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Agricultural production and productivity constraints and opportunities in Dasenech and Nyagatom districts of South Omo Zone, Ethiopia

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The economy of the South Omo Zone heavily relies on livestock and crop production, but there are multiple challenges and constraints that are affecting these sectors. It is important to identify these issues at the grassroots level because the approach of delivering agricultural technologies from the top-down is not effective. This study was conducted to assess agricultural production and productivity constraints and opportunities in the Dasenech and Nyagatom districts of Ethiopia. To achieve the intended purpose, one Kebele was chosen from each district, and one pastoral and agro-pastoral research and extension group (PAPREG), which consisted of about 25 agro-pastoralists (15 males and ten females) was formed after conducting a community meeting. The existing crop varieties, productivity per hectare, prevailing agronomic practices, existing livestock breeds, livestock feed bases, animal husbandry system, agricultural technological demands and crop and livestock production constraints, and opportunities were important issues forwarded to PAPREG members. The results showed that a shortage of improved crop varieties and gasoline was ranked first and second in both districts, while drought was ranked third in Dasenech and sixth in Nyagatom district. Crop diseases and pests were ranked fifth in both districts, and a lack of awareness of improved agronomic practices was ranked

third in Nyagatom and sixth in Dasench district. The agro-pastoralists in both districts were ranked feed shortages, animal disease and parasite prevalence, and limited access to veterinary services as first, second and third, respectively. In Dasench, the lack of improved breed and forage seeds was ranked fourth, while in Nyagatom, it was fifth. The Dasenech pastoralists strongly preferred cultivating improved Panicum grass, whereas the Nygatom preferred cultivating improved sorghum. The availability of fertile farmland and the sustainable Omo River present important opportunities for small-scale producers and investors. Based on the findings, efforts should be made to boost agricultural production and productivity by introducing improved crop and forage varieties, managing diseases and pests, improving indigenous breeds, strengthening veterinary drug supply services, developing improved forage banking systems, and providing capacity-building services.

Key words: *agriculture, agro-pastoralists, production, productivity, constraints, opportunities*

INTRODUCTION

The agricultural sector in Ethiopia contributes to about 42% of the country's GDP, 85% of its export revenue, and 80% of its employment opportunities. According to Dharmasiri (2009) and ATA (2017), agricultural productivity is determined by the output-input ratio and the sector plays a crucial role in providing raw materials and generating foreign currency to import necessary inputs and food for the increasing population. The agricultural production system in Ethiopia is mainly based on traditional farming methods, yet it is still a leading producer of various agricultural goods in Africa. Despite using traditional methods, Ethiopia ranks first in Africa and fifth in the world for coffee production, and also the top producer of honey and has a significant cattle population (Abdissa et al., 2017). In rural Ethiopia, agriculture plays a crucial role in reducing poverty, and the government plans to showcase various agricultural technologies and innovations to improve productivity and output (Abdissa et al., 2017). However, many research works have been conducted on the demonstration of best agricultural technologies by governmental and non-governmental organizations indicated that the agricultural technological adoption rate by smallholders is very low. According to a study conducted by Shita et al., 2018 indicated that less than 10% of the crop land in the country is occupied by improved seed with irrigation, and 20% of the land is affected by crop disease and pesticides. Moreover, the meat productivity in Ethiopia is approximately 25-30% lower than in other East African countries (143 kg/head), the continental average (156 kg/head), and the global average (212 kg/head) (Ritchie, 2019 & Abebe et al., 2022). Despite the availability of advanced agricultural technologies that increase productivity and production, smallholder agriculture innovations have not met the short-term goal of transformation due to various reasons (MoFED, 2016).

The South Omo Zone is one of the arid and semi-arid regions of the South Nations Nationality and Peoples Regional State. Pastoralism is a way of life that extensively relies only on cattle production, while agro-pastoralism is characterized by the dominance of livestock husbandry and limited crop production practice are the main agricultural production system prevailed in the studied areas (Adicha et al., 2022 & Hidosa et al., 2022). The Zone has approximately 297,486 pastoral and agro-pastoral people inhabiting the omo river valley, keeping a large number of cattle, sheep, and goats (Adicha et al., 2021 & Zelalem et al., 2021). From the South Omo Zone, the pastoral and agro-pastoral districts possess about 3,776, 027, and 3, 265,321, cattle and shoat populations (CSA, 2017). As reported by different scholars, pastoral and agro-pastoral communities of South Omo have been facing chronic food and feed security problems despite having a large livestock population (Salo et al., 2017; Asmera & Yidnekachew, 2021; Mekuyie & Mulu, 2021; Hidosa et al., 2022). The productivity improvement of livestock and

crop can be accomplished through the various coordinated action of numerous developmental organizations, as well as the functions and responsibilities. However, in the past decade, researchers and extension organizations have worked very hard to develop enhanced agricultural productivity and convey them to customers with top-to-bottom approaches, while the planned outcome and output are not successfully achieved (Almekinders & Elings, 2001). Also, the other problem that the end-user of agricultural technologies has challenged is the lack of information-gathering systems from the farming communities at the grassroots level to identify the technological requirements. Thus, this study was conducted to assess agricultural production and productivity constraints and opportunities in Dasenech and Nyagatom districts of the South Omo Zone in order to design a better research agenda and plan for further research implementation.

MATERIALS AND METHODS

Study area description

Dasenech and Nyanghtom are one of the ten districts of the South Omo Zone. Both districts have been located at the Lower Omo Valley of the South Omo Zone and are boarded in North by the Bench Maji zone and Salamago districts and to the West by Kenya and South Sudan. The total human population of the Dasenech and Nyanghtom districts is 70, 466 and 22, 562, respectively (CSA, 2021). The study districts have high irrigation water potential from the Omo River and have produces major cereal crops like sorghum and, maize, and improved forage like Panicum grass (Hidosa et al., 2022). The main livelihood sources for the districts are extensive pasture-based livestock production including fishing from the Omo River.

Study team composition

The study used a participatory research approach to collect field-level data from two districts of South Omo Zone in September, 2022. A team of researchers participated in the data collection from different disciplines such as agricultural economics, livestock research and Low Land Resilient Project (LLRP).

Source and data collections tools

Primary and secondary data were gathered, with the primary data coming from agro-pastoralists and agricultural experts. The methods used for data collection included observing agricultural technologies and the approaches of organizations towards beneficiaries, as well as using focus group guide questions and conducting key informant interviews. In addition, secondary data was collected through the review of project documents and reports on crop and livestock production constraints and opportunities in each study district.

Questioner preparation

The checklist was prepared to guide focus group discussions and the key informants' interviews. The checklist aimed at generating relevant information on the potential commodities crop, livestock and natural resource management related production constraints.

Focus groups discussions (FGDs)

In order to select Kebeles for the data collection, discussions were made with the district administrative bodies (heads of crop and livestock offices) and a list of the available Kebeles in the respective districts were mentioned by district administrative bodies and one Kebele per

district was purposely selected based on livestock and crop production potential and experiences. Accordingly, Arsamoyi from the Dasench and Napitokoyit from the Nyagatom were selected to identify the agricultural production and productivity constraints and an opportunity. Then the Kebele level community sensitization was conducted in order to identify the most experience agro-pastoralists who have better knowledge to list and prioritize the agricultural production and productivity related constraints and opportunities. Accordingly, after a community level meeting, about 25 agro-pastoralists (15-male and 10-women) were selected and organized into pastoral and agro-pastoral research and extension groups (PAPREG).

The FGD was made with selected PAPREG members. The important agricultural production and productivity related issues such as major types of crop technologies (improved/local variety) grown, productivity per hectare, and crop production constraints (Availability of crop technologies, crop diseases and pests, post-harvest and handling practices and crop marketing relating issues, etc.), cattle breeds, livestock feed bases, livestock husbandry practices, animal health and veterinary drugs, livestock marketing situation and overall existed technological demands, production constraints and an opportunities were important points forwarded to PAPREG members during the FGDs.

Figure 1. KII with district experts and Kebele Elders

Figure 2. Community-level problem analysis and FGD with selected PAPREGS members

Key informants interview (KII)

A total of 8 agricultural production experts (4 experts from the livestock and four from the crop and natural resource management disciplines) participated during a Key-informants interview. Also, the important agricultural production and productivity related issues such as major types of crop technologies prevailed in the farming situation, major crop and animal production constraints were important points forwarded to experts during the KII(Figure 1&2).

Data analysis

Collected data were analyzed using descriptive statistics and a narrative approach. The primary and secondary data gathered from different sources were triangulated and analyzed to be the basis for this report.

RESULTS AND DISCUSSION

Crop production constraints

The primary crop cultivation practice in the Dasench and Nyagatom districts relies on water from the Omo River. The agro-pastoralists use furrow irrigation and flood retreat to grow cereal crops like sorghum (*Sorghum bicolor*) and maize (*Zea mays*), as well as root crop (Onion) and fruit crops like banana (*Musa Paradisiaca*) and papaya (*Carica papaya*).

Table 1. Ranks of crop production constraints in the Dasenech and Nyagatom districts in 2022

Major agricultural production constraints	IV	AP	BA	ES	DR	ER	Score	Rank
Dasenech district								
Lack of Improved variety (IV)	---	IV	IV	IV	IV	IV	5	1
Lack of awareness to improved agronomic practice (AP)		---	BA	DR	DR	ER	0	6
Bird attack (BA)			---	ES	BA	ER	2	4
Disease and pest (ES)				---	DR	ER	1	5
Drought (DR)					---	ER	3	3
Shortage of gasoline to pump water (ER)						---	4	2
Nyagatom district								
Lack of Improved variety (IV)	--	IV	IV	IV	IV	IV	5	1
Lack of awareness of improved agronomic practice (AP)		---	BA	AP	AP	ER	2	3
Bird attack (BA)			---	ES	BA	ER	2	4
Disease and pest (ES)				---	DR	ER	1	5
Drought (DR)					---	ER	1	6
Shortage of gasoline to pump water (ER)						---	4	2

Agro-pastoralists of both districts were mainly use raw planting and occasionally broadcasting practices, and the cropping season depends on irrigation access during autumn or "Belig"in Ethiopia, and summer or "Mehere" in Ethiopia. However, agro-pastoralists of studied districts have faced several challenges in crop production, including drought, bird attacks, crop diseases, a lack of improved agronomic practices, weak extension support, a shortage of gasoline to pump water, and limited access to improved crop seeds (Table 1). According to agro-pastoralists rank, a lack of improved crop variety and shortage of gasoline to pump irrigation water from Omo River to farm was ranked as the top two constraints in both studied districts, while the frequent occurrence of drought is ranked as 3rd constraint in Dasenech district but it was ranked as 6th in Nyagatom district, which is a demonstrated that the Nyagam district less affected by drought than Dasenech district.

The occurrence of crop diseases and pests was ranked as 5th in both districts, while a lack of awareness on improved agronomic practice is ranked 3rd in Nyagatom, but it was ranked as 6th in the Dasench, which showed that capacity building program related to improved agronomic practices is more needed in the Nyagatom district than Dasenech district. Additionally, agro-pastoralists expressed a strong demand for improved seed supply and agricultural tools to boost crop production. Similarly, the studies found that poor soil fertility, severe land degradation, high dependence on rainfall, low availability and as well as poor quality of seeds and fertilizers were major constraints to crop production in South Omo Zone and other parts of Ethiopia (Njeru et al., 2016; Gezie & Tejada, 2019; Zerssa et al., 2021; Adicha et al., 2022).

Livestock production constraints

The respondents of the FGDs reported that the livestock categories being reared in the Dasenech and Nyagatom districts include local cattle, sheep, goat, poultry, and donkey. Almost all of livestock breeds were indigenous except the only a few improved cattle breed like Borana heifers and bulls that were recently introduced by governmental and NGO organizations. Similarly, the studies that were reported earlier have confirmed that South Omo's pastoral and agro-pastoral communities have raised the almost local breed of cattle, goats, sheep, poultry and donkeys (Terefe et al., 2015; Zelalem et al., 2021; Hidosa et al., 2022). Pastoralists have reported that they use Kraals as a housing system for their ruminant animals around their homes, which are constructed from locally available materials to protect their animals from predators and enemies. The findings of the present study align with the reports of Tewodros (2008) and Zelalem et al. (2021), who stated that in Borena and South Omo Zone of Southern Ethiopia, respectively, the majority of pastoralists (94.70% and 86.70%) housed their cattle in open constructed barns (Kraals) at night.

Respondents reported that natural pasture, communal grazing and browsing, and crop residues were the main feed sources for animals in both districts. They also mentioned that there were major feed shortages between December and February, caused by a lack of grass in natural grazing areas. The findings of this study are in agreement with those of previous research conducted in pastoral areas like Mursi, Bena-Tsemay, Hamer, Malle, and Dassench, which showed that natural pastures consisting of pasture grasses, legumes, and shrubs are the primary source of feed for livestock (Terefe et al., 2015; Hidosa et al., 2017; Hidosa & Tesfaye, 2018; Zelalem et al., 2021). However, while the production of improved Panicum grass began in 2018 and is expanding to all Kebeles in Dasenech district, it has not been widely adopted in Nyagatom district due to inadequate training and poor extension services. In Dasench district, 28 Kebeles are involved in producing improved Panicum grass for feed and income through irrigation schemes, whereas other improved forage species are less popular among agro-pastoralists in both districts.

Additionally, a study conducted by Tolera & Hidosa (2023) revealed that a majority of smallholder farmers in Jinka town (67.7%) had not embraced the cultivation of improved forage due to various reasons such as lack of knowledge (41.93%), limited access to enhanced forage seed (12.9%), insufficient training and support from experts (22.58%), and shortage of land for improved forage production (19.35%). According to agro-pastoralists, the main constraints to livestock production in both studied districts are feed shortage, animal diseases and parasites, low productivity of local breeds, inadequate market information, limited access to animal health services and drug supply, lack of improved breed and forage seeds, and drought as shown in Table 2. In Dasenech and Nyagatom districts, pastoralists identified feed shortage as their top concern, followed by the prevalence of disease and parasites and limited access to veterinary services. In Dasench district, the lack of improved breed and forage seeds ranked fourth, while in Nyagatom district, it was fifth, with both districts also experiencing a

lack of market information. Similar to the present study, previous research conducted in South Omo found that feed shortage, followed by disease prevalence, poor genetic potential, and inadequate extension services, have all contributed to the challenges facing cattle production (Terefe et al., 2015; Hidosa et al., 2017; Hidosa & Tesfaye, 2018; Tolera & Hidosa , 2023).

Table 2. Ranks of livestock production constraints in the Dasenech and Nyagatom districts in 2022

Major constraints	IB	FS	DP	MS	VS	DR	TC	Score	Rank
Dasenech district									
Lack of Improved breed and forage seeds (IB)	--	FS	IB	IB	VS	DR	I B	3	4
Feed shortage (FS)		---	FS	FS	FS	FS	FS	6	1
Disease and parasite (DP)			---	DP	DP	DP	DP	4	2
Lack of market information (MS)				---	VS	DR	MS	1	6
Less access to vet service (VS)					---	VS	VS	4	3
Drought (DR)						---	TC	3	5
Technological constraints (TC)							---	1	7
Nyagatom district									
Lack of Improved breed and forage seeds (IB)	--	FS	IB	IB	VS	DR	I B	3	5
Feed shortage (FS)		---	FS	FS	FS	FS	FS	6	1
Disease and parasite (DP)			---	DP	DP	DP	DP	4	3
Lack of market information (MS)				---	VS	DR	MS	1	6
Less access to vet service (VS)					---	VS	VS	4	2
Drought (DR)						---	TC	3	4

Overall ranks for agricultural technologies

During the FGDs with agro-pastoralists regarding their agricultural-technological demands, it was observed that their demands varied across locations (Table 3). In the Dasenech district, agro-pastoralists ranked improved Panicum grass for cluster-based production as their top priority followed by sorghum, whereas in the Nyagatom, they ranked Sorghum production as their main concern, followed by improved Panicum grass.

Table 3. Overall ranks for agricultural technological demands in Dasenech and Nyagatom districts in 2022

Category	S	M	B	P	Score	Rank
Dasenech district						
Sorghum (S)	---	S	S	P	2	2
Maize (M)		---	B	P	0	4
Banana (B)			---	P	1	3
Panicum (P)				----	3	1
Nyagatom district						
Sorghum	---	S	S	S	3	1
Maize		---	B	P	0	4
Banana			---	P	1	3
Panicum				----	2	2

The preference for improved Panicum grass in Dasenech district is due to its ability to provide frequent harvests every 45 days, which is beneficial for feeding their livestock through a cut and carry system. Additionally, it can fetch more money in a short amount of time via selling seed and herbage or hay. On the other hand, agro-pastoralists were less interested in sorghum and maize due to their susceptibility to diseases and pests like America Armyworm, which has caused economic losses in recent years. Moreover, sorghum and maize takes a long duration (90 days) to get mature.

On the contrary, in the Nyagatom district, agro-pastoralists showed a strong preference for cluster-based sorghum production, followed by Panicum grass and bananas. The reason for this preference was due to the chronic food insecurity they faced. By cultivating sorghum, they were able to combat this issue and increase their resilience to food shortages. Additionally, they prioritized the production of improved Panicum grass as a second technological option. Some agro-pastoralists in the area cultivated Panicum grass seed and hay to increase their income rather than using it to feed their livestock. This was because their livestock, such as cattle, sheep, and goats, were grazed on rangelands located far away from their farming sites.

Opportunities for Agricultural Production

Availability of fertile farm-land

Agricultural lands are important assets to cultivate and produce various types of grains and livestock feeds. During the FGDs with agro-pastoralists and agricultural experts, they reported that issue of land is not their problems due to we have surplus fertile communal land which is consider as an opportunities for crop and forage production.

Availability of sustainable Omo-river

During the FGDs with agro-pastoralists and agricultural experts reported that yearly available sustainable Omo River in the body study districts is also another important opportunity in their area to cultivate food grains for human consumption and forage for livestock (cattle, sheep and goats) feedings.

CONCLUSION

Identifying the constraints facing agricultural production and productivity at the grassroots level is extremely important because the top-down approach to delivering agricultural technologies to end-users is not demand-oriented and does not provide solutions to these constraints. The study found that some of the major constraints in the Dasenech and Nyagatom districts include a lack of improved crop varieties, gasoline shortages, frequent occurrence of droughts, crop diseases and pests, a lack of awareness of improved agronomic practices, feed shortages, animal diseases and parasites, low productivity of local breeds, inadequate market information, limited access to animal health services and drug supply, and a lack of improved breed and forage seeds.

However, the availability of fertile farmland and the sustainable Omo River present important opportunities for small-scale producers and investors who plan to invest in the agricultural sector. Based on the findings, efforts should be made to boost agricultural production and productivity by introducing improved crop and forage varieties, managing diseases and pests, genetically improving indigenous breeds, strengthening veterinary drug supply services, developing improved forage banking systems, establishing legal crop and livestock marketing systems, and providing capacity-building services to producers and experts to maximize the benefits of agricultural production.

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AUTHOR CONTRIBUTIONS

Mr. Asmera Adicha created checklists for questioning, participated in collecting and analyzing field data, and wrote the initial version of this manuscript. Mr. Denbela Hidosa participated in field data collection, edited and formatted this paper according to journal guidelines. Dr. Yibrah G/Meskel involved in field data collection process and organized the data collection process.

COMPETING INTERESTS

The authors declare they have no conflict of interest. The manuscript has not been submitted for publication in other journal.

ETHICS APPROVAL

Not applicable

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