



# The Odisha livestock sector analysis

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# Contents

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Tables	v
Figures	vii
Acknowledgements	viii
Abbreviations/acronyms	x
1 Introduction and objectives	1
2 Description of livestock production systems and zones	4
2.1 Agricultural regions and production systems in Odisha	4
2.2 Livestock systems in Odisha	4
2.3 Livestock numbers by species and production zone	7
2.4 Livestock production by species and production zone	12
2.5 Contribution of livestock to Odisha gross state domestic product	15
3 Policy and organizations relating to Odisha’s livestock sector	17
3.1 Animal health	18
3.2 Animal breeding	19
3.3 Animal nutrition	20
3.4 Livestock research	21
3.5 Livestock extension services	21
3.6 Dairy	22
3.7 Small ruminants	22
3.8 Poultry	23
3.9 Hides and skin	23
3.10 Livestock and livestock products processing and marketing	24
3.11 Social and gender inclusion—policy requirements	24

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4	Livestock production constraints and opportunities for growth	27
4.1	Constraining and facilitating factors in cattle systems	27
4.2	Constraining and facilitating factors in goat systems	29
4.3	Constraining and facilitating factors in sheep systems	30
4.4	Constraining and facilitating factors in chicken value chains	32
5	Projections of production and con-sumption: the business-as-usual scenario	34
5.1	Projected livestock numbers and production to 2035/36	34
5.2	Projected consumption of livestock products to 2035/36	36
5.3	Comparisons of projected production and consumption	38
6	Conclusion	40
	References	42
	Annex I.The livestock sector and investment policy toolkit	45
	Annex II. Production and reproduction parameters	46
	Annex III. Financial parameters	51
	Annex IV. Livestock production zones	58
	Annex V. Current and projected livestock numbers, production and gross state domestic product by production zones	59
	Annex VI. Odisha human population from 2020/21 to 2035/36	62
	Annex VII. Participants of stakeholder consultation workshops	63

# Tables

---

Table 1:	Indicators for classification of traditional livestock production systems in Odisha, by production zone	5
Table 2:	Human demographic indicators in three livestock production zones, 2019	6
Table 3:	Livestock growth rates and initial numbers used to estimate 2020/21 livestock numbers in Odisha	8
Table 4:	Estimated number of livestock by species, production zone and type of system, 2020/21	8
Table 5:	Estimated red meat production by species and production zone, 2020–21	12
Table 6:	Estimated annual milk production by animal species and production zone, 2020–21	13
Table 7:	Estimated value of livestock contribution to Odisha gross state domestic product, 2020–21, by species and product type (crore)	16
Table 8:	Estimated value of livestock contribution to Odisha gross state domestic product, 2020–21, by production zone, crore	16
Table 9:	Constraining and supporting factors in cattle production, by production zone	28
Table 10:	Constraining and supporting factors in goat production, by production zone	29
Table 11:	Constraining and facilitating factors in sheep production, by production zone	30
Table 12:	Constraining and facilitating factors in backyard poultry (BYP) production, by production zone	32
Table 13:	Constraining and facilitating factors in commercial layer poultry production, by production zone	33
Table 14:	Constraining and facilitating factors in commercial broiler poultry production, by production zone	33
Table 15:	Projected animal numbers by 2035/36 and percentage change by animal species and breed, herd size category, or type of production system	35
Table 16:	Projected livestock production by 2035/36 and percentage change by livestock product category	35
Table 17:	Projected gross value of livestock production by 2035/36 and percentage change by livestock product category (crore/year)	36
Table 18:	Projected gross value of livestock production by 2035/36 and percentage change by livestock species (crore/year)	36
Table 19:	Annual per-capita consumption of livestock products in Odisha, by household location, 2011	37
Table 20:	Population, real gross state domestic product (GSDP) and annual growth rates for Odisha, 2011/12 to 2019/20	37

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Table 21:	Income elasticities of livestock products used for demand projections	38
Table 22:	Projected per-capita and percentage change by 2035/26, by livestock product	38
Table 23:	Estimated and projected livestock production and consumption in Odisha, 2020–21 and 2035–36, without additional investments or interventions	39

# Figures

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Figure 1:	Designated livestock production zones in Odisha State	6
Figure 2:	Land utilization pattern in different livestock production zones	7
Figure 3:	Number of bovine animals, by species and breed, selected years	9
Figure 4:	Number of small ruminants and poultry, by species, selected years	9
Figure 5:	Percentage change in total cattle population by production zone, 2012 to 2019	10
Figure 6:	Percentage change in crossbred cattle population, by production zone, 2012 to 2019	10
Figure 7:	Percentage change in local cattle population, by production zone, 2012 to 2019	11
Figure 8:	Percentage change in numbers of small animals, by production zone and species, 2012 to 2019	11
Figure 9:	Density of livestock population (animals per hectare) by species and production zones	12
Figure 10:	Meat production by production zone, selected years	13
Figure 11:	Milk production by production zone, selected years	14
Figure 12:	Egg production by production zone, selected years	14
Figure 13:	Per-capita milk availability for Odisha and India, selected years, grams/person/day	15
Figure 14:	Per-capita egg availability for Odisha and India, selected years, eggs/person/year	15
Figure 15:	Government of Odisha budget for agriculture and livestock development	17
Figure 16:	Livestock share of state agriculture budget and livestock contribution to agricultural gross state domestic product (GSDP)	18

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Sirak Bahta, PhD

Senior agricultural economist, ILRI, and project leader, Odisha livestock master plan

# Abbreviations/acronyms

---

ADRI	Animal Diseases Research Institute
AHD	Animal Husbandry Department
AI	Artificial insemination
AU-IBAR	African Union Inter-African Bureau for Animal Resources
BAU	Business as usual
BYP	Backyard poultry
CAE	Commercial agri-enterprise
CDVO	Chief District Veterinary Officer
CEO	Chief Executive Officer
CPR	Common property resources
CVSc & AH	College of Veterinary Sciences and Animal Husbandry
DAH & VS	Directorate of Animal Husbandry & Veterinary Services
DMF	District mineral fund
GSDP	Gross state domestic product
ICAR	Indian Council of Agricultural Research
KVK	Krishi Vigyan Kendra
LIT	Low-input technology
LSIPT	Livestock sector investment and policy toolkit
LSS	Livestock sector strategy
NGO	Non-governmental organization
NSS	National Sample Survey
OLM	Odisha Livelihoods Mission
OLMP	Odisha livestock master plan
ORMAS	Odisha Rural Development and Marketing Society
OUAT	Odisha University of Agriculture and Technology
SAD	Small Animal Development
WSHG	Women's self-help group

# 1 Introduction and objectives

---

Odisha is a coastal state situated in the eastern part of India. The state ranks 8<sup>th</sup> in terms of land surface area and 11<sup>th</sup> in terms of population – accommodating 3.5% of the country’s total. About 33% of the Odisha population lives below the poverty line, earning less than USD 2 per day (NITI Ayog 2019). Four-fifths of the population lived in rural areas as of the latest census (Government of India 2011) and the primary occupation of about 63% of the rural workforce is in agriculture, including livestock (Government of Odisha 2021). Odisha is prone to natural calamities such as cyclones, floods and droughts.

Odisha’s economy has been growing since 2010, driven mostly by the service and industry sectors. The agriculture and allied sectors contributed about 21% of the gross state domestic product (GSDP) of Odisha in 2020–21, and of this, livestock production is an important component (Government of Odisha 2021). The share of livestock farming in agricultural GSDP has been increasing faster than that for crops in the past decade, due to rising demand for livestock products resulting from growth in income, population and urbanization. However, the contribution of livestock production to total and agricultural gross domestic product has been lower in Odisha than in India as a whole: the value of livestock farming in Odisha contributes 3% to GSDP and 23% to agriculture GSDP compared to 4.5% to National GDP and , and 25.5% to national agriculture GDP (Government of Odisha 2020a).

Besides contributing to agricultural GSDP, livestock production can have an important role in reducing poverty. Many of the rural and urban poor keep livestock and use them in various ways beyond income generation (Randolph et al. 2007). Multiple development frameworks therefore view livestock as capital assets that can be reproduced to generate wealth (Carlson-Bremer et al. 2018).

The Odisha livestock policy (Government of Orissa 2002) identified livestock as a poverty reduction instrument – more than 80% of rural households own livestock, and this generates up to 30% of their income. Although crop production is the principal activity, livestock is an important source of secondary income for many small-scale and marginal farmers in Odisha who may own only a few animals. Livestock products such as milk, meat and eggs also provide important macronutrients (proteins and fats) and micronutrients (vitamins and minerals) to farm households.

To facilitate increases in public and private investment and budget allocations for livestock development, the Fisheries and Animal Resources Development Department in the Government of Odisha, through Samagra Governance<sup>1</sup>, requested that the International Livestock Research Institute (ILRI) provide technical assistance for the development of an Odisha livestock master plan (OLMP) supported by the Bill & Melinda Gates Foundation. This initiative aims to increase appropriate investments in the livestock sector, and improve livestock contributions to achieving state development goals. The main objectives of the OLMP are to:

- build robust state capacity to undertake a livestock sector analysis and develop a livestock sector strategy (LSS) that will facilitate investment planning and support implementation of livestock policy and investment options.

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1. Samagra Governance: <https://www.samagrಾಗovernance.in/>

- conduct an evidence-based livestock sector analysis that facilitates the development of alternative scenarios to be considered in the foresight analysis of the LSS and investment road maps.
- develop a long-term (15-year) livestock sector strategy based on foresight analysis.
- develop an investment action plan with commodity value chain ‘road maps’ that can also support efforts to promote livestock development and related advocacy.

The OLMP process comprises three stages:

1. a livestock sector analysis that describes current characteristics and contributions of livestock production and likely future growth over the next 15 years without additional livestock sector investment.
2. development of a livestock sector strategy that analyses the impacts, benefits, costs, and trade-offs associated with additional investments or policy initiatives, in order to identify priority actions to promote livestock development at the state level.
3. delineation of a five-year livestock master plan comprising an investment plan with commodity-specific road maps that indicate the required actions by value chain stakeholders and relevant timelines.

This document provides the Odisha livestock sector analysis, a diagnostic assessment for a business-as-usual scenario that establishes a baseline for comparing investment alternatives assessed in the LSS (Bahta et al, 2022b). The LSS provides quantitative and evidence-based justification for public and private investments in the Odisha livestock sector’s recommended and prioritized commodity value chains. As part of the analysis, the Odisha livestock sector experts identified development objectives with measurable indicators, and the Fisheries and Animal Resources Development Department concurred with these objectives. These development objectives are impacts or contributions anticipated to result from the investment and policy interventions recommended in the LSS and the investment plans (road maps). The objectives comprise:

- poverty reduction: improvement in household incomes that move some households above the poverty line.
- economic growth: increased contribution of the livestock sector to agricultural GSDP and GSDP.
- food and nutrition security of rural people, especially women and children: increased availability of, and access to, animal-source foods for women and children with food access below recommend levels.
- export potential: increased value of livestock products provided to the rest of India and neighbouring countries.
- social equity: reduced inequality in household and post-production incomes; greater empowerment of women; employment and investment opportunities for women, youth and specific minority ethnic groups.

The baseline analysis was developed with data inputs from experts, and secondary sources integrated using quantitative tools from the livestock sector investment and policy toolkit (LSIPT)<sup>2</sup>. A core component of the LSIPT is a herd and economic sector model that was used to evaluate the trajectory for livestock production, and its monetary value over the next 15 years based on the sector’s current technical and economic performance but without additional investments in technologies or changes to policies. This analysis was undertaken for each priority livestock value chain. To complement this, separate analyses identified specific livestock production systems which have the potential for greater positive impacts on gender outcomes. Analysis of gender issues included a review of published and grey literature, government surveys, stakeholder meetings and virtual key informant interviews. This provided an initial assessment of the potential and differential impacts of proposed technology or policy interventions on men and women.

2. The LSIPT is a spreadsheet-based program that facilitates the integration of production and economic data to project future trajectories for livestock production and its monetary value. The LSIPT was developed by a group of international agencies under the aegis of the African Union Inter-African Bureau for Animal Resources. The LSIPT directly represents potential impacts on economic growth. Impacts on other development objectives require additional analysis linking to the LSIPT’s production and profitability projections.

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This document describes the livestock sector analysis and is organized as follows: Section 2 describes livestock systems and production zones, and documents the population, production and contribution of the sector. Section 3 describes livestock-related institutions, programs and policies, noting constraints and opportunities. Section 4 summarizes livestock production constraints and factors facilitating growth opportunities. Section 5 provides projections for production and consumption of priority livestock products through to 2035/36 and a baseline analysis for the next phase (the livestock sector strategy). Finally, Section 6 provides a summary of key findings.

## 2 Description of livestock production systems and zones

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This section summarizes the distinguishing characteristics of the livestock systems in each of the three production zones of Odisha. It describes the livestock population and geographic distribution for major species, as well as the production and value of livestock products from each species. It also discusses the major gender and social inclusion considerations in these livestock production systems.

The development of the livestock sector analysis was supported by the continual involvement of state livestock experts, and consultation with a wide range of key sector stakeholders. The systems and zones were discussed and agreed upon in a series of meetings and workshops with the livestock experts of Odisha, and other key sector stakeholders involved in the state's livestock sector. These consultations included technical staff from the Government of Odisha; experts from agricultural universities and the research institutes of the Indian Council of Agricultural Research; policymakers; livestock project staff from donor-supported development projects; and technical staff from ILRI. Details of the department staff and experts involved in the discussion process are provided in Annex VI.

### 2.1 Agricultural regions and production systems in Odisha

The agricultural sector plays an essential role in Odisha's economy, contributing about 20% of GSDP and employing more than 63% of the population. Odisha is divided into ten agro-climatic zones<sup>3</sup> (Hoda et al. 2021). For the OLMP, we considered three agricultural regions in the state – northeastern, western and southern – which correspond to the livestock production zones of 'coastal plain', 'northwest', and 'hilly and mountain' respectively. The northeastern region has the greatest distinction between 'kharif' (monsoon season) and 'rabi' (winter season) crops, and its intercropped area contains rice with pulses. Agriculture in the western region is a mixture of rice paddies, maize, cotton and other cash crops. Farmers in the southern region grow rice, maize, vegetables, millets and tree crops like coffee. The economies of these regions are based primarily on crop agriculture. The northeastern region has the highest cropping intensity (the proportion of land used for crop production), followed by the southern and western regions.

### 2.2 Livestock systems in Odisha

The production systems of livestock can be classified using many indicators. Indeed, there can be as many system classifications as there are possible combinations of criteria used (Jahnke 1982; Wilson 1986; Mortimore 1991; Seré and Steinfeld 1996; Otte and Chilonda 2003). In this study, the Odisha livestock production systems are

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3. Agri-climatic zones of Odisha: [agriodisha.nic.in](http://agriodisha.nic.in) (accessed 4 April 2021).

classified based on the Seré and Steinfeld (1996) approach, which combines criteria with the farming system concept. It classifies livestock systems into four types: 1) landless livestock production systems (which may be monogastric or ruminant), 2) grassland or grazing land systems (in which crop-based agriculture is minimal), 3) mixed-rainfed systems (mostly rainfed cropping combined with livestock keeping), and 4) mixed irrigated systems (in which a significant proportion of cropping uses irrigation and is interspersed with livestock).

According to Dixon et al. (2001), a farming system is defined as a group of farms with a similar structure, such that individual farms are likely to share similar production characteristics. Studying and classifying livestock production systems into production zones based on agroecological criteria and farming systems characteristics provides an opportunity for grouping production systems with similar challenges and opportunities, and can thus simplify the planning of development options/interventions.

Accordingly, the Odisha livestock production systems have been classified into three production zones: hilly and mountain; northwest; and coastal plain (Figure 1 and Annex III). Within these three production zones, commercial or specialized livestock production systems exist. These systems include urban and peri-urban dairy, and layer and broiler poultry.

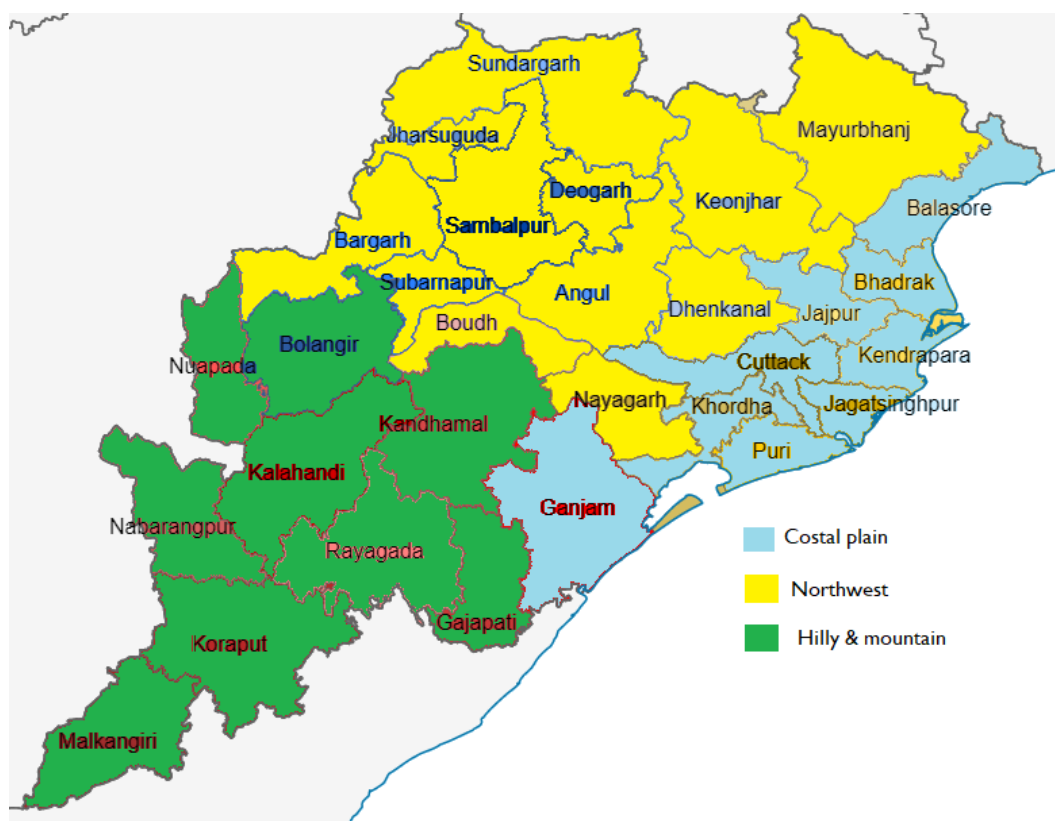
Classification of livestock production systems in the three regions considers dominant species, feeding practices, and the potential for future improvement (Table 1). Cattle dominate in the coastal plain zone, whereas goats and poultry are more common in the northwest and hilly and mountain zones. There are large differences in feed management between the zones: farmers in the coastal plain zone mostly depend on commercial feed, but unimproved grazing dominates in the hilly and mountain zone. The landholding size is small (0.77 ha) in the coastal plain zone compared to other zones, and stall-feeding predominates. However, the coastal plain has better irrigation facilities and thus better access to water than the other two zones. The frequent occurrence of cyclones and floods in the coastal plain zone hinders investment in both ruminants and poultry production.

**Table 1: Indicators for classification of traditional livestock production systems in Odisha, by production zone**

Criteria	Livestock production zone		
	Hilly and mountain	Northwest	Coastal plain
Dominant species	Goat, poultry, cattle, sheep	Goat, cattle, buffalo, poultry	Cattle, buffalo, goat, sheep, poultry
Livestock feeding practice	Extensive (mostly grazing) for all species	<ul style="list-style-type: none"> <li>Semi-intensive (grazing and stall feeding);</li> <li>extensive (sheep and goat)</li> </ul>	<ul style="list-style-type: none"> <li>Semi-intensive (stall feeding, grazing);</li> <li>intensive feeding for crossbred cattle;</li> <li>more dependence on the market for feed</li> </ul>
Challenges	Affected by both drought and flood	Affected by both drought and flood	Prone to floods and cyclones
Irrigation	Not much land under irrigation	Medium irrigation facilities	Better irrigation facilities
Opportunities	<ul style="list-style-type: none"> <li>Suitable for small ruminants;</li> <li>suitable for chickens and pigs</li> </ul>	<ul style="list-style-type: none"> <li>Suitable for goat and backyard poultry;</li> <li>dairy farming is increasing</li> </ul>	<ul style="list-style-type: none"> <li>A well-developed market for dairy and goat;</li> <li>the crossbred cattle population dominates</li> </ul>

Source: Expert opinion and field visits.

Figure 1: Designated livestock production zones in Odisha State.



The coastal plain zone also has a relatively better marketing infrastructure. In contrast, the northwest and hilly and mountain production zones have larger areas of forest and grazing lands that sustain goat and poultry production.

The demographic structure of the human population also differs in the livestock production zones (Table 2). There is a considerably higher population density in the coastal plain zone than in the northwest and hilly and mountain zones.

Table 2: Human demographic indicators in three livestock production zones, 2019a

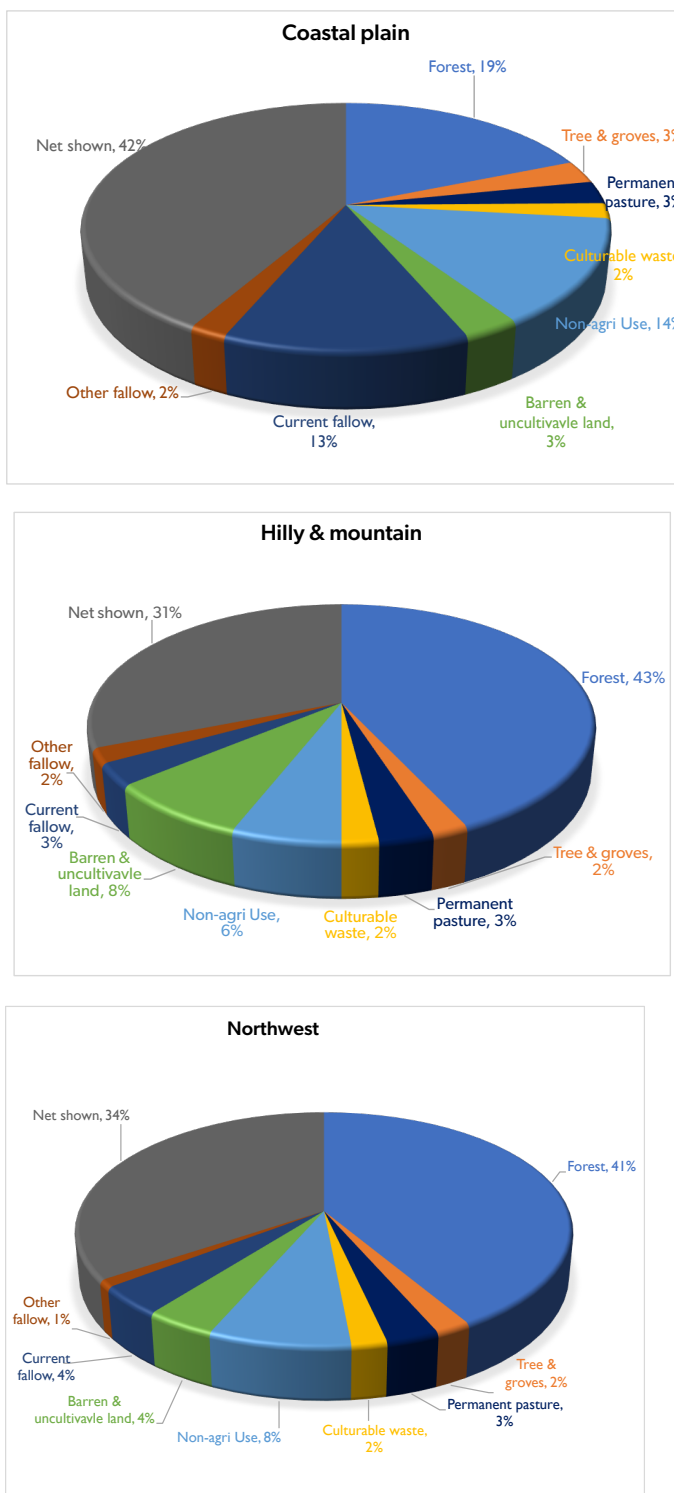
Indicators	Livestock production zone			Odisha
	Hilly and mountain	Northwest	Coastal plain	
Density of population (people per km <sup>2</sup> )	163	216	655	270
Sex ratio, (females per 1,000 males)	1,023	967	967	972
Literacy rate (%)	54.8	74.1	82.5	72.9
Scheduled Caste population (%)	15.4	17.0	20	17.1
Scheduled Tribe population (%)	45.7	27.5	4.0	22.8
Workforce (% of total population)	39.9	43.8	39.2	44.0
Per-capita income (INR)	35,408	47,327	40,726	41,772
Poverty rate (%)	63.8	41.3	22.3	35.0

a Based on data, different indicators were calculated for different livestock production zones.

Source: Government of Odisha 2020b.

The female-to-male ratio is higher in the hilly and mountain zone, which is dominated by the tribal population. The literacy rate is higher in the coastal zone, while the poverty rate is higher in the hilly and mountain zone. There is not much difference in the workforce in the three livestock production zones (Government of Odisha 2020b). In all zones, women provide most of the labour in caring for livestock and traditional poultry.

Figure 2: Land utilization pattern in different livestock production zones<sup>a</sup>.



<sup>a</sup> 'Net shown' represents the total area sown with crops and orchards. An area sown more than once in the same year is counted only once. [http://eands.dacnet.nic.in/PDF\\_LUS/Concepts\\_%26\\_Definitions.pdf](http://eands.dacnet.nic.in/PDF_LUS/Concepts_%26_Definitions.pdf) (accessed 1 July 2021). Source: Government of Odisha 2018b.

Land utilization differs between livestock production zones (Figure 2). The land used for cultivation (net shown area<sup>4</sup>) is highest in the coastal plain zone, whereas the other two zones have much larger proportions of forest cover (>40%). The land area under permanent pasture is smaller than both these uses in all three livestock production zones.

4. Net shown area represents the total area sown with crops and orchards. An area sown more than once in the same year is counted only once. [http://eands.dacnet.nic.in/PDF\\_LUS/Concepts\\_%26\\_Definitions.pdf](http://eands.dacnet.nic.in/PDF_LUS/Concepts_%26_Definitions.pdf) (accessed 1 July 2021).

## 2.3 Livestock numbers by species and production zone

Data on livestock numbers and production for 2020–21 are not yet available for most species. For this reason, values for livestock farming other than commercial chicken production were projected using values from the 2018–19 livestock census and observed growth rates from the previous livestock census published in 2012. Using data from these two censuses, a seven-year growth rate was calculated for each species, and the average annual growth rates were used for the projection (Table 3). This assumes that the rate of growth during the past two years has been equal to the previously observed annual average, despite the potential effects of factors like the COVID-19 pandemic. The 2020/21 data for commercial layers and broiler chickens were collected from the Directorate of Animal Husbandry & Veterinary Services, Odisha.

Table 3: Livestock growth rates and initial numbers used to estimate 2020/21 livestock numbers in Odisha

Species/breed	Annual growth rate	2018/19	Estimated 2020/21
Indigenous breeds	-3.0%	79,94,977	75,19,721
Crossbreeds	2.9%	15,80,380	16,99,921
Total cattle	-2.0%	95,75,357	92,19,642
Sheep	-2.7%	12,79,149	12,10,153
Goats	-0.2%	63,93,452	63,62,982
Desi chicken, backyard	2.3%	1,50,55,875	1,57,48,983
Improved crossbreed chicken, backyard	5.1%	11,67,225	12,90,127
Commercial chickens (layer)	a	a	86,87,000
Commercial chickens (broiler)	a	a	60,00,000

<sup>a</sup>not needed for 2020/21 estimates because up-to-date data were collected from the Odisha livestock department.

According to the projections for 2020–21, Odisha has considerable numbers of cattle, goats and chickens, and a smaller number of sheep (Table 4). Most animals (especially cattle) are managed in non-commercial production systems; the number of cattle in peri-urban and urban dairy systems is quite small as a proportion of the total.

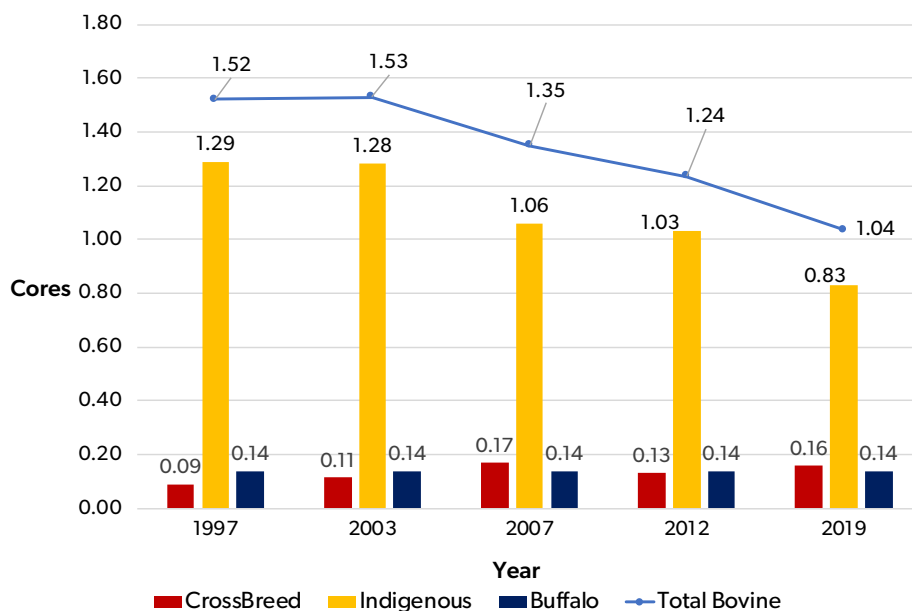
Table 4: Estimated number of livestock by species, production zone and type of system, 2020/21

Species, system	Total animals, (lakh)	Livestock production zones and systems			
		Hilly and mountain zone (lakh)	Northwest (lakh)	Coastal plain zone (lakh)	Peri-urban and urban dairy (lakh)
Cattle	92.2	24.2	31.8	35.9	0.3
Goats	63.6	15.8	33.3	14.5	--
Sheep	12.1	5.0	4.2	3.0	--
Chickens			309.1		
Desi			150.6		
Improved			12.90		
Layers			86.9		
Broilers			60.0		

Source: Projections based on data from 2018–19 and average annual growth rates from 2012–19.

Although the Odisha livestock population is still large, the numbers of bovine species (cattle and buffalo) have been declining for more than two decades (Figure 3). Overall, the total number has declined by more than 30% since 1997, with a larger decline for indigenous cattle breeds. Despite the overall decline in bovine animals, the number of crossbred cattle was 14% higher in 2019 than in 1997, and the share of crossbreeds reached 16% of the total cattle population. The decrease in the total bovine population is due to a decrease in the indigenous cattle population. In addition, implementation of artificial insemination programs has resulted in an increased share of the crossbred population.

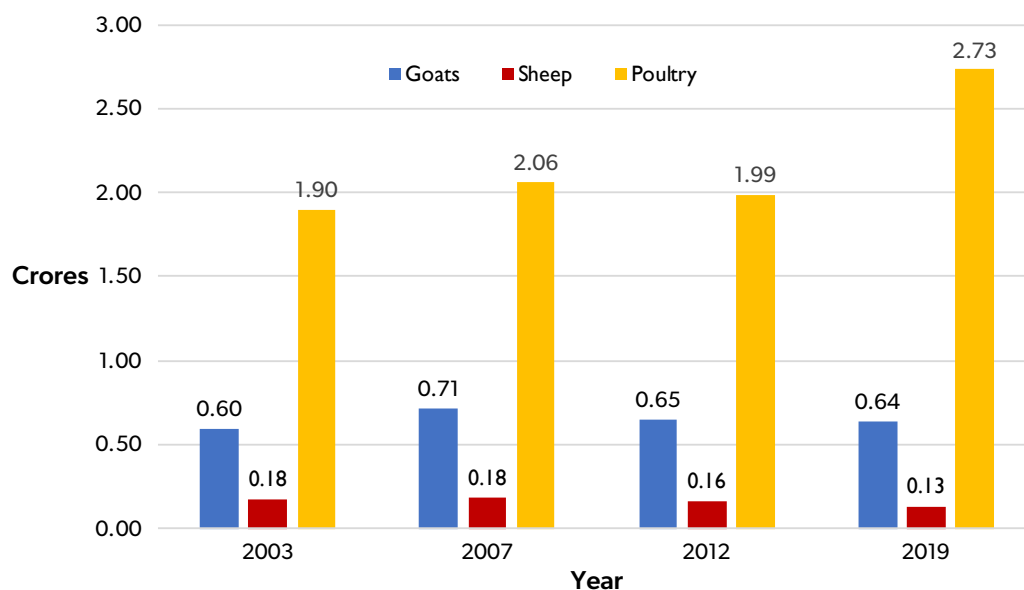
Figure 3: Number of bovine animals, by species and breed, selected years.



Source: Estimated from 16<sup>th</sup>, 17<sup>th</sup>, 18<sup>th</sup>, 19<sup>th</sup> and 20<sup>th</sup> livestock censuses (Government of India 2003, 2005, 2010, 2014, 2020).

For other livestock species, the patterns of change are different (Figure 4). Although the number of sheep has experienced a pattern of decline similar to that of cattle, there has been some growth in the number of goats from 2003 to 2019. The number of poultry (primarily chickens) has shown the most growth, increasing by 37% from 2012 to 2019.

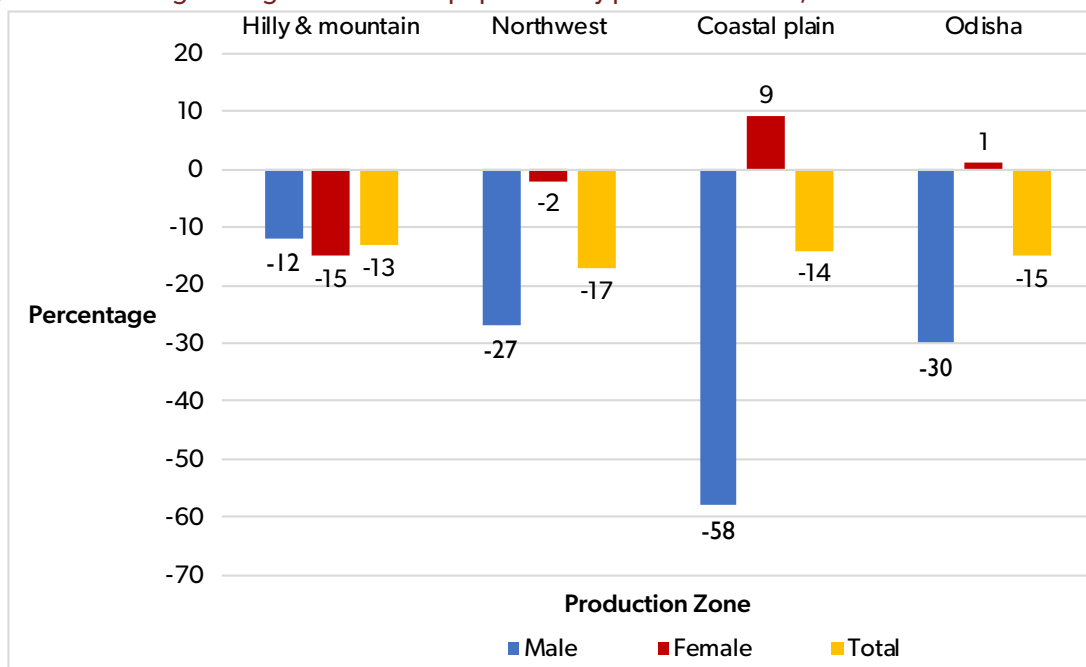
Figure 4: Number of small ruminants and poultry, by species, selected years.



Source: Estimated from 17<sup>th</sup>, 18<sup>th</sup>, 19<sup>th</sup> and 20<sup>th</sup> livestock censuses (Government of India 2005, 2010, 2014, 2020).

The structure of the livestock population has changed from 2012 to 2019, but the changes differ by zone based on available data (Government of India 2020 and 2014). The overall number of cattle has decreased in all zones (Figure 5), but the patterns differ by sex and genetic potential. The female cattle population has increased by 9% in the coastal plain zone but declined in the northwest and hilly and mountain zones.

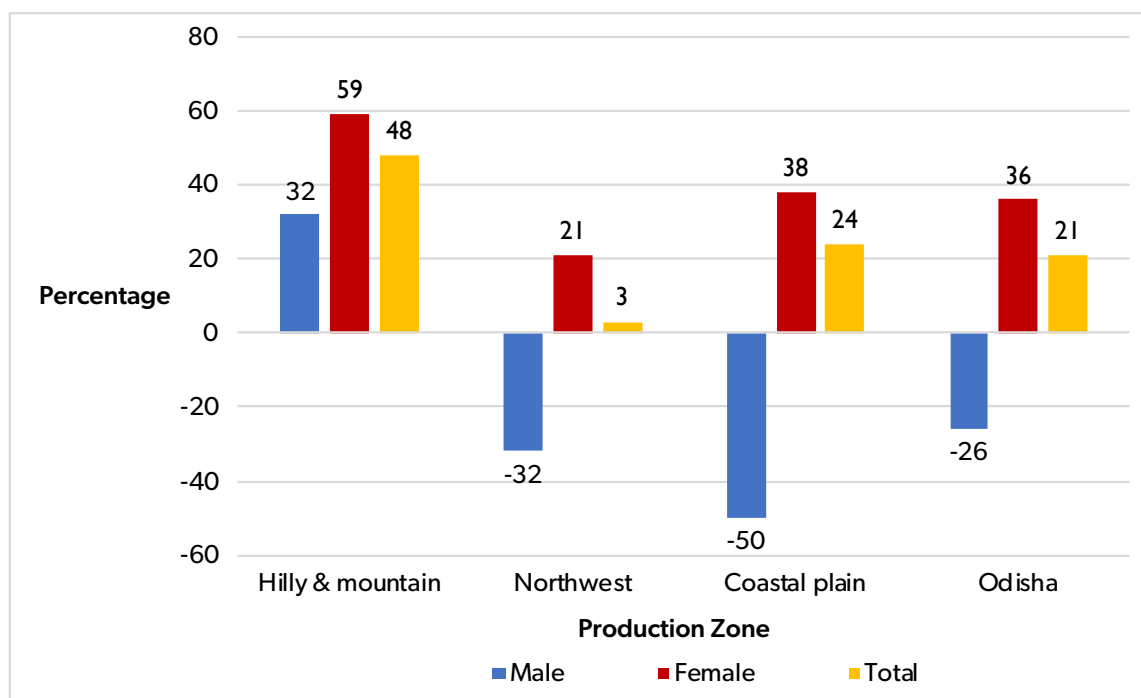
Figure 5: Percentage change in total cattle population by production zone, 2012 to 2019



Source: Estimated from 19<sup>th</sup> and 20<sup>th</sup> livestock censuses (Government of India 2014, 2020).

Crossbred female cattle have increased in all zones, with the largest proportional increase in the hilly and mountain zone and lowest in the northwest area. Overall, the female crossbred population increased by 36% in 2019 as compared to 2012 in the whole state (Figure 6).

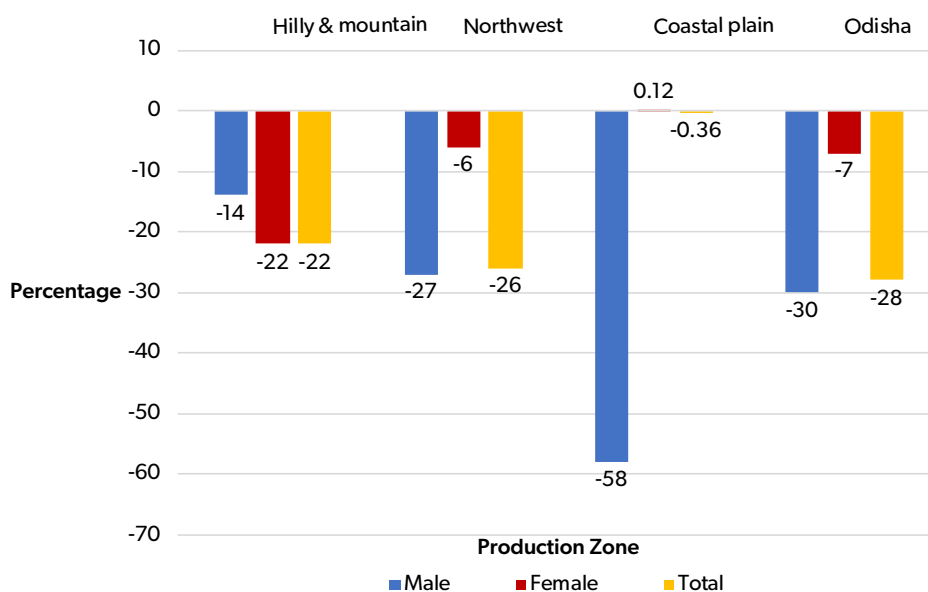
Figure 6: Percentage change in crossbred cattle population, by production zone, 2012 to 2019



Source: Estimated from 19<sup>th</sup> and 20<sup>th</sup> livestock censuses (Government of India 2014, 2020).

Both male and female populations have decreased in the hilly and mountain and northwest zones, while there is little change in the coastal plain zone (Figure 7). The number of male cattle has decreased for all zones, as has the number of females for local breeds. The largest decrease for the local cattle population occurred in the coastal plain zone, with smaller decreases in the northwest zone, and the lowest decrease in the hilly and mountain zone. The high decrease in the local cattle population in the coastal plain zone could be attributed to increased mechanization in farming and the promotion of crossbreeding.

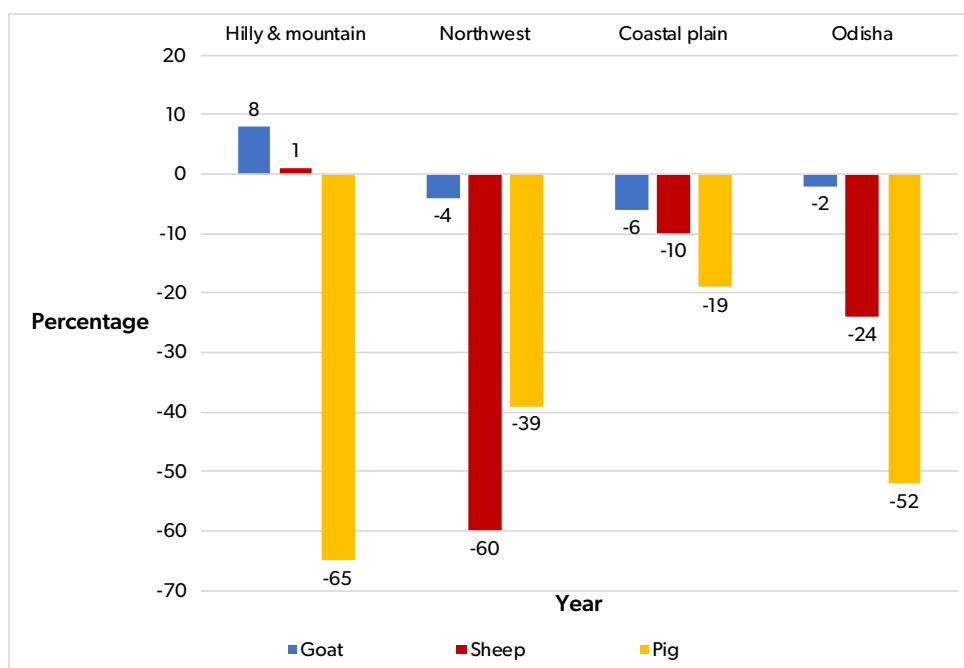
Figure 7: Percentage change in local cattle population, by production zone, 2012 to 2019



Source: Estimated from 19<sup>th</sup> and 20<sup>th</sup> livestock censuses (Government of India 2014, 2020).

The total populations of goats, sheep and pigs in Odisha also decreased from 2012 to 2019. (Figure 8). There were modest increases in goat and sheep populations in the hilly and mountain zone, but these were offset by decreases for all species in the other two zones: the pig population decreased by 52%, the sheep population by 24%, and the goat population by 2%.

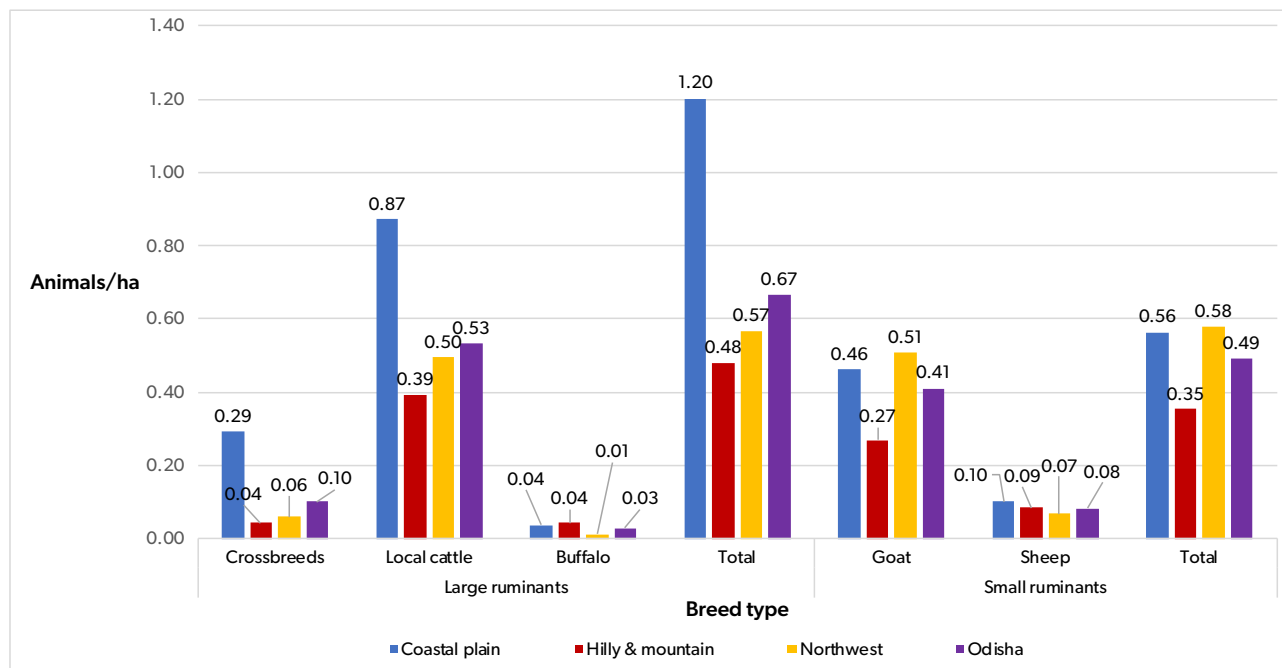
Figure 8: Percentage change in numbers of small animals, by production zone and species, 2012 to 2019



Source: Estimated from 19<sup>th</sup> and 20<sup>th</sup> livestock censuses (Government of India 2014, 2020).

The current livestock density (animals per hectare) differs by production zone and animal species (Figure 9). Cattle and buffalo density is highest in the coastal plain zone – more than double the density of the other two zones. In all zones, local cattle breeds are much more common than crossbred animals. Goat and sheep densities are similar in the coastal plain and northwest zones, but the density for all livestock species is lowest in the hilly and mountain zone. The coastal plain zone also has a poultry population density nearly twice that of the northwest and hilly and mountain zones (3.1 versus 1.6 and 1.2 birds/ha).

Figure 9: Density of livestock population (animals per hectare) by species and production zones



Source: Estimated from 20th Livestock Census 2019 (Government of India 2020) and Odisha Agricultural Statistics 2017–18 (Government of Odisha 2018a).

## 2.4 Livestock production by species and production zone

Red meat production is largest in the northwest production zone (Table 5). Both the northwest and hilly and mountain zones contribute more than three-quarters of the total meat production from ruminants. The quantity of sheep meat is low compared to that from goats, which contribute about 85% of total small ruminant meat production in Odisha.

Table 5: Estimated red meat production by species and production zone, 2020–21

Livestock production zones	Goat meat, tonnes	Sheep meat, tonnes	Total meat production, tonnes	% of total red meat production
Hilly and mountain zone	7,475	2,129	9,604	25.4%
Northwest zone	17,277	1,809	19,086	50.4%
Coastal plain zone	7,471	1,674	9,145	24.2%
Total red meat	32,223	5,612	37,835	100%

Source: Odisha livestock master plan projection.

Annual milk production in the most recent year is about 20 lakh t (Table 6). Nearly all this milk derives from cattle. About two-thirds of the total milk production is from the coastal plain production zone, and the rest of the milk is produced in the northwest (about 22%) and hilly and mountain zones (about 11%).

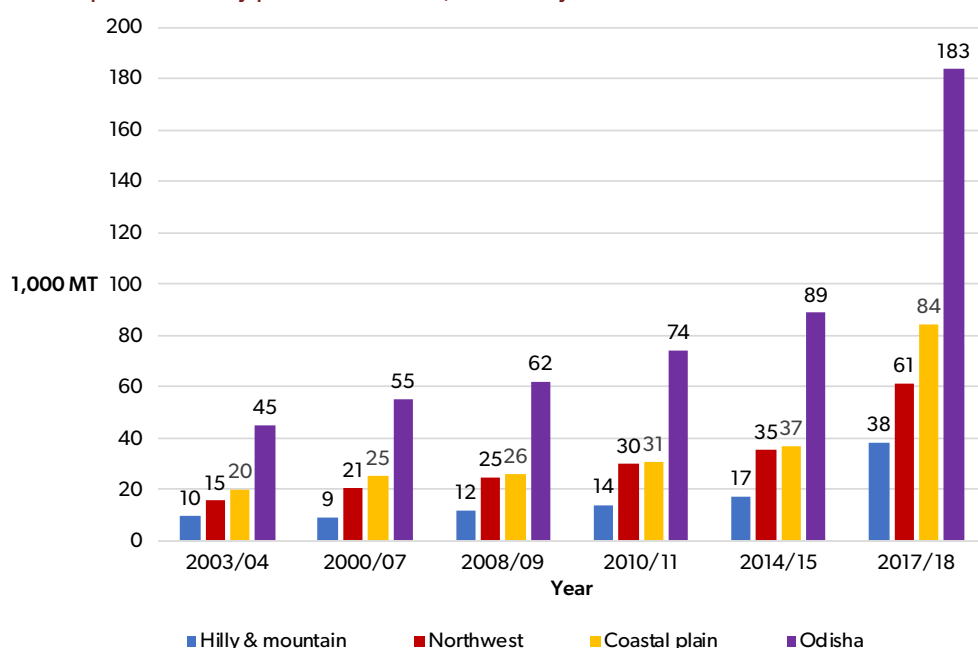
**Table 6: Estimated annual milk production by animal species and production zone, 2020–21**

Livestock production zones	Cattle	Goat	Total	% of total milk production
Hilly and mountain zone	2,188.6	1.7	2,190.2	11%
Northwest zone	4,520.0	3.0	4,523.0	22%
Coastal plain zone	13,003.1	1.5	13,004.7	65%
Commercial dairy	396.4	-	396.4	2%
Total milk	20,108.2	6.2	20,114.4	100%

Source: Own calculation.

Commercial dairy contributes only 2% of the total cow's milk production. Draught power and manure are other important products from cattle: indigenous cattle are almost the sole source of draught power, and all species produce manure. The distribution of these products follows the pattern of cattle numbers in the different production zones.

Meat production increased by 306% between 2003–04 and 2017 (Figure 10), an average annual compound increase of about 8%. Although meat production doubled from 2003–04 to 2014–15, growth was much more rapid from 2014–2015, averaging 27% per year. This recent more rapid growth is primarily attributed to an increase in poultry production.

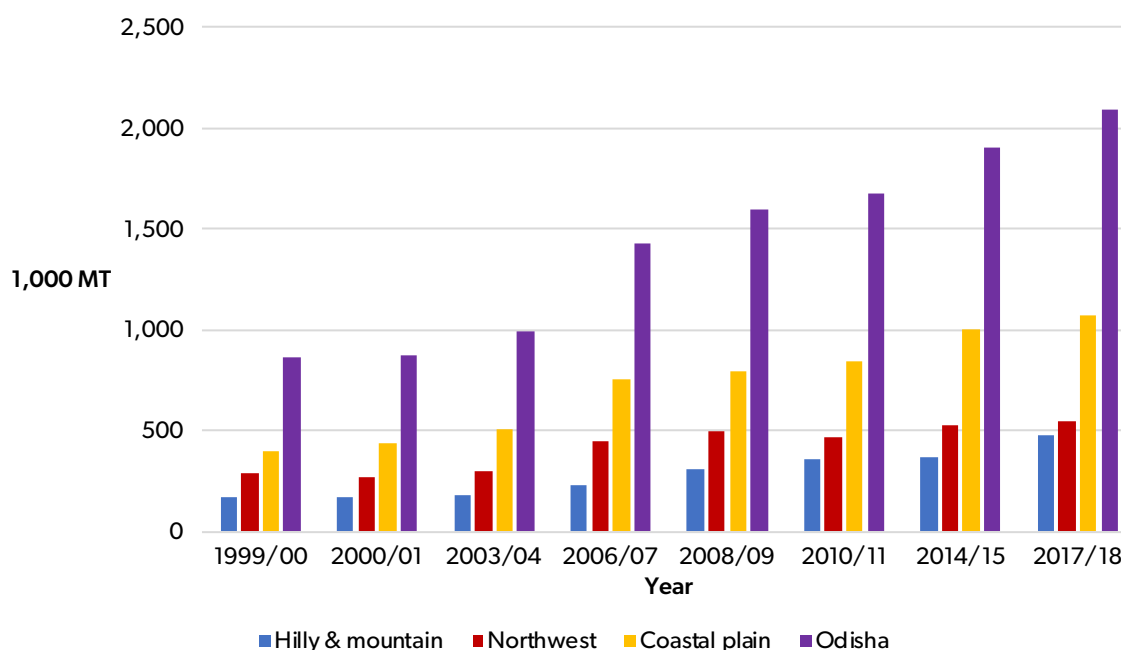
**Figure 10: Meat production by production zone, selected years**

Source: Estimated from district statistical handbooks of different districts (Government of Odisha 2001, 2005, 2007, 2009, 2010a, 2011, 2015a, 2020b).

Milk production in Odisha has increased by 243% between 1999–2000 and 2017–18, an average annual compound growth rate of about 5% (Figure 11). The fastest rate of growth (5.9% per year) was in the hilly and mountain zone, but more than half of the increase in total milk production occurred in the coastal plain zone.

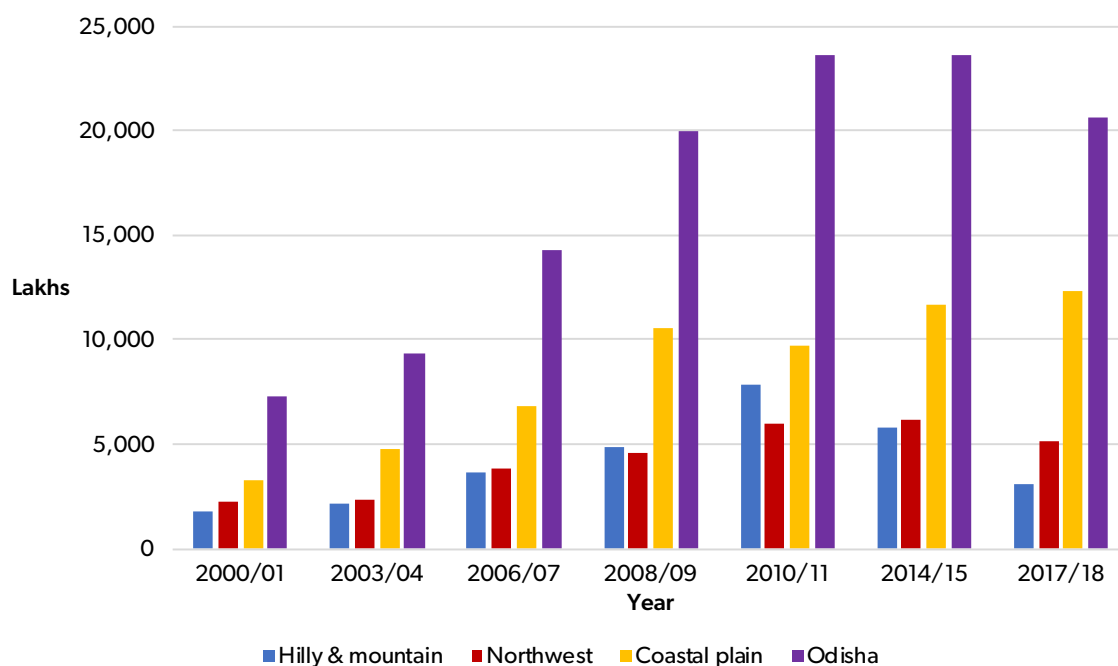
Egg production in Odisha also increased markedly over the past two decades (Figure 12), with an average annual compound growth rate of about 6%. Two-thirds of the increase in production occurred in the coastal plain zone, which grew at more than 8% per year. Production in the other two zones was highest in 2014–15, and then declined until 2017–18 by 10% in the northwest zone and by more than 60% in the hilly and mountain zone. The declining trend in the hilly and mountain zone could be attributed to a decline of the backyard poultry population in the region.

Figure 11: Milk production by production zone, selected years



Source: Estimated from district statistical handbooks (Government of Odisha 2001, 2005, 2007, 2009, 2010a, 2011, 2015a, 2020b).

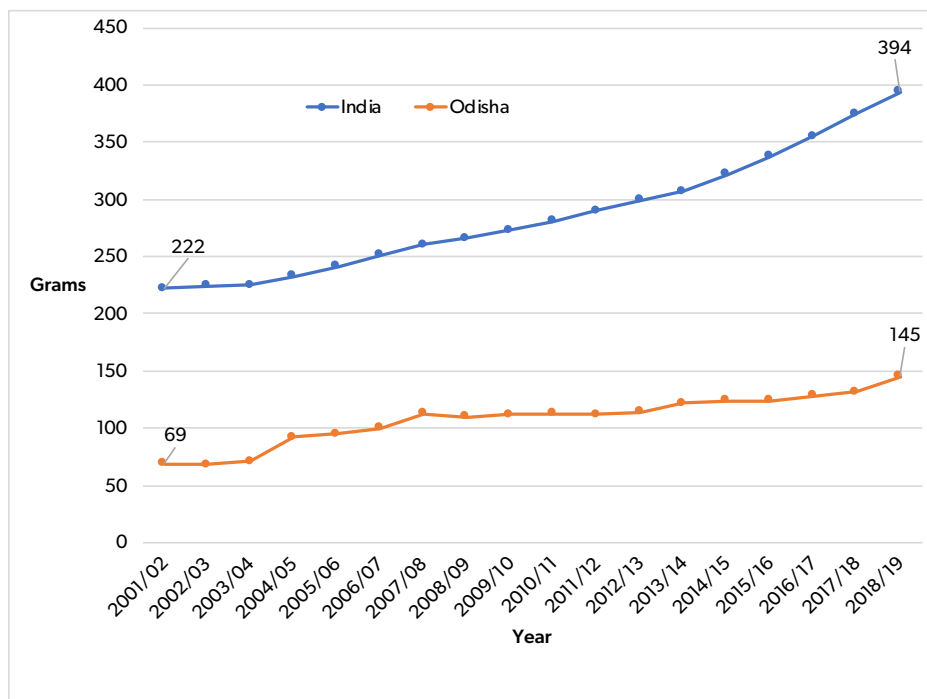
Figure 12: Egg production by production zone, selected years



Source: Estimated from district statistical handbooks (Government of Odisha 2001, 2005, 2007, 2009, 2010a, 2011, 2015a, 2020b).

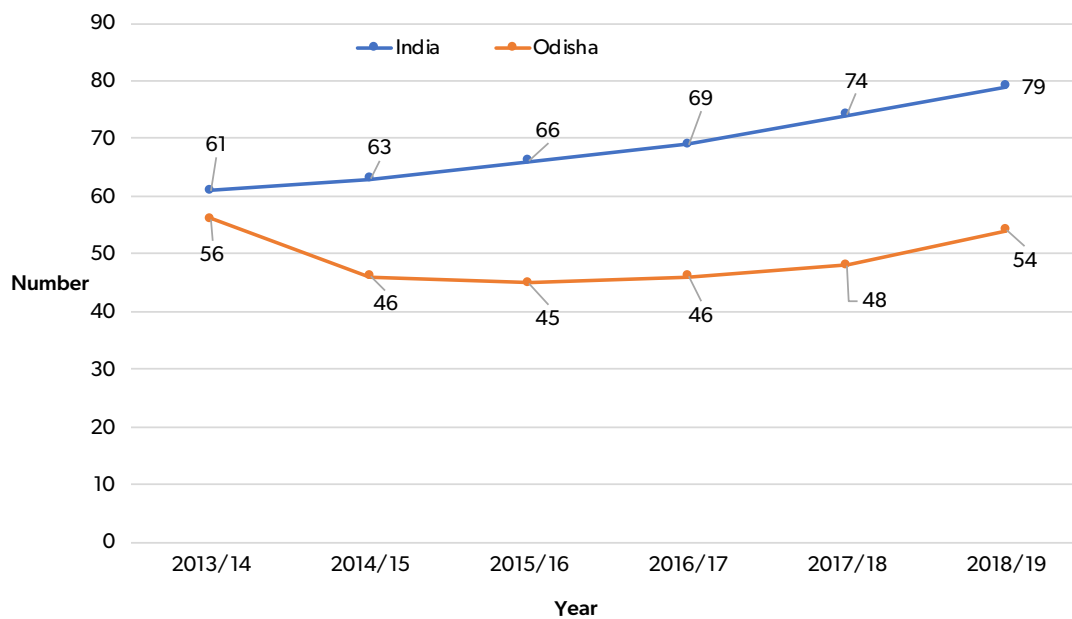
Changes in per-capita availability (production divided by human population) is another way to assess changes in livestock production. Milk production per capita increased in Odisha from 2001–02 to 20017–18, but at a slower rate than for India as a whole (Figure 13), and per-capita availability in Odisha has been only about one-third of the value for India. Although egg production has increased in Odisha, per-capita egg availability in 2018–19 was lower than in 2013–14 (Figure 14) due in part to production declines noted previously for zones other than the coastal plain. Notably, the rate of increase in per-capita egg availability has been greater for India as a whole than for Odisha.

Figure 13: Per-capita milk availability for Odisha and India, selected years, grams/person/day



Source: NDDB 2020.

Figure 14: Per-capita egg availability for Odisha and India, selected years, eggs/person/year.



Source: Government of India 2019.

## 2.5 Contribution of livestock to Odisha gross state domestic product

According to data from the Directorate of Economics and Statistics Odisha, livestock production made an important contribution to GSDP during 2019/20, with a value of about INR 18,800 crore (USD 2.5 billion at current exchange rates), using values at current basic prices, i.e. nominal GSDP. Projections using the approach

described above resulted in an estimated value for livestock output in 2020–21 of about INR 21,000 crore (USD 2.8 billion at current exchange rates). Cattle accounted for more than 80% of the value of livestock products in 2020–21 (Table 7), with large contributions from milk production, manure and draught power. Most of this value was provided by indigenous cattle rather than crossbreds. Draught power continues to be an important product from cattle in Odisha. Both cattle and buffaloes provide draught power, and crop production still depends on these animals (Akila et al. 2016; Kurup 2003).

**Table 7: Estimated value of livestock contribution to Odisha gross state domestic product, 2020–21, by species and product type (crore)**

Species	Meat or live animals	Milk	Eggs	Hides and skins	Manure	Draught power	Total	% of total
Cattle	818.7	4,640.1			5,519.3	6,168.5	17,146.6	81%
Goats	1,858.7	2.9		13.5	23.7		1,898.9	9%
Sheep	281.8			0.5	5.7		288.0	1%
Chickens	1,564.7		234.4		20.5		1,819.6	9%
Total	4,523.9	4,643.0	234.4	14.0	5,569.2	6,168.5	21,153.1	100%

Source: Values projected using the livestock sector investment and policy toolkit.

Each of the three production zones contributes about one-third of the economic contribution from livestock in Odisha (Table 8). Commercial dairy and chicken production are not reported by production zone, but they contribute about 9% of the value of livestock production overall.

**Table 8: Estimated value of livestock contribution to Odisha gross state domestic product, 2020–21, by production zone, crore**

Production zones	Value of livestock product	% of livestock contribution
Hilly and mountain zone	6,551.42	31%
Northwest zone	6,097.21	29%
Coastal plain zone	6,568.62	31%
Not bounded by zone (e.g. peri-urban or urban dairy)	1,935.81	9%
Total	21,153.06	100%

Source: Analysis using the livestock sector investment and policy toolkit.

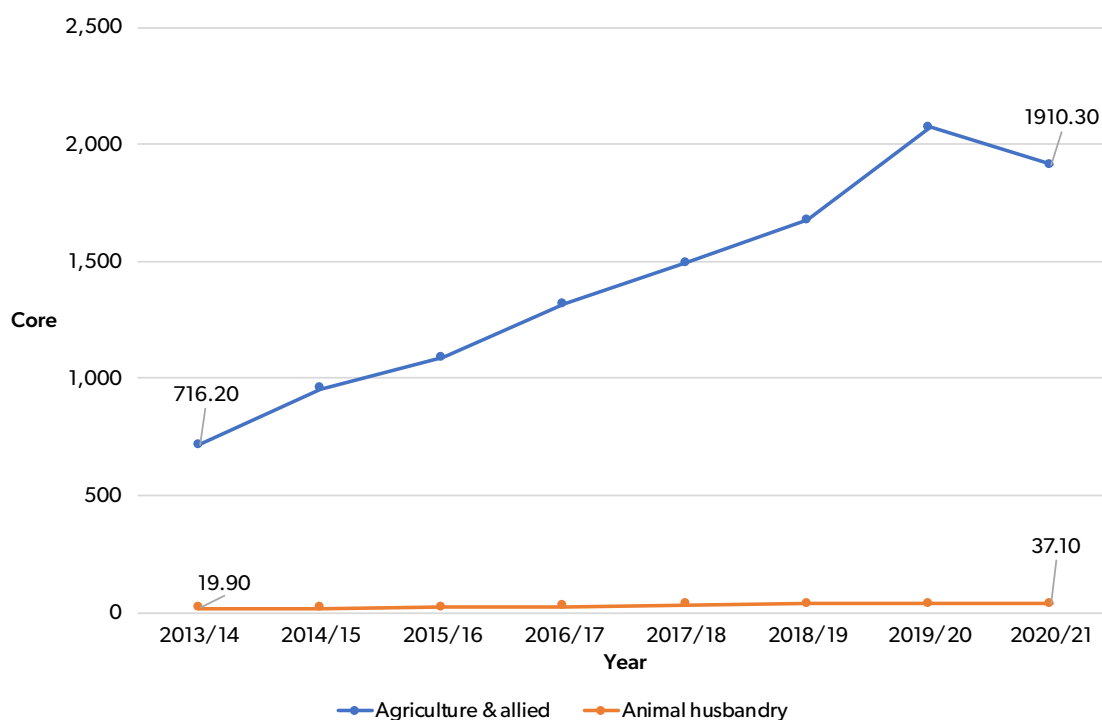
### 3 Policy and organizations relating to Odisha’s livestock sector

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The Government of Odisha has implemented several policy measures with the objective of improving livestock productivity and reducing poverty. In 1996, the state formulated its first comprehensive agricultural policy that included livestock, and in 2002, it became the second Indian state to formulate a separate state-level livestock policy. This policy aimed to make the livestock sector an engine for socio-economic development of the rural poor and to increase household income, rural employment and quality of life. In 2020, the Government of Odisha launched a new agricultural policy known as Samrudhi (Government of Odisha 2020a). This policy supports individual farmers and women’s self-help groups (WSHG) on egg and poultry meat production.

Despite the increasing contribution of the livestock sector to GSDP, the proportion of the state budget for agriculture that is focused on livestock has grown less rapidly than for agriculture as a whole since 2013/14, with its share declining from 3% to 2% (Figures 15 and 16). The budget for the livestock sector constitutes a small fraction of the state agricultural budget, which seems inconsistent with the large share of agricultural GSDP generated by livestock and the stated priorities to leverage improved livestock production for economic growth and poverty reduction.

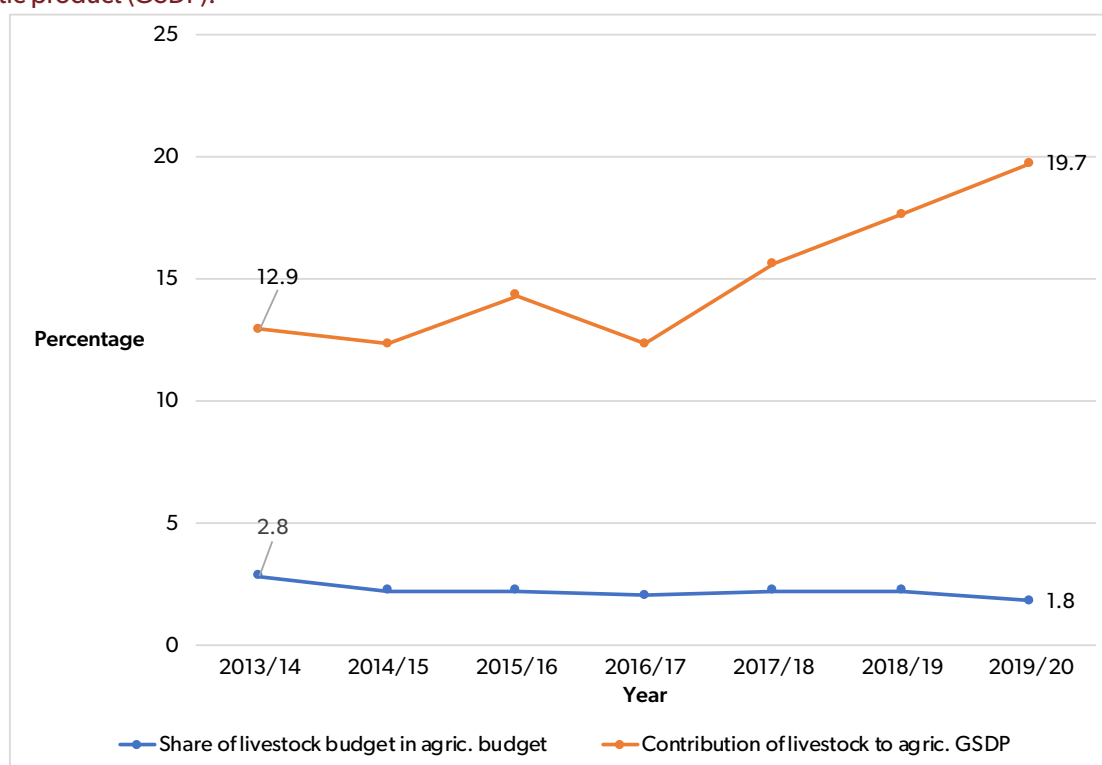
Figure 15: Government of Odisha budget for agriculture and livestock development.



Source: Estimated from agriculture budgets (Government of Odisha 2013, 2014, 2015b, 2016, 2017, 2018b, 2019, 2020c).

This section reviews the current major policies and organizations affecting Odisha's livestock sector and discusses institutional constraints, evidence and suggested/recommended actions for priority livestock production systems in Odisha. The information in this section derives from many studies, including major policy documents, government directives, regulations, acts, laws, strategies, previous road maps and research papers. The review covers general topics in animal health, animal breeding, animal nutrition, livestock research and livestock extension services; it then discusses areas relevant for more specific livestock species or products: milk (dairy), poultry (chickens) and goats. This section concludes with a discussion of the important issue of gender inclusion.

**Figure 16: Livestock share of state agriculture budget and livestock contribution to agricultural gross state domestic product (GSDP).**



Source: Estimated from agriculture budgets (Government of Odisha 2013, 2014, 2015b, 2016, 2017, 2018b, 2019, 2020c).

### 3.1 Animal health

Animal health plays an important role in livestock production, especially as Odisha's tropical climate facilitates contagious and parasitic diseases (Sethi and Tripathi 2017). Despite appreciable growth in the animal health service sector, there is still a prevalence of economically important diseases, including foot and mouth disease, mastitis, brucellosis, haemorrhagic septicaemia, black quarter, theileriosis and infectious bovine rhinotracheitis. The main deterrent behind more effective animal health services is the inadequate availability of doorstep services (services provided at the farm/home rather than the veterinary hospital/dispensary) and insufficient veterinary institutions.

With the addition of more mobile veterinary units in all the state blocks (especially in inaccessible pockets), doorstep services have increased remarkably in recent years. However, health services are dispersed and not always accessible to female farmers who rear goats and backyard poultry, or to farmers more generally in the hilly and mountain zone. Sahoo et al. (2020) argued that coverage is very low despite a zero-cost vaccination policy in a disease-endemic region. The low uptake of livestock vaccination appears more strongly associated with social and cultural factors rather than economic ones. Similarly, Nayak et al. (2019) found that the outbreak of animal diseases like anthrax in the tribal region is attributed to poor vaccination coverage and unsafe handling and disposal of contaminated carcasses.

Despite all districts having a disease diagnostic lab as a referral unit for testing pathological samples, the units are not performing at capacity. This is because of a shortage of subject matter specialists and lab assistants, or a lack of reagents and equipment. Additional constraints include a lack of quality control and service regulation, and an inadequate disease reporting system. The National Animal Disease Reporting System that links to the Animal Diseases Research Institute (ADRI) and the Central Disease Reporting and Monitoring Unit at New Delhi is currently in operation, but it needs improvement and proper monitoring. A functional link between ADRI and the district diagnosis lab should be established for proper disease surveillance, diagnosis and exchange of information. Involving the community in disease reporting is an important way forward. The policy recommendation is to target more women than men in 'One Health training' to ensure better compliance of control strategies for zoonotic disease: women need to be trained since they work closely with animals.

The main approaches to further developing the livestock sector include facilitating greater private sector involvement in rural areas. Agencies involved in the marketing of livestock inputs and products (including integrators) could be encouraged to invest in the animal health care sector. Eight districts in Odisha have a district mineral foundation (DMF)<sup>5</sup>, and this could be allocated to improve animal health for deprived groups through coordination with the State Animal Husbandry Department (AHD).

Since AHD focuses mainly on dairy animals, Prani Mitra and other private players interested in providing services to livestock farming more broadly should also be supported. A memorandum of understanding has been signed with the Odisha Livelihoods Mission (OLM) to ensure that the Prani Mitra program runs aligned with AHD's objectives and synergies, in order to make it more efficient and effective. Convergence with other programs like Odisha Tribal Empowerment Livelihoods Programme (OTELIP) (a project of the Government of Odisha supported by funding from the International Fund for Agricultural Development) would be useful in increasing production by farmers, and for the long-term sustainability of service providers. Similarly, WSHG created by Mission Shakti could be a good platform for engaging with female livestock farmers for extension and training.

## 3.2 Animal breeding

Optimizing the reproductive performance of an animal is one strategy for enhancing the sustainability of livestock production (White et al. 2015). Animal breeding services have made considerable progress in advancing this strategy for the bovine sector in recent years. The Animal Husbandry Department provides bovine breeding services with assistance from the Odisha Livestock Resources Development Society. Other actors such as the Odisha State Cooperative Milk Producers' Federation and the BAIF Development Research Foundation also provide bovine breeding services.

Artificial insemination (AI) has increased the population of breeding livestock, but the impact of AI is limited as more than 50% of animals are outside the AI program. More engagement of non-governmental organizations (NGOs) in breeding services is restricted due to stringent government guidelines, and privatization of AI services lacks proper monitoring and assessment. The major factors and constraints in animal breeding include inbreeding due to improper storage of semen straw, and poor monitoring and selection of bulls for semen collection.

There are initiatives to conserve and develop four recognized cattle breeds of Odisha State: Binjharपुरi, Motu, Ghumsari and Khariar (Government of Odisha, 2015d). However, not much effort has been made to upgrade goat, sheep and pig breeds. According to a perspective plan for livestock development in Odisha, the recommended breeding policy for sheep and goats is selective breeding within the existing distinctive Odisha breeds of sheep and goats. Odisha State intends to implement this plan by promoting the production of breeding stock for sheep and goats through large- and medium-scale farmers, and by promoting breeders' associations for input supply, training and extension.

5. District Mineral Foundation (DMF) is a non-profit body primarily established in those districts affected by the mining works. DMF are statutory bodies in India established by state governments to benefit people in mining affecting areas. Every mining leaseholder pays a fraction of royalty costs, not exceeding one-third, to the DMF as per rates prescribed by central government. The funds are used for the development of the area those affected by the mining.

The state has a breeding policy covering all geographic regions that focus on species-breeding issues. It recognizes the importance of research institutes, and includes a uniform curriculum on AI training. However, the policy doesn't encompass a regulatory authority to govern the use of germplasm, or an institutional framework for implementing a regulatory framework, including a strategy on monitoring AI. Nor does it establish an animal identification authority or mention strategies for adapting to climate change.

There is a high incidence of repeat breeding; however, it is difficult to identify the specific causes for this. Other constraints include inadequate monitoring, an irregular supply of liquid nitrogen, poor semen quality, a shortage of manpower, and a disproportionate and untargeted allocation of AI.

Recommended policy action includes revisiting and properly implementing the breeding policy; privatizing AI services; reinforcing genetic improvement; encouraging private and public partnerships; developing a breed standard and initiating herd/clock books for existing local breeds; providing extension services and training to farmers; establishing an identification, registration and performance testing system for purebred animals; ensuring adequate expertise and infrastructure; and establishing livestock breeders' associations and societies.

Until breeder associations are formed and are functional as proposed by the perspective plan, it would help if breeding bucks could be supplied from government farms. Moreover, given that more than 80% of goat production is in the hands of female farmers, the policy needs to involve women during implementation. Furthermore, government schemes and policies targeting poor and marginalized livestock farmers should not include land ownership as a prerequisite to receiving goats, backyard poultry (BYP) or even cattle, as women rarely have land registered in their names.

### 3.3 Animal nutrition

Animal nutrition is an important component of livestock production. Studies have found that a higher intake of animal feed generally increases production and quality (Garg 2012). The currently observed mean values of milk production per cow (both crossbreed and indigenous) suggest that dairy animals' genetic potential for milk production is not fully exploited (Sethi and Tripathy 2017). This is likely due to a shortage of feed resources, and feeding of unbalanced rations. Animal feeding in Odisha is traditional and depends mainly on locally available feed resources, including crop roughages like paddy straw and home wastages. In addition, female goat farmers depend on common property resources to graze their animals, and forests to collect fodder grass.

There is insufficient land and water to produce the number of cultivated feeds (grains and forages) necessary for improved animal diets. In addition, there is a lack of technical support services for fodder cultivation, inadequate fodder seed/stem, and a non-existent fodder market. On top of this, the relief code that compensates agricultural crop damage caused by natural calamities or by wild animals doesn't cover fodder crop damage, which discourages farmers from cultivation of fodder crops in Odisha.

The Government of Odisha plays an active role in making land available for feed production, establishing feed quality standards and monitoring, regulating forage seed markets, supplying high-yielding multi-cut forage varieties, and establishing policies, regulations and incentives to support private sector investment in animal feeding. It recognizes that policies enabling women to access and sustainably develop common property resources (CPR) and forests result in better availability of green fodder, and an increase in subsequent production. Likewise, introducing simple technologies like cultivating *Azolla* or making mineral blocks can enhance productivity and incomes.

To further enhance animal nutrition, the Ministry of Environment, Forest and Climate Change could encourage the planting of fodder trees during tree plantation drives and afforestation exercises. In addition, the Animal Husbandry Department can improve feed marketing and supply channels by strengthening animal feed factories and distribution selling points, supporting community fodder banks and technologies, and providing training, extension and professional education for farmers.

## 3.4 Livestock research

Development of the livestock sector requires adequate investment in research, education and training to generate and disseminate new technology, inputs, services and institutional options. Currently, there are inadequate operational resources, and the share of animal sciences among total agricultural research staff expertise and expenditure remains low. Only 0.5% of the total state budget and 3.5% of the agricultural budget were allocated to all-livestock-related activities in 2019–20. And the state has only one veterinary college – at the Odisha University of Agriculture and Technology (OUAT).

Although many in-service officers undertake higher education courses with state government assistance, there is no platform for selecting research problems based on the state's research priorities. As a result, most livestock research appears oriented towards academic interest instead of need-based issues. The department's research-based activities are also narrow – generally limited to increases in cattle milk production. Research and development in the small ruminants sub-sector are limited, as is the development of technology that helps to save time and reduce drudgery for women.

The Odisha University of Agriculture and Technology coordinates the Krishi Vigyan Kendra (KVK) knowledge network, which disseminates research findings in all 30 districts of Odisha State. But most of the KVK groups have limited numbers of animal production and health scientists, resulting in poor technology transfer. As a result, animal husbandry institutions are deprived of information on emerging issues. Moreover, training sessions run by KVK reach few farmers, and women are generally not the recipients due to mobility issues and household responsibilities that do not allow them to travel far.

Despite the importance of livestock in rural economies, gender roles in livestock rearing in Odisha are still not fully researched, documented or recognized in economic terms. The state's censuses do not collect sex-disaggregated data, and this lack of information affects the success of any intervention targeting beneficiaries whose livelihoods depend on livestock.

There is a growing recognition of the need to integrate gender equality into livestock research initiatives. Gender equality enhances economic efficiency and productivity and leads to better health and educational outcomes for children. Training veterinarians and livestock production staff in gender issues, and teaming them up with social scientists, is therefore recommended – in order to get appropriate research questions that lead to more grounded research with efficient use of resources.

Collaboration between veterinary universities and research organizations, and national and international research organizations could pave the way for building capacity in Odisha State. Required policy action includes developing multidisciplinary systems-oriented livestock research that must include all stakeholders; encouraging research, training and extension linkage and platforms; building capacity for research scientists including animal scientists; and promoting private and public partnerships for infrastructure investments.

## 3.5 Livestock extension services

The extension service plays an important role in raising farmers' awareness of improved technologies that can enhance farm efficiency, income and welfare (Purcell and Anderson 1997). Livestock aid centres and additional veterinary assistant surgeons, functioning under the Animal Husbandry Department, provide extension services in their jurisdictions. In most cases, there are uniform and adequate extension materials. Similarly, during their routine visits to villages, livestock inspectors are expected to share useful information and promote department activities – but often this does not happen. In addition to AHD, other agencies involved in livestock programs like KVK provide extension services, but are unable to do so effectively as most have few veterinarians. Moreover, the coverage of, and access to, these agencies is limited. Some private entities, such as poultry integrators, provide both inputs and technical know-how to their clients.

Within livestock extension, services are primarily focused on milk production rather than other roles of livestock, and are concentrated in areas of high potential. Veterinarians provide multiple services related to animal health (i.e. routine, urgent and important care) but are also expected to provide extension services that include breeding, feeding, marketing and management for all livestock and poultry species. As a result, not all intended extension messages reach target clients. This is most pronounced in the case of the (mostly female) owners of small ruminants and poultry, who are not targeted for extension meetings, and whose species are not given adequate attention. Livestock extension through agencies like KVK and OUAT is not realistic as their major focus is on crops. Extension for animal husbandry requires a completely different knowledge base and skillset and hence a dedicated workforce that engages with both male and female livestock farmers close to their farms.

Policy recommendations include improving coverage of livestock extension to include all livestock species, and considering a restructuring of AHD to include extension programs with both male and female extension staff. In addition, sensitizing extension workers on gender issues could improve extension by facilitating the inclusion of both a husband and a wife in training sessions. In conjunction, training for women's groups would be more effective if situated at venues close to women's homes, with childcare and separate bathrooms provided. For female farmers, in particular, ICT (information and communication technology) can strengthen the linkages between extension, research and farmers. The Animal Husbandry Department should therefore invest in the creation of communication and training materials that use smartphones, cell phones, radio, TV and the internet, where appropriate, to disseminate extension and advisory services to female farmers.

Moreover, there is also a need for strong partnerships between the public sector, private sector, local and international NGOs, farmer organizations, and research and education agricultural institutions. Besides a sufficient quantity and quality of knowledge, other factors also important for the delivery of an efficient livestock extension service: linkages between farmers, research and training; adequate infrastructure in strategic locations; and local facilities.

## 3.6 Dairy

Although the share of milk in the total output value of the livestock sector is declining, dairy farming remains a major source of income among small and marginal farmers in rural Odisha. Production and marketing for the dairy sector have not developed in Odisha as they have in other northern or southern Indian states. Given the growing demand for milk, the dairy industry has an opportunity to expand profitable production, but this requires strong institutional support, improvement of the milk value chain, better rural infrastructure and health-care facilities, and improved availability of good quality feed. Private sector investment in dairy infrastructure is also needed in the state.

Appropriate policy actions include monitoring and supervising AI service delivery, strictly enforcing a breeding policy, enhancing the capacity of field staff, providing additional training for farmers, strengthening quality control, running educational campaigns to improve the quality of milk and dairy products, improving the monitoring of feed quality, increasing the capacity of formal milk processing, and strengthening the marketing chain.

## 3.7 Small ruminants

Small ruminants are reared predominantly by the landless, marginal farmers and smallholders, for whom they have considerable value. Despite this, small ruminant production faces numerous challenges. Organizations that provide basic services are largely absent in rural areas. In addition, the sector is constrained by inadequate availability of good quality feed, a lack of effective policy for using CPR, the absence of a market for goat feed, poor health-care services, a lack of regulation for vaccine quality control, and inadequate extension services.

Appropriate policy actions to improve the goat sub-sector include improving service delivery for animal health, nutrition and breeding, enhancing the availability of good quality feed, formulating effective policies for better utilization of CPR, strengthening goat breeding farms and fodder farms, and enhancing access to input and output markets by encouraging the formation of farmer producer organizations. Strengthening women's participation and leadership roles in existing or new livestock-related groups through rules such as a rotating leadership or a 30% reservation in the board would also facilitate the dissemination of knowledge. For CPR, AHD should work with the relevant departments to help livestock farmers gain access to communal land for growing fodder grasses and trees (subabul, sesbania) sustainably. Concurrent training for women and youth about feed production and animal nutrition (e.g. formulating rations) could reduce feed costs and increase productivity.

## 3.8 Poultry

The poultry development program in Odisha encompasses most aspects of poultry, meat and egg production in the state. In 2015, the Government of Odisha initiated a new policy for improving the poultry sector (Government of Odisha 2015c). The main objective of the Poultry Policy 2015 is to create an environment conducive for both commercial and backyard poultry farming, and increase egg and meat production. The government has implemented different initiatives, but production remains constrained by multiple factors: limited availability of feed resources, poor quality feeds, limited research in improving local breeds of chicken, an inefficient marketing system, inadequate processing facilities and technical support services, a lack of basic infrastructure such as storage and transportation, limited assessment of investment options and inadequate access to credit.

Appropriate policy responses include strengthening the quality audit and compliance of commercial feeds, creating an environment conducive to public-private partnerships in the sector of feed provision, improving disease control and supporting genetic improvement. Other solutions include improving marketing infrastructure, providing additional technical support to farmers, and facilitating credit access for farmers and others in the value chain. The poultry sector would also benefit from the provision of low-cost hatcheries in backyard poultry areas at the community level, for WSHG and rural unemployed youth in particular.

Strengthening facilities for hygienic meat processing and storage of eggs could be linked with improved marketing. In addition, strengthening the capacity of research scientists working on chicken nutrition and health would support the development and dissemination of relevant production technologies. Further evaluation of low-input technology (LIT) birds as an income-generating option is required, as desi birds often are an accessible livelihood option for low-income households. LIT birds have the potential to provide animal-source protein sufficient to combat undernutrition, especially for women and children.

## 3.9 Hides and skin

Hides and skins are an important by-product that comprises a major input to the leather industry, contributes significantly to farmer incomes and earns foreign exchange. Although there is a large goat population in Odisha, formal processing of hides and skin is limited and the market is not well organized. As a result, the Odisha leather and footwear industries are not as developed as those in other states (Government of India 2011). Leather processing in Odisha comprises about 13 facilities (one public) but is constrained by a lack of modern treatment plants, high taxes and an irregular power supply. Most leather processing is concentrated in a small number of locations in the coastal region of Odisha, including Bhubaneswar, Berhampur, Cuttack, and Jatni (Government of India 2011). There are no large abattoirs in the state from where good quality hides and skins can be retrieved; instead, these hides and skins come from informal slaughterhouses.

An appropriate policy response is to create an environment that enables the private sector to build good quality leather-processing industries. There is a need to increase awareness of the industry among livestock farmers, and initiate support mechanisms such as tax breaks and subsidies to encourage existing leather industries. Moreover,

improved management of production resources (land, water, biodiversity) and enhanced breeding strategies, along with an improved value chain and marketing for hides and skins, are crucial. Likewise, strategies are required for accumulating critical volumes of good quality products that attract buyers, so that differential prices can be negotiated.

## 3.10 Livestock and livestock products processing and marketing

Demand for livestock and livestock products in terms of quantity and quality is expected to increase in the future due to an increase in per-capita incomes and urbanization. However, the marketing and processing system in the livestock sector is relatively unorganized compared to that for other products. For example, more than 80% of milk is sold outside of formal milk marketing channels, and 100% of goats are sold through informal channels.

Most goat keepers, especially female farmers in remote areas, lack market power compared to middlemen or goat traders and may not benefit sufficiently from seasonal increases in demand, such as that provided by the Eid festival. The presence of multiple intermediaries in the marketing chains for informal livestock products probably contributes to higher transaction costs. Small and marginal farmers have a very small marketable surplus, and these higher costs reduce any market benefits they can derive. The development of organizations that vertically integrate small and scattered producers could benefit these producers if they can reduce costs and increase bargaining power.

Recommended actions to improve livestock marketing include creating extension and communication campaigns to improve farmers' awareness about the importance of quality and hygiene standards; enhancing the livestock market information and research system; strengthening monitoring and certification of standards; encouraging the formation of farmer producer organizations in rural areas; and encouraging private sector investment in the processing of livestock products. AHD focuses on production and does not have a mandate for the processing or marketing of livestock products. Forming linkages with other departments is therefore recommended; these departments include the Department of Agriculture and Farmers' Empowerment, the Department of Mission Shakti, the Directorate of Export Promotion and Marketing, and the Panchayati Raj and Drinking Water Department in the Government of Odisha, as well as the Odisha Rural Development and Marketing Society and Panchyati Raj. Likewise, partnerships between AHD and the private sector could help train women on food safety and hygienic milking practices, entrepreneurial and technical skills in product development, animal-source foods, and value addition (e.g. by producing ghee, paneer and sweets).

## 3.11 Social and gender inclusion—policy requirements

### 3.11.1 Samrudhi Agriculture Policy 2020

The Samrudhi Agriculture Policy 2020 acknowledges the role of women in agriculture and mandates that at least 30% of horticulture and small livestock scheme budgets are dedicated to women. The scheme extends interest-free loans for WSHG up to 5 lakh, and tracks the share of women in the total number of beneficiaries in government assistance initiatives. However, the policy does not mention women's role in livestock farming as separate from crop production; therefore, interventions for empowering women in the livestock sector do not get enough attention. The need for extension material to cater for women engaged in backyard livestock/poultry farming has been stated, but there is as yet no clarity on how this will be institutionalized given the limited outreach of AHD. It is recommended that AHD employs dedicated staff for carrying out extension activities related to livestock, especially small ruminants and BYP, and village-level Prani Mitra vets can be trained for this purpose.

The Samrudhi policy document focuses on BYP but fails to acknowledge desi birds and LIT birds as two distinct production systems. While desi BYP is done traditionally by almost all rural female poultry keepers, LIT birds have been introduced (as a livelihood support mechanism) through various government schemes, and make poultry farmers dependent on inputs like day-old chicks and poultry feed. Economic analysis suggests that BYP are more lucrative than LIT birds in terms of enhancing livelihoods. Evaluation of whether farming of LIT birds genuinely supports livelihoods should therefore be carried out before more schemes are launched.

Samrudhi also states that female vaccinators should be available to administer poultry vaccinations, but that subsidized vaccines are to be provided only by the Government of Odisha. This has implications for program effectiveness, as budgets for vaccination are limited and there are not enough to cover the entire population of BYP and small ruminants, especially after discounting vaccinations for large ruminants. NGOs have successfully piloted various models for paid vaccinations in Odisha and other states, and these need to be scaled up.

Creating awareness of the advantages of preventive health care, and the availability of vaccines (with private sector involvement) and vaccinators, would decrease mortality and increase production. Vaccinations of goats and BYP would also benefit from a vaccinator–private sector partnership to ensure that vaccination is timely, with each entity in the value chain standing to benefit. It is recommended that a mass vaccination program runs as a sustainable business model, with vaccines supplied by the private sector, services delivered by Prani Mitra, and services paid for by female farmers. The involvement of Prani Mitra as a service provider will increase employment avenues for rural women and provide role models for young girls.

### 3.11.2 Gender-responsive policies, programs and schemes for rural women

Many Government of Odisha policies, programs and schemes are directed towards increasing the incomes and agency of rural women, and have included goat and BYP keeping as a livelihood option. These programs can serve as a platform for AHD to increase its outreach and enhance livestock production by female farmers. This convergence is imperative since the activities of AHD are focused on enhancing the health of livestock and providing adequate bullock power for agricultural operations: they do not necessarily include managing social aspects to achieve this mandate. Moreover, AHD does not have an extension department enabling it to share up-to-date technologies or conduct training with farmers of both genders.

Under the Deen Dayal Antyodaya Yojana National Rural Livelihoods Mission of central government, OLM aims to mobilize and organize poor women – building their skills, facilitating access to credit, providing marketing assistance, and offering other livelihoods services. Around 18 lakh women are connected with OLM through 1.6 lakh self-help groups spread across 24 districts. OLM supported the training of 2,120 Prani Mitra vets through modules on poultry and goat rearing lasting 15 days. It intends to support about 20,000 households in backyard poultry activities, and another 10,000 households for goat rearing.

The Department of Women and Child Development's Mission Shakti program has provided support to help operationalize about 6.02 lakh WSHG, involving more than 70 lakh women of Odisha State. For livestock, Mission Shakti has supported commercial layer farming using a deep litter system, in order to increase egg production in convergence with Odisha's Directorate of Animal Husbandry and Veterinary Services. This will increase egg production in Odisha State, as well as enhance the nutrition of women and children. More joint programs with Mission Shakti can help AHD to reach female farmers using WSHG.

The Odisha Rural Development and Marketing Society (ORMAS) has widened WSHG's marketing scope through the 'Pallishree Mela' and 'Sisir Saras' crafts and produce fairs. Linking female farmers in WSHG to ORMAS so that they can sell value-added livestock products would enable them to increase production of animal-source foods.

Change is needed within AHD. The role of female livestock keepers needs to be acknowledged, appreciated and applauded by AHD first; then communities and households will follow suit. Some additional gender-responsive policy recommendations include:

- AHD should collect sex-disaggregated livestock data to inform the design of gendered policies for the livestock sector.
- AHD should consider recruiting a gender focal person, or assigning someone from its department for this role, and training him/her in mainstreaming gender into all activities and schemes.

AHD should include gender issues in its induction program in order to sensitize staff members to the differential needs of male and female livestock farmers to encourage them to provide services accordingly. This will also help AHD staff to acknowledge women as primary livestock farmers and their main clients.

## 4 Livestock production constraints and opportunities for growth

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The livestock sector plays a vital role in economic development and poverty reduction in Odisha. However, it must confront several limitations: a lack of improved germplasm; an inadequate supply of good quality semen; the frequent occurrence of diseases, floods and cyclones; an acute shortage of feed and fodder; and limited market linkages. Furthermore, many socio-economic and institutional factors – such as shrinking common lands for grazing, and a lack of access to markets, credit, and information about livestock technologies – restrict farmers from realizing the production potential of their animals. Overcoming these challenges and constraints requires suitable development strategies targeted to the regions and species that can generate significant economic and social gains without causing damage to the environment and natural resources.

In the 2010–20 perspective road map of the Government of Odisha’s Fisheries and Animal Resources Development Department, efforts were made to identify the problems faced by the livestock sector and the interventions required to achieve targets by 2020 (Government of Odisha 2010b). However, this analysis was not systematic, nor was it detailed with priority value chains and livestock production zones. This section of our analysis highlights the most important constraints to current production and identifies factors that could facilitate future growth – considering feed resources, animal health, animal breeding, and processing and marketing challenges. This information provides useful background information for the identification of potential interventions, as set out in the foresight scenario analysis of the state’s livestock sector strategy (Bahta et al, 2022b). The information on constraints and facilitating factors derives from discussions with experts and published materials.

### 4.1 Constraining and facilitating factors in cattle systems

The cattle sector in Odisha is constrained by low productivity, a lack of access to good quality feed, and a frequent occurrence of diseases. Low productivity is due to several different factors, including low-yielding breeds, poor animal health and insufficient feed and fodder (Swain et al. 2015). Research into, and reduction of, these constraints are crucial for improving productivity in the livestock sector (Hardenberg 2016).

Odisha State has made significant improvements in milk production. However, milk productivity is still low compared to the national average and to that in neighbouring states like Andhra Pradesh. Lower production is attributed to the low percentage of crossbreeds and other improved breeds within the bovine population, and low milk yield from available indigenous breeds. Milk production per cow for indigenous breeds in Odisha is only about half that for indigenous breeds across the whole of India (Government of India 2019). At the same time, demand for milk and milk products within the state is increasing with growing urbanization and increased per-capita income. An increase in milk production would not only help meet this demand but would also substantively benefit marginal and landless households and provide additional employment to rural women .

The Government of Odisha has undertaken various measures supporting cattle production in the state. However, various constraints and challenges still exist within the sector (Table 9), as do factors facilitating opportunities for growth.

**Table 9: Constraining and supporting factors in cattle production, by production zone**

Category, region	Constraining factors	Supporting factors and opportunities for improvement
<b>Feeding</b>		
Coastal plain	Shortage of forage during summer, damage to fodder and crop residues during cyclone season, limited land for fodder production	Good water availability for forage production, good commercial feed availability, good resources for farmer training
Northwest	Limited water for forage production, high feed costs	Moderate water availability for forage production, legume residues availability, good resources for farmer training
Hilly and mountain	A predominance of grazing rather than stall feeding, limited forage production, fodder shortages, high cost of concentrate feeds	Natural forage availability, potential grazing in the forest periphery, potential for some forest products to be used as livestock feed, availability of crop residues (maize, millet, legumes)
All zones	Limited knowledge of animal feeding, limited use of concentrates and forage production, limited training (particularly for women), inadequate infrastructure and training at fodder seed production facilities and forage breeding research stations	Forage producer groups, government fodder and seed production farms, a climate conducive to increased fodder production
<b>Health</b>		
Coastal plain	Common incidence of milk fever and parasite infestations, high incidence of protozoan diseases, presence of anthrax, black quarter, haemorrhagic septicaemia and foot and mouth disease	Established network of animal health organizations
Northwest	Limited animal health infrastructure, high occurrence of anthrax, black quarter, haemorrhagic septicaemia and protozoan disease, pollution from industrial waste	
Hilly and mountain	Limited animal health infrastructure, high occurrence of anthrax, black quarter and haemorrhagic septicaemia	
All zones	Increasing costs of veterinary supplies, limited dissemination of information on disease prevalence	Mobile veterinary units
<b>Breeding</b>		
Coastal plain		Large breeding cattle population
Hilly and mountain	Uncontrolled breeding due to stray bulls	
All zones	Low productivity of indigenous cows, need for repeated breeding, anestrus, high cost of semen for artificial insemination	National artificial insemination program, eight 'bull mother' farms under the Directorate of Animal Husbandry & Veterinary Science, government and breeders' society organizations for breed improvement
<b>Markets</b>		
Coastal plain	Inaccessibility to formal milk collection centres, high cost of marketing A2 milk	Good infrastructure and producer organizations
Northwest	Limited marketing infrastructure and organizations (such as producer cooperatives)	Improved proximity to markets due to industrial development

Category, region	Constraining factors	Supporting factors and opportunities for improvement
Hilly and mountain	Low demand for milk products for cultural reasons, limited marketing infrastructure and organizations (such as producer cooperatives)	
All zones		Potential for women's increased involvement in milk production and marketing and greater control over income generated

Source: Literature review, expert opinion and stakeholder consultation.

## 4.2 Constraining and facilitating factors in goat systems

Small ruminants, especially goats, can play a crucial role in reducing poverty among the rural population – especially for the landless, the poor, and marginal farmers, including nomadic and ethnic tribal groups. Goat farming is widespread in Odisha, and the main source of livelihoods for the state's rural population. Odisha has potential to enhance the production of goat meat as more than 30% of its land still covered in forest, and demand for goat meat has been increasing over the years due to urbanization and a rise in per-capita income. About 95% of the state population are non-vegetarian (OB Bureau 2019) and goat meat is a popular food. However, the goat sub-sector faces many challenges, including a high mortality rate<sup>6</sup> and low productivity (Table 10).

Table 10: Constraining and supporting factors in goat production, by production zone

Category, region	Constraining factors	Supporting factors and opportunities for improvement
<b>Feeding</b>		
Coastal plain	Shortage of forage, damage to fodder and crop residues during cyclone season, limited land for fodder production, high cost of concentrate feeds	Potential for rice bunds to be used for fodder production, good water and irrigation access, availability of training
Northwest	Pollution of forage-producing land, seasonal water scarcity, limited organizational support for the development of silvopastoral production systems	A climate suitable for lucerne (alfalfa) production, availability of land for cultivation after kharif harvest, availability of water in reservoirs and rivers
Hilly and mountain	Large distance of common lands used for grazing from villages, limited cultivation of green fodder	Availability of browse plants in forests, field bunds wide enough for fodder trees, abundant grazing resources
All zones	Limited availability of concentrate feeds, limited information about appropriate fodder trees or grasses	27 departmental farms with fodder/seed production and fodder demonstration plots
<b>Health</b>		
Coastal plain	Adverse health impacts of cyclones and flooding	
Northwest	Summer heatwaves, industrial pollution, limited awareness of de-worming and vaccination and of access to facilities that provide these services	
Hilly and mountain	Limited awareness of de-worming and vaccination and of access to facilities that provide these services, natural disasters	

6. Previous studies reported that 27% of the mortality rate of goats is due to major diseases like PPR (peste des petits ruminants), brucellosis and endoparasites (IFAD 2018).

Category, region	Constraining factors	Supporting factors and opportunities for improvement
All zones	Absence of veterinary services, limited access to functional diagnostic facility, limited extension suitable for women, exposure of women to zoonotic diseases, high mortality rates, high incidence of parasites, limited awareness of the impacts of goat health on profitability	Animal health organizations and qualified personnel, private sector vaccine availability, mobile veterinary units in all areas
<b>Breeding</b>		
Coastal plain	No proper conservation or improvement of native breeds (e.g. Ganjam)	Availability of improved breeds such as Black Bengal and Ganjam
Northwest		Availability of improved breeds such as Black Bengal and Ganjam, experience with a buck exchange program
Hilly and mountain	Limited use of improved goat breeds, higher proportion of nondescript goats	Availability of improved breeds such as Black Bengal and Ganjam, experience with a buck exchange program
All zones	Unavailability of good breeding bucks at village level, sale of best bucks for slaughter (limited selection by farmers), inbreeding that reduces breed performance, no artificial insemination technology for goats	
<b>Markets</b>		
Coastal plain		Significant bargaining power for goat farmers
Northwest		
Hilly and mountain		Preference for meat as a food, positive perception of goat farming as a way to earn income quickly
All zones	A lack of market power and lower returns for farmers in informal markets, limited availability of market information and prices based on visual inspection, limited use of by-products such as bones and blood, few organizations for goat producers, limited participation of women in stages of the value chain other than production	Increasing demand and higher prices for goat meat, improved linkages between rural and urban areas, low investment requirements for women and youth, goat-rearing experience among poor and landless women which provides potential for additional growth, potential for youth to be involved in semi-intensive production, government programs supporting goat farmers, e.g. National Mission for Protein Supplement

Source: Literature review, expert opinion and stakeholder consultation.

## 4.3 Constraining and facilitating factors in sheep systems

The sheep value chain focuses on both small and large sheep farms. Many of the constraints and facilitating factors for sheep (Table 11) are similar to those for goats, but sheep production differs in that it is less widely practiced.

Table 11: Constraining and facilitating factors in sheep production, by production zone

Category, region	Constraining factors	Supporting factors and opportunities for improvement
<b>Feeding</b>		
Coastal plain	Shortage of forage, damage to fodder and crop residues during cyclone season, limited access to common land for grazing	Potential for seasonal fodder production in rice fallows
Northwest	Pollution of forage-producing land	A climate suitable for lucerne (alfalfa) and silvopastoral production, availability of land for cultivation after kharif harvest

Category, region	Constraining factors	Supporting factors and opportunities for improvement
Hilly and mountain	Limited cultivation of green fodder	Potential for fodder tree production in forests, field bunds wide enough for fodder trees
All zones	Limited forage cultivation and concentrate availability	Reservoir bunds and riverbanks available for fodder trees, 27 departmental farms with fodder/seed production and fodder demonstration plots
<b>Health</b>		
Coastal plain	Adverse health impacts of cyclones and flooding	
Northwest	Summer heatwaves, industrial pollution	
Hilly and mountain	Limited awareness of de-worming and vaccination and access to facilities that provide these services	Balangir breed that is resistant to high ambient temperatures and drought
All zones	Limited access to veterinary services, especially for migratory populations, limited extension services focused on sheep health	Native breeds that are adapted to their environment
<b>Breeding</b>		
Coastal plain	Lack of conservation and upgrading for recognized breeds (Kendrapara, Ganjam)	Producer popularity of the Kendrapara breed recognized by the National Bureau of Animal Genetic Resources
Northwest		Recognition of the Balangir breed
Hilly and mountain	Lack of conservation and upgrading for recognized breeds (Kendrapara, Ganjam)	Increasing sheep population and desirable production characteristics of the Koraput breed
All zones	Low productivity because of inbreeding, no artificial insemination available for sheep	Supply of rams from sheep-breeding farms at reasonable prices
<b>Markets</b>		
Coastal plain		Improvements in farmer bargaining power
Northwest		High demand for sheep meat in Andhra Pradesh and Chhattisgarh
Hilly and mountain		Preference for meat as a food, positive perception of sheep farming as a way to earn income quickly, demand for sheep meat in Andhra Pradesh and Chhattisgarh
All zones	Preference for meat other than sheep, a lack of market power and lower returns for farmers in informal markets, limited availability of market information and prices based on visual inspection, limited use of by-products such as bones and blood, few organizations for sheep producers	High demand for sheep meat, no religious taboos on consumption of sheep meat, low investment requirements allowing low-income farmers to own sheep, potential for profitability of commercial sheep with appropriate management, ability to sell sheep as liquid assets when cash is needed, experience of sheep production in low-income and landless households (especially with women and children), scope for further development of female sheep producers
<b>Other factors</b>		
All zones	Low social status of sheep farmers, no support programs for sheep, limited promotional programs compared to other livestock	

## 4.4 Constraining and facilitating factors in chicken value chains

The chicken value chain comprises both production in BYP systems and the commercial and specialized production of broilers and layers. Keeping backyard poultry can be an effective way to enhance access to micronutrients and protein-rich foods, and combat malnutrition in children and anaemia in women. It is an appropriate traditional activity for women because chickens are valued for various socio-religious ceremonies in tribal households. Notably, poultry birds are among the very few assets that a female farmer owns, and for which she has the power to decide on sales and usage of income accrued. Despite these advantages, BYP presents both challenges and factors facilitating growth (Table 12), as do commercial layer (Table 13) and broiler production (Table 14).

Table 12: Constraining and facilitating factors in backyard poultry (BYP) production, by production zone

Category, region	Constraining factors	Supporting factors and opportunities for improvement
<b>Feeding</b>		
Coastal plain	Limited area for scavenging	Availability of broken rice as a feed
Northwest		Availability of broken rice as a feed
Hilly and mountain		Availability of large areas for scavenging, low feed costs and management requirements
All zones	Reliance on scavenging as a feed without supplementation, potential for population increases to stress available feed supplies	
<b>Health</b>		
All zones	Lack of conservation or development of indigenous breeds, no formal egg-hatching capacity	Disease resistance of common breeds, potential for increased production and revenue through vaccination against Ranikhet (Newcastle) disease
<b>Breeding</b>		
All zones	High disease and predation mortality, limited capacity for vaccinating, limited extension capacity for increasing awareness of preventative health practices and food safety	Good brooding capacity of indigenous breeds that need only limited inputs
<b>Markets</b>		
Coastal plain		Increasing demand for poultry meat due to urbanization, potential for marketing a 'niche' product to urban consumers
Northwest		Increasing demand for poultry meat due to industrialization, importance of poultry in socio-cultural events
Hilly and mountain		Dietary preference for poultry meat, importance of poultry in socio-cultural events
All zones	Informal nature of markets, limited awareness of market potential among producing households, dependency of women on traders for sales (which are not based on weight)	Preference for meat and eggs from BYP, price premiums for BYP, ease of sales, increasing demand
<b>Other factors</b>		
All zones	Lack of policy recognition and support, potential for breed improvements to reduce genetic diversity, lack of compensation for women affected by natural disasters	Low workload for women and children, limited required health inputs (vaccination and worming), compatibility with other agricultural activities, low requirement for initial investment, potential for high financial returns

Source: Literature review, expert opinion and stakeholder consultation.

**Table 13: Constraining and facilitating factors in commercial layer poultry production, by production zone**

Category, region	Constraining factors	Supporting factors and opportunities for improvement
<b>Feeding</b>		
Coastal plain	Lack of maize for feeding	
All zones	Limited availability of materials for feed, limited feed-processing capacity and quality control, increasing and variable feed and ingredients prices	Availability of knowledge on feeding and production, potential to increase feed production
<b>Health</b>		
All zones	Natural disasters, recurrent disease, poor management (health and sanitary codes, light, ventilation)	Potential for health care to be provided by individual farms
<b>Breeding</b>		
All zones	Limited availability of day-old chicks and foundation parent stock	Availability of improved layer breeds and government support schemes
<b>Markets</b>		
Coastal plain	Cyclone impacts which discourage investment	
All zones	Limited shelf life of eggs at ambient temperatures, availability of eggs imported from other regions	Increasing demand for eggs, participation of roadside egg vendors in the commercial layer market
<b>Other factors</b>		
All zones	High initial investment costs, increasing costs of production, difficulty in complying with regulatory standards	Support of state government, labour availability, growing interest from entrepreneurs

Source: Literature review, expert opinion and stakeholder consultation.

**Table 14: Constraining and facilitating factors in commercial broiler poultry production, by production zone**

Category, region	Constraining factors	Supporting factors and opportunities for improvement
<b>Feeding</b>		
All zones	Increasing feed prices and lack of quality control	Potential for broiler integrators to provide feed and supplements, availability of broiler feed in the market
<b>Health</b>		
All zones	Increases in zoonoses, drug resistance and high mortality in informal production systems	Potential for broiler integrators to administer vaccines, tendency for farmers to seek vaccination support from local technical staff
<b>Breeding</b>		
All zones	Increasing prices for chicks and limited availability of good quality chicks	Potential for broiler integrators to provide chicks
<b>Markets</b>		
All zones	Potential for rapid increases in production to decrease future prices and lower profit margins, high degree of fluctuation in market prices, insufficient hygiene in production and marketing	Positive perception of broiler poultry products among consumers, potential for broiler production to provide opportunities for adding value (especially for youth), availability of multiple outlets for product sales, ability to provide a rapid return on investment, supportive government policy

Source: Literature review, expert opinion and stakeholder consultation.

# 5 Projections of production and consumption: the business-as-usual scenario

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Previous sections have described the historical performance of Odisha's livestock sector, summarized key policy initiatives and recommendations, and identified factors constraining or facilitating future growth of specific livestock value chains. This section complements the previous ones by projecting the future supply of, and demand for, livestock products (and their monetary value).

Projections of supply are made using quantitative tools from the livestock sector investment and policy toolkit. The LSIPT is a spreadsheet-based program that facilitates the integration of production and economic data to project future trajectories for livestock production and its monetary value. It was developed by a group of international agencies under the aegis of the African Union Interafrican Bureau for Animal Resources.

A core component of the LSIPT is a herd and economic sector model, which requires data inputs relating to current herd demographics and productivity, as well as per-unit product values. The LSIPT calculates future livestock numbers and the amount and value of livestock products. The model can be used to evaluate the trajectory for livestock production and its monetary value over the next 15 years based on the sector's current technical and economic performance but without additional investments in technologies or changes to policies. This is the business-as-usual scenario and is undertaken for each of the priority livestock value chains. This analysis can provide useful information for planning, and facilitates the assessment of future impacts of alternative investments.

One limitation of the LSIPT framework is that it requires each of the inputs to be entered as annual values over the projected (15-year) time horizon. Accurate prediction of future values for factors like mortality and prices can be challenging, which means that the projections (for baseline and investment scenarios) are best interpreted as approximations. Another important limitation of the model is the limited feedback between production parameters and factors like profitability, and limited interactions with the demand trajectory (which is calculated independently of the LSIPT).

The LSIPT also assumes average values that apply to all sets of producers, whereas there is often a good deal of heterogeneity among producers (especially smallholders), and for future investments, the impacts on adopters and non-adopters may differ substantially. Previous dynamic analyses of investments in technology adoption (e.g. Simões et al. 2019) have indicated that each of these factors can be important for future projections and assessment of investments.

## 5.1 Projected livestock numbers and production to 2035/36

Projections from the LSIPT indicate that the numbers of most ruminant species are expected to decline through 2035/36 (Table 15), although by less than 1% per year over the 15-year-period for most species and herd sizes.

The numbers of crossbred cows and chickens are projected to increase, with growth in the number of chickens being particularly rapid. Crossbred cows are projected to increase from 18% to 27% of the total cattle herd by 2035/36, which implies an increase in average milk produced per cow.

**Table 15: Projected animal numbers by 2035/36 and percentage change by animal species and breed, herd size category, or type of production system<sup>a</sup>**

Species and breed, herd size category, or production system	Estimated 2020/21	Projected 2035/36	Per cent change between 2020/21 and 2035/36	Compound annual growth rate
Cattle	92,19,642	91,74,996	0.5%	0.0%
Indigenous breeds	75,19,721	66,92,781	-11.0%	-0.8%
Crossbreeds	16,99,921	24,82,215	46.0%	2.6%
Sheep	12,10,153	10,89,275	-10.0%	-0.7%
Small flocks	8,35,378	7,61,187	-8.9%	-0.6%
Large flocks	3,74,775	3,28,088	-12.5%	-0.9%
Goats	63,62,982	62,60,432	-2.0%	-0.1%
Small herds	50,90,386	50,32,079	-1.1%	-0.1%
Large herds	12,72,596	12,28,353	-3.5%	-0.2%
Chickens				
Desi backyard	1,57,48,983	2,20,72,495	40.0%	2.3%
Improved crossbred backyard	12,90,127	27,33,486	112.0%	5.1%
Commercial chickens (layer)	86,87,000	3,62,87,756	318.0%	10.0%
Commercial chickens (broiler)	60,00,000	1,65,54,190	176.0%	7.0%

<sup>a</sup>Estimated values for 2020/21 are based on 2018/19 data and annual average growth rates for 2012 to 2019. Projected values are based on assumptions used in the livestock sector investment and policy toolkit, for which details are provided in Table 3. The compound annual growth rate is calculated as:  $(\text{value from 2035/26}/\text{value from 2020/21})^{1/(\text{number of years})} - 1$ . For comparison with Table 3, average annual growth rates from 2012 to 2019 were: -3.0% for indigenous cattle, 2.9% for crossbreeds; and -2.0% for all cattle, -2.7% for sheep, -0.2% for goats, 2.3% for desi backyard chickens, 5.1% for improved crossbred backyard chickens.

Changes in livestock numbers imply changes in projected production through 2035/36, with 33% more milk production, a more than doubling of chicken meat production, and four times as much egg production (Table 16).

**Table 16: Projected livestock production by 2035/36 and percentage change by livestock product category**

Livestock product category	Estimated 2020/21	Projected 2035/36	Per cent change between 2020/21 and 2035/36	Compound annual growth rate
Milk and milk products (lakh litres)	20,114.4	26,493.0	31.7%	1.9%
Cow milk	20,108.2	26,486.9	31.7%	1.9%
Goat milk	6.2	6.1	-1.5%	-0.1%
Meat (000 t)	140.9	280.3	98.9%	4.7%
Goat meat	32.2	31.7	-1.6%	-0.1%
Mutton	5.6	5.0	-10.7%	-0.8%
Chicken meat	103.1	243.6	136%	5.9%
Eggs (lakh)	21,666.6	85,543.3	295%	9.6%
Hide and skins (t)	2,679.1	2,593.7	-3.0%	-0.2%
Manure (000 t)	28,068.2	29,172.2	4.0%	0.3%
Draught power (000 days)	1,23,060.9	1,13,019.3	-8.2%	-0.6%

The economic value of all livestock production is projected to increase by about 14% by 2035/36 (Table 17), with decreases in the highest-value category of draught power more than offset by increases of about one-third

in meat and milk production. The value of eggs shows the largest increase, more than doubling by 2035/36. By species, the value of chickens (i.e. eggs and meat) is projected to nearly double (Table 18), the value for cattle is projected to increase less than 1% per year, and the value of small ruminant production is set to decrease.

**Table 17: Projected gross value of livestock production by 2035/36 and percentage change by livestock product category (crore/year)**

Livestock product category	Estimated 2020/21	Projected 2035/36	Per cent change between 2020/21 and 2035/36	Compound annual growth rate
Meat and live animals	4,523.9	5,809.1	28.4%	1.7%
Milk	4,643.0	6,338.4	36.5%	2.1%
Eggs	234.4	552.7	135.8%	5.9%
Hides and skins	14.0	13.7	-2.8%	-0.2%
Manure	5,569.2	5,645.3	1.4%	0.1%
Draught power	6,168.5	5,663.5	-8.2%	-0.6%
Total	21,153.1	24,022.7	13.6%	0.9%

**Table 18: Projected gross value of livestock production by 2035/36 and percentage change by livestock species (crore/year)**

Livestock species	Estimated 2020/21	Projected 2035/36	Per cent change between 2020/21 and 2035/36	Compound annual growth rate
Cattle	17,146.6	18,505.8	7.9%	0.5%
Goats	1,898.9	1,860.7	-2.0%	-0.1%
Sheep	288.0	255.6	-11.2%	-0.8%
Chicken	1,819.6	3,400.6	86.9%	4.3%
Total	21,153.1	24,022.7	13.6%	0.9%

## 5.2 Projected consumption of livestock products to 2035/36

Projections of future consumption complement projections of future production and help in planning future investments. Although projecting consumption and production increases separately does not ensure consistency, comparing these projections can indicate the degree to which incentives may exist for expanded consumption and production. In principle, projections of consumption and production should be linked, and other factors such as inter-regional trade accounted for.

By definition (conservation of mass), it is not possible to have an actual gap (or surplus) in consumption that equals the difference between the projections. This is because market conditions are affected by a change in demand relative to supply, implying changes in prices or inter-regional trade that would bring the two quantities more closely into balance. A gap between 'actual consumption' (which is affected by prices and income) and 'potential consumption' is possible, but is difficult to assess using simple projection methods.

Future consumption is projected using information on current estimated per-capita consumption, the expected growth in population, and the effects of income growth as measured using an income elasticity value. (An income elasticity value indicates the percentage change in consumption for a 1% increase in income.) Using an income elasticity of demand ( $\eta$ ) for a given livestock product, annual growth rates ( $\gamma$ ) of real per-capita GSDP, and baseline per-capita consumption ( $LC_0$ ) of a given livestock product, projected per-capita livestock product consumption ( $LC_t$ ) based on annual compounding (Sarma 1986) for a given year  $t$  can be calculated as:

$$(1) \quad LC_t = LC_0 * (1 + \eta * \gamma)^t$$

The projected total consumption ( $TLC_t$ ) of a given livestock product in period  $t$  can be calculated by multiplying the projected per-capita consumption with the projected population ( $POP_t$ ) for a given period  $t$ :

$$(2) \quad TLC_t = LC_t * (1 + \eta * \gamma)^t * POP_t$$

The data inputs required for these calculations derive from a number of sources. Data on per-capita annual consumption (LCO) for livestock products in Odisha were not available for the base year 2020/21. The most recently available per-capita annual consumption data that are used in this study are from National Sample Survey (NSS) 68<sup>th</sup> round conducted during 2011 to 2012 (Table 19). Data on the average per-capita income from 2011/12 to 2019/20 were obtained from the Odisha Directorate of Economics and Statistics and were used to calculate an average annual growth rate in real per-capita GSDP of 6.5% that is assumed to apply through to 2035/36 (Table 20).

A figure for the population of Odisha for the baseline year was not available, as the last census in India was conducted in 2011. We therefore used data published by the Odisha Directorate of Economics and Statistics indicating a constant annual population growth rate of 1.02%. The population was disaggregated by location to allow for the use of income elasticity values that differ for rural and urban locations. An annual urbanization rate (the proportion of the total human population living in the urban areas) of 11% – the rate of urbanization from 2001 to 2011 – was used to compute urban and rural populations from the aggregate population.

Values for income elasticities ( $\eta$ ) were derived from studies using data from the NSS 68<sup>th</sup> round consumer expenditure surveys conducted during 2011/12 (Table 21). Income elasticity estimates for milk, eggs and chicken (urban consumers) are based on Chengapa et al. (2016) but adjusted to reflect the situation in Odisha. Income elasticities for goat and sheep meat are based on the study by Gandhi and Zhou (2010), which used household consumer expenditure data from the 2004/2005 NSS 67<sup>th</sup> round. Note that elasticities from these studies are derived from analyses of household income rather than the GSDP value projected, but as changes in the two quantities are often highly correlated, they are acceptable as an approximation.

**Table 19: Annual per-capita consumption of livestock products in Odisha, by household location, 2011**

Livestock product	Rural households	Urban households	Weighted average <sup>b</sup>
Liquid milk (litres)	14.00	32.00	23.20
Egg (number)	16.00	22.00	19.20
Goat meat/mutton (kg)	0.30	0.92	0.59
Chicken (kg)	1.20	1.30	1.26
Milk and milk products (litres) <sup>a</sup>	14.40	32.20	23.38
Sheep meat/mutton (kg)	0.30	0.92	0.59

Source: Government of India 2015.

<sup>a</sup>Milk and milk products including liquid milk, curd and ghee. The amount of curd and ghee was converted to liquid milk equivalent based on sources available at <https://www.quora.com/How-much-milk-is-required-to-produce-1-kg-of-ghee>. This conversion overstates the consumption of milk solids other than butterfat.

<sup>b</sup>Average of values for rural and urban households based on relative population size.

**Table 20: Population, real gross state domestic product (GSDP) and annual growth rates for Odisha, 2011/12 to 2019/20<sup>a</sup>**

Year	Total population (crore)	Annual population growth rate	Real GSDP (INR crore)	Per-capita real GSDP (INR)	Annual growth rate, per-capita GSDP
2011/12	4.222	--	23,098	54,708	--
2012/13	4.265	1.02%	24,336	57,059	4.3%
2013/14	4.308	1.02%	26,589	61,715	8.2%
2014/15	4.352	1.02%	27,067	62,190	0.8%
2015/16	4.396	1.02%	29,223	66,472	6.9%

Year	Total population (crore)	Annual population growth rate	Real GSDP (INR crore)	Per-capita real GSDP (INR)	Annual growth rate, per-capita GSDP
2016/17	4.441	1.02%	33,770	76,040	14.4%
2017/18	4.486	1.02%	35,905	80,036	5.3%
2018/19	4.532	1.02%	38,740	85,487	6.8%
2019/20	4.578	1.02%	41,126	89,841	5.1%
Mean	4.398	1.02%	31,095	70,394	6.5%

a Assumes a constant annual population growth rate.  
Source: Government of Odisha (2020d).

**Table 21: Income elasticities of livestock products used for demand projections**

Livestock product	Rural households	Urban households	All households
Milk and milk products	1.2	1.3	1.3
Egg	2.0	2.0	2.0
Goat meat and mutton	1.3	1.3	1.3
Chicken	1.4	1.2	1.4

Source: Adapted from previous studies of household expenditure data (Chengapa et al. 2016; Gandhi and Zhou 2010).

Consistent with higher income elasticity values, the projected increases in per-capita consumption are largest for eggs and smallest for milk and milk products (Table 22). At a minimum, projected per-capita consumption is expected to triple during the next 15 years and increase to more than four times the current value for eggs.

**Table 22: Projected per-capita and percentage change by 2035/26, by livestock product**

Livestock product	Estimated 2020/21	Projected 2035/36	Percentage increase in per-capita consumption
Milk and milk products (litres)	44.14	145.70	230%
Egg (crore)	5.71	30.926	510%
Goat meat and mutton (kg)	1.16	4.03	249%
Chicken (kg)	2.39	7.93	232%

Source: Calculations based on previous per-capita consumption, projected growth in gross state domestic product, and income elasticities from previous studies.

## 5.3 Comparisons of projected production and consumption

The projections suggest that consumption is likely to grow more rapidly than production for all livestock products (Table 23). The largest differences between production and consumption projections are for milk and milk products (consumption growth is projected to be more than eight times production growth) and for eggs (consumption growth is projected to be more than twice production growth). The differences suggest that the production share of consumption in Odisha would decrease by 2035/36 in the absence of market responses. This implies a potential for increases in prices and profitability for Odisha livestock producers over the next 15 years, tempered by the availability of products transported from other regions or countries.

Table 23: Estimated and projected livestock production and consumption in Odisha, 2020–21 and 2035–36, without additional investments or interventions

Livestock product category	Production		Consumption		Projected production as % of consumption	
	Estimated 2020/21	Projected 2035/36	Estimated 2020/21	Projected 2035/36	Estimated 2020/21	Projected 2035/36
Milk and milk products (Crore litres)	201	265	160	680	126%	39%
Eggs (Crore)	217	855	231	1,668	94%	51%
Goat and mutton (Crore t)	3.2	3.27	10.7	18.2	30%	17%
Chicken (Crore t)	10.3	24.4	22.0	41.3	47%	59%
Lamb (Croer t)	0.56	0.5	3.8	18.2	15%	3%

Source: Production is projected based on assumptions included in the livestock sector investment and policy toolkit. Consumption is projected based on percentage changes in per-capita consumption from Table 21 times population.

## 6 Conclusion

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This report assessed and estimated values for livestock population numbers, production and GSDP, according to the Odisha livestock production zones, species and sub-systems. We have carried out this assessment in order to provide a baseline that will be used in the LSS foresight scenario analyses (ILRI 2022). Although many values were estimated for 2020/21, these estimates generally align with the observed data available from government sources.

The key findings for this assessment include:

- Livestock production is an important economic activity in Odisha, comprising about 3% of GSDP in 2020–21, with an estimated value of about INR 21,000 crore (USD 2.8 billion), or about 20% of the total value of agricultural production.
- Products and services from cattle accounted for about 80% of the value of livestock products in 2020–21.
- The cattle population has declined overall over the past two decades; however, there has been an increase in the number of crossbred animals which has allowed milk production to grow at roughly 5% per year.
- The number of sheep has also declined during this period, and the number of goats is roughly unchanged.
- In contrast to the dynamic of ruminant animals, there has been a marked increase in chicken and poultry production, particularly since 2012.
- Three different livestock production zones (coastal plain, northwest and hilly and mountain) in Odisha have experienced different development dynamics during the past two decades, in part due to differences in biophysical environments (e.g. land-use patterns and climate) and other economic activities (industrialization). Factors constraining or facilitating the future growth of livestock production are therefore somewhat different for each zone.
- Low productivity due to limited genetic potential and feed availability, a prevalence of animal diseases, and under-developed marketing systems affects most forms of livestock production in Odisha other than commercial chicken production (which benefits from technologies that can be promoted by private integrators).
- Multiple limitations have been noted for existing policies and programs to promote livestock production, especially a low budgetary commitment relative to livestock's economic contribution, the lack of focus on animals other than cattle, and limited support for those species and production systems where female farmers play an important role. Suggested responses to these limitations have been noted but not yet more fully assessed.
- The quantity and gross value of production in Odisha is projected to increase by 2035/36 for eggs (295%), chicken meat (136%), milk production (32%) and manure (4%), but to decline for other livestock products.

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- Consumption in Odisha is projected to increase based on available data and assumptions about population growth, income growth and urbanization. The projected increase by 2035/36 for milk and milk products is 230%. Egg consumption is projected to increase by 510%, whereas goat and mutton, and chicken are set to increase by 249% 232%, respectively.
  - For all livestock products, consumption is projected to grow more rapidly than production, providing additional incentives for both the production and sourcing of livestock products through inter-regional trade.

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## Annex I. The livestock sector and investment policy toolkit

The livestock sector and investment policy toolkit (LSIPT) was developed by a group of international agencies that include French Agricultural Research Centre for International Development (CIRAD), the Food and Agriculture Organization of the United Nations, the World Bank, the International Livestock Research Institute and others under the aegis of ALive at the African Union Inter-African Bureau for Animal Resources (AU-IBAR) .

The LSIPT is a very rigorous livestock sector analysis tool that uses mathematical models, format questionnaires, and other aids. The LSIPT consists of a set of interacting and individual tools and checklists, which operate in three phases of the analysis:

- Based on an initial survey of the importance of livestock (Module 1), a first phase looks at how well livestock is represented in the national development strategy and budget documents, and whether the sector has unnoticed and unrealized potential. A set of tools in Module 2 helps set up a preparatory analysis of the needs (manpower, budget) and participatory mechanisms (steering committee, stakeholder consultations) required for a detailed, quantitative sector analysis.
- In the second phase, the tools in Module 3 help to develop a typology of prevailing livestock production systems, carry out a detailed analysis of the contribution of livestock to the household economy for each of these production systems, and assess the defined key quantitative (volume) and financial parameters of the main value chains. Then, the tools in Module 4 help illustrate the sector's direct and indirect contributions to the national economy and provide instruments for assessing the main technical (feed, genetics, health), political and institutional constraints.
- In the third phase, the tools in Module 5 allow for a participatory process in order to set development priorities for evaluating the impact of alternative policy investment scenarios following these priorities. In addition, the third phase uses Module 5 tools to test the economic, social, nutritional and environmental impact of these scenarios. Module 6 then guides monitoring and evaluation.

The LSIPT enables in-depth and systematic quantitative analysis of the livestock sector's significant constraints and the effects of proposed interventions on economic growth and poverty alleviation. The LSIPT uses cost-benefit analyses of proposed policy and technology investment options to enable investment scenario analysis, providing guidance for prioritizing investments according to their potential impacts on private and social development goals.

ALive, housed in AU-IBAR, provided a team with training and technical support for implementing the LSIPT. It also advised on how to best capitalize on data in order to develop livestock sector analysis. Then, the LSIPT was used to analyse the livestock sector of many countries: Zambia, Ethiopia, Tanzania, Rwanda, Uzbekistan and Bihar (India). There is also huge interest from other countries on using this tool in their livestock sector analysis.

Further description of the LSIPT methodology can be accessed at the LSIPT website ([www.alive-ls iptoolkit.org](http://www.alive-ls iptoolkit.org)). Please contact the authors of this report to obtain a username and password.

## Annex II. Production and reproduction parameters

Table 1: Production and reproduction parameters of cattle

Parameters	Production zones/systems							
	Hilly and mountain		Northwest		Coastal plain		Urban and peri-urban dairy	
	Indigenous	Crossbred	Indigenous	Crossbred	Indigenous	Crossbred	Small (5–30)	Large (>30)
<b>I. Demography</b>								
Reproduction								
Parturition rate (per year)	0.55	0.74	0.55	0.75	0.57	0.75	0.8	0.85
Rate of net prolificacy	1	1	1	1	1	1	1	1
Mortality								
Total	4.7%	7.9%	4.5%	7.2%	4.0%	6.3%	5.8%	5.0%
<b>II. Production</b>								
Offtake								
Total	9.0%	22.2%	12.4%	32.3%	26.8%	39.5%	37.3%	42.3%
Live weight, kg/animal								
Female								
Juvenile	50	75	60	80	60	80	100	100
Sub-adult	130	200	140	220	150	230	250	260
Adult	200	270	220	300	220	320	350	370
Male								
Juvenile	60	75	70	80	70	90	90	90
Sub-adult	130	150	150	150	140	160	200	200
Adult	230	280	250	280	260	300	450	450
Financial price (INR per animal)								
Female								
Juvenile	800	5,000	800	5,530	800	6,530	7,500	7,500
Sub-adult	1,200	12,000	1,400	14,000	3,500	15,000	17,000	17,000
Adult	5,000	23,000	6,000	25,000	7,000	26,000	30,000	30,000
Male								
Juvenile	1,500	400	1,000	438	1,000	438	438	438
Sub-adult	9,000	6,000	9,000	7,000	8,000	7,000	7,000	7,000
Adult	22,000	13,000	21,000	14,706	20,000	14,706	14,706	14,706
Milk (litre)								
Length of milking period (days)	200	300	200	300	200	300	300	300
Milking quantity per day (litre/cow)	1	6	1.6	6.5	2	7	10	11
Production (litres)	200	1800	320	1,950	400	2,100	3,000	3,300
<b>III. Population structure</b>								
Female								
Juvenile	6%	15%	8%	17%	14%	21%	22%	24%
Sub-adult	6%	7%	7%	7%	13%	9%	10%	10%
Adult	24%	44%	29%	53%	52%	63%	61%	59%
Male								
Juvenile	6%	11%	8%	10%	7%	6%	7%	7%
Sub-adult	3%	3%	4%	2%	1%	0%	0%	0%
Adult	55%	20%	44%	11%	12%	0%	0%	0%
Total female	36%	66%	45%	76%	80%	94%	93%	93%
Total male	64%	34%	55%	24%	20%	6%	7%	7%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Source: Data obtained using the livestock sector and investment policy toolkit.

Table 2: Production and reproduction parameters of goats

Parameters	Production zones/sub-systems					
	Hilly and mountain		Northwest		Coastal plain	
	Small (1–10)	Large (>10)	Small (1–20)	Large (>20)	Small (1–10)	Large (>10)
<b>I. Demography</b>						
Reproduction						
Parturition rate (per year)	1.5	1.5	1.5	1.5	1.5	1.5
Rate of net prolificacy	1.25	1.25	1.50	1.50	1.50	1.50
Mortality						
Total	21.5%	24.5%	20.3%	22.5%	19.5%	23.2%
<b>II. Production</b>						
Offtake						
Total	50.2%	49.2%	54.7%	53.8%	68.0%	66.2%
Meat						
Dressing percentage	50%	50%	50%	50%	50%	50%
Live weight, kg/animal						
Female						
Juvenile	5	5	5	5	5	5
Sub-adult	14	14	14	14	13	13
Adult	20	20	20	20	18	18
Male						
Juvenile	6	6	6	6	5	5
Sub-adult	15	15	15	15	13	13
Adult	22	22	22	22	20	20
<b>Financial price (INR per animal)</b>						
Female						
Juvenile	2,000	2,000	2,000	2,000	2,500	2,500
Sub-adult	6,000	6,000	6,000	6,000	6,000	6,000
Adult	5,000	5,000	5,000	5,000	5,000	5,000
Male						
Juvenile	2,000	2,000	2,000	2,000	2,500	2,500
Sub-adult	4,500	4,500	4,500	4,500	5,000	5,000
Adult	7,000	7,000	7,500	7,500	8,000	8,000
Milk (litre)						
Length of milking period (days)	90	90	90	90	90	90
Milking quantity per day (litre/cow)	0.002	0.002	0.002	0.002	0.002	0.002
Production (litres)	0.18	0.18	0.18	0.18	0.18	0.18
<b>III. Population structure</b>						
Female						
Juvenile	8%	8%	9%	9%	10%	10%
Sub-adult	20%	19%	21%	20%	25%	24%
Adult	39%	39%	33%	34%	39%	39%
Male						
Juvenile	8%	8%	9%	9%	10%	10%
Sub-adult	17%	16%	18%	17%	14%	14%

Parameters	Production zones/sub-systems					
	Hilly and mountain		Northwest		Coastal plain	
	Small (1–10)	Large (>10)	Small (1–20)	Large (>20)	Small (1–10)	Large (>10)
Adult	9%	8%	11%	11%	2%	2%
Total female	66%	67%	63%	63%	74%	74%
Total male	34%	33%	37%	37%	26%	26%
Total	100%	100%	100%	100%	100%	100%

Source: Data obtained using the livestock sector and investment policy toolkit.

**Table 3: Production and reproduction parameters of sheep**

Parameters	Production zones/sub-systems					
	Hilly and mountain		Northwest		Coastal plain	
	Small (1–10)	Large (>10)	Small (1–20)	Large (>20)	Small (1–10)	Large (>10)
<b>I. Demography</b>						
<b>Reproduction</b>						
Parturition rate (per year)	1	1	1	1	1	1
Rate of net prolificacy	1.1	1.1	1.1	1.1	1.5	1.5
<b>Mortality</b>						
Total	7.6%	7.6%	6.9%	6.9%	15.9%	15.9%
<b>II. Production</b>						
<b>Offtake</b>						
Total	43.1%	43.2%	41.5%	41.8%	56.2%	56.3%
<b>Meat</b>						
Dressing percentage	50%	50%	50%	50%	50%	50%
<b>Live weight, kg/animal</b>						
<b>Female</b>						
Juvenile	5	5	5	5	5	5
Sub-adult	13	13	13	13	14	14
Adult	20	20	20	20	22	22
<b>Male</b>						
Juvenile	5	5	5	5	5	5
Sub-adult	17	17	17	17	18	18
Adult	24	24	24	24	25	25
<b>Financial price (INR per animal)</b>						
<b>Female</b>						
Juvenile	2,500	2,500	2,400	2,400	2,500	2,500
Sub-adult	5,000	5,000	3,500	3,500	4,500	4,500
Adult	4,500	4,500	5,500	5,500	6,500	6,500
<b>Male</b>						
Juvenile	2,500	2,500	2,000	2,000	3,000	3,000
Sub-adult	4,000	4,000	4,500	4,500	5,000	5,000
Adult	6,000	6,000	7,000	7,000	7,500	7,500
<b>III. Population structure</b>						
<b>Female</b>						
Juvenile	6%	6%	6%	6%	8%	8%

Parameters	Production zones/sub-systems					
	Hilly and mountain		Northwest		Coastal plain	
	Small (1–10)	Large (>10)	Small (1–20)	Large (>20)	Small (1–10)	Large (>10)
Sub-adult	16%	16%	15%	15%	20%	20%
Adult	46%	46%	43%	43%	47%	47%
Male						
Juvenile	6%	6%	6%	6%	8%	8%
Sub-adult	15%	15%	14%	14%	13%	13%
Adult	11%	11%	16%	17%	3%	3%
Total female	68%	68%	63%	63%	76%	76%
Total male	32%	32%	37%	37%	24%	24%
Total	100%	100%	100%	100%	100%	100%

Source: Data obtained using the livestock sector and investment policy toolkit.

Desi chicken parameters is depicted in the table below. Desi chicken farming system is more or less uniform across the three livestock production zones. Therefore, desi chicken is not divided by production zones and the parameters indicated in the table below (Table 27) depict desi chicken parameter in the whole Odisha state.

**Table 4: Production and reproduction parameters of backyard chickens – desi**

Parameters	Values
Adults	
Average number of hens	2.5
Average number of cocks	1
Age of hens at the start of the laying period (months)	7
Duration of the laying period (months)	29
Age of layers at culling (months)	36
Age of cocks at culling (months)	30
Adult mortality (per year)	12%
Production	
Number of eggs laid (per hen/year)	66
Eggs sold or consumed on farm (% eggs laid)	0.5%
Eggs available for incubation	75
Egg fertility	80%
Males hatched/year	30
Females hatched/year	30
Mortality in livestock production (% of animals that die before marketing)	40%
Age of males when sold (months)	12
Males raised/year	18
Females raised/year	18
Hens culled/year	1
Cocks culled/year	0.6
Number of females to keep for replacement/year	1.1
Number of males to keep for replacement/year	0.7
Males sold or consumed on farm/year	17.3
Female sold or consumed on farm/year	16.8
Feed consumption and production parameters	
Feed consumption layer (g/animal/day)	70

Parameters	Values
Feed consumption growers and cockerel (g/animal/day)	30
Proportion of total feed supplemented for layers	6%
Proportion of total feed supplemented for growth	13%
Average live weight of chickens (growers) sold (kg)	1.2
Average live weight of culled hens (kg)	1.5
Average live weight of culled cocks (kg)	2
Average dressing percentage	65%
<b>Results</b>	
Principle indicators	
Total number of animals present per hen	16.6
Total number of animals sold or consumed on farm/year	35.8
Average live weight of animals sold or consumed on farm	1.2
Animals sold or consumed on farm/year/hens	14.3

Source: Data obtained using the livestock sector and investment policy toolkit.

## Annex III. Financial parameters

Table 1: Economic and financial performance of cattle herds

Parameters	Unit	Production zones and systems											
		Hilly and mountain			Northwest			Coastal plain			Urban and peri-urban dairy		
		Indigenous	Crossbred	Indigenous	Crossbred	Indigenous	Crossbred	Indigenous	Crossbred	Indigenous	Crossbred	Indigenous	Crossbred
Veterinary costs and medicines	INR/animal/year	400	1,800	500	1,800	1,000	1,954	2,000	2,300				
Artificial insemination	INR/cow/year	60	375	60	375	60	375	300	1150				
Herder hired	months/year	1	0	1	0	1	0	0	0				
Salaried labour hired	days/year	0	35	0	40	0	50	438	2,190				
Herder	INR/month	225	0.0	187.5	0.0	187.5	0.0	0.0	0.0				
Salaried labour	INR/day	0	200	0	200	0	250	300	300				
Cost of loan for working capital	%	0%	0%	0%	0%	0%	0%	50%	60%				
% of production costs and general expenses financed by a loan	%	0%	0%	0%	0%	0%	0%	50%	60%				
Annual interest rate on a loan	%	12%	12%	12%	12%	12%	12%	12%	12%				
Duration of loan	months	6	6	6	6	6	6	6	6				
<b>I. Products and their development</b>													
Valuation of animal products													
Meat	INR/kg												
Milk	INR/litre	35.00	38.00	35.00	38.75	40.00	39.50	44.50	47.50				
Hides and skins	INR/kg	0	0	0	0	0	0	0	0				
Organic matter	INR/kg	2.0	2.0	2.0	2.0	2.0	2.0	1.5	1.5				
Animal draught	INR/pair-day	500	500	500	500	600	500	0	0				
Number of draught animals in the herd	no.	1.5	0.0	0.9	0.0	0.2	0.0	0.0	0.0				
Number of days of animal traction per year	no.	53	0	45	0	35	0	0	0				
Results- herd level													
<b>II. Annual production costs and general expenses</b>													
Feed costs													
Forage	INR/year	4,648	6,870	5,942	9,845	7,578	12,759	81,014	4,22,830				
Concentrated feeds	INR/year	1,754	15,616	1,186	16,028	1,579	26,484	2,71,366	16,55,273				
Additives	INR/year	0	2,328	0	1,918	0	2,317	9,459	50,629				
Salts and minerals	INR/year	328	222	273	183	272	221	901	4,822				
Total feed costs	INR/year	6,730	25,035	7,400	27,974	9,429	41,781	3,62,740	21,33,553				
Costs of forage crops and grassland maintenance													

Parameters	Unit	Production zones and systems															
		Hilly and mountain				Northwest				Coastal plain				Urban and peri-urban dairy			
		Indigenous	Crossbred	Indigenous	Crossbred	Indigenous	Crossbred	Indigenous	Crossbred	Indigenous	Crossbred	Indigenous	Crossbred	Indigenous	Crossbred		
Salaried labour/forage system	INR/year	0	24	0	0	105	0	0	252	1,512	37,800	0	24	0	0	0	0
Operational costs (seed, fertilizers, other)	INR/year	0	25	0	0	51	0	0	101	608	15,195	0	25	0	0	0	0
Veterinary costs and medicines	INR/year	1,197	5,468	1,246	4,505	2,486	5,906	2,481	5,906	24,681	1,51,919	43	501	44	78	715	44,983
Artificial insemination	INR/year	225	0	188	0	188	0	0	0	0	0	0	0	0	188	0	0
Salaried labour	INR/year	0	7,000	0	8,000	0	12,500	0	12,500	1,31,400	6,57,000	0	0	0	0	0	0
Cost of maintaining investments	INR/year	0	0	0	0	0	0	0	0	12,000	24,000	0	0	0	0	0	0
Taxes and contributions	INR/year	0	0	0	0	0	0	0	0	1,200	30,000	0	0	0	0	0	0
Cost of access to grazing	INR/year	0	0	0	0	0	0	0	0	4,936	46,338	0	0	0	0	0	0
Livestock taxes	INR/year	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agricultural taxes	INR/year	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cost of access to water	INR/year	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total taxes and contributions	INR/year	0	0	0	0	0	0	0	0	6,136	76,338	0	0	0	0	0	0
Annual total production costs and general expenses	INR/year	8,195	38,054	8,878	41,132	12,180	61,295	5,41,323	31,40,787	8,878	31,40,787	8,195	38,054	8,878	41,132	12,180	61,295
<b>III. Annual income</b>																	
Live animal + inventory change	INR/year	3,341	9,801	3,844	8,421	3,020	12,796	69,096	3,91,129	3,844	3,91,129	3,341	9,801	3,844	8,421	3,020	12,796
Live animal sell	INR/year	3,538	8,713	4,047	8,328	3,205	11,927	54,361	3,46,242	4,047	3,46,242	3,538	8,713	4,047	8,328	3,205	11,927
Milk	INR/year	2,771	67,684	4,514	75,228	11,792	1,18,606	7,99,499	52,11,664	4,514	52,11,664	2,771	67,684	4,514	75,228	11,792	1,18,606
Hides and skins	INR/year	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wool	INR/year	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Organic matter	INR/year	1,951	5,823	3,568	8,391	5,056	12,581	83,840	4,56,160	3,568	4,56,160	1,951	5,823	3,568	8,391	5,056	12,581
Animal draught	INR/year	3,908	0	2,973	0	521	0	0	0	2,973	0	3,908	0	2,973	0	521	0
Total livestock produce	INR/year	12,169	82,220	15,103	91,948	20,574	1,43,114	9,37,700	60,14,065	15,103	60,14,065	12,169	82,220	15,103	91,948	20,574	1,43,114
Total livestock produce + inventory change	INR/year	11,972	83,308	14,900	92,040	20,388	1,43,984	9,52,434	60,58,952	14,900	60,58,952	11,972	83,308	14,900	92,040	20,388	1,43,984
Net income per farm (gross margin)	INR/year	3,777	45,254	6,022	50,908	8,208	82,689	4,11,111	29,18,165	6,022	29,18,165	3,777	45,254	6,022	50,908	8,208	82,689
Profit margin	%	31.55%	54.32%	40.42%	55.31%	40.26%	57.43%	43.16%	48.16%	40.42%	48.16%	31.55%	54.32%	40.42%	55.31%	40.26%	57.43%
Net income per cow	INR/year	5,248	33,842	8,218	38,351	6,349	43,373	54,918	74,604	8,218	74,604	5,248	33,842	8,218	38,351	6,349	43,373
Net income per animal	INR/year	1,262	14,898	2,417	20,341	3,301	27,357	33,313	44,180	2,417	44,180	1,262	14,898	2,417	20,341	3,301	27,357
Other indicators																	
Structure of production costs and general expenses																	
Salaried labour	%	2.7%	18.5%	2.1%	19.7%	1.5%	20.8%	24.6%	22.1%	2.1%	22.1%	2.7%	18.5%	2.1%	19.7%	1.5%	20.8%
Feeds	%	82.1%	65.9%	83.4%	68.1%	77.4%	68.3%	67.1%	68.4%	83.4%	68.4%	82.1%	65.9%	83.4%	68.1%	77.4%	68.3%
Veterinary costs + artificial insemination	%	15.1%	15.7%	14.5%	12.2%	21.0%	10.8%	5.0%	6.3%	14.5%	6.3%	15.1%	15.7%	14.5%	12.2%	21.0%	10.8%
Other (water + taxes)	%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	3.4%	3.2%	0.0%	3.2%	0.0%	0.0%	0.0%	0.0%	0.1%	3.2%

Parameters	Unit	Production zones and systems													
		Hilly and mountain				Northwest				Coastal plain				Urban and peri-urban dairy	
		Indigenous	Crossbred	Indigenous	Crossbred	Indigenous	Crossbred	Indigenous	Crossbred	Indigenous	Crossbred	Indigenous	Crossbred		
<b>Product structure</b>															
Live animal sell	%	29.1%	10.6%	26.8%	26.8%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Milk	%	22.8%	82.3%	29.9%	29.9%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Hides and skins	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Wool	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Organic matter	%	16.0%	7.1%	23.6%	23.6%	9.1%	9.1%	24.6%	8.8%	8.9%	8.9%	8.9%	8.9%	7.6%	
Animal draught	%	32.1%	0.0%	19.7	19.7	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
<b>Unit margin for milk</b>															
Production cost	INR/lt	23.6	17.6	20.6	20.6	17.3	17.3	23.7	16.9	25.7	25.7	25.7	25.7	24.8	
Sale price	INR/lt	35.0	38.0	35.0	35.0	38.8	38.8	40.0	39.5	44.5	44.5	44.5	44.5	47.5	
Gross unitary benefit	INR/lt	11.4	20.4	14.4	14.4	21.5	21.5	16.3	22.6	18.8	18.8	18.8	18.8	22.7	
Profit rate (gross benefit/production cost)		0.5	1.2	0.7	0.7	1.2	1.2	0.7	1.3	0.7	0.7	0.7	0.7	0.9	
<b>Summary/synthesis of net income</b>															
Net income from animal production (gross margin)	INR/year	3,777	45,254	6,022	6,022	50,908	50,908	8,208	82,689	4,11,111	4,11,111	4,11,111	4,11,111	29,18,165	
Net income per animal	INR/year	1,262	14,898	2,417	2,417	16,847	16,847	2,417	14,898	1,262	1,262	1,262	1,262	74,604	
Net income per cow	INR/year	5,248	33,842	8,218	8,218	38,351	38,351	6,349	43,373	54,918	54,918	54,918	54,918	74,604	
Profit margin	%	31.5%	54.3%	40.4%	40.4%	55.3%	55.3%	40.3%	57.4%	43.2%	43.2%	43.2%	43.2%	48.2%	
Total net income after financing the loan for working capital	INR/year							3,95,548	28,09,808						

Source: Data obtained using the livestock sector and investment policy toolkit.

Table 2: Economic and financial performance of goat herds

Parameters	Unit	Production zones and systems					
		Hilly and mountain		Northwest		Coastal plain	
		Small (1–10)	Large (>10)	Small (1–20)	Large (>20)	Small (1–10)	Large (>10)
<b>I. Annual production costs and general expenses</b>							
Consumables and small equipment							
Veterinary costs and medicines	INR/animal/year	80	80	85	80	90	85
<b>II. Products and their development</b>							
Valuation of animal products							
Meat	INR/kg	580	580	597	597	683	684
Milk	INR/litre	50	50	50	50	50	50
Organic matter	INR/kg	1.3	1.3	1.3	1.3	1.3	1.3
Results – herd level							
<b>I. Annual production costs and general expenses</b>							
Annual total production costs and general expenses	INR/year	814	3,162	835	7,604	761	2,778
<b>II. Income</b>							
Total livestock produce	INR/year	12,528	40,783	14,004	71,381	14,327	52,395
Total livestock produce + inventory change	INR/year	12,666	40,907	13,966	71,167	14,193	51,805
Net income per farm (gross margin)	INR/year	11,852	37,746	13,130	63,563	13,432	49,027
Profit margin	%	94%	92%	94%	89%	95%	95%
Net income per ewe	INR/year	6,807	6,388	8,776	8,172	8,734	8,334
Net income per animal	INR/year	2,625	2,514	2,920	2,766	3,370	3,282
Other indicators							
<i>Structure of production costs and general expenses</i>							
Salaried labour	%	0.0%	14.2%	0.0%	45.4%	0.0%	0.0%
Feeds	%	0.4%	0.3%	0.4%	0.2%	0.3%	0.3%
Veterinary costs + artificial insemination	%	44.3%	38.0%	45.8%	24.2%	47.1%	45.7%
Other (water + taxes)	%	55.3%	47.4%	53.9%	30.2%	52.6%	54.0%
Product structure							
Meat	%	99.2%	99.2%	99.3%	97.8%	98.6%	98.1%
Milk	%	0.2%	0.2%	0.1%	0.1%	0.1%	0.2%
Organic matter	%	0%	0%	0%	0%	0%	0%
Animal draught	%	0%	0%	0%	0%	0%	0%
Unit margin for meat							
Production cost	INR/kg	37.7	45.0	35.6	63.6	36.3	36.3
Sale price	INR/kg	580	580	597	597	683	684
Gross unitary benefit	INR/year	543	535	562	534	647	648
Profit rate (gross benefit/production cost)	INR/year	14.4	11.9	15.8	8.4	17.8	17.9
Unit margin for milk							
Production cost	INR/lt	3.3	3.9	3.0	5.3	2.7	2.7
Sale price	INR/lt	50	50	50	50	50	50
Gross unitary benefit	INR/lt	46.7	46.1	47.0	44.7	47.3	47.3
Profit rate (gross benefit/production cost)		14.4	11.9	15.8	8.4	17.8	17.9

Source: Data obtained using the livestock sector and investment policy toolkit.

Table 3: Financial performance of sheep flocks

Parameters	Unit	Production zones and systems					
		Hilly and mountain		Northwest		Coastal plain	
		Small (1-10)	Large (>10)	Small (1-20)	Large (>20)	Small (1-10)	Large (>10)
<b>I. Production costs and general expenses</b>							
Consumables and small equipment							
Veterinary costs and medicines	INR/animal/year	73	73	73	73	73	73
Herder hired	months/year	12	12	12	12	12	12
Salaried labour hired	days/year	0	0	0	0	0	0
Herder cost	INR/month	21.6	180.0	24.0	450.0	30.0	270.0
Salaried labour cost	INR/day	0	0	0	0	0	0
Other costs	INR/year	450	1,000	500	2,000	500	1,500
<b>II. Products and their development</b>							
Valuation of animal products							
Meat	INR/kg	485	485	564	564	586	586
Milk	INR/litre	0	0	0	0	0	0
Wool	INR/kg	0	0	0	0	0	0
Organic matter	INR/kg	1.3	1.3	1.3	1.3	1.3	1.3
Results – herd level							
<b>I. Annual production costs and general expenses</b>							
Total production costs and general expenses	INR/year	1,042	3,899	1,155	9,233	1,229	5,848
<b>II. Annual income</b>							
Meat + inventory change	INR/year	9,603	21,333	11,624	57,908	16,120	48,331
Meat	INR/year	9,577	21,307	11,929	60,002	16,429	49,325
Milk	INR/year	0	0	0	0	0	0
Hides and skins	INR/year	0	0	0	0	0	0
Wool	INR/year	0	0	0	0	0	0
Manure	INR/year	9	19	10	48	22	65
Animal draught	INR/year	0	0	0	0	0	0
Total livestock produce	INR/year	9,586	21,326	11,939	60,051	16,451	49,389
Total livestock produce + inventory change	INR/year	9,611	21,352	11,633	57,957	16,142	48,395
<b>III. Annual income and other financial indicators</b>							
Financial indicators for animal activity							
Net income per farm (gross margin)	INR/year	8,569	17,453	10,478	48,724	14,913	42,548
Profit margin (net income/product)	%	89.16%	81.74%	90.07%	84.07%	92.38%	87.92%
Net income per doe	INR/year	4,116	3,774	4,919	4,598	6,342	6,036
Net income per animal	INR/year	1,903	1,745	2,109	1,966	3,000	2,854
Total net income per farm before financing the loan for working capital	INR/year	8,569	17,453	10,478	48,724	14,913	42,548
Other indicators							

Parameters	Unit	Production zones and systems					
		Hilly and mountain		Northwest		Coastal plain	
		Small (1-10)	Large (>10)	Small (1-20)	Large (>20)	Small (1-10)	Large (>10)
<b>Structure of production costs and general expenses</b>							
Herder and salaried labour	%	24.9%	55.4%	24.9%	58.5%	29.3%	55.4%
Feeds	%	0.4%	0.2%	0.4%	0.3%	0.5%	0.3%
Veterinary costs	%	31.6%	18.7%	31.4%	19.6%	29.5%	18.6%
Other (maintenance, etc.)	%	43.2%	25.6%	43.3%	21.7%	40.7%	25.7%
<b>Product structure</b>							
Meat	%	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%
Milk	%	0%	0%	0%	0%	0%	0%
Hides and skins	%	0%	0%	0%	0%	0%	0%
Wool	%	0%	0%	0%	0%	0%	0%
Organic matter	%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Animal draught	%	0%	0%	0%	0%	0%	0%
<b>Unit margin for meat</b>							
Meat production cost	INR/kg	52.7	88.8	54.6	86.7	43.8	69.4
Sale price of meat	INR/Kg	485.3	485.5	563.8	563.8	586	586.1
Gross unitary benefit	INR/kg	432.5	396.7	509.3	477.1	542.3	516.7
Profit rate (gross benefit/production cost)		8.2	4.5	9.3	5.5	12.4	7.4
<b>Summary/synthesis of financial performance</b>							
Net income per farm (gross margin)	INR/year	8,569	17,453	10,478	48,724	14,913	42,548
Net income per animal	INR/year	1,903	1,745	2,109	1,966	3,000	2,854
Net income per doe	INR/year	4,116	3,774	4,919	4,598	6,342	6,036
Profit margin (net income/product)	%	89.2%	81.7%	90.1%	84.1%	92.4%	87.9%

Source: Data obtained using the livestock sector and investment policy toolkit.

**Table 31: Financial performance of desi backyard chicken flocks**

Parameters	Unit	Number of units
<b>I. Production costs and general expenses</b>		
<b>Consumables and small equipment</b>		
Vaccines, veterinary costs, and medicines	cost/animal/year	3
<b>II. Products and their development</b>		
<b>Amount of produce</b>		
Eggs	no./year	85
Chickens	heads	24
Culled hens	heads/year	1
Culled cocks	heads/year	0.6
Manure	kg/year	0
<b>Results – flock level</b>		
<b>I. Production costs and general expenses of the flock</b>		
<b>Cost of feed</b>		
Total feed costs	INR/year	849

Parameters	Unit	Number of units
Purchase of animals		
Total cost of purchasing animals	INR/year	0
Consumables and small equipment		
Vaccines	INR/year	180
Costs of maintaining investments	INR/year	50
Total cost of consumables and small equipment	INR/year	232
Salaried labour	INR/year	0
Total salary costs	INR/year	0
Taxes and contributions	INR/year	0
Total taxes and contributions	INR/year	0
Total production costs and general expenses	INR/year	1,080
<b>II. Income</b>		
Total revenues	INR/year	12,524
<b>III. Income and other financial indicators</b>		
Net income from animal production	INR/year	11,443
Profit margin (net income/product)	%	91.37%
Net income per hen	INR/year	4,577.2
Other indicators		
Structure of production costs and general expenses		
Salaried labour	%	0%
Feeds	%	78.5%
Purchase of animals	%	0%
Veterinary costs	%	16.8%
Costs of maintaining investments and small equipment	%	4.6%
Taxes and contributions	%	0%
Product structure		
Eggs	%	6.8%
Chickens	%	86.6%
Culled hens and cocks	%	6.5%
Manure	%	0%
Unit margin per egg		
Production cost	INR/egg	0.2
Sale price	INR/egg	10
Gross unitary benefit	INR/egg	9.8
Profit rate (gross benefit/production cost)	%	4324.2%
Unit margin per carcass		
Production cost	INR/kg	33.2
Sale price	INR/kg	410.6
Gross unitary benefit	INR/kg	377.4
Profit rate (gross benefit/production cost)	%	1137.1%

Source: Data obtained using the livestock sector and investment policy toolkit.

## Annex IV. Livestock production zones

Table 1: Lists of districts by production zone

	Coastal plain	Northwest	Hilly and mountain
1	Balasore	Anugul	Balangir
2	Bhadrak	Bargarh	Gajapati
3	Jajpur	Boudh	Kalahandi
4	Kendrapara	Deogarh	Kandhamal
5	Cuttack	Dhenkanal	Koraput
6	Jagatsinghpur	Jharsuguda	Malkangiri
7	Khordha	Kendujhar	Nabarangpur
8	Puri	Mayurbhanj	Nuapada
9	Ganjam	Nayagarh	Rayagada
10		Sambalpur	
11		Subarnapur	
12		Sundargarh	

## Annex V. Current and projected livestock numbers, production and gross state domestic product by production zones

Table 1: Livestock numbers and distribution over the three livestock production zones in 2020/21

Livestock production zone	Indigenous cattle	Crossbred cattle	Total cattle	Goats	Sheep
Hilly and mountain	21,47,820	2,76,677	24,24,497	15,82,106	4,95,112
Northwest	27,78,077	3,97,545	31,75,623	33,32,063	4,16,167
Coastal plain	25,93,824	9,98,959	35,92,783	14,48,813	2,98,874
Specialized or peri-urban dairy system <sup>1</sup>		26,740	26,740		
<b>Total</b>	<b>75,19,721</b>	<b>16,99,921</b>	<b>92,19,642</b>	<b>63,62,982</b>	<b>12,10,153</b>

Source: Output of livestock sector analysis.

Table 2: Red meat production in tonnes by production zone (2020–21)

Livestock production zone	Goats	Sheep	Total meat production	% red meat
Hilly and mountain	7,475	2,129	9,604	25.4%
Northwest	17,277	1,809	19,086	50.4%
Coastal plain	7,471	1,674	9,145	24.2%
<b>Total red meat</b>	<b>32,223</b>	<b>5,612</b>	<b>37,835</b>	<b>100%</b>

Source: Output of livestock sector analysis.

Table 3: Annual milk production by production zone (2020/21)

Livestock production zones	Milk production (lakh litres)			% of milk production
	Cattle	Goat	Total	
Hilly and mountain	2,188.6	1.7	2,190.2	11%
Northwest	4,520.0	3.0	4,523.0	22%
Coastal plain	13,003.1	1.5	13,004.7	65%
Commercial dairy	396.4	-	396.4	2%
<b>Total milk</b>	<b>20,108.2</b>	<b>6.2</b>	<b>20,114.4</b>	<b>100%</b>

Source: Output of livestock sector analysis.

Table 4: Annual egg productions by chicken production systems and sub-systems (2020–21)

Production system	Production sub-system	Egg production (lakh)	% contribution
Village backyard chicken	Desi (1–5)	1,417.7	6.5%
	Improved	499.6	2.3%
Commercial chicken	Layers	19,749.3	91.2%
	Broilers	-	0%
<b>Total egg production</b>		<b>21,666.6</b>	<b>100%</b>

Source: Output of livestock sector analysis.

1. The specialized or peri-urban dairy system is not classified by production zones. It has uniform farming systems across the three production zones

Table 5: Total gross state domestic product (GSDP) by livestock production zone

Livestock production zone	GSDP (crore)	% contribution to GSDP
Hilly and mountain	6,551.42	31%
Northwest	6,097.21	29%
Coastal plain	6,568.62	31%
GSDP from productions not bounded by zones	1,935.81	9%
Total GSDP	21,153.06	100%

Source: Output of livestock sector analysis.

Table 6: Comparison of current (2020/21) and business-as-usual (BAU) projected (2035/36) livestock numbers

Livestock production zone	Breed	Cattle population		
		Base year 2020/21	BAU 2035/36	% change base year to BAU
Hilly and mountain	Indigenous breeds	21.5	20.0	-7%
	Crossbreeds	2.8	4.0	45%
	Total	24.2	24.0	-1%
Northwest	Indigenous breeds	27.8	25.0	-10%
	Crossbreeds	4.0	5.8	45%
	Total	31.8	30.8	-3%
Coastal plain	Indigenous breeds	25.9	22.0	-15%
	Crossbreeds	10.0	14.5	45%
	Total	35.9	36.4	1%
Commercial dairy		0.3	0.6	120%
Total population	Indigenous breeds	75.2	66.9	-11%
	Crossbreeds	17.0	24.8	46%
Grand total population		92.2	91.7	-0.5%

Source: Output of livestock sector analysis.

Table 7: Comparison of current (2020/21) and business-as-usual (BAU) projected (2035/36) goat and sheep numbers

Livestock production zone	Breed	Goat population (lakh)			Sheep population (lakh)		
		Base year 2020/21	BAU 2035/36	% change base year to BAU	Base year 2020/21	BAU 2035/36	% change base year to BAU
Hilly and mountain	Small (1-10)	12.7	13.9	10%	3.5	3.5	2%
	Large (>10)	3.2	3.2	3%	1.5	1.5	1%
	Total	15.8	17.2	9%	5.0	5.0	2%
Northwest	Small (1-20)	26.7	25.9	-3%	2.5	2.1	-17%
	Large (>20)	6.7	6.5	-3%	1.7	1.3	-23%
	Total	33.3	32.4	-3%	4.2	3.4	-19%
Coastal plain	Small (1-10)	11.6	10.4	-10%	2.4	2.0	-16%
	Large (>10)	2.9	2.6	-12%	0.6	0.5	-17%
	Total	14.5	13.0	-10%	3.0	2.5	-16%
Total population	Small	50.9	50.3	-1%	8.4	7.6	-9%
	Large	12.7	12.3	-3%	3.7	3.3	-12%
Grand total population		63.6	62.6	-1.6%	12.1	10.9	-10%

Source: Output of livestock sector analysis.

**Table 8: Base year (2020/21) and business-as-usual (BAU) (2035/36) projected annual milk production by production zone**

Livestock production zone	Milk production (lakh litres)		
	Base year (2020/21)	BAU (2035/36)	% change base year to BAU
Hilly and mountain	2,190.2	2,877.0	31%
Northwest	4,523.0	5,761.1	27%
Coastal plain	13,004.7	16,985.0	31%
Commercial dairy	396.4	869.9	119%
Total milk	20,114.4	26,493.0	32%

Source: Output of livestock sector analysis.

**Table 9: Goats and sheep meat production at base year and 15 years under business as usual (BAU)**

Livestock production zone	Goat meat production (in tonnes)			Sheep meat production (in tonnes)		
	Production 2020/21 base year	Production 2035/36 BAU	% change base year to BAU	Production 2020/21 base year	Production 2035/36 BAU	% change base year to BAU
Hilly and mountain	7474.6	8,115.6	9%	2129.0	2,164.1	2%
Northwest	17277.4	16879.2	-2%	1809.1	1459.1	-19%
Coastal plain	7,471.2	6,708.6	-10%	1,673.7	1,401.2	-16%
Total meat production	32,223.2	31,703.4	-2%	5611.8	5024.3	-10%

Source: Output of livestock sector analysis.

**Table 10: Base year (2020/21) and business-as-usual (BAU) (2035/36) projected total gross state domestic product (GSDP) by livestock production zone**

Livestock production zone	GSDP (crore)		% change base year to BAU
	Base year (2020/21)	BAU (2035/36)	
Hilly and mountain	6,551.4	6,440.3	-2%
Northwest	6,097.2	6,166.7	1%
Coastal plain	6,568.6	7,760.9	18%
GSDP from productions not bounded by zones <sup>a</sup>	1,935.8	3,654.9	89%
Total	21,153.1	24,022.7	14%

Source: Output of livestock sector analysis

<sup>a</sup> Production systems that are not production zone bounded are commercial systems and all chicken production systems.

## Annex VI. Odisha human population from 2020/21 to 2035/36

Table 1: Odisha human population from 2020/21 to 2035/36

Year	Rural population	Urban population	Total population
2020	3,53,33,455	1,13,40,410	4,66,73,865
2021	3,53,43,308	1,18,50,125	4,71,93,434
2022	3,53,47,550	1,23,65,452	4,77,13,002
2023	3,53,46,181	1,28,86,390	4,82,32,571
2024	3,53,39,199	1,34,12,940	4,87,52,139
2025	3,53,26,606	1,39,45,102	4,92,71,708
2026	3,53,08,402	1,44,82,875	4,97,91,277
2027	3,52,84,585	1,50,26,260	5,03,10,845
2028	3,52,55,158	1,55,75,256	5,08,30,414
2029	3,52,20,118	1,61,29,865	5,13,49,983
2030	3,51,79,467	1,66,90,084	5,18,69,551
2031	3,51,33,204	1,72,55,916	5,23,89,120
2032	3,50,81,330	1,78,27,359	5,29,08,689
2033	3,50,23,844	1,84,04,414	5,34,28,257
2034	3,49,60,746	1,89,87,080	5,39,47,826
2035	3,48,92,037	1,95,75,358	5,44,67,395

Source: Government of Odisha (2020)

## Annex VII. Participants of stakeholder consultation workshops

Table 1: Consultation with state technical teams in different periods

	Name	Designation
1	Dr. Premananda Rout	Additional director, Livestock Development, Directorate of Animal Husbandry and Veterinary Services (DAH & VS) Odisha, Cuttack
2	Dr. Gopal Krushna Tripathy	Joint director, Veterinary Officers Training Institute
3	Dr. Gopal Charana Bal	Research officer, Animal Disease Research Institute, Cuttack
3	Dr. Soumyendra Dhal	Deputy director poultry, DAH & VS Odisha, Cuttack
4	Dr. Partha Sarathi Swain	Additional veterinary assistant surgeon, Baranga, Cuttack
5	Dr. Samir Das	Additional veterinary assistant surgeon, Sumandal, Ganjam
6	Dr. Sadasiv Mohapatra	Deputy director, Balasore

Table 2: Participants of consultation and appraisal workshop, 18 January 2021

	Name	Designation
1	Shri Ratnakar Rout	Director-cum-commissioner, Directorate of Animal Husbandry and Veterinary Services (DAH & VS) Odisha, Cuttack
2	Dr. P.N. Rout	Additional director, DAH & VS Odisha, Cuttack
3	Dr. P.K. Khamari	Additional director, DAH & VS Odisha, Cuttack
4	Dr. R.N. Pradhan	Veterinary expert, State Project Monitoring Unit, DAH & VS Odisha, Cuttack
5	Dr. Gopal Krushna Tripathy	Deputy director, Veterinary Officers Training Institute
6	Dr. Dipti Mahapatra	Deputy director (Small Animal Development), DAH & VS Odisha, Cuttack
7	Shri Swopnananda Mohapatra	Additional fodder development officer, DAH and VS Odisha, Cuttack
8	Shri. Anup Kumar Badajena	Fodder development officer, DAH & VS Odisha, Cuttack
9	Dr. D.N. Biswal	Joint director-1 (Planning, Monitoring and Information Service), DAH & VS Odisha, Cuttack
10	Dr. Digambar Nayak	Deputy director (poultry), DAH & VS Odisha, Cuttack
11	Dr. Keshab Chandra Pradhan	Joint director-1 (Human Resource Development), DAH & VS Odisha, Cuttack
12	Dr. DInabandhu Mishra	Deputy Director (Dairy Development), DAH & VS Odisha, Cuttack
13	Dr. K.V.K. Pattanaik	Consultant, International Livestock Research Institute (ILRI)
14	Dr. Brajabandhu Swain	Scientist, ILRI
15	Shri Sanjay Kumar Palai	Consultant, ILRI

Table 3: Participants of data collection and verification workshop on cattle production in Odisha, 27 March and 2 April 2021

	Name of expert	Designation
1	Dr. Bhagirathi Panigrahi	Professor, Department of Livestock Production and Management, College of Veterinary Sciences and Animal Husbandry (CVSc & AH), Odisha University of Agriculture and Technology (OUAT), Bhubaneswar
2	Dr. Niranjana Panda	Professor, Department of Animal Nutrition, CVSc & AH, OUAT, Bhubaneswar
3	Dr. K.V.K. Pattanaik	Retired chief executive officer, Odisha Livestock Resource Development Society, Bhubaneswar
4	Dr. Gopal Krushna Tripathy	Joint director, Veterinary Officers Training Institute, Bhubaneswar
5	Shri Swapnananda Mohapatra	Additional fodder development officer, Directorate of Animal Husbandry and Veterinary Services Odisha, Cuttack

**Table 4: Participants of virtual data collection and verification workshop on goat production in Odisha, 1 April and 3 April 2021**

	Name of expert	Designation
1	Dr. D.K. Karna	Professor, Department of Animal Breeding and Genetics, College of Veterinary Sciences and Animal Husbandry, Odisha University of Agriculture and Technology, Bhubaneswar
2	Dr. K.V.K. Patnaik	Retired chief executive officer, Odisha Livestock Resource Development Society, Bhubaneswar
3	Dr. Gopal Krushna Tripathy	Joint Director, Veterinary Officers Training Institute
4	Dr. Anirudh Biswal	Chief district veterinary officer, Bolanagir, Government of Odisha
5	Dr. Biswanath Sahoo	Scientist, Indian Council of Agricultural Research-Central Institute for Women in Agriculture
6	Dr. Partha Sarathi Swain	Additional veterinary assistant surgeon, Baranga, Cuttack

**Table 5: Participants of data collection and verification virtual workshop on goat production in Odisha, 12 April 2021**

	Name of Expert	Designation
1	Dr. D.K. Karna	Department of Animal Breeding and Genetics, College of Veterinary Sciences and Animal Husbandry, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha
2	Dr. K.V.K. Patnaik	Retired chief executive officer, Odisha Livestock Resource Development Society, Bhubaneswar
3	Dr. Gopal Krushna Tripathy	Joint director, Veterinary Officers Training Institute
4	Dr. Biswanath Sahoo	Scientist, Indian Council of Agricultural Research-Central Institute for Women in Agriculture
5	Dr. Anirudh Biswal	Chief district veterinary officer, Bolanagir, Government of Odisha
6	Dr. Satyabrata Khadanga	Additional veterinary assistant surgeon, Korkunda, Malkangiri

**Table 6: Participants of virtual data collection and verification workshop on goat production in Odisha, 14 April and 23 April 2021**

	Name of expert	Designation
1	Dr. M.K. Padhi	Principal scientist, Regional Centre, Indian Council of Agricultural Research-Directorate of Poultry Research, Bhubaneswar
2	Dr. Bibhudesh Patra	Poultry Breeding Farm, Chiplima; Government of Odisha
3	Dr. Arun Kumar Panda	Principal scientist, Indian Council of Agricultural Research-Central Institute for Women in Agriculture
4	Dr. Niranjana Panda	Professor and head, Department of Animal Nutrition, College of Veterinary Sciences and Animal Husbandry, Odisha University of Agriculture and Technology, Bhubaneswar
5	Dr. Mamta Dhawan	Consultant, ILRI

**Table 7: Participants of virtual data validation workshop on cattle (crossbreeds, local), 7 May to 10<sup>th</sup> May 2021**

	Name of expert	Organization
1	Dr. N. Panda	Professor and head, Department of Animal Nutrition, College of Veterinary Sciences and Animal Husbandry, Odisha University of Agriculture and Technology (OUAT), Bhubaneswar
2	Dr. C.R. Pradhan	Retired professor, Livestock Production Management, OUAT
3	Sukant Jena	Retired fodder development officer, Directorate of Animal Husbandry and Veterinary Services Odisha, Cuttack
4	Dr. K.V.K. Patnaik	Retired chief executive officer, Odisha Livestock Resource Development Society, Bhubaneswar
5	Dr. C.R. Pradhan	Retired professor, LPM OUAT
6	Dr. Saroj Kumar Sahu	General manager, Bolangir-Kalahandi-Nuapada Regional Co-Operative Milk Producer's Union Ltd
7	Dr. J.K. Patnaik	Deputy general manager – Procurment & Inputs, Odisha State Cooperative Milk Producers' Federation, Bhubaneswar

**Table 8: Participants of virtual data validation workshop on goats including commercial farms, 12 May and 13 May 2021**

	Name of expert	Organization
1	Dr. K.V.K. Patnaik	Retired chief executive officer, Odisha Livestock Resource Development Society, Bhubaneswar
2	Dr. Rabi Maharatha	Retired additional director, Directorate of Animal Husbandry and Veterinary Services (DAH & VS) Odisha, Cuttack
3	Dr. G.Ch. Mohapatra	Retired chief district veterinary officer (CDVO), Jharsuguda
4	Dr. D.N. Biswal	Retired joint director, DAH & VS Odisha, Cuttack
5	Dr. Gaura Sahu	Retired CDVO, Kandhamal
6	Biren Sahoo	Owner, Manikstu Goat Farm, Kalahandi
7	Pramod Kumar Ghosh	District coordinator, BAIF Development Research Foundation, Odisha
8	Mr. Ranjan Kumar Bhokta	Project officer, BAIF Development Research Foundation, Odisha
9	Dr. Mamata Dhawan	Consultant, International Livestock Research Institute

**Table 9: Participants of data validation workshop on sheep, 14 May 2021**

	Name of expert	Organization
1	Dr. K.V.K. Patnaik	Retired chief executive officer, Odisha Livestock Resource Development Society, Bhubaneswar
2	Dr. G.Ch. Mohapatra	Retired chief district veterinary officer, Jharsuguda
3	Dr. D.N. Biswal	Retired joint director, Directorate of Animal Husbandry and Veterinary Services Odisha, Cuttack
4	Dr. Mamata Dhawan	Consultant, International Livestock Research Institute

**Table 10: Participants of data Validation Workshop on Poultry (Backyard, Commercial), 18<sup>th</sup> May to 20<sup>th</sup> May 2021**

	Name of Experts	Organization
1	Dr. N.C. Behura	Retired professor and head, Department of Animal Nutrition, College of Veterinary Sciences and Animal Husbandry, Odisha University of Agriculture and Technology (CVSc & AH, OUAT), Bhubaneswar
2	Dr. Arun Kumar Panda	Principal scientist, Indian Council of Agricultural Research-Central Institute for Women in Agriculture
3	Dr. Pravat Kumar Sahoo	Retired chief district veterinary officer, Malkangiri,
4	Dr. Niranjana Panda	Professor and head, Department of Animal Nutrition, CVSc & AH, OUAT, Bhubaneswar
5	Dr. Rudra Narayan Pradhan	Project Management Unit Directorate of Animal Husbandry and Veterinary Services Odisha, Cuttack
6	Dr. M.K. Padhi	Principal scientist, Regional Centre, Indian Council of Agricultural Research-Directorate of Poultry Research, Bhubaneswar
7	Dr. Mamata Dhawan	Consultant, ILRI

**Table 11: Participants of data validation workshop on goats and backyard poultry from a gender perspective, 21 May 2021**

	Name of expert	Organization
1	Mr. Ajit Nayak	Pradhan non-governmental organization
2	Dr. Sushmita Parai	Heifer International
3	Dr. Arun Kumar Panda	Principal scientist, Indian Council of Agricultural Research-Central Institute for Women in Agriculture
4	Dr. Mamta Dhawan	Consultant, International Livestock Research Institute
5	Dr. Rudra Narayan Pradhan	Project Management Unit, Directorate of Animal Husbandry and Veterinary Services Odisha, Cuttack

Table 12: List of stakeholders interviewed for a gender perspective


	Name of expert	Organization	Date
1	Mr. Ajit Nayak	Pradhan non-governmental organization	19 May 2021
2	Dr. Arun Kumar Panda	Principal scientist, Indian Council of Agricultural Research-Central Institute for Women in Agriculture (ICAR-CIWA) Odisha	19 May 2021
3	Dr. Sushmita Parai	Senior programme manager, Heifer International India	25 May 2021
4	Mr. Bhibhuti	Monitoring and evaluation officer, Heifer International India	15 May 2021
5	Dr. Beth Miller	Gender consultant, President, International Goat Association	26 May 2021
6	Dr. Rudra Narayan Pradhan	Project Management Unit, Directorate of Animal Husbandry and Veterinary Services Odisha, Cuttack	7 June 2021
7	Ms. Meera Mishra	Gender focal person, South Asia Hub, International Fund for Agricultural Development	10 June 2021
8	Dr. K.V.K. Patnaik	Ex-chief executive officer (CEO), Odisha Livestock Resources Development Society	11 June 2021
9	Ms. Babita Mohapatra	Dy CEO, Odisha Livelihoods Mission (OLM)	16 June 2021
10	Dr. Gopal Tripathy	Joint director, Veterinary Officers Training Institute	15 June 2021
11	Dr. Charles Jeeva	Principal scientist (Agricultural Extension), ICAR-CIWA	25 June 2021
12	Ms. Shraddhanjali Hota	Gender focal person, OLM	28 June 2021
13	Mr. Sudhira Rath	Livelihood officer, OLM	28 June 2021



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