

DAIRYING: A MAJOR DRIVING FORCE TOWARDS SUSTAINABLE LIVELIHOOD AND FOOD SECURITY IN DISADVANTAGED DISTRICTS OF MAHARASHTRA**R. S. Sonwane**Department of Dairy Science, Yashwant Mahavidyalaya, Nanded, MS, India
rajkumarsonwane2013@gmail.com**ABSTRACT**

Despite the fact that India is a dairy self-sufficient nation, we are facing several issues in regard to dairying and cattle industries. Protein-rich food production is directly influenced by livestock animals, which provides milk, meat, and eggs. Though the livestock products are expensive, they are the best sources of high-quality protein and micronutrients required for good health. The population residing in disadvantaged districts consume less milk and meat on a yearly basis, resulting in low per capita consumption. Though the swiftly growing urbanization augments income but it is at the cost of impairment of environmental. The various livestock production activities are aimed at sustainable food production and livelihood security. This review encompasses the study based on secondary data collected from various online, printed literature and reports of survey conducted by various workers.

Keywords: Food security, meat, milk, egg production, India, Maharashtra

Introduction

The concept of sustainable development was described by the 1987 Brundtland Commission Report as “*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*”. The entire issue of sustainable development centres around inter- and intra-generational equity anchored essentially on three-dimensional distinct but interconnected pillars, namely the environment, economy, and society. Decision-makers need to be constantly mindful of the relationships, complementarities, and trade-offs among these pillars and ensure responsible human behaviour and actions at the international, national, community and individual levels in order to uphold and promote the tenets of this paradigm in the interest of human development. We can achieve the food security when all individuals have physical and economic access to enough, safe, and nutritious food to suit their dietary needs and food preferences for an active and healthy life at all times (FAO, 2012). This idea encompasses three dimensions of food security: availability, access, and stability. India is now self-sufficient in terms of food. Dairy farming is the practise of raising animals for milk production and its processing into value added products for human consumption. Dairy sector today provides nutritive food, supplementary income and employment generation, notably mainly for women. Dairy farming with crossbred cattle and high-yielding

buffaloes has proven to be profitable. On a low margin, high volume basis, milk processing has suddenly become a successful company. Animal husbandry is an important part of Indian agriculture, sustaining the livelihoods of over two-thirds of the country's rural people (India has 56.7% of the world's buffalo population, 12.5% of cattle, and 20.4% of small ruminants). 2.4% camel, 12.5% pig, and 3.1% poultry.

According to international livestock research, the livestock sector grew at a rate of 5.3 percent in 1980. The cattle sector's growth slowed in later decades, peaking at 36.7 percent in 2000. By being a source of food, livestock production directly helps to food security. Although livestock products are costly, they are the best sources of high-quality protein and micronutrients that are essential for development and good health. However, poor people prefer to sell them rather than consume them at home, resulting in low per capita annual consumption of milk (69 kg) and meat (69 kg) (37Kg). Food security is built on a foundation of food production. Food is one of the three basic requirements for survival. Food security has changed over the years, and academics, policymakers, and non-governmental organizations are debating what constitutes food security. What can be done at the global, regional, national, state, and individual levels to achieve it? Food security is a fundamental requirement that underpins all human needs. The livestock industry's most

well-known contribution is the production of milk and dairy products. This industry also supplies meat, hides, hides, compost, and draught power, in addition to dairy. Individual farms of various sizes produce dairy products. This feature of milk production systems, combined with the perishability of milk, severely inhibits the development of improved milk collection, processing, and distribution systems. The aim of the study is to contribute to the identification of existing gaps in the understanding of the role of livestock production and food security in India.

Objectives

The present study was carried out by the following objectives are:

1. To study the milk production in India and Maharashtra.
2. To study the per capita availability of milk in India and Maharashtra
3. Contribution of Indian Dairy and Livestock Sector towards Food Security

Methodology

The above objectives are achieved by using secondary data collected from the various published reports, books and internet sources and the study period was during 1991-92 to 2018-2019. The simple Descriptive Statistics used to analysis the data. The collected data is analyzed to arrive at a logical conclusion.

Review of Literature

There are three dimensions underlying food security definition, i.e., food availability, access and utilization. As per (FAO, 1996). Nutritional Status and Food security is a situation “when all the people, at all the times, have physical and economic access to sufficient, safe and nutritious food and to meet their dietary needs and food preferences for an active and healthy life.” According to (Winrock, 1992), De Boer et al, (1994), and livestock can play a significant role. A sufficient supply of well-balanced and nutritious food is a key determinant of human well-being and development. Animals are a valuable source of protein, minerals, vitamins, and micronutrients, especially high-quality protein. Because it provides critical amino acids that are lacking in grains, the value of

dietary animal protein exceeds its percentage in diets. Because animal proteins are more digested and metabolized efficiently than plant proteins, even a modest amount of animal products can fix amino acid imbalances in cereal-based human diets, allowing more of the total protein to be utilized.

Sheikh, et al., (2017) concludes that human communities across the country rely heavily on livestock for a variety of purposes, includes meat, milk, and other milk products, wool, as well as transport, draught, and fertilizers provision. Various environmental var according to (FAO, 1996). Food Security and Nutritional Status Food security is defined as “having physical and economic access to sufficient, safe, and nutritious food at all times to match their dietary needs and food preferences for an active and healthy life. Variables such as temperature and humidity have a direct impact on the productivity and reproduction of livestock. Climate change not only leads to a decline in reproductive efficiency, such as a decline in the viability of eggs and sperm, and a decline in pregnancy rates, but also a decrease in milk Production is also quantitative and qualitative

Key findings on Dimensions of Food Availability that Nampanya et al. (2017); Heath (2008);

Mayberry et al. (2017); Frelat et al. (2016) Greater food availability must be accompanied by increased food accessibility. Policies and regulatory compliance should be considered to increase the production of animal source food variables such as disease control, reproductive performance, land-use difficulties, and improvements in trade and marketing systems, particularly for rural and disadvantaged producers. Epizootics have a direct impact on the world economy, altering animal product and feed grain costs. - The rise of large-scale commercial farming, which is at odds with small-scale farmers. Crop output surpluses can influence livestock production. Food security is discussed as one of the concerns in their different disciplines, particularly the environmental challenges. In developing countries, food security is highlighted as a desirable outcome of livestock and aquaculture production. The literature frequently examines disease eradication options for cattle

production and the effects of disease on the value chain. Farmers' knowledge and education are widely considered as potential causes of production system and animal disease-related problems, as well as potential solutions.

Bogard et al. (2017); Bell et al. (2015); Beveridge et al. (2013). The key finding on food access dimensions is that livestock raising improves households' economic and physical access to food in general, and animal-source food in particular. Livestock keeping provides direct access to animal-source meals, and monetary proceeds from the sale of livestock and livestock products can be used to buy food, particularly during times of scarcity. As a result of greater productivity through the use of manure and traction, livestock contributes to increased food supply. Livestock provides physical access to food in some rural locations of developing countries by assisting their keepers in transporting food items to markets and from markets to homesteads. Technology equipment, in combination with a household's social, political, and economic capacity, can improve access to animal source food. Changes in consuming behaviour are influenced by the rapid expansion of commercial animal source food.

Key findings on Dimensions of Stability of Food by Hauck and Rubenstein (2017); Krause et al. (2015); Tibbo and van de Steeg (2013) Pastoralists and consumers' economic strategy and market involvement are impacted by globalised markets and production systems, especially in developing nations, increasing their danger of losing access to food. To alleviate food insecurity, participative approaches, decision-making, and policy formation are essential. In order to respond to climate change, economic crises, rangeland degradation, and other factors, food stability necessitates technical, infrastructure, and informational features.

The important result on the dimension of food use by Ström et al. (2017); Chagomoka et al. (2017); Qekwana and Oguttu (2014) is that livestock keeping contributes to food and nutritional security, as well as the livelihoods of rural and poor people. Animal infections are difficult to regulate and eradicate, especially in traditional production systems due to animal care. Livestock is frequently used in traditional

and cultural contexts, and is regarded as a source of status as well as social and recreational aspects.

Discussion

Contribution of Indian Dairy and Livestock Sector towards Sustainable development and Food Security: The livestock industry accounts for roughly 26% of agricultural GDP. The country's per capita milk availability is at 334g per day, which is in line with the ICMR's recommendations. However, as compared to other industrialised countries, per capita spending is significantly lower, with the main cause being a lack of affordability by some segments of society. When processed and sold as fluid milk and value-added milks, 50 percent of the milk produced in the country is marketable excess. Small holder milk production system provides nutritional security to rural households in the form of milk for children, expectant and nursing mothers in rural areas because 50 percent is retained by the producer for family consumption. Organizers are in charge of 30% of the workload.

Milk as a complete food: Cow and buffalo milk are the primary sources of milk in India. India is mostly an agricultural country, with the majority of people living in villages and earning their livelihood from agricultural products. While there are numerous resources available, they are restricted and must rely on seasonal rain for healthy crop and green fodder. We get milk from cows. A 5–6-year-old child's protein requirements are met by one 250 mL glass of whole milk from cows, which contains calcium, magnesium, selenium, riboflavin, vitamin B12, and vitamin B5. Key micronutrients calculated at 9% of calories for a youngster with modest physical activity. Expert advice on the importance of protein and amino acids in human nutrition. (FAO/WHO/UNU. 2004 and 2007)

Swine Production: Pig production is primary a small scale unorganised rural activity in India, Swine production is profitable enterprise, which requires comparatively small investment and income comes. Rather quickly pig production can be very useful in poverty alleviation especially in eastern states and tribal

areas. Pig is efficient converts of feed into food for human consumption where demand for pork is more.

Poultry Sector: Annually about 38 million tonnes of meat is produced in country per capita consumption of poultry meat is about 28 Kg per year against ICMR's recommendation of 11 Kg and global per capita consumption of 12 Kg per year. The annual egg production in country is about 75 billion. The average per capita egg consumption is about 70 eggs per year against ICMR's recommendation of remaining 70 percent is tracked by unorganised sector. It is necessary to increase share of organised sector in interest of both products and consumers. Poultry meat and eggs are regarded to be the most affordable animal protein sources. Because of the low value units of eggs and the low cost of young broiler meat, chicken products have a stronger consumer preference. Unlike other animal fats, egg and chicken lipids are oils that are beneficial for your health because they include higher omega-9 fatty acid-MUFA, which raises the good HDL cholesterol in your blood. Furthermore, they contain significant amounts of omega-3 fatty acids (N-3 PUFA), which help to lower harmful LDL cholesterol levels in the blood. As a result, egg and chicken lipids are beneficial to one's health. The most efficient converters of grain into meat and eggs are chickens. It just takes 1.6 kg of feed to create one pound of meat. In today's world of scientific and technological growth, we should have a system in place that allows us to be self-sufficient in terms of our fundamental nutritional needs. This can be achieved through improving livestock production and management practises. The majority of this meat and egg originates from the unorganised sector (75%). The poultry industry is growing at a pace of 10% to 12% per year. Chicken meat production is thus promoted as a viable and valuable option for poverty alleviation in rural areas, focusing on small-scale family-based backyard poultry systems. Poultry farming will play a big role in marketing targeted poultry meat and egg production in short time contributing fixed security for population of India.

Sheep and Goat Production: Major share of sheep's and Goat meat comes from small, Marginal and Landless farmer's sheep and Goat contributes significantly to agasirarian economy. Beside meat, Sheep and Goat also contribute milk, Fibre and manure. They play significant role in income generation, Capital storage, employment generation and household nutrition. There is very huge potential in sheep and Goat production for providing food security and economic development and gainful employment to resource poor people especially in arid and semiarid parts of country. Technology adaptation is very low in sheep and Goat production. Margin of profit can be enhanced by providing technical package for scientific feeding and management practices of sheep and Goat.

Milk Production in India and per capita availability: Table 1 presents the trends observed in the annual milk production and per capita availability of milk in India. It is observed from the table 1 shows that per capita availability of milk (Gms/Day) showed upward trend in India i.e., from 222gms and 394gms between 2001-02 and 2018-19, CGR is 3.41 per cent and production of milk increased from 84.4 to 187.7 million tons during the same period, CGR is 4.51 per (Annual report, 2021).

Table 1: Milk Production in India and Per capita milk availability in India

Year	Production (Million Tonnes)	Per Capita Availability (gms/day)
1991-92	55.6	178
1992-93	58.0	182
1993-94	60.6	186
1994-95	63.8	192
1995-96	66.2	195
1996-97	69.1	200
1997-98	72.1	205
1998-99	75.4	210
1999-2000	78.3	214
2000-01	80.6	217
2001-02	84.4	222
2002-03	86.2	224
2003-04	88.1	225
2004-05	92.5	233
2005-06	97.1	241
2006-07	102.6	251
2007-08	107.9	260
2008-09	112.2	266
2009-10	116.4	273
2010-11	121.8	281

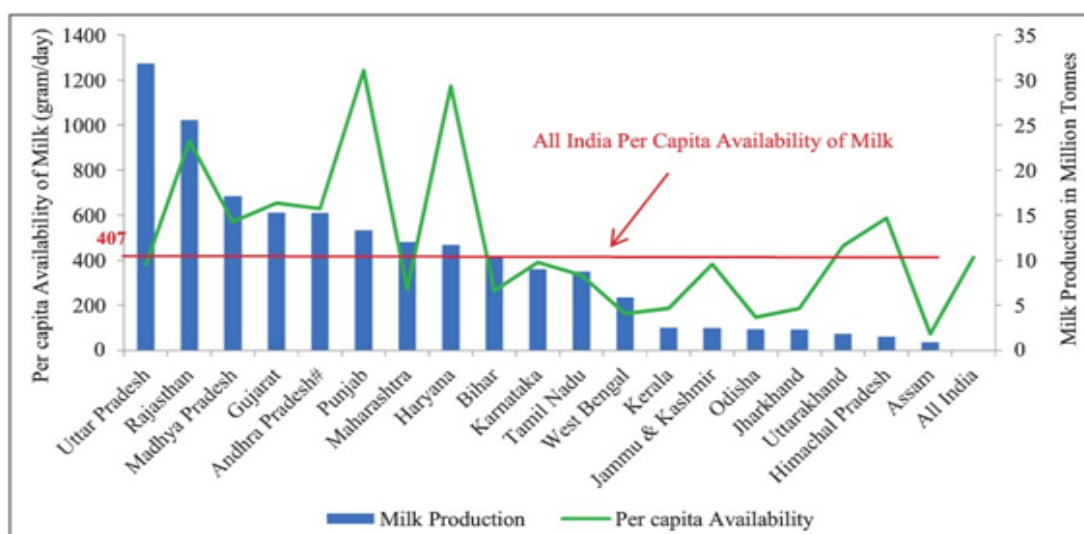
2011-12	127.9	290
2012-13	132.4	299
2013-14	137.7	307
2014-15	146.3	322
2015-16	155.5	337
2016-17	165.4	355
2017-18	176.3	375
2018-19	187.7	394
CGR	4.2%	3.41%

Source: Basic Animal Husbandry Statistics, DAHD&F, GoI

Milk production and per capita availability of milk in India: Milk production, which had remained stagnant at 22 million tonnes in the sixties and seventies, has increased to about 187.7 million MT in 2018-19. Milk production in our country is growing at an annual growth rate of over 6 per cent since the last 6 years. The daily per capita milk availability has also increased from 110 grams in 1973-74 to 394

grams in 2018-19. According to Associated Chambers of Commerce and Industry of India (ASSOCHAM) report "But despite being the largest milk producer in the world, per-capita milk availability in India at 252 grams falls below the global average of 279 grams per person per day," a study titled 'Unlocking the growth potential of Indian dairy industry' New Zealand (9,773 grams), Ireland (3,260 grams) and Denmark (2,411 grams) are top three countries in terms of per-capita milk availability India's milk production is expected to outperform global production and grow at a similar 4.2 per cent CAGR to 185 million MT per annum, and surpass EU to emerge the largest dairy producer by 2020. Interestingly, the country's per capita milk consumption has also been increasing at 3 per cent CAGR as compared to 1 per cent CAGR globally.

Figure 1 Inter-State Variability in Milk Production & Per Capita Availability of Milk during the Year 2019-20*



Source: Based on Data received from DAHD and NDDB Website.
Includes also the figure of Telangana for per capita availability of milk.

Table 3: Per Capita Availability Of Milk By States (GAMS/Day)

Year	All India	Maharashtra
2001-02	225	172
2002-03	230	172
2003-04	231	172
2004-05	233	176
2005-06	241	178
2006-07	251	181
2007-08	260	184
2008-09	266	188
2009-10	273	190
2010-11	281	197

2011-12	290	206
2012-13	299	213
2013-14	307	219
2014-15	322	228
2015-16	337	239
CGR		4.07%

Source: Deptt. Animal Husbandry, Dairying & Fisheries, MoA&FW, GoI

In Maharashtra, as per the 2012 animal census, the total livestock is over three crores that included 1.55 crore cows, Bull, and bullocks, 55 lakh – buffaloes while the remaining one

crore goat and sheep's, etc. October and December is the best season to increase the milk production. "Most of the milk, Maharashtra is getting from the corporate and private dairies. Mainly getting milk from Nasik, Ahmednagar, Pune, and Kolhapur region

The cost of fodder has gone up while the prices of the milk are not increased. Besides, water and fodder are major issues. Therefore, they prefer to sell them today rather than see them suffering later, dairy experts say that the production of milk has decreased and might decrease further due to a variety of reasons. It has become very expensive to maintain livestock. The cost of fodder has gone up but, that of milk has not been increased. The maintenance cost of one buffalo in a week amounts to more than Rs 3,000. Income from the same buffalo is Rs 1,800-2,000 per week. So that the output cost is more than the income. Therefore, currently, most of the cattle market is flooded with cattle. This is a major concern and that can have an impact on several levels.

According to Sudhir-suryawanshi, 2018 Maharashtra's daily milk Collection is 123 lakh liters per day in the month of September. "In June and July, it was 120 lakh liters per day. The milk production has down. Further study has to access that the reason behind the lower milk productions and do the course correction. October and December is the best season to increase the milk production. "Most of the milk, Maharashtra is getting from the corporate and private dairies. Mainly getting milk from Nasik, Ahmednagar, Pune and Kolhapur region. Out of the total milk animals in Maharashtra, 41% are in Marathwada and Vidarbha areas, whereas it contributes only 28 per cent (261 lakh kg per day) in the State's total milk production. This is due to the presence of large number of low-productive indigenous cows and buffaloes. The average

milk productivity of animals in this area is 3.21 kg per day which is less than the state and the country average of 4.42 kg per day and 4.32 kg per day respectively.

Only 13% of reproductive animals are reproduced with artificial insemination. Thus, there is a great possibility of improving the genetic potential of milk animals by artificial insemination. 58% of those who keep milk cattle have only one cattle per family. Per capita availability of milk in these areas is only 170 gm per day, which is less than the state and country average of 239 and 337 grams per day respectively. The consumption of milk in this area is quite less and malnutrition is increasing.

Table 4 Top 10 Milk Producers (2019)

These countries produce about 62% of world production

Country	Per Cent
USA	11
Brazil	4
France	3
Germany	4
Turkey	3
Pakistan	6
India	21
New zeland	2
China	4
Russian federation	4

Table 5 Global And India Milk Production By Specie

Global Milk Production By Species		India Milk Production By Species
Cattle	81%	36.04 per cent
Buffaloes	15%	20.47 per cent
Goats	2%	27.74 per cent
Sheep	1%	13.83 per cent
Camels	0.4%	-
Others	-	0.23 per cent
Pig	-	1.69 per cent

Table 6 Animal Products Statistics

Commodity	Total Production (Per year)	Per Capita Availability	ICMR Recommendations
Milk	187.75 MT	394 grams/day	280 grams/day
Meat	8.11 MT	-	11 kg/year
Eggs	103.32 billion	79 eggs/year	182 eggs/year
Wool	40.42 million kg	-	-

Table 7 Standings of India In The World

Ranking	Sector
1 st	Total Livestock Population, Milk Production, Buffalo Population, Carabeef Production, Goat Milk Production, Total Bovine Population
2 nd	Cattle Population, Goat Population, Bristle Production (a pig industry by-product), Aquaculture, Goat Meat Production
3 rd	Egg Production, Sheep Population, Fisheries Production
5 th	Poultry Production, Meat production
6 th	Poultry Meat Production

Table 8 Share Of States In Production Of Livestock Products

Largest Share in Total Milk Production in India: Uttar Pradesh	16.30%
Second Largest Share in Total Milk Production in India: Rajasthan	12.60%
Largest Share in Total Egg Production in India: Andhra Pradesh	19.10%
Second Largest Share in Total Egg Production in India: Tamil Nadu	18.20%
Largest Share in Total Meat Production in India: Uttar Pradesh	15.10%
Second Largest Share in Total Meat Production in India: Maharashtra	12.60%
Largest Share Total Wool Production in India: Rajasthan	35.90%
Second Largest Share Total Wool Production in India: Jammu & Kashmir	18.90%

Table 9 Annual Growth Rate Of Livestock Products

Product	Growth Rate
Meat	5.99 per cent
Broiler production	11 per cent
Egg production	8.51 per cent
Milk production	6.47 per cent
Wool production	-2.51 per cent

Table 10 Highest Annual Growth Rate Of Livestock Products

Highest growth rate in egg production: Rajasthan (14.2%)	14.20%
Highest growth rate in meat production: Telangana (16.9%)	16.90%
Highest growth rate in wool production: Bihar (4.79%)	4.79%

Table 11 Species Wise Egg Contribution to Total Egg Production in India

Species	Percentage of Total Eggs
Improved fowl	87.33 per cent
Desi fowl	11.52 per cent
Desi duck	0.89 per cent
Improved duck	0.26 per cent

Egg production from commercial poultry: 84.91 billion	(82.2% of total egg production)
Egg production from backyard poultry: 18.41 billion	18.41% of total egg production
Egg production from commercial poultry: 84.91 billion	82.2% of total egg production
Egg production from backyard poultry: 18.41 billion	17.8% of total egg production

Table 12 Species Wise Meat Contribution To Total Meat Production In India

Species	Percentage of Total Meat
Poultry	50.06 per cent
Buffalo	19.05 per cent
Goat	13.35 per cent
Sheep	8.36 per cent
Pig	4.98 per cent
Cattle	4.02 per cent

Way forward

According to the FAO's population projections, India will be the world's most populated country by 2050, with 1.7 billion people, the majority of whom will be middle-income. The cattle production is in peril. Due to reduced pasture lands and shrinking availability of land for fodder and forage production, reduction in the availability of potable water for animals, and extreme weather conditions due to climate change, increased production of animal origin products such as milk and eggs would have to come from increased productivity rather than increased numbers. As a result, the focus must be on continuous improvement. The health-conscious younger generation is willing to pay a higher premium for better health.

The health-conscious younger generation is willing to pay a higher price for safe and healthy poultry products. What's needed is the development of disease-resistant backyard chicken breeds, poultry feed formulations based on locally available resources, veterinary

support for rural backyard poultry growers, as well as training, extension, and marketing assistance.

Conclusion

According to the data, India is a big country in terms of milk production, ranking first and being one of the world's leading milk producers. Milk production in the country increased from 84.4 million tonnes in 2001-02 to 187.7 million tonnes in 2018-19, with 394

grammes per day available per capita. India produces 7.2 percent of the global milk supply. Despite having the world's highest number of dairy cattle, India's production is quite low. In India, the dairy business is not run scientifically, and the majority of milk produced is consumed locally. The key milk-producing states in India are Punjab, Haryana, Gujarat, Maharashtra, western Uttar Pradesh, Rajasthan, and Madhya Pradesh.

References

1. 20th Livestock Census (2020). DADF, DADF, Ministry of Fisheries, Animal Husbandry & Dairying, GoI.
2. Basic Animal Husbandry & Fisheries Statistics (2019). Animal Husbandry Statistics Division, DADF, Ministry of Fisheries, Animal Husbandry & Dairying, GoI
3. Bell, J. D., Albert, J., Andréfouët, S., Andrew, N. L., Blanc, M., Bright, P., Brogan, D., Campbell, B., Govan, H., Hampton, J., & Hanich, Q. (2015). Optimizing the use of nearshore fish aggregating devices for food security in the Pacific Islands. *Marine Policy*, 56, 98–105.
4. Beveridge, M. C. M., Thilsted, S. H., Phillips, M. J., Metian, M., Troell, M., & Hall, S. J. (2013). Meeting the food and nutrition needs of the poor: The role of fish and the opportunities and challenges emerging from the rise of aquaculture. *Journal of Fish Biology*, 83(4), 1067–1084
5. Bogard, J. R., Farook, S., Marks, G. C., Waid, J., Belton, B., Ali, M., Toufique, K., Mamun, A., & Thilsted, S. H. (2017). Higher fish but lower micronutrient intakes: Temporal changes in fish consumption from capture fisheries and aquaculture in Bangladesh. *PLoS One*, 12(4), e0175098
6. Chagomoka, T., Drescher, A., Glaser, R., Marschner, B., Schlesinger, J., & Nyandoro, G. (2017). Contribution of urban and periurbanagri [1]culture to household food and nutrition security along the urban-rural continuum in Ouagadougou, Burkina Faso. *Renewable Agriculture & Food Systems*, 32(1), 5–20.
7. FAO. (2012). *The State of Food Insecurity in the World 2012: economic growth is necessary but not sufficient to accelerate reduction of hunger and malnutrition*. Rome: FAO
8. FAO (1996) Declaration on world food security. World Food Summit, FAO, Rome
9. Frelat, R., Lopez-Ridaura, S., Giller, K. E., Herrero, M., Douxchamps, S., Djurfeldt, A. A., Erenstein, O., Henderson, B., Kassie, M., Paul, B. K., & Rigolot, C. (2016). Drivers of household food availability in sub-Saharan Africa based on big data from small farms. *Proceedings of the National Academy of Sciences*, 113(2), 458–463.
10. Hauck, S., & Rubenstein, D. I. (2017). Pastoralist societies in flux: A conceptual framework analysis of herding and land use among the Mukugodo Maasai of Kenya. *Pastoralism*, 7(1), 18
11. Heath, S. E. (2008). The impact of epizootics on livelihoods. *Journal of Applied Animal Welfare Science*, 11(2), 98–111.
12. <https://www.dnaindia.com/authors/sudhir-suryawanshi>
13. Krause, G., Brugere, C., Diedrich, A., Ebeling, M. W., Ferse, S. C., Mikkelsen, E., Agúndez, J. A. P., Stead, S. M., Stybel, N., & Troell, M. (2015). A revolution without people? Closing the people-policy gap in aquaculture development. *Aquaculture*, 447, 44–55
14. Mayberry, D., Ash, A., Prestwidge, D., Godde, C. M., Henderson, B., Duncan, A., Blummel, M., Reddy, Y. R., & Herrero, M. (2017). Yield gap analyses to estimate attainable bovine milk yields and evaluate

- options to increase production in Ethiopia and India. *Agricultural Systems*, 155, 43–51
15. Nampanya, S., Khounsy, S., Young, J.R., Napasirth, V., Bush, R.D., & Windsor, P.A. (2017). Smallholder large ruminant health & production in Lao PDR: Challenges and opportunities for improving Urbanization, livestock systems and food security in developing countries: A systematic review of the literature 297domestic & regional beef supply. *Animal Production Science*, 57(6), 1001–1006.
16. Qekwana, N. D., & Oguttu, J. W. (2014). Assessment of food safety risks associated with preslaughter activities during the traditional slaughter of goats in Gauteng, South Africa. *Journal of Food Protection*, 77(6), 1031–1037
17. Sheikh, A. A., Bhagat, R., Islam, S. T., Dar, R. R., Sheikh, S. A., Wani, J. M., & Dogra, P. (2017). Effect of climate change on reproduction and milk production performance of livestock: A review. *Journal of Pharmacognosy and Photochemistry*, 6(6), 2062-2064.
18. Ström, G., Djurfeldt, A. A., Boqvist, S., Albihn, A., Sokerya, S., San, S., Davun, H., & Magnusson, U. (2017). Urban and peri-urban familybased pig-keeping in Cambodia: Characteristics, management, and perceived benefits and constraints. *PLoS One*, 12(8), e0182247
19. Tibbo, M., & van de Steeg, J. (2013). Climate change adaptation and mitigation options for the livestock sector in the near east and North Africa. In M. V. K. Sivakumar, R. Selvaraju, & I. Hamdan (Eds.), *Climate change and food security in West Asia and North Africa* (pp. 269–280). Dordrecht: Springer
20. WHO/FAO/UNU Expert Consultation on protein and amino acid requirements in human nutrition. WHO Tech Rep Ser, 935:1-265