



Sector Profile: India

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Including a case study of the dairy sector by Franziska Haupt, Climate Focus

A. Overview

The agriculture sector is extremely important for India, providing food for more than 1.2 billion people, employing more than half of the country's labor force, especially the poor, and contributing to almost one fifth of national GDP. Low productivity, inefficiencies, increasing farm fragmentation and rising production costs will continue to pose significant challenges to agricultural development and food security.

Agriculture is easily the most crucial part of Indian economy touching the lives of most people across its vast geographical spread. Focused efforts in land reforms, agriculture research and extension, expansion of irrigation, and increased access to fertilizers after gaining independence in 1947 have transformed a once famine-prone country to a net exporter of food. Between 1950 and 2000 food grain production quadrupled to 201.8 million tons (MT) with a buffer stock of 40 MT even as the population increased from 361 million to 1 billion¹. Today, with only 9% of global arable land, Indian agriculture supports 18% of world population and generates 8% of global agricultural gross domestic product.² India also maintains 10.71% of world's livestock over barely 2.29% of land. The country's milk production of 127.9 MT is the highest in the world and fish production of 8.85 MT the second highest. Total meat production from cattle, buffalo, sheep, goat, pig and poultry was 5.5 MT in 2011-12.

There are five principal agricultural regions: Himalayan region - with tea and rice as the dominant crops in wetter Eastern Himalayas and fruits, maize and potato in drier Western Himalayas; Northern dry region - with wheat, maize, cotton, gram and millet as main crops; Eastern wet region - with rice, Jute, sugarcane and tea as main crops; Western wet region - with rice, coconut, rubber, coffee, cashew and spices as key crops; and the Southern medium rainfall region - with a predominance of coarse cereals, groundnut and cotton. Livestock-crop mix prevails throughout the country but milk cattle are more prevalent in western drier parts. Of the total geographical area of 328.7 million hectares (ha), the net sown area is 140.0 million ha and the gross cropped area is 192.2 million ha³. With access to irrigation limited to less than half of the net sown area, agriculture in India is highly dependent on the Monsoons reflected in sharp variations in annual growth rates, varying from barely 0.1% in the 2008-09 draught to a high of 7.9% in the 2010-11 rain surplus.

About 52% of India's population is still dependent on agriculture for their livelihood and employment, down from about 61% two decades ago.⁴ The contribution of agriculture to India's

¹ Indian National Science Academy. *Pursuit and Promotion of Science: The Indian Experience*. New Delhi: Indian National Science Academy, 2001.

² Joshi, P., Trivedi, T., Sharma, R., Verma, S., Bharti, V. and Gupta, K. *ICAR's Vision 2030*. New Delhi: Indian Council of Agricultural Research, 2011.

³ Department of Animal Husbandry, Dairying and Fisheries. *Annual Report 2012-13*. New Delhi: Ministry of Agriculture, 2012.

⁴ Joshi, P., Trivedi, T., Sharma, R., Verma, S., Bharti, V. and Gupta, K. *ICAR's Vision 2030*. New Delhi: Indian Council of Agricultural Research, 2011.

total GDP is, however, relatively small at 13.7% and has been declining steadily over the past few years as other sectors of economy register faster growth.

Fiscal year	Total GDP growth (%)	Contribution of ag. to GDP (%)	Growth (%)
2007-08	9.3	16.8	5.8
2008-09	6.7	15.8	0.1
2009-10	8.6	14.6	0.8
2010-11	9.3	14.5	7.9
2011-12	6.2	14.1	3.6
2012-13	5.0	13.7	1.2

Table 1: Contribution of agriculture to the economy.⁵

India is self-sufficient in food with a steadily rising grain production estimated at 259.32 Mt during 2011-12, which included record productions of rice (105.31 MT) and wheat (94.88 MT), and good production of coarse cereals (42.04 MT) and pulses (17.09 MT). Minimum support prices for cereals, pulses, sugarcane and oilseeds for the entire country at the beginning of both summer and winter cropping seasons have limited the ill-effects of market flaws on production. Increased prosperity in recent years has led to higher demands and sharper growth in non-grain horticulture basket of fruits, vegetables, root and tuber crops, spices, tea, coffee, flowers and aromatic crops which now cover an area of 23.2million ha. This registers an increase of 15% in total area and 22% in production between the 11th Plan period of 2007-08 to 2011-12.⁶

A defining feature of the Indian food scenario is the exceptionally low consumption of meat proteins. India's meat and fish production in 2010 were barely 6.2 MT and 9.3 MT⁷, compared to comparably populated China with 81 MT and 53 MT, respectively. There is, however, a relatively higher annual increase suggesting a limited degree of changes in food habits. Increasing population, higher incomes and more gastronomically informed citizenry are placing higher and more varied demands on food commodities. Demand for food grain is expected to rise from 192 MT in 2000 to 345 MT in 2030, during which the demand for high value perishables like fruits, dairy, fish and meat is expected to double, placing enormous stress on the limited capacity for handling, transporting, storage and value addition.

The majority of domestic production is consumed internally, however in recent years India has recorded a small increase in surplus in agricultural trade. India's agricultural exports amounted to USD 34billion with a share of 2.1% of world trade in agriculture in 2011, while imports were valued at USD 23billion with a share of 1.3% of the world trade in agriculture.⁸ Exports of many commodities like non-basmati rice, wheat, onions and cotton are sometimes regulated through minimum export prices, or even banned for brief periods, to check domestic food price inflation. The majority of agricultural imports are vegetable oils, pulses, cashew, raw fruits and nuts, milk, cream and spices.

Agricultural holdings in India are predominantly small in size with 84.97% of these holdings totaling 44.31% of total operational area measured at less than 2 ha, while 14.3% of holdings are

⁵ Department of Animal Husbandry, Dairying and Fisheries. *Annual Report 2012-13*. New Delhi: Ministry of Agriculture, 2012; Department of Animal Husbandry, Dairying and Fisheries. *Annual Report 2011-12*. Ministry of Agriculture, 2011.

⁶ Department of Animal Husbandry, Dairying and Fisheries. *Annual Report 2012-13*. New Delhi: Ministry of Agriculture, 2012.

⁷ Food and Agriculture Organisation of the United Nations. *FAO Statistical Yearbook 2013*. Rome: Food and Agriculture Organisation of the United Nations, 2013.

⁸ Escaith, H., Maurer, A., Piezas-Jerbi, N., Lanois, A., d'Andrea-Adrian, B., Degain, C., Eberth, F., Liberatore, A., Madeleine, J., Marcus, Y., Tamenu, B. and Yan, Y. *International Trade Statistics 2012*. World Trade Organization, 2012.

medium-sized and measure between 2 to 10 ha covering another 44.77% of total operational area. Large holdings of 10.0 ha and above are very few, constituting a mere 0.73% of total number of holdings with 10.92% of total cultivable land area.⁹

Agriculture expansion has almost ceased to be a cause of deforestation since early 1980s after the enactment of the Forest Conservation Act. However, forest degradation through removal of forest wood and leaf biomass for fuel and field nutrition continues to be a cause of concern. Soil erosion affects nearly 120.72 million ha while soil salinity and water-logging severely lower the productivity of another 8.4 million ha¹⁰ of arable lands.

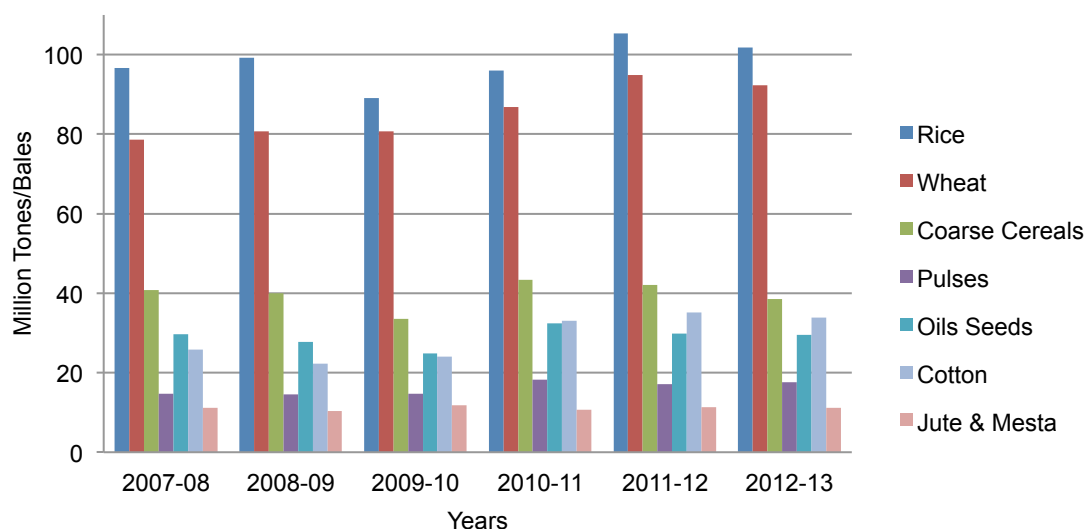


Figure 1: Production trends of major crops in recent years.¹¹

The horrors of the Great Bengal Famine of 1942 which took the lives of up to 4 million people, led to a firm political resolve of the newly independent Indian state in 1947 to accord the highest priority to agriculture. A wide slew of concerted steps addressing land reforms to place land in the hands of tillers, increased productivity through irrigation, fertilizers and pest control, agricultural research, and extension led to visible success within a few decades (Table 2).

Year	1950	1960	1970	1980
Foodgrain production (MT)	50.8	82.0	108.4	129.6
Food grain import (MT)	4.8	10.4	7.5	0.8
Buffer stock (MT)	-	2.0	-	15.5
Population (million)	361	439	548	683

Table 2: Increasing self-sufficiency in food production.¹²

⁹ Department of Animal Husbandry, Dairying and Fisheries. *Annual Report 2012-13*. New Delhi: Ministry of Agriculture, 2012.

¹⁰ Joshi, P., Trivedi, T., Sharma, R., Verma, S., Bharti, V. and Gupta, K. *ICAR's Vision 2030*. New Delhi: Indian Council of Agricultural Research, 2011.

¹¹ Department of Agriculture and Cooperation. *State of Indian Agriculture 2012-13*. New Delhi: Ministry of Agriculture, 2012.

¹² Indian National Science Academy. *Pursuit and Promotion of Science: The Indian Experience*. New Delhi: Indian National Science Academy, 2001.

B. Major influences and trends

Rapid fragmentation of small farms. Due to a combination of domestic inflation and increasing labor costs, rising input costs are forcing smallholders who are unable to compensate by mechanization or new technologies to scale down their operations. As various policies still hinder consolidation and the scaling-up of operations, the already small average farm size is projected to drop to 0.68 ha by 2020.

Within three decades the average size of landholdings declined from 2.30 ha to 1.32 ha in 2000, with the number of operational holdings increasing by 68% to 121 million. Average holding sizes are projected to drop down to 0.68 ha by 2020 and to a mere 0.32 ha by 2030¹³. This rapid farm fragmentation resulting in decreased farm income at a time when high levels of domestic inflation have driven up input costs is a potential cause of agrarian distress. Neutralization of increased labor costs by increasing mechanization and the rapid adoption of technological advances are economically viable in larger holdings, but national land ceiling laws discourage consolidation through purchase while state agricultural land tenancy laws (transferring ownership to tenants following cultivation for specified periods) serve to limit long-term leases as instruments of consolidation. Short-term contract farming has brought a larger extent of agricultural lands under a single management for high paying cash crops, but is not economically viable for grain production with narrow profit margins.

Commodity-specific producer companies are new innovations in bringing viable land sizes under same management. However, the provincial Agriculture Produce Marketing Control (APMC) laws around which agri-businesses in India are organized, and which permits farmers to sell their products only to registered dealers in designated market places, are a hindrance. Originally intended to protect the farmers from being forced to hand over their produce to the village money lender at rock bottom prices, this law now obstructs farmers from accessing more attractive market options. The presence of intermediaries between the producer and the consumer blocks the discovery of true prices at which they are willing to sell and purchase, while low-quality transport and storage facilities with intermediaries often reduce product value. This is now recognized politically and the central government has proposed a model APMC law that enables direct marketing and contract farming, a mechanism which has already been adopted by half of the states. In particular, Bihar, which suffers most from land fragmentation, has gone to the extent of abolishing this law altogether. These alternate marketing channels will induce competition and enable farmers get remunerative prices. Contract farming agreements between farmers with small holdings and user companies willing to invest in technology and high-quality inputs with the expectation of assured quality and quantities of the desired produce would benefit all stakeholders.

Rising labor costs. Due to extremely low levels of mechanization, agriculture in India is a labor-intensive activity with wages accounting for almost half the variable costs. With the institution of guaranteed rural employment for 100 days in a year for anybody in need of work, the rise in agricultural daily wages has been 9.2% annually (2010), compared to only 6.3% in industrial daily wages¹⁴. The returns to the farmer have not kept pace with this rise in input costs. Migration of socially disadvantaged populations to urban areas in an effort to escape social inequity in more conservative rural areas also contributes to the reduced availability of farm labor. This should make farm mechanization an economically attractive option, but instead the small size of holdings is an effective barrier.

¹³ Joshi, P., Trivedi, T., Sharma, R., Verma, S., Bharti, V. and Gupta, K. *ICAR's Vision 2030*. New Delhi: Indian Council of Agricultural Research, 2011.

¹⁴ Ibid.

High rates of capital formation in agriculture and related sectors. The journey from India's food-deficient to food-surplus status began with the land reforms of 1952, which also served to strengthen grassroot democracy and enhance social equality in the country. This was followed by continually high levels of investments in capital formation in agriculture and allied sectors, particularly in irrigation, land improvement, laying of new orchards and plantations, setting up of livestock farms and additions to livestock, purchase of agricultural machinery, fishing boats and implements and agriculture construction works. In the recent years, this investment in gross capital formation (GCF) from public and private sources has risen to about one fifth of the GDP from agriculture and allied sectors¹⁵ (see Table 3~~Error! Reference source not found.~~). But the share of public investment in capital formation has dropped from about 25% in 2006-07 to just 16% in 2011-12, implying that less public assets are being created in the agricultural sector, which may lead to welfare implications if the trend continues.

Fiscal Year	GCF as a % of GDP from agriculture
2007-08	16.1
2008-09	19.4
2009-10	20.1
2010-11	18.4
2011-12	19.8

Table 3: Gross Capital Formation (GCF) in the agriculture sector.¹⁶

Access to credit and insurance. Small-sized holdings, low and uncertain returns, lack of savings and inability to secure loans against collaterals severely restricts farmers' ability to access low interest credits from banks, affecting agricultural productivity and reducing agricultural asset formation leaving a lasting impact. Several steps have been initiated to address this problem. Under the Farmer Credit Package the disbursement of agricultural loans was doubled to INR 5110billion in 2011-12 over a five-year period and the upper limit of collateral-free loans has risen to INR 100,000¹⁷. The Farmer Credit Card scheme to enable purchase of seeds, fertilizers, pesticides, etc has been quite effective in the disbursement of loans. But loan recovery remains poor and thus the long-term sustainability of these loan disbursements is doubtful. The National Agricultural Insurance Scheme provides risk coverage on the basis of experimentally measured yield over a unit area within which the insured cultivation is located. The weather-based insurance scheme on the other hand insures crops against adverse weather as assessed through automatic weather stations. Premium rates range from 1.5% and 3.5% of the total insurance for food and oilseed crops and a subsidy of 10% in premium is available to smallholders. Both these insurance schemes are still in their nascent stages.

Irrigation. Of the estimated total irrigation potential of 140 million ha, actual irrigation is only 62 million ha, 70% of which comes from ground water. There is underutilization of major potential sources such as large rivers, and the existing irrigation network is not adequately maintained. Reluctance to recover water-use charges from politically influential farming communities has resulted in low public investments in irrigation development as well as increased salinity in lands exposed to excessive flood irrigation. Sub-optimal pricing of electricity for irrigation has also been a cause of excessive use of groundwater and a decline in the water table across the country.¹⁸

¹⁵ Department of Agriculture and Cooperation. *State of Indian Agriculture 2012-13*. New Delhi: Ministry of Agriculture, 2012.

¹⁶ Ibid.

¹⁷ Ibid.

¹⁸ Ibid.

C. Agricultural policies

C.1 Overview

Public support for agriculture reached USD 48 billion in 2008, which is still relatively low on a per-capita basis. Public spending mostly focuses on self-sufficiency in grains and poverty alleviation, with roughly half of spending reserved for inputs such as fertilizer, electricity, irrigation, and credit.

The National Policy for Farmers of 2007 aims to: substantially increase farmers' incomes; protect and improve the agriculture resource base of land, water, bio-diversity and genetic resources; develop support services, increase access to crop insurance and credit at affordable prices; strengthen bio-security and encourage agri-entrepreneurship. The agriculture credit policy makes access to institutional credit easier by providing extensive coverage under the farmer credit card scheme, promotion of micro credit and micro insurance for encouraging production and reducing risk as well as establishing credit counseling centers to advise severely indebted farmers in the matter of debt rescue or rescheduling package to save them from a debt trap.

C.2 Agricultural policies, plans and programs

Market Intervention Scheme and Minimum Support Prices. The central Government, in consultation with states and the Commission for Agricultural Costs & Prices, fixes the Minimum Support Prices (MSP) of various agricultural crops well before the planting season. This acts as its commitment to the price of procurement should the farmer decide to sell it to the government. The farmer is free to sell his produce in the market if it fetches better prices there. For perishable produce that is not covered under the MSP, there is a Market Intervention Scheme (MIS) that protects farmers against steep falls in prices in the event of a bumper crop, provided there is a minimum of 10% production increase or price decrease over the previous year.

Tax exemption on income from agriculture. There is a complete exemption from income tax for profits from primary agriculture activity. This is, however, available only to traditional farmers and not new investors in agriculture. Income from agriculture processing is taxable just as any other industrial activity. Income from exports of primary and processed agriculture produce is also tax exempt. Many states, however, levy a nominal agriculture income tax on some produce such as tea and coffee.

Nutrition management. Fertilizer is heavily subsidized and its availability is managed by the central government through a process involving an assessment of N, P and K twice a year before each cropping season, taking into account the Gross Cropped Area, Irrigated Area and Cropping Pattern. The average estimated consumption of chemical fertilizers in 2011-12 was 144.33 kg/ha but varies greatly from a mere 5 kg/ha in some states of North Eastern India and 56.52 kg/ha in Odisha to as high as 266.11 kg/ha in Andhra Pradesh. Urea has been placed under the statutory price control with its price revised in accordance with the input prices and international price trends. Phosphatic and Potassic fertilizers are subsidized under the Nutrient Based Subsidy Policy, with additional subsidies allowed for Boron and Zinc as micronutrients. India currently imports about 6 MT of potash annually, which is financed largely through government subsidies of about USD 1 to 5 billion each year.¹⁹

Innovations in extension services. Effective measures for quick absorption of research-based findings by farmers are one of the biggest challenges for a country with a large illiterate rural population. India has invested heavily in developing agriculture extension services and in recent years an institutional arrangement for farmer-driven technology dissemination has been set up under the Agricultural Technology Management Agency. This agency has active participation from commodity-based farmer interest groups, 'agri-preneurs', input suppliers, village level

¹⁹ Mehta, P., "Singed by the potash cartel." *Business Line*. 17 September 2013. Available at: <http://www.thehindubusinessline.com/opinion/singed-by-the-potash-cartel/article5138520.ece>.

governments, and civil society organizations operating at village level. Outstanding farmers are encouraged to set up Farm Schools for village clusters and more than 55,000 such schools have already been organized so far. At least 10% of outlay on extension is mandatorily spent through the non-governmental sector. Mass media support to extension is provided through regular agricultural programs on government owned country-wide TV and radio networks, e.g. the program *Krishi Darshan*.

An important innovation in agricultural extension is the establishment of the Agri-Clinics and Agri-Business Centers. Credit linked subsidies at 36% (44% for women and other disadvantaged sections) of the capital cost are available under this scheme. Training and subsidy support to these Agri-Clinics is organized with the support of two national level organizations of repute. A *National Gender Resource Centre in Agriculture* has been set up with the objective of bringing women into the mainstream of agriculture production, technology, research and development, extension, value addition, marketing, and as both a generator and consumer of employment in the sector.

C.3 Climate change policies

The national government adopted a National Action Plan for Climate Change to be implemented through eight National Missions of which the Missions on Sustainable Agriculture, Water, Sustaining the Himalayan Ecosystem, and on Strategic Knowledge for Climate Change are most relevant to the agriculture sector. The guiding principle of India's National Action Plan for Climate Change²⁰ is the pursuit of high national growth achieved through development pathways that enhance mitigation of and adaption to climate change, and lead to an enveloping ecological sustainability. Most relevant is the Mission on Sustainable Agriculture with a strong focus on climate change adaptation. Implementation of the Mission will start after its approval by the Prime Minister, not expected until after 2014 elections.

The National Mission on Sustainable Agriculture²¹ is largely oriented towards adaptation by enhancing resilience to climate change through the development of new varieties of crops and new cropping patterns capable of withstanding extreme temperatures, droughts and floods without loss of productivity. Technology would be relied upon to improve the productivity of rain-fed agriculture by developing drought- and pest-resistant crop varieties, conserving soil and water to ensure optimal utilization, creating innovative credit and insurance mechanisms to promote the adoption of desired practices and establishing Model Villages and Model Farm Units in rain-fed areas as demonstration units. The Mission has proposed strategic planning at the Agro-Climatic Zone level in the areas of agricultural research, and development of technologies for quick responses towards changes in climate. An Automatic Weather Stations network will be established at the village level and linked to the Weather Based Crop Insurance Scheme and other risk mitigating activities.

The Mission plans to focus on the following ten broad areas of intervention:²²

1. Improved crop seeds, livestock and fish culture through promoting biotechnology including research on developing C₄ pathways in C₃ plants, conserving indigenous genetic resources, public-private partnership in research, dissemination and management of Improved varieties and conserving India's agricultural heritage.
2. Water use efficiency with investment in research and development in energy-efficient water systems, integrated management of rainwater, surface and ground water, strengthening local institutions in managing water allocation and utilization and evolving suitable policies in public-private partnership in water management in agriculture.

²⁰ Prime Minister's Council on Climate Change. *National Action Plan on Climate Change*. New Delhi: Prime Minister's Council on Climate Change, 2010.

²¹ Department of Agriculture and Cooperation. *National Mission on Sustainable Agriculture*. New Delhi: Ministry of Agriculture, 2010.

²² Ibid.



3. Pest management through development of insect forecasting models and decision support system for pest and disease surveillance, environmentally sound pest management, institutional mechanisms for rapid response during crisis and promotion of bio-pesticides.
4. Improved agronomic practices to reduce farm losses, precision farming, soil and moisture conservation, policy instruments for optimal land use.
5. Nutrient management by developing nutritional strategies and use of bio-fertilizers, strengthening capacity of existing soil testing labs and enhancing quality standards and quality control system.
6. Agricultural insurance by helping design user-friendly decision support systems to help assess risks and develop region specific contingency plans, strengthening Weather Based Crop Insurance Scheme.
7. Credit support by developing new forms of credit assessment and risk management systems, promoting micro finance, directing flow of credit to critical infrastructure and up-scaling the Kisan Credit Card Scheme.
8. Strengthen markets by aligning Research and Development programs with the evolving market demand and supply trends, improving supply chain efficiency and creating new market infrastructure.
9. Access to information by minimizing information asymmetry through IT enabled systems, supporting measures that help discover prices, commodity arrivals, etc.
10. Livelihood diversification by developing more off-farm economic activities for supplementing incomes and introducing crop-livestock-fisheries farming system.

The Mission proposes mitigation of GHG emissions, without setting any targets through:

1. Improved agronomic practices to increase carbon storage in soil.
2. Partial shift towards bio-fertilizers to reduce nitrogen related emission.
3. Promotion of system of rice intensification for reducing emission of methane.
4. Change in dietary practices of livestock to curb methane emissions from enteric fermentation.
5. Research on creation of C₄ pathways in C₃ plants and genetic manipulation of enzymes for enhanced CO₂ fertilization effect.

D. Voluntary initiatives

Early action is needed to respond to the threats posed by climate change as it will cost less to find effective ways to reduce emissions now rather than later. It is also necessary to prepare both individuals and institutions to cope with the emerging issues. Early action will also enhance food security among small, isolated, local communities. Since governments tend to take an extraordinarily long time to decide on a course of action and raising necessary resources, voluntary initiatives become very important for early action. In the area of mitigation, capture of methane from agricultural waste and using it as a source of energy has attracted the most attention from private initiatives. Early mitigation actions without close and credible institutional supervision are in the thousands and are spread across the country, for example mitigation projects under the Clean Development Mechanism of the United Nations Framework Convention on Climate Change, for methane avoidance and renewable energy generation from agricultural wastes.

E. Actors

Actor	
Government	<p>Prime minister's office</p> <p>Central government ministries, including agriculture, environment and forests, rural development, etc.</p> <p>State departments of agriculture, animal husbandry, environment & forestry, etc.</p> <p>District planning committees</p> <p>Panchayati Raj Institutions</p>
Research & technical assistance service providers	<p>Indian Council of Agricultural Research</p> <p>State Agricultural Research Departments</p> <p>Central and State Agricultural Universities</p> <p>Indian Agricultural Research Institute, New Delhi</p> <p>National Dairy Research Institute, Karnal</p> <p>Indian Veterinary Research Institute, Izatnagar</p> <p>ICAR Institutions</p> <p>National Research Centres for Agriculture Economics & Policy Research, New Delhi</p>
Associations & cooperatives	<p>Indian Dairy Association</p> <p>Confederation of Indian Industry</p> <p>Council for the Advancement of Peoples Action and Rural Technology</p> <p>National Agricultural Cooperative Marketing Federation of India</p> <p>State Agricultural Cooperative Marketing Federations State Cooperative Milk Marketing Federations</p> <p>Commodity specific Growers' Association</p> <p>United Planters Association of Southern India</p> <p>Federation of Indian Chambers of Commerce & Industry</p> <p>Federation of Indian Export Organizations</p> <p>Confederation of Indian Industry</p> <p>National Agriculture and Livestock Confederation</p>
Agribusiness	<p><i>Dairy:</i> e.g. Nestlé, Chitale Dairy</p>
Financial institutions	<p>Reserve Bank of India</p> <p>National Bank for Agriculture & Rural Development</p> <p>State Cooperative Agriculture & Rural Development Banks</p> <p>Primary Cooperative Agriculture & Rural Development Banks</p>

Case Study: Dairy Sector

Author: Franziska Haupt, Climate Focus

Better feeding practices offer potential for productivity improvements and climate change mitigation. India is home to the world's largest livestock population – more than 400 million heads of cattle and buffalo mainly for dairy production and meat as a byproduct. Indian buffalo and dairy cows account for roughly 17% of global dairy production²³, most of which is consumed domestically. Small farmers – typically crop-livestock systems with one to three buffalos or cows fed on crop residues, seasonal pastures and some additional feed – produce the majority of output.

The country faces a steep rise in dairy demand, while there is a substantial gap in feed and fodder availability. The supply gap is 40%, 36% and 57% in dry fodder, green fodder and concentrates, respectively.²⁴ Prices are increasing for both dairy products and feedstock. At the same time, productivity remains low at roughly half the world average²⁵. The main limitation to productivity is inadequate and insufficient feed, which typically consists of agricultural residues and seasonal pastures with poor nutritional quality. Deficiencies of essential nutrients lead to losses in productivity by affecting feed use efficiency, long-term animal health and reproduction. Fodder, such as from agricultural residues receives low priority and competes with other uses.

The cooperative movement, a remarkable supply chain network has enabled what is praised the “White Revolution of India”, by providing processing facilities, market access, technical assistance and veterinary services to millions of smallholders.²⁶ Over several decades, cooperatives have triggered substantial production increases, improving livelihoods and food security of millions of marginal farmers, especially women as dairy farming is traditionally their domain. The *Amul* cooperative system, for instance, comprises 22 Cooperative Milk Marketing Federations at the state level, 184 Unions at the district level, 144,500 villages, 15 million dairy farmers and extends to several hundred thousand retailers²⁷. Cooperatives have been successful also in the use of information communication technologies. But achievements of the movement have yet to extend to improved animal productivity. The high level of vertical market integration, political leverage, umbrella institutions, technical and institutional capacities present a unique opportunity for the mobilization and support of the private sector through policies, NGO or private sector outreach. In particular, cooperatives provide a framework for better coordinating feedstock resources at the local level.

Better feeding practices by improving supply, its coordination at the local level and the balancing of nutrition have major potential for improving the resource- and GHG emissions-efficiency of the livestock sector and for enabling farmers to making better use of the feed resources available. For instance, despite its potential for substantial productivity increases and cost-savings, the use of maize stover as feedstock is still uncommon. Barriers include traditional and technological factors, e.g. handling of maize residues is more difficult than for other crops. In addition to local

²³ National Dairy Development Board. Annual Report 2012-2013. Available at:

<http://www.nddb.org/English/AnnualReports/nddb-annual-report-2012-2013.pdf>.

²⁴ Department of Animal Husbandry, Dairying and Fisheries. *Annual Report 2012-13*. New Delhi: Ministry of Agriculture, 2013.

²⁵ The Working Group on Animal Husbandry and Dairying. *Report of The Working Group on Animal Husbandry and Dairying 12th Five Year Plan (2012-17)*. New Delhi: Planning Commission Government, 2012.

²⁶ Verghese Kurien. “*The Economist*.” 22 September 2012. Available at:

<http://www.economist.com/node/21563260>.

²⁷ *Amul: About Us*. 2013. Available at: <http://www.amul.com/m/about-us>.



supply constraints of better quality feed resources, many farmers lack awareness, capacity, market information and access to provide sufficient and balanced feeding.²⁸

Policies supporting improved productivity. Policy makers have recognized the urgent need for productivity improvements in dairy production and have launched several initiatives, mainly to improve breeding and feeding. The Ministry of Agriculture defined priority areas for improved feedstock, including the optimized utilization of land resources, improved fodder production, strengthening of extension services etc. The central government is also assisting states through two schemes, mainly by providing technical assistance and financing: A centrally sponsored Fodder and Feed Development Scheme supporting various activities and the Central Fodder Development Organization includes seven regional stations for forage production and demonstration with the objective to produce and promote seeds of high-yielding fodder crops.²⁹

The National Dairy Development Board (NDDB) has developed a National Dairy Plan, a central government policy aimed at improved animal productivity, among other objectives. Implementation is supported by the World Bank through the National Dairy Support Project, including among other activities a USD 258.3million component for improved breeding and feeding practices. Activities will be implemented through the cooperative system in 14 states. Activities relevant to improved feeding include (i) extension services to farmers to support better-balanced feeding, based on a sophisticated Information Network for Animal Productivity and Health; Farmers receive advice on the least cost ration for feeding, based on a software taking into account available resources (local libraries will be created) and requirements, giving preference to local resources; (ii) extension services and interventions to support fodder development, such as through seed production and silage demonstration activities.³⁰ Climate change mitigation is not the primary objective of sustainable intensification policies in the dairy sector, but it is a co-benefit, for instance, mentioned in the National Dairy Plan.

Voluntary efforts for improved productivity. Several processing companies, a sector increasingly dominated by the private sector, have also recognized the economic necessity of increased efficiency of dairy production. The company Chitale Dairy, for instance, has established a cooperative structure and provides high-tech extension to its suppliers, such as blood testing of nutritional status, demonstration of silage making or management systems based on computer-cell phone interfaces. Extension services for improved farming practices are also promoted by global corporations, such as Nestlé, which operates a dairy processing facility that is currently sourcing milk from 100,000 small-scale producers and supports an extension program to promote practices for increased fodder production.³¹

²⁸ Corporate Communications. "Dual-purpose maize could reduce fodder shortages in India." *International Maize and Wheat Improvement Center*. 26 November 2013. Available at: <http://blog.cimmyt.org/?p=11595>; Erenstein, O., Samaddar, A., Teufel, N. and Blummel, M. "The paradox of limited Maize stover use in India's smallholder crop-livestock systems." *Experimental Agriculture* 47 (4), 2011: 667-704.

²⁹ The World Bank. *Project Appraisal Document of the National Dairy Support Project*. Washington, D.C.: The World Bank, 2012.

³⁰ Ibid.

³¹ Nestlé: *Working with dairy farmers*. 2013. Available at: <http://www.nestle.com/brands/dairy/dairycsv>; Nestlé: *Responsible sourcing: Milk*. 2013. Available at: <http://www.nestle.com/csv/responsible-sourcing/milk>.