

Table 1. Population in 2002 and poverty headcount ratios by district of Pemba, Tanzania.²

District of Pemba	Males (no.)	Females (no.)	Total (no.)	Urbansation rate (% of total population)	Basic needs poverty headcount ratio (%)*	Food poverty headcount ratio (%)*
Wete	49,784	52,276	102,060	24.5	70.8	23.8
Micheweni	40,733	42,533	83,266	6.7	74.2	33.4
North Region	90,517	94,809	185,326	16.5	72.3	28.1
Mkoani	45,191	47,282	92,473	13.2	42.1	7.3
Chake Chake	40,223	42,775	82,998	23.2	56.8	15.9
South Region	85,414	90,057	175,471	17.9	49.1	11.4
Total Pemba	175,931	184,866	360,797	17.2	61.0	20.0
Mainland Tanzania [#]	20.2 mio	21.1 mio	41.3 mio	26.0	33.6	16.6

* Basic needs poverty is defined as a line attempting to calculate the cost of a basket of necessities including food, clothing, shelter, and some limited additional items, connected to the society in which people live; calculation of Food poverty is based on calorie consumption and food expenditure of a given population.

[#] All data for 2007 from UNDP (2010).

² Population from CCO (2003); Poverty ratios from Zanzibar Agricultural Research Proceedings (2010-2011, cited by Mohamed and Temu, 2011)

Agriculture and livestock production in Pemba Island

Ecologically, Pemba lies in the humid tropics with relatively high annual rainfall of about 1900 mm in a bimodal pattern, high humidity of 60-80%, and temperatures from minimum 18-21 °C to maximum of 28-32 °C (DFA, 1986). On average, rainfall in Pemba is higher than in Unguja (Ali, 1998). The island is characterized by four seasons as pertained to rainfall distribution, namely two rainy seasons and two relatively drier seasons. Three quarters of the island are cultivated land because its territory contains only 30% coral rag area (Balsem, 2011). Generally, Pemba is hilly and has fertile soils. Hence, agriculture is an important part of livelihoods of the people of Pemba, but rarely is it the sole income source for rural households (Milne-Price, 2011). Land use is characterized by a patchwork of crops, including mainly cloves, coconut, cassava and rice. Since the revolution of 1964, land belongs to the government and can be allocated to farming families, typically 3 acres per family (2.5 acres = 1 hectare).

Table 2. Cattle population and cattle holders (no.) by district of Pemba, Tanzania (Ministry of Agriculture and Natural Resources, unpublished; data on cattle in general from the National Census 2008, those on improved cattle from October 2012).

District of Pemba	Total cattle		Holders of cattle	
	Local (no.)	Improved (no.)	Local (no.)	Improved (no.)
Wete	—	727	—	266
Micheweni	—	313	—	170
North Region	44,033	1,040	17,613	436
Mkoani	—	297	—	162
Chake Chake	—	769	—	310
South Region	31,824	1,066	12,730	472
Total	75,857	2,106	30,343	908

Livestock production forms an integral part of agriculture in Zanzibar and about one third of the farming households keep large ruminants (cattle, goats), while two thirds of them keep both local and commercial chickens (Milne-Price, 2011). Indigenous cattle belong to the Small East African Zebu according to Ali (1998); this so-called 'Zanzibar Zebu' is characterized by unique adaptation to the island environment. The number of cross-bred cattle has increased from 2 to 5% between 1993 and 2003 (RGoZ, 2009a); common dairy cows are Zebu crosses with Friesian, Jersey and Ayrshire and between breeds (RGoZ, 2009a). The cattle number is currently about 77,000 for Pemba Island (2002 census), including both local and improved breeds; having more than doubled from the 32,000 heads reported in 1986 (DFA, 1986). This cattle population represents a density of currently 1 head per 0.9 ha of cultivated land area. According to Sarwatt and Mollel (2006), ruminants were unimportant in the humid, tsetse-infested archipelago. However, tsetse eradication campaigns in the 1970s and 1980s have been successful in 1997 (RGoZ, 2009a), and today sleeping disease does not play any role on the archipelago (Milne-Price, 2011). There are slightly more cattle in the North

Region of Pemba than in the South (Table 2). Nevertheless, the number of improved/crossbred cattle is very low everywhere, with a tendency of higher animal as well as cattle holder numbers in the urban zones of Wete and Chake Chake. Overall, there are about 900 holders of improved cattle (3% of cattle keepers).

As there is little availability of pastures on the island, most animals are tethered outside during the day, and rarely are they provided with supplementary feed beyond kitchen or farm waste. Consequently, traditional animal productivity is low. During the lactation period (100-150 days), indigenous Zebu cows produce an average of 1 to 2.13 litres of milk per day (Ali, 1998; RGoZ, 2009a; Milne-Price, 2011), yet 95% of cattle farmers sell some of this milk. Cross-bred cows have an average of 8.8 l during a lactation of 280-300 days (RGoZ, 2009a). Improved/exotic cattle are mainly kept at the homestead (zero-grazing) and provided with cut and carry grasses in addition to some cereal-based concentrates. Milk sales are an important source for cash income. Milk production on the archipelago has steadily increased over the past decade (Figure 1), though this is probably more due to the increasing cattle population than to productivity increases. Other main purposes for keeping cattle are their functions as living savings accounts and for traction (Ali, 1998).

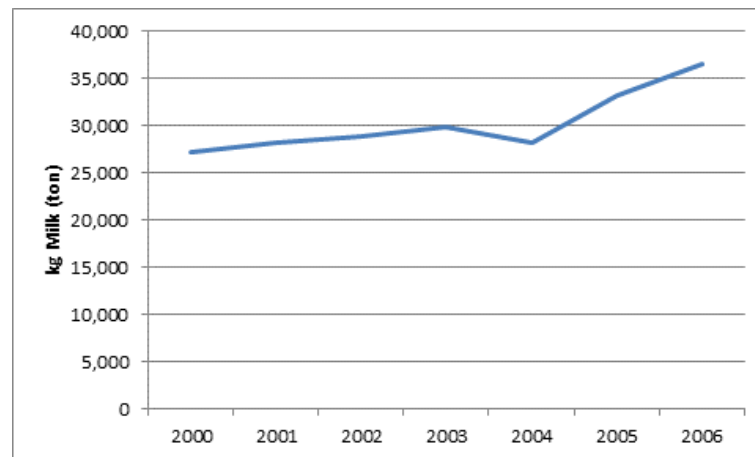


Figure 1. Development of milk production (kg in ton) in Zanzibar from 2000 to 2006 (modified from RGoZ, 2009a)

Livestock production projects in Pemba

A few projects, financed by Irish Aid and the United Nations International Fund for Agricultural Development (IFAD), have targeted Pemba Island for improving livestock production (Table 3). The Irish-funded Smallholder Livestock Development Project (SLDP) during the 1980s concluded that the largest amount of milk will still come from local cows despite their efforts of introducing improved cows. This is due to the large number of local cows as compared to the introduced ones.

Nevertheless, milk sales price was perceived too high for most potential consumers due to their low income levels and purchasing power (Burrell and Ngassamiakwi, 1998). The same authors conclude from their market study that there is a very limited market opportunity on Pemba Island. This supports Biwi's (1993) statement that the increasing demand for milk in the 1990s mostly resulted from the strongly growing tourism on the archipelago. However, Biwi (1993) found that more and more smallholders entered dairy business as the demand for milk and milk products increased.

The Zanzibar Sub-Programs of Agricultural Services Support Programme (ASSP) and Agricultural Sector Development Programme-Livestock (ASDP-L) are part of the respective Tanzanian programs. They are funded by IFAD and implemented in the nine rural districts of Zanzibar under the Ministry of Agriculture and Natural Resources³. The two programs complement one another; their goal is to reduce poverty, improve food security and increase incomes among communities with high level of livelihood dependence on agriculture (Table 3). One of the successful instruments used in Pemba has been the establishment of farmer field schools (FFS), of which 190 livestock FFSs have been implemented in the four districts of Pemba. Within the projects, the immediate objective was to increase production both for self-sufficiency and income generation. Since production has risen, activities on improved processing and marketing have now become more crucial for the producers.

Table 3. Livestock development projects in Pemba Island

Project	Donor	Duration	Main objectives and interventions in Pemba
SLDP – Smallholder livestock development project	Irish Aid	1983-1998	Introduction of improved breeds, established cross-breeds, veterinary services, improved feeding by cultivating forages
PADEP – Participatory Agricultural Development and Empowerment Project	GoT, Worldbank	2003-2010	Introduction of dairy goats
Agricultural Services Support Programme (ASSP) – Zanzibar sub-programme	IFAD	2007-2013 (7 years)	Main objectives: (i) Farmer Empowerment – improving demand; (ii) Agricultural Services Provision – improving supply; and (iii) Programme Management – ensuring sound coordination. Interventions: Service support and farmer empowerment through Farmer Field Schools.
Agricultural Sector Development Programme-Livestock (ASDP-L) – Zanzibar sub-programme	IFAD	2007-2014 (8 years)	Main objectives: A) Farmer Empowerment; B) Technical Support to Livestock Development; C) Support to Policy Dialogue, Legal and Regulatory Frameworks and Institutions; and D) Programme Management. Interventions: Farmer field schools, covering all livestock

Developing the dairy value chain is considered among the best opportunities that can contribute towards improving the livelihoods of smallholders (e.g., Kurwijila, 2002a,b; Omore et al., 2009). The CGIAR, through its Livestock and Fish Program (CRP 3.7), will therefore engage in research that assists to improve the dairy value chain in Tanzania. One of the first projects in research for development within this larger program is the ‘MilkIT’ project (‘Enhancing dairy-based livelihoods in

³ Until 2010, the Ministry of Agriculture also covered livestock. Since the ASSP and ASDP-L projects were initiated before, the Ministry of Agriculture and Natural Resources continues as their implementing agency.

India and the United Republic of Tanzania through feed innovation and value chain development approaches'). This project aims at enhancing dairy-based livelihoods of smallholder farmers through feed interventions by applying approaches of innovation and value chain research; it is financed through an IFAD grant.

Objectives

The main objectives of the current study were to (i) characterize the dairy value chain in Pemba Island with emphasis on milk production, and (ii) identify possible interventions for feed and feeding improvement on the island.

Methodology

In order to characterize the livestock production system, with emphasis on dairy cattle, and its potential for enhancing productivity through improved feed and feeding interventions in Pemba, a two-step approach was performed. First, the Feed Assessment Tool (FEAST, version from 15 June 2012 by Duncan et al.) was used to characterize the livestock production system and, in particular, feed-related aspects. The FEAST tool is a rapid and systematic method that combines a PRA (Participative Rural Appraisal) with individual farmer interviews. The PRA provides an overview of the farming system, in particular, the livestock production system. It also helps identify major problems, issues and opportunities within the livestock production system. The individual farmer interview gathers both quantitative and qualitative information according to major wealth groups based on relative land size owned. The assessment was carried out through two structured group discussions and completion of short questionnaires by key farmer representatives on 9th and 10th July 2012. The composition of the groups is shown in Table 4. On the first day, farmers came from different Shehia's⁴ of the northern region and the second day from the southern region.

Participating farmers were chosen by the Program District Officers (PDO) from the Ministry of Agriculture and Natural Resources of Zanzibar.

Table 4. Group composition of farmer representatives during two days of feed assessment applying FEAST (Duncan et al., 2012) in Pemba, Tanzania; number of individual interviews in parentheses.

Day	Shehia	Men	Women	Total
1	Wete District: Kisiwani	13 (5)	3 (2)	16 (7)
2	Chake Chake District: Wawi, Wara, Chanjaani, Mkoroshoni, Vitongoji, Ziwani, Ng'ambwa Mkoani District: Kangaani, Mjimbini, Kiwani	16 (4)	5 (2)	21 (6)

The first PRA and subsequent interviews took place in Kisiwani village, located in the North of Pemba, in Wete District (Table 4). The travel distance by road is approximately 15 kilometers from Chake Chake, the center town of Pemba. The second PRA as well as the two group discussions with other value chain actors were conducted at the building of the Ministry of Agriculture and Natural Resources in Chake Chake town. Overall 16 and 21 persons participated in Kisiwani and Chake Chake, respectively. From each PRA group, 1-2 representatives of different wealth classes (Table 5) were chosen for the individual interviews. Apparently the group from Chake Chake and Mkoani Districts was wealthier than that from Wete District, as reflected in their land ownership.

⁴ Administratively, a 'Shehia' is equivalent to the Ward on the mainland of Tanzania, while the superior administrative entity in Pemba is a 'Jimbo', equivalent to Division on the mainland.

Table 5. Average land sizes owned by different categories of farmers in Pemba, Tanzania.

Category of farmer	Wete District (Kisiwani village)		Chake Chake and Mkoani Districts	
	Range of land size (ac)*	% of households that fall into the category	Range of land size (ac)	% of households that fall into the category [#]
Landless	0	0.0	0	0.0
Small farmer	<0.5	46.7	0.5-2	33.3
Medium farmer	0.5-1.5	13.3	2.5-5	50.0
Large farmer	1.5-3.0	40.0	>5	16.7

* One hectare is composed of 2.5 acres. [#] The percentages from Chake Chake and Mkoani Districts refer to the participants of the PRA.

Table 6. Group composition of value chain representatives during value chain assessment in Pemba, Tanzania.

Actor in the value chain (gender)	Farmer/ vendor (m)	Processor/ farmer (m)	Feed supplier (m)	Feed & vet supplier (m)	Vet supplier (m)	Consumer (f)
Wete District:						
Kisiwani, Wete town	–	1	1	1	1	–
Chake Chake District:						
Chake Chake town, Gombani, Machomane	1	2	1	1	–	1
Total	1	3	2	2	1	1

In a second step, both input/service providers and vendors/traders along the dairy value chain were gathered in two separate structured group discussions on 13th July 2012 (Table 6). Tools applied during these discussions are from the methods toolkit of the Livestock and Fish Program of the CGIAR system (CGIAR LaF, 2012). Some of the group members were visited briefly on 11th July to obtain an impression of their location, working conditions and environment. Group composition is displayed in Table 6. Most participants indicated that they were also farmers and kept livestock. In addition, we can assume that all participants were consumers as well.

Overall, any chance was taken to discuss issues of the dairy value chain with various actors, particularly key informants. Relevant literature and unpublished reports were also gathered.

The following are the findings of the assessment and conclusions for further action.

Results and discussion

Most important results are presented and discussed here, while all details are available in the appendix. The dairy value chain consists of a number of actors, namely, producers, milk processors, traders/vendors and consumers. In addition, input and service providers support the value chain at the producers' end (Figure 2). In the following, we will describe main findings from each actor level in the dairy value chain of Pemba, starting with production.



Figure 2. Model of the actors in a value chain

Producers

Agriculture

Pemba is dominated by small scale farming households with a few large scale farmers mainly engaged in growing cloves (*Syzygium aromaticum*) and other spices, such as pepper (*Piper nigrum*), very lucrative cash crops. Subsistence crops are mainly cassava, rice and bananas. Figure 3 shows the average area (ha) per household of dominant arable crops. Households in surveyed areas of Pemba are composed of approximately 7-9 (range 4-18) people per household. With an average of 1.5 acres (range 0.5-3 acres), households from Kisiwani utilize substantially less land than those from Chake Chake and Mkoani that use 3.7 acres (range 1-12 acres). Farmers' perceptions about average land sizes for different categories of farmers are shown in Table 5. Pemba experiences four different cropping seasons spread quarterly over the year. The high rainfall season 'Masika' is from March to May, while a secondary rainy season 'Mchoo' is from June to August. It is in the main dry season 'Kasikazi' from November to January, when almost no precipitation takes place. Finally, 'Vuli' distinguishes a transition from September to October (low/start of rainfall season) (Table 7).

Table 7. Cropping seasons occurring in Pemba

Condition (Name of season)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dry, hot (Kasikazi or Kiangazi)	✓	✓										✓
Heavy rains, hot (Masika)			✓	✓	✓							
Showers, cool (Mchoo)						✓	✓	✓				
Scattered showers, warm (Vuli)									✓	✓	✓	

Land owned by farmers is not enough for all their farming and livestock activities. Farmers mainly practice inter-cropping and, in some cases, relay cropping. Due to land shortage, no fallowing takes

place. Agricultural inputs such as fertilizer, seeds, agro-chemicals as well as implements are in short supply. In addition they are not affordable to most farmers. Labor is generally available and is mostly required in the rainy season for land preparation, planting and harvesting. Labour costs TZS 12,000-15,000⁵ per person per day. Most tasks are performed by men and women jointly; however, women are mainly confined to tasks related to rice and vegetable growing. There is limited movement of population to the few urban centers of Pemba because most people rely on agricultural activities for their livelihoods, including livestock (Fig. 10).

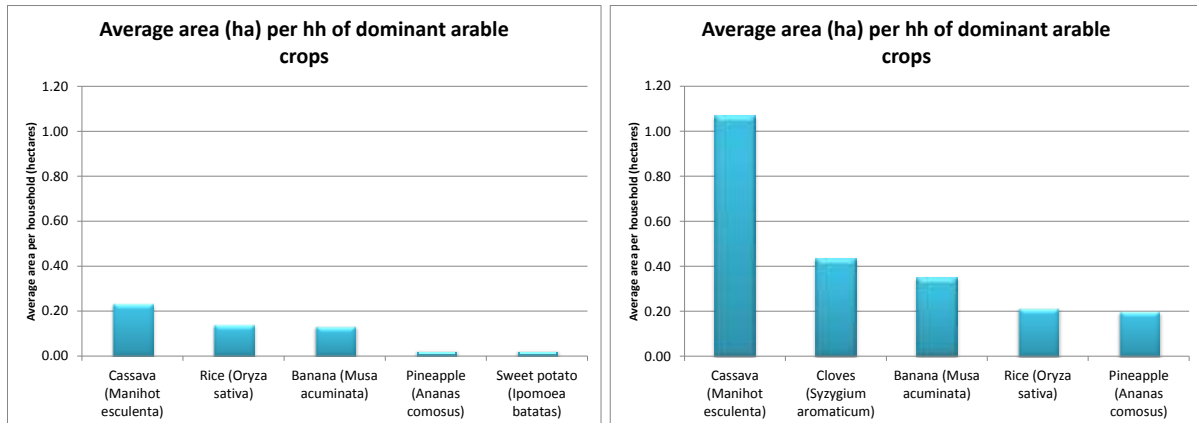


Figure 3. Average area (ha) per household of dominant arable crops as perceived by farmers from Kisiwani (left) and Chake Chake and Mkoani (right)

Livestock production systems

The most common livestock production systems in Pemba are:

- The zero-grazing system that farmers mainly use for improved cows, practicing cut and carry feeding systems. Fodder is often chopped before feeding and often supplemented with concentrate feeds.
- The semi-zero-grazing mainly used for keeping local cattle. Cattle are tethered on personal land and/or along road sides and on public land for grazing often under tree shade; they are often also provided with additional feed resources like kitchen wastes or residues from cassava and banana pseudo-stem when available.

Milk production is an important means of regular income generation with many farmers possessing crossbreds of Jerseys and Friesians. Farmers from Wete district (Kisiwani village) generally had less livestock, but more local dairy cows and indigenous poultry than those from Chake Chake and Mkoani districts (Table 8). The majority of farmers (51% to 75%) own local dairy cows and have an average of 1-3 dairy cows and/or 2-4 local cows. In addition to providing milk, these are also sold for meat to supply substantial income when the need arises, and to pay dowries. A few farmers (less than 5% in Kisiwani, 35% in Chake Chake and Mkoani) keep improved cross bred animals for increased milk production. About a third of the farmers keep goats for sale, when funds are needed quickly. Most farmers also keep indigenous chickens. The average livestock holdings (TLU) per

⁵ 1 US\$ is equivalent to about 1550-1570 TZS at the time of the survey.

household of dominant species are shown in Figure 4, whereas the farmers selected for interview were more dedicated to dairy cattle (Table 8) than the overall group described the holdings.

Table 8. Proportions of farmers owning different species of livestock, average herds per household (HH) and use according to District in Pemba

Livestock species	Use	Wete (Kisiwani village)		Chake Chake and Mkoani	
		HHs owning the species (%)	Animals per HH (average no.)	HHs owning the species (%)	Animals per HH (average no.)
Local dairy cows	Milk, skin, manure, meat sale (income)	75	2-3	51	3-4
Improved dairy cows	Milk, manure, sale for breeding (income)	4.3	1	35	2-3
Draught cattle	Draught power	14.3	1	26	1
Sheep	Meat and sale for income; skins	0	n.a.	2	10
Goats	Milk, meat and sale for income; skins	1.4	1	36	5
Indigenous poultry	Eggs, meat and sale for income; guano	99	>20 (up to 200)	91	10
Commercial poultry	Eggs, meat and sale for income; guano	1.9	100 (50-300)	7	200
Donkeys	Draught power	0	n.a.	1	1-2

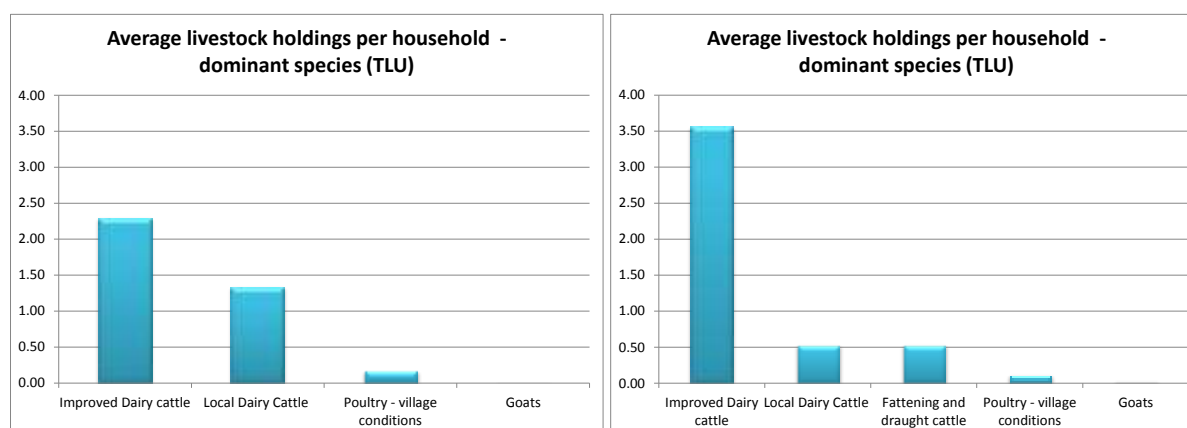


Figure 4. Average livestock holdings (in tropical livestock units, TLU) per household of dominant species in Wete (left) and Chake Chake and Mokoani (right) districts of Pemba

Generally, livestock input services such as feeds and veterinary drugs are available but were reported to be costly. Both private and government veterinarians provide animal health services to farmers in Pemba. Veterinary services are generally available but not easily accessible, and they are

costly for most farmers. For example, treating East Coast Fever (ECF) costs farmers TZS 20,000 per treatment in addition to transport cost of TZS 3,000 and labor charges of TZS 2,000. It costs TZS 10,000 to treat mastitis, while treating simple eye infections is about TZS 3,000. The most common diseases are ECF, mastitis, internal worms, eye infections and lumpy skin disease.

Artificial Insemination (AI) services are lacking particularly in Mkoani district, where it is not accessible due to lack of AI service providers. The cost of a single insemination is TZS 8,000-10,000 per single dose of semen, regardless of whether it is the first or a repeat serve. In addition, farmers pay TZS 5,000 for the AI service. The rates of repeat are high (up to 3-4 times), especially among high producers. Low producers tend to record lower repeat rates of 2-3 times. Improved bulls are mainly used for breeding at a cost of TZS 5,000 per service, while local bulls are offered for free.

There is generally no credit from institutions for crop or livestock production. However, farmers have access to a few small self-help credit and saving groups. Income is mainly obtained from crop, livestock and small businesses. These businesses include fishing and service provision. At present, cattle prices vary with season but range between TZS 1,200,000 and 1,500,000 per head. Goat prices tend to remain the same throughout the year at about TZS 80,000 per head.

Feed types and sources throughout the year and feeding systems

Improved cattle are stall-fed with cut and carry grasses that are manually chopped with a ‘panga’ (local machete) or a big knife before feeding and provided three times or twice per day. Feed for the improved animals is often supplemented with concentrates, such as pollard, maize bran, rice polish, minerals, and coconut or sunflower cakes. Animals are mostly kept in sheds, however, some people keep even improved cows permanently under a tree. Whereas, local cattle are mainly tethered under shade and also provided fodder through the cut and carry system, or they graze in any open land, such as along road sides and on public land. Both men and women participate in feeding livestock, including also the tethering of animals farther away from the farmstead.

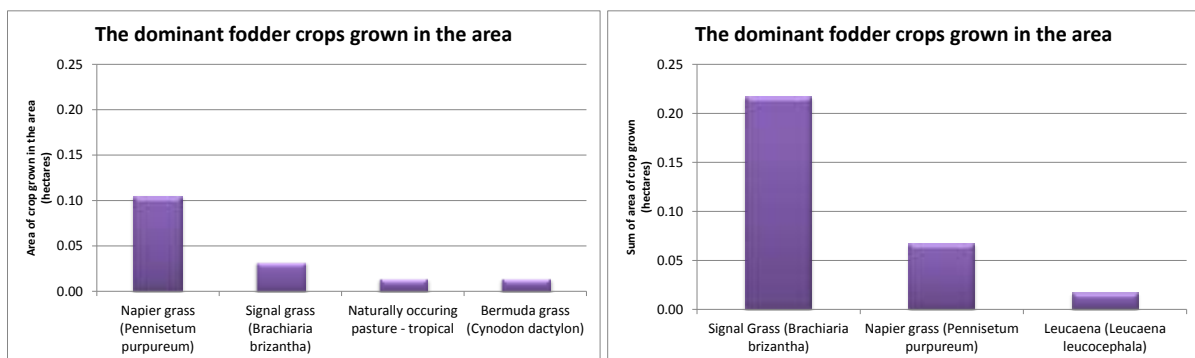


Figure 5. Dominant fodder crops grown in the area (ha) Kisiwani (left) and Chake Chake/Mkoani (right)

Fodders given include Napier and Signal⁶ grass, cut grass, harvested legume leaves (e.g. Kudzu, *Pueraria phaseoloides*), or cowpea residues (haulms), leaves of fodder shrubs like *Gliricidia sepium*

⁶ Signal grass (also called Para grass by some participants) is commonly *Brachiaria decumbens*, but also *Brachiaria brizantha* is sometimes called signal grass. Para grass is usually *Brachiaria mutica*, a species that

and *Leucaena leucocephala*. In the evening all cattle are supplied in addition with garden and kitchen wastes – like peels of cassava, banana, sweet potato, and food left from the household. Crop residues are relatively little used for feeding despite their abundance, except maybe during the dry season. In Kisiwani, for example, rice straw is usually burnt. Whereas farmers from Chake Chake and Mkoani stated that rice straw as well as banana pseudo-stems and peels, pineapple waste, breadfruit, cassava peels and leaves were also fed to cattle, especially during the dry season. Also during the dry season, some farmers use dry grass and add molasses to make the feed more palatable. Only two farmers treated rice straw either with urea or molasses.

Some farmers wished to establish forages plots, however, land scarcity is preventing them. Common forages are Napier grass (*Pennisetum purpureum*), Signal grass (*Brachiaria decumbens*), and rarely Guatemala grass (*Tripsacum andersonii*) for cut and carry, as well as Bermuda grass (*Cynodon dactylon*) and naturally occurring grass mainly for grazing. Almost half of dairy farmers have cultivated forages. Napier has been introduced more than 50 years ago. Widely spread are ‘Gold coast’ and ‘Morogoro’ varieties. It is highly appreciated because of the high biomass production. Signal grass was introduced in the 1970s. The first *Leucaena* was established in the early 1980s, probably by SLDP.

The most commonly purchased feed are commercially mixed rations that include maize (*Zea mays*) gluten with bran, sunflower (*Helianthus annuus*) seed cake, rice (*Oryza sativa*) bran (with germs), wheat (*Triticum aestivum*) pollard, and rice polishing (Figure 6).

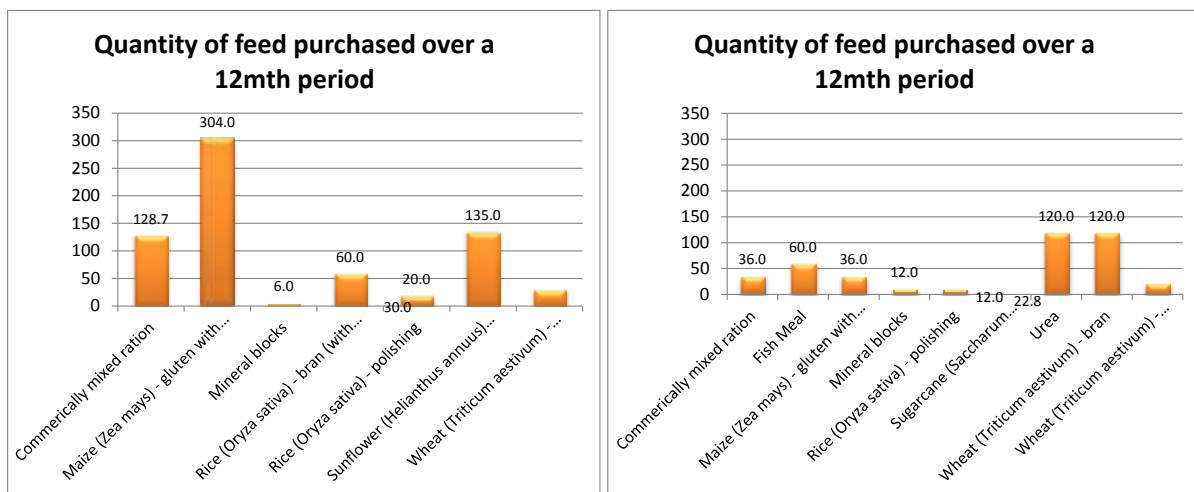


Figure 6. Quantity of feed purchased over a 12-month period in Kisiwani (left) and Chake Chake/Mkoani (right)

Naturally occurring and collected feeds contribute the largest proportion of 39-43% DM and 46-54% ME (Figures 7, 8); while the highest proportion of CP also comes from naturally occurring and collected feeds in Kisiwani (39%), it is also high in Chake Chake and Mkoani (33%), however,

grows well in swampy areas. We assume that people in Pemba only have one *Brachiaria* species available, namely *Brachiaria decumbens*.

cultivated fodder (45%) contribute substantially more CP to the diet (Figure 9).

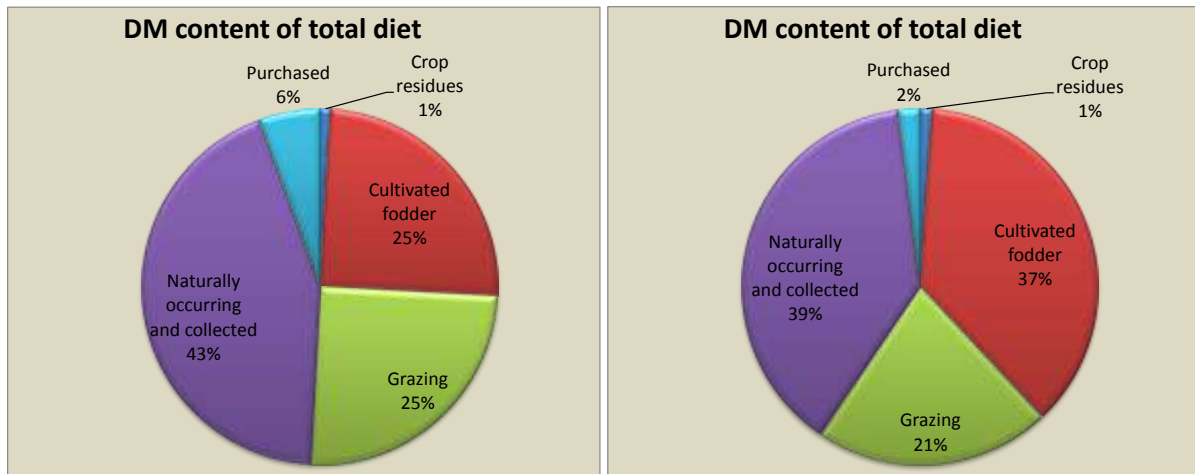


Figure 7. Proportion of dry matter (DM) content in the total diet Kisiwani (left) and Chake Chake/Mkoani (right)

Collecting naturally occurring forages is the primary component of the feed base within Pemba throughout most of the year. However, grazing drastically reduces during the dry season, December to January, when crop residues are plentiful compared to grazing as shown in Figure 10. However, after April the quantity of residues is proportionally smaller than grazing, but residues are still present for most of the year. Crop residues comprise mainly rice straw and maize stover. Farmers also purchase significant amounts of concentrate feeds throughout the year, especially in the wet season. However, what farmers refer to as concentrate feeds are predominately wheat bran, wheat pollard or rice polish. Concentrate feeding tends to be targeted toward improved breeds with higher amounts available during the wet than dry season.

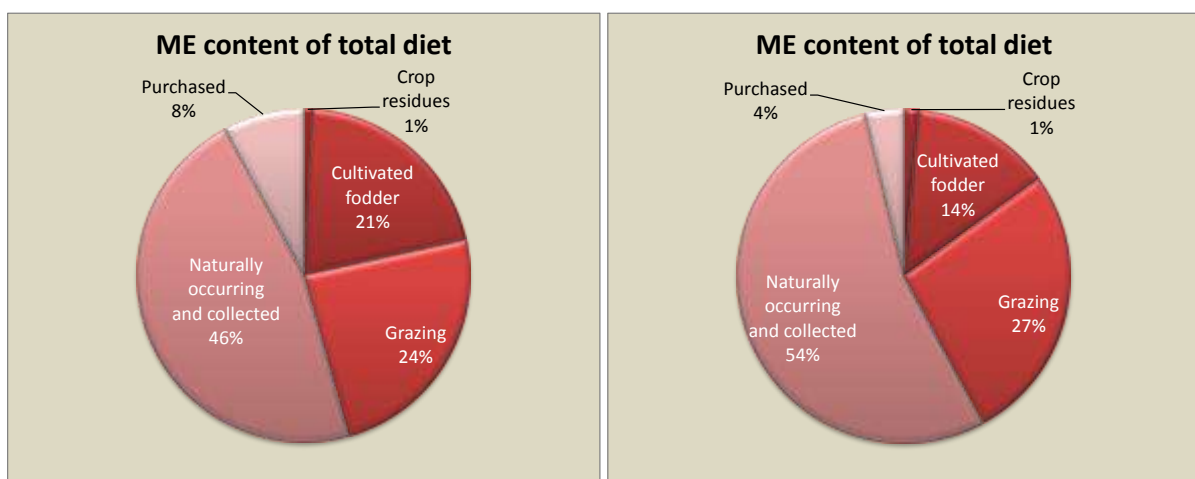


Figure 8. Proportion of energy (ME) content in the total diet Kisiwani (left) and Chake Chake/Mkoani (right)

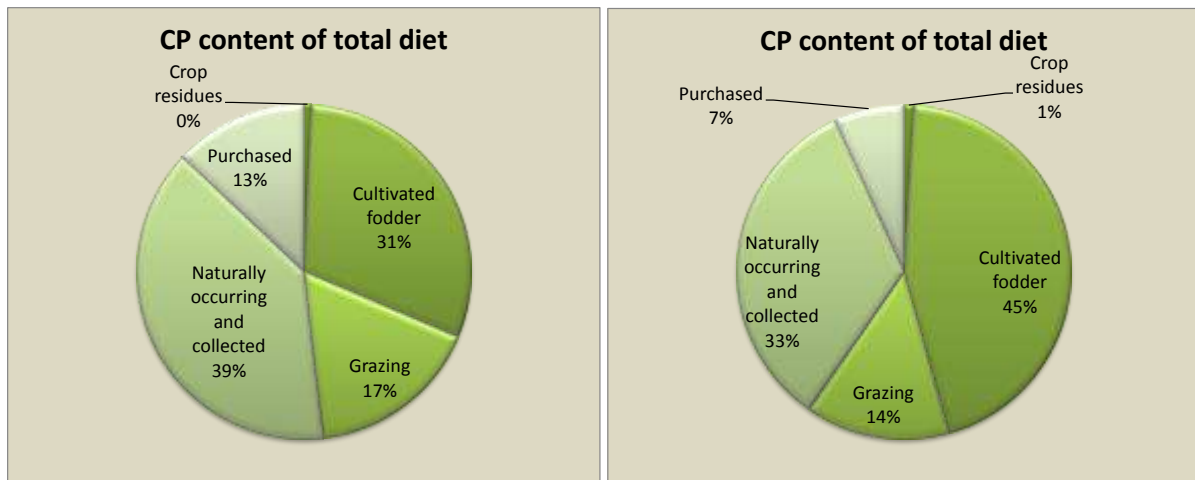


Figure 9. Proportion of crude protein (CP) content in the total diet Kisiwani (left) and Chake Chake/Mkoani (right)

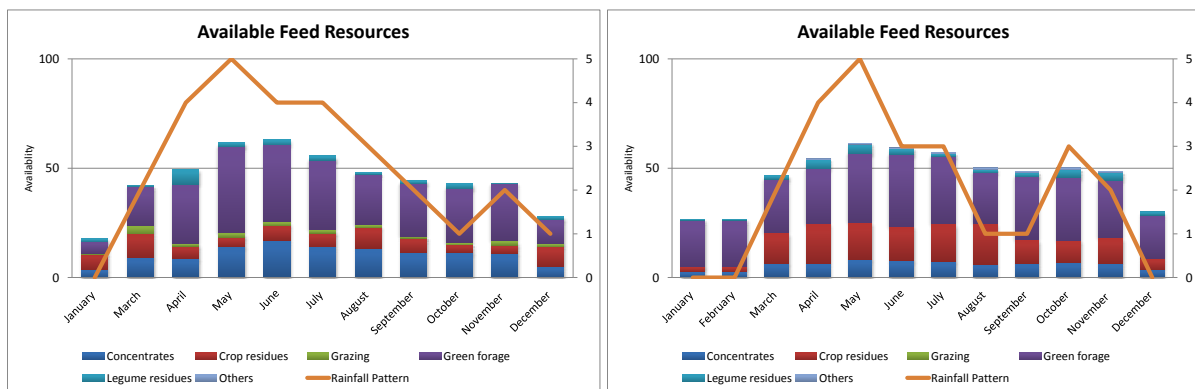


Figure 10. Variation of feed availability throughout the year Wete (Kisiwani village, left) and Chake Chake and Mkoani (right) districts of Pemba

Major income sources

In both groups of respondents, the main contributors to income are livestock (43-52%) and agriculture (34-49%); and dairy generates the predominant part of incomes from livestock (Figure 11). In Kisiwani, more participants also get income from business (14%) than in Chake Chake and Mkoani (3%). The result may reflect stronger the group compositions than the actual situation in Pemba. On the other hand, Figure 11 indicates the general importance of agriculture and livestock husbandry for the livelihoods of Pemba people. Also, the relative proportions indicate that people with more land available, probably get good incomes from agricultural products, such as cloves. Whereas for farmers with less land, livestock and especially dairy, can become crucial for their livelihoods.

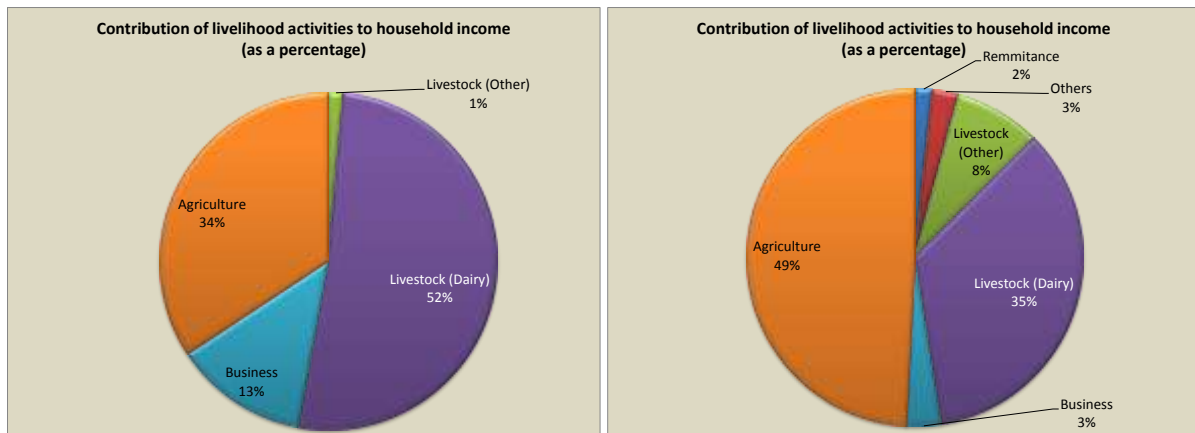


Figure 11. Contribution of livelihood activities to household income (as a percentage) in Kisiwani (left) and Chake Chake and Mkoani (right) districts of Pemba

Dairy cooperatives

Dairy cooperatives participate in several roles along the dairy value chain. Nevertheless, they mainly appear to be producers, for which reason we deal with them here. Although during our study, dairy cooperatives and their activities were mostly highlighted when dealing with processing. According to participants, only two dairy cooperatives exist on Pemba Island, 'Jambonia' cooperative in Chake Chake and 'WEMA' (WEMA Cooperative Society Dairy) cooperative in Kisiwani. Both cooperatives are involved in dairy processing, producing butter, yoghurt and ghee, but at small scale. When visiting WEMA cooperative in Kisiwani, it was indicated that they could not sell more than 100 liters of deep-frozen milk due to the high production during the rainy season facing low demand.

Challenges and opportunities

Overall, the main issues that farmers face in the farming systems are listed in Table 9. Feed problems were considered important in both the peri-urban areas of Chake Chake and the rural areas of Kisiwani, mainly where farmers have small areas of land and depend almost entirely on zero-grazing their animals. In Chake Chake, milk marketing was not a major problem because of available and easy access to urban markets. The feeding system in peri-urban areas relies heavily on 'cut and carry' fodder and collected feedstuffs, such as agro by-products as a source of feed. However, feeds were considered less important by participants from the more rural Mkoani district, whereas milk marketing was a major problem for them as well as for those from Kisiwani (Table 9). The latter may be due to increasing levels of production because of more improved dairy cows per household. Unorganized transport to reach the market was especially highlighted in Kisiwani. But marketing issues were also partly attributed to poor milk drinking culture of the local people; a large proportion of the milk produced is targeted to the hotel industry.

A lack of credit facilities is also a clear constraint to the further development of crop and livestock production in Pemba. This may be linked to the fact that there are few micro finance institutions operating on the island, while farmers are not organized into self-help groups or cooperative societies. The island does not have adequate animal health services. Artificial Insemination (AI) services could help disseminate improved genetics; however, the service is not reliable within the area and is costly to farmers. With more farmers taking up dairy production in Pemba, the ability of the existing skeleton extension staff on the island is decreasing to reach out to many farmers. This is

aggravated by lack of private sector presence and involvement in livestock production. As a result, a lack of technical knowledge is also a clear constraint to the development of crop and livestock production. Farmers' perceptions of potential solutions to their problems are shown in Table 9. It was calling for attention that farmers rather expected solutions to come from outside instead of engaging themselves in finding them, except for the formation of cooperatives for better milk marketing or purchasing of feeds and other inputs.

Table 9. Ranking of main problems in livestock production and proposing possible solutions by farmers from Wete, Chake Chake and Mkoani districts after pairwise ranking in each PRA

Challenges	Ranking Wete	Ranking Chake Chake	Ranking Mkoani	Possible solutions
Lack of credit facilities to invest in crop and livestock production	1	1	1	<ul style="list-style-type: none"> • Formation of SACCOs for providing credit facilities • Lobby for financial institutions for credit services provisions (lower interest) • No clear solution
Inadequate feeds in some areas and especially during the dry season	3	2	5	<ul style="list-style-type: none"> • Adequate land for pasture establishment • High quality pasture seeds • Credit facilities to invest in feed development • More technical knowledge in feeds and feeding • Reduce costs of feeds by procuring them together (cooperative) • Plant fodders
Lack of/difficulty to reach milk markets	2	5	3	<ul style="list-style-type: none"> • Organize milk transport together • Formation of cooperatives for milk marketing • Processing of milk • Sensitizing population about culture of milk drinking
Lack of access to and costly animal health services	5	4	4	<ul style="list-style-type: none"> • Lower cost of inputs • More technical knowledge in animal health services • Improved health laboratories • Government training of animal health assistants (paravets?) from each Shehia
Lack of technical knowledge of crop and livestock production	n.a.	3	2	<ul style="list-style-type: none"> • Improved extension services
Difficulties to access water, especially during the dry season	4	n.a.	n.a.	<ul style="list-style-type: none"> • Use draught animals to fetch water from distant streams • No clear solution available

Consumers of milk and milk products

Local population

Consumption of fresh milk is not a tradition among the population of Pemba and Zanzibar (Zanzibar Protectorate, 1937). Nevertheless, in the urban areas of Wete and Chake Chake, for example, a few milk kiosks sell boiled milk for immediate consumption. Some milk products, such as ghee however, are part of the traditional island cuisine. In some villages with few dairy cattle, people who work in town may buy milk there and take it back to the village for rural consumption. This study did not include a specific consumer survey.

Tourism

Only a minority of international tourists (1-5% according to Gössling et al., 2006 and Sharpley and Ussi, 2012) going to Zanzibar travel to Pemba. In one of the few existing tourist resorts visited in Pemba, no processed milk products were offered in any of the meals except butter. According to the hotel manager, for tea packed milk was bought in a shop in Chake Chake. A spontaneous informal interview with some of the tourists in the same hotel highlighted that they would not dare to consume milk products that look 'homemade', but rather expect professional packaging and labeling before they would consider choosing a local product, such as yoghurt. This supports the appraisal by RGoZ (2009b) that local milk quality is considered doubtful; and most hotels purchase UHT milk and milk products from Tanzania mainland or countries such as Kenya and South Africa.

Processors and traders/vendors

Milk processing

Processing of milk into various products is practiced by several actors along the dairy value chain, such as farmer groups, women cooperatives, traders and consumers (Table 10). The WEMA cooperative in Kisiwani produces butter and ghee; but members acknowledged that they faced a lack of demand, especially for butter. A private processor and shop keeper in Chake Chake town stated that, during the hot dry season, he sells yoghurt from about 100 liters of skimmed milk daily. Seasonality in both milk supply and local demand is very high (Table 11), which makes matching difficult as far as only local markets are concerned.

Table 10. Milk products available in Pemba and respective processors

Processor	Fermented milk	Yoghurt	Ice cream	Ghee	Butter
Consumers	X				
Traders		X	X	X	X
Women cooperatives				X	X
Farmers groups				X	X

Despite the practice, all these actors pointed out that milk is handled and processed under very poor standards from storage until the packaging stage. Thus, inadequate knowledge, capital for

investment, proper storage facilities, quality control standards, and standardized packaging were mentioned to be major constraints in milk processing.

Quality control

Producers sell milk either fresh or refrigerated. Most urban farmers bring fresh milk, as most dairy farmers have a refrigerator or they store their milk at their neighbours'. Generally the evening milk is stored/refrigerated and delivered together with the morning milk. In Kisiwani, where many farmers collect their milk in one point, milk is always tested by lactometer for adulteration. Processors also test for adulteration. Most vendors also test, however, some only taste/smell (organoleptic perception) the milk due to inadequate knowledge. Traded milk is usually boiled, so bacteria should not play a role for consumers. Milk is always boiled at home before consumption. Rarely, people keep raw milk to go sour and consume it in sour state served with rice or ugali. Nevertheless, there is not much sour milk consumption, except for the villages/in rural areas.

Table 11. Seasonal variability of milk availability in Pemba

Season	Milk production – availability	Value chain channels	Comments
Kasikazi	Very little milk	Commonly from farm to consumer	Essentially no processing; demand is very high in town, very hot; some processors process as much as possible (yoghurt, cultured milk), high % of fat in milk
Masika	Little milk	Both from farm to consumer, processor, and vendor	
Mchoo	Plenty of milk (excess)	All channels! From farm to consumer, seller/processor and vendor	Processing little (yoghurt) as demand is low due to cold; profit is very little
Vuli	Intermediate milk	All channels, from farm to consumer, seller, vendor (milk less available)	Vendor has to “work hard” to find enough milk

Milk markets

Fresh milk sales are only operating within the island. The produced milk volume from local cattle still exceeds that from improved dairy cows; however, the marketed milk is mainly from the latter. Milk is usually consumed by the producers' families, but also sold in their neighborhoods. Most milk is sold to vendors, urban processors/sellers or directly to urban consumers (Figure 12). Quite some milk volume is sold directly to consumers at milk kiosks in the urban areas. Less fresh milk volume goes directly from producers to rural consumers or rural processors. While there are only few processors in Pemba (3 in Chake Chake, 1 in Wete and 2 in Micheweni), hundreds of sellers exist, in every village, grocery, and operating kiosks in town. It was not possible to estimate the number of vendors for the whole of Pemba, but participants suggested a variable number of 9-15 in Chake Chake, according to season.

If rural producers manage to directly market their milk in urban centers, they can fetch substantially higher prices than if they sell the milk to vendors (Figure 12). Usually, producer prices do not change throughout the year, as producers and processors/sellers balance price changes over the year by special agreements/ contracts. Nevertheless, all participants in PRAs complained about the non-organized transport of milk to town. Typically, they would put their milk container into a local bus ('daladala') and send it to town without having any control over transport conditions or further handling of their produce. Vendors often collect milk by bicycle, which may take up to 5 hours; they usually start in the early morning. Consumers typically go to the seller/ processor to purchase milk. Distances from producer to consumer are not more than 16 km in Pemba, for example from Kisiwani to Chake Chake.

Packed long life (UHT) milk imported from Kenya is in short supply in Pemba and is only found in a few grocery shops and supermarkets in towns. UHT milk from Kenya is sold at 3,500 TZS/litre. Powdered milk from South Africa is sold at 11,000 TZS/kg. Condensed milk from Singapore is available in many shops and sold at 2,500 TZS/100-g-pack.

Importantly, the demand and supply scenario seems not to be clear for the different value chain actors. During the seasons with surplus milk production, many producers fail to sell all their milk due to limited market channels and/or less demand from consumers. On the other hand during the hot dry season, there is a lack of fresh milk to meet the demand on the island. Participants acknowledged that milk cooperatives could improve marketing as they are dealing with larger milk volumes and, hence, operate at larger scale.

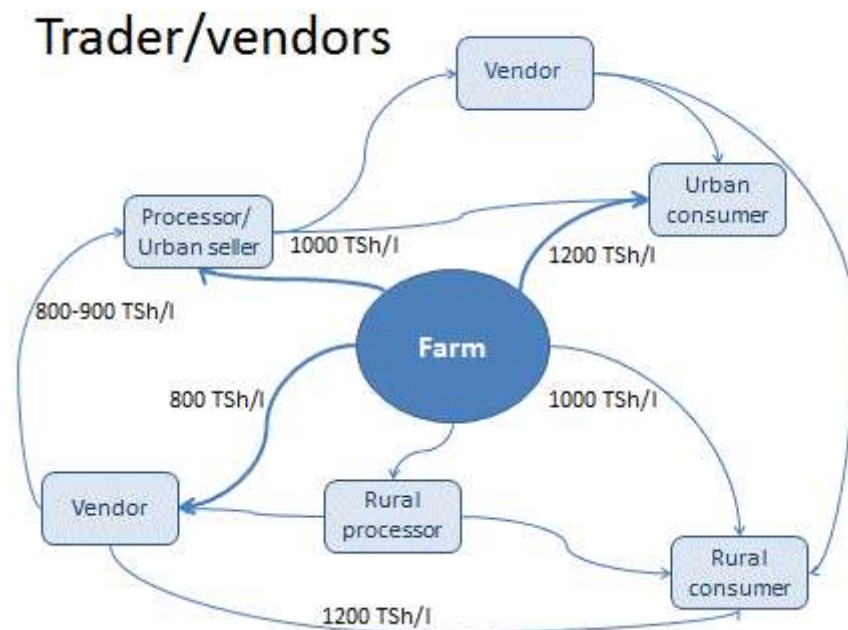


Figure 12. Channels for milk from producers to intermediaries and consumers, indicating importance of milk volume (weight of arrows) and sales prices on Pemba Island

Payment mechanisms, credit and check-off system

In almost all channels of the value chain (Figure 12), milk is paid in cash, usually monthly, but sometimes also daily, weekly or on 10-day basis. Especially between producer and processor/seller, payment mechanism depends on individual interest of the producer and may change any time according to cash needs. Credit is not available, though, by the fact that producers are paid at the end of the month, vendors/traders have an advancement of capital. If the milk seller has grocery on sale, producers can buy from the seller on check-off system. There is one seller, who is providing veterinary drugs on check-off system.

Main constraints

A substantial list of constraints was listed by the trader/vendors. To access milk purchases, limitations in storage facilities and shortage of processing units/machines were seen of high priority. Participants also emphasized the ignorance of producers regarding handling of milk and hygiene. Finally, the shortage of capital for investment was stressed.

Shelf life of milk and milk products is too short considering the lack of adequate storage and packaging facilities. Traditional consumer habits also hamper sales as most consumers are reluctant to use skimmed milk. But the demand for milk and processed products, such as ghee and butter, is also too low to match the available supply, especially in peak production times (Mchoo season). The potential market from tourism is not accessible for current local products due to their inadequate shelf life and packaging/presentation. Processors, consequently, feel the competition with imported products from Kenya, South Africa or the Emirates, which are preferred by the hotels.

Participants identified as main constraint to broaden their business so as also to supply inputs or services to producers in lack of capital and credit as well as lack of entrepreneurship skills. In conclusion, they emphasized the need for improving the internal marketing system of milk and milk products in Pemba by standardizing packaging and storage. A sensitization/promotion campaign would be additionally needed to increase the demand of the local population in Pemba.

Input and service providers

Generally, input and service provision is a secondary activity and the main income of most participants originates from other sources, especially from farming and livestock keeping. Participants stated that, when they are occupied with their main job, they usually employ someone to look after the shop. It is unusual that women engage in input and service provision as a business. Overall there is a limited number of providers available (Table 12); particularly in Mkoani district, there exists no veterinary drug supplier. Mostly, veterinary drugs are sold together with feeds, while a number of specialized feed suppliers exist in all districts.

As Pemba Island is fairly small and road infrastructure is good, there are no long ways between input and service providers and their clients, the farmers (Table 13). Most ways are done either by public transport or motorbike, however, farmers also walk to suppliers. Distances to the agents either on Tanzanian mainland or in Kenya are substantial and transport takes several days by ship, except when going by dhow⁷ that takes a day between Mombasa (Kenya) and Pemba.

⁷ A dhow is a traditional sailing boat with one or more masts with lateen sails used in the Indian Ocean region.

Table 12. Total number of feed and veterinary drug suppliers existing in Pemba

District	Feed suppliers (no.)	Veterinary drug suppliers (no.)	Feeds and drug suppliers (no.)	Total suppliers (no.)
Chake Chake	3	1	1	5
Wete	2		2	4
Mkoani	1			1
Micheweni	1		1	2

Table 13. Distances between different value chain actors concerning input and service supply

Channel	Distance to consumer	Time to consumer
Supplier – farmer	0.5-30 km	Max. 1 hour (mostly public transport)
Vet officer – farmer	0-15 km	Max. 1 hour (farmer uses public transport) Max. 30 min., Vet officer uses motorbike
Vet officer – supplier	2-30 km	Max. 1 hour (motorbike)
Agent Pemba – supplier	2-30 km	Max. 1 hour (motorbike)
Agent TZA – supplier		2-3 days by ship; ships first go to Unguja before Pemba
Agent KEN – supplier		1 day by dhow, especially for drugs

Payment mechanisms, credit and check-off system

Payments in all value chain channels (see Table 13) are either on cash or (monthly) credit basis. Generally, there is no seasonal variation in payment mechanisms. No sources of credit exist in Pemba; however, government employees can get credits from banks.

Some farmers have agreed with vendors that the input suppliers provide them with check-off credit, but this is not frequent. Sometimes also triangular arrangements among various actors exist. Usually, there are no official arrangements, but agreements are oral. Participants stated that these arrangements work well because people trust each other. Nevertheless, it became clear that first there had to be agreement among the different actors on the different payments to be made. Only one supplier out of 5 participants had experience with check-off credit and was satisfied with the system. The other participants were inexperienced but demonstrated interest in the system because there is a high level of trust in the communities. Generally, the system is initiated by the farmers.

When dealing with a cooperative, input and service providers saw more advantages than disadvantages. Particularly, the possibility of dealing with larger volumes, more clients and the customer binding were especially appealing to input and service providers. On the other hand, they

were concerned about the pressure that would be on producer prices. They also considered to run a higher risk if a cooperative wanted a credit, as they might not be able to pay if a business failed.

Challenges and opportunities

Main challenges listed by the input and service providers were dealing with high prices and the general lack of credit, which prevent them from taking advantage of the economy of scale. In addition, delayed transport between Pemba and the Tanzanian mainland as well as Unguja Island was raised. Strikingly, it was stated that there was no reliable transport between the two neighboring main islands of the Zanzibar archipelago, which makes people in Pemba feel a bit 'marginalized'. Overall, there was the hope that with increasing milk production and increasing demand, business would improve. Finally, a need for lobbying towards standardization of feeds was perceived to not fully depend on the agents.

In the following some peculiarities of the different supplier groups are given.

Feed suppliers

The feed value chain is relatively short for feed suppliers from Pemba (Figure 13). Concentrate feeds are usually ordered from an agent on the Tanzanian mainland and are mostly delivered to suppliers in Pemba; only larger farmers are supplied directly by the agent from the mainland. Other feed supply comes from millers in Unguja Island and millers from Pemba itself.

Feed suppliers

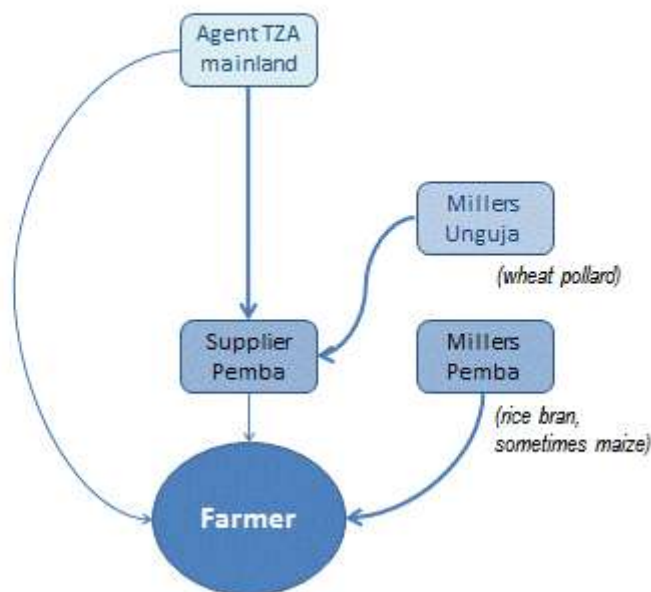


Figure 13. Channels of feed supply and their relative importance (weight of arrow) on Pemba Island (TZA, Tanzania)

The availability of feeds depends on the cropping season on Tanzania mainland, where July to September is harvesting time. During the harvesting time, there is an excess of feeds, whereas during the month of Ramadan – as people are fasting – milling machines are working to a minimum,

which creates a deficit on the market. Consequently, the demand for agricultural by-products is high in that time and prices can increase. Supplies are also affected by transport issues. The suppliers in Pemba do not formulate any feeds/concentrates, but resell them as they arrive. They are therefore fully dependent on the nutritional quality supplied by the agent. Quality control does not exist, neither in Pemba nor on the mainland. Nevertheless, suppliers react on farmers' appreciation concerning the feed effectiveness in their animal production. If a complaint occurs, Pemba suppliers usually give feedback to their agents in order to improve the situation. However, this may lead to an increase in price.

Feed suppliers establish prices themselves, depending on the cost of raw materials and transport. They stated that profit for wholesale was 10% on average and that sometimes they lose. Nevertheless, they also indicated that their prices may depend on availability of competitors. Suppliers change feed prices depending on any change of transportation charges as well as when agents change prices. Usually the changes are increases, rarely prices decrease. For example in this year, there have been three times changes in price, going up from 31,000 TZS in January, to 35,000 TZS in March, and 38,000 TZS in May for 50 kg of layers mash. Earlier in the year, wheat pollard was 30,000 TZS, while currently it is only 27,000 TZS per bag of 70 kg, as an example for prices going down. Suppliers indicated that producers react to price increases in that they initially will buy for the same cash amount until they adjust to the new price. However, this will depend on the packaging of feeds.

Vet drug suppliers

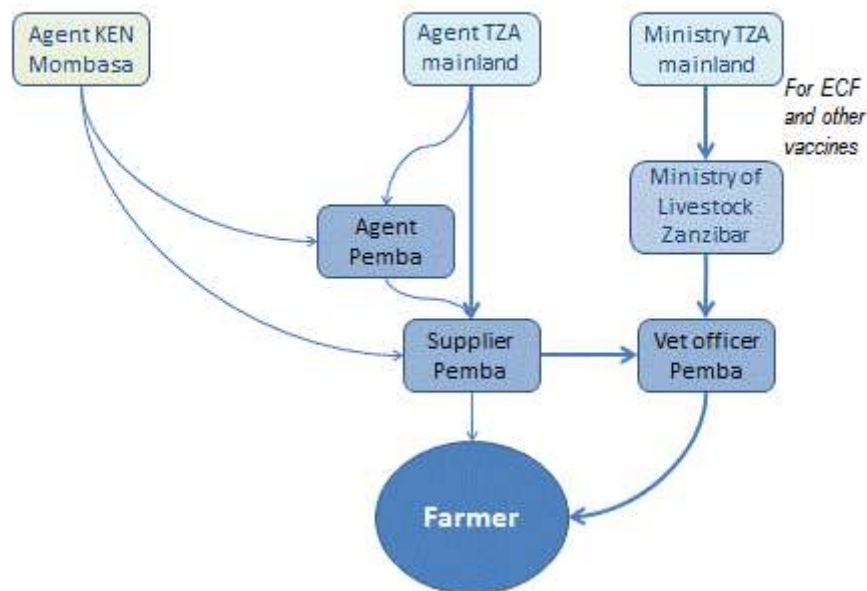


Figure 14. Importance of veterinary drug supply flow (weight of arrow) on Pemba Island (KEN, Kenya; TZA, Tanzania)

Veterinary drug suppliers

Veterinary drugs are also mostly supplied by an agent from the Tanzanian mainland to a supplier in Pemba, who then provides the veterinary officers in Pemba (Figure 14). Nevertheless, some drugs

that are more difficult to obtain are also sourced from Mombasa, Kenya. These supplies are usually transported by dhow as these are faster (Table 13) than the regular ships that usually first stop in Unguja Island for unloading goods, before they reach Pemba. In terms of vaccines, for example for ECF, the Tanzanian Ministry will supply them to the Ministry of Livestock in Zanzibar. In most cases, it is the veterinary officer who deals with farmers and not the veterinary drug supplier in Pemba.

There is not much quality control ongoing, except that drug suppliers check on expiry dates. Supplier sales prices usually allow 15-20% profit as suppliers sell in retail. But price also depends on those of competitors.

Conclusions

Pemba is characterized predominately by mixed crop-livestock production systems. Cloves are an import cash crop and foreign exchange earner. At present, agriculture and livestock, especially dairy, are the primary sources of household income. Cattle are the most important livestock species. Improved crop and dairy production is constrained by a lack of credit facilities, milk markets and feeds in intensive feeding systems. Other constraints are knowledge gaps by milk producers and inadequate animal health services. To mitigate these constraints farmers (and other stakeholders) will be required to take an integrated approach to improve livestock production through (i) milk market improvement strategies, (ii) improving access to AI facilities to ensure farmers can rapidly upgrade the genetic merit of their cattle holdings, and also (iii) access to credit facilities to enable farmers invest in the crop and livestock production enterprises.

Generally, poor market channels have been among the major limiting factors towards market development in the livestock sector in Tanzania in general and Zanzibar in particular. As this limits the potential linkage between producers and traders (e.g., free market trade), the entrance to competitive markets of products for both the farmers/producers and traders is also hampered.

From the dairy value chain assessment study, the following conclusions are drawn:

- Milk production has increased over the recent past in Pemba, but consumption of milk and milk products remain low.
- Promotion of consumption of milk and milk products is needed to match it with the increased production in Pemba.
- Improved marketing of milk and milk products both on Pemba Island and to Unguja Island and the Tanzanian mainland currently requires more attention than further increasing milk production in Pemba in order to better match supply and demand. This also includes more professional processing and packaging than done at present.
- Because of its focus on using feed interventions to increase milk production, the IFAD-funded MilkIT project should not regard Pemba as a priority intervention area under the current circumstances of dairy development on the island.

Acknowledgements

We acknowledge the unreserved collaboration by all survey respondents. The Pemba team is thanked for excellent logistic support. Funding by IFAD through the MilkIT project is highly appreciated.

References

- Ali, K.O. 1998. Indigenous cattle of Zanzibar: the need for conservation. *Animal Genetic Resources Information* 23:13-20.
- Balsem, T. 2011. Sustainable Management of Land and Environment 2nd Phase 2010-2013 (SMOLE II) – Report of the international land use planning advisor’s mission. Retrieved 2013 May 02 from: <http://www.smole.or.tz/doc/Land.pdf>.
- Biwi, K.M. 1993. Development of smallholder dairying in Zanzibar. In: Kategile, J.A. and Mubi, S. (eds.). *Future of livestock industries in East and southern Africa. Proceedings of a Workshop in Zimbabwe, 20-23 July 1992*. International Livestock Centre for Africa, Addis Ababa, Ethiopia. pp. 173-176.
- Burrell, G.H. and Ngassamiakwi, P.S. 1998. Milk marketing survey for Smallholder Livestock Development Project, Pemba Island. Unpublished report prepared for Irish Aid, Dar es Salaam, Tanzania. 21 pp.
- CCO (Central Census Office), 2003. 2002 Population and housing census. Tanzania census 2002, Vol. II – Age and sex distribution. CCO, National Bureau of Statistics, President’s Office, Planning and Privatization. Dar es Salaam, Tanzania. 352 pp.
- CGIAR LaF (Livestock and Fish Research Program) 2012. Tanzania dairy value chain assessment process tool kit. Unpublished version from June/July 2012. Retrieved 2013 Jan. 17 from: <http://livestock-fish.wikispaces.com/VCD+Tanzania>.
- Daily News. 2012. Pemba has made rapid development recently. Published by Daily News Tanzania, 12 Jan. 2012. Retrieved 2012 Aug. 12 from: <http://touch.dailynews.co.tz/index.php/features/popular-features/897-pemba-has-made-rapid-development-recently>
- DFA (Department of Foreign Affairs). 1986. Review of the Pemba Smallholder Livestock Development Project. Pemba Island, Zanzibar, Tanzania, 8-13 May 1986. Unpublished report by Department of Foreign Affairs, Dublin, Ireland. 23 pp.
- Duncan, A., York, L., Lukuyu, B., Samaddar, A. and Stür, W. 2012. Feed Assessment Tool (FEAST): A systematic method for assessing local feed resource availability and use with a view to designing intervention strategies aimed at optimizing feed utilization. Questionnaire for Facilitators (Version 5.3); updated: 15 June, 2012. ILRI, Addis Ababa, Ethiopia. Retrieved from: <http://www.ilri.org/feast>.
- Gössling, S., Bredberg, M. Randow, A., Sandström, E. and Svensson, P. 2006. Tourist perceptions of climate change: A study of international tourists in Zanzibar. *Current Issues in Tourism* 9 (4-5): 419-435. DOI: 10.2167/cit265.0
- Kurwijila, L. 2002a. An overview of dairy development in Tanzania. In: Rangnekar, D. and Thorpe, W. (eds.). 2002. *Smallholder dairy production and marketing – Opportunities and constraints*. Proceedings of a South-South workshop held at NDDDB, Anand, India, 13-16 March 2001. NDDDB (National Dairy Development Board), Anand, India, and ILRI (International Livestock Research Institute), Nairobi, Kenya. Retrieved 2013 Jan. 15 from: http://www.ilri.org/InfoServ/Webpub/fulldocs/South_South/ch17.htm.
- Kurwijila, L. 2002b. Evolution of dairy policies for smallholder production and marketing in Tanzania. In: Rangnekar, D. and Thorpe, W. (eds.). 2002. *Smallholder dairy production and marketing – Opportunities and constraints*. Proceedings of a South-South workshop held at NDDDB, Anand, India, 13-16 March 2001. NDDDB (National Dairy Development Board), Anand, India, and ILRI (International Livestock Research Institute), Nairobi, Kenya. Retrieved 2013 Jan. 15 from: http://www.ilri.cgiar.org/InfoServ/Webpub/fulldocs/South_South/Ch27.htm.
- Madulu, Ndalawha F. 2004. Assessment of linkages between population dynamics and environmental change in Tanzania. *African Journal of Environmental Assessment and Management (AJEAM-RAGEE)* 9:88-102.

- Milne-Price, S. 2011. Veterinary issues and livestock development in Zanzibar: Farmer practices and attitudes. SIT Study Abroad, ISP Collection, paper 1004. Retrieved 2013 May 02 from: http://digitalcollections.sit.edu/isp_collection/1004
- Mohamed, K.S. and Temu, A.E. 2011. Assessing the outreach performance of microfinance institutions in Zanzibar. In: Haji, H.M., Akil, J.M. and Juma, S.M. (Eds.). Up-scaling agricultural research for improved livelihood of the resource poor. Proceeding of the 2nd Annual Research Review Workshop, Zanzibar, 20-21 Oct. 2010. Ministry of Agriculture and Natural Resources, Zanzibar, Tanzania. Pp. 160-180.
- Omore, A., Staal, S. J., Wanyoike, F., Osafo, E. L. K., Kurwijila, L., Barton, D., Mdoe, N., Nurah, G. and Aning. G. 2009. Market mechanisms and efficiency in urban dairy products markets in Ghana and Tanzania. ILRI Research Report 19. ILRI (International Livestock Research Institute), Nairobi, Kenya. 56 pp. Retrieved 2013 Jan. 15 from: http://results.waterandfood.org/bitstream/handle/10568/20/MarketMechanismsGhanaTanzania_RR_No_19.pdf?sequence=4.
- RGoZ (Revolutionary Government of Zanzibar). 2009a. Zanzibar Livestock Policy – First draft 9 April 2009. Retrieved 2013 May 02 from: <http://www.kilimoznz.or.tz/images/Research/LivPolicyFDraft.pdf>.
- RGoZ (Revolutionary Government of Zanzibar). 2009b. Zanzibar Human Development Report – Towards Pro Poor Growth. Retrieved 2013 May 02 from: <http://zifa.ac.tz/data/ZPHDR.pdf>.
- Sarwatt, S. and Mollel, E. 2006. Country Pasture/Forage Resource Profiles – United Republic of Tanzania. FAO, Rome, Italy. Retrieved 2013 May 02 from: http://www.fao.org/ag/aGp/agpc/doc/Counprof/PDF%20files/Tanzania_English.pdf.
- Sharpley, R. and Ussi, M. 2012. Tourism and governance in small island developing states (SIDS): the case of Zanzibar. International Journal of Tourism Research. First published online 2012 July 15; doi: 10.1002/jtr.1904.
- UNDP (United Nations Development Program). 2010. Tanzania – Basic country data and country overview. Retrieved 2013 May 02 from: <http://www.tz.undp.org/docs/countryinfo1.pdf>.
- Zanzibar Protectorate. 1937. Nutritional review of the natives of Zanzibar. 20 pp. Abstract retrieved 2013 May 02 from cabdirect: <http://www.cabdirect.org/abstracts/19371402285.html;jsessionid=5A6A8EC8DECCED43C5535BBE5AFD06E4>.

Further literature consulted

- Akil, J.M. and Bryant, M.J. 2011. Small-scale dairy farming on Zanzibar Island – Tanzania: An investigation into the factors associated with the adoption of selected farm practices. In: Haji, H.M., Akil, J.M. and Juma, S.M. (Eds.). Up-scaling agricultural research for improved livelihood of the resource poor. Proceeding of the 2nd Annual Research Review Workshop, Zanzibar, 20-21 Oct. 2010. Ministry of Agriculture and Natural Resources, Zanzibar, Tanzania. Pp. 39-55.
- ASDP (Agricultural Sector Development Programme). 2009. M&E Progress Report 2008/09. ASDP M&E Working Group. The United Republic of Tanzania. Dar es Salaam, Tanzania. 104 pp. Retrieved 2013 May 02 from: http://www.agriculture.go.tz/M&E/ASDP%20M&E%20HP/Progress%20of%20ASDP/ASDP%20M&E%20Progress%20Report%202008-09_100608.pdf

- Fagerholm, N. and Käyhkö, N. 2009. Participatory mapping and geographical patterns of the social landscape values of rural communities in Zanzibar, Tanzania. *FENNIA – International Journal of Geography* 187 (1):43-60.
- GoT (Government of Tanzania). 2002. Poverty and Human Development Report 2002. Retrieved 2013 May 02 from: <http://www.tanzania.go.tz/pdf/phdrmain.pdf>.
- Index Mundi. 2012a. Tanzania – poverty headcount ratio. Retrieved 2013 May 02 from: <http://www.indexmundi.com/facts/tanzania/poverty-headcount-ratio>.
- Index Mundi. 2012b. Tanzania urbanization. Retrieved 2013 May 02 from: <http://www.indexmundi.com/tanzania/urbanization.html>.
- Jacobsen, P. 1983. East Coast Fever as a cause of calf mortality in Zanzibar. *Tropical Animal Health and Production* 15 (1):43-46, DOI: 10.1007/BF02250761.
- Maghimbi, S. 2010. Cooperatives in Zanzibar: Decline and renaissance. CoopAFRICA Working Paper No. 17. ILO (International Labor Organisation) Office, Dar es Salaam, Tanzania. Retrieved 2013 May 02 from: <http://www.ilo.org/public/english/employment/ent/coop/africa/download/wpno17cooperativesinzanzibar.pdf>.
- Mkenda, A.F., Luvanda, E.G., Rutasitara, L. and Naho, A. 2004. Poverty in Tanzania: comparisons across administrative regions. An interim report. Retrieved 2013 May 02 from: http://www.povertymonitoring.go.tz/researchreport/poverty_comparisons_regionally_Luvanda_et_al.pdf.
- Mwaseba, D.L., Johnsen, F.H., Nchimbi-Msolla, S. and Makungu, P.S.J. 2004. Does agricultural research reduce poverty among smallholder farmers? The case of Tanzania. Noragric Working Paper No. 35, Noragric Agricultural University of Norway, Ås, Norway. 37 pp. Retrieved 2013 May 02 from: <http://www.eldis.org/vfile/upload/1/document/0708/DOC15085.pdf>.
- Ogali, I.N. 2010. Experience from the field: constraints to poultry production among trained FFS farmers in Pemba Island, Tanzania. *Family Poultry Communications* 9 (2):7-12. Retrieved 2013 May 02 from: <http://www.fao.org/AG/AGAINFO/themes/en/infpd/documents/newsletters/Infpd19-2.pdf#page=9>.
- RAWG (Research and Analysis Working Group, United Republic of Tanzania). 2009. Poverty and human development report 2009. Dar es Salaam, Tanzania. Retrieved 2013 May 02 from: http://www.tz.undp.org/docs/Tanzania_PHDR_2009.pdf
- Reynolds, S.G. 1989. Possible reasons for non-adoption of pasture and forage crop research findings at farmer level. Halim, R.A. (ed.). *Grasslands and Forage Production in Southeast Asia*. Proceedings of the First Meeting of the Regional Working Group on Grazing and Feed Resources of South-east Asia. FAO, Rome, Italy. Vol. 27: 181-191. Retrieved 2013 May 02 from: <http://www.fao.org/ag/agp/agpc/doc/publicat/GRASSLAN/181.pdf>.
- RGoZ (Revolutionary Government of Zanzibar). 2010. The Zanzibar Strategy for Growth and Reduction of Poverty: 2010-2015 (ZSGRP) Mkuza II. Available 2013 May 02 from: <http://planipolis.iiep.unesco.org/upload/Tanzania%20UR/Zanzibar/Zanzibar-Mkuza-II-2010-2015.pdf>.
- The World Bank. 2005. Poverty Manual. Chapter 4, Measures of poverty. Retrieved 2013 May 02 from: http://siteresources.worldbank.org/PGLP/Resources/povertymanual_ch4.pdf.
- The World Bank. 2009a. Tanzania: Country Brief. The World Bank, Washington, DC, USA. Retrieved 2013 May 02 from: <https://openknowledge.worldbank.org/bitstream/handle/10986/2629/486010PUB0Tanz101Official0Use0Only1.pdf?sequence=1>.

The World Bank. 2009b. Tanzania – Mainland Trunk Roads & Zanzibar Rural Roads Baseline Survey 2009.
Retrieved 2013 May 02 from: <http://microdata.worldbank.org/index.php/catalog/287>.

WHO (World Health Organization). 2012. United Republic of Tanzania: Background information. Retrieved
2013 May 02 from: <http://www.afro.who.int/en/tanzania/united-republic-of-tanzania.html>.

Appendix 1: Local measures in Pemba as indicated by FEAST participants

Lokal weight measurement	Lokal weight/ 1 kg		Explanation
	Wete District (Kisiwani village)	Chake Chake and Mkoani Districts	
Block		0.20	Unit for mineral block
Gunia	0.05	0.01	Bag, sack
Mkungu (also spelled Mikungu, Mkungwe or Mpungu)	0.0556 to 0.0667	0.05 to 0.0667	Bunch of banana
Ndoo	0.05		Bucket
Polo	0.0083	0.01	A mini bag (packed with commercial feeds)
Tenga		0.0278	Said to be a sachet (of tomato)
Susu			A local basket, often used on a bicycle
Kicha (pl. vicha)	2	2	Leaf vegetables tied together to form a single unit (especially <i>Amaranthus</i>)

Appendix 2: Illustrations

Applying FEAST in Kisiwani and Chake Chake



Focus group discussion with producers in Kisiwani



Individual interviews of producers from Kisiwani



Focus group discussion with producers in Chake Chake



Individual interviews of producers from Chake Chake and Mkoani



Milking a cow in Chake Chake



Manure collection in Chake Chake

Feeds and feeding



Roadside grazing of a tethered cow



A tethered local cow grazing at the roadside



Feeding crossbred cows with cut grasses and legumes in Chake Chake



Planted signal grass (*Brachiaria decumbens*) with legumes for cut-and-carry system



Cotton cake for sale in a shop



Molasses for sale in a shop

Processing and consumption



Interview in a milk kiosk in Wete town



Boiled and raw milk on offer in a milk kiosk in Wete town



Milk consumers in a restaurant adjacent to a milk kiosk in Wete town



Imported long life milk from Kenya in a shop in Chake Chake town



Butter and ghee produced by a cooperative in Kisiwani



Yoghurt, ice cream and fresh milk cooled in a shop of Chake Chake town

Local units and transport



A local basket called 'susu'



An input supplier in Wete town



Transporting forages on a cattle-pulled cart



Draught cattle in Chake Chake town



Local transport in a 'Daladala' or 'gari ya abiria' on between Wete and Chake Chake



Unloading goods from dhows in Pemba harbor