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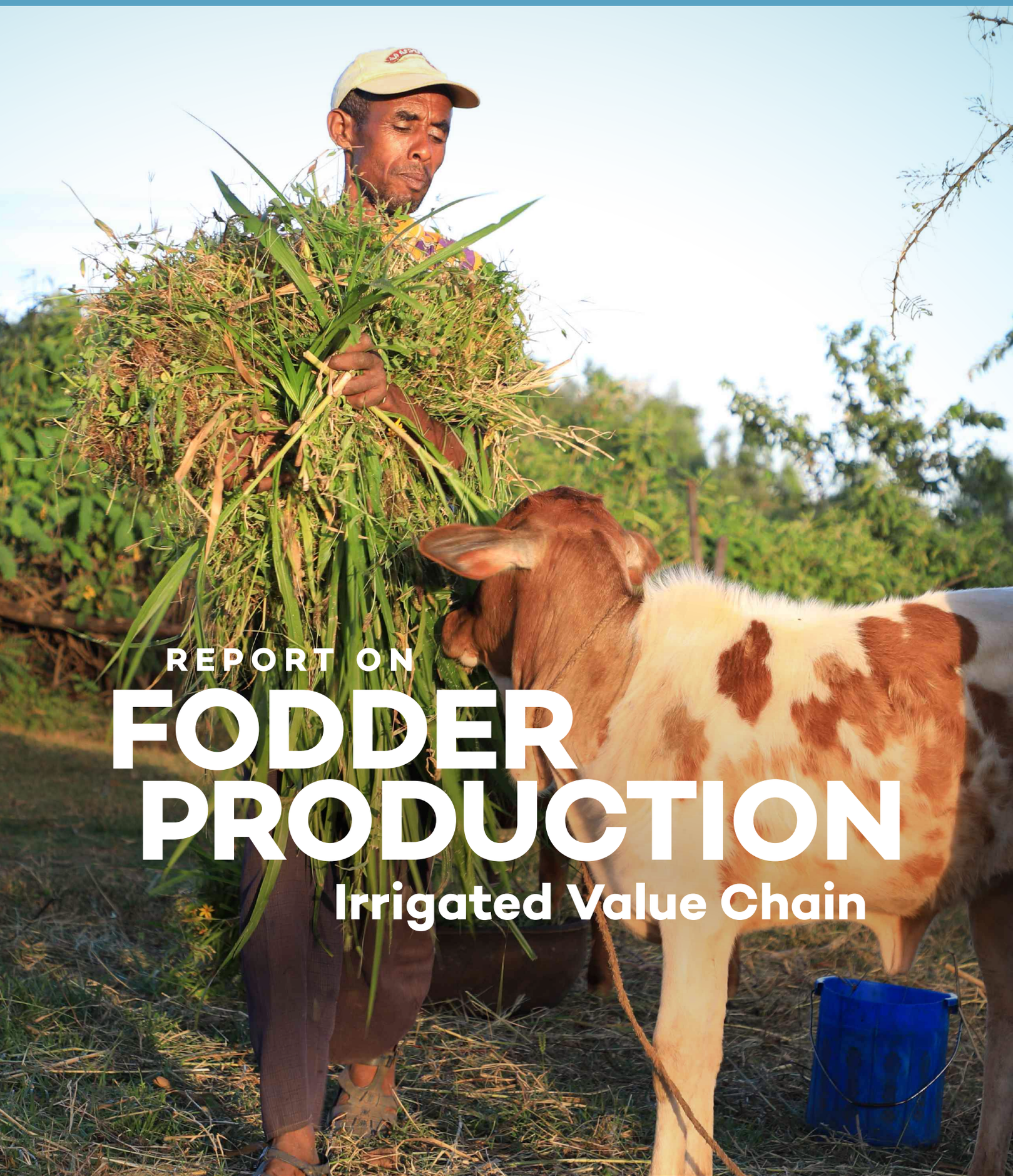

REPORT ON

FODDER PRODUCTION

Irrigated Value Chain

FEED THE FUTURE INNOVATION LAB FOR SMALL SCALE IRRIGATION | ILSSI.TAMU.EDU

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Why irrigated fodder?

Livestock contributes to socio-economic and nutritional well-being in many Sub-Saharan African countries, but the sector is constrained by low productivity. The lack of reliable and quality feed, particularly during dry seasons and droughts, is one of the key constraints.

The Innovation Lab for Small Scale Irrigation undertook research on the potential to irrigate fodder to fill the feed gaps and to improve the livelihoods of producers. Initial studies on markets for fodder in Tanzania, Ghana and Ethiopia pointed to Ethiopia as having the highest potential for irrigated fodder development in the region. Focused on Ethiopia, studies showed a range of benefits: irrigated fodder production is profitable, lends to improved nutrition for households, and offers market-based opportunities for value chain actors. **Fodder produced under irrigation improved dairy productivity, particularly when other constraints are also addressed**. Analysis also showed significant areas of Ethiopia are suitable for producing fodder, including under irrigation, which could be critical to mitigating the impacts of climate change.

The project engaged with fodder and dairy cooperatives to further understand constraints in the market, and strengthen capacity to build fodder markets in milk sheds in Ethiopia.

Daughter of an irrigated fodder producer in the Amhara Region

High potential for smallholder households for income and nutrition benefits from irrigated fodder

Initial market studies showed growing demand particularly in Ethiopia, for reliable supply of good quality feed. While smallholder dairy farms are the backbone of the dairy sector, multiple studies have indicated that they require a regular supply of fodder to become efficient in dairy production. We wanted to understand if small-scale irrigation investments could be viable enterprises for both fodder producers and dairy and meat producers.

One study projected the economic feasibility of irrigated fodder production at the household farm scale as a business enterprise.

Using the FARMSIM model, smallholders that irrigated fodder showed higher productivity and income

The model also suggested that the introduction of crossbred dairy cows with a potential for milk production increased the potential profits three times that of native cows. In terms of nutrition, the analysis also indicated that deficits in fat intake at the household level would be addressed largely through increased income, while deficits in calcium could be partially alleviated through the increase in own consumption of milk produced.

Feed supply (quality and quantity) and forage commercialization are important drivers of smallholder dairy transformation, according to another study. Recently, irrigated fodder has helped dairy farmers to increase milk yield and quality, particularly in the dry season.

Field studies in the Bahir Dar milk shed provided further evidence that irrigated green fodder can be commercialized profitably and that production for own dairy cows can also increase income for smallholder dairy farmers. In a comparative study (see chart below), irrigated fodder had higher annual net returns (USD 482) than irrigated vegetable farming (296 USD) but lower than khat (USD 564) on one hectare of production. However, given the lower pesticide and labor requirements, as well as the concerns over negative socio-cultural and health impacts, many farmers are converting farms from khat to fodder. While fodder producers and dairy smallholder farmers point to constraints, such as poor feed storage and bulkiness of feed, problems in the dairy markets, and insufficient extension support, more and more farmers are making investments in water lifting equipment, land and fodder seed, to produce fodder.

INDICATORS		CASE A	CASE B	CASE C
Revenue (ETB)	**Yield revenue**	21,869.3	12,815.13	31,383.30
	Straw revenue	0	3,750.00	0
	Total revenue	21,869.3	16,565.13	31,383.30
Variable cost of production (ETB)	**Human labor cost**	1,140	2,166.00	3,420.00
	Animal labor cost	263.33	542.00	396.66
	Farm inputs cost	467.15	1,573.86	4,148.10
	Total variable cost (ETB/ha)	1,870.48	4,281.86	7,964.76
Net return (ETB)		**19,998.82**	**12,283.27**	**23,418.54**

SUMMARY OF REVENUE, VARIABLE COST, AND NET ECONOMIC RETURNS FOR THREE CASES

Case A = irrigated fodder production

Case B = irrigated fruit & vegetable production

Case C = khat production

USD $1 = 41.5 ETB at time of study.

Source: ILRI Discussion Paper — Economic analysis and trade-offs of irrigated fodder production in Ethiopia: Implications for smallholder dairy transformation

Women farmers and the pathways to empowerment in irrigated fodder value chains

Members of the Genet Lerobit Dairy Cooperative, Bahir Dar Zuria District, process and sell dairy products.

A study in Amhara and Southern Nations, Nationalities and Peoples' Regions showed significant gendered differences in the fodder to dairy value chain, indicating that women seem to benefit less from business opportunities. Women participate mostly in the lower nodes of the value chains. Women supply milk and milk processed products in much smaller scales, compared to men traders. While women do participate, they are limited by gender roles that lead to lower mobility and less access to finance and credit. For example, women lack bank accounts so are paid in cash, but that in turn becomes a hurdle to building credit worthiness for loans. Men also tend to receive higher prices than women for the same goods, despite women's reputations for supplying higher quality dairy products. Traders in the dairy value chain recognize and adapt to women's limitations, though it is unclear if that addresses all or the main constraints to open opportunities to more women. In Amhara region, value chain actors noted a shift in the norms of milk ownership from women to men as the dairy value chain grows in value and scale. With support, cooperative hubs could play a larger role in providing production and market information and credit for inputs, and in doing so, support women's empowerment as the dairy value chain grows.

CASE STUDY 1

Understanding and enhancing equitable opportunities in the fodder value chain

A study on the fodder value chain identified overarching constraints in the feed value chain as shortage of improved fodder seeds, poor fodder storage and management, shortage of water and lack of awareness about improved forage production. Researchers mapped out the main activities, actors and enablers in the fodder value chain in two sites in Ethiopia.

The study reflected the variation between areas in terms of financial and information flows, and influence of stakeholders. In Hossana, donors funds and public institutions are important in finance and influence, while in Bahir Dar, research institutions and public agencies are important, but so are private sector actors and unions. One other variation is in access to and source of fodder seed—noted as a major problem. Understanding the variations in finance and information flows, as well as level of influence of different actors, enabled identification of local entry points to support resilience in the fodder sub-sector, including in ILSSI's partnerships with fodder and dairy cooperatives.

Localized platforms on the fodder value chain are needed to increase awareness on improved fodder production and benefits, facilitate better access to improved fodder seed, and strengthen the resilience of the fodder market. Strong linkages with the dairy value chain would contribute to the profitability of the fodder business, as forage-based dairy production helps to ensure a sustainable market and a stable, good price for cultivated fodder. The commercial dairy sector is mainly located in peri-urban areas where there is limited options for fodder cultivation. Local platforms are the bridge to link fodder producers in rural areas with the commercial dairy producers.

CASE STUDY 2

ILSSI partnered with Dairy Cooperatives to increase milk supply and strengthen the commercial fodder and dairy value chains

Dairy cooperatives have the potential to play a major role in development of both fodder and dairy value chains. A close analysis of three selected cooperatives in areas where ILSSI operates in Ethiopia indicated that they have a major capacity limitation to serve dairy producers in their localities. **ILSSI partnered with the cooperatives and strengthened capacity of these entities to drive fodder commercialization and increase dairy production.** The support aimed to enhance the ability to collect, process and market fluid milk efficiently to serve as a pull factor for fodder development, and diversify cooperatives' role as supplier of forage seeds and other farm inputs. After a few years of engagement through training, technical and logistical support, the cooperatives had significantly boosted capacity, reflecting in more than doubling their membership numbers and the daily milk supply to the local market.

The partner dairy cooperatives now produce and supply forage seeds, planting materials, and other farm inputs to customers — a first in their operations. This has enabled the cooperatives to diversify and increase their income. Establishment of milk collection and processing facilities, and sales shops for milk and forage seeds helped to create market opportunities and increased interest among farmers to invest more in irrigated fodder.

The partnerships demonstrated the importance of the cooperative business model to strengthen local institutions and to catalyze smallholder dairy transformation through irrigated fodder development. Moreover, the results of the ILSSI partnerships attracted the attention of major development partners and allowed the cooperatives to leverage additional resources to enhance their capacity and expand their operations.

Irrigated forages increase dairy and meat productivity

Research projects including ILSSI, supported analysis on several fodder species. Field studies in multiple locations in Ethiopia showed that

improved forage varieties including oat-vetch mixture annuals and Desho and Napier perennial grasses provide high biomass yield of good nutritional quality from small plots of land.

Ex-ante analysis of economic gains from plot level experiments on 100 m2 irrigated land showed that productivity gains from oat-vetch mixture could potentially reach as high as 184 kg of milk or 30 kg of meat, assuming maintenance requirements are met from other local feed resources. The productivity gains from Desho and Napier grasses during the first season of establishment were lower than oat-vetch mixture, but gained in subsequent years as they reached their maximum biomass yield potentials.

On-farm feeding trials with local and cross-bred lactating cows showed that supplementing 2kg of oat-vetch mixture hay daily increases milk yield by 50% and 70%, respectively. Moreover, use of oat-vetch mixture hay as a replacement for commercial concentrates in the diet of fattening sheep indicated that oat-vetch mixture hay can effectively replace costly commercial concentrate needs by about 67% while proving optimal body weight gain of 110 g/day/head and increasing the income of farmers.

67%

IN SOME INSTANCES, IRRIGATED OAT-VETCH MIXTURE HAY CAN EFFECTIVELY REPLACE ABOUT TWO-THIRDS OF COSTLY COMMERCIAL CONCENTRATES.

FRESH FODDER BIOMASS AND QUALITY FROM A SINGLE CUT IN ONE IRRIGATION CYCLE.

Feed[1]	Rainfall mm	Irrigation[2] mm	Fresh Yield[2] t/ha	Dry Yield[2] t/ha	Protein %	Energy MJ/kg	Meat[2] kg	Milk[2] kg
Desho	182	56 ±8	67.7 ±13.5	13.3	17.8	6.96	24.5	163.4
Napier	282	342 ±123	9.5 ±5.3	2.2	8.6	8.00	5.4	32.3
Oats				12.8	9.2	7.92	30.5	184.7
Vetch	173	43 ±9	65.3 ±10.0	4.5	20.0	8.82	13.2	74.3
Weed				1.4	17.9	8.10	3.5	21.2

[1] Data on feed quality is based on one single cut. The yield for Napier is an average of the first cut after 104 days and the second cut (30 days later) given that the yield for the first cut is very low and increases in the subsequent cuts due to tillering and increased growth. Dry matter and feed quality for Oats, Vetch and weed obtained from the irrigated Oats & Vetch plots were seperately analysed.

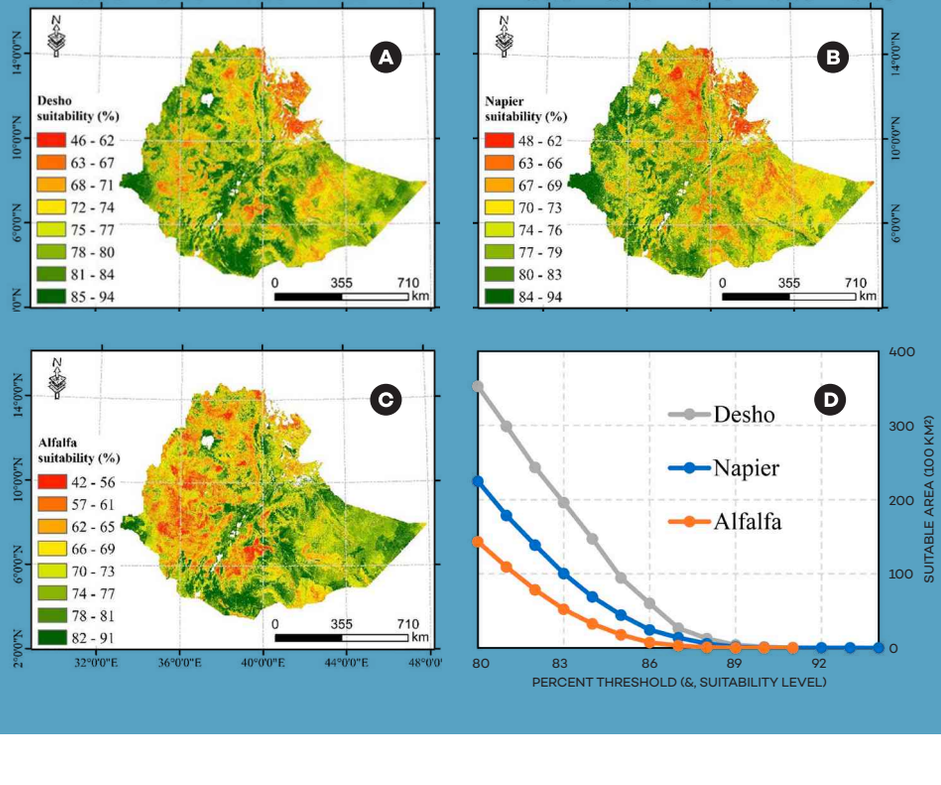
[2] Average and standard deviation based on all particpating farmers. Milk and meat production is based on feeding the dry matter obtained from 100 m² to improved cattle breed. Animal mainentance requirements are assumed to be provided by other feed resources than the planted forages. *Source: Factsheet* — Irrigated fodder opportunities for small-scale irrigators

Suitability for irrigated fodder production for:

A Desho, B Napier, C Alfalfa D potential suitable irrigated fodder production (in 1000 km2) at different threshold levels.

The values in the map represent the level of suitability; the higher values represent the most suitable areas, and vice versa.

Source: Brief — Identification of Areas Suited for Fodder Production In Ethiopia



High potential for sustainable feed production in Ethiopia

Having evidence that irrigated fodder offers a feasible business model for the green fodder market and for dairy producers, the Feed the Future Innovation Lab for Small Scale Irrigation and Livestock Systems collaborated to identify suitable sites for fodder production in Ethiopia, particularly considering environmental sustainability.

The study used Global Information Systems (GIS)-based Multi-Criteria Evaluation to evaluate the irrigation potential of groundwater using simple water-lifting technologies for Napier, alfalfa, vetch, oats and Desho. The study estimated areas potentially suited for fodder production in Ethiopia, considering biophysical and socio-economic factors. Results indicate that there is substantial suitable land for fodder production in Ethiopia: at an 85% suitability threshold, ~31% of Ethiopian land (about 351,907 km2) is highly suitable for Desho grass production followed by vetch (23%), Napier (20%), alfalfa (13%), and oat (12%).

The areas suitable for fodder production are located where there are sufficient groundwater resources, which could be accessed using simple water-lifting technologies. In addition, analysis showed a substantial amount of agricultural land and green and blue water resources to cultivate biomass feed for livestock in Ethiopia using small-scale irrigation during the dry season, based on application of the SWAT model. Field-based studies showed that vetch, being a legume forage and nitrogen fixer, provided superior quality feed and environmental services as it can be grown intercropped with oat and other food crops like maize.

Across studies, results showed that water resources can be used sustainably for fodder production to ease major livestock production constraints through producing better quality and quantity feeds.

Students and farmers collect data at an Ethiopian demonstration mother plot trial.

Irrigated fodder leaf area measurement at the Robit Bata site.

Small-scale irrigated fodder enables climate adaptation and mitigates impacts of climate change

Fodder and dairy value chain actors understand the spiraling implications of climate change, some of which are already being felt. Extreme weather events cause shortage of feed and drive up input costs, forcing smallholders to sell of portions of their herds. The lack of feed also reduces supply of milk by about half, which increases the costs for aggregators to collect milk. Many in the value chain are pushed out of business. Primary suppliers — often women — often lose out the most. Smallholder households may reduce dairy consumption with negative outcomes for nutrition, especially on women and children.

Irrigation specialist explains intercropping fodder and avacado at Koga, Ethiopia.

Adapting to climate change through irrigated fodder production by smallholders can stabilize the feed supply and reduce feeding costs. Regular supply of feed even through drought periods, will be felt by individual farmers at herd level and also by the livestock and dairy products businesses at larger scales. Irrigated fodder promotes increased resilience to climate variability, smoothing access to nutritionally important animal source foods.

CASE STUDY 3

Potential for commercializing fodder production under irrigation in Ghana

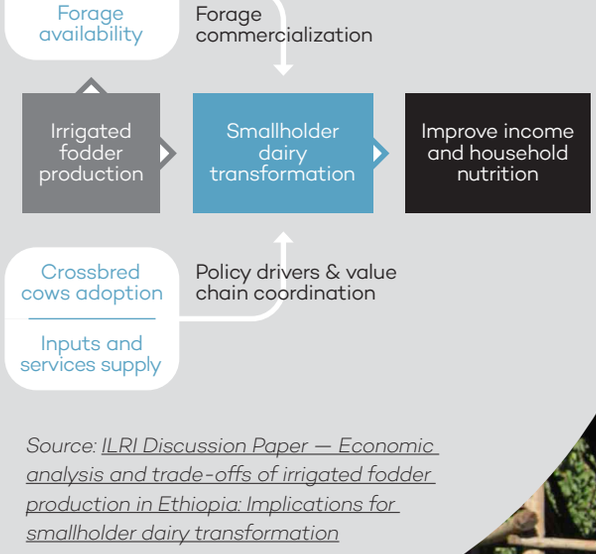
The market for fodder in Ghana is in the early stages of development. Commercialization of fodder production can be enhanced by investing in farmer capacity, particularly on fodder seed production, fodder storage and conservation techniques, and the co-development of profitable fodder production business models.

Fodder producers could gain from aligning peak production yields with seasons of greatest demand, such as for ram fattening, to obtain higher prices. In addition, high land value of most irrigation areas reduces net profits; promising land for use in perennial fodder production is fenced off transition-zone land.

Both cogon grass and forage sorghum are well adapted to northern Ghana, and provide both good yields and nutrient values as fodder. However, improved agronomic approaches would be needed to support adequate supplies for commercial sales after the first harvest.

With urbanization, increasing demand for animal source foods and climate change, fodder gaps are likely to increase and catalyze commercialization of fodder production. Additional research on irrigated production and post-harvest management, and facilitating market linkages, is becoming more urgent.

FEED AND DAIRY TECHNOLOGY DRIVERS CAN SHAPE AND INFLUENCE TRANSFORMATION OF THE SECTOR.



Source: ILRI Discussion Paper — Economic analysis and trade-offs of irrigated fodder production in Ethiopia: Implications for smallholder dairy transformation

Abate Wale with milk produced from cows fed irrigated fodder, in Robit Bata

KEY POINT:

Investing in irrigated fodder has potential to contribute to a transformation of smallholder farmer livelihoods, particularly in Ethiopia.

Evidence shows economic and nutritional benefits from irrigating fodder for the green fodder market and especially the dairy sector. Smallholders that produce fodder under irrigation gain net profits and improve their household nutrition. Linking the fodder and dairy value chains offers opportunities for multiple actors to benefit. **Substantial area in Ethiopia is suitable for producing fodder, including in areas with sufficient shallow groundwater. Identified suitable areas have sufficient water resources to support sustainable production.** Some fodder species provide environmental services, require less water and display tolerance to drought, contributing to the resilience of smallholder systems.

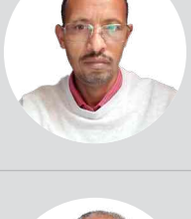
Strong partnerships among public and private stakeholders are needed to support fodder and dairy value chains. Smallholder dairy transformation would be possible through creating an enabling environment and investing in local institutions.

One promising entry point to support equitable and sustainable value chain development is investing in cooperative hubs. Cooperatives provide loans to their suppliers, access to inputs such as fodder seeds, compound feeds, irrigation equipment and milk utensils, while also acting as an important source for information and technologies. Farmers organized into cooperatives are able to access government services and better negotiate input and output prices.

While the biological and economic efficiencies of small-scale irrigated fodder development are becoming evident, more information is needed on the macro-level socio-economic impacts for rural poverty reduction, and the returns on investments across the value chain, including interventions to support equitable employment opportunities for youth and women. Further research is also needed on small-scale mechanization across both irrigated fodder and the related dairy value chains. More knowledge in these areas would enable policy makers and development partners to prioritize interventions in irrigated fodder production, and leverage investments.

As households and cooperatives increasingly invest in fodder production and management, and as other stakeholders continue to mitigate constraints, support for irrigated fodder is an opportunity to meet goals on economic development and improved nutrition and food security, while also enabling resilience of smallholder producers to cope with climatic shocks.

CONTRIBUTORS



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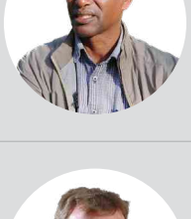

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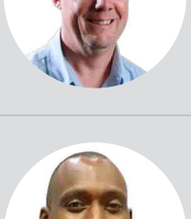

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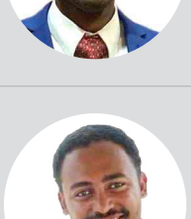

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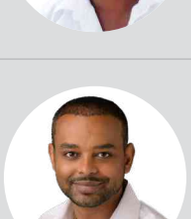

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