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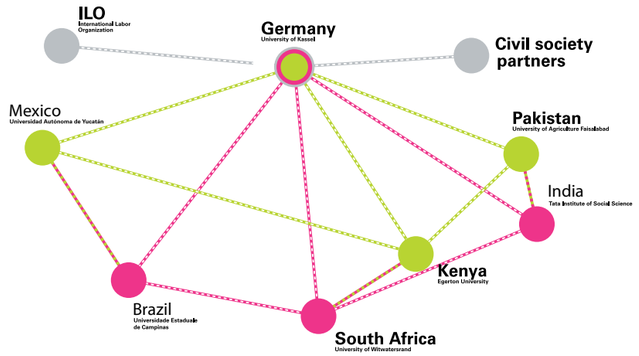

Jonas Hagmann

Opportunities and constraints of peri-urban buffalo and dairy cattle systems in Faisalabad, Punjab, Pakistan

International Center for Development and Decent Work

University of Kassel

Kurt-Schumacher-Straße 2

D - 34117 Kassel

Phone: ++49 (0) 561 804-7397

E-Mail: icdd@uni-kassel.de

www.icdd.uni-kassel.de

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Jonas Hagmann

Jonas Hagmann studied Organic Agriculture at the University of Kassel in Witzenhausen. During his studies, he participated in several international projects and excursions. He conducted the field studies for his master thesis in Pakistan, funded by ICDD. Currently he is working as freelancer in agriculture and consultancy.

Contact Address

Prof. Dr. Christoph Scherrer
ICDD - Universität Kassel
Kurt-Schumacher-Str. 2
D-34109 Kassel
Germany

Contact Email : felmeden@icdd.uni-kassel.de

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Opportunities and constraints of peri-urban dairy buffalo and dairy cattle systems in Faisalabad, Punjab, Pakistan

Jonas Hagmann

This working paper is based on an MSc thesis completed in October 2011
at the University of Kassel, Faculty of Organic Agricultural Sciences,
Animal Husbandry in the Tropics and Subtropics

ABSTRACT

In the big cities of Pakistan, peri-urban dairy production plays an important role for household income generation and the supply of milk and meat to the urban population. On the other hand, milk production in general, and peri-urban dairy production in particular, faces numerous problems that have been well known for decades. Peri-urban dairy producers have been especially neglected by politicians as well as non-government-organizations (NGOs).

Against this background, a study in Pakistan's third largest city, Faisalabad (Punjab Province), was carried out with the aims of gathering basic information, determining major constraints and identifying options for improvements of the peri-urban milk production systems. For data collection, 145 peri-urban households (HH) engaged in dairy production were interviewed face to face using a structured and pretested questionnaire with an interpreter. For analyses, HH were classified into three wealth groups according to their own perception. Thus, 38 HH were poor, 95 HH well off and 12 HH rich (26.2%, 65.5% and 8.3%, respectively). The richer the respondents perceived their HH, the more frequently they were actually in possession of high value HH assets like phones, bank accounts, motorbikes, tractors and cars.

Although there was no difference between the wealth groups with respect to the number of HH members (about 10, range: 1 to 23), the educational level of the HH heads differed significantly: on average, heads of poor HH had followed education for 3 years, compared to 6 years for well off HH and 8 years for rich HH. About 40% of the poor and well off HH also had off-farm incomes, while the percentage was much higher - two thirds (67%) - for the rich HH. The majority of the HH were landless (62%); the rest (55 HH) possessed agricultural land from 0.1 to 10.1 ha (average 2.8 ha), where they were growing green fodder: maize, sorghum and pearl millet in summer; berseem, sugar cane and wheat were grown in winter.

Dairy animals accounted for about 60% of the herds; the number of dairy animals per HH ranged from 2 to 50 buffaloes (Nili-Ravi breed) and from 0 to 20 cows (mostly crossbred, also Sahiwal). About 37% (n=54) of the HH did not keep cattle. About three quarters of the dairy animals were lactating.

The majority of the people taking care of the animals were family workers; 17.3% were hired labourers (exclusively male), employed by 11 rich and 32 well off HH; none of the poor HH employed workers, but the percentages were 33.7% for the well off and 91.7% for the rich HH. The total number of workers increased significantly with increasing wealth (poor: 2.0; well off:

2.5; rich: 3.4). Overall, 69 female labourers were recorded, making up 16.8% of employed workers and one fourth of the HH's own labourers. Apparently, their only duty was to clean the animals´ living areas; only one of them was also watering and showering the animals. Poor HH relied more on female workers than the other two groups: 27.1% of the workers of poor HH were women, but only 14.8% and 6.8% of the labour force of well off and rich HH were female.

Two thirds (70%) of the HH sold milk to dhodis (middlemen) and one third (35%) to neighbours; three HH (2%) did doorstep delivery and one HH (1%) had its own shop. The 91 HH keeping both species usually sold mixed milk (97%). Clients for mixed and pure buffalo milk were dhodis (78%, respectively 59%) and neighbours (28%, respectively 47%). The highest milk prices per liter (Pakistani Rupees, 100 PKR ≈ 0.8 Euro) were paid by alternative clients (44 PKR; 4 HH), followed by neighbours (40 PKR, 50 HH); dhodis paid lower prices (36 PKR, 99 HH). Prices for pure buffalo and mixed milk did not differ significantly. However, HH obtaining the maximum price from the respective clients for the respective type of milk got between 20% (mixed milk, alternative clients) and 68% (mixed milk, dhodi) more than HH fetching the minimum price. Some HH (19%) reported 7% higher prices for the current summer than the preceding winter. Amount of milk sold and distance from the HH to the city center did not influence milk prices.

Respondents usually named problems that directly affected their income and that were directly and constantly visible to them, such as high costs, little space and fodder shortages. Other constraints that are only influencing their income indirectly, e.g. the relatively low genetic potential of their animals due to neglected breeding as well as the short- and long-term health problems correlated with imbalanced feeding and insufficient health care, were rarely named. The same accounts for problems accompanying improper dung management (storage, disposal, burning instead of recycling) for the environment and human health. Most of the named problems are linked to each other and should be addressed within the context of the entire system. Therefore, further research should focus on systematic investigations and improvement options, taking a holistic and interdisciplinary approach instead of only working in single fields. Concerted efforts of dairy farmers, researchers, NGOs and political decision makers are necessary to create an economic, ecological and social framework that allows dairy production to serve the entire society. For this, different improvement options should be tested in terms of their impact on environment and income of the farmers, as well as feasibility and sustainability in the peri-urban zones of Faisalabad.

TABLE OF CONTENTS

INDEX OF FIGURES

INDEX OF TABLES

PREFACE

This second working Paper addresses aspects of urban and peri-urban dairy production, taking the example of Faisalabad City in Pakistan. Global population growth and climate change phenomena reinforce rural-to-urban migration in many parts of the world. Numerous rural migrants, but also urban residents, engage in agricultural activities within and around city centers, taking advantage of the increasing urban demand for easily perishable crop and livestock products of high value, such as vegetables and fruits, milk, meat and eggs. Even in southern countries, particularly poultry, meat and egg production is predominantly organized in large-scale industrialized holdings near cities. Dairy production, however, is still dominated by small- to medium-sized family farms, sometimes cooperating in so-called 'colonies' across the rural and urban spaces of the African and Asian continents.

Within the ICDD, several PhD students from Kenya, Pakistan and India are analyzing bio-physical and socio-economic aspects of small- to medium-sized (peri-)urban agriculture. Milk production, mainly based on Holstein Frisian cattle in Kenya and Nili-Ravi buffaloes in Pakistan, is one of the production chains studied in more detail. Opportunities for creating (decent) jobs along the channels of forage provision to the cows, in the dairy barn itself and along the milk marketing and processing chain are therefore a main focus. Other issues are the efficient use of natural resources (forages) for producing milk, the milk prices in different marketing channels, and hence the remuneration of the farmers' (and probably also the employees') labor time. Within this framework, the MSc thesis of Mr. Jonas Hagman, former student at the Faculty of Organic Agricultural Sciences at Kassel University, Witzenhausen Campus, provided baseline information on the general characteristics of the dairy buffalo holdings in and around Faisalabad, the third largest city in Pakistan.

Based on structured semi-quantitative interviews, his study addressed the general bio-physical and socio-economic setup of dairy farms, as well as their labor endowment and dairy employment, forage input into the milking unit and milk output, and the various milk marketing channels available to Faisalabad's dairy farmers. His MSc thesis, from which the present working paper is an excerpt, draws a very detailed and balanced picture of the different production steps pertaining to urban dairy, and points to current problems but also potential options for improvements of natural resource use and animal management on the one hand; on the other hand, it addresses labor input, infrastructural and administrative/legislate issues and economic constraints. This provides a sound foundation for further in-depth analysis of such aspects in the context of Faisalabad and comparable Pakistani cities.

Witzenhausen, Jan. 26, 2012

Prof. Dr. Eva Schlecht
Member, International Center for Development and Decent Work

1 OVERVIEW

Agriculture is the largest sector in the economy of Pakistan and almost 45% of the total labour force in the country works in this domain, with an increasing tendency. Although the contribution of agriculture to the Gross Domestic Product (GDP) has been constantly declining over the past years, it remains at almost 22%. Meanwhile, the agricultural sector has been growing at an average rate of 4% (range: 1.1 - 6.5%) per year since 2002; despite the "financial crisis", it performed exceptionally well and was actually the only growing economic sector in 2008-09 (Government of Pakistan 2009).

In terms of market value, milk production contributes more to the GDP of the country than any single major crop. Milk production alone contributes almost half (49%) of the value of produced agricultural products. Traditionally, buffalo milk is preferred over cow milk in Pakistan (Habib et al. 2007) and usually sells at a higher price (Burki et al. 2005). Consequently, buffalo milk production contributes approximately 38% to the value of agricultural products, followed by cattle (ca. 11%) and goat milk (ca. 0.08%). With 20,372 Mt a^{-1} Pakistan was second worldwide with respect to buffalo milk production – only India produced more – and ranked 13th for cattle milk (11,130 Mt a^{-1}) in 2007 (FAOSTAT 2010).

Despite these impressive figures, the dairy sector in Pakistan is not performing even close to its potential (Government of the Punjab 2006); the milk yield per animal in particular is very low (Burki et al. 2005; Habib et al. 2007). Multiple interacting problems have been analyzed, targeting effects of nutrition, reproduction, environment and genetics (Ghaffar et al. 2007). In general, the low performance of the animals is a consequence of poor management and housing as well as restricted access to resources such as fodder, capital, breeding animals, veterinary services, and public support, resulting in imbalanced feeding, poor animal health, low fertility and low genetic potential (Burki et al. 2005; Moaeen-ud-Din and Babar 2006; Habib et al. 2007). These problems are not new and were already identified by Akhtar in 1986 (Afzal 2000).

1.1 Milk production systems

Several authors distinguish four general milk production systems in Pakistan (e.g. Ghaffar et al. 2007; Mahmood 2008; Riaz 2008), most of them following the classification of the Pakistan Livestock Sector Study carried out by FAO in 1987. In addition to these four systems, families in the cities occasionally keep one or two animals to guarantee their own supply of fresh milk and sell the surplus, usually to neighbours (Afzal 2000; Burki et al. 2005).

(i) **Rural subsistence small holdings**: Herds of about three animals, including young stock; production mainly to meet family needs. Little use of external inputs, little attention given to genetic make-up of animals.

(ii) **Rural market oriented small holdings**: Mostly stall-fed herds of less than six animals, good genetic make-up for production, always two or three lactating cows. Feed consists of green fodder and straw; some concentrates for lactating animals. Main source of milk in Pakistan.

(iii) **Rural commercial farms**: Specialized dairy and mixed crop-livestock farms with more than forty highly productive animals, mostly buffaloes. Breed development pursued, herds usually include a bull; use of governmental artificial insemination service. Due to low number, contribution to national milk supply from this group is small.

(iv) **Peri-urban commercial dairy farms**: Around all big cities; herd sizes between fifteen and fifty animals, mostly adult, lactating, high potential buffaloes. Animal turnover very high. Animals close to calving or in early lactation purchased; calf is allowed to suckle for a few days and is then sold, commonly for slaughter. Dry females are either sold for slaughter or returned to rural areas for reproduction. Most cows are not mated, as farmers perceive that pregnancy reduces milk yield. Feed is mainly purchased concentrates and straw. Thus, capital demand for animals and feed is high. Nonetheless, marketing margins for this group tend to be high due to direct marketing to the final consumers. In recent years, peri-urban farming has evolved into an important production system in Pakistan (Ghaffar et al. 2007) and about 20% of the total produced milk in the country is coming from urban or peri-urban regions (Zia 2007; Jalil et al. 2009).

The rising demand for milk among the urban population has been a driving force for the establishment of peri-urban farms. The number of such farms increased three-fold between 1986 and 1996. Within the same period, urbanization in Pakistan also increased by 78% (Habib et al. 2007). It was estimated in the mid-1990s that the livestock

population for milk production in Faisalabad was 100,000 heads of buffaloes and cattle (Suttie 2000). In view of the projected increase in the human urban population of Pakistan from 55 million in 2005 to 89 million in 2020 and 186 million in 2050 (FAOSTAT 2010), the number of peri-urban dairy farms and animals is also expected to increase quickly to supply enough milk and meat (Habib et al. 2007). Despite the importance of urban dairy farms for food supply, many authorities have expelled animals from cities, resulting in a concentration of animals in peri-urban regions and the establishment of so called *Gawala* Colonies around urban areas (Burki et al. 2005; Moaeen-ud-Din and Babar 2006).

Despite ample information on the dairy sector in Pakistan (e.g. Teufel 2007; Mahmood 2008; Riaz 2008), there is limited information available that focuses specifically on peri-urban dairy production. One study dealing with feeding has been published from Peshawar (Habib et al. 2007); from Lahore there are two studies available (Ghaffar et al. 2007; Jalil et al. 2009), and one from Islamabad (Ghaffar et al. 2007). Another study analyses the economy of peri-urban dairy colonies in Karachi, the largest city in Pakistan (Khan et al. 2008). For Faisalabad, the third-largest city in the country, Moaeen-ud-Din and Babar (2006) described the peri-urban dairy production system. Aden et al. (2008) studied the impact of herd size on various economic factors, and Akhtar et al. (2008) focused on the role of livestock in poverty alleviation and adequate nutrition among the urban population.

1.2 Objectives of the working paper

This working paper is based on an MSc thesis completed in October 2011, summarizing the most important components. The aim of the text at hand is to:

(i) provide the reader with basic information about the peri-urban buffalo and cattle milk production systems of Faisalabad;

(ii) highlight major constraints to milk production as indicated by the collected data and as perceived by farmers, and identify options for improvements;

(iii) suggest topics for further research, based on the results and discussions given.

2 MATERIAL AND METHODS

2.1 Study area

With a population density of about 359 heads per km^{-2} in 1998, Punjab has the second highest population density in the country after Islamabad (Government of Pakistan 1998a). The City of Faisalabad, the second-largest city in Punjab and the third-largest city in the country, had a population of more than two million in 1998 with an average annual growth rate of 3.58% (Government of Pakistan 1998b). It is located in the District Faisalabad, Punjab Province, just outside the tropics at 31,4190° N and 73,0792° E (city center, own measurement) at an altitude of about 184 m a.s.l. (Cheema et al. 2006). Four seasons can be distinguished, namely winter (December-March) with cool weather and moderate rainfall, dry summer (April-June), which is extremely hot and dry, humid summer (July-September) with high temperatures and scattered rainfall, and autumn (October and November) with cold and dry weather (Mustafa and Khan 2008). The climate is semi-arid subtropical and continental with average annual temperature and rainfall during the period from 1975 to 2004 being 24.5°C and 408 mm, respectively. The highest temperature in summer may hit 50°C, and the lowest in winter may fall below the freezing point. Temperatures range from a mean daily minimum of 6.8°C in December to a mean daily maximum of 40.7°C in June (Cheema et al. 2006).

2.2 Data collection

145 households (HH) keeping dairy buffaloes and dairy cattle in the urban and peri-urban zone of Faisalabad within a radius of about 4 to 9.4 km from the city center were interviewed face to face using a structured questionnaire from 27.08.2009 until 21.10.2009. The questions were orally translated during the interviews into Punjabi or Urdu for the respondents. In return, the answers of the respondents were directly translated orally into English and noted down by the interviewer. The questionnaire covered socio-economic aspects and fields of production, marketing, feeding, housing, animal health and breeding as well as farmers' perceptions of problems and future prospects; it aimed at the acquisition of qualitative and quantitative information. The duration of an interview ranged from 18 to 78 minutes (mean: 37 minutes). A pre-test was conducted from 21.08.2009 until 26.08.2009 with 16 farmers and the questionnaire was adjusted where necessary. For sample selection, the first HH that visibly kept dairy animals in different regions of the urban and peri-urban zone of the city was chosen, informed of the reasons for the survey and

interviewed immediately if the respondent agreed; in most cases, the interviewer and the interpreter as well as the interviewee and her/his relatives, friends and neighbours were sitting in public places under a shade tree; the respondents were often but not necessarily the HH head or the person actually taking care of the animals. After the interview, the respondents were asked to give names and addresses of three other HH keeping dairy animals. From these three names one was randomly selected, visited, informed and immediately interviewed once the respondent agreed. If all three of the addresses given were spatially too close to the formerly interviewed HH, none of them were chosen and another visually identified dairy HH further away was selected. Thus, the interviewed HH were evenly scattered within the peri-urban area of the city (Figure 1).

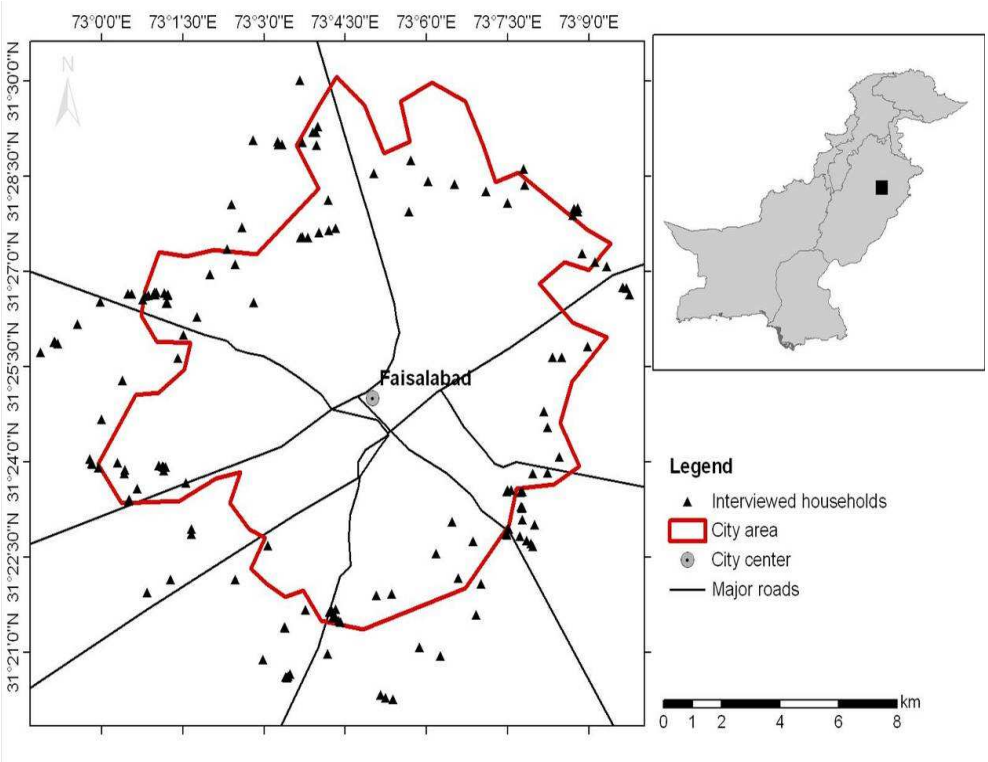


Figure 1: GIS based map of Faisalabad City with the approximate expansion of the dense housing area (inside the red polygon) and major roads as well as the position of the city center and the 145 interviewed households. The positions of the respondents´ households were taken using a GeoExplorer® II (Trimble Navigation Limited, Sunnyvale, California). The coordinates of the city center of Faisalabad (Clock Tower in the middle of the old town) were taken from a Landsat image of the City of Faisalabad using ArcView GIS 3.2.

2.3 Statistical analysis

The collected information and data was tabulated, coded into numerical values and subjected to statistical analyses with SPSS 17.0 (SPSS Inc., an IBM Company, Chicago, Illinois). Because most of the data was not distributed normally (Kolmogorov-Smirnoff-

Test), non-parametric tests were applied (Bortz et al. 2008). To detect significant differences between groups, the Kruskal-Wallis-H-Test was used; to separate the groups, the Mann-Whitney-U-Test was applied. A Chi-square and Kruskal-Wallis-H-Test were used for cross tabulation. Correlations were tested using Spearman-Rho. Alpha was set to 0.05 ($p<0.05$) for Kruskal-Wallis, Mann-Whitney and Chi-square tests, and to 0.01 ($p<0.01$) for correlations (Bortz et al. 2008).

3 RESULTS AND DISCUSSION

3.1 Classification of farmers

In the interviews, respondents were asked to classify their HH according to their total income as either poor, well off or rich. Of the total 145 interviewed HH, 38 were poor, 95 well off and 12 rich, according to their own perception (26.2%, 65.5% and 8.3%, respectively).

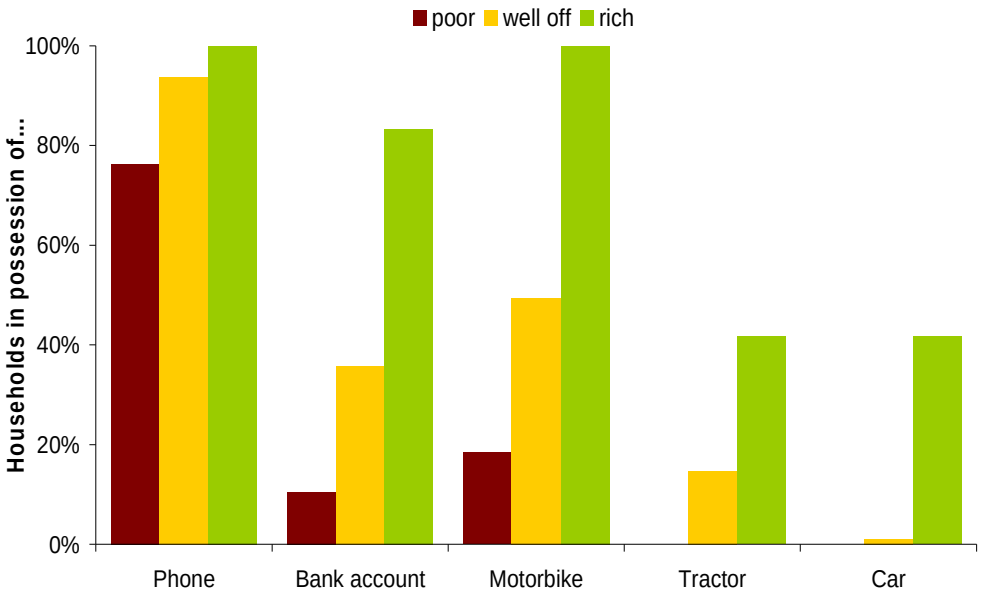


Figure 2: Percentage of households possessing a bank account and/or different high investment assets. Significant differences (cross tabulation, chi-square, a=0.05) exist between poor (n=38), well off (n=95) and rich (n=12) households which were defined according to the perception of the respondents.

To validate the perception of the respondents, a cross tabulation and chi-square test was done comparing HH assets such as phones, bank accounts, motorbikes, tractors and cars among the three groups (Figure 2). Differences between the groups were significant, indicating that the richer the respondents perceived themselves, the more frequently they actually owned the selected assets. From this it was concluded that farmers' self-assignment to one of the three wealth groups also pointed to differences in other fields such as milk marketing, feeding of their dairy animals, or animal health care. The self-classification was therefore maintained as the basis for the present analyses of dairy farms in Faisalabad.

3.2 Household structure

The number of total household members (HHM) was very heterogeneous, ranging from only 1 to 23. Taking males and females together, on average 4 members were children aged up to 15 years; about 6 were 16 to 55 years old and only about 1 member was older than 55 years. The average number of HHM (about 10) did not differ significantly between the three groups. It was, however, larger than the average of all HH in the city of Faisalabad (7.3 HHM; Government of Pakistan 1998b). While we found no difference in HHM between the wealth groups, Sabir et al. (2006) reported that in rural areas poorer HH had a higher number of HHM. Similarly, Chaudhry (2009) concluded that reducing HH size could reduce poverty in rural southern Punjab. The difference between these findings and our results might be due to the more diversified job and income opportunities of urban over rural dwellers.

Household heads (HHH) were almost exclusively male - only one out of 145 (0.7%) was female. The majority of the HHH were married (89%); some were widowed (8%) or single (3%). Their ages ranged from 25 to 80 years and there was no significant difference between the three wealth groups in the average age of the HHH. This is again in contrast to Sabir et al. (2006), who found that old age of the HHH was one of the causes of poverty in rural HH.

There was a significant difference in the educational level (expressed in years of schooling, Figure 3) between the HHH of the poor and the rich HH. On average, poor HHH had followed education for 3 years (SD 3.8), compared to 6 years (SD 5.0) for well off HHH and 8 years (SD 4.1) for rich HHH. This seems to support the notion of Sabir et al. (2006) that education of the HHH reduces poverty. In the present study, more than 60% of the poor HHH had not attended school at all and none of them had an education above matric (10 years), whereas 14% and 16% of the well off and rich HHH had benefited from secondary education (12 years) or even graduated from universities. Still, 37% of the well off, 8% of the rich and in total 41% of all HHH did not have any education.

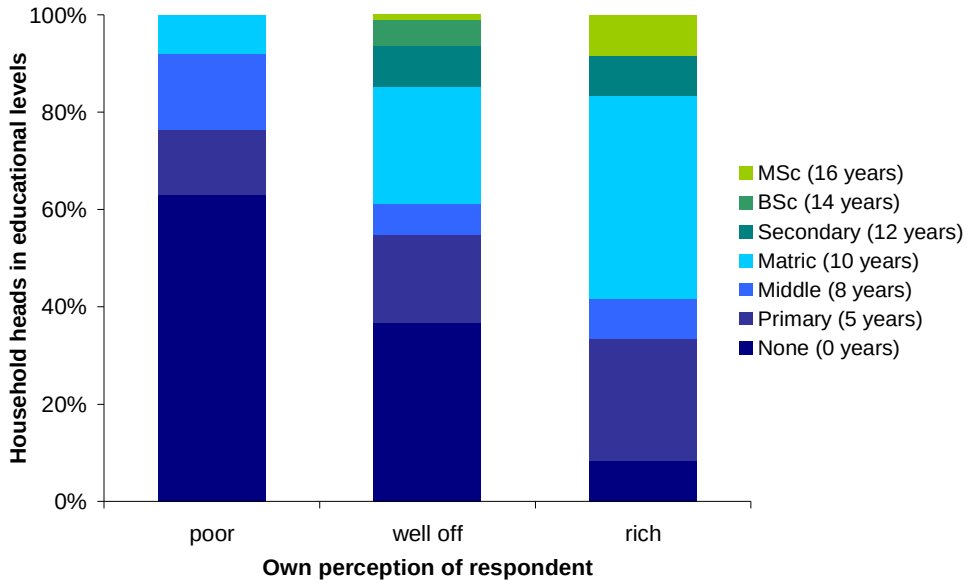


Figure 3: Percentage of poor (n=38), well off (n=95) and rich (n=12) household heads having achieved different educational levels.

3.2.1 Income sources

The most common – but not always the most important – source of income for HH across the three wealth groups was milk sales (Figure 4).

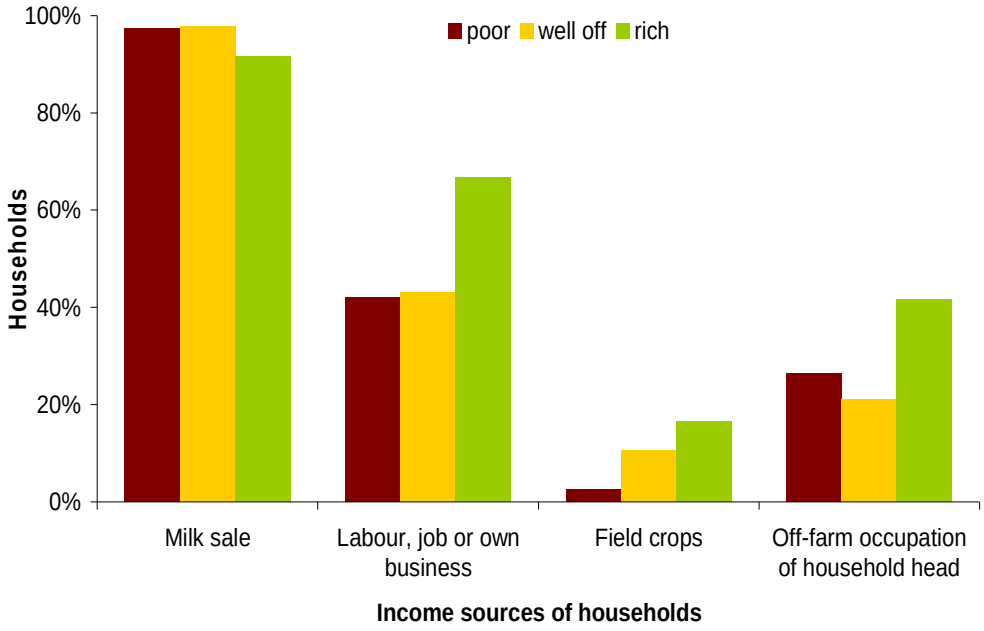


Figure 4: Percentage of poor (n=38), well off (n=95) and rich (n=12) households earning income from different sources. The category "labour/job/business" includes the category "off-farm occupation of household head". Every household could mention several income sources.

Other sources of income were day labour, jobs, small shops or larger businesses (labour/job/business) of some HHM as well as the sale of field crops (mainly wheat and

fodder crops) from cultivated land. About 40% of the poor and well off HH also had income from jobs, small shops or businesses, but the percentage was much higher - two thirds (67%) – for the rich HH. Some of the HHH themselves had occupations aside from their animals; however, these were only 26%, 21% and 42% of the poor, well off and rich HHH, respectively. Independent of wealth status, HHH with off-farm income (n=35) had a significantly higher level of education than HHH without off-farm occupations (n=110), pointing to the fact that a higher literacy level provided better chances to find a job.

3.3 Land holdings

The majority of the HH were landless (62%); the rest (55 HH) possessed agricultural land. The areas they owned (calculated from the answers of only 17 HH, the others were not asked for their area) ranged from 0.1 to 10.1 ha (0.25 to 25 acres), the average being 2.76 ha (6.83 acres). Typical crops were green fodder plants such as maize (*Zea mays* L.), sorghum (*Sorghum bicolor* [L.] Moench) and pearl millet (*Pennisetum glaucum* [L.] R. Br.) in summer; berseem (*Trifolium alexandrinum* L.), sugar cane (*Saccharum officinarum* L.) for fodder and wheat (*Triticum aestivum* L.) for grain production were grown in winter. There was no significant difference between the wealth groups with respect to the area of land owned (only 17 HH included). Furthermore, wealthier HH did not own land more frequently than poorer HH (all 145 HH included). Akhtar et al. (2008) reported that none of 210 surveyed HH keeping dairy animals in Faisalabad were cultivating land, whereas Aden et al. (2008) found average land ownership to be 2.3, 4.6 and 8.7 hectares for small (1-3 animals), medium (4-6 animals) and large (≥7 animals) farmers in peri-urban Faisalabad (75 HH interviewed).

3.4 Livestock

The only breed of buffalo that was recorded was Nili-Ravi, considered the best dairy breed in Pakistan (Khan 2009). For cattle, the genetic makeup was more diverse. Of the 91 HH (63% of all HH) keeping at least one dairy cow, the vast majority (93%) kept crossbred cows, often between local zebu breeds and exotic taurine breeds.

The number of dairy animals per HH ranged from 2 to 50 buffaloes and from 0 to 20 cows. There was a significant difference between the poor and the wealthier HH with respect to the number of adult dairy buffaloes and cattle: poor HH had about 4, well off HH about 9 and rich HH about 17 adult dairy buffaloes.

Regarding cattle, the figures were about 1, 2 and 4, respectively (Figure 5). Adult dairy animals accounted for about 60% of the herds. They were followed in numbers by calves and then young stock, male adult animals being the category with the smallest number. Although richer HH kept a higher number of adult buffalo and cattle bulls, differences between the three wealth groups were only significant for buffalo bulls. Concerning cattle bulls, poor HH had less animals than well off and rich HH.

Buffaloes were the preferred dairy animals, accounting for 87% (SD 18.4), 82% (SD 17.1) and 76% (SD 19.3) of the dairy animals of poor, well off and rich HH ($p>0.05$).

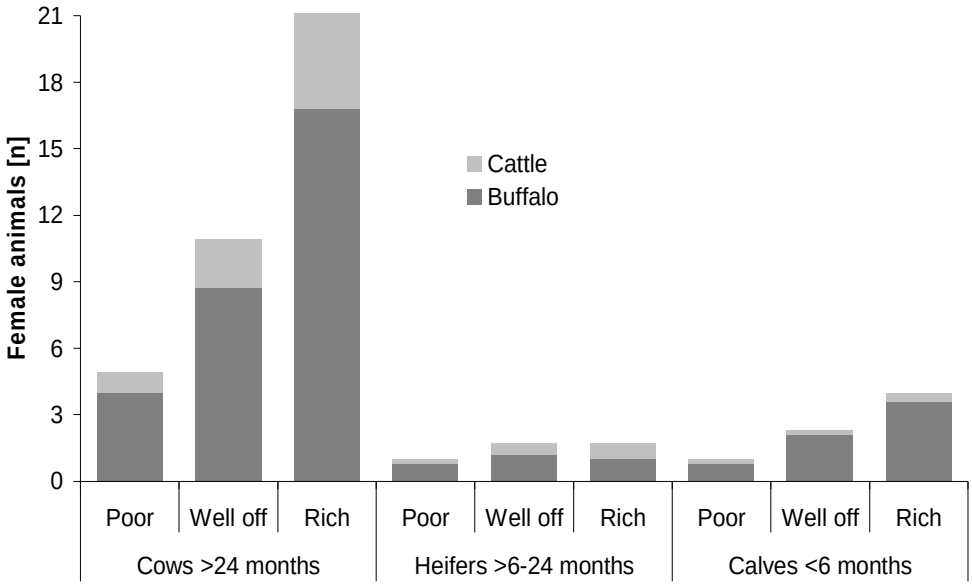


Figure 5: Cumulative numbers of female animals in the dairy herd of the three household wealth groups.

3.5 Use of animal excreta

Interviewees were asked what their HH usually did with animal dung. One third (36%) said they did not use it at all but gave it away to other people or just dropped it somewhere. Again one third (33%) used it exclusively as fuel for cooking and 13% solely used it on their fields as fertilizer (Photographs 8). Since multiple answers were possible, fuel was the most frequent answer and half of the HH (51%) made use of dung cakes for cooking. Still, 58 HH (40%) also gave or threw the excreta away. Overall, 28% put the dung on their fields along with other uses. Thus, 73% (40 of 55) of the HH having cropland used farmyard manure to fertilize the soil. Poorer HH used dung more frequently as fuel than wealthier ones (74%, 43% and 42% for poor, well off and rich HH).

Akhtar (2005) found that 87.1% of interviewed HH (210) in peri-urban Faisalabad sold dung in the form of dung cakes, but apparently none of the HH interviewed for the present study sold dung in any form, although it is reported from other cities in Pakistan that manure is even sold as fertilizer (Raja 2002). However, Akhtar (2005) explicitly asked for female involvement in livestock production, and since dung cakes are usually processed by women, this might explain the differences between the findings. On the other hand, 51% of our HH used dung cakes for fuel and 40% also gave dung away. We do not know who took this dung, but it is likely that women not belonging to the HH transformed it into cakes and sold these, meaning that this dung reappeared in the value chain. It is also likely that some of the HH using dung cakes themselves also sold some without mentioning this to us. This seems plausible because dung cake trade is common and widespread in the country; about 60% of all Pakistani HH rely on dung for fuel, and it is estimated that one third of the total dung produced in the country is burned (WHO 2005).

As can be concluded from the results above, a large proportion of the animal dung in Faisalabad is either burned or disposed of as waste instead of being returned to the fields where it initially came from via animal fodder. This has not only several potential environmental consequences (gaseous emissions, leaching, declining soil organic matter and soil fertility), but also social and financial consequences. Furthermore, people usually use inefficient traditional stoves or simply open fires for cooking (Photographs 6), which leads to incomplete combustion and emission of extremely high amounts of substances detrimental to health (Fullerton et al. 2008; Colbeck et al. 2010). The poor air quality caused by biomass fuels, especially animal dung, is a serious threat particularly to women and children present during cooking (Venkataraman et al. 2002). Chronic bronchitis (Akhtar et al. 2007) and lung cancer (Behera and Balamugesh 2005) in women as well as respiratory problems in children (Awasthi et al. 1996) are strongly associated with the use of dung as fuel. It is estimated that indoor air pollution from biomass fuels causes 28,000 deaths per year and 40 million cases of acute respiratory disease in Pakistan, imposing a significant economic burden on the country with an annual cost of 1% of the GDP (Colbeck et al. 2010).

3.5.1 Biogas

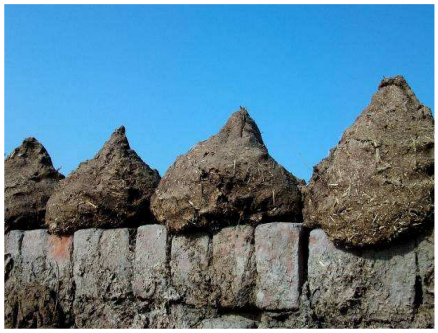
The construction of biogas plants, combined with the proper application of the remaining slurry to crop fields, could solve at least some of the issues mentioned above. The uncontrolled disposal of dung would decline; stables might get cleaned more regularly in order to have enough “feed” for the digester, improving sanitation. After

fermentation, the slurry would constitute an excellent fertilizer for crop production, having the potential to replace expensive and at times unavailable mineral fertilizers. Last but not least, the substitution of dung cakes by biogas would significantly reduce combustion emissions dangerous to humans, thus enhancing public health. On the other hand, dung cake production – almost exclusively being carried out by women (WHO 2005, Photographs 2 to 4) – would no longer be necessary, possibly depriving poor women of an income source.

Photograph 1: Huge heap of disposed dung.

Photograph 2: Women forming dung cakes for fuel from animal droppings and fodder leftovers.

Photograph 3: Dung cakes drying on a wall.



Photograph 4: Dung cakes on top of a wall.

Photograph 5: Dung cake storage: plastered with dung against the rain (Tariq 2009).

Photograph 6: Preparing bread (*chapati*) on a traditional stove with wood and dung as fuel.

Photograph 7: Biogas digester in rural Punjab.

Photograph 8: Manure heaps on a field for fertilization.

The construction of biogas plants requires expertise and money – both not easily available to most of the peri-urban farmers of Faisalabad. Therefore, farmers could cooperate by building bigger digesters for an entire group; enterprising people could even establish larger, more efficient biogas plants on a commercial basis, exploiting the dung from many farms. During data collection for the present survey, no biogas plant was found in the peri-urban zone of Faisalabad. Only one larger rural farm, which was not part of the present study, was using biogas for cooking (Photographs 7).

3.6 Labour

3.6.1 Labour force

In total, 410 people within the 145 interviewed HH were taking care of the animals. Of those, 339 (82.7%) were HHM and only 71 (17.3%) were hired labourers not belonging to the HH. These were employed by 11 rich and 32 well off HH. Hence, while none of the poor HH employed workers, this was a practice in 33.7% of well off and 91.7% of rich HH. However, our overall value of 29.7% of HH with hired workers is substantially lower than

the 48.1% (of 210) HH hiring labourers reported by Akhtar et al. (2008) for peri-urban Faisalabad.

All hired labourers of the HH interviewed for the present study were male and worked fulltime. Most of the women (89.9%) engaged in livestock management worked only part time. Overall, 69 female labourers were recorded, accounting for 16.8% of the employed people and for 25.6% of the HH's own labourers. Their only duty, according to the respondents, was to clean the areas where the animals were kept; only one female worker was also watering and showering the animals; feeding and milking was exclusively done by men. This is in contrast to reports of other authors who claim that livestock production in Pakistan and Punjab is to a great extent women's business, not only in rural areas (Javed et al. 2006; Bilal et al. 2008; Jamali 2009) but also in peri-urban environments (Akhtar 2005; Aden et al. 2008). The reluctance to talk about women and their work is surely related to the Punjabi culture; therefore, while we assume that more women are engaged in livestock management in peri-urban Faisalabad, not only cleaning but also doing more of the work related to animal keeping, our interviews were not suited to overcome this reluctance.

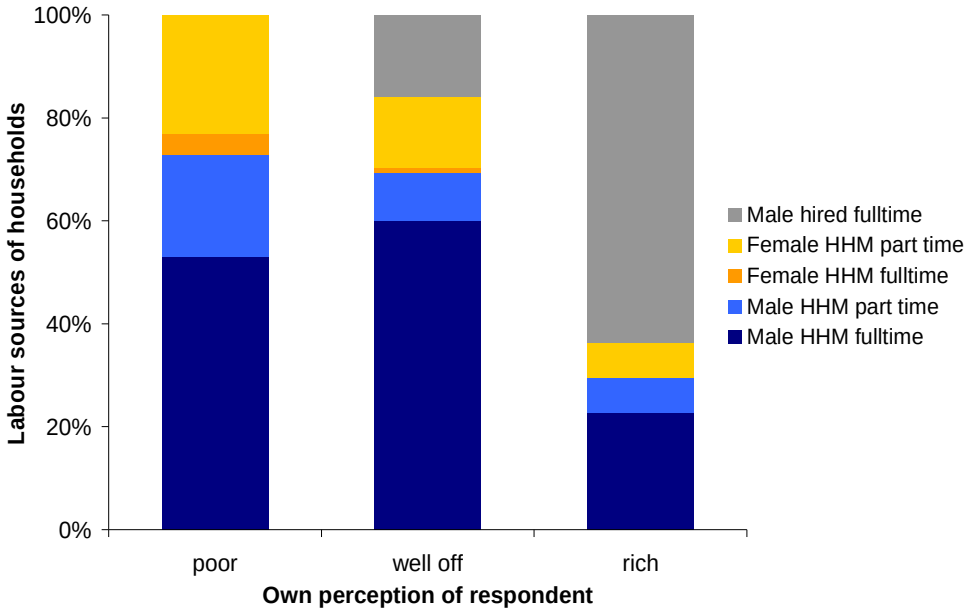


Figure 6: Percentage of people occupied in livestock keeping and their distribution according to wealth group (n: poor=38; well off=95; rich=12), origin (household members [HHM] or hired), sex and working hours per day (fulltime: >7 h d^{-1}; part time: <7 h d^{-1}).

Poor HH did not hire any labourers, covering 100% of their labour demand with family workers (Figure 6); in contrast, the percentages were 84.1 and 46.4 for well off and rich

HH, respectively. Thus, the major part of the work in rich HH was done by hired labourers. Moreover, poor HH relied more on female labour than the other two groups: 27.1% of the workers in poor HH were women, compared to 14.8% and 6.8% in well off and rich HH. The total number of workers employed increased significantly with increasing wealth (poor: 2.0, SD 0.74; well off: 2.5, SD 1.16; rich: 3.4, SD 1.56).

The hired labourers of 42 HH earned between 2,000 and 8,000 PKR per month (average: 4,826, SD: 1,345; 100 PKR ≈ 0.8 EUR). One HH paid the hired worker only with fodder for his animals. In addition to their wages, the labourers of 26 HH (62% of 42 HH) received meals; 25 HH (60%) offered residence and 6 HH (14%) also gave some milk to their workers. The granting of in-kind payments was not related to the monetary remuneration of the workers.

3.6.2 Labour tasks

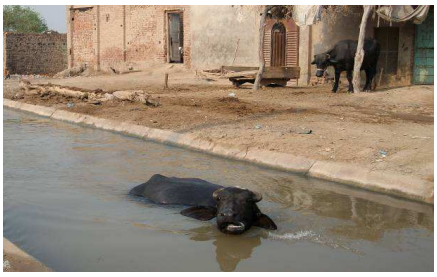
Within the different steps of the (peri-urban) dairy production chain, there are numerous tasks to be completed. These range from forage purchase/production/harvest and fodder transport and chopping, to feeding, cooling, watering and herding the animals, to milking, milk processing, stable cleaning, dung collection and dung cake making. Furthermore, the products (milk, animals, and dung cakes) must be marketed and livestock breeding as well as health care must be managed. All these tasks provide jobs to more or less untrained labourers or family members. Some demand physical strength, others special skills; most of them are "dirty" and many even dangerous. In the following sections, some of these tasks are described in detail.

3.6.2.1 Cooling and watering

During the hot part of the year (summer), daily cooling is essential for buffaloes (De Rosa et al. 2007). In peri-urban Faisalabad, this is usually done two to four times per day by washing the animals with a hose (92% of HH) or letting them wallow in ponds (6%) and bathe in canals (3%; Photographs 9 to 12). One rich HH (0.7% of 145 HH) had an installed shower for cooling. Furthermore, twelve HH (8.3%) also had ceiling fans installed in their sheds to provide additional cooling for the animals. These were one poor (2.6% of 38), nine well off (9.5% of 95) and two rich HH (16.7% of 12); the frequencies between the groups were not significantly different. Drinking water is usually provided two to four times per day, mostly simultaneously to cooling. The animals are led to the watering point, where they are washed and allowed to drink at the same time.

Photograph 9: Worker giving a shower to a proud buffalo.

Photograph 10: Farmer cooling and watering buffalo calves.



Photograph 11: Buffalo taking a bath in a fresh water irrigation channel.

Photograph 12: Buffalo being washed in a fresh water irrigation channel.

3.6.2.2 Feeding and dung collection

Most of the farmers were using green fodder crops (95.2%), wheat straw (91.7%) and concentrates (87.6%, mostly industrial by-products: cottonseed cake, maize oil cake, cereal by-products) to feed their animals. One HH (0.7%) was also feeding rice hulls instead of wheat straw, whereas another HH only let the animals graze. In general, HH were feeding mixed rations, meaning they chopped the roughage into pieces of about two centimeters in length using special machines (Photographs 13 and 14) and mixed all the ingredients together before offering them to the animals. Many farmers had their own machines; others got readily chopped fodder delivered. There are a few large fodder markets in Faisalabad, supplying peri-urban animals with green fodder from mostly rural areas (Photograph 15). Wheat straw was mostly bought on a daily basis from retailers, and was already cut into fine pieces (Photographs 17 and 18), since only a few farmers had larger storage facilities at their farms.

Photograph 13: Buffalo feeding on chopped green fodder.

Photograph 14: Labourer chopping green fodder maize.

Photograph 15: Fodder market in Faisalabad (Tariq 2009).

Photograph 16: Farmer and his donkey bringing green fodder with weeds from the field.

Photograph 17: Huge load of chaffed wheat straw.

Photograph 18: Truck delivering chaffed wheat straw to a larger storage facility.

For the majority of the HH, grazing was not a means to feed their animals. However, 31 HH (21.4%) responded that they did grazing occasionally during different months of the year, especially during the period of fodder scarcity at the beginning of and during the hot dry summer (Figure 7). None of the respondents said they were grazing their animals during the other known period of fodder shortage at the beginning of winter. Animals were predominantly grazed on waste land (77.4%) and wheat stubbles (51.6%); other locations were road sides (16.1%) and train tracks (6.5%). During the data collection for this study, grazing animals were even observed in very dense housing areas of Faisalabad. The HH letting their animals graze were 11 poor HH (28.9% of 38), 19 well off

HH (20% of 95 HH) and one rich HH (8.3% of 12 HH). The figures imply that grazing was more important for less wealthy HH; however, the differences in frequencies were not statistically significant.

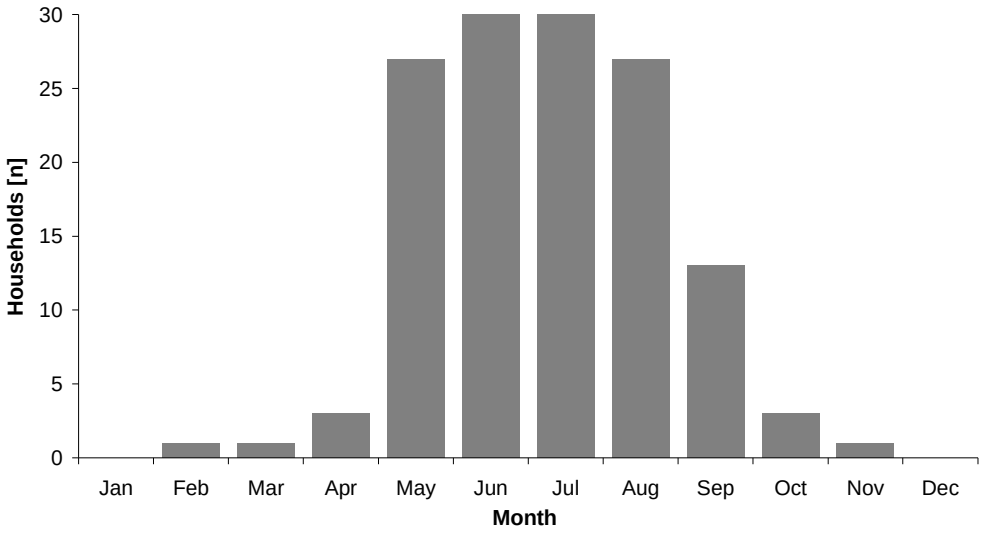


Figure 7: Number of households generally letting their dairy animals graze during different months of the year.

According to Akhtar (2005), none of her 210 interviewed HH in peri-urban Faisalabad grazed their animals, apparently because the available area was insufficient. On the other hand, she also reported that there was generally some grazing done in and around Faisalabad, which is also confirmed by Moaeen-ud-Din and Babar (2006).

The collection of dung and fodder leftovers to form dung cakes for fuel is a widespread practice in Pakistan and almost exclusively carried out by women. During the field work for this study, only one male was observed forming dung cakes: an adolescent, mentally-challenged boy working together with his mother.

3.7 Milk production and marketing

Income generation for a dairy farm is directly related to the efficiency of milk production and marketing. A producer obtaining more milk per animal with the same input through better management as well as a producer getting higher prices per liter for milk will have higher returns immediately.

Dairy animals in peri-urban Faisalabad were milked twice daily, exclusively by hand. As mentioned earlier (section 3.4), richer HH kept more lactating animals on average than poorer ones. Consequently, they produced significantly more milk per day and could also

sell significantly more milk (Table 1). Even though the percentage of milk sold varied between the three wealth groups, differences were not significant. On average, 77% of the produced milk was sold. The range was very wide (0 to 98%) since 11 HH (7.6%) did not sell milk, 3 because they were keeping animals only for domestic needs and the rest sometimes consumed their total production. Two HH were excluded from the calculations because they only kept dry animals.

Table 1: Comparison of households (HH) by group with respect to different milk production parameters. Means with different letters differ significantly in the respective variable between the groups (Mann-Whitney-U-Test, a=0.05). SD = standard deviation; HHM = household member.

Parameter		HH group	n	Mean	SD	Min	Max
Total milk production [l d^{-1}]		Poor	38	24[a]	25.8	0	143
	On day before interview; figures given by respondents; partly estimated because milk consumed by HHM is not measured.	Well off	95	64[b]	63.5	0	420
		Rich	12	171[c]	180.7	24	540
		Total	145	63	81.6	0	540
Total milk sold [l d^{-1}]		Poor	38	21[a]	26.0	0	140
	On day before interview; figures given by respondents; reliable because actually measured before sale.	Well off	95	57[b]	62.4	0	400
		Rich	12	153[c]	178.5	0	500
		Total	145	56	79.1	0	500
Sold milk of produced milk [%]		Poor	37	74[a]	28.1	0.0	98.0
	Liters sold divided by liters produced on day before interview.	Well off	94	80[a]	23.3	0.0	98.0
		Rich	12	67[a]	32.8	0.0	97.6
		Total	143	77	25.6	0.0	98.0
Mean milk yield per buffalo [l d^{-1} $buffalo^{-1}$]		Poor	24	8[a]	2.4	1.0	12.0
	Total milk production on day before interview, divided by lactating buffaloes of HH having only buffaloes or selling milk separately.	Well off	36	9[a]	2.4	5.0	16.0
		Rich	5	11[a]	4.7	6.3	18.0
		Total	65	9	2.7	1.0	18.0
Mean milk yield mixed [l d^{-1} $animal^{-1}$]		Poor	13	7[a]	2.3	2.5	11.9
	Total milk production on day before interview, divided by lactating animals of HH having buffaloes and cattle and selling mixed milk.	Well off	60	8[ab]	2.1	3.2	12.5
		Rich	8	9[b]	2.3	5.8	12.5
		Total	81	8	2.2	2.5	12.5

Although richer HH obtained a higher average milk yield per day and animal than poorer HH, yield differences were not significant at the level of individual animals (Table 1). Therefore, the higher total of milk produced by richer HH seemed to be an effect of their larger dairy herds, although their best animals had a higher yield at peak lactation (Figure 8). However, the present results were derived from questions about the milk yield on the day preceding the interview, and data might vary if daily milk yields were measured over a longer period of time.

Per capita availability of milk in Pakistan in 2008 was about 200 kg year^{-1} or 0.56 kg day^{-1} (32.54 Mt total milk production per year [FAOSTAT 2010], divided by 160.97 million people [Federal Bureau of Statistics 2008]). According to our data, richer HHM consumed significantly more milk per day (1.9 liters, SD 1.99) than poorer HHM (well off: 0.9, SD 1.16; poor: 0.4, SD 0.30). Compared to the national statistics, poor HHM consumed 22% less milk than the national per capita availability, while well off and rich HHM consumed 50% and 107% more. However, a milk consumption of up to 10 liters per day and person given by one well off HH seems unrealistic. Our questionnaire did, however, not inquire whether HH regularly served milk or milk products to guests which would have increased HH milk consumption. Richer HH also processed milk significantly more frequently than poorer HH (45% of poor, 65% of well off and 100% of rich HH), but apparently none of the HH sold processed milk products.

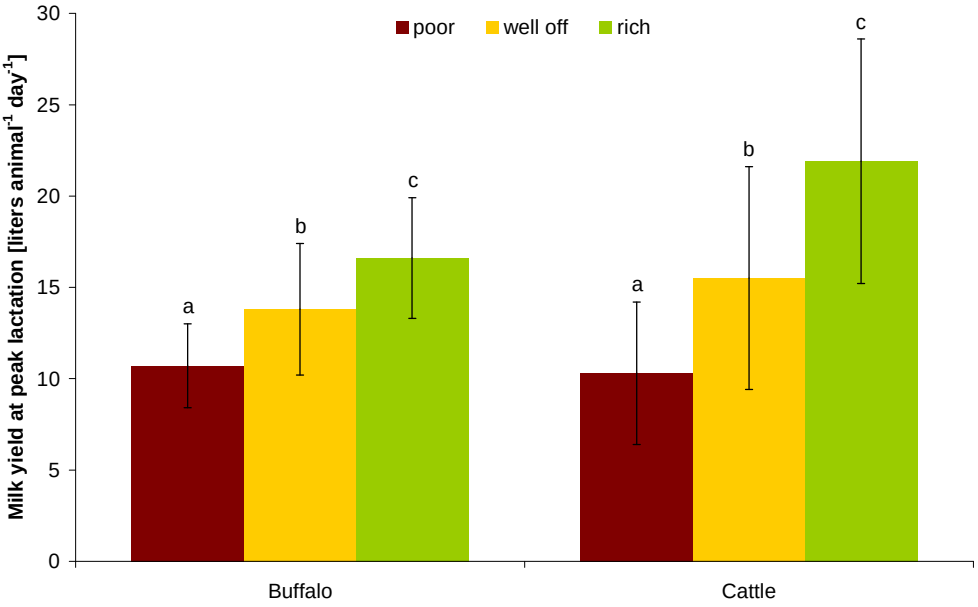


Figure 8: Maximum milk yield in liters per day and animal at peak lactation for the best animals of the herd of the household (HH) wealth groups. Different letters above the columns indicate significant differences between the HH wealth groups (Mann-Whitney-U-Test, a=0.05). Error bars show one standard deviation.

3.7.1 Milk marketing

In Pakistan, only 3 to 5% of total milk production is processed and marketed through formal channels. Since the price for packed milk is about twice the price of fresh milk (Raja 2002; Ali 2007), the demand for open raw milk is much higher than for processed milk (Zia 2007). In addition, consumers dislike heat-treated milk because of its taste (Raja 2002). Thus, about 95% of the milk produced reaches consumers via the informal sector, an extensive, multi-level distribution system of middlemen (Teufel 2007; Tariq et al. 2008; Jalil et al. 2009). Those middlemen or milk collectors/traders are known as *gawalas*

(*gavalas*) or *dhodis* (*dodhees*) (Ali 2007; Photographs 19 and 22). They collect the milk from producers and pass it on to small local companies, shops, collection points or directly to the consumers, generally having oral agreements concerning supply with the producers as well as with the local companies. Although some middlemen have refrigerated milk storage and transport systems (Ali 2007), raw milk quality in Pakistan is currently below international standards and hygienic conditions of the delivered milk are often alarming (Raja 2002; Tariq et al. 2008). Apparently, there is no quality testing at any stage along the marketing chain and many shops in urban areas are exposed to exhaust emissions, dust and flies. Only very few shops have cooling facilities (Jalil et al. 2009). Furthermore, the quality of milk delivered by middlemen is often very poor due to lack of skimming, dilution with contaminated water and addition of unhygienic ice cubes (Photographs 20), cane sugar or chemicals such as antibiotics, urea, hydrogen peroxide and formalin (Khan et al. 1999; Tariq et al. 2008; Lateef et al. 2009). Formalin was detected even in most milk packs from big companies available in Pakistan (TheNetwork for Consumer Protection 2006).

Photograph 19: Dhodi.

Photograph 20: Ice cube transporter.

Photograph 21: Milk buckets and cans for transport.

Photograph 22: Dhodis transporting milk.

In rural areas of Gujranwala, Punjab, about 70% of milk producers sold their milk to middlemen and about 30% directly to consumers (uz-Zaman et al. 1998, cited in Teufel 2007); a study of peri-urban dairy producers in Lahore reported 72% of farmers selling to

middlemen (Jalil et al. 2009). Consequently, middlemen have some sort of monopoly and are prone to exploiting their suppliers by offering low prices and binding contracts as well as keeping additional returns for themselves when prices are seasonally high due to lower milk supply (Ali 2007; Tariq et al. 2008). Mahmood (2008) stated that the dominance of middlemen is the major cause of low milk prices and inefficiencies in milk marketing. On the other hand, middlemen can also provide advantages to their suppliers by giving out credits and reducing the supplier's marketing risk due to the aforementioned undocumented contracts (Teufel 2007; Tariq et al. 2008). Due to the proximity of milk producers and consumers in peri-urban environments, the role of middlemen might not be so important because farmers can sell milk directly to the customer (Zia 2007).

The results of the present study show, however, that two thirds (70%) of the HH sold to dhodis (63%, 70% and 91% of poor, well off and rich HH, respectively), and one third (35%) to neighbours (45%, 32% and 27% of poor, well off and rich HH, respectively); three HH (2%) did doorstep delivery (all in the well off group) and one well off HH (1%) had its own shop. The frequencies with respect to the clients did not differ significantly between the HH groups.

As stated above, three HH (2%; 2 well off, 1 rich HH) said they never sell milk and keep animals only to meet their domestic milk demand. Of the remaining 142 HH, 53 (37%) sold pure buffalo milk because they were not keeping cattle; of the 89 HH keeping buffaloes and cattle and selling milk, the vast majority (97%) sold mixed milk, meaning they blended buffalo and cattle milk before sale; only three HH (3%) sold buffalo and cattle milk separately, the cattle milk to a dhodi and the buffalo milk to neighbours (1 HH) or also to dhodis (2 HH).

More than two thirds (69%) of the HH selling mixed milk sold exclusively to a dhodi; 16 (19%) sold only to neighbours, 8 (9%) sold to a dhodi and neighbours, two (2%) did doorstep delivery and one HH (1%) used all three options. Although the percentage of HH selling mixed milk decreased with increasing HH wealth – 100% of the poor, 97% of the well off and 88% of the rich HH keeping both species sold mixed milk – the differences were not significant.

The main clients for pure buffalo milk were dhodis (57%) and neighbours (45%); one HH (2%) sold to a dhodi and neighbours and another HH had its own small shop to sell pure

buffalo milk. The share of neighbours – representing the customer – buying pure buffalo milk from producers was much higher than for mixed milk. This supports the notion that people in Pakistan prefer buffalo milk and implies that consumers choose to buy "good quality directly from the producer", if possible.

3.7.1.1 Milk prices and influences on their formation

According to Ali (2007), two factors mainly influence the milk price that producers get in Pakistan: the arrangement between buyer and seller (thus market power and business skills of the two parties) and the geographical location (generally regions with favourable climate for milk production and regions with good infrastructure have lower prices). Therefore, this author claimed that the price is not linked to quality; on the other hand, he stated that consumers paid higher prices for unprocessed milk with higher fat content (Ali 2007), which is supported by Suttie (2000) who said buffalo milk would fetch higher prices on the market due to its higher fat concentration compared to cattle milk. A third influencing factor is the season, due to fluctuations in supply and demand (Anjum et al. 1989, cited in Teufel 2007).

Household wealth groups

The fact that richer HH produced and also sold more milk than poorer HH could imply that there was a difference in milk prices that HH got from their clients: HH with a large amount of marketable milk could benefit from some sort of monopoly and thus from higher prices, especially from dhodis. On the other hand, HH with many animals could benefit from higher production efficiency (economies of scale) and thus offer milk to their clients at a lower price. In fact, richer HH on average had more adult dairy animals per labourer than poor HH (Table 2), so they might benefit from higher labour efficiency. Still, since richer HH also employed more paid labourers than poor HH, their expenses for animal management might also be higher.

Table 2: Number of adult dairy animals per labourer in households of three wealth groups. Different letters indicate significant differences between the groups (Mann-Whitney-U-Test, a=0.05). SD = standard deviation.

Household group	n	Mean	SD	Min	Max
Poor	38	2.6[a]	2.24	0.8	13.0
Well off	95	4.4[b]	2.30	1.0	11.0
Rich	12	5.0[b]	3.30	1.5	10.0
Total	145	4.0	2.50	0.8	13.0

Nonetheless, no significant differences were found between the three wealth groups with respect to the prices fetched for milk from different clients. Additionally, there was no correlation between the amount of milk sold and the fetched price.

Clients and type of milk

There was a difference between the average prices HH got from different clients (Figure 9). The lowest average price was paid for pure cattle milk from dhodis (30 PKR l^{1}, SD 3.5) and the highest average price was paid for mixed milk and doorstep delivery (43 PKR l^{-1}, SD 4.6). Surprisingly, pure buffalo milk did not fetch higher prices than mixed milk from the respective clients on average, even though buffalo milk is richer in milk fat content and preferred by Pakistani people. More important for milk price formation were the clients farmers sold to. On average, neighbours paid 13% and 11% more for pure buffalo and mixed milk than dhodis; other marketing channels fetched 29% and 19% more on average for pure buffalo and mixed milk compared to the prices from dhodis. However, HH using alternative marketing channels like doorstep delivery or their own shop must have also had higher marketing costs than HH selling their milk to dhodis; therefore, revenues might be higher for HH with alternative marketing channels but their actual profit might be similar to HH selling to dhodis. To get precise data, a comprehensive study on marketing and economics of milk production in peri-urban Faisalabad would be needed.

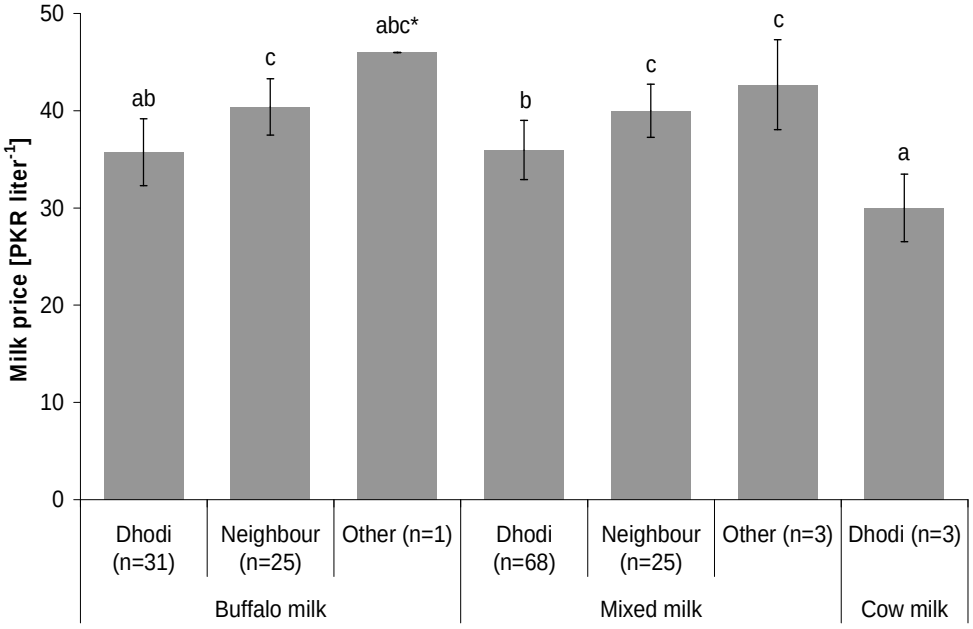


Figure 9: Average milk prices in Pakistani Rupees per liter (100 PKR ≈ 0.8 EUR) fetched by interviewed households (n=142) with respect to milk type (buffalo, mixed and cattle) and client (dhodi, neighbour and other) on the date of the interview (August-October 2009). Different letters above the bars indicate significant differences (Mann-Whitney-U-Test, a=0.05). Error bars show one standard deviation.

The price range reported for each client group for a given type of milk was quite remarkable. HH obtaining the maximum price got between 20 and 68% more money than HH fetching the minimum price.

Season

Milk production in Punjab is subjected to seasonal variations: first, there is more calving in summer and autumn than in winter and spring (Khan 1986, cited in Khan 2009) which leads to more lactating animals during autumn and winter; second, temperatures during the colder period are more favourable for milk production than the hot and humid climate during summer (Afzal et al. 2007; Khan 2009); third, fodder availability is low at the end of spring but also at the beginning of winter (Teufel and Gall 1999). In contrast to milk supply, which is at its maximum between January and April and hits a low from May to August (Umm e Zia 2006, cited in Tariq et al. 2008), milk demand is low in winter and at its peak in summer (June to September; Raja 2002). These seasonal fluctuations have an effect on prices (Ali 2007). The respondents of the present survey confirmed that they produced less milk in summer than in winter. Some of the respondents (27 of 142, 19%) said there was a seasonal difference in milk prices, the prices in summer being higher than in winter. On average, prices in summer 2009 were 7% (SD 3.7; 27 HH) higher than those of the preceding winter season (Table 3). This is not much; however, for individual HH the difference was as high as 14%, leading to significant differences between the prices of milk in summer and winter.

Table 3: Differences in percent between milk prices in winter 2008-2009 (100%) and summer 2009 for different types of milk and clients of 27 households.
The sum of responses may be higher than 27 (i.e. number of HH considered here) because some households sold to more than one client. SD = standard deviation.

			Reporting price difference		Price difference [%]			
Milk	Client	HH (n)	HH (n)	HH (%)	Mean	SD	Min	Max
Buffalo	Dhodi*	31	7	22.6	8	3.7	5.3	14.3
	Neighbour*	25	7	28.0	7	4.1	2.2	12.5
	Own shop	1	0	0.0	.	.	.	.
Mixed	Dhodi*	68	8	11.8	8	4.4	2.9	14.3
	Neighbour*	25	5	20.0	6	3.1	2.6	11.1
	Doorstep delivery	3	0	0.0	.	.	.	.
Cow	Dhodi	3	2	66.7	7	0.0	6.7	6.7
Total		142	27	19.0	7	3.7	2.2	14.3

*significantly higher milk prices in winter 2008-2009 than in summer 2009 (Wilcoxon-Test; a=0.05) where marked.

Taking the above results into account, and since HH that sold milk for advance payment to the dhodi (meaning they had a "contract" and got short term loans; 34 of 142 HH; 24%; no difference between HH groups in frequencies) did not get lower prices than others, it seems that for the interviewed HH the choice of customer was the main determinant of the milk price, while within a certain client group the producer's individual marketing skills were relevant. This supports the view of Ali (2007) that – other than geographical location – the arrangement between supplier and customer is the main factor influencing producer milk prices.

3.7.1.2 Marketing cooperatives

In view of the above results, peri-urban dairy producers in Faisalabad might establish milk marketing cooperatives – as suggested by Ali (2007) and Afzal (2010) – thereby concentrating their market power, making use of the good marketing skills of some producers and of the proximity to their customers, thus overcoming the dominance of the middlemen, who are said to be the major cause of low prices and marketing inefficiencies in Pakistan (Teufel 2007; Mahmood 2008). Furthermore, dairy producers would then have more power in negotiations with city planners and real estate investors. On the other hand, the direct marketing of milk by the producers would leave some dhodis unemployed – unless they were hired by the cooperative. Indeed, some examples of milk marketing cooperatives and producer groups from India and also Punjab in Pakistan are very successful; the rural milk producer cooperative Idara-e-Kissan close to Lahore is the most famous (Government of the Punjab 2006; Riaz 2008). However, the establishment of groups and cooperatives is a long process and cannot be implemented top-down, but rather needs active participation by the target group (Government of the Punjab 2006). Thus, another marketing strategy in the context of group formation could be a modified Participatory Guarantee System (PGS) as described in the PGS Guidelines of IFOAM by May (2008) and often successfully used for organic certification worldwide (IFOAM 2008). Peri-urban milk producers could form marketing cooperatives and enhance their marketing through educational advertising of their potential customers. Producers could use the preference of consumers for buffalo milk to gain higher prices, by guaranteeing that their milk is pure and natural, hygienic and unchanged because of the abandonment of potentially poisonous feedstuffs[1], oxytocin injections to animals to facilitate milk flow and addition of substances (e.g. water, acids) or subtraction of milk fat,

[1] Aflatoxins (mycotoxins) can occur in concentrates (e.g. cottonseed cake) when stored unsuitably. This might have negative affects on animal and eventually even consumer health, since ingested aflatoxins as carcinogenic and metabolites are secreted in the milk (Steyn 1995, IARC 2002 and Cupid et al. 2004, all cited in Hussain et al. 2008). Feed plays an important role for the occurrence of aflatoxin metabolites in milk and several studies from Pakistan have found milk samples being contaminated (Hussain and Anwar 2008; Hussain et al. 2008; Hussain et al. 2010).

which would have to be controlled independently. In the long run, further criteria like animal welfare and environmentally friendly milk production could be included – depending on the demand of the consumers and their willingness to pay higher prices for a "better" product. It is even conceivable to expand the PGS to fodder growers, thereby including fodder production and in turn the recycling of animal droppings into a holistic concept of sustainable milk production and marketing.

3.8 Animal turnover and livestock trade

The topic of livestock trade or turnover is very difficult to capture due to the habits of sharing animals, buying or changing animals from middlemen, neighbours and markets, or by bringing them to and from farms located in rural areas. In addition, some of the interviewed HH were also engaged in livestock trade (n=7), selling and buying large numbers of animals – sometimes more than 300 buffaloes per year; in such situations, it was not possible to get the exact price per animal, but the respondents were asked to estimate the average.

Middlemen – livestock traders – play an important role for buying and selling dairy animals in peri-urban Faisalabad. Between 35% and 40% of the most recently bought or sold cattle and buffaloes of the HH came from or went to one of these businessmen. Other important business partners for the purchase of animals were rural farmers, peri-urban neighbours and vendors at local livestock markets. Whereas many animals were purchased from villages, only a few of them were directly sold back to rural areas. A large proportion of the adult dairy animals sold by the peri-urban dairy producers went to butchers, providing Faisalabad's population with meat. Thus, many animals with a good genetic potential for milk production bought from rural areas and brought into the city, were slaughtered after one lactation in the city and withdrawn from breeding. In the long run, this might lead to genetic erosion and decline of the yield potential of the good dairy cattle and buffalo breeds in the country, and especially in Punjab. The fact that many high potential animals from rural Punjab are transported to cities where eventually most of them and their offspring are slaughtered, has also been described by other authors (Khan et al. 2007; Khan et al. 2008; Klein et al. 2008).

3.8.1.1 Prices of dairy animals

Prices reported by the respondents for animals they had bought during the twelve months preceding the interview varied greatly (Figure 10); however, the average price reported for buffaloes was similar to the price milk producers in dairy colonies of Karachi,

Sindh, had to pay (60,000 PKR; Khan et al. 2008). Although the average values given by the different wealth groups imply that richer HH sold and bought animals at higher prices, the differences were only significant for the buying price of buffaloes; here, rich HH paid significantly more money (average 72,000 PKR) per animal than well off (average 60,000 PKR) and poor HH (average 57,800 PKR).

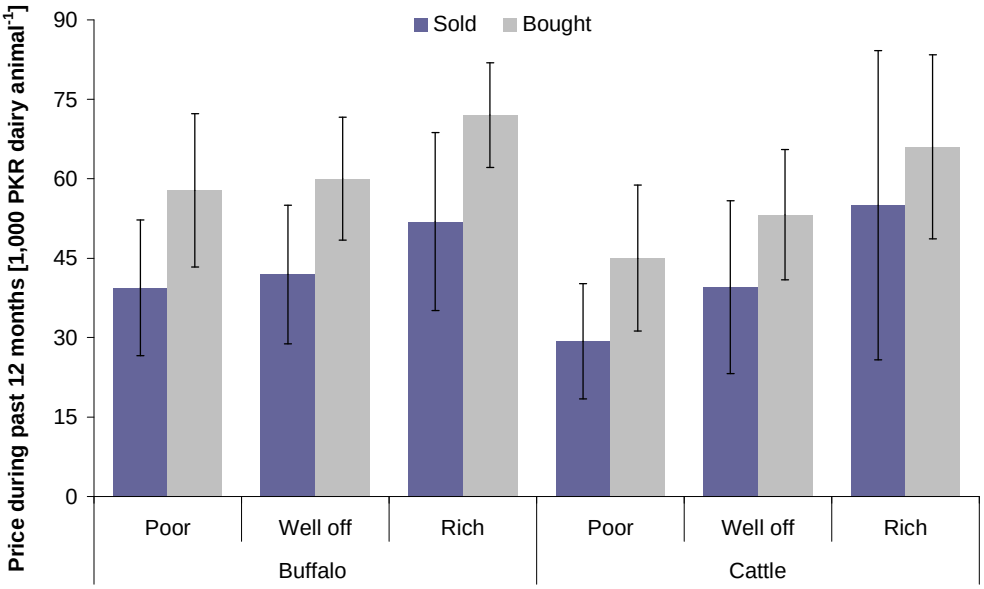


Figure 10: Average prices for dairy buffaloes and cattle by wealth group and direction of trade (sale or purchase). PKR = Pakistani Rupees (100 PKR ≈ 0.8 EUR); error bars show one standard deviation.

The difference between species was only significant for purchased animals, where farmers had to pay 61,100 PKR per buffalo on average and 52,900 PKR per cow, but not for sold animals. However, the difference between average sale and purchase price within one species was significant and relatively high, with the purchasing price being 44% and 31% higher than the sale price for buffaloes and cows, respectively. This is not surprising since HH tend to buy good animals and sell not so good animals; simplified, they buy healthy, lactating animals from middlemen and sell diseased and/or dry animals back to these businessmen or even to the butcher.

3.9 Future prospects and challenges

3.9.1 Future development of animal numbers

In order to get a picture of the future plans of dairy farmers in peri-urban Faisalabad, respondents were asked whether they would like to increase or decrease the size of their dairy herds. In the case of buffaloes, 73% of all HH wanted to keep more animals, whereas

26% wanted to maintain the same number and 1% thought about decreasing their herd size. Considering cattle, HH already keeping cattle (n=91), 68% wanted to increase their animal number, whereas 31% wanted to maintain and 1% wanted to decrease their cattle herd size (Table 4). Half of the 54 HH not keeping cattle wanted to start anew with dairy cows, leaving only 18% of all HH (n=145) without plans to keep dairy cows in the future. Overall, 75% of the 145 HH wanted to increase their total number of dairy animals, 24% wanted to maintain and 1% thought of decreasing their herd size, with no differences with respect to wealth groups.

Table 4: Aspired development of the number of dairy cows of all households (HH), HH not keeping dairy cows yet and HH already keeping dairy cows.

	All HH		HH without cattle		HH keeping cattle	
Future of dairy cows in HH	n	%	n	%	n	%
More dairy cows	62	42.8	-	-	62	68.1
Same number of dairy cows	28	19.3	-	-	28	30.8
Start new with dairy cows	28	19.3	28	51.9	-	-
Not starting with dairy cows	26	17.9	26	48.1	-	-
Less dairy cows	1	0.7	-	-	1	1.1
Total	145	100.0	54	100.0	91	100.0

3.9.2 Ideas for changes and improvements given by respondents

At the end of the interview, respondents were asked about plans or improvements with respect to the future development of their dairy production unit. The question was left completely open, so the respondents were able to come up with ideas. Although poor farmers on average mentioned only one idea for improvements, compared to 1.4 and 1.5 ideas for well off and rich HH (the range within each group was 0 to 4 ideas), the differences were not statistically significant. Overall, 38.6% of the 145 respondents did not have any idea about what to change or how to improve their production. On the other hand, 48.9% wanted to keep better animals with higher milk yield per animal, and 8.3% wanted to improve their breeding management. One respondent (0.7%) also said he would like to move towards meat production. Furthermore, 17.9% of the respondents wanted to improve animal nutrition by either feeding larger amounts, or fodder of better quality. Other ideas were linked to better management in general (2.1%) and the provision of improved medical care for the animals (0.7%). Many respondents (40%) came up with ideas related to infrastructure; 18.7% wanted to invest more money in their infrastructure in general, while 13.8% wanted to improve animal housing in particular. Some thought it would be good to offer more space to the animals (3.4%) and to buy land (2.8%), as well as to improve sanitation (1.4%) and drinking water quality for animals

(0.7%). About 7% explicitly said they would like to expand their business by taking out a loan and 1.4% wanted to try and get subsidies from public institutions.

In summary, of the 61.4% (n=89) respondents giving ideas for improvements, the majority anticipated "higher milk yield". From the answers given, it cannot be clearly derived whether the respondents were aware of the complex interactions occurring between different factors influencing the milk yield of animals; however, some respondents seemed to be aware of the importance of feeding and housing for animal productivity, whereas proper breeding and health care appeared not to be perceived as influencing variables.

3.9.3 Challenges of peri-urban milk production

In the preceding chapters, general problems of milk production in Pakistan, as well as the special constraints of peri-urban milk production described in the literature, and the problems of peri-urban milk production in Faisalabad identified in the present study were discussed. However, the scientists' view might not always reflect the opinion of farmers. Therefore, constraints of milk production in Faisalabad City according to our respondents are presented in the following chapter. These are compared to reported results and to problems that were identified in the course of the present study. Furthermore, possible links and interactions between problems will be analyzed.

3.9.3.1 Problems addressed by respondents

Most of the problems mentioned by the respondents (multiple answers were possible) were closely related to finances (red circles in Figure 11). Almost half of them (44.1%) lamented high feeding costs; one third (33.8%) mentioned high costs or low profit in general and 10.3% were of the opinion that limited financial resources, i.e. lack of money to buy inputs or to invest in infrastructural improvements, were a problem. Directly related to the above mentioned problems were high buying prices for animals (4.1%) as well as a low milk price, poor milk marketing opportunities and the monopoly of the dhodis (0.7% each). Taking into account that in peri-urban systems feeding accounts for 60 to 90% of the production costs (Habib et al. 2007; Khan et al. 2008; Jalil et al. 2009), it is not surprising that so many respondents named high feeding costs or high costs in general as problems. The next largest category of constraints was seen in issues related to infrastructure (blue circles in Figure 11). Many of the respondents (22.1%) said that they had too little space for their animals; 3.4% found it challenging that they did not own land and 2.8% said dung disposal was problematic.

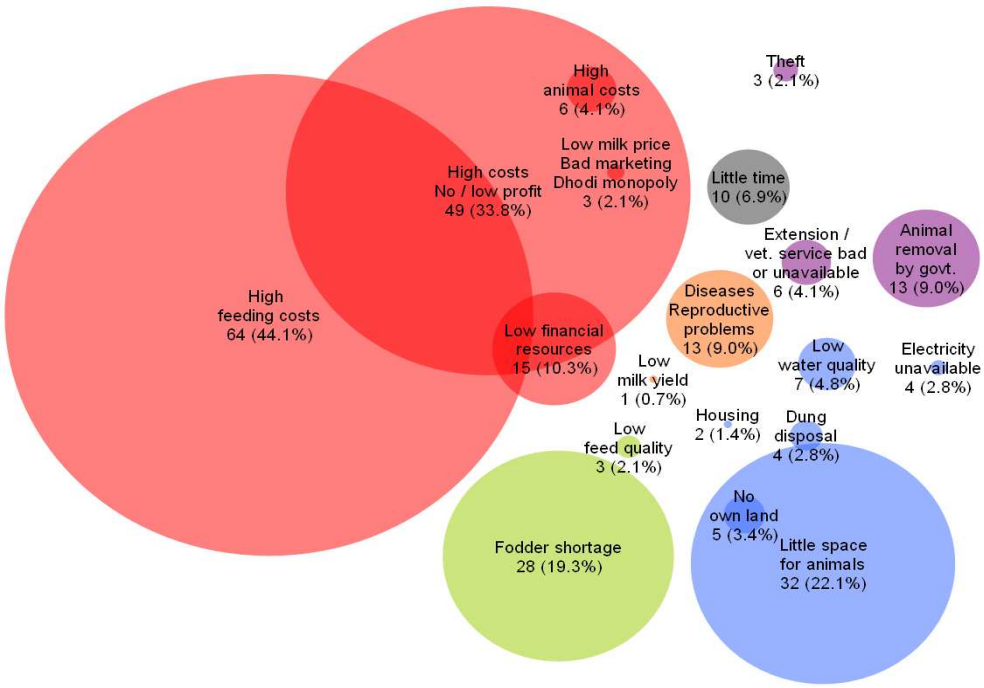


Figure 11: Modified Chapati diagram (after Anyaegbunam et al. 2004) depicting problems named by 145 peri-urban dairy producing households in Faisalabad. Open question, respondents could give several answers.
The size of the circles depends on the number of respondents naming the respective problem (first figure - one unit diameter for each ten respondents; second unit [in brackets] gives the respective percentage of respondents). The size of circles is not related to the importance of the problems, only to their frequency of mention. The colour of the circles groups problems into categories. The location of the circles shows relationships and possible interactions among the different problems named.

Furthermore, poor ground water quality (4.8%), unavailability of electric power (2.8%) and poor animal housing (1.4%) were perceived as problems. The seasonal fodder unavailability often mentioned in the literature (Teufel and Gall 1999; Ghaffar et al. 2007) was seen as a constraint by 19.3% of the respondents, while 2.1% said that feed quality (concentrates) was low (green circles in Figure 11). This might correspond with reports of high aflatoxin concentrations (see footnote in section 3.7.1.2) in different concentrates and milk samples from Pakistan, especially from peri-urban areas (Hussain and Anwar 2008; Hussain et al. 2010), and the reported cases of feed poisoning in animals of the HH interviewed for the present study. Only a few of the problems named by our respondents were directly associated with animal properties (orange circles in Figure 11): 9% said that diseases or reproductive problems were constraints and one respondent (0.7%) had problems with low milk yield. With respect to constraints related to society or authorities (violet circles in Figure 11), 9% complained about the removal of the animals from the urban space (area inside the red city border in Figure 1), 4.1% mentioned lack of or poor veterinary and/or extension services, and 2.1% had to cope with animal theft. Furthermore, 6.9% mentioned that they were short on time to manage their dairy unit, which was categorized as a general management problem (grey circle in Figure 11).

Overall, there were no differences in the percentages of HH naming specific problems between the three wealth groups. Poorer HH, however, lamented high feeding costs, limited space and the lack of own land more frequently than richer HH (Table 5); on the contrary, rich HH reported few or no problems more frequently than poorer HH. Although the differences were not statistically significant, this shows a tendency towards financially induced problems for poorer HH. Aden et al. (2008) reported that small farmers in particular were affected by rapidly increasing feed prices in peri-urban Faisalabad.

Table 5: Percentage of respondents of the three household (HH) wealth groups that named selected problems. Differences between groups were not statistically significant (Chi-square, a=0.05). Open question, respondents could give several answers.

		Named problems			
HH group	(n)	High feeding costs	Space limited	No own land	Nothing
Poor	38	52.6	26.3	5.3	10.5
Well off	95	44.2	22.1	3.2	10.5
Rich	12	16.7	8.3	0.0	25.0
Total	145	43.4	22.1	3.4	11.7

Furthermore, HH not cultivating crop land and thus not producing their own fodder viewed the constraint of high feeding costs significantly more frequently than HH having land for fodder production - of the 64 HH reporting high feeding costs as problematic, 46 (71.9%) did not posses agricultural land. On the other hand, HH growing their own fodder reported fodder shortages more frequently as constraints compared to HH that bought all fodder from crop growers or traders; 60.7% of the 28 HH naming fodder shortage as a problem were at least partially growing their own fodder.

3.9.3.2 Problems addressed in literature

Comparing the above results to problems generally reported in the literature and observed during the present study (Table 6), it is noticeable that none of the problems are “new” and all of them have been known for several years. Furthermore, a certain bias between the “internal view” of the respondents and the “external view” of the researchers is noticeable; it stands out that the respondents usually named problems that directly affected their income and that were directly and constantly visible to them, such as high costs, little space and fodder shortages. Other constraints that might be even more important but are not directly influencing their income, e.g. the relatively low genetic potential of their animals due to neglected breeding as well as the short- and long-term health problems correlated with imbalanced feeding and insufficient health

care, were rarely named by respondents. Moreover, problems of improper dung management (storage, disposal, burning instead of recycling) for the environment and human health were not present in the respondents´ answers.

Table 6: Problems of milk production in Pakistan from the literature*, observed by the author during the present survey in Faisalabad, as well as problems and plans for improvements named by 145 peri-urban milk producers. Both questions (problems/plans) were asked openly and independently from each other; respondents could name as many problems and improvements as they liked. 11.7% of the respondents did not name any problems and 38.6% did not have any plans for improvements.

Problems named by respondents	**Planned improvements named by respondents**	**Problems described in the literature***	**Problems found during the present study**
44.1% feeding costs		high feeding costs	
33.8% high costs/low profit		inefficiencies	
22.1% little space 3.4% no own land	3.4% more space 2.8% buy land	little space	crowded stables and backyards
19.3% fodder shortage		fodder shortage	
10.3% low financial resources	7% take loan 2.1% management 1.4% get subsidies		
9% diseases or reproductive problems	0.7% medical care	bad health care	diseases, reproductive problems, unhygienic oxytocin injections, alternative treatments, private practitioners
9% animal removal from cities		animal removal from cities	
4.1% vet./extension service		little technical public support	no extension service little gov. vet. service
2.8% improper dung disposal	1.4% sanitation	improper disposal of dung	hazards to humans: dung storage, disposal; burning instead of recycling
2.1% feed quality		aflatoxin in feed	
	17.9% animal nutrition	improper feeding	feeding imbalanced
1.4% animal housing	13.8%animal housing		
0.7% bad marketing		bad marketing monopoly of dhodis	milk price formation

0.7% monopoly of dhodis			
0.7% low milk yield	48.9% keep animals with higher milk yield	low genetic potential	
	8.3% breeding	neglected breeding	breeding unplanned
		unhygienic milk	yes, looked like it
		low educational level of milk producers little adaptation of new technologies	many uneducated HH heads no use of hay, silage or urea molasses blocks
		high mortality rates	high calf mortality
		slaughtering of good dairy animals and their offspring	geneticerosion by movement of best animals from rural to urban areas, many get slaughtered
			"dung work" mostly done by women

*Teufel and Gall 1999; Dost 2002; Akhtar 2005; Moaeen-ud-Din and Babar 2006; Cain et al. 2007; Ghaffar et al. 2007; Habib et al. 2007; Hussain and Anwar 2008; Khan et al. 2008; Mahmood 2008; Tariq et al. 2008; Ahmad et al. 2009; Jalil et al. 2009; Muhammad et al. 2009; Hussain et al. 2010.

This shows that education and awareness through extension services and veterinarians as well as non-governmental-organizations (NGOs) are prerequisite if farmers are to change their management practices. Farmers who are unable to understand the links between different factors and thus do not perceive a need for changes are very unlikely to modify their dairy management. As can be derived from the anticipated improvements of the respondents (section 3.9.2 and Table 6), they seem to be aware of the influence of feeding and housing on animal productivity, whereas breeding and health care appear not to be seen as major influencing factors. This might be interlinked with the distribution of "responsibilities" in the system: feeding is done at the farm every day, and they also have to cope with the infrastructure (housing) regularly. On the other hand, planned and well-managed breeding has not been picked up yet and is outsourced to rural areas or the very few "professional" breeders in the peri-urban zone. Similarly, health care (direct curative and indirect preventive) is mostly done by "professionals" and not by farmers themselves. Therefore, farmers might not be aware of the severity of certain diseases, and of the interaction between suboptimal health status and suboptimal milk yield.

In conclusion, there are several problems seen by farmers and they have plans for the (improved) future of their dairy units. On the other hand, scientists and politicians partially perceive the same but also different problems associated with peri-urban dairy

production. Farmers would surely welcome improvements in the fields of animal nutrition, health care, breeding and marketing as well as good technical public support through effective extension services, whereas authorities would additionally focus on consumer health and therefore on milk hygiene and proper disposal of dung. The difficult task is to identify those problems that are to be changed urgently, and to develop respective improvement options with positive effects on farmers as well as on their environment, which will be accepted and implemented by farmers. The latter will only take action if they perceive either financial incentives or are forced by authorities and/or social norms.

4 DISCUSSION OF THE METHODOLOGY

The questionnaire used to collect the data was developed in Germany beforehand, using available literature on the topic. However, the reality in peri-urban Faisalabad was much more complex. Thus, corrections were necessary during the pretesting of the questionnaire. In order to create a comprehensive questionnaire, more knowledge and understanding of the investigated system would be necessary in advance: "…spending enough time to learn about the culture and build trust with those participating in the research (…), because they can only be understood when researchers have invested enough time in the setting" (Holloway and Wheeler 1998, p. 164, cited in Kapborg and Berteroe 2002, p. 54) is a prerequisite in order to collect good data and interpret accordingly. The researcher is coming from a certain cultural background, which might be reflected in the questions posed or at least in the way they are being posed, thereby influencing the information obtained from the respondents (Kapborg and Berteroe 2002).

For the interviews, an interpreter was necessary. Even interviews without translation are challenging due to complex interpersonal communication processes. Combining these complex situations with translators makes it even more complicated. Numerous studies conducted around the world in the health sector describe problems arising when physicians and patients do not speak the same language and interpreters are necessary during patient interviews and diagnosis of diseases. The sources for mistakes are plentiful in such situations; cultural differences in habits and perceptions, misinterpretation or faulty summarization by the translator as well as general misunderstandings occurring during communication can influence the results of the interviews (e.g. Farooq et al. 1997; Flores 2005). It is stressed, though, that no matter how well-qualified an interpreter is, errors can occur, often not due to language problems but due to cultural differences (Farooq et al. 1997; Kapborg and Berteroe 2002). Thus, following the quotation: "In an interview it must be realised that interpreters do not simply translate what they hear; they interpret" (Farooq et al. 1997, p. 209). The translator's involvement in the research process, including expertise of the topic, competence and style of translating as well as impact on findings must be accounted for when analyzing the results (Wallin and Ahlstroem 2006).

Only a few interviews were conducted solely with the respondent present; usually at least two to three other people or more often a larger group of curious folks were around, in some cases even answering questions that were posed to the interviewee. Furthermore,

the suspicion of some respondents, the possible ignorance of a few due to being only indirectly engaged in livestock management and sometimes disinterest might have influenced the quality of the answers. Therefore, when interpreting the results, it must be kept in mind that the information was given *ad hoc* during interviews. Due to this, figures concerning income, milk production, animal prices and so on must be handled with care; even the number of animals kept by the HH, which could be easily confirmed by counting, needed correction here and there.

5 CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Numerous problems related with peri-urban milk production in Faisalabad but also opportunities have been presented in the preceding chapters. Some of these problems lie in the nature of peri-urban farming in general and cannot be resolved easily. A wide range could be solved by a change in management, while others call for bigger changes within the system or even an alteration of the farmers' attitudes, the latter definitely being the most challenging. As mentioned before, most of these problems are interlinked and should be addressed in the context of the entire system. Therefore, further research should focus on systematic investigation of improvement options, taking a holistic and interdisciplinary approach. The overall management of these systems must be considered and improved in order to achieve sustainable development. Concerted efforts of dairy farmers, researchers of different disciplines, NGOs and political decision makers at national and local level are necessary to create an economic, ecological and social framework that allows dairy production to serve the entire society. Toward this goal, different improvement options should be tested with respect to impact on environment and income of the farmers as well as feasibility and sustainability in the peri-urban zones of Faisalabad.

5.1 "Identification of household types fit for a micro credit program"

A large proportion of the respondents in the present study were of the opinion that low financial resources and high costs were constraining milk production; nevertheless, many wanted to invest in infrastructure and animal housing, if they had the money. The provision of micro credits to poor people has been a mostly successful strategy to reduce poverty worldwide (Panjaitan-Drioadisuryo and Cloud 1999, women in rural Indonesia; Zaman 1999, Bangladesh), as well as in Pakistan since the beginning of the 1980s (Shirazi and Khan 2009; Muhammad 2010). Studies from different regions of Pakistan on the impact of the National Rural Support Program (NRSP) as well as the Punjab Rural Support Program (PRSP), which was established in June 1998 by the Punjab Government, report that the provision of micro credits to females or males showed positive effects on poverty alleviation through increased income, and in consequence improved education of children, social status of the HH as well as nutrition of HHM (Ali 2002; Kamran 2002; Adil and Badar 2003). Furthermore, it seems that through such improvements, the persons' care for their surroundings increased and environmental problems were reduced

(Anderson et al. 2002). Problems related to the provision of micro credits, however, are also reported: Rahman (1999) found that women in rural Bangladesh were prone to slipping into debt traps after having been granted a credit, which is confirmed by Muhammad (2010) for Pakistan. This could lead to stress and sometimes depression among rural women in Bangladesh (Ahmed et al. 2001). Moreover, micro credits do not necessarily reach the very poor and vulnerable, but rather the better off among the poor are likely to benefit; this led to further polarization within the target groups (Navajas et al. 2000, rural and urban Bolivia; Copestake 2002, rural Zambia; Waheed 2009, rural Punjab, Pakistan). Therefore it was claimed that in Pakistan "for extremely poor and destitute a separate kind of poverty intervention strategy is required" (Waheed 2001: 743). Research in peri-urban Faisalabad could, therefore, focus on the identification of household groups that would benefit from a micro credit. For the others, different solutions should be found.

5.2 "Impact of peri-urban dairy production on the income of rural households"

It has been well known for years that migrants from rural areas in so-called developing countries transfer financial and other resources from the cities to rural relatives (Rempel and Lobdell 1978; Banerjee 1984). Whereas Rempel and Lobdell (1978) found little evidence that urban-rural remittances were a significant means to rural economic development; recent research in China confirmed that rural-urban money transfer partially played a vital role for rural household income (Yang et al. 2008; Zhu and Luo 2008). During the present study, no useful data on the regional origin of the families and employees of dairy HH in peri-urban Faisalabad were collected, but there are indications that a certain proportion of them moved from rural areas to the city during the past years. Furthermore, as described above (sections 3.6.2.2. and 3.8), substantial amounts of fodder and many animals are brought to the city from rural areas. In return, there must be some sort of cash flow to areas where fodder and animals are produced. In order to convince policy makers and local authorities of the importance of peri-urban milk production, not only for food security for the urban population but also for income generation of urban and rural HH, data on the geographical aspects and financial extent of feed and animal transactions should be identified.

5.3 "How to cope with growing cities and rural farmers becoming urban?"

If the city of Faisalabad keeps growing as fast as it has been during the past decades – and this is very likely – the peri-urban and rural farmers of today will become the urban and peri-urban farmers of tomorrow. This exposes them to several challenges, e.g. shrinking arable land, rising fodder prices and possibly further expelling of their animals from urban areas; on the other hand, many farmers would like to increase their herd size, and the city population must also be fed. Against this background, research could focus on sustainable development options for peri-urban and rural farms around Faisalabad, especially in view of rapid urban growth.

5.4 "Safety, decency and gender aspects of labour in dairy production"

As mentioned in the chapter "Labour" (3.6), the peri-urban dairy production chain offers multiple job opportunities to both family members as well as unskilled hired labourers. The wages for these tasks are, however, relatively low and working conditions are difficult. Most likely, hired workers have neither employment contracts nor any social security or health insurance. Looking from the outside (the researcher's view) at the jobs, safety aspects can be assessed quite easily and objectively: the unprotected fodder chopping machines; the dhodis racing through the city's traffic without helmets; labourers working barefoot among the animals. The decency of work, especially in light of gender aspects, needs further investigation. All hired workers were exclusively male and women were apparently only engaged in stable cleaning and forming dung cakes. For the outside observer the work of forming dung cakes seems rather indecent: the women are sitting in the animal droppings without shoes forming dung cakes with their bare hands. But how do they feel about the work they are doing? How is "dung work" valued by the society? Women usually refused to be photographed while forming dung cakes; when I wanted to try and form dung cakes, I needed all my powers of persuasion to convince a woman to let me do it. She said it was no job for a man and my fingers would stink from it. Still, she and many more are doing the work every day. In summary, working conditions of labourers in dairy production as well as their social security and the division of labour between genders should be recorded in greater detail in order to preserve jobs but also to increase their decency.

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