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## Farmer attitudes to the improvement of productivity in Senegalese low input cattle systems

# Farmer attitudes to the improvement of productivity in Senegalese low input cattle systems

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## ABSTRACT

Livestock contribute both directly and indirectly to the emission of greenhouse gases; a recent study suggests that 14.5% of global anthropogenic emissions arise from livestock systems. Despite this significant impact, predictions suggest that the demand for livestock produce will continue increasing, particularly in developing regions such as sub-Saharan Africa. It is important to understand how improvements to smallholder productivity can help meet this demand. This paper seeks to contribute to this by presenting a case study of low input mixed produce cattle systems in the Sahelian region of Senegal. Specifically, the following questions are investigated:

1) What are farmers' attitudes towards improving productivity?
2) What are the key barriers preventing productivity improvements?

Focus group discussions, with over two hundred farmers, and interviews with supply chain stakeholders reveal that there is a desire to improve productivity amongst farmers, frustrated by barriers such as a lack of financial means, lack of access to resources and system characteristics and traditions. Growing urban demand represents a potential opportunity for low input smallholders; however, they face competition from more intensive developed systems. If low input systems do improve productivity, it is likely they will largely continue to meet the rural and subsistence demands only.

## IMPLICATIONS

The findings will assist in the identification of measures that could be implemented at farm level, to improve productivity, and the barriers to their adoption.

**KEYWORDS:** Senegal, Cattle production, Productivity, Development barriers, GHG emissions

# 1. Introduction

## 1.1. The impact and future of livestock

Global livestock agriculture has been estimated to contribute around 14.5% of total anthropogenic greenhouse gas (GHG) emissions; 41% and 20% of this can be attributed to beef and dairy cattle systems respectively (Opio et al., 2013; Gerber et al., 2013). Population growth (Gerland et al., 2014), changing diet preferences and increasing wealth, particularly in developing regions, will increase the demand for livestock produce (Pinkovskiy & Sala-i-Martin, 2014; Herrero et al., 2008). Consequently livestock production and its associated GHG emissions (De Vries & De Boer, 2010) will increase, particularly in areas where crop production is unfeasible (Ripple et al., 2014).

## 1.2. Cattle in sub-Saharan Africa

Sub-Saharan Africa's (SSA) cattle population of over 230 million (Herrero et al., 2008) supports a large proportion of the human population, particularly the poor and food insecure (Herrero et al., 2013). Cattle in SSA are an important source of revenue (Udo et al., 2016), nutrition (Seck & Fadiga, 2014; Dror & Allen, 2011), status (Herrero et al., 2013), and provide services such as draft power (Tano et al., 2003) and crop fertilization via manure (Tano et al., 2003; Herrero et al., 2013). Smallholders produce a large proportion of domestically consumed food (Oosting et al., 2014) and their low system productivity means there is significant potential for increasing output without proportionate increases in GHG emissions (Herrero et al., 2013, 2014). Improving smallholder livestock system productivity therefore has a key role in climate change mitigation and meeting food security goals (Havemann & Muccione, 2011).

## 1.3. Senegal

Low input agro pastoral cattle systems (which, alongside pastoral, account for much of the production systems in Senegal (Knips, 2006, p.28) ) were studied (see appendix A for production parameters). Around 70% of the Senegalese population are engaged in agriculture, with 30% of households being maintained by livestock (Knips, 2006, p.26; Gning, 2004, p.1). Senegal imports the majority of domestically consumed dairy products (Stads & Sène, 2011;

Seck & Fadiga, 2014); national production does not meet national demand (Stads & Sène, 2011, p.2) and struggles to compete with cheap imported milk powder (Gning, 2004, p.6). Government development plans describe an agenda to improve livestock sector productivity and competitiveness, through the development of both industrial and small scale systems (Republique du Senegal, 2014, p.67). The government launched a National Program for Livestock Development, aiming to reach self-sufficiency for livestock produce by 2026 (Seck & Fadiga, 2014) . It is also recognized that the development of local dairy industries is an opportunity to improve rural livelihoods, population health and macro-economic development, deserving of focus from non-government organizations and donors (Gning, 2004, p.30); particularly for the population who live in fragile ecosystems where it is one of the few viable economic activities (Seck & Fadiga, 2014). The national program suggest government interest in improving livestock productivity, but it is not clear to what extent livestock keepers are willing and able to engage in the actions required to improve productivity. To this end, this study aims to answer the following questions:

1) What are farmers' attitudes towards improving productivity?
2) What are the key barriers preventing productivity improvements?

## 2. Methods

Methods employed for information gathering in the field comprised of (a) focus group discussions (FGD) with cattle farming household members (see appendix B for template) and (b) semi structured interviews with several accessible stakeholders (local veterinarian, feed merchant and local livestock researchers).

### 2.1. Focus group discussions

FGD templates were designed to begin with gaining an understanding of how important improving productivity of animals is to farmers. This was followed by open questions covering how they would proceed to achieve improved productivity, what prevents them from acting, and if they had reasons to not improve animal productivity. Next the templates ask about attitudes towards more specific measures that could be employed for improving productivity, including specific feeding options, animal health improvements and breeding.

The templates were designed in this way to first give the farmers open questions, allowing an understanding of where their attention lies. Then the use of more specific questions considers the viability of specific measures.

Following drafting focus group discussions were piloted with a group of local non-project farmers to identify any problems allowing revision before proceeding to the project farmers.

Participants of the FGDs were recruited through their previous involvement in ILRI's Senegal Dairy Genetics Project where cattle keeping households were purposely sampled based on the breed composition of their cattle (Marshall et al., 2014), and as such care must be taken in using them to represent the views and opinions of the wider farmer population. The FGDs were carried out at eight meetings of households, attendees included 88 women and 166 men from the Thies and Diourbel regions (Figure 1). FGDs were held between 25th April and 20th May, 2016, each focus group had an average of 20 participants.

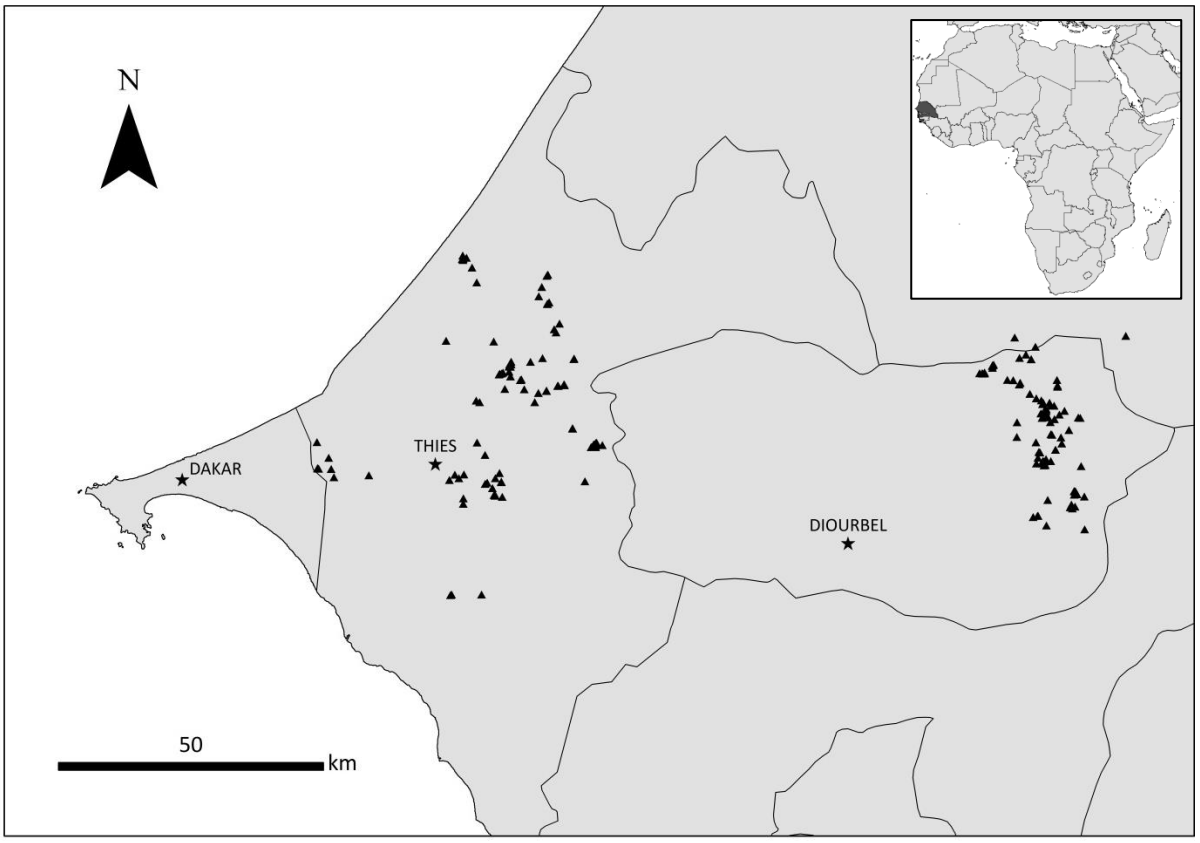


**Figure 1. Map of locations of households participating in the study.**

At each meeting, farmers were divided into low and high wealth groups; the definition of which was based on farmers' last sale of milk. The assumption was that during the current dry season, wealthier farmers were more likely to have been able to sell milk more recently. Varying timescales were used until each meeting was divided into approximate halves. This proxy was deemed appropriate to avoid publicly asking farmers about their wealth, and the unsuitability of herd size as an indication of wealth.

Facilitators and enumerators had previously worked with the farmers through the SDG project, so had an existing relationship and spoke both French and the local Wolof. FGD were conducted in Wolof and recorded in French.

Focus group discussion transcripts were manually coded to identify common themes appearing in answers and comments.

### 2.2. Semi – structured interviews

The purpose of the interviews with stakeholders was to understand their opinion on farmers' attitudes and challenges to improving the productivity of their animals, as well as discussing more specific measures for improved productivity to check viability. Interviewees included a veterinarian practicing in the study region, a nutrition scientist for a feed merchant, an individual farmer and livestock researchers based in Senegal. As well as broad open questions concerning the study systems, questions were designed to fit the relevant specialisms of each stakeholder. For instance the veterinarian was asked more specifically about animal health challenges, whilst the feed merchant about nutrition improvements.

## 3. Results and Discussion

### 3.1. What are farmers' attitudes towards improving productivity?

To begin the focus groups farmers were asked to discuss questions 1 to 8 (see Appendix B), opening with:

*'How important is it for you to increase your milk production?'*

*'How important is it for you to increase your income from the sale of animals?'*

In each of the focus groups, participants were unanimous in responding that it was "very important". They demonstrated a real desire to improve productivity. Later in the FGDs farmers were also asked 'Would they be interested in producing the same output with fewer animals?'. The majority answered yes; there were a minority in both low and high wealth groups that answered no (Figure 2). This fits with other examples of low wealth groups tending to put more emphasis on keeping cattle for other purposes other than protein production (Ejlertsen et al., 2013).

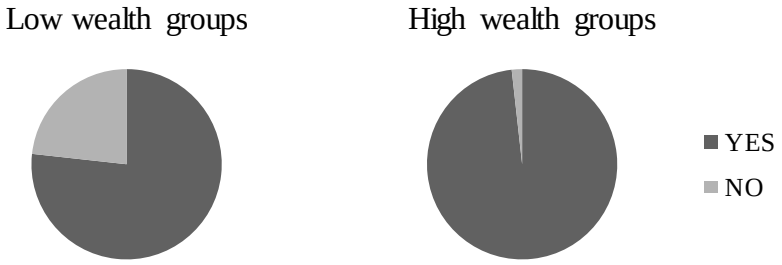


**Figure 2. Responses of farmers to the question: 'Would they be interested in producing the same output with fewer animals?'**

Reasons for answering yes included smaller herds requiring fewer inputs and lower costs, 'less animals require less investment' (High wealth FGD, Thies, Thies, 04.5.16), and effective management, 'managing a smaller herd is easier' (Low wealth FGD, Touba Toul, Thies, 03.5.16). In some groups a smaller herd was seen as advantageous as it meant 'investing more in less animals' (Low wealth FGD, Touba Toul, Thies, 03.5.16) and an 'easier management of their nutrition' (Low wealth FGD, Touba Toul, Thies, 03.5.16).

Reasons for answering no to a smaller more productive herd centred around the challenge of how to value cattle in smallholder systems (Weiler et al., 2014). Farmers 'do agree that more milk from less animals is good, but there are other needs for cattle' (High wealth FGD, Thies, Thies, 04.5.16) and 'choices are not based solely on milk production, for example the sale of animals to cover certain expenses is important' (One group FGD, Tivouane, Thies, 15.5.16) (as demonstrated by Ejlertsen (2013)). There was also mention of the ceremonial or social function of cattle, 'cattle are important for ceremonies, a cow is slaughtered, if they have less cows this makes a big impact on their herds, with many cows this isn't a problem' (High

wealth FGD, Thies, Thies, 04.5.16). Social status can be judged by herd sizes, with 'more animals meaning more consideration and respect' (Low wealth FGD, Kael, Diourbel, 10.5.16). One group also mentioned a significant challenge to improving productivity when risks are so high and investment low, 'with a high number of local cattle breeds, feeding isn't that important and I still get milk' (One group FGD, Tivouane, Thies, 15.5.16); without increased support or system change having many low yielding cows that exploit cheap but poor forage is reasonable.

### 3.2. How would they proceed to improve productivity?

It is likely farmers will be more responsive to productivity improving measures that they already understand and value (Ndjeunga & Bantilan, 2005; Adesina & Chianu, 2002), there must also be recognition that these farmers have valuable indigenous knowledge, as well as social and cultural features, that must be considered when planning improvements (Nyong et al., 2007; Gning, 2004, p.4). Farmers were therefore asked open questions 'what can you do to improve milk production of your animals?' and 'what can you do to improve your income from the sale of your animals?'. The majority of answers from low and high wealth groups for both questions encompassed broad themes including the improvement: of housing, feed quality and quantity, health status, breeds and water access. These themes are expected as they were largely communicated in training and education given by the SDG project. Some individual groups proposed more specific ways to improve productivity including improved disease treatments, training for farmers in health and milk preservation, and forage conservation and processing. The results did not indicate any significant differences between low and high wealth groups. It is suggested there will be positive response to measures farmers already appreciate, however as mentioned in FGDs there is room and an appeal for further education and capacity building for productivity improving measures.

### 3.3. What are the key barriers preventing productivity improvements?

Farmers were asked about the barriers which prevented them from improving productivity (questions 3 and 7). Both low and high wealth groups (100% of groups) cited a lack of financial resources as one of the main barriers, for example:

- *"No financial resources to build housing for cattle"* (Low wealth FGD, Pire, Thies, 16.5.16)
- *"No money to access AI in private AI programs"* (Low wealth FGD, Thies, Thies, 04.5.16)
- *"No financial resources for health management"* (Low wealth FGD, Thies, Thies, 04.5.16)
- *"Financial constraints to buying certain breeds"* (Low wealth FGD, Missira, Diourbel, 12.5.16)
- *"No financial resources to provide adequate feed"* (Low wealth FGD, Pire, Thies, 16.5.16)

The next most frequently cited barrier was a lack of information and training, this was mentioned by a greater proportion of high wealth, than low wealth groups. Other commonly cited barriers included limited access to vets, low pasture quality, challenge in securing access to adequate areas of pasture, the access and high cost of desirable breeds and large herd sizes. The obstacles regarding veterinary care were referenced more by low wealth groups than high wealth, other themes showed no difference between low and high wealth groups. Other obstacles mentioned by a low number of groups included: the need for transhumance to access feed resource and limiting other inputs whilst on transhumance, the high cost and poor results of artificial insemination, competition for land between pastoralists and farmers. These results would suggest that farmers could improve productivity if measures were more affordable; however other barriers (such as effective access to natural resources and service providers) would also need to be overcome.

### 3.4. Specific productivity improvement measures

The focus groups further investigated attitudes to more specific measures (see Table 1).

**Table 1. Summarised results of FGD discussions around specific productivity improving measures.**

| Measures | Responses | Commonly cited barriers (ordered in frequency of reference) | Other barriers |
|---|---|---|---|
| **Improved and increased use of concentrate feeds** | All groups positive | • Limited financial resources<br>• High cost of concentrate feed<br>• Limited access to concentrate feed | • Increasingly less rain in the wet season leading to poor harvest yields<br>• Lack of materials or equipment<br>• Limited by space<br>• Limited access to credit<br>• Increased labour required |
| **Pasture improvement** | Majority of groups positive<br>Minority of groups - cattle housed so pasture not important | • Pastoralist/farmer land competition<br>• Other land competition<br>• Pasture damage by cattle<br>• Limited financial resources<br>• Land ownership/rights problems<br>• Bush fires<br>• Lack of state support<br>• Limited access to good seed | • Increasingly less rain in the wet season<br>• Soil degradation |
| **Improved and increased use of conserved feed** | All groups positive | • Lack of time<br>• Lack of materials or equipment<br>• Lack of storage facilities<br>• Limited financial resources<br>• Lack of knowledge and training<br>• Large herd size<br>• Lack of labour<br>• Poor pasture | • Limited access to pasture space<br>• Bush fires<br>• Transhumance |
| **Improved and increased forage treatment and processing** | Majority of groups positive<br>Minority of groups - lack of technical knowledge concerning the processing and treatment of forages | • Lack of knowledge and training<br>• Lack of materials or equipment<br>• Lack of time<br>• Lack of labour<br>• Large herd size<br>• Limited financial resources | • Limited access to resources<br>• Transhumance |

### 3.4.1. Financial resources

Despite finance providers existing in Senegal, with the purpose of modernising livestock production (e.g. FONSTAB[1]), the lack of financial resource was cited as a barrier for all the productivity improvement measures discussed. In the case of concentrate feed, the low wealth groups expressed a lack of financial resource more than high wealth; *'low income level of*

[1] http://www.ladoum.sn/generalites/fonstab-un-credit-adapte-a-l-elevage.html

*farmers does not allow them to buy feed to the quality and quantity required'* (Low wealth FGD, Mbacke, Diourbel, 11.5.16).

### 3.4.2. High cost of resources

*'The high cost of concentrate feed'* (High wealth FGD, Pire, Thies, 16.5.16) was commonly referenced as a barrier to its increased application. High wealth groups mentioned the high cost of resources, as opposed to the lack of financial resource, to a greater extent than low wealth groups.

### 3.4.3. Limited access to resources

The lack of access to resources was a commonly referenced barrier to the increased application of all the productivity improvement measures suggested to farmers. For concentrate feed and pasture improvement it was the lack of access to the resource itself, *'availability and proximity of feed, at times is a problem'* (High wealth FGD, Pire, Thies, 16.5.16), or seed for pasture improvement; whereas for forage conservation, treatment and processing it was a lack of access to equipment to carry out the processes. The lack of access to feed was seasonal, felt more in the dry season. There is also mention of poor harvests limiting the use of any homemade concentrates; this is likely to worsen with the expected influences of climate change (Jones & Thornton, 2009). Poor access to concentrate feed was felt equally amongst households from both Thies and Diourbel sites.

### 3.4.4. Land availability

Land availability was commonly cited as limiting to the improvement and effective utilisation of pasture, '*there are many new industries in the area* (e.g. transforming cassava into powder) *which limits grazing land space'* (Low wealth FGD, Pire, Thies, 16.5.16). Competition between pastoralists and arable farmers was the most commonly cited barrier (62% of groups) this is a common challenge experienced in SSA (Oosting et al., 2014), and is a difficult debate to conclude on with regards to food security goals. There was a feeling amongst study farmers that state support favours arable agriculture over livestock with regards to space; reviews have suggested this is true, particularly with political weight from large mono-crop producers and a historic emphasis on agricultural production (Gning, 2004, p.5).

### 3.4.5. Communally accessed land

Farmers comments suggest that the communal nature of pasture use is a constraint to their improvement; *'there are misunderstandings between farmers, so they struggle to improve communal pastures'* (Low wealth FGD, Pire, Thies, 16.5.16) and *'animals do not have a fixed route during transhumance, so other cattle can destroy pastures'* (Low wealth FGD, Touba Toul, Thies, 03.5.16). There is no incentive to improve pastures or their utilisation, whilst other farmers can exploit your efforts or cattle herding destroy improved pastures. For this reason, the improvement of natural pastures is an uncommon practice (Lo, M. personal communication, 29.4.16).

### 3.4.6. Time constraints

The lack of time to implement measures was a key barrier to both the increased conservation of forages and their treatment and processing. A key feature of this was time competition as the *'time for cultivation and preparation of forages coincides with the harvest season'* (Low wealth FGD, Mbacke, Diourbel, 11.5.16), the high seasonality of vegetation growth means labour is limiting due to the harvest of food crops for human consumption.

### 3.4.7. System characteristics

The act of transhumance, when cattle are herded greater distances to access pasture resources, limits the feasibility of increased use of conserved feeds or the processing and treatment of forages before feeding. Large herd sizes were also cited as a challenge to the use of feed conservation techniques and forage processing and treatment, *'because there are a lot of animals to feed'* (High wealth FGD, Kael, Diourbel, 10.5.16) *and 'herds are big, so difficult to feed'* (Low wealth FGD, Thies, Thies, 04.5.16). There were also comments concerning the quality of pastures limiting the feasibility of forage conservation, this indicates the importance of development being progressed as packages of measures, rather than standalone acts.

### 3.4.8. Knowledge and the need for training

The lack of understanding of how to implement certain measures and the need for relevant training was apparent as a limitation for feed conservation, processing and treatments; particularly amongst low wealth groups. There is however an understanding of the benefits of

investing in cross breeds and concentrate feed, this could be related to the involvement in the SDG project.

### 3.5. Agricultural productivity

A close link between livestock and cropping is common amongst SSA smallholders (Herrero et al., 2009); this was fully understood by study farmers, with all groups unanimously agreeing there is a close link between crop and cattle productivity. This link was based on the use of crop residues to feed cattle and the reciprocal use of manure to fertilise crop growth. There was also mention of the insurance cattle provide, should harvests fail; and the importance of draft power. All farmer groups agreed they would like to improve their crop yields to help improve cattle productivity. When farmers were asked how they would do this, common responses included: the increased use of manure as crop fertiliser, increased labour dedicated to cropping, the sale of livestock to access resources such as good seed, and more draft power. These results suggest that within these particular systems the link between livestock and cropping could be further integrated through increased draft power, effective manure application and resource utilisation.

When asked about the obstacles to making these improvements the responses were varied with no overly common themes. The *'lack of means to transport manure'* (High wealth FGD, Pire, Thies, 16.5.16) to use for fertiliser was the most commonly referenced. Space problems were also mentioned, with *'no space to store manure'* (High wealth FGD, Touba Toul, Thies, 03.5.16); as were the broad themes of need for financial resources and access to resources. A theme widely discussed was the security challenge of *'cattle theft making it difficult to keep animals on crop farms, meaning that manure had to be carried to crop farms'* (Low wealth FGD, Pire, Thies, 16.5.16).

### 3.6. Animal health

Health challenges represent a substantial burden to cattle productivity in developing regions (Perry & Grace, 2009; Perry & Sones, 2007). This was understood by focus groups participants, who all saw improving cattle health as a way of increasing productivity. The three most commonly cited health challenges were pasteurellosis, foot and mouth disease and

trypanosomiasis. There was no difference evident in the experience of low and high wealth households. Through an interview with a local practicing veterinarian, it was revealed that *'Pasteurellosis could be commonly misdiagnosed by the farmer, and could be symptoms of something else'* (Dr N'Diaye, personal communication, 7.5.16). From a veterinarian's perspective the three most problematic conditions for cattle productivity were lumpy skin disease, foot and mouth disease and trypanosomiasis (Dr N'Diaye, personal communication, 7.5.16).

The main barrier farmers mentioned, concerning improving the health of their cattle, was the difficulty of accessing vets. When the practicing veterinarian was asked about this, he responded: *'It is true there are not really enough vets for the number of farmers in the region, but cost is also prohibitive. The government used to provide vet services for free, but this has now stopped, with increasing budget cuts and privatisation. There are private vet services, but the farmers are not used to having to pay for the service.'* (Dr N'Diaye, personal communication, 7.5.16). The veterinarian also commented that the uptake of animal health improvement measure depends largely on the cost to farmers. *'The uptake by farmers to make change depends largely on cost, for example the foot and mouth vaccines are expensive, if they have to sell a cow to be able to afford the vaccine for other cows, they are unlikely to do this, it is hard to justify. Whereas the lumpy skin vaccine is much cheaper, so they are more likely to uptake this. To treat trypanosomiasis is fairly cheap, so it's common for farmers to use trypanocides'* (Dr N'Diaye, personal communication, 7.5.16)

### 3.7. Animal breeding

The genetic selection and cross breeding of cattle can improve production potential (Chagunda et al., 2015; Marshall et al., 2016), consequently there have been efforts in SSA to improve the resilient indigenous breeds, with the introduction of exotic breeds, with higher yields (Marshall et al., 2014; Menjo et al., 2009; Somda et al., 2005). When asked in the focus groups *"What are the characteristics of your animals that you would change?"* respondents cited increased milk production and increased body size, illustrating the multi-purpose of the cattle. A challenge when cross breeding that became apparent was the breeding of a zebu dam with an exotic sire, as the increased calf size can cause damage or death to the dam. For this reason, farmers also looked to *'pick breeds that calf easily; there is a high calf mortality and*

*female mortality with calving, particularly when cross breeding with larger breeds'* (Low wealth FGD, Touba Toul, Thies, 03.5.16). Artificial insemination and accessing desirable animals were the commonly referenced methods to improve herd characteristics. The obstacles to using these to make improvements included limited financial resources, expressed equally by low and high wealth groups. The high expense of AI was also expressed by low wealth groups, whilst both low and high had trouble accessing private and public AI services (the public AI service is a government program of fully subsidised AI). The lack of information regarding breeding options was also mentioned by both sets of groups. Less commonly referenced were the poor results of AI, *'we stopped inseminating because the results were not encouraging'* (Low wealth FGD, Touba Toul, Thies, 03.5.16) and access to desirable bulls. AI was discussed with the local practicing veterinarian, he commented that the government offer annual AI programmes to improve the genetics of herds, however this is very thinly spread across regions and declining with budget cuts. Others have suggested that the government AI is not fairly distributed (Gning, 2004, p.14). Private AI is available, but the cost and poor results make this unattractive to the farmers.

### 3.8. Other challenges

To conclude FGDs farmers were asked if anything had not been covered in the discussion. All groups commented that there was a significant problem with theft of cattle, with suggestion that there was a need to *'identify thieves at the level of the market and to reinforce police officers'* (Low wealth FGD, Missira, Diourbel, 12.5.16). Risk of cattle theft can be considered a strong disincentive for any improvements to cattle. A minority of groups mentioned seasonal oversupply of milk: *'Pire region produces a lot of milk, the price for milk is low* (400 FCFA). *This is noticed most in the wet season when the market is flooded and we see a price crash'* (Low wealth FGD, Pire, Thies, 16.5.16). A milk boom in the wet season, with empty markets in the dry season is also mentioned in the literature (Knips, 2006, p.33). Incentives to improve productivity may therefore be seasonal, with the challenge of maintaining productivity throughout the year. There was also an element of dissatisfaction with state support, with farmers mentioning state constraints. An example was given concerning the *Acacia albida* trees, which remain green all year and provide a vital last resort feed resource for cattle farmers. However, the act of cutting the branches to let the cattle feed is now controlled under conservation policies (Tebug, S., personal communication, 2016).

### 3.9. What does the future look like for these systems?

Senegal has seen the establishment of more intensive cattle systems around urban areas, and with greater investment and inputs a constant reliable supply of product is guaranteed (Knips, 2006, p.28,30; Yameogo et al., 2008). Stakeholders were asked what they thought the future was for the low input cattle systems investigated in this study. There was a common understanding that the emergence of more intensive systems was likely to continue to meet growing demand, and that the low input systems were unlikely to be competitive in the same markets. The practicing veterinarian stated that we are *"already seeing a decline in the more traditional smallholder systems. These are being replaced by more productive peri-urban higher systems"* (N'Diaye, 2016, personal communication, 7 May). The feed supplier nutritionist commented that *"there is a move towards more intensive/industrial systems, there is an increasing demand for milk, with larger processing customers, so these systems are growing to meet this. The processing customers want a consistent supply, so they can guarantee production. Smallholders cannot guarantee this consistent supply, so are at risk of missing this market. The future of dairy production is with larger groups as it is a good investment. There is a cultural challenge with the smallholders, who have it in their culture that they take their cattle out to graze poor dry pastures. They want to keep practicing this. There is a slow movement towards a realisation that they can improve productivity by keeping them indoors and feeding higher quality feeds"* (Konate, 2016, personal communication, 6 May). The view of smallholders having cultural and tradition challenges to productivity improvements was discussed further with Dr Tebug who had worked closely with the farmers during the SDG project, he confirmed there were cultural challenges with *'farmers taking time to change (maybe through generations). They discuss and say things are a good idea, but how many actually practice and improve is questionable'* (Tebug S. 2016, personal communication, 6 May). The lack of consistency of supply and competition with cheap imported milk powder (Gning, 2004, p.v) make low input systems unattractive to commercial customers (Knips, 2006, p.33). The intensive systems are better equipped to meet growing demands. However, efforts to increase the productivity of the systems under study are still relevant, firstly to assist in local food security. There are also examples of commercial viability of smallholder systems through a more collective approach to the market. Nestlé collected milk from pastoral regions through village cooling tanks and effective transport to

markets in urban areas, this ended in 2003, largely due to the seasonality of supply limiting Nestlé's return on investment (Knips, 2006, p.35). Laitière du Berger (Parisse, 2012) and other cooperatives and family businesses still source rural milk, process and sell to urban markets, they focus on branding of local produce as a higher quality than imports and effective distribution (Knips, 2006, p.34; Gning, 2004, p.v). The Senegalese ministry of employment has been keen to promote these small scale dairy units, and reduce reliance on milk imports (Knips, 2006, p.39).

# 4. Conclusion

## 4.1. What are farmers' attitudes towards improving productivity?

The discussion with farmers would suggest there is a willingness to improve the productivity of their herds. The majority reasoned that smaller, more productive herds would be easier to manage and require less investment. Those that wanted to retain large herds were motivated, in part, by the broader functions of cattle herds, i.e. in providing manure, draft power and conferring social status. Although this was a minority amongst farmers in the focus groups, the broader functions may be more important in the wider farmer population. The focus groups showed that the participants had broad awareness of how their productivity could be improved, and cited a wide range of measure for doing so. To some extent this could illustrate the success of training and information provided by the SDG project, to confirm these non-project farmers would need to be interviewed and their responses compared.

## 4.2. What are the key barriers preventing productivity improvements?

Barriers to making productivity improvements generally followed common themes: a lack of financial resource, the high cost of, and limited access to, resources, land use competition and conflicts, time and labour constraints, and the need for specific training and information. The focus groups did not reveal any significant differences in the experiences of low and high wealth groups. The variety of more specific challenges mentioned by groups suggests that barriers to improvements are complex and improving productivity may require the removal of multiple barriers.

### 4.3. What does the future look like for these systems?

It is likely that the low input systems will face increasing competition from more intensive developed systems for the growing urban milk market. The improvement of productivity in low input systems remains important for local consumption, the rural markets, and its development may be assisted via the further formation of co-operatives.

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## Appendix A – System Production Parameters

| Example breeds | Zebu Gobra or Zebu Maure | Zebu Gobra X Guzerat | Zebu Gobra X Holstein Friesian or Montbeliarde | Holstein Friesian or Montbeliarde (and crosses) |
|---|---|---|---|---|
| Lactation milk-offtake (litres)[1,2] | 307-899 | 408-907 | 931-1863 | 2251 |
| Annual milk-offtake (litres)[2] | 175-568 | 223-640 | 508-1315 | 1422 |
| Age at first calving (years) | 4.25-3.75 | 3.67 | 3.5 | 3.33 |
| Calving interval (years) | 1.79-1.5 | 1.79-1.5 | 1.79-1.5 | 1.5 |
| Age at culling (years) | 9 | 9 | 9 | 9 |
| Annual mortality rate males (rate) | 0.04 | 0.04 | 0.04 | 0.04 |
| Annual mortality rate females (rate) | 0.02 | 0.02 | 0.02 | 0.02 |
| Adult Female Average all cows 3+ (kg) | 294-317 | 302-309 | 333-414 | 433 |
| Adult Male Average all cows 3+ (kg) | 383-413 | 393-403 | 434-539 | 564 |
| Calves (birth weight) (kg) | 21-22 | 21-22 | 23-29 | 30 |
| [1] For 365 day lactation, averaged over parities; [2] Does not include milk suckled by calves | | | | |

# Appendix B – Focus Group Discussion Template

## Incentive to improve milk productivity

1. How important is it to you to increase your milk production?
   - *Very important - I would like to increase the milk productivity of my animals*
   - *Quite important – I would be interested in increasing the milk productivity of my animals*
   - *Not important - I would not be interested in increasing the milk productivity of my animals*
   - *Don't know*

2. What can you do to improve milk production of your animals?
3. What are the obstacles preventing you from practicing these previous actions?
4. Why do you not want to improve your milk production?

## Incentive to improve revenues from the sale of animals

5. How important is it for you to increase your income from the sale of animals?
   - *Very important - I would like to increase the revenues from the sale of animals*
   - *Quite important – I would be interested in increasing the revenues from the sale of animals*
   - *Not important - I would not be interested in increasing the revenues from the sale of animals*
   - *Don't know*

6. What can you do to improve your income from the sale of your animals?
7. What are the obstacles preventing you from practicing these previous actions?
8. Why do not you want to improve your revenue from sale of animals?

## Specific measures for increased production

### Feeding measures

9. Would you improve feed rations using concentrate feeds for your animals more than usual?
   - *Yes*
   - *No*
   - *No idea*
10. If yes, why you do not do?
11. If no, why?

12. Would you improve pastures (use and cultivation) for your animals?
   - *Yes*
   - *No*
   - *No idea*
13. If yes, why you do not do?
14. If no, why?

15. Would you improve conservation feed management (e.g. making silage or hay bales, etc ...)?
   - *Yes*
   - *No*
   - *No idea*
16. If yes, why you do not do?
17. If no, why?

18. Would you like to improve forage management (treatment of straw or chopping of grass)?
   - *Yes*

- *No*
- *No idea*

19. If yes, why you do not do?
20. If no, why?

**Animal health**

21. How important is it to improve animal health to increase productivity of livestock?
    - *Very important - I would like to improve the health of my animals*
    - *Quite important – I would be interested in improving the health of my animals*
    - *Not import0ant - I would not be interested in improving the health of my animals*
    - *Don't know*

22. What are the most frequent diseases on your cattle farms?
23. What are the three most detrimental diseases to the production of your animals?

**Improving genetics and breeding**

24. What are the characteristics of your animals that you would change?
25. How would you do this?
26. What prevents you from doing so?

**Other management**

27. Would you be interested in producing the same output with fewer animals?
28. If yes, why?
29. If no, why?

30. Is there a relationship between your crop and animal production?
31. If yes, why?
32. If no, why?

33. How important is the contribution of improving crop yields in improving animal productivity?
    - *Very important - I would like to improve my crop yields*
    - *Quite important – I would be interested in improving my crop yields*
    - *Not important - I would not be interested in improving my crop yields*
    - *Don't know*

34. How would you improve agricultural production?
35. What prevents you from doing so?

## Final question

36. Have we missed anything that is important to contributing to improving livestock production?