Livestock feed and forage development in Uzbekistan

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1. Background

In Uzbekistan, livestock production accounts for 40% of agricultural output, of which dairy represents 45%. During the last 30 years areas planted with forage and feed crops have been reduced by 70%, whereas the cattle population has increased by 150%, reaching 15 million head and leading to a significant increase in GHG emissions. Since independence in 1991, the agricultural area has decreased by 33%, with cotton (31%) and wheat (35%) being the main crops. In the past, livestock provided manure for cotton, and forages were planted after the cotton crop, which helped restore soil fertility. With the introduction of production quotas, wheat replaced forages, putting pressure on soil fertility in cotton fields. Delinking livestock from cotton production has led to decreased cotton yields and reduced feed availability. Feed crop area per livestock unit is only 32 m^2 and decreasing (World Bank, 2019).

The bulk of livestock products (96% of milk, 94% of meat) are produced by 4.7 million ‘Dehkan’ farms (Table 1). Private or individual farms account for 3.5% and 3% of respectively milk and meat production. The remaining small percentage is produced by corporate farms (former large-scale collective farms). Dehkan farm systems combine small agricultural plots and small-scale animal husbandry with communal grazing and individual watering points. The main feeds are maize (forage) and crop residues (wheat, maize). With only slightly over 8 percent of their sown area allocated to forages, private farms account for over three-fourths of the total area dedicated to feed production (i.e., 333,000 ha). Dehkan farms with almost 95% of the cattle herd account for only 13 percent of the forage area and rely for a very large part on low-quality communal pastures and crop and agro-industrial by-products.

Inadequate management of pastures and former irrigated cotton fields has led to degradation (including salinization) with significant reductions in species composition, vegetation cover and palatable biomass, while erosion rates and soil loss have increased (GEF, 2019; World Bank, 2019: Asian Development Bank, 2020). While development potential is limited due to poor governance of land and natural resources, the rapidly growing demand for livestock products is opening up opportunities for poverty reduction by obtaining additional income for poor livestock keepers.

Table 1: Selected characteristics of farm types in Uzbekistan

	Private farm	Dehkan farm	Corporate farm
Basic characteristics	Individual commercial farm with leased land, emphasis on crops (wheat, cotton, potato)	Small-scale household farm, very little on-farm land, most feed resources purchased or communal (grazing)	Large-scale farm, "agrifirm" (former collective farm)
Number	132,000	4.7 million	
Size	50 ha	0.2 ha	
Number of livestock units (LSU)	100	7-8	
Share livestock output	3%	95%	2%
Milk production		70% subsistence	
Share of total feed and forage crop area	75%	13%	10%

Source: World Bank (2019), own calculations

Insufficient feed resources and lack of land area are key factors constraining livestock production in Uzbekistan. Production per animal is 1,800 kg of milk per year and 110 kg per year of liveweight gain on private farms, and 2,300 kg milk per year and 200 kg of liveweight gain on Dehkan farms.

These low yields are mainly due to feed (rather than, for example, genetic) constraints. Poor quality untreated maize stover, rice and wheat straw account for a high proportion of cattle diets. Natural pastures are of poor quality due to degradation and salinization. Among Dehkan farmers, 70% grow some feed crops (mainly maize) and 50% have access to (communal) pastures; 91% have to buy feeds, which are expensive and of variable quality. Farmers face administrative restrictions on feed crop production and land tenure issues prevent farmers from investing in land.

The current situation is acknowledged in Presidential Resolution No. UP-4243 (28 March 2019) and proposes measures to support livestock enterprises and increase feed supply. District administrations are to allocate land from their reserves for feed and forage crop production. The resolution also proposes to improve feed marketing and supply chains.

2. Assessment of improvement options

To assess the environmental impacts and climate change mitigation potential of improved feeds and forages, two scenarios were analysed for Private and Dehkan farms: the current situation (i.e., ‘business as usual’, or BAU) and a scenario with improved feed and forage options. For each scenario, livestock production, environmental and climate impacts were assessed, and partial cost-benefit ratios were calculated. Analysis was conducted using the CLEANED (Comprehensive Livestock Environmental Assessment for Improved Nutrition) tool (Notenbaert et al., 2016).

Table 2 shows the livestock characteristics in each scenario. The BAU scenarios are based on the average production levels and feed baskets as found in the literature (Siegmund-Schultze et al. 2013, FAO 2021 and World Bank 2019). The intervention scenarios focus on (1) increasing livestock productivity through increased (on and off-farm) feed quantities, and (2) mitigating environmental impacts through improved nutrient management (legumes), reduced GHG emissions and water use per kg of milk and meat, and carbon sequestration (trees/shrubs). The improvements considered are:

- establish silvopastoral systems on-farm (Private farms) or on communal lands (Dehkan farms) with drought resistant and salt-tolerant legume shrubs/ trees. Here, we consider *Atriplex* spp., but there are also other similar options available for degraded and salinized soils. Shrubs and treeds restore land productivity, contribute to soil fertility, carbon stocks and biodiversity, while also providing income for farmers in the form of fodder, fuel wood, or fruit (Gupta et al., 2009; Walden et al., 2017; Djumaeva et al., 2009);

- increase the use high-quality agro-industrial by-products such as cotton seed cake to increase livestock productivity; and
- increase on-farm areas of forage legumes and cereal forages (maize, sorghum), also as silage.

Table 2: Herd composition and production levels of Private and Dehkan farms, BAU and intervention scenarios

	Private farms - BAU		**Private farms – with feed/forage options**		**Dehkan farms - BAU**		**Dehkan farms – with feed/forage options**	
Livestock category	N	milk/LWG kg/animal/yr	N	milk/LWG kg/animal/yr	N	milk/LWG kg/animal/yr	N	milk/LWG kg/animal/yr
Cows	21	1800	15	3000	2	2300	2	3500
Steers/heifers	10	110	7	200	1	160	1	250
Calves	10	110	7	200	1	160	1	250
Bulls	15	110	12	200	0		0	
Sheep	80	20	60	40	9	20	9	40
Goats	21	20	15	40	6	20	6	40
Stable/grazing	70%/30%		80%/20%		70%/30%		85%/15%	

Source: based on Siegmund-Schultze et al. (2013), World Bank (2019), Yuspurov et al. (2010), FAOSTAT (2021). **N**: Number; **LWG**: live weight gain

3. Results

3.1 Production impacts

Livestock numbers and production levels for the different farm types and scenarios at national level are presented in Table 4. The proposed feed and forage options allow for a reduction in livestock (by 20%) while increasing milk and meat output (by 20 to 40%).

Table 4: Livestock numbers, production levels and partial benefit-cost ratio – current (estimate 2020) and with (feed/forage) interventions scenario

Livestock category	**Private farms - BAU**	**Private farms – feed/forage options**	**Dehkan farms - BAU**	**Dehkan farms – feed/forage options**
Cows	296,000	220,000	5,300,000	4,200,000
Steers/heifers	148,000	130,000	4,000,000	3,500,000
Calves	148,000	130,000	4,000,000	3,500,000
Adult male cattle	148,000	120,000		
Sheep	5,300,000	4,500,000	13,800,000	12,000,000
Goats	610,000	500,000	3,300,000	3,000,000
LSU	1,757,000	1,409,000	20,328,000	16,740,000
Milk (1000 tons)	564	698	12,895	15,550
Meat (1000 tons)[1]	83	138	811	1,184
Benefit-cost ratio (partial)[2]	2.9	5.4	4.5	7.2

[1]based on 50% carcass weight. **LSU**: Livestock Unit, in this case a hypothetical ruminant of 250 kg

3.2 Environmental impacts and climate change mitigation potential

The environmental impacts and climate change mitigation potential are presented in Tables 5 and 6. Land requirements (based on herd composition, production levels and feed basket) decrease by over 10% (see Figure 1). On Dehkan farms, on-farm land requirements reduce by as much as one third, mainly due to increasing the proportions of forage legumes (Lucerne-alfalfa) and forage maize/sorghum in the feed ration.

GHG emissions reduce by almost 15%. This is mainly reduced enteric fermentation as a result of increased feed quality and reduced livestock numbers. GHG emission intensity decreases even more (30%). Silvopastoral options increase annual carbon sequestration by up to 2.5 t CO_2e per ha on Private farms, which can compensate for 75% of the GHG emissions. For the Dekhan farms, these options sequester up to 4 t CO_2e /ha (off-farm).

Table 5 : Environmental and climate impacts of Private and Dehkan farms – national level

	Private farms		Dehkan farms	
	BAU[1]	options	BAU	options
Land requirement – on-farm (1000 ha)	1,109	795	1,489	960
Land requirement – total (1000 ha)	1,499	1,130	15,581	13,243
N-balance (1000 tons)	-11.7	-13.2	-203.1	-125.5
Water requirement (million m^3)	1,589	1,755	31,552	22,416
GHG emissions - enteric methane (1000 t CO_2e)	2,792	2,489	30,963	26,397
GHG emissions – other (1000 t CO_2e)	789	867	9,942	8,800
GHG emissions – total (1000 t CO_2e)	3,581	3,356	40,905	35,179
Carbon stock change (1000 t CO_2e) on-farm	-128	1,993	-133	-67

[1]Based on estimated figures for 2020 (Worldbank, 2019). **Source**: Aldaya et al. (2010)

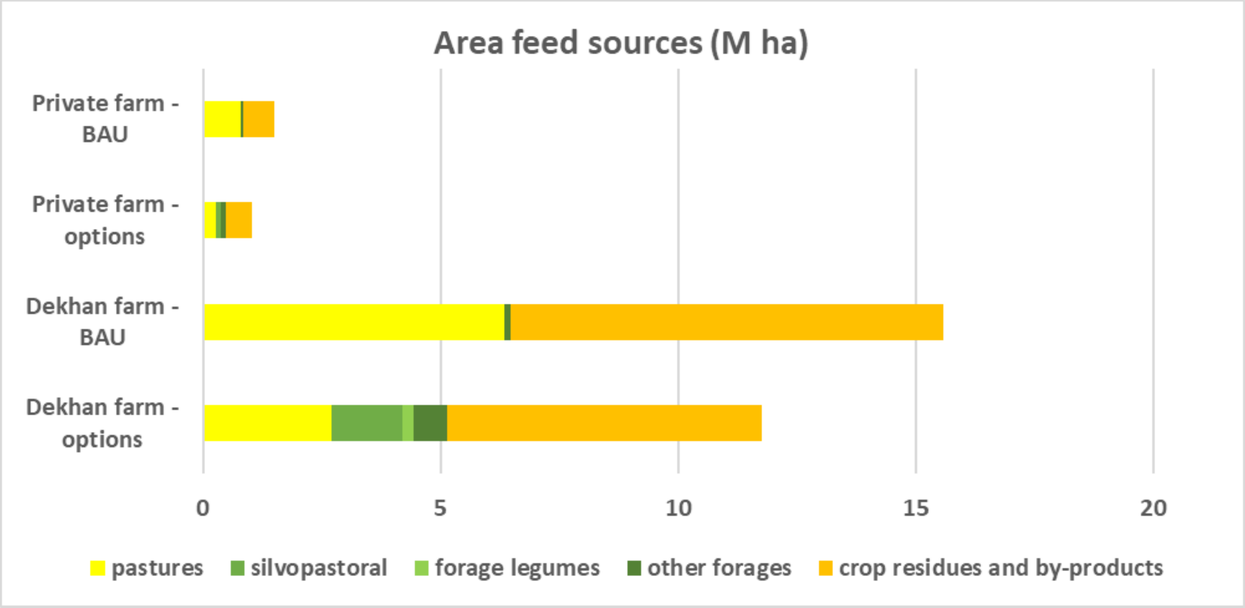

Figure 1: Areas of feed sources in each scenario

Table 6: Relative terms (per ha or intensity - per kg of product)

	Private farms		Dehkan farms	
	BAU[1]	**options**	**BAU**	**options**
Stocking rate (LSU/ha)	1.2	1.2	1.3	1.3
N-balance (kg/ha)	-30	-24	-31	7
Water requirement (m3/kg milk)	2.8	2.5	2.4	1.4
Water requirement (m3/kg meat)	32.9	21.9	50.9	26.5
GHG emissions (kg CO_2e/kg milk)	6.4	4.8	3.2	2.3
GHG emissions (kg CO_2e/kg meat)	43.0	24.4	50.4	29.7
GHG emissions (t CO_2e/ha)	2.4	3.0	2.6	2.7
Carbon stock change (t $CO2_e$/ha) on-farm	-0.1	2.5	0.0	0.0

[1]Based on estimated figures for 2020 (World Bank, 2019). **Source**: Aldaya et al (2010)

4. Implications for livestock sustainability

The livestock sustainability checklist provides several insights on the outcome of the proposed measures/investments related to environment, productivity, food security and nutrition (Table 7). The key findings are that GHG emissions from livestock can be reduced if livestock productivity increases enable a decrease in livestock populations; and land can be planted to shrubs and trees to sequester carbon if land requirements for livestock are reduced. GHG emission reductions are not the only benefit of improved feed and fodder management. Improved feeding and livestock management could increase farm incomes by about 25%. Vulnerability to climate risks is reduced by using drought tolerant varieties, improving water use efficiency and by managing soils for organic carbon sequestration. While the nitrogen balance is still negative (at -10 kg N/ha), the deficit is reduced by 23%. Off-farm, increased volumes of milk and meat could further provide job creation in processing and marketing because of higher production volumes. Value chains with higher volumes likely have better conditions for improving food safety of livestock products.

Table 7: Integrated assessment of livestock sustainability issues for Uzbekistan

Core interventions / practices	**Environment**					**Food security**					
	Climate change			Water, soil	Biodiversity	Production			Income		
	Reduce GHG emissions	Increase carbon stocks	Reduce climate vulnerability	Maintain/ improve water, air, soil quality	Maintain/ improve biodiversity	Increase productivity	Improve nutrition/ safety	Animal welfare measures	Reduce poverty	Create jobs	Improve working conditions
Improved forages	++	++	+++	+	+-	++	++	+	+	+	+-
Improved use crop residues and agro-industrial by-products	+	+-	++	+-	NA	+	+	NA	+	+	+-
Integration trees/shrubs	+	+++	++	+	++	+	+	++	+	+	+
More efficient water use	NA	NA	+++	+	NA	+	+	+	+	+	+-
Animal genetics	++	NA	+	NA	NA	++	++	NA	+	+	+-

Legend for impact: +++ = High; ++ = Medium; + = Low; - = Negative; NA = not applicable

4 Recommendations

- Investigate possibilities to liberalize land markets (ownership, land rights) to allow farm restructuring responding to market signals. Focus on Dehkan farms representing over 90% of livestock production.
- Create a conducive policy framework, with emphasis on increasing opportunities for knowledge generation, institutional strengthening, and policies or investments to overcome adoption barriers and scale sustainable livestock production technologies and practices. This includes support for increased involvement of research institutes at national and international levels.
- To further reduce GHG emissions and land and water requirements, look into possibilities to increase the proportion of monogastric livestock, like poultry, and fish as animal source foods (poultry meat production is less than 5% of beef and mutton production).
- Considering the importance of crop residues and agro-industrial by-products for livestock production (60-70% of the feed basket), evaluate options for rotations or intercropping of food and cash crops with forages, and more adequate and strategic use of higher-cost agro-industrial by-products.
- Emphasise on-farm forage production, limiting dependence on expensive agro-industrial by-products and other inputs (e.g., fertilizer). This includes pasture and rangeland management (rotation) and the untapped potential local feed sources, such as fallow lands and high-quality tree foliage.
- Ensure the production and availability of seedlings of (leguminous) forage trees for silvopastoral systems by establishing regional and local nurseries (GEF, 2019).

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