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Intercooperation (IC) has been working in India for 25 years in close collaboration with the Swiss Agency for Development and Cooperation (SDC).

The role of livestock in livelihood contribution is very well acknowledge. But in the context of 'livestock revolution' and 'climate change', its negative impacts on eviornment raise criticism. How can the trade-offs be minimised is the challenge before us.

This working paper, through six different case studies describes the drivers and consequences of livestock production in the country, and how public and private responses are shaped and implemented. After analysing each case the possible options to address the issues are suggested with model cases, wherever available. However, it is to be appreciated that the cases discussed are only sporadic and cannot be generalized for the country as a whole.

This working paper should be of interest to anyone, intersted in the livestock- livelihood-envionment triad.

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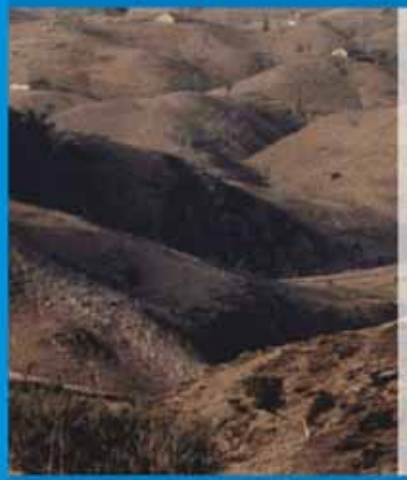

Livestock in the changing landscape in India; its environmental, social and health consequences and responses

A case study

inter cooperation

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This case study was conducted for FAO by a multi-displinary team supported by the CALPI programme of SDC and Intercooperation for inclusion in the 'Case study volume' of FAO's global assessment on 'Issues of livestock in a changing landscape from a social enviorn-mental and health perspective'. This is reproduced with the consent of FAO.

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Livestock in the changing landscape in India; its environmental, social and health consequences and responses

A case study

C. T. Chacko[1], Gopikrishna[2], Padma kumar[3],
Shailendra Tiwari[4] , Vidya Ramesh[5]

Summary

The concerns over the environmental impacts of livestock production in India are of relatively recent origin. It is generally considered that the environmental, social and health impacts of livestock production in India have more positive implications than negative ones as the production system is still largely dominated by a rural-based crop livestock integrated smallholder mixed farming system. But methane emission, degradation of common lands and grain based intensive poultry production are causes of serious concern. Large scale industrial production units, especially poultry are on the increase in India. Though there are several regulations to prevent over-use and undermining of natural resources, their strict enforcement is a challenging task. Hence the environmental, social and health concerns of livestock production are justified and need attention.

This paper, through six different case studies describes the drivers and consequences of livestock production in the country, and how public and private responses are shaped and implemented. After analysing each case the possible options to address the issues are suggested with model cases, wherever available. However, it is to be appreciated that the cases discussed are only sporadic and cannot be generalized for the country as a whole.

Key words: Livestock, environment, waste management, social impacts, health issues

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Content

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Abbreviations

ACU	Adult Cattle Units
AI	Artificial Insemination
BAFCO	Bangalore Animal Food Corporation
BOD	Biological Oxygen Demand
CALPI	Capitalisation of Livestock Programme Experiences India
CB	Cross-bred
CBD	Convention on Biological Diversity
CETP	Central Effluent Treatment Plant
CH_4	Methane
CLRI	Central Leather Research Institute
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CPR	Common Property Resource
DAP	Di-Ammonium Phosphate
ETP	Effluent Treatment Plant
FAI	Fertiliser Association of India
FAO	Food and Agricultural Organisation
FCR	Feed Conversion Ratio
GDP	Gross Domestic Product
GHG	Green House Gases
GIS	Geographical Information System
GoI	Government of India
IC	Intercooperation
ICRISAT	International Crop Research Institute for Semi Arid Tropics
IETP	Individual Effluent Treatment Plant
IFPRI	International Food Policy Research Organisation
INR	Indian Rupees
IWMI	International Water Management Institute
JFM	Joint Forest Management
KLDB	Kerala Livestock Development Board
KMPMCL	Karnataka Meat and Poultry Marketing Corporation Limited
KSPCB	Kerala State Pollution Control Board
LEAD	Livestock Environment and Development
MMPO	Milk and Milk Products Order
MT	Metric Tonne
N_2O	Nitrous Oxide
NATCOM	National Commission on Environment and Forestry
NDDB	National Dairy Development Board
NGO	Non-Government Organisation
NRM	Natural Resource Management
PBC	Pig Breeding Centre

PIA	Programme Implementation Agency
PPS	Parallel Plate Separator
PTP	Primary Treatment Plant
PVC	Poly Vinyl Chloride
SC	Supreme Court
SDC	Swiss Agency for Development and Cooperation
SS	Suspended Solids
SWOT	Strengths Weaknesses Opportunities and Threats
TERI	The Energy Research Institute
Tg	Trillion grams
TLWK	Tonne Live Weight Killed
UNCCD	United Nations Convention on Combating Desertification
UNEP	United Nations Environment Programme
UNFCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organisation
UPPCB	Uttar Pradesh Pollution Control Board
UV	Ultra Violet
WTO	World Trade Organisation

Introduction

India, as the world's largest democracy, embraces countless cultures, languages and religions but is also home to a population exceeding one billion. With an annual Gross Domestic Production (GDP) growth rate of 8 per cent (driven mainly by industrial growth of 9 per cent and service sector growth of 9.8 per cent) and inflation around 5 per cent, India ranks today as the world's fourth largest economy. The global consultancy firm Jones Lang LaSelle, in its recent report, said "with forecasts of economic growth rates of 8-9 per cent, India is expected to become the world's third largest economy after the US and China and ahead of economies like Japan, Germany and the UK by 2010" (Jones Lang LaSalle, 2005).

Agriculture, the mainstay of the Indian economy, and allied sectors contribute nearly 18 per cent of GDP, while about 65-70 per cent of the population is dependent on agriculture as a livelihood.

Based on agro-ecological features, India has been divided into 15 zones and geographically there are three major regions (the Himalayas, the Indo-Gangetic Plain, and the Peninsula and their agro-ecological sub-regions). Topography, soils, rainfall, and the availability of water for irrigation have been major determinants of the crop and livestock patterns characteristic of these geographic regions. The agricultural output depends on monsoon, as nearly 60 per cent of the area sown is dependent on rainfall. The public sector in India has played a crucial role in the development of infrastructure like irrigation, electricity, agricultural research, roads, markets and communications.

Agriculture, including livestock, is a subject handled by the state governments. The Government of India deals in livestock issues on a policy level and controls the import and export of livestock and their products.

Though the national agricultural policy (2000) targets an annual growth rate of 4 per cent by 2020, the sector is trapped in a low growth regime of below 2 per cent per annum. Despite taking great strides in addressing poverty, there remains a distinct rural-urban divide and India's emerging image as a global economic force sits uncomfortably with the harsh reality of its human development statistics. Though the agricultural sector shows a decline in growth rate, the contribution of livestock to agriculture sector GDP has been steadily increasing, mainly contributed by the dairy and poultry sectors. The demand for livestock products has shown an increasing trend, which is driven by sustained economic growth, rising incomes and urbanisation. It is likely that more and more organised, larger, industrial livestock production units would emerge sooner or later to meet the growing demand. The large-scale livestock production units would marginalise the smallholders (constituting 22 per cent landless and 63 per cent with less than 2 ha) who possess about three-fourths of the country's livestock wealth and predominantly follow a mixed crop-livestock farming system, unless pro-poor policies are put in place.

Objectives of the study

The purpose of this case study is to show how the drivers and consequences of the livestock sector changes resonate in India, and how public and private responses are shaped and implemented. The specific objectives are:

1. examination of the factors driving livestock production over the last two and a half decades in India and the production trends

2. studying the beneficial and adverse environmental, social and human health consequences of production changes and

3. discussing the public and private responses and mechanisms to address the consequences and the lessons learnt.

The study is discussed in six sections. After the introduction **(section 1), section 2** focuses on general overview of the changes and current trends in livestock production and the main drivers of such changes namely, demography, urbanisation, income, trade liberalization, sector policy etc. **Section 3** deals with environmental, social and health consequences of the production changes in India. **Section 4** considers the responses to address the consequences by different actors /stakeholders, the instruments and implementation mechanisms, institutional background etc. In **Section 5,** five examples are given: (1) peri urban dairy colonies in Mumbai, Maharashtra (2) industrial poultry production in the state of Chattisgarh (3) organised slaughter house in Bangalore city, Karnataka and unorganized village slaughter houses in Kerala (4) model pig farm in Trichur, Kerala (5) common grazing land in Kalyanpur, Rajasthan and (6) tanneries in Kanpur, Uttar Pradesh. Section 6 provides conclusions.

2. Drivers of changes and trends in the livestock sector in India

2. Drivers of changes and trends in the livestock sector in India

2.1 The Drivers of Change

With more than a billion people, India's population is still growing at the rate of 2.11 per cent per annum. Between 1991 and 2001, India has added 182 million people. The country's population growth is set to continue to increase until at least 2030, before stabilising around 1.5 billion, by which time India will overtake China as the world's most populous country (Jones Lang LaSalle, 2005). The United Nation's World Population Prospects, released in 2005, estimates that there will be 1,395 million people in India by 2025, and 1,593 million in 2050. Out of the current 1,027 million population of India, 742 million live in rural areas and 285 million in urban areas comprising 72.2 per cent and 27.8 per cent of the population respectively (GoI, 2001).

India is urbanising at a rapid rate of 2.5 per cent per year. The number of cities over one million is expected to double from 35 in 2001 to 70 by 2025. Between 1981 and 2001 the urban population grew at an annual rate of 3 per cent compared to 1.7 per cent growth in rural population. India's per capita income is showing a fast growing trend. The per capita income was estimated to be $310 during 2004-05. It increased by 5.2 per cent from $295 in 2003-04 (Central Statistical Organisation). With a booming economy, real annual personal disposable income is set to increase by 8-10 per cent per year over the period 2006-10, providing a significant boost to the demand for lifestyle products and services (Jones Lang LaSalle, 2005). Median household incomes are expected to grow from $2250 in 2005 to $3600 by 2010. A large middle class has emerged in India, currently

estimated at 120 million. India's National Council of Applied Economic Research expects a further 180 million to join the middle-class category by 2010.

Increasing population, urbanisation and sustained income are causing significant changes in the food basket of India. It is reported that there is significant change in the recent past in the food consumption pattern in India. Kumar and Birthal (2004) report that between 1977 and 1999 the per capita cereal consumption declined by 20 per cent, while there was a significant increase in the consumption of fruits (553 per cent), vegetables (167 per cent), milk products (105 per cent) and meat, eggs and fish (85 per cent). The demand for animal food products is more income elastic, as compared to staples. The low income groups spend more on high-value foods with rise in income.

The consumption of milk and meat during the last few years shows an impressive growth of 2.3 per cent and 1.3 per cent respectively (Table 1)

Table 1: Per capita consumption of livestock products (gram/ day/ person)

Product /year	1996	1997	1998	1999	2000	2001	2002	2003	2004	Average growth % /yr
Milk	193.04	200.38	206.38	213.95	217.75	224.82	227.89	234.25	233.12	2.301
Meat	13.81	13.23	13.48	13.70	14.30	14.63	14.88	15.29	15.29	1.293

Source: FAOSTAT, 2006

It is found that the per capita consumption of milk has increased by 71 per cent in 2000 compared to 1983 (43 kg per annum in 1983 to 73.5 kg in 2000). While small ruminant meat consumption has not changed much (1.1 kg to 1 kg), beef and buffalo meat has increased by 50 per cent (0.6 kg to 0.9 kg) and poultry by 133 per cent (0.3 kg to 0.7 kg) during the same period.

Interestingly, it is found that the consumption of milk and eggs in the rural areas increased faster than in the urban areas. It is also noticed that the difference between increase in the urban and rural consumption of animal products is narrowing over the years. The income elasticity of demand for animal food products for the

very poor households is 0.70 and that for the very rich is 0.39 (Birthal and Taneja, 2006). This implies that the demand for animal food products would grow faster when there is a rapid increase in the purchasing power of the poor people.

Apart from rising income and urbanisation, prices are important determinants of demand growth. During 1983 to 2000 retail prices of meats and eggs (except mutton and chevon) declined in the range of (-) 0.2 to (-) 3.6 per cent per year. With real prices going down, growth in demand is expected to grow (Birthal and Taneja, 2006).

Coupled with the above factors, the Government of India's (GoI) trade liberalisation policy propelled fast growth in the livestock sector in India. As part of the economic reforms in 1991, the GoI introduced a number of trade reforms such as reduction in tariffs, removal of quantitative restrictions and demonopolisation of imports and exports. Import tariffs were reduced significantly. The GoI also took a number of policy initiatives to boost exports of livestock products, especially buffalo meat (Birthal and Taneja, 2006). Minimum export price condition for meat was abolished in 1993, and exports of milk, cream and butter were freed but subject to quota. The export-oriented units and the firms in the export processing zones are allowed duty-free import of goods for manufacturing and processing. They also enjoy tax holidays and other benefits such as concessional rent, sales tax, excise duty, corporate taxes etc.

The producer price of milk in India is lower than that in the US. India has a competitive advantage in the export of mutton and beef. One of the reasons for the tremendous growth in export of buffalo meat from India is its liberalisation policy. A number of modern export-oriented processing units have been established in the private sector in collaboration with foreign firms.

All these factors point to the fact that the demand for livestock products will keep on increasing in the years to come. Projections to 2020 indicate that the demand for milk is expected to double in the range of 132-140 million tonne compared to 2000 and that of meat would treble to eight to nine million tonne (Parthasarathy Rao et al., 2004). The current changes in the sector such as production trends, population dynamics; species shifts etc. had already given signals of a booming livestock sector scenario in India.

2.2 Current changes in the livestock sector

2.2.1 Trends in livestock production

Between 1980-81 and 2003-04, livestock production increased at an annual rate of 4.3 per cent, much faster than the agricultural sector (2.8 per cent) as a whole. Notable growth occurred in the dairy and poultry sector (Table 2). In the case of poultry meat production, a more than ten-fold increase has been reported.

Milk production has increased from 44.02 million tonne in 1985 to 91.94 million tonne in 2005. Growth in milk production has been quite robust. The sustained growth in milk (brought about by technological change and improvement of producer's access to market) led the country into self sufficiency. Milk markets are largely informal. Dairy cooperatives comprise an important segment of organised milk markets and their number has expanded considerably since 1970. Meat production increased from 2.67 million tonne (1985) to 5.66 million tonne in 2005. Birthal and Taneja (2006), report that in the early 1980s small ruminants were the major suppliers of meat followed by large ruminants and poultry. The meat production structure since then has undergone a drastic shift with poultry emerging as one of the major contributors.

Table 2: Livestock production from 1985 to 2005

	Year				
Figures (in million tonnes)	**1985**	**1990**	**1995**	**2000**	**2005**
Milk	44.02	53.68	65.25	80.83	91.94
Beef and buffalo meat	1.95	2.40	2.72	2.86	2.98
Sheep and goat meat	0.53	0.61	0.66	0.70	0.71
Poultry meat	0.19	0.37	0.62	1.14	1.97

Source: FAO STAT, 2006

2.2.2 Trade in livestock products

Trends in India's exports and imports for the last two decades indicate that in 2001-03 livestock products accounted for 6.6 per cent of exports and 5.8 per cent of imports of agricultural products. Interestingly, the share in exports (mainly buffalo meat and dairy products) has almost doubled compared to '89-'91, while its imports (dairy products, animal fat) fell drastically (Birthal and Taneja, 2006).

Table 3: Livestock population over years (million)

Species	1992	2003	Change (92-03)
Cattle	204.58	185.2	-09.47%
Buffalo	84.21	97.9	16.26%
Sheep	50.78	61.47	21.05%
Goat	115.28	124.36	07.88%
Pigs	12.79	13.52	05.71%
Poultry	307.07	489.01	59.25%

Source: GoI, 2003

2.2.3 Changes in livestock population

As of 2003, the cattle population in the country was 185 million, buffaloes 98 million, sheep 61.5 million, goats 124.4 million, pigs 13.5 million and poultry 489 million (Table 3). While the cattle numbers are declining over the last 10 years there is decelerated growth of buffalo, goat and swine population during the same period vis-à-vis the previous decade. Sheep showed a better annual growth rate compared to the previous decade, while poultry had grown almost 60 per cent.

Table 4: Ruminant and monogastric population (million)

Species	1992	2003	Change (92-03)
Ruminants	454.85	468.93	3.0%
Pigs	12.79	13.52	5.7%
Poultry	307.07	489.01	59.0%

Source: GoI, 2003

2.2.4 Species shift

Table 4 shows that monogastrics, mainly poultry, are gaining importance. Between 1992 and 2003 the poultry population increased by 59 per cent, whereas the pig and ruminant population showed only a marginal increase (except cattle, which showed a decline).

Poultry is one of the fastest growing segments of the agricultural sector in India today. While the production of agricultural crops has been rising at a rate of 1.5-2.0 per cent per annum, the production of eggs and broilers has been rising at a rate of 8-10 per cent per annum (Mehta et al., 2003). The growth of the poultry sector in India has also been marked by an increase in the size of the poultry farm. For example, in earlier years broiler farms used to produce a few hundred birds per cycle on an average; whereas now units with less than 5,000 birds are becoming rare, and units with 5,000 to 50,000 birds per week cycle are common.

Table 5: Livestock population trends (urban and rural) in million

Species	1992		2003		Change	Change
	Rural	Urban	Rural	Urban	Rural	Urban
Cattle	195.88 (96%)	8.69 (4%)	175.65 (95%)	9.53 (5%)	-20.23 million	+0.84 million
Buffalo	79.92 (95%)	4.29 (5%)	91.93 (94%)	5.99 (6%)	+12.01 million	+1.70 million
Sheep	48.86 (96%)	1.91 (4%)	57.99 (94%)	3.48 (6%)	+9.13 million	+1.57 million
Goat	109.36 (95%)	5.92 (5%)	117.48 (94%)	6.88 (6%)	+8.12 million	+0.96 million
Pigs	11.25 (88%)	1.54 (12%)	11.41 (84%)	2.10 (16%)	-0.16 million	+0.56 million
Poultry	282.67 (92%)	24.40 (8%)	449.14 (92%)	39.87 (8%)	+166.47 million	15.47 million

Source: GoI, 2004, 2006

2.2.5 Geographical shift

Livestock production is largely a rural activity. About 95 per cent of ruminants, 84 per cent pigs and 92 per cent poultry are still raised in rural areas (Table 5). No geographical shift has been noticed from rural to urban areas during the last 10 years, though a proportionate increase in population has been observed in both

urban and rural areas (except cattle). Urban livestock production is small, but specialised dairy and poultry enterprises may emerge in future in response to rising demand for animal foods by the urban population.

While there was a reduction in rural cattle population by about 20 million, the urban cattle population though small showed a marginal increase. The increase in buffalo population was noticed both in urban and rural areas with the ratio between rural and urban populations tilting slightly in favour of the urban population. Noteworthy shift to urban can also be seen in swine population.

2.2.6 Changes in the production system

A large proportion of the cattle and buffaloes in India are either or belonging to draught breeds that have a poor milk production potential. This coupled with feed and fodder scarcity has been the major constraints in raising livestock productivity. A scientific genetic selection was yet to be put in place for many parts of the country and for most of the species exceptions are certain states like Kerala for cattle and species like poultry under the organized private sector. Even under the above mentioned constraints it is satisfying to note there was increased per animal production and reproduction (Table 6).

Table 6: Milk and egg yield and proportion of producing livestock

	Milk /egg yield (kg/year)				Percentage milked/laying			
Species/ year	1990	1995	2000	2005	1990	1995	2000	2005
Cattle	732	806	944	1000	15.0	18.6	19.9	21.2
Buffalo	1122	1294	1423	1450	32.1	33.2	33.5	34.9
Chicken	10.1	11.7	11.6	11.6	39.1	40.3	41.6	42.7

Source: FAO STAT, 2006

Economic reforms have paved way for increased participation by private sector in livestock products market. The markets are now transforming from an open to vertically coordinated structures like cooperatives, producers' associations and contract farming.

The private sector has been increasingly relying on contracts to source a sustained supply of raw material. Much of the poultry production in major producing states is now produced under contract. Contract farming has emerged in a big way, providing an assured market and returns to the producers.

In India mixed rainfed systems are practiced on 46 per cent of land and mixed irrigated system on 37 per cent, where cattle or buffalo rearing forms the second or third largest economic activity (Parthasarathy Rao et al, 2004). However, mixed farming systems are undergoing a steady transformation due to increasing pressure on livestock to produce more to meet the growing food demand (Birthal and Taneja, 2006). The interaction between crop and livestock production is likely to weaken, giving way to emergence of commercial production systems based on high producing animals and external inputs. For instance, poultry production in India has largely been transformed from a backyard activity to a commercial activity.

2.2.7 Changes in feed /grazing resources

Recent estimates of demand, supply and requirement of different feedstuffs (Birthal et al, 2006) show that there is significant deficit in fodder (green and dry) and concentrates. On an average about 35 per cent of livestock-keeping households use common land for grazing and about 23 per cent report fodder collection from common land (GoI, 1999). The area under permanent pastures and grazing lands comprise a mere 3.3 per cent of the total area and has been declining steadily It has reduced from 12 million ha in 1981-82 to 10.5 million ha in 2001-02 (FAI, various years, Fertiliser statistics).

2.2.8 Changes in draught animal population

Zebu cattle and buffalo are the main draught animals in India. In most parts of the country only male bovines are used for draught purpose. From 1971-72 to 1991-92, the population of draught animals declined from 80.8 million in '71-'72 to about 62.2 million in 2003 (GoI, 2003). During the

same period the number of tractors increased rapidly from 1,50,000 to 18,20,000 (Birthal and Parthasarathy Rao, 2002). This shows a shift away from draught animals, which has been facilitated by the rising mechanisation of agriculture. The use of male buffaloes for meat purposes is increasing over the years.

2.2.9 Shift in producer categories

Table 7 shows that changes in the scale of livestock in different land classes vary widely. On large farms, the average number of cattle more than doubled and increased by 17 per cent on

Table 7: Average no. of animals per 100 households in India

	Landless <0.002ha)	Sub-marginal (0.002-0.5ha)	Marginal (0.5-1.0ha)	Small (1.0-2.0ha)	Medium (2.0-4.0ha)	Large (>4.0ha)	All
Cattle							
1991-92	196	281	335	340	306	274	305
2002-03	200	226	293	318	357	433	295
Buffalo							
1991-92	151	190	211	259	287	352	246
2002-03	153	197	225	256	286	366	245
Small ruminants							
1991-92	335	339	378	427	513	800	419
2002-03	153	371	428	443	523	998	433
Pigs							
1991-92	337	266	262	267	298	486	285
2002-03	177	319	283	233	261	311	304
Poultry							
1991-92	641	701	783	816	1138	1029	790
2002-03	366	794	876	1025	867	3311	888

Source: (1) GoI, 1992. NSS 48th round unit level data on land and livestock holdings (ii) Govt. of India. 2002-03. NSS 59th round report on livestock ownership across operational land holding classes in India as quoted by Birthal, Jha and Joseph, 2006.

medium farms. While on small farms there was a decline in their number in the range of 6-20 per cent. For the landless, the size of cattle holding remained unchanged. The average buffalo holding increased in landless, sub-marginal, marginal, medium and large households and in other categories there was reduction. The average number of small ruminants reduced to half in the landless households, remained almost stable on small and medium farms, and increased by 25 per cent on large, 13 per cent on marginal and 9 per cent on sub-marginal farms. The scale of pig production improved on sub-marginal and marginal farms. Elsewhere it declined in the range of 13-48 per cent, the maximum being in the landless households. For poultry there was a decline of 48 per cent in the landless and 24 per cent in medium land class, while for others there was an increase, the maximum being for the large landholders.

2.2.9 Contribution of livestock to national income

The livestock sector in India contributes about one-third of the agricultural GDP and has increased impressively during the last 20 years (Birthal, et al., 2003). Livestock's contribution to agriculture was about 22.51 per cent in 99-2000. This has increased to 24.72 per cent in 2004-05, while the contribution of agriculture to national GDP has reduced from 23.17 per cent to 17.62 per cent during the same period. It is expected that the livestock sector in the immediate future will emerge as an engine of growth for the agricultural economy in India, mainly driven by urbanisation, increased purchasing power and changing consumption pattern. But while embracing a booming economic growth path, one has to be watchful and should pay attention to curb all possible adverse social and environmental impacts (see the chapter on "consequences") that might accompany the increasing economic upsurge.

3. Consequences of changes in the livestock sector in India

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3.1. Social consequences

The livestock wealth is largely concentrated among the marginal and small landholders in India. Therefore it is expected that any growth in the livestock sector would bring prosperity to the smallholders. From the perspective of the poor, small animals like sheep, goats, pigs and (backyard) poultry are considered important because of their low initial investment, zero/low input requirement and quick returns to investment on a continuous basis (Birthal et al, 2006). But the trends in the livestock sector provide a picture of how sector growth does not go hand-in-hand with poverty reduction (sector growth is mainly contributed by big industrial poultry production units and large cattle farms). The landless poor are becoming increasingly marginalised (in terms of ownership as well as share in livestock population) with respect to small ruminants, pigs and poultry (see Table 7). There is an increasing exodus of the landless households out of livestock production, mainly because of reduced access to grazing resources, lack of access to non-exploitative markets and credit and services.

In the context of changing consumption pattern and rapid increase in the demand for quality meat and milk products, it is assumed that smallholder livestock producers may be displaced by large industrial producers who have the capacity to invest in food quality and safety and sell the products through well organised marketing systems such as supermarket chains. This has already happened in the case of poultry and is slowly moving to the milk and small ruminant meat sector, the majority of which is currently handled by the informal sector. The concern becomes significant in the context of the present system of poor standards of hygiene and sanitation maintained by the informal sector.

3.2 Environmental consequences

3.2.1 Increasing grazing pressure in arid, semi-arid dry lands

The grazing intensity in India is already very high. In rainfed areas, the present stocking rate is 1-5 adult cattle units (ACU) /ha against the rate of 1 ACU /ha allowed by government norms, while in arid zones, the stocking rates are 1-4 ACU /ha as against 0.2-0.4 ACU /ha (Shankar and Gupta, 1992). It is estimated that about 100 million cow units graze in forests against a capacity for 31 million. More than 80 per cent of resource poor households depend on common property resources for the fodder requirement of their livestock. Several studies (Jodha, 1992, FAI, 2002) show that there has been a decline in the area under permanent pastures and grazing land from 1950 onwards because of privatisation, encroachment, distribution of land by government to the poor, requirements of real estate conversion into national parks and sanctuaries etc.

The growth rate of livestock, in general, has shown a static trend during the period from 1997 to 2003 (485.39 million in 1997 and 485 million in 2003). Also there has been a shift in the livestock population from large ruminants to small ruminants. The large ruminant population has reduced from 289 million in 1992 to 283 million in 2003, whereas the small ruminant population has increased from 166 million to 186 million during the same period.

Though there is some relief because of overall reduction in population, the increase noticed in the case of the small ruminant population, especially sheep (which is an exclusive grazer) is sending alarm signals. This is further aggravated by a steady decline in common grazing areas. The quality and productivity of grazing lands are also showing a declining trend due to improper management, unregulated land use, over grazing and lack of reseeding of pastures. The pastoral system is putting more pressure on the limited land available. It is argued that one of the reasons

for deforestation is uncontrolled grazing of livestock in forest land. This is a contentious issue wherever livestock interact with forests. Further, the food function of livestock is nowadays becoming more important than draught and manure. All these factors contribute to land degradation, particularly in the open grazing areas in the arid and semi-arid ecosystem. The LEAD study (CALPI-IWMI, 2005) conducted in five semi-arid watersheds in India revealed that common grazing land in most of the villages studied are under various stages of degradation. Here, the grazing lands are used as open access resources without any control on the intensity of use. The insecurity of user rights prevents villagers from investment in biomass development. The study also indicated that wherever management systems were in place, land quality had improved even in high-arid zones.

3.2.2 Involution of mixed farming in high input intensive areas

The crop livestock integrated mixed farming is generally considered as a sustainable system as it affects resource enhancement and supports resource sparing. Trends indicate that in some parts of India like the Indo-Gangetic river basin, where high input farming is practiced, livestock are not properly integrated with crops such as paddy. In the western part of the Indo-Gangetic region, large amounts of straw are left in the fields due to mechanised harvesting and which must be removed for agronomic or management reasons. Farmers normally burn the straw (over 70 per cent of rice straw and 50 per cent of wheat straw produced in the region are burnt) in the field itself as an easy solution (Parthasarathy Rao, 2003). Burning results in the loss of valuable organic carbon necessary to maintain soil health and it also increases green house gases in the atmosphere and contributes to environmental pollution.

There is also a decline in recycling of farm yard manure due to the lack of integration. This necessitates increased use of inorganic fertilisers in a soil which is already overdosed with chemical fertilisers. This affects the soil quality, soil health, water holding capacity and infiltration.

Another important consequence of reduced crop livestock integration is its impact on water use efficiency. A much discussed study conducted to estimate irrigation water productivity of dairy animals in Gujarat (Singh et al, 2004) found that 1,900 to 4,600 litre of water were used to produce one litre of milk. Milk and meat production, particularly if based on intensive grain feeds and irrigated forages, requires 10-50 times more water than crop production (Onyekakeyah, 2006). For efficient use of water (more nutrition per drop of water), especially in water deficient areas in India, the mixed farming system has to be promoted through appropriate policies and incentive mechanisms.

3.2.3 Industrial poultry /dairy production units

Poultry is one of the fastest growing segments of the agricultural sector in India. While the livestock population of different species showed slight changes, the poultry population has shown a massive increase of 59 per cent during the same period. It is reported that the poultry sector in India has a potential to grow over 20 per cent a year over the next 10 years.

The broiler industry in India is growing at about 15 per cent per annum. Fast growth in the commercial poultry sector has serious environmental, social and health implications. The main feed ingredients for poultry production are grains. Maize constitutes 50-55 per cent of broiler feed. The increasing demand for grains will create pressure on land to cultivate (or /and import) feed grains, which will ultimately compete with grain production for human consumption (currently India produces only 11 million tonne of maize, of which five million tonne are used for the poultry sector. The grain-based intensive system, though efficient in terms of output per unit of input, is less efficient in terms of energy. Large amounts of fossil fuels are burnt to produce meat /eggs under the intensive system.

Consumers' preference for live and fresh chicken forces retailers to slaughter birds in their shops. In a large number of cases this is done in a very unhygienic manner. Air pollution results as the nitrogen in manure is converted to ammonia (almost 85 per cent of the feed nitrogen is unutilised and excreted through manure). Soil toxicity occurs when there is a build-up of nitrogen and phosphorous in the soil deposited through manure over a period of time. The rampant use of antibiotics is also a major concern for the health of the public at large.

The IFPRI-FAO study conducted by Mehta et al (2002) shows that there are bio-security issues associated with industrial poultry production in India such as air pollution, polluted water, soil toxicity, wastage disposal and health hazards, especially when the production units are located too close to densely populated areas. Farms close to densely populated areas and water bodies produce ecological harm due to over concentration of nutrients and human health issues. The same thing will happen in rural industrial units as well if the wastes are not properly handled /managed. It is reported that 250 chickens produce about 135 kg of nitrogen and 95 kg of phosphorous per year. Water pollution may occur if nutrients from manure enter the water body, especially when there is rain.

Issues from industrial dairy /piggery production units will also cause similar threats to the environment. Here the issues will be all the more serious as manure is produced in liquid form. Unlike in the case of poultry, the manure can easily enter water bodies, unless strict precautionary measures are taken.

3.2.4 Green house gas production

The important greenhouse gases associated with livestock are methane (CH4), nitrous oxide (N2O) and carbon dioxide (CO2). Methane and other gases are produced due to enteric fermentation in ruminants; some via their dung too. Released into the environment, they join methane produced from other sources such as rice fields, coal burning, biomass burning, transport, solid waste treatment, coal beds, mines etc. N2O production is mostly from manure.

India has the highest density of cattle and buffaloes as well as small ruminants, reared under an extensive system - small herds in large numbers dispersed over a vast area. Also livestock is fed poorly under this type of rearing - inadequate rations based on feeding less digestible crop byproducts and grazing on poor quality rangelands. These conditions are most conducive for release of high levels of methane via enteric (in rumen) fermentation into the atmosphere. A cow emits around 100 kg of methane every year. Methane gas is 24 times more aggressive than CO2 in contributing to climate change. The methane contribution by livestock in India towards global warming is significant. Natcom (an organisation under the Ministry of Environment and Forests, GoI) has estimated that in 1994 around

300 million bovines plus 180 million small ruminants produced around 10 million metric tonne (mt) of methane In India, which is 15 per cent of the global methane production from livestock.

The accumulation of these gases in the atmosphere leads to damage of the protective ozone layer that filters the sun's UV rays, thus preventing them from reaching the earth. This in turn has deleterious effects on the climate and thus on agriculture and human life, especially that of the low income groups. The potential effects of climate change on agriculture are yet uncertain and could be positive in some respects and negative in others. At the regional level, changes in precipitation and temperature patterns could jeopardise current agricultural practices. The frequency of extreme weather phenomena like floods, droughts, severe storms may perhaps increase, sea levels could rise, threatening vulnerable coastlines around the world, and tropical diseases and pests that affect plants and animals could increase their range. Since CH4 loss by livestock means some 8-10 per cent loss of energy for the animal, any steps taken to reduce enteric methane emission are bound to improve animal condition and production. Thus enteric emission is not only a major sources category in the agriculture sector for GHG, but also a net energy loss for livestock.

4. Public and Private Responses

4. Public and Private Responses

The global food market is undergoing major changes, especially in the developing world. Driven by an increasing level of income of a large number of city dwellers, the per capita consumption of food of animal origin has increased dramatically. As the economy changes and there are positive changes in society, the relative importance of livestock for non-food functions like draught power, status symbol, insurance against income shocks etc. becomes less and less important and the food functions get strengthened.

With the rapid growth of milk and poultry production in India between the 1980s and 2004, the critical question for economic managers and planners is no longer whether the livestock revolution is manifest in the country or not, but to what extent poor people and smallholders can play a significant part in this enterprise. There is a risk that the livestock revolution, similar to the Green Revolution, will polarise the inequality between the rich and poor. Decisive action needs to be taken to ensure that the poor benefit from such developments (Khan and Bidabadi, 2004).

Studies by the World Bank (1996) and Delgado et al, (1999) forecast that the demand for the production of milk, meat and poultry products would double by 2020 and that the production would shift from temperate to humid and warm regions situated in the developing world. There could be three scenarios in this

change; the demand will be met by large-scale industrialised units, small-scale producers will develop livestock production that can satisfy the demand and a harmonised combination of the first two.

4.1 Private sector

With the reduction in subsidies under WTO agreement by the European countries, India's export of dairy products is likely to expand on account of price competitiveness. The private sector already handling more than 75 per cent of the poultry production in the country, anticipates growth in dairy, poultry and meat industry. While large scale livestock production units are in a position to cope with the increasing demand, they can be a threat to the environment, if not properly regulated.

The private sector is playing a pro-active role in the marketing of livestock products. It has a vital role in strengthening forward linkages and value-addition particularly in areas that have remained neglected. There are however, some constraints that hinder their entry. The much-needed interface between public andprivate sector is sadly missing. Investment in the livestock sector is mainly in production systems and processing. Good examples include Nestle, Cadburys, and Dumex in dairying /dairy products, Venketeswara hatcheries, and Shanti group, in the poultry industry and Al-Kabeer in the meat industry. Large farms are mostly located near metros and have relatively better awareness of the environmental issues associated with livestock production. However the system of contract rearing of poultry and the milk collection from a large numbers of small farms by the private dairies has the advantage of shifting the major production units to the villages. Such systems facilitate for better use of wastes.

The livestock feed manufacturing industry of the country is dominated by the private sector and the dairy cooperatives. More than 80 per cent of the compounded feed for livestock including poultry is manufactured by these sectors. From the late Nineties the private sector has been providing breeding services for large ruminants. The Gopal mitras of Andhra Pradesh, the Paravets of Uttar Pradesh and Bharatiya Agro Industries Foundation (an NGO) are providing breeding and health-care for cattle and buffaloes in a large way in many states. Their services reach the doorstep of the farmer on a cost-plus basis and are well received by the farmers.

4.2 Government Policies

4.2.1 Livestock related

National agricultural policy: There is a high priority for agriculture in the policies of the government at both the central as well as the state level. The National Policy on Agriculture seeks to actualise the vast untapped growth potential of Indian agriculture, strengthen rural infrastructure to support faster agricultural development, promote value addition, accelerate the growth of agri business, create employment in rural areas, secure a fair standard of living for the farmers, discourage migration to urban areas and face the challenges arising out of economic liberalisation and globalisation. It emphasises use of the watershed approach to manage land resources which, while protecting the inhabitants of fragile eco systems from acute distress, helps to develop rain-fed agriculture through other ingredients like technology, credit, market and roads and a remunerative price environment.

National livestock policy: The GoI has approved the national livestock policy with a view to improve the quality of livestock and livestock products. The policy changes required for the livestock sector in the next millennium have been identified as improvement of the livestock breed through genetic upgradation, eradication of diseases like Foot and Mouth, constitution of the Indian Council of Veterinary Research, intensification of fodder development on wastelands and degraded lands, development of poultry, small ruminants and swine, preservation of endangered indigenous livestock breeds and production-linked livestock insurance.

The National Project for Cattle and Buffalo Breeding operated by the GoI has the major objectives of providing quality artificial insemination (AI) service on payment, supporting conservation of genetic diversity among cattle and buffaloes, and increasing the coverage of AI from the present 12 per cent to 40 per cent in the next 10 years. Many states did not succeed in implementing the

breeding policy, involving the participation of farmers in the drawing up of programmes and policies, developing a long-term plan and increasing the coverage of AI over years on the basis of a sound plan.

Milk and milk products order: In 1991, the dairy sector was delicensed by the Milk and Milk Products Order (MMPO) in order to attract private investment and new technologies. On the allegation that this would weaken the cooperative sector, the MMPO was promulgated in 1992. The intention of promoting viable and vibrant cooperatives is a national priority. However, blanket protection to the entire sector may encourage inefficiency in the guise of national interests. Therefore the government withdrew the MMPO, which placed restrictions on the quantum of milk traded by a private dairy enterprise, to create a 'level playing field for the private sector to compete with the government-supported cooperatives', as recommended by the World Bank in 1996. Since close to 70 per cent of milk is traded through traditional milk markets in the unorganised sector, it can be tapped by private capital and investment through creating a favourable environment (GoI, 1999).

National Dairy Development Board: The contribution of the dairy cooperatives of India, the biggest cooperative venture in the world, to handle milk produced by millions of small farmers is a positive example of dairy production without much of environmental hazards and with the involvement of small holders. The National Dairy Development Board (NDDB) establishes and supports dairy cooperatives throughout the country. There are more than 10 million farmers in more than 80,000 villages handling 16 per cent of the marketable milk surplus and reach out to 15 per cent of the milch animal households in about 20 per cent of the Indian villages (Amrita Patel, 2006).

4.2.2 Environmental policy

The GoI recognises land degradation and improved natural resource management as a key priority in a number of key policies, strategies and action plans, including: the National Water Policy (1987), National Land Use Policy Outline (1988), National Forest Policy (1988), National Agricultural Policy (2000), National Policy for CPR lands etc. Some of the major environmental acts and rules in India are the Water (Prevention and Control of Pollution) Act, 1977, Air (Prevention and Control

of Pollution) Act, 1981, the Environment (Protection) Act, 1986, the Hazardous Wastes (Management and Handling) Rules, 1989, the Public Liability Insurance Act, 1991, the Environmental (Protection) Rules "Standards", 1993 and the National Environment Tribunal Act, 1995.

India has a large number of environmental acts and regulations, although opinions differ on the effectiveness of the implementation of these. Pollution limits for various industries have been prescribed in the environmental protection rules. Environmental clearance from the Union Ministry of Environment and Forests is mandatory for setting up new industries in many sectors. All major industry associations have a climate change division and have taken initiatives to conduct training and generate awareness in key areas, such as energy efficiency and other environment-friendly projects.

Government initiatives such as the diffusion of renewable energy technologies, joint forest management, water resource management, petroleum conservation research and consumer awareness, energy parks for demonstration of clean energy technologies etc. represent a broad spectrum of initiatives on climate and related issues.

In various public actions for environmental conservation, economic efficiency should be sought to be realised. Grazing lands are usually common property resources, and insufficient empowerment of local institutions for their management leads to overexploitation of the biomass base. The impacts of pollution may differentially impact the poor, or women, or children, or developing regions, who may also have relatively low contributions to its generation, and accordingly the costs and benefits of abatement may have important implications for equity.

Increasing demographic pressure and transition of livestock production from subsistence to market-driven causes has accelerated degradation. In the absence of appropriate

mitigation schemes, the pressure on the environment further increases, rendering the environment (land, water, air) more vulnerable to irreparable damages. A clear understanding of the interactions between livestock and environment is a prerequisite in designing programmes and projects to mitigate negative interactions and enhance positive ones so that the livelihood of livestock keepers can be improved. An example can be seen in the case study of grazing land in Kalyanpur (Section 5.5).

As per the new Scheduled Tribes (Recognition of Forest Rights) Bill, rights to hold and live in forest land are given to those who have been living in the forests for the last three generations (forest dwellers). Forest dependent communities (those who live near and around forests) and scheduled caste pastoralists are also covered under this, which enable them to use forest land. The government has also regulated encroachments before 13 December 2005. Similarly the land ceiling limit has been removed (now there is no limit for the land to be allotted). Though this has been appreciated by many people, there is also criticism, which mainly said "this is privatisation of commons to commodity'.

4.2.3 Watershed development

The increasing pressure of human and livestock population on natural resources in the semi-arid zones of India has impacted the agro-ecosystems. Many efforts are being made to reverse these trends and to promote sustainable natural and land management practices. The largest effort made by the GoI in addressing this issue is through the implementation of the Watershed Development Programmes. These activities were based on provision of grants or technical inputs. But sustainability of the land development interventions carried out is an issue. The government is now on the look-out for an effective exit protocol to sustain the outcomes.

The LEAD (Livestock Enviornment And Development) initiative of FAO supported by the CALPI programme of SDC and Intercooperation conducted a reasearch on livestock environment interactions in the watershed context. It created a lot of awareness among policy makers,

planners, implementers and researchers on the importance of sustainable management of land and water while focusing on livestock development. It could also influence the GoI to bring about reforms on watershed guidelines with emphasis on livestock integration and common land management in watershed development programmes.

Different organisations with no direct livestock or environmental linkage started discussing and integrating 'livestock-environment' themes in their agenda (e.g. IWMI, ICRISAT, TERI) because of the impact created by the LEAD study. The GoI, for the first time, included "Livestock and Environment" as one of the working group themes in the proposal for the 11th Five-Year Plan.

5. Case study focus

Case study locations

1. Peri-urban dairy colonies in Mumbai (Maharashtra)
2. Peri-urban industrial poultry production in Chhattisgarh
3. Organised slaughter houses in Bangalore city (Karnataka) and Village slaughter houses in Kerala
4. Model pig farm in Trichur (Kerala)
5. Grazing land in Kalyanpur watershed (Rajasthan)
6. Tanneries in Kanpur (Uttar Pradesh)

5. Case study focus

The case study was focused on six distinctive livestock-linked systems that have environmental, social and health implications in the changing context. They are identified in different locations of the country (Figure 1) such as:

1. Peri-urban dairy colonies in Mumbai (Maharashtra)
2. Peri-urban industrial poultry production in Chhattisgarh
3. Organised slaughter houses in Bangalore city (Karnataka) and Village slaughter houses in Kerala
4. Model pig farm in Trichur (Kerala)
5. Grazing land in Kalyanpur watershed (Rajasthan)
6. Tanneries in Kanpur (Uttar Pradesh)

It is to be appreciated that the above cases make only sporadic presence in identified locations in the country and hence cannot be generalized for India as a whole.

5.1 Peri-urban dairy colonies in Mumbai (Maharashtra)

5.1.1 The background

For meeting the fluid milk requirements of the urban population, big dairy colonies with milking buffaloes have been in operation around the metros. Though their numbers have been decreasing over the years, even till 2006 there were some 1,000 such colonies, with around 100,000 milking buffaloes in and around Mumbai, the second biggest city of India.

The authors visited two colonies with around 350 milking buffaloes in an area of less than 1,200 sq metre and 25 milking buffaloes in an area of 50 sq metres both within busy sections of the city. Only milking animals are kept there and the unproductive ones are either sold or sent for contract rearing.

The sheds are semi-temporary structures and in the centre of the shed, a platform is made at a height of two metre from the ground and used as a temporary resting place for labourers. The floor is made of concrete and is kept dry and clean. There is a narrow and shallow drain at the back for draining out urine, dung and shed washings. The drain comes out as an open channel leading to the bigger open sewage canal. The animals are stall-kept throughout the year. As water is a scarce resource, only half the required quantity of water is used per animal per day. Most of the animal diseases are treated by the supervisor of the dairy colony and it is felt that use of antibiotics and milk-flow inducing hormones are high. Except mastitis and calcium deficiency on rare occasions, the animals are reported to be in good health. All animals are vaccinated routinely against Foot and Mouth Disease.

Waste management varies during the summer and rainy season. During the summer months the dung is stored within the farm or nearby, on lands belonging to perhaps a neighbor, till it is sold to villagers. During the rainy season the dung is pushed into the drains.

5.1.2 Drivers

The relevance of large dairy colonies in big metros is decreasing in recent times. However, there is a small group of traditional urbanites who still want fresh buffalo milk for their domestic use. The intention of the dairy owners to keep the land obtained on long-term lease at nominal cost in their possession could prove to be a factor in the continuing existence of these dairies against many threats.

5.1.3 Consequences

The availability of pasteurised milk in sachets, mounting pressure from the corporation authorities, resistance from the public, rising urban demands for new buildings, and the resource crunch in terms of water, waste disposal facility etc are serious constraints for the sustenance and effective functioning of these dairies.

A large number of milking animals stationed in a small area in the middle of a big city naturally would cause environmental problems on a big scale. The land available at the disposal is far too inadequate to have a satisfactory dairy farm management system in place. This adversely affects the waste management system, in turn contributing to environmental pollution by way of soil nutrient overloading, water pollution and air pollution besides problems associated with flies /mosquitoes. The animals are also not provided with the required standing space. The owners also reported hoof problems and very high calf mortality on account of lack of exercise for the stock. Waste management and keeping the surroundings clean and hygienic becomes all the more difficult when water sources are limited and when they have to buy tank loads of water at exorbitant costs.

Residents in areas where such dairy operations are located often protest against the inconvenience caused by such operations, complaining about the increasing risk of human diseases. The owners are willing to move dairy colonies to rural areas if they are given sufficient land and the required support. It was also reported that many dairy colonies were closed during the last decade on account of pressure from the neighbourhood, government, municipality, builders etc and disinterest of the new generation to continue in this profession.

The facilities available for the employees for work and stay are rather minimal. They stay in temporary shelters built on the 'first floor' of the animal sheds, although the employees look healthy and contented even in such a setting.

5.1.4 Public private responses to address the issues

In 2005, based on a public interest litigation on the grounds that the dairy colonies were an all-round nuisance, contributing to health hazards and traffic jams, putting pressure on sewers and

drains, were definite eye sores amidst residential colonies, were noisy and causing diseases, there was a court order for implementing environmental norms by dairies in urban areas. The Pollution Control Board, Mumbai issued guidelines for prevention of pollution caused by urban dairy colonies. These guidelines include relocating dairies one km away from residential areas, one km away from rivers and lakes, 15 metre away from existing wells and 100 metre away from state and national highways. However, no concrete actions as per the guidelines have happened so far. A large public sector dairy colony, the Array Milk Colony, not being able to run on its own revenue was restructured with private participation. Around 100 dairy owners from the metro got the shed and fodder cultivation facilities on long-term lease and relocated their dairies with 40,000 plus milking animals.

However, the basic question that remains is: are metros the right place to keep milch animals when milk produced in rural areas is available in the cities in abundance?

5.1.5 Options to mitigate negative implications and strengthen positive ones

With the expansion of the city and the availability of alternate sources of milk the relevance of maintaining urban dairy colonies is fast declining. However, it will take many more years before they disappear from the social map of cities. From the primary and secondary information collected it appears that there could be several options with long-term and short- term priorities.

Keeping the size optimum with regard to the space available, awareness creation and training of the employees and owners in proper waste management and hygienic practices, providing sufficient water and better facilities for accommodation of the employees are options in the short-term.

Government authorities have already initiated action to relocate the dairy colonies at appropriate places for the benefit of the people involved as well as the animals maintained. The restructuring of the Array Milk Colony with private participation is said to be a good move in this direction. Plans must also be made to gradually phase out all the dairies to appropriate locations, with the government providing adequate infrastructure and financial support.

5.2 Peri-urban industrial poultry production in Chhattisgarh

The state of Chhattisgarh has a poultry population of eight million, 75 per cent of which is in the hands of the organised commercial poultry industry. Statistics indicate that the broiler poultry population shows an annual growth rate of 13.3 per cent and, in case of layers, it is 11.10 per cent. Annual production of chicken meat is 42 million MT and the consumption is 44 MT, showing a deficiency of two million MT. Similarly there was a shortage of 176 million eggs in 2005-06. At present the poultry industry in Chhattisgarh has emerged as the most dynamic and fastest expanding segment in the animal husbandry sector within the state.

The case study refers to the Shanti group of industries where nearly one million birds in a batch are reared in a decentralised way by 1,200 farmers (contract farming) and the manure is sold to nearby agriculturists. Shanti provides chicks, mainly from their hatchery, with feed from its factory and vaccine and medicines to farmers besides supervision and technical advice. The broiler farmers' contribution comes in the form of sheds with equipment, litter material, water, electricity, labour and management. The company takes back ready-to-sell birds, paying the rearing charge at a mutually agreed rate per kg of live bird. According to the management, all the risks are borne by the company and the role of the farmer is only to concentrate on rearing and management.

5.2.1 Drivers

The demand for poultry meat and eggs is growing at rates higher than the production and, as such, the number of big farms along with a substantial increase in the number of birds in the existing farms, is growing at a rapid pace. The predictions are that there will be rapid changes towards large-scale production as small independent farmers will find it increasingly difficult to run farms with marginal profits (Sharma et al; 2003). The size of farms will continue to increase, and they will have their own breeding

facilities, feed mills, hatcheries and processing units. The existence of small farms will be under threat and the backyard system of poultry keeping will soon become history.

5.2.2 Consequence

At present no significant negative externalities are noticed as the hatchery is located away from the city, the birds are reared in a decentralised way through farmers, and the manure is sold to nearby farmers. The company's approach to contract farming is providing a good means of a livelihood to many small farmers in the surrounding villages.

Displacement of smallholders and involution of the backyard farming system (loss of biodiversity) are other negative impacts of the fast changes happening in the poultry sector in Chhattisgarh. Though the issues discussed above are not very critical at the moment, these will assume greater significance in the near future, unless appropriate corrective mechanisms are put in place.

5.2.3 Public private responses to address the issues

At the moment there seems to be no awareness among the stakeholders and the public on the environmental or health issues arising out of commercial poultry production in the state. Regulations are weak and not strictly enforced to check potential hazards in future.

5.2.4 Options and models to mitigate negative and strengthen poitive implications

a) Relocating commercial production units. The commercial units that are near the cities and rivers may be relocated to rural areas (reversing livestock transition) with the help of policy regulations and incentive /disincentive systems. Zoning policies (like in China) can be developed wherein large-scale production can be restricted to pre-identified sensitive areas.

b) Regulating the industrial production system. There should be strict regulation and technical support for pollution neutralising mechanisms. Regulatory mechanisms to control pollution can take a variety of forms. The negative environmental costs can be internalised into the consumer price. To achieve this, a

wide variety of financial instruments can be used such as levies on waste discharge, taxes on excess animals or phosphate loads and removal of subsidies favouring concentrate-based intensive production. The provision of subsidies to encourage investment in emission control technologies and the removal of import restrictions on materials and equipment that improve feed efficiency shall be made (FAO, 2006). Effluent charges may be imposed, based on the amount of pollutants discharged. Limits may be fixed on the number of birds per hectare. Technical options for manure management are to be specified, improving feed conversion with enzymes, synthetic amino acids may be advised and installation of biogas may be made compulsory. Use of antibiotics should be regulated and checked at frequent intervals.

c) Managing emerging disease outbreaks. Considering emerging diseases like avian influenza, there is a need to strengthen bio-security (hygiene, cleaning and movement of birds). There should be mechanisms for compensating farmers in the event of outbreak and consequent culling.

d) Promote ecologically-friendly production systems. Incentives and policy support should be provided to promote environment-friendly production systems. Funds required for the incentives can be generated by applying the 'polluter-pays-provider-gets' principle. If poultry meat is produced by industrial units causing damage to the environment, high taxes should be levied to discourage such systems or to put in place pollution neutralising mechanisms such as waste treatment plants, bio gas digesters etc. (presently the negative environmental externalities are imposed on society). The money thus generated shall be used to provide incentives to those who follow eco-friendly production processes. Thus the negative environmental externalities can be internalised. The decision to implement this will depend on the importance assigned to the environment compared to other objectives such as livelihoods or cheap supply of animal products. However, this requires political will and sustained efforts.

e) Knowledge sharing. Awareness creation and knowledge sharing on appropriate technologies and practices of industrial production and the pollution pathways shall be given high importance.

5.3. Slaughter houses

Nationwide there are more than 3,600 authorised slaughter houses in the government sector. Most of them are operated and maintained by municipal bodies. A large number of these slaughter houses maintain poor standards of hygiene and sanitation. The capacity of these units varies from 100 to 500 large animals and 25 to 800 small ruminants per day. In states like Kerala where there is no taboo on slaughtering cattle, almost all villages have slaughter houses under the panchayat or run privately. This section has two parts -- one describing the functioning and the other discussing the issues, concerns and challenges posed by a large slaughter house in a metro and the village level slaughter houses in Kerala.

5.3.1 Large organised slaughter house in Bangalore city (Karnataka)

The slaughter house spread over an area of 4.5 acre, owned and managed by the Karnataka Meat and Poultry Marketing Corporation (KMPMCL), is providing facilities to contractors for slaughtering and dressing of sheep, goats and cattle at a stipulated price. The slaughter house has a lirage, small ruminants slaughter area, large ruminant slaughter area, solid waste disposal yard and office complex. There is an open well and bore well to meet the water requirements and an effluent treatment plant with 150,000 litre-a-day capacity. The animals are brought to the slaughter house a day before slaughter and rested in the lirage and examined for health. As the number of animals brought for slaughter often exceeds the capacity of the slaughter house, the animals are kept in public parks and open spaces in the adjoining localities, disturbing the neighbourhoods and generating conflicts.

About 650 to 700 small and 100 to 150 large animals are slaughtered on normal days and this number goes up to a 1,000 small ruminants and 200 large animals on Sundays and up to 2,000 small animals and 300 large animals on festival days. The butchers employed by the contractors carry out all slaughter-related jobs. After slaughter/dressing, the veterinary surgeon appointed by KMPMCL certifies the carcass as fit for human consumption. Generally, a very small percentage of the carcass-es or their parts are rejected. Stomach and intestinal contents, together with inedible /non-saleable portions, essentially form

solid waste. The estimated solid waste on a normal day is 14,200 kg which goes up by 35 per cent on Sundays and even 100 per cent on festival days. The entire solid waste is collected and disposed of as land fill for which trucks are engaged. There is no designated site for disposal of solid waste from slaughter houses and the contractors dump it in unauthorised suburbs. The effluent treatment plant installed to treat the waste water from the slaughter house was defunct during the study visit. There are no high pressure pumps and jets for proper floor cleaning of the slaughter house.

5.3.2 Village slaughter houses in Kerala

An estimated 1.5 to 1.7 million cattle and buffaloes are slaughtered annually in Kerala where majority are reported to eat beef. With an estimated average meat yield of 60 kg per large animal, Kerala handles around 90,000 to 100,000 MT beef per year. More than 45 per cent of the large animals are slaughtered and marketed in villages which do not have even minimum facilities for the purpose. The village-level slaughter houses are of two types, the panchayat slaughter houses and the privately-owned village slaughter houses. There are more than 1,000 panchayats in the state and each has at least a place to slaughter animals. Slaughter is done in open places and the inedible parts like bones, fat and blood are not often used. The visceral contents and effluents are dumped on e nearby land and in streams. The butchers are not properly trained and practice below-average hygienic procedures. Village slaughter houses are temporary thatched sheds where one or two large animals are slaughtered on weekends and its surroundings are relatively clean. The slaughter and sale is done from the same place.

5.3.3 Drivers

The fast growth in demand for meat and meat products, changing food habits and accelerated growth in urbanisation are the driving forces behind the increase in the number of large and small ruminants slaughtered in the country. According to official statistics (FAOSTAT, 2006),

beef production has increased from 1.95 million MT to 2.98 million MT and sheep and goat meat production from 0.53 million MT to 0.71 million MT during the period 1985 - 2005. However, due to non-reporting of animal slaughter at the village level and the prevalence of unauthorised slaughter in many municipalities and corporations the actual quantity of meat production, especially from large ruminants, is far higher than the reported figures.

5.3.4 Consequences

The capacity of many of the major slaughter houses is inadequate to handle the present demand for meat. In the absence of a fully-equipped slaughter house neither proper use of the by-products nor disposal of effluents and waste from the slaughter is possible. It is observed that there is no organised system for disposal of solid wastes in the slaughter houses. The capacity of the trucks used for solid waste transport in Bangalore is only 60 per cent of the requirement, resulting in stagnation of the wastes in the slaughter house complex. Its effluent treatment plant was defunct during the visit. The absence of high pressure pumps and jets makes floor cleaning inefficient and unsatisfactory. As the space available for lirage is inadequate, the animals are kept in public parks and open spaces in the adjoining localities disturbing the neighbourhoods and generating conflicts between the contractors and local residents.

The wastes and effluent from many village slaughter houses are often left fully or partially in the slaughter house for it to leach down the soil and could eventually end up in the nearby stream. It often pollutes the rivers, canals nearby and the adjacent drinking water wells. Farmers refuse to dump wastes in their agriculture lands because of the stench, and protests from the local residents. Blood, urine and water used for cleaning are disposed of through open drainage systems which during the rainy season overflows, contaminating land and water sources.

There are serious health hazards from the unhygienic slaughter and sale of meat, to people handling meat as well as to consumers. Even if the animals are not infected per se, meat kept at room temperature in a hot, humid environment serves to accelerate the process of contamination, resulting in the production of toxins. The animals are flayed on the ground and the carcass is eviscerated and cut into pieces without lifting it

from the ground, providing ample chances for contamination from the soiled ground as well as from the visceral contents and dung. However, health problems from precooking contamination are comparatively less as meat is consumed only after it is fully cooked.

The places of meat sale in the municipalities and village towns are identical in appearance. They have different levels of display and storage; some are well maintained and have cold storage /refrigeration facilities. The carcass is often hanged from the legs in front of the shop and customers get the required quantity of beef carved out from the hanging pieces of the carcass. It is customary that the de-skinned head with the horns is exhibited in front of the sale point to indicate as to whether it is cattle meat or buffalo meat. There are preferences for these two types of meat among people in different parts of the state and among different communities.

Apart from pollution-related issues, non-utilisation of slaughter by-products creates a considerable economic loss. It could be shown that the amount invested to create facilities for production and sale of good quality meat could well be recovered by the sale of by-products within a period of five to seven years.

Often the very location of some of these slaughter houses and the sales counters for meat are appalling with blood all over the place, mutilated parts of the carcass lying around etc, all in an unclean surrounding with marshy areas formed of waste water and visceral contents. Solid wastes are generally left in the premises emanating bad odour and are scavenged by predator birds and stray dogs.. Wastes invite vultures and other such birds in large numbers, a potential risk for aircrafts and helicopters ('bird hits').

5.3.5. Responses to address large and small slaughter house issues

The transport of meat and solid waste disposal is emerging as a major factor of urban conflict and communal disharmony in peri-urban

areas. The respective local bodies are mainly responsible for day-to-day operation/ maintenance of the slaughter houses. Greater attention is being bestowed nowadays to issues related to pollution from livestock waste, thanks to the heightened awareness and the efforts of the media in this direction. Public awareness regarding slaughter of disease-free and healthy animals, clean meat production, avoiding/minimising environmental pollution and aesthetic marketing are at a lower plane. Local bodies (panchayats, municipalities and corporations) can do a lot more to improve the situation.

The involvement of the Bangalore Municipal Corporation for solid waste management and effluent treatment and KMPMC for meat certification and outsourcing of slaughtering /dressing services are causing confusion on the roles and responsibilities of respective organisations. In the absence of designated sites for waste disposal, contractors are dumping solid wastes in unauthorised private or municipal lands in the outskirts of the city.

There are laws emerging as a result of public pressure or court directives regulating health, manner, place and number of animals that may be slaughtered for meat. However the absence of adequate infrastructure, institutional and enforcement mechanisms makes regulation difficult.

State Pollution Control Boards are given powers for taking action against defaulting slaughter house owners. It is important that we adopt community-friendly, decentralised and low-energy driven systems for management of meat production and marketing activities. Whenever modernisation /expansion /addition of slaughter houses are planned, there must be involvement of different actors and stakeholders concerned. The system should be anticipatorily and organically evolved rather than thrust upon.

5.3.6 Options

The slaughter house issues, especially of village slaughter houses, can be addressed through awareness creation, strict ante- and post-mortem examination, improving infrastructural facilities in slaughter houses, training and orientation of butchers and others, effective supervision and inspection of slaughter related processes, improving the set up in the sale places and maintaining of cold chains.

A well planned awareness campaign highlighting the environmental, health, social and economic issues with participation of government agencies (animal husbandry, health and local bodies departments), local bodies, NGOs, meat traders, media, schools and colleges must be attempted.

There must be strict ante and post-mortem examination before the meat is passed for human consumption. Local bodies and statutory organisations must ensure that the quality and regularity of these inspections are satisfactory. The government's plan to set up a Meat Board to oversee and regulate the meat industry in the country is a welcome move.

Slaughtering facilities are often inadequate and insufficient. Even though there are modern slaughter houses in corporations and major municipalities, rarely are the available facilities in place/being used due to one or the other reason. It is felt that there is some kind of mismatch between what is offered in the form of facility and what is acceptable to the butchers. A possible solution could be to create facilities as per the needs of the situation discussed and decided in a forum with the participation of all concerned, looking into hygienic and environmental aspects, and making the operations user friendly and acceptable to all the stake holders. Such a facility must be simple, moderately priced, and ensure hygienic meat production with an effective system to handle the by-products, effluents and solid waste.

Training and orientation of butchers with a view to making positive changes in their mindset is found to be extremely difficult. A SWOT analysis to identify the reasons for non/partial adaptation of the systems advocated to the butchers will be helpful to orient the training efficiently. Rather than trying to totally change the operational style of the butchers the objective must be to make slow but steady, gradual and incremental changes, each time giving them a first-hand experience of the advantage of the change.

5.4 Model pig farm in Kerala

5.4.1. Introduction

Kerala one of the states in India has a Pig Breeding Centre (PBC) run by the Kerala Livestock Development Board a government company, producing and marketing more than 9000 high quality piglets annually. The effluent treatment system running in the PBC since 2000 without break is discussed in this study.

The first step in selecting and sizing effluent treatment systems is estimation of quantum of manure and wastewater that would be generated. The effluent from farms, comprising dung, urine and wash water, including feed wastage contain less than 15 per cent total solids and would be in slurry form when mixed and can be handled as a "liquid." Per day production of approximately 40 m3 in slurry form is handled as liquid manure. The effluent is collected by a flushing system through open/under-slat drains from the shed to collection tanks adjacent to these sheds. The collection tanks are connected to the effluent treatment plant (ETP) with underground PVC pipes with an inspection chamber in between.

Experimental studies done on the tractability of the raw effluent employing mechanical sedimentation, chemical precipitation technique, biochemical oxidation and activated sludge process in tandem have revealed that the Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and suspended solids (SS) can be brought to levels, which permit direct discharge to even fresh water sources. The results of the study conducted are shown in Table 8.

Table 8: Reduction in effluent parameter in initial study conducted

Parameter	Raw waste water	After plain sedimenta-tion	After chemical precipitation	After alter-nate bio-filtration	After aeration	Final outlet
PH	5.5	5.6	7.2	7.3	7.2	7.2
SS	3500	2050	120	115	80	75
BOD	9000	6000	2400	500	30	26
COD	15000	6800	3500	800	225	215

5.4.2 Mechanical sedimentation and chemical precipitation

The effluent in slurry form reaching the ETP is initially subjected to sedimentation in two clarifiers with hopper bottom. The semi-solid sediment is collected at the bottom and handled separately in the solid manure treatment zone. The supernatant from the clarifier placed serially is directed to the water treatment unit. This initial raw wastewater is mixed with an aqueous solution of the chemical reagent consisting of inorganic salts, free acid and polyelectrolyte for precipitation and sedimentation of the solid wastes in a parallel plate separator (PPS) with hopper bottom. Mixing tanks are attached at the top of the PPS for mixing the chemicals and the raw wastewater. Through the precipitation in the PPS, the colloids and suspended particles along with carry-over sediments from the clarifiers accumulate as sludge at the bottom, which is removed to the solid manure-handling zone. This process reduces about 60 per cent of the BOD and COD and settling experiments reveal that the sludge volume gets reduced to one-fifth in 20 minutes.

Biological oxidation process: alternate double filtration. The overflow from PPS is collected in a sump tank and pumped to the top of bio-tower. The bio-towers are filled with coconut shell as a packing material tied in pairs within brick jally-work, the latter for providing an aerobic environment. The aerobic bacteria cultured from pig dung and supplemented with DAP and urea is developed as a film over the coconut shell, which oxidises the organics.

The drain out from the PPS is collected in the basin below, which is connected to the sump tank. Hence the drain out is re-circulated at 2:1 ratio and the overflow from this basin is diverted to the next unit of the ETP. The wastewater from the bio-tower is further subjected to aerobic oxidation by using an aerator tank, where the water body is agitated and aerated with a surface aerator while the aerobic bacteria is allowed to remain in suspension, consuming and thereby destroying the organics. The overflow of the aerator containing aerobic organisms is

subjected to secondary settling by using another PPS and the sludge at the bottom is re-circulated back. The overflow is send to stabilisation or polishing ponds comprising three units. The effluents discharged flows to a tree-lined area within the farm, about r 250 metre from the nearest well and over half a kilometer from the river. The discharged water has less than 30 mg/l BOD and is free from E. coli/ coliforms and hence cannot cause any bacterial contamination to the neighbouring wells.

5.4.3 Solid manure handling

The semi-solids from the clarifiers are subjected to anaerobic digestion in a bio-gas tank with a floating dome and two chambers inside. The sludge after removal of the gaseous products from digestion - carbon dioxide, methane and hydrogen sulfide - is dried in drying beds with graded filter material at the bottom. The odour-free dry manure is sold in sealed bags for application as fertiliser, while the drain-out from the bed is treated along with wastewater from a clarifier. The sludge from a parallel plate separator after chemical precipitation is also dried, similar to the bio-digested sludge.

5.4.4 Odour control

The farm proper is situated at the centre of a 40-hectare piece of oval-shaped land and provides a satisfactory "buffer zone" to reduce complaints regarding odour. A green belt has been developed in the buffer zone by planting trees. The PBC being situated on top of a hill helps to carry the odour, if any, away from human habitation. As a precautionary measure,fogging/ sprinkling is done in sheds and the ETP area at periodical intervals which renders the pig farm completely odour free.

5.4.5 Drivers

There is very high demand for quality piglets for fattening within the state and for breeding in many parts of the country. With the fast growth in the economy, demand for pork and other meat products are steadily increasing. The earlier backyard system of

operations is changing as more entrepreneurs emerge in the state engaged in piggeries as a major source. Pig production in Kerala implies a significant re-use ofhousehold/ restaurant waste, the waste from commercial enterprises and industrial (brewery, abattoir) activities. The people of the state are highly aware of the issues relating to environment and pollution.

5.4.6 Consequences

The absence of proper manure and effluent management systems in many pig farms has attracted some negative propaganda against swine farming, even to farms with efficient waste management programmes. The good management of the PBC and the pollution control systems adopted there makes it a model for others to follow. There are only positive social implications for the farm. There are no health implications for humans from this farm. Environmental pollution due to odour, toxic materials and methane emission is not present here.

The effluent-treated water is free of any objectionable materials and does not cause any type of water pollution. The farm land, which was mostly barren, became a thick plantation of usufructs after the setting up of the farm making the area green and cool. The fertiliser produced from the ETP which would have been otherwise lost is generating a significant income for the farm as an organic manure product.

5.4.7 Options to mitigate negative implications and strengthen outcome

The pig production sector of the state has immense opportunities. However, environmental issues have been one of the major obstacles in the growth of the industry. Cutting down on pig production activities is not an option for controlling possible environmental hazards, especially because swine production in Kerala implies a significant re-use of household/restaurant waste, the waste of commercial enterprises and some industrial activities. There are ample procedures suitable to convert the pig farms into an environment-friendly venture.

5.5 Grazing land in Kalyanpur watershed (Rajasthan)

A preponderant number of livestock farmers in India still depend on common land (known as common property resources-CPRs) for grazing their animals. Several studies show that there has been a steady decline in the area under CPRS from 1950 onwards. The common grazing area in Kalyanpur (Rajasthan) has reduced from 1.85 million ha in 1983 to 1.70 million ha in 2005 due to various reasons. A snapshot study conducted by an NGO (Sevamandir) showed that 100 per cent of revenue lands, 56 per cent of panchayat lands and 24 per cent of forest land have been encroached upon. There is a 6000-ha of watershed area, 50 per cent of which is public land. The watershed area has a livestock population of 49 million, which is dominated by goats (47 per cent) and camels (37 per cent). The marginal and small landholders keep higher number of small ruminants than large ruminants. Small ruminants, mainly kept by lower castes, largely depend on common /fallow lands for grazing. This study was undertaken in Kalyanpur to understand the changing trends in CPR management.

5.5.1 Drivers

With increasing human population and industrial development there is pressure on the CPRs for purposes other than grazing. Privatisation, encroachment, distribution of land by government to the landless, establishment of national parks and sanctuaries are all forces that reduce the area under CPRs which include village pastures, revenue land and forest land. The management of common lands was the responsibility of the village community who are the beneficiaries of the CPRs. Under the land settlement Act of 1956, the control and authority of such lands changed hands from the community to the gram panchayat concerned. In most of the villages grazing lands are used as an open access resource with no control on the intensity of use.

5.5.2 Consequences

Because of shrinking grazing resources, poor bio-physical conditions and high livestock number, the grazing lands are subjected to degradation. The overuse of grazing area because of larger number of animals than the resource base can support, coupled with shrinking grazing areas and lack of regeneration efforts has contributed to the denudation of land. Most of the CPRs are unavailable for grazing as they are contested, degraded and encroached on.

The lack of an institutional mechanism to regulate the CPR use is a big issue in its development and sustainability. It threatens rural livelihoods and the ecological security of the region, which is already in a state of depletion. The most affected with the reduction of the CPRs is the small and marginal farmers whose major means for livelihood is livestock, especially small ruminants.

The grazing system, besides its economic contribution (milk, meat, wool) is very valuable in conserving animal biodiversity and improves the dry land ecology. Because of reduction in grazing areas the pastoralists are forced to migrate to longer distances and for longer periods in search of grazing land. There has been increased tension between agricultural and pastoral communities on grazing by livestock. Some of the pastoral members tried to quit the pastoral way of life as a coping mechanism, by moving to cities to take up menial jobs but often were not successful.

The gram panchayat having no direct involvement in these lands has shown less responsibility for its upkeep, resulting in its shrinkage and degradation. Lack of user rights keep villagers from investing in biomass development.

5.5.3 Responses

Now there are emerging public and private sector responses to address the issue of land degradation. The respondents include local communities, NGOs, government etc.

The government of Rajasthan (Ministry of Rural Development) has launched a watershed development programme for reversing land degradation. The present project period of five years needs to be extended for obtaining sustainability of the land development interventions.

The Joint Forest Management (JFM) programme implemented by the Ministry of Environment & Forests is another attempt towards the development and sustainable management of forest areas including up to 25 per cent of watershed area. The forest department in association with the panchayat developed 45 ha of degraded forest land through community participation. The land was fenced and closed for five years for regeneration and now it is opened for (controlled) livestock grazing. The Planning Commission of the Government of India, for the first time, included 'livestock and environmental interactions' as one of the themes of the working groups constituted for preparing the 11th Five-Year plan proposal.

5.6 Tanneries in Kanpur (Uttar Pradesh)

In India, the tanning industry is located along the river basins and their number is close to 1,600 (as per the Central Leather Research Institute-CLRI records). The annual survey of industries shows that the number of production units in the tanning sector has grown 17 per cent and the net value added 84 per cent during the period from 1990-91 to 1997-98 (Schjolden, 2000). While the production has increased, the annual growth rate of production has slowed down from 2.1 per cent in the 1970s to 1.3 per cent in the 1990s (Brithal, et al, 2003). In India, more than 90 per cent of the leather processing activity involves chrome tanning. It has been estimated that annually 0.9 million MT of hides and skins are processed in India..

This case study examines the tanneries in Kanpur, a city in Uttar Pradesh with a view to analyse the drivers, consequences and responses to the tanning industry in the country.

While the records of CLRI show only 170 tanneries in Kanpur area, a study conducted in 2000 found twice this number in just one tanning cluster in Kanpur (Schjolden, 2000). Most of the tanneries in Kanpur are family owned and managed and is a traditional occupation in the area.

5.6.1 Drivers

Production of hides and skin in India has increased from 0.7 million MT in the early Seventies to 1.1 million MT in 2000-2001 and the major source is buffaloes and cattle (85 per cent). The remaining 15 per cent is obtained from small ruminants; goats

contributing greater share than sheep. The finished leather from India is rated very well in the international market and is a source of foreign exchange for the country. Lesser government regulations on environmental issues, cheap labour and facilities to set up tanneries near the river side are conducive to the expansion of tanneries handling imported raw hides.

5.6.2 Consequences

Tanneries are a source of livelihood for several families that belong to the lower economic strata of society. Dixit (1995) estimated that the Indian tanning industry employs 80,200 people which, by all probability, might have increased by now. After the massive closing down of textile mills in the Kanpur area during the 1980s and 1990s, many unemployed persons were engaged in the tanneries and now it represents the primary source of livelihood in Kanpur. For the country the tanning industry brings income from other parts of the world.

During the tanning process, 68-80 per cent of the hide processed and 90 per cent of the water used ends up as waste. The pollution load from the tanning activity is both organic and chemical in nature. The solid waste generated by tanneries includes hair, trimmings, fleshing, sludge, salts, shavings, and vegetable tannins like bark and nuts (Yadav, 1998). Though some of these are used to make by-products like glue, dog bones, chicken feed, organic fertiliser, heel-caps form shoes, shavings for stuffed toys etc, its demand is very small in comparison to the waste generated. It has been estimated that 35-40 litre of water is required per kg of hide/skin processed (from the raw to the finished stage).

In chrome tanning, which is the most common method employed, the chemicals get dissolved in water and are not absorbed by the hide. This results in the effluent containing huge quantities of chrome and other fixing chemicals, causing overload of chemicals in the water bodies. Annually these tanneries discharge 1500 MT of chromium sulphate as waste (CPCB, 1999 and CLRI, 1996).

An economically viable use of the sludge has not been identified. The sludge therefore needs to be dumped on specially identified land to prevent the leaking of chemicals into the groundwater. In reality, due to the complex industrial scenario in Kanpur, a visibly adverse impact on groundwater quality has been observed. The

groundwater contains high concentration of chromium, pesticides, nitrate and colour.

The performance of the Central Effluent Treatment Plant (CETP) established by the government to treat tannery effluents was poor as shown in a study carried out by Eco Friends, an NGO in Kanpur. The Central Pollution Control Board (CPCB) reported in 1997 that the treated water coming out of the CETP had chromium concentrations 124-258 times higher than the permissible limit. The post-treated water, meant for irrigation, is heavily laden with toxic pollutants such as arsenic, cadmium, mercury, nickel and chrome VI. These pollutants not only cause grave damage to the soil, but also pollute the groundwater resources and due to frequent breaches in the sewage irrigation water channel, the hazardous water seeps into the river Ganga. Due to the toxic concoction that is used to irrigate land, year after year agricultural crops are destroyed. The food chains, including milk is contaminated and has led to several diseases affecting humans and livestock in the area. The aquatic life in the river has almost disappeared. The functioning of the CETP is unsatisfactory. Public interest litigations and regulations to control the environmental impacts of the tannery waste during this period have resulted in a mixed response. The control of chemicals and organic matter in the effluents has not been achieved to meet the standard set.

The hexavalent form of the chemical, Chrome VI, a product transformed out of the Chrome III used in the tanning process is known to be carcinogenic. (UNEP 1991). Although the polluted water is not fit even for irrigation, people continue to drink it as alternate supplies are not available. While tanneries are a source of employment for people from the economically weaker sections of society, they have several negative social, health and environmental impacts. Air pollution in the tanneries is mainly from the release of dust from the buffing of the leather, the finishing and use of solvents and dyes that can be toxic when released.

5.6.3 Public private responses

Tannery regulations to be met are all related to water pollution where tanneries are required to treat their effluents to match with a certain set standards. As a result of the ruling on public interest litigation, a CETP has been established to treat effluents

from all of the 354 tanneries in the area since 1994. Tanneries not connected to a CETP need to have their own individual ETP that takes care of both primary and secondary treatment.

The state pollution control board (SPCB) has the authority to inspect any tannery, at any time and initiate action against those not conforming to the set standards. Since the CETP is run by the government, the control function of the SPCB is less towards CEPT than towards the tanneries.

All tanneries are required to treat their effluents to match with a certain standard for pH, total suspended solids, sulphides and chrome before releasing it into either the sewage system or a river. Tanneries are either connected to a CETP and therefore have a PTP where sludge in the effluent can settle and where the pH is adjusted prior to going to the CETP. The cost of complying with environmental regulations in the tanning industry has been estimated to be around 5 per cent of the production cost (Schjolden, 2000).

Eco-friends, an NGO, is working to create awareness among the local people and the tannery owners and government officials regarding less polluting and community-friendly production systems. Recently, they brought to fore issues of skin-problems among those villagers who use the water from the CETP.

Against the petition filed by Mr. M.C. Mehta, an activist and social worker, the court ordered relocation or closure of tanneries which have not established an ETP or connected to CETPs. There were several litigations that followed and helped to strengthen the case of tanneries versus the environment.

The development of cleaner process-technology is a positive development that has occurred in the tanneries. One such technology is automatic feeding of chemicals which considerably reduced the uptake of chemicals. Two tanneries in Kanpur adopted the technology as part of a collaboration project with the United Nations Industrial Development Organisation (The cost of the equipment was partly covered by UNIDO). Another is addition of a chrome recovery unit which precipitates and separates the unabsorbed chrome to be reused. While saving on the cost of chromium this technology drastically reduces the chrome content of the effluent. Even though this technology can bring paybacks to the tannery, only less than 25 per cent of the

tanneries using chrome have installed it due to the high cost of the machine; however this system is likely to be installed by more numbers of larger tanneries in due course.

UNIDO also introduced use of enzymes during the tanning process which increases the uptake of chrome and therefore reduces chrome in the effluent. By using enzymes and magnesium oxide for basification instead of soda, the chrome uptake can go up from 40 per cent to 80-85 per cent. UNIDO covered six large/medium tanneries in Kanpur in this exercise. What needs to be looked at is an affordable working system for small-scale tanneries that form 80 per cent of the tanneries in India.

5.6.4 Options

In spite of the Supreme Court ruling and establishment of environmental regulations, they are not being implemented in an effective manner. The options proposed are:

a) strengthen awareness among tanners. There is a need to combine awareness generation with strict regulation application to bring about the desired change in the tanneries.

b) initiate research in viable clean technology. There are several new technologies that are being tried out in Kanpur. Unfortunately, the costs of these technologies are way beyond the affordability of the small-scale tanneries. Government and other supports are welcome moves to put in place the new and environmental friendly technologies.
Presently, CETP managed by the Uttar Pradesh Jal Nigam, releases the treated water into the water body/irrigation channel. Since this water is unhealthy, efforts to develop systems to reuse this water by the tanneries must be made.

c) there is a need to set up a network of stakeholders involved in tannery activities and those impacted (both positively and negatively) by the tannery operations. This will generate greater understanding of the way different communities are affected by the tannery activities and can be a forum to develop collective understanding and identify solutions to address the negative impacts of the tanneries.

6. Conclusion

6: Conclusion

Proven technologies are readily available for industrialised production. Promotion of technology intensive industrial production may lead to faster growth of livestock sector economy in the country. But such an approach, however, might produce a number of negative side effects like risk of pollution from high concentration of animals and risk of zoonotic diseases, often combined with antibiotic resistance. Other negative aspects are the marginalizing of small-scale producers and the negative impact on rural employment. The 'technical barriers' to free trade will in practical continue to exclude small-scale producers from the world market even if the economic barriers are removed. Another problem the local producers occasionally have to compete with is dumping of surplus production.

Geographically, most large-scale industrial production takes place in and around major cities. This leads to massive pollution in these areas, particularly of surface and ground water. The current policy framework often favours the development of large scale industrial production making the poor even more vulnerable.

Economic growth, in its turn, bears a dichotomous relationship to environmental degradation. On the one hand, growth may result in "excessive" environmental degradation through use of natural resources and generation of pollution aggravated by institutional failures. On the other hand, economic growth permits improvement in environmental quality by making available the necessary resources for environmental investments, and generating societal pressures for improved environmental behaviour, and institutional and policy change.

Industrialisation has a high risk of creating a diversion of livestock production from being an important factor in the rural economy to an activity with limited developmental effect, particularly in a developing country like India, where a vast majority of livestock keepers are small holders, who keep livestock just for their livelihood/sustenance and depend on traditional natural resource-based pastoral/agro pastoral/integrated mixed crop-livestock systems.

Industrialised large-scale livestock production is expanding due to economies of scale, vertical integration and high demand for quality products. Industrialised production is often favoured by

more or less hidden subsidies, but it entails environmental hazards and risk of enzootic diseases, it changes consumer preferences and tends to marginalise small-scale producers and have a negative impact on economic growth and employment in rural areas. Development of semi-industrialised livestock production systems is well known from our part of the world and is taken as a natural consequence of technological developments. How will the small-scale producers be able to cope with this is the big issue in a development perspective? That smallholder livestock production can be competitive has been proved both in the dairy sector (Operation Flood) and in the poultry sector (Bangladesh) while the pig sector still lags behind.

The expected high demand for meat, eggs and dairy products will provide opportunities as well as challenges for development of smallholder land/rural-based systems in the coming decades.

The big issue in a development perspective is how to stimulate and support the livestock sector, so that the growing demand for animal products will benefit also small-scale producers and lead to more equity and poverty reduction (Henriksen 1998).

The following conclusions are made:

The governments should:

- Promote development of modern smallholder livestock production systems, which satisfy consumer's requirements for quantity and quality.
- Develop policies, infrastructure and vertical integration, that will promote private investment and interventions in the livestock sector.
- Impose rules and regulations related to environmental impact of industrialised livestock production after the "polluter pays" principle.
- Develop veterinary rules and regulations required for protection of public health.
- Empower producer organisations to enable farmers to influence agricultural policies and strategies to make them an important player in the livestock industry.
- Make use of the increased urban demand as an opportunity for rural growth and poverty alleviation.

It is felt that if left unregulated, the expected high demand for meat, eggs and dairy products is likely to result in a scenario with high concentration of animals in large-scale industrialised production systems and a marginalising of small-scale livestock producers.

The recommendations on possible interventions to modify the impact of industrialised livestock production and subsequent marginalising of small-scale producers suggested by IFPRI and de Haan (2000) are summarised below:

- Remove policy distortions that artificially magnify economies of scale on industrialised/ not land-based livestock production (more or less hidden subsidies, inappropriate environmental regulations, inadequate property rights for small-holders, favourable concessions to large-scale operators).
- Reduce risks through insurance schemes and prevention and control of diseases.
- Pursue a policy that promotes food security, alleviate poverty and minimise adverse effects on public health and the environment.
- Avoid enforcing rigid standards inappropriate to small-scale producers and avoid introducing regulations that cannot be enforced.

Due to the small-holder livestock sector's proven record as an efficient tool for poverty alleviation, it is recommended that livestock production, processing and marketing is promoted as an integrated part of an agriculture sector support programme, together with industrialised production systems with measures to mitigate risks to the environment and to human health.

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