Full Length Research

Smallholder cattle production systems in Metekel zone, northwest Ethiopia

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A cross-sectional survey was conducted in Metekel zone, Benishangul Gumuz National Regional State, Northwest of Ethiopia to assess livestock production system, productive and reproductive performance of cattle and identify constraints to livestock. Stratified random sampling technique was used to select 160 farming households and administer a pre-tested and structured questionnaire. The study showed that mixed crop-livestock production system was the dominant farming system in the study area. The average landholding per household was 2.12±0.15 ha. The average livestock holding per household was 13.99±1.08 cattle, 11.37±1.37 goats, 6.14±1.06 sheep, 1.13±0.09 mule, 1.50±0.14 donkey, and 8.45±0.54 chickens, respectively. The major feed resources were natural pasture, crop residue, conserved hay from natural pasture, stubble grazing, and non-conventional feeds. The average milk productions per cow per day during wet and dry seasons were 1.78±0.97 and 0.88±0.56 liters, respectively. Average age at first calving, calving interval and lactation length were reported to be 46.06±13.99, 23.38±13.95 and 9.81±3.91 months, respectively. Respondents revealed feed shortage, disease prevalence mainly bovine trypanosomiasis, lack of capital, water and labor scarcity as major livestock constraints in that order of importance. Thus, intervention options should aim to alleviate the prevailing constraints to smallholder livestock production in the area.

Key words: Cattle production systems, Metekel, Ethiopia.

INTRODUCTION

More than 80% of the Ethiopian population is dependent on agriculture which contributes 45% of the country’s Gross Domestic Product (GDP) and more than 90% of the export earnings (MOA, 2010). Livestock contributes 30-35% of the agricultural GDP and more than 85% farm cash income of smallholders (Befekadu and Berhanu, 2000). Livestock have diverse functions in the livelihood of Ethiopian farmers in the various farming system (Ehui et al., 1998; Belete et al., 2010) and serves as a source of food, traction, manure, row materials, investment, cash income, foreign exchange earnings and social and cultural identity.

Ethiopia has the largest livestock population in Africa estimated at about 70.79 million head of cattle, 28.48 million sheep, 25.91 million goats, 24.56 million donkeys, 11.39 million horses, 8.08 million mules, 8.39 million camels, 42.51 million poultry and 71.62 million beehives (CSA, 2010/2011). Despite the significantly large livestock population, its contribution to the national economy is below the potential due to various factors including, feed shortage, poor genetic potential for productive traits, poor health care and management practices (Zegeye, 2003).

In the highland agro-ecology of the country where crop-livestock system dominates, livestock is an essential component of the overall farming system and contributes up to 87% of the cash income of smallholders (NABC, 2010). In the pastoral and agro pastoral areas, livelihoods of the people entirely depend on livestock (Birhan, 2013). As in the other parts of the country, farming system of Benishangul Gumuz National Regional State is dominated by mixed crop-livestock production, and 55% of the livestock population of the region exists in

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Metekel zone (WBISPP, 2003). According to Negassa et al. (2011), in smallholder mixed farming systems, livestock provides nutritious food, additional emergency and cash income, a means of transportation, farm outputs and inputs, and fuels for cooking. Although livestock plays a significant role in the livelihood of smallholder farmers in the study area, there is limited information on livestock production system, productive and reproductive performance of cattle, and constraints to livestock production have not been identified. Characterization of the production systems and understanding the socio-economic implications would help to design appropriate development interventions in the study area. Thus, objective of the study was to assess livestock production systems, productive and reproductive performance of cattle and to identify constraints to livestock production in general.

MATERIALS AND METHODS

The study area and sampling procedure

The study was conducted in Metekel zone of Benishangul Gumuz Regional State, Northwest Ethiopia. About 80% of the zone is characterized by having sub-humid and humid tropical climate. The topography of the zone presents undulating hills slightly sloping down to low land Plateaus having an altitude range from 600-2800 meter above sea level. The surrounding of Metekel zone has a wide climatic range varied from hot to warm moist lowlands (M1) and hot to warm sub humid lowlands (SH1) (Engda, 2000).

To obtain the sample households, a three stage stratified sampling technique was employed. First, based on altitude, land use system, district's situation in representing the zone, ethnic group and socio-cultural setting and ease of accessibility, four districts namely Guba (700 masl), Pawe (1120 masl), Dibate (1200 masl), and Wombera (2400 masl) were chosen for the study. From each district 5 Villages or Kebeles were chosen at random. From each village or Kebele 8 households were randomly chosen to reflect the existing tribal settlements giving a total of 40 households per district.

Data collection and analytical techniques

Data were collected using multiple subject formal survey using a pre-tested, structured questionnaire. The data collected include: socio-economic characteristics, landholding and land use pattern, livestock composition, feed resources and feeding systems, breeding system, milking practices, housing and housing system, production and reproductive performance of cattle and constraints to livestock production. The data was analyzed statistically using Statistical Package for Social Sciences (SPSS) software, version 20.

RESULTS AND DISCUSSION

Socio-economic characteristics and respondents profile

The interviewed households were from Amhara (34.5%), Gumuz (23.2%), Shinasha (15.5%), Oromo (18.3%) and others (8.5%) like Kemebata, Agew, Wolayita and Hadiya nationality. Results showed that from the total of 160 households interviewed 82.5% were males and 17.5% were females. The average age of the respondents was 43.20±1.00 years. The mean family size was 4.03 members per household. Overall, 51.9% of the households were followers of the Orthodox Christian church and the rest 31.3, 4.4 and 12.5% were Muslims, Protestants and other religion followers, respectively. Out of the total household members found in the 160 interviewed households, 29.64 and 13.6% of the households had primary and secondary school and above education, respectively. The rest 39.41% of the household members had no formal education and 17.59% could read and write.

The overall average landholding per household was 2.12±0.15 ha, which is higher than the national average of 1.02 ha (EEA, 2002). The result in this study is comparable with the report of Duguma et al. (2012) and Zelalem (1999) who reported 2.5 and 2.4 ha of landholding per household in Dandi district and Sellale areas of central Ethiopia, respectively. The proportion of land allocated for crop production and grazing was 76.12 and 18.7% of the total farm size respectively, indicating the major proportion of land owned by the households was used for crop production. The remaining 2.12% of the land is occupied by trees/fruits and living quarters.

Farming system

The results of the study showed that the respondents' entire are occupied in agricultural activities dominated by mixed crop-livestock production, which accounts 96.2% of the farmers and the rest 3.8% were involved only in livestock production. Livestock production is an important component of the mixed farming system. Livestock are kept as sources of draft power; milk, meat, skin and hides, and they are also the main sources of income and are closely linked to the social and cultural lives of the community. Type of crops grown in the study area vary with the agro-ecological zone and includes cereals (maize, sorghum, finger millet, wheat and teff), oil crops (sesame, Niger seed and groundnuts), pulses (mainly haricot beans and soya beans), vegetables, fruits (mainly mango and papaya) and root crops (mainly potato and sweet potato). Due to resource limitation, smallholder
farmers manage farm household with several objectives and several activities (Anandajayasekeram et al., 2008). Furthermore, in mixed crop/livestock farming system, due to strong interdependence of crop and livestock, neither crop nor livestock productivity be increased without careful consideration of the interaction in between (Hart and McDowell, 1985).

Livestock composition

Livestock composition per household by districts surveyed is shown in Table 1. Cattle were the dominant species reared by the respondents, and they are used primarily for draught purposes (traction) (72.1%), while small ruminants and chickens are used to generate income and meat production for household consumption. The overall average household cattle composition was 2.88±0.18 oxen, 4.10±0.28 cows, 2.76±0.25 bulls, 3.09±0.28 heifers, and 3.09±0.20 calves, respectively. There was no significant variation in cattle holding between the districts. The relative proportion of oxen in the total cattle holding indicates their major importance in draught power in the study area, mainly by non-Gumuz farmers. In smallholder crop-livestock system of Ethiopia, the importance of keeping cattle is also highly related with oxen use for draught purpose (Sansoucy et al., 1995; Negassa et al., 2011).

In the study area, almost all of the cows owned by the households were reared on farm, whereas oxen used for draught purpose were 27.4% home reared, 31.5% purchased and 41.1% both home reared and purchased. Most of the farmers sell their oxen when they reach average age of 7.3±2.4 years and replace them with younger ones by purchasing from market and neighboring farmers. A study by Negassa et al. (2011) also indicated that in majority of smallholders and pastoralists, building and maintaining cattle herd size through births from the current herd is much more important than market purchase.

Feed resources and feeding practices

Most of the feeding requirements of all types of livestock were met by natural pasture grazing, crop residue, conserved hay from natural pasture, stubble grazing, and non-conventional feeds like local beer byproduct “Attela” (Table 2). Natural pasture was the major feed resource in the study area. Grazing and browsing account for nearly 91% of feed supply of Metekel zone livestock (WBISPP, 2003). Results showed that respondents were supplementing milking cows (50.7%) and calves up to 3 months of age (83.9%) with crop residues, hay from natural pasture and local beer byproduct “Attela”. This result is in agreement with the report of Seyoum et al. (2001) in the highlands of Ethiopia and Duguma et al. (2012) in Dandi district of central Ethiopia.

Overall, 81.2% the farmers reported a decrease in grazing area in the past ten years because of the practice of converting grazing lands to crop fields which is driven by the ever increasing human population. A study by Firew and Getenet (2010) also indicated that in Amhara National Regional State of Ethiopia the feed supply of the natural pasture is decreasing for the same reasons. Critical months of feed shortage were also reported to be between March and May (51.8%), and January and May (49.2%). The major coping mechanism of feed shortage by Guba farmers is sending their animals to the lowlands where there is more feed resource, whereas farmers from Wombera, Dibate and Pawe districts were preserving some feed from crop residues and hay from the natural pasture. Results also showed that 95% of the households did not practice cultivation of improved forage species

### Table 1. Average (Mean ±SE) number of livestock owned per household in four districts of Metekel zone, Ethiopia (n=160)

<table>
<thead>
<tr>
<th>Category</th>
<th>Pawe</th>
<th>Dibate</th>
<th>Wombera</th>
<th>Guba</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>12.05±3.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>14.38±1.86&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15.11±1.51&lt;sup&gt;a&lt;/sup&gt;</td>
<td>14.59±1.74&lt;sup&gt;a&lt;/sup&gt;</td>
<td>13.99±1.08&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Oxen</td>
<td>3.22±0.51&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.95±0.27&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.98±0.25&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.09±0.25&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.88±0.18&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cows</td>
<td>3.43±0.79&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.56±0.44&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.05±0.41&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.30±0.53&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.10±0.28&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Bulls</td>
<td>2.50±0.92&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.47±0.28&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.69±0.28&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.46±0.57&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.76±0.25&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Heifers</td>
<td>3.32±1.13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.83±0.36&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.03±0.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.30±0.45&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.09±0.28&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Calves</td>
<td>2.55±0.46&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.75±0.41&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.16±0.26&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.83±0.45&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.09±0.20&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Goats</td>
<td>3.50±0.87&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.88±2.15&lt;sup&gt;b&lt;/sup&gt;</td>
<td>9.00±3.49&lt;sup&gt;b&lt;/sup&gt;</td>
<td>14.68±2.08&lt;sup&gt;c&lt;/sup&gt;</td>
<td>11.37±1.37&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sheep</td>
<td>3.38±0.90&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.00±2.00&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.44±0.67&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.33±3.43&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.14±1.06&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Horse</td>
<td>-</td>
<td>1.00±1.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.00±1.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-</td>
<td>2.00±1.00&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Mule</td>
<td>1.67±0.33&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.00±0.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.00±0.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.00±0.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.13±0.09&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Donkey</td>
<td>1.50±0.29&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.67±0.33&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.24±0.14&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.71±0.32&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.50±0.14&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Chickens</td>
<td>7.77±0.96&lt;sup&gt;a&lt;/sup&gt;</td>
<td>10.68±0.92&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.67±0.83&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.00±1.31&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.45±0.54&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Means within the same row with different superscripts are significantly different (P<0.05); n= number of respondents.
due to scarcity of land, forage seed and labour (Table 2). Regarding introduction of improved forage species and management practices in the study area, the Ethiopian Institute of Agricultural Research (EIAR), Pawe Research Center has developed and still developing various feed technologies (Agza et al., 2012, 2013).

Breeding system and other management practices

Farmers (100%) in the study area use natural mating system to inseminate their cows. The respondents expressed their interest towards having improved breeds; however they doubt their adaptability to the environmental conditions especially in relation to disease prevalence and availability of feeds. In the study area, except the Gumuz farmers all the respondents practice milking. Prior to milking, farmers stimulate milk let-down by letting the calves to suckle their dam for about two minutes. Milking is done twice a day, early morning and evenings. All the respondents use hand milking system. Milk collection is done by traditional or plastic containers after washed with water and smoked with some wood and herbs to give a distinct flavor to the milk.

Making shelter for cattle is not a usual practice in the study area, however farmers (90.4%) were found to separate calves from the flock and provide day and night shelters during dry and rainy seasons. The result in the study revealed that family labour was the major source of labour for livestock management. However when family labour is in short supply during cropping and harvesting and children attend school, hired labour is responsible for livestock herding and watering. During rainy season, herding and watering was done 52.7, 41.7 and 6.3% by children, hired labour and household head, respectively. Whereas, during dry season, herding was done 47.6, 39.3 and 13.1% by hired labour, children and hired labour, and household head, respectively.

Productive and reproductive performance of cattle

Age at First Calving (AFC) and Calving Interval (CI)

In the present study, the overall mean AFC and CI were 46.06±13.99 and 23.38±13.95 months, respectively. Both AFC and CI showed significant statistical variation among districts (Table 3). The highest mean AFC was observed in Wombera (59.38±14.62 months) followed by Dibate (45.48±8.0 months) and Pawe (45.08±11.10 months), and the lowest in Guba (33.95±7.93 months). Variation of AFC among districts might be due to feed availability, breed and management status. The mean AFC in this study is in agreement with that of Kassa and Arnanson (1986) who reported a mean AFC of 41.5 (ranged 24.3 to 63.4) months for indigenous Boran cows. Duguma et al. (2012) also reported mean AFC of 50.59±6.94 months for indigenous cows in Dandi district of central Ethiopia. The average CI in this study is lower than reported by Mugerwa et al. (1989) who reported an average CI of 26 months for indigenous cattle in central Ethiopia.

Lactation length and milk production

Overall, average lactation length was reported to be 9.81±3.91 months. The overall average milk productions per cow per day during wet season (June to October) and dry season (November to May) were 1.78±0.97 and 0.88±0.56 liters, respectively. Average lactation length showed significant variation between the districts. The daily milk yield recorded in Wombera district was significantly lower than the other districts (Table 3). The overall mean lactation length and mean daily milk

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Districts (n=40/district)</th>
<th>Overall (n=160)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed types</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural pasture grazing</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Hay made from natural pasture</td>
<td>71.80</td>
<td>35.0</td>
</tr>
<tr>
<td>Stable grazing</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Crop residues</td>
<td>65.0</td>
<td>95.0</td>
</tr>
<tr>
<td>Local beer byproduct “Attela”</td>
<td>50.0</td>
<td>90.0</td>
</tr>
<tr>
<td>Improved forage practice</td>
<td>Farmers not practicing</td>
<td>95.6</td>
</tr>
<tr>
<td>Reason for not practicing improved forage</td>
<td>Scarcity of land</td>
<td>61.5</td>
</tr>
<tr>
<td></td>
<td>Scarcity of labour</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Scarcity of seed</td>
<td>30.8</td>
</tr>
<tr>
<td></td>
<td>Both scarcity of land and labour</td>
<td>7.7</td>
</tr>
</tbody>
</table>
Table 3. Average productive and reproductive performance (month) of cattle in four districts of Metekel zone, Ethiopia.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Pawe</th>
<th>Dibate</th>
<th>Wombera</th>
<th>Guba</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at first calving</td>
<td>45.08±11.10a</td>
<td>45.48±8.0ab</td>
<td>59.38±14.62b</td>
<td>33.95±7.93c</td>
<td>46.06±13.99</td>
</tr>
<tr>
<td>Calving interval</td>
<td>22.03±10.26a</td>
<td>26.91±8.15b</td>
<td>28.00±8.39b</td>
<td>17.84±8.07ac</td>
<td>23.38±9.60</td>
</tr>
<tr>
<td>Weaning age of calves</td>
<td>14.37±6.41a</td>
<td>13.94±5.83a</td>
<td>17.00±7.79b</td>
<td>11.04±3.69c</td>
<td>13.95±6.32</td>
</tr>
<tr>
<td>Lactation length</td>
<td>10.28±3.96ab</td>
<td>11.05±2.95a</td>
<td>9.58±3.82b</td>
<td>7.90±4.43c</td>
<td>9.81±3.91</td>
</tr>
<tr>
<td>Milk Yield in wet* season (lit/ cow/ day)**</td>
<td>2.08±0.98a</td>
<td>1.84±0.96a</td>
<td>1.08±0.50b</td>
<td>2.36±0.96a</td>
<td>1.78±0.97</td>
</tr>
<tr>
<td>Milk Yield in dry*season (lit/ cow/ day)**</td>
<td>1.12±0.59a</td>
<td>0.87±0.50a</td>
<td>0.52±0.28b</td>
<td>1.36±0.69a</td>
<td>0.88±0.56</td>
</tr>
</tbody>
</table>

Means within the same row with different superscripts are significantly different (P<0.05); 1=Productivity estimates were based on the assessment of the interviewee; *Wet season is from June to October, and dry season is November to May; **= average milk yield above calf off-take.

Figure 1. Frequency ranking of major constraints to livestock production as identified by farmers (n=160) in four districts of Metekel zone, Ethiopia.

production found in this study was higher than the report of CSA (1996), which is 5 to 7 months of mean lactation length. However the result in this study is consistent with the reports of Zelalem (1999) and Duguma et al. (2012), who reported average lactation length of 11.33 and 8.96±4.63 months, respectively. Duguma et al. (2012) also reported a mean daily milk production of 1.76±0.89 liters per cow for indigenous cows in Dandi district of central Ethiopia.

Constraints on livestock production

Feed shortage during the dry season and disease, mainly trypanosomiasis to cattle were the major constraints of livestock production in all areas surveyed. Other constraints included lack of capital, water and labor scarcity (Figure 1). Constraints to smallholder livestock production are caused by both natural and man-made factors, which are interrelated with each other affecting livestock productivity (Tesfaye et al., 2002). According to Azga et al. (2013), seasonality in availability of quality and quantity forage and absence of improved forage production practice to supplement the feed shortage has been a major constraint for livestock production in the study area. Moreover, in the past few years, expansion of crop production and increase in livestock number are considerably adding the feed shortage in the study area (Fetsum et al., 2009).

In lowlands of Metekel zone, trypanosomiasis is found to cause substantial economic loss through cattle mortality, drug purchase and draft power loss (Tesfaye et al., 2012). A study by PATTEC (2001) also indicated that in the tsetse infested areas of Africa, from 50 million cattle population which are already at risk, about 3 million cattle die every year due to trypanosomiasis. In general, smallholder farmers are facing challenges to increase the quantity and qualities of animals rose for market, and
obtain significant off-take both in terms of quantity and quality (Negassa et al., 2011).

Conclusion and recommendation

The results of the present study shows that livestock particularly cattle plays a significant role in the livelihood of the farming community of Metekel zone. In the study area, milk production and reproductive performance of cattle is generally low, and making shelter for cattle is not a usual practice. Feed shortage mainly caused by lack of feed conservation practices followed by bovine trypanosomiasis was the major constraint of livestock production. Other constraints included lack of capital, water and labor scarcity. Together, these factors resulted in low level of productivity and decreased the direct benefit of the farmers. To alleviate the prevailing constraints and bring a sustainable development to the smallholder livestock production, intervention options need to base on the production systems, and identify and prioritize constraints in the study area.

ACKNOWLEDGMENTS

The authors thank district's agriculture office experts and key informants of the community in the study area for understanding and passing the purpose of the project to the subordinates down to livestock farmers to the Kebele level. The authors are also grateful to the interviewed farmers for their active participation in sharing their knowledge and time.

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