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Rural and Urban Linkages

Operation Flood's Role in India's Dairy Development

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A total of 20 case studies are included in this project, each one based on a synthesis of the peer-reviewed literature, along with other relevant knowledge, that documents an intervention's impact on hunger and malnutrition and the pathways to food security. All these studies were in turn peer reviewed by both the Millions Fed project and IFPRI's independent Publications Review Committee.

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Notices

[1] Effective January 2007, the Discussion Paper series within each division and the Director General's Office of IFPRI were merged into one IFPRI–wide Discussion Paper series. The new series begins with number 00689, reflecting the prior publication of 688 discussion papers within the dispersed series. The earlier series are available on IFPRI's website at www.ifpri.org/pubs/otherpubs.htm#dp.

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ABSTRACT

Between 1970 and 2009, India has overcome many infrastructural, market, and institutional challenges to transition from a dairy importing nation to the top producer in the world of both buffalo and goat milk, as well as the sixth largest producer of cow milk. In India, at least 100 million households are involved in farming and 70 million have dairy cattle.

In India, dairy production is important for employment, income levels, and the nutritional quality of diets. Milk production in India is dominated by smallholder farmers including landless agricultural workers. For example, 80 percent of milk comes from farms with only two to five cows. A well-known smallholder dairy production initiative, Operation Flood, laid the foundation for a dairy cooperative movement that presently ensures returns on dairy investments to 13 million members. Operation Flood also advanced infrastructural improvements to enable the procurement, processing, marketing, and production of milk and to link India's major metropolitan cities with dairy cooperatives nationwide. This intervention transformed the policy environment, brought significant technological advancements into the rural milk sector, established many village cooperatives, and oriented the dairy industry toward markets.

Keywords: Millions Fed, Food Security, Operation Flood, India, Dairy, NDDB, Dairy Cooperatives

Summary impact of Operation Flood (OF) table

Indicator	During Operation Flood (1970-96)	Post Operation Flood	Citation
Beneficiaries/ Employment	.25 (1970) to 9 million (1995); 1970 to 1990 cooperatives, increased almost 27 times	13.4 million (2008)	National Dairy Development Board (NDDB) Annual Reports 2005, 2006, and 2007. Government of India (GOI) 2008; Fulton and Bhargava 1994
Cooperatives	From 1,600 to 70,000 dairy cooperatives; From 70 to 90 cooperatives, increased 40 times	128,799 dairy cooperatives (2008)	Fulton and Bhargava 1994; NDDB Annual Report
Production increases	Milch animal productivity tripled; From 42 million liters per day (lpd) in 1988-89 to 67 million lpd in 1995-96)		Shukla and Brahmankar 1999; Aneja 1994a
Milk Sale/Marketing Increases	1 to 10 million lpd; In urban areas, cooperatives' milk marketed increased more than 50 times (1970-90); OF coops met 60 percent of urban milk demand and comprised 22 percent of all milk marketed in India (end of OFIII); Peak Marketing—OF 1 (2.8 million lpd), OF II (5.0 mill lpd), and OF III (9.4 million lpd)		Fulton and Bhargava 1994; Gupta 1997
Peak Procurement	Peak Procurement—OF 1 (3.4 million lpd), OF II (7.9 mill lpd), and OF III (13 million lpd)		Gupta 1997
Consumption increases of Dairy Farmers	From 290 grams per day in 1988-89 to 339 grams per day in 1995-96		Shukla and Brahmankar 1999

Summary impact of Operation Flood (OF) table (Continued)

Indicator	During Operation Flood (1970-96)	Post Operation Flood	Citation
Infrastructure established	175 dairy plants, 45 cattle feed plants, about 15,000 centers for artificial insemination, 100 rail milk tankers and more than 1,500 road milk tankers		Tikku 2003
Geographical Coverage	170 milksheds in 362 districts		NDDB Annual Reports 2005, 2006, and 2007.
Women/Pro-poor	73 percent of households were small, marginal, landless farmers	3.7 million (2008); Over 25 percent of members; 2700 cooperatives managed by all women management committee	GOI 2008
Incomes	Landless farmers' incomes doubled; Annual milk supply profit: Rs 1,845 Bonuses: Rs 400 (1985-86)		FAO Information Division 1978
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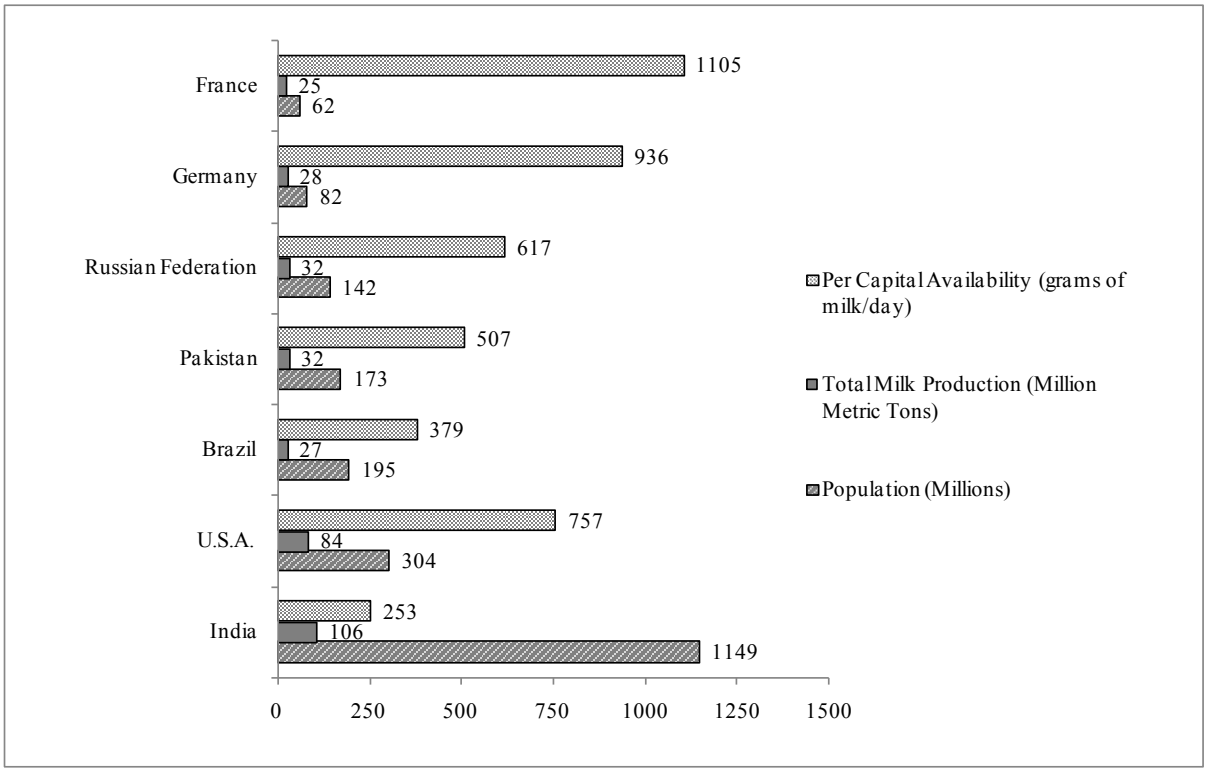
1. INTRODUCTION

Overview

India, historically a milk-consuming country, was dependent on milk imports for decades. In fact, 50-60 percent of the dairy industry's total throughput in the 1950s and 1960s was externally produced (Aneja 1994a). As such, a variety of development programs and interventions have targeted India's dairy industry as a way of increasing production to meet domestic demand and in turn, combat food insecurity. Since 1970, India's output of milk and milk products has increased faster (at a rate of 4.5 percent per year between 1970 and 2001) than crop output and has outpaced the world's 1 percent annual rate of increase (Sharma and Gulati 2003). As of the early part of the twenty-first century, milk and milk products were 70.8 percent of the total output value of all livestock products in India and were the largest agricultural commodity category by value (Staal, Pratt, and Jabbar 2008b). These production increases were met between the early-1980s and late-1990s with a nearly twofold increase in aggregate milk consumption throughout India, a total summing up as 31 percent of all developing countries' milk consumption and 13 percent of the world's total (Delgado 2003).

By 2007, with more than 12 million milk producers, India had become one of the largest producers of buffalo, goat, and cow milk in the world— and milk was a bigger contributor to the nation's gross domestic product (GDP) than rice. As milk production nearly tripled, India not only has become self-sufficient in milk but also an exporter of milk powder. Considering that India has a population of more than 1 billion people— of which at least 100 million households are farming households and 70 million of them have dairy cattle—this increase in dairy production is of great consequence as it has improved employment, income levels, and the nutritional quality of diets. For instance, at least 20 percent of India's agricultural economy is composed of dairying and approximately 70 percent of the rural population is involved in milk production. Importantly, milk production in India, as is true in many parts of Asia, is dominated by smallholder farmers, including landless agricultural workers, who rely primarily on family labor. To be precise, 80 percent of milk comes from farms with only two to five cows (Perumal et al. 2007, Morgan 2009a). (Annex 2). In short, although India has had to overcome many infrastructural, market, and institutional challenges in meeting domestic dairy demand, it now ranks with the United States, France, Pakistan and others as a major milk-producing nation (Figure 1.1).

Figure 1.1. India and other major milk producing nations, 2008



Sources: Calculated by author using data from Population Reference Bureau 2008 World Population Data Sheet and FAO Statistics Division 2009.

2. AN INTRODUCTION TO OPERATION FLOOD

India's sizeable vegetarian population ensures a constant demand for dairy products and milk has been an integral part of the Indian diet for millennia. In India, there is a long-standing household tradition of keeping milch animals. Traditionally, draught animals have had many agricultural uses, including threshing and transportation, in addition to providing milk (Aneja 1994a, Perumal et al 2007). But population growth, economic development, a rise in income levels, and late twentieth-century urbanization presented India with challenges in meeting an increasing dairy demand given limited domestic production. For instance, as incomes have risen in India, milk demand has followed as well due to dairy's relatively high-income elasticity: demand for milk in New Delhi alone increased by 50 percent between the mid-70s and mid-80s (Saxena 1997, Batra 1990). In the mid-twentieth century, the Kaira District Cooperative Milk Producers' Union and its replications demonstrated that smallholder dairy cooperatives could improve milk supplies and smallholder income levels and in 1970, national efforts to scale up this process began with the implementation of Operation Flood by the National Dairy Development Board. Prior to this, government initiatives throughout India were unsuccessful in implementing a variety of strategies to modernize the national dairy sector.

Operation Flood, a well-known smallholder dairy production initiative, laid the foundation for a dairy cooperative movement. India's dairy industry is dominated by an unorganized, traditionally informal sector, which involves traders handling raw milk and traditional milk products—only 10-15 percent of the market is formalized. As such, Operation Flood cooperatives actually produced and marketed only a small percentage of dairy (Munshi and Parikh 1994). Yet this integrated dairy development venture was critical to the industry's overall evolution in India: it transformed the policy environment, brought significant technological advancements to the rural milk sector, established many village cooperatives, and oriented the dairy industry toward markets. While the cooperatives set up under Operation Flood accounted for only a small share of the milk procured and marketed in relation to total milk supply, Operation Flood should still be credited for the white revolution because it established a new policy environment friendly to smallholder farmers in the dairy sector (World Bank 2006).

The intervention also has brought about infrastructural improvements to enable the production, processing, procurement, and marketing of milk throughout India Developing India's best milk sheds. Operation Flood linked India's major metropolitan cities with dairy cooperatives nationwide Many Indians benefited from this large-scale agricultural intervention, including small-scale dairy farmers, urban and rural consumers, and even landless milk producers. Furthermore, by increasing milk production, this cooperative scheme has enhanced food security for millions of people throughout India and improved employment, income levels, and the nutritional quality of diets. Because the cooperatives processed an average of 30 million liters of milk daily and reached more than 9 million members, this livestock intervention also successfully reduced poverty, improved human health, and reduced malnutrition. Presently, this movement ensures returns on dairy investments to 13 million members of the cooperatives (NDDB 2009).

3. THE INTERVENTION: OPERATION FLOOD I, OPERATION FLOOD II, AND OPERATION FLOOD III

There have been four main stages of India's dairy development: pre-independence (before 1947), post independence/pre-Operation Flood (1950s-60s), Operation Flood and pre-reforms (1970s-80s), and post-Operation Flood and post-reforms (1990s onwards) (Staal, Pratt, and Jabbar 2008b). In the pre-Operation Flood period India's dairy industry and attempts to modernize it had been riddled with obstacles. The challenges and market constraints included an urban-focused production scheme (for example, a lack of market access to the market for many smallholders), lack of a method for procuring milk produced in rural areas, high transaction costs and the highly perishable nature of dairy, among others challenges. These challenges formed the impetus for dairy reforms in the 1970s (Banerjee 1994).

The antecedent to the Operation Flood initiative was a milk producers' private cooperative venture in Anand, Gujarat. In 1946 these milk producers organized themselves into a private cooperative called Kaira District Cooperative Milk Producers' Union Ltd India's Prime Minister Lal Bahadur Shastri visited the cooperative and was impressed with the effectiveness and success of the dairy cooperative union in Gujarat. In 1965, the government of India established the National Dairy Development Board (NDDB) — a parastatal organization—and mandated that it replicate this Anand model of dairy cooperatives throughout India for the benefit of as large a number of farmers as possible. This dream of the then Prime Minister manifested itself into the setting up of the National Dairy Development Board which conceived a program 'Operation Flood' to flood India with milk through a sophisticated procurement system using rural production to satisfy urban demand.

The NDDB assumed responsibility for setting up cooperatives and provided technical support for planning, farmer extension services, engineering, dairy technology, veterinary services, and nutrition for fostering dairy development. Verghese Kurien, General Manager of KDCMPUL later named as Anand Milk Union Limited (AMUL), was appointed by the government as the founding Chair and transformed the idea of cooperative dairying into reality. In 1970, the Indian Dairy Corporation (IDC) was established to manage financial aspects of Operation Flood, such as receiving and monetizing donated commodities: the profits generated from selling the donated commodities were used to finance the Operation Flood program. Later, the two entities merged, and today the NDDB continues to fund and provide technical assistance to cooperatives throughout India. The Institute of Rural Management (IRMA) in Anand, founded in 1979, was set up to provide professional management and research support to cooperatives (Terhal, 1983).

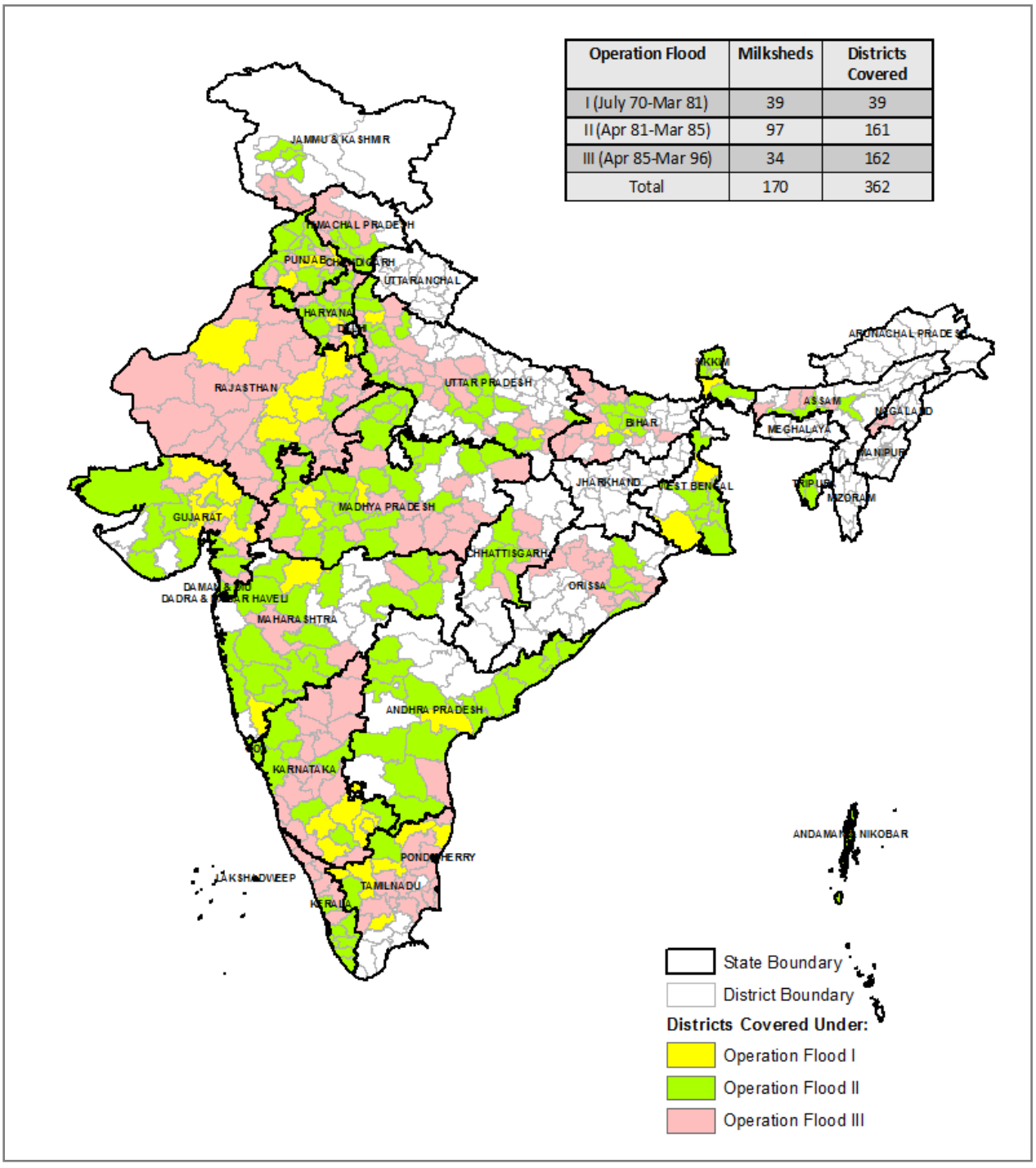
With an organizational structure in place, Operation Flood—a federally sponsored, national intervention that lasted from1970 to 1996—was to ensure that dairy products reached both rural and urban consumers in an efficient and effective manner while also off-setting seasonal fluctuations in the supply and price of milk. The scale of Operation Flood and the dairy cooperative movement it engendered is fairly unique: millions of rural farmers and millions of urban dwellers simultaneously benefited from this agricultural intervention in dairying. According to Banerjee (1994), by the time the program ended in 1996, approximately 70,000 dairy cooperatives in 170 milk sheds encompassing 8.4 million milk-producer families operated under Operation Flood. Other scholars have commented more recently that Operation Flood currently has 77,000 village dairy cooperative societies with more than 10 million farmer members— and each cooperative is affiliated with 1 of 170 district and regional cooperative unions. A state cooperative marketing federation oversees the sub-state levels, and overall the industry produces enough to almost entirely eliminate India's importing of dairy products (Perumal et al. 2007).

The scaling up of production, marketing, and processing was strategically synchronized in three distinct phases over a period of 25 years: Operation Flood I (OF I), Operation Flood II (OF II), and Operation Flood III (OF III). Each phase of the intervention was adapted to what had already been done: Operation Flood became a large-scale program gradually as each phase of the project built upon the achievements of the previous phase. Some implementation delays did affect each phase. For instance, OF

I was achieved in double the time that was originally anticipated. Lags in aid delivery, the global dairy crisis, difficulties with absorbing commodities locally, and internal program difficulties all contributed to the delays (Doornbos et al. 1990).

OF I, which was carried out from 1970 to 1981, essentially focused on market policy and initially, only targeted the four major Indian metropolitan cities of Mumbai, Kolkata, Delhi, and Chennai— at the time known as Bombay, Calcutta, Delhi and Madras—for milk distribution. During OF I, only 1 million rural milk producers with 1.8 million milch animals were incorporated into the scheme. OF II lasted, from 1981 to 1985, during which time 10 million rural producers with several million heads of improved animal stock adopted the program. During this second phase, the number of milk sheds also increased from 18 to 27, and urban milk centers grew to cover all 147 major Indian cities. OF III, operational through 1996, consolidated and filled in the remaining gaps. The effort targeted nearly 7 million farmer families and 170 milksheds, and improved overall veterinary healthcare (Atkins 1988, Chothani 1989). All three stages of the intervention were backed financially in v arious ways including international loans, donations of commodity aid, the Government of India, and internal program resources as well as finances generated from the intervention. The geographical spread of Operation Flood throughout the various stages demonstrates how large this initiative was and how it was scaled up gradually (Figure 1.2). More farmers became members of the cooperative and more village cooperatives existed as Operation Flood expanded (Table 1.1)

Figure 1.2. Operation Flood's geographical coverage



Notes: The division of Operation Flood years into three phases will follow this map for this entire report. Publications vary in how the OF phases are divided and slightly different time periods (with Operation Flood II ending in 78, for example) are used. To be consistent, the time periods reported by the NDDB to the author are used in all text, tables, and graphs.

Source: National Dairy Development Board

Table 1.1. Cooperative growth during and after Operation Flood, 1970-2006

Year	Farmer members (millions)	Village milk cooperatives (Thousands)
1970/71	0.3	1.6
1975/76	0.6	4.5
1980/81	1.8	13.3
1985/86	4.5	42.7
1990/91	7.5	63.4
1995/96	9	69.6
2000/01	10.7	96.2
2003/04	12	108.6
2004/05	12.3	113.2
2005/06	12.4	117.6

Sources: Gupta 1997; National Dairy Development Board 2005; Aneja 1994a.

4. OPERATION FLOOD: APPROACHES TO DAIRYING

This section describes some of the factors that allowed Operation Flood to live up to its initial goal of ensuring long-term, self-reliance in milk while maximizing benefits for smallholder producers.

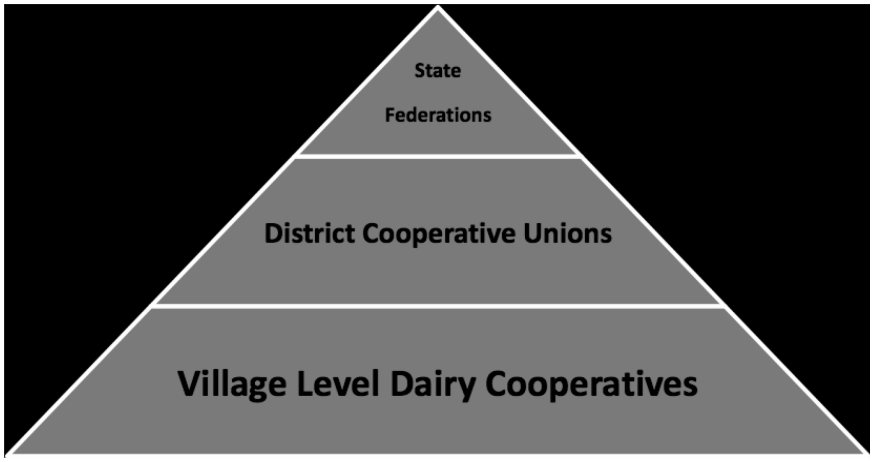
Getting Organized

Through Operation Flood, an organized, intricate dairy supply chain process replaced the ad hoc production marketing and selling of milk. One way of thinking about Operation Flood's organizational structure is to envision a pyramid with three levels (Figure 1.3). At the base level were the village-level cooperatives responsible for all of the micro-inputs, including the production and testing of milk that was not only to be brought into the production-marketing chain but also be sold. Local farmers along with an elected management committee controlled these primary societies; over time they were required to include at least one female manager.

The middle level, comprised of district-level cooperative unions, consisted of macro-inputs, such as the transportation of milk collection and processing equipment. These unions owned and operated the dairy processing plants, managed the cattle feed plants, and provided animal healthcare at the village level. State-level marketing federations formed the third level of the pyramid and these bodies were used for marketing as well as coordinating logistics for interstate sales (Aneja 1994a). In addition to the three-tiered structure, the NDDB operated externally as a facilitator— providing guidance and support for setting up the cooperative structure, funding it, and providing technical assistance.

While an evaluation of the three-tiered structure indicates some inefficiencies and diseconomies, which suggest that there may have been an even better approach, this structure created a clear chain for getting milk from the small peasant cattle owner to the ordinary urban consumer, ensured seasonal continuity and fluidity from production to consumption. Also, the organizational structure allowed for simplicity and focus: for example, village-level cooperatives could not become overly ambitious and invest in high capital endeavors, which might have been beyond their own management capabilities.

Figure 1.3. Pyramid structure of Operation Flood scheme

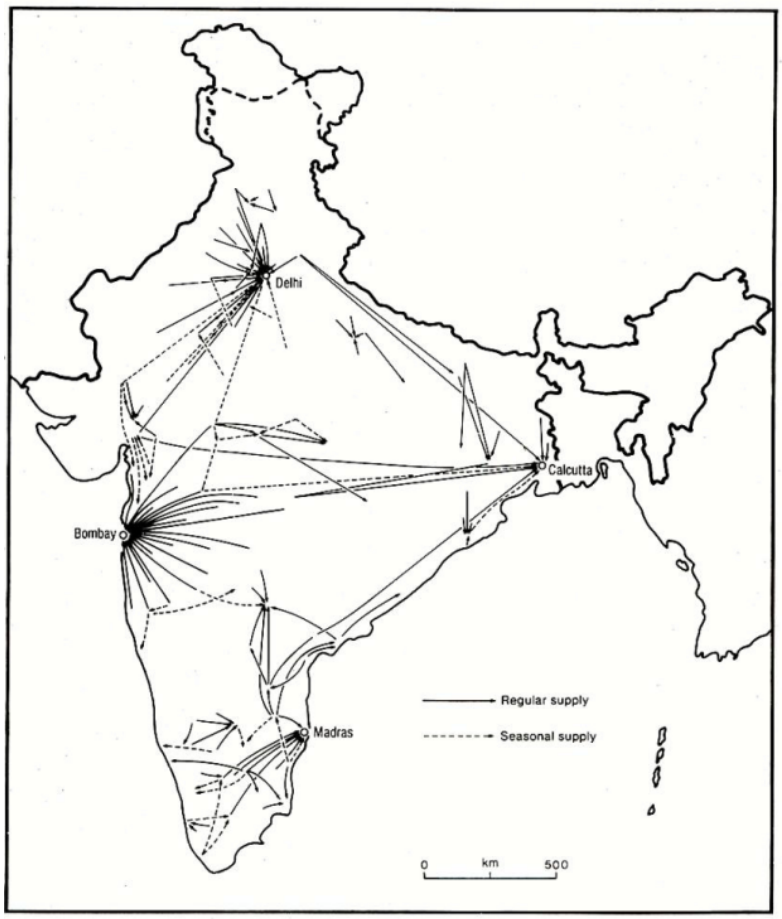


Source: Devised by author.

In short, this entire organizational structure allowed for a smooth transition to a cooperative way of dairying. The cooperatives, voluntary groupings of individual economic entities that are rooted in equality and democratic practices aiming to fulfill economic objective(s), in turn ensured that dairy development was directly responsive to the evolving needs of smallholder farmers (Narayanaswamy 1996). Dairy cooperatives enable those who dominate India's agriculture and livestock sectors— small

producers—to contribute to sustainable growth of India's economy, specifically to increase dairy productivity, increase their market participation, and earn fair profits on their investments (Patel 2004). Dairying through the cooperative system created natural channels to disseminate information, promote community wide knowledge and information sharing, and efficiently distribute technologies for dairy production and processing (Munshi and Parikh 1994). In fact, a national milk grid provided the physical infrastructure and organizational direction linking the surplus milk in one region to the demand for milk in another region (Figure 1.4).

Figure 1.4. National milk grid



Source: Atkins 1993.

Operation Flood attempted to simultaneously address various types of barriers that smallholder producers could face: a lack of assets and technical skills, socio-cultural differences, and transaction costs. While cooperatives were the mechanism through which to address these obstacles in smallholder dairying, Operation Flood efforts did not always succeed. Sometimes dairy development occurred even faster in places where cooperatives were weak or didn't exist. Some challenges for cooperatives included weak management, overstaffing, poor market orientation, and a lack of flexibility to respond to changes in market conditions (World Bank 1996). All cooperatives are not the same and hence the success rates have varied: success at the village or federal level often has been based on how effectively the cooperative serves the main needs of its members and usually to be effective in this endeavor requires appropriate design of the cooperative (Shah 1995).

Using Aid for Development

The way in which Operation Flood used donated dairy products was unique: it was the first time food aid was viewed as a critical investment resource (Banerjee 1994). During Operation Flood, the European Economic Community (EEC) donated surplus dairy commodities to India and the World Bank, as well as some bilateral donors, provided soft loans and grants as financial support for this intervention.

To fund OF I, the idea was that the EEC would use the World FoodProgram as a conduit through which to donate surplus skimmed milk powder and butter oil; the total investment for this phase was estimated at Rs1200 million (Doornbos and Nair 1987). Ultimately, donated commodity aid for this period (1970-1981) was valued in the end at approximately Rs 1160 million and estimated to have generated over Rs1000 million (Terhal 1983; Chothani 1989; Aneja 1994).

The original outlay cost of OF II was over Rs 4800 million of which nearly 50 percent would be received as dairy commodities (Doornbos and Nair 1987). This phase was also to be funded with EEC commodity aid, but this time the donation would be direct to India instead of through an international organization. During OF II, the value of donated skimmed milk powder and butter oil totaled Rs2452 million. At this point, the World Bank (WB) came into the picture and began financing Operation Flood through a WB International Development Assistance soft loan of about US$150 million or the equivalent of about Rs1730 million (Chothani 1989; Sahni 1993; Terhal 1983).

Finally, Operation Flood III was also meant to be partially funded by the World Bank and partially by EEC donations; including the NDDB's use of its own resources of about Rs2077 million, the original additional outlay for this phase was estimated at Rs 6806 million (Gupta 1997; Doornbos and Nair 1987). This time the World Bank provided India with a credit loan valued around Rs360 million and the commodity aid provided by the EEC was valued at over Rs2200 million (Chothani 1989; Gupta 1997).

Some attempts have been made to sum up the total project costs. According to Gupta (1997), the total investment in Operation Flood exceeded Rs1600 million starting in 1970. The total inv estment of Rs16 billion or US $1 billion dollars, estimated at the time of the intervention, was divided into three large categories: 50 percent loans which India has been repaying since Operation Flood, 40 percent commodity aid from the EEC, and 10 percent investment of the NDDB's own resources (Tikku 2003) The World Bank's ex-post facto evaluation of Operation Flood reported a higher total project cost: US$2.7 billion, at 1996 dollar value. This figure includes the state milk plants that were transferred or leased to the initiative. Using data from the NDDB, World Bank, and the Government of India, this report summarizes that in 1996 dollar, nearly 2 billion dollars was provided in real direct subsidies and nearly .7 billion in bank loans and credits (Candler and Kumar 1998).

In addition to the donated commodity aid and the soft loans and grants provided by multilateral institutions, bilateral financial and technical assistance from Australia, Canada, Denmark, Germany, Sweden, and the United Kingdom was provided during the early years of Operation Flood (Doornbos et al. 1990). However, correspondence with the NDDB indicates that this type of assistance was not substantial and exact values are not documented. It is also important to note that member equity and profits generated by cooperative business were also a large part of Operation Flood's financing The Indian people established creditworthy businesses and these cooperatives helped India achieve milk self-sufficiency.

The commodity aid (Table 1.2) and the financial donations were used to support the beginning stages of India's dairy industry development and were gradually phased out. Indian leaders sought to use EEC dairy surpluses to meet India's demand for milk which could not be met through domestic production alone, but to also concurrently use the aid to modernize India's dairy industry Specifically cooperative and farmer owned processing plants which would combine surplus skimmed milk powder and butter oil they had received as commodity aid with milk that had been produced by Indian farmers, procured by local dairy cooperatives, and was sold to urban consumers at the then prevailing market price. They would then sell this new recombined milk to help meet domestic demand for milk and to help finance Operation Flood.

Table 1.2. European Economic Community aid for Operation Flood, 1970-1996

	Skimmed Milk Powder (tons)	Butter Oil (tons)
Operation Flood I (July 1970-March 1981)	126,000	42,000
Operation Flood II (April 1981March 1985)	240,000	84,700
Operation Flood III (April 1985-March 1996)	75,000	25,000

Sources: Gupta 1997; Kaye 1994; Atkins 1988.

Fortunately, Indian leaders had the foresight to consider the potential dangers to domestic markets if all the excess European milk were simply dumped into India's dairy market instead of allowing this inefficiency to happen, they recognized the potential of modernizing the industry with the surpluses. As such, Operation Flood stressed reliance on local production, procurement, marketing, and selling, and used the commodities and proceeds to promote overall dairy development instead of dependence. The Indian government used the European surplus to create needed dairy supply and this helped to eliminate existing gaps in supply and demand. Once production and processing attained a certain scale there was an impetus to produce more milk for supply to the processing plants. Imported commodity aid was then phased out.

However, some scholars criticized the use of food aid for development: they argue that subsidizing Operation Flood through donations of Europe's surplus dairy products provided a disincentive for local producers to produce. According to Doornbos and Gertsch (1994), aid also skewed the market: by not allowing for a natural evolution of market forces, the aid usually ended up in favored regions or with larger producers. Yet Operation Flood demonstrated that aid is not synonymous with charity, but rather it can be channeled in such a way as to strengthen indigenous efforts, including small-scale producers. For instance, more than 70 percent of households in Operation Flood regions were marginal, landless farmers. In this context, food aid ensured that products offered for free or at extremely low prices would not over-flood the market and squeeze out local dairy farmers. The commodity financing of India's dairy development played a role in relieving the European countries of their excess dairy, but also in protecting India's dairy market

Given that Indian dairy production has continued to grow autonomously in post-Operation Flood, the dangers of dependency seem to have been avoided. In fact, as of 1976, India completely stopped commercial imports of milk and milk products— other than from 1987-1989, when prolonged droughts wrecked havoc on agriculture overall (Shah 1993). Ultimately, if the goal of aiding a nation is to end that nation's future aid needs building its economies truly is a mechanism for reaching that goal (Banerjee 1994).

On the economic front, the use of food aid as a development investment was an anti-inflationary decision because it helped to ensure market stabilization and to limit fluctuations in prices since there was a constant buffer stock (Banerjee 1994). Several additional sound economic principles also helped to engender success. For instance, milk was recognized as a marketable commodity due to long-standing market demand and markets were established in urban areas to give confidence to the suppliers—dairy farmers— to increase their investment. Several examples illustrate this success India's larger economic reforms in 1991 and the 1994 General Agreement on Tariffs and Trade and World Trade Organization agreements allowed India to exploit its comparative advantage in milk production relative to production costs in the United States and the European Union–provided that Indian farmers and processing units met international hygiene standards (Scholten 1998).

Using Political Support Strategically

Economic leadership, policies, and environments are crucial, but the political ones were also important in ensuring smooth implementation of Operation Flood. Indian leaders were not only the impetus for a successful intervention, but also a link to the many institutions and policies that helped Operation Flood to succeed. Government policies supportive of dairy cooperatives enabled the industry to develop in sync with the evolving needs of dairy farmers. Prime Minister Shastri's leadership in setting-up a National Dairy Development Board, appointing Dr. Kurien - with the experience he had in setting up the AMUL cooperatives - to replicate the model nationally, and his social entrepreneurship in the overall design of Operation Flood were prerequisites to the many achievements.

The NDDB's autonomy allowed it to place producers at the forefront of decisions and create supporting entities to meet the needs of the growing cooperative movement. Overall, state interference and assistance with this project was minimal and Operation Flood exemplified the benefits of having dedicated professionals working on behalf of rural populations. Having an autonomous, dedicated body supporting dairy development was crucial, because the NDDB was able to create supporting entities to provide people, technology, veterinary services, equipment, and marketing that the cooperatives needed at an affordable price. Some of the wholly owned direct subsidiary organizations include the Indian Dairy Machinery Company, Ltd., Indian Immunologicals, and Mother Dairy (Tikku 2003).

Some scholars, such as scientist Claude Alvares (1985), have criticized the minimal state intervention aspect of the program and argue that such immunity from government scrutiny enabled corruption, conflicts of interest, and duplicitousness to infiltrate. For example, political interference by some local politicians was a barrier to successful replication; in essence, sometimes government cooperatives were supported at the expense of farmer-managed cooperatives. Despite having a well-thought-out plan and a strong programmatic design, Operation Flood faced several hiccups during the implementation of the program. Institutional integration issues, overlaps and gaps in program coverage, and competing jurisdictions sometimes meant that ultimately the cooperative scheme that was adopted was not exactly the same as the original Anand plan (Doornbos and Gertsch 1994). In some cooperatives, state control over input and output pricing existed and some state officials were appointed to management positions. This diversion from farmer-control cooperatives contributed to the poorer performance of led some cooperatives. Because the program spread vastly and quickly, to meet demand for the model, teams were created to administer and manage the establishment of state federations and district unions. In some instances, officials continued to hold onto this power even after Operation Flood instead of turning the cooperatives over to the farmers for bottom-up development. Even in these instances, while dairy plants and milk routes were developed, true development was limited a capacity building of non-elites was not prioritized (Kurien 1996).

While Operation Flood was federally sponsored and managed by semi-state institutions, it was not a government-run initiative: ownership and management of day-to-day activities and resources happened locally. This minimized political interference, turf battles, and administrative red tape. Four consecutive prime ministers supported the large-scale dairy intervention (Kaye 1988), which speaks to the durability of the cooperative movement. Another political dynamic worth noting is that the NDDB was not headquartered in New Delhi, but was located in Anand so as to help prevent the organization from turning into an ivory tower institution (Kurien 1996). The WFP's *Terminal Evaluation Report* notes the lack of political interference in the Operation Flood model, and further includes as the program's assets its quality control standards, reliable technical assistance and the multi-level structure of representative democracy within dairy marketing and processing facilities. One main lesson to be learned is that nonpolitical interventions can be successful and can enjoy the backing of executives long past their initial implementation.

Focusing on Local Methods and Markets

Aside from having adequate technology for producing, procuring, processing, and marketing milk, an appropriate approach— namely, taking the local context into account— was another prerequisite to

success. Operation Flood used existing, indigenous dairy farming techniques and was not a large imposition of foreign ideas, processes, and tools. Rather, this intervention employed ways in which to enhance local dairying or to spread the benefits to a larger number of people: it was a mechanism for production by the masses but not a switch to mass production (Patel 2007). Operation Flood promoted low-capital and low-energy intensive dairy production—labor-intensive production was important as smallholder farmers rely primarily on family and local labor. The Indian approach to dairying—using crop residues and by-products for milk production— was emphasized.

When considering dairy in India, one should know that the Indian population places an intrinsic value on milk and milk products and that milch animals have played a role in Indian tradition throughout history. Implementation of improved dairying methods required a true understanding of how to process milk so that it was suitable for and accepted by Indian farmers and consumers. Those designing Operation Flood had to be cognizant of what new approaches dairy farmers would adopt and what type of milk and milk products consumers would purchase. Dairy development, including animal husbandry practices, can become a reality only if the population buys into the methods.

Focusing on the local Indian market demands, Operation Flood advanced the industrial processing of traditional products through the cooperatives. Presently, around 95 percent of dairy is produced in India (Kurien 2004). An indigenous dairy equipment manufacturing industry has also been created and as of the late-1990s, less than 10 percent of India dairy equipment was being imported. There have been several other positive by product impacts of Operation Flood: a remarkable accumulation of indigenous expertise on topics of animal nutrition, animal health, artificial insemination, management information systems, dairy engineering, and food technology (Candler and Kumar 1998).

Another critical approach that was emphasized throughout the intervention was the local ownership of resources. Unlike most agricultural development interventions, local producers owned and controlled all of the resources. This allowed the rural population to use their initiative, insights, and energy to gain better prices as producers. As such, the roles of middle actors were eliminated and their cut of the profit stayed with the producers, allowing cooperatives to generate enough revenue to upgrade production (Kaye 1988). Historically, both the private and public sector have not proven to be equipped, trained, and incentivized to work with the poor; therefore, cooperative institutions for dairy seemed to be a way forward for the poor. Through these means, the poor circumvented bureaucratic hurdles and instead acted collaboratively to reap the benefits of modern science and technology (Kurien 1996). Operation Flood's successful balancing of external support—such as that of the NDDB— for a locally managed program prevented tyranny by the middle players and benefited millions of farmers.

5. OPERATION FLOOD: IMPACTS AND ACHIEVEMENTS

Twelve years after the end of Operation Flood, it is worth taking a moment to re-examine this large-scale intervention and determine its achievements. While the cooperative share of national production is less than 10 percent, it does account for around 70 percent of the organized market share. Operation Flood's total share of cooperatives is but a small percentage of overall milk procured and marketed in India and, therefore, the intervention's overall impacts should not be overstated although overall growth in India's dairy sector may have occurred regardless and other factors may have played an even larger role in the development of India's dairy sector, Operation Flood created a new policy environment in the dairy sector and linked rural and urban populations, introduced market orientation and technological advancements, developed extension services, and supported the growth of cooperatives in a sustainable manner.

Rural/Urban Linkages

Through a system of cooperatives, this intervention established some important urban-rural linkages, such as those in key markets of Bombay and Delhi. This linkage of rural farmers and urban consumers may not have been accomplished by an informal dairy sector. It's important to consider that the primary goal of Operation Flood was to increase the production of milk and to increase the income generated from dairying for millions of producers. Therefore, increasing one's purchasing power was a prerequisite to addressing food insecurity at the individual and household level, since malnutrition—except for in emergency situations—is often due to a lack of income, not always a lack of food availability (Jul 1988). With Operation Flood, as the number of investments in the program increased so did the number of producers, convinced as they were of the stable and profitable nature of dairy sales.

In other words, rural milk producers were gradually ensured a market through which to sell their milk and thus their confidence in the ability of dairying to serve as a source of employment and an income-generating activity increased. This idea was at the center of the Kaira District Cooperative Milk Producers' Union the foundation for Operation Flood's design.

If markets could pull production then these markets needed to be protected and guaranteed. Donated and subsidized imports were a noted threat to Indian dairying and the livelihoods of tens of millions of producers. For the Indian economy, it was important for the government to protect the Indian markets. Therefore, during Operation Flood, the government placed quantitative restrictions on dairy imports and used licensing requirements restricting new entrants as a means of regulating the private sector and. protecting cooperatives (Staal, Pratt, and Jabbar 2008b).

In India, agriculture is the main means of livelihood and income for millions of farmers, with crop production and dairying the primary and secondary activities respectively. In rural areas, Operation Flood was India's largest sustainable employment program—and it developed transportation routes and urban employment in dairy plants as well. A study of three districts—Bikaner in Rajasthan, Periyar in Tamil Nadu, and Sabarkantha in Gujarat—indicated that in cooperative villages, the average household income from all income sources are higher, the average income from milk is generally larger, and the average level of employment is higher (Singh and Das 1984).

Smallholder dairy farmers brought in more than 60 percent of milk procured by cooperatives and these producers in turn were paid approximately Rs 34,000 million (Aneja and Puri 1997). For poorer farmers, dairy may be more significant. Atkins (1989), for example, argues that Operation Flood had been India's most promising large-scale, wealth-generating rural development program. Achaya and Huria (1986a) assert that poverty levels have declined and that drops in rural poverty were more pronounced than in urban poverty—Operation Flood, they say, is one of the critical reasons that poverty in India lowered from 49 percent to 38 percent. Jul (1988) points out that increased productivity in the dairy industry had also enhanced economic development. Specifically, the development of a national milk grid, village cooperatives and district unions increased employment throughout India. Staff was hired to run the thousands of dairy cooperative societies that had emerged and provide animal husbandry services, including veterinary care and artificial insemination. As of the early twenty-first century, dairy

cooperatives employed 11 million households; Indian households benefited from cooperatives they owned, cooperatives that sold animal feed to them, veterinary coverage for dairy animals, and cooperatives which purchased their milk, for example (Kurien 2004).

Dairying Breakthroughs

Breakthroughs in the methods for improving the production, processing, procurement and marketing of dairy were substantial. For example, technological advances in drying, storage, and transportation partially alleviated fluctuations in production levels between the lean and flush seasons. Table 1.3 provides detailed information about the overall increases in India's production levels and per capita availability of milk between 1950 and 2008. It is important to stress that even at the end of Operation Flood, the cooperative share of dairying still accounted for only about 6-7 percent of India's overall milk production. Not much has changed over the years and the informal sector continues to share more than 80 percent of the total market for milk and milk products (Staal, Pratt, and Jabbar 2008b). However, milch animals' productivity tripled between 1970 and the early-1990s, and total milk production in Operation Flood areas increased from 42 million liters per day to 67 million liters per day between 1988-89 and 1995-96 (Shukla and Brahmankar 1999, Aneja 1994a).

Regarding production capacity, about 726 tons of milk powder could be produced per day (Banerjee 1994). Some counter that production in India hasn't had a major breakthrough seasonality of milk production still creates irregular supplies, and that Operation Flood perpetuated traditional regional differences in Indian dairying. If this were true, Operation Flood could not be defended as an intervention which addressed the internal limitations of the dairy sector in India. However, using an econometric approach (1987), Mergos and Slade determined the influence of Operation Flood on milk production in a group of villages in Madhya Pradesh and unambiguously rejected the hypothesis that the intervention did not result in an increase in milk production. Their studies revealed that the project can be credited with increasing milk output in those areas by 17.4 percent in a five-year period. In sum, exposing a particular household to the project increased the probability of that household's milk output would rise substantially. Furthermore, in the eyes of many beneficiaries, the fact that Operation Flood also created opportunities for the expansion of marketing and processing services justified its continuous aid worthiness (Baviskar and Terhal 1990, 341).

This study is available as a World Bank discussion paper and used a cross-sectional comparison using project and control samples. The authors did not use baseline data on dairy activities of the sampled farmers. Therefore, the potential for selection biases does exist within this study. Other studies referenced in this paper may be stronger given their larger data sets and more rounds of surveying.

Table 1.3. Production and per capita availability of milk in India, 1950-2008

Years	Production (Million Tons)	Per Capita Availability (Grams/Day)
1950	17	132
1960	20	127
1968	21	113
1973	23	111
1980	32	128
1990-91	54	182
1995-96	66	207
2000-01	81	230
2005-06	97	241
2006-07	101	246
2007-08	105	252

Source: Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, Government of India, NDDB website, accessed 9/15/09; Gupta 1997; Nair 1985.

Milk processing also advanced during Operation Flood. As the sheer amount of processed goods increased, so did the amount of equipment, such as silos, pasteurizers, rail and road storage tanks, and refrigerators that conformed to international standards. Milk testers were designed to weigh, test, and record milk production levels. The capacity for processing milk reached about 15.6 million liters per day whereas the capacity for chilling milk reached 6.5 million liters per day (Banerjee 1994). Processing increases were not always uniform, however. For example, in December 1980, raw milk processing in four OF I dairies based in Gujarat was at full capacity (1.6 million liters/day), but it was below capacity in other OF facilities (Terhal 1983). Throughout Operation Flood, the NDDB devised new storage methods were devised and milk was converted from a highly perishable commodity into one that can be stored and traded nationwide. As reported by Kurien (1996), the NDDB developed and owned a fleet of rail milk tankers which they hired out to cooperatives; this was to ensure transportation of milk from areas of excess to those in deficit, diminishing seasonal production and consumption disparities. To link village producers and city-based consumers, a network was established that included trucks, chilling plants, refrigerated vans, railway wagons, and processing plants.

As for milk procurement, a comparison of the years 1988-89 and 1995-96, shows an increase in milk procurement in Operation Flood areas from 28 million liters per day to 35 million liters per day (Shukla and Brahmankar 1999). Baviskar and Terhal (1990) have rightfully stated, however, that milk procurement increases among dairy cooperatives don't indicate that milk-animal productivity or even overall milk productivity has increased. They further note that any overall increases in milk production that did occur were not necessarily attributable to Operation Flood. Toward the end of Operation Flood, average milk procurement was at about 12.3 million kg per day with 8.2 of the 12.3 marketed as liquid milk, and the rest turned into milk powder, butter, and cheese.

Interestingly, it is neither the national milk grid nor the transportation advances alone that have changed the way milk is being marketed in India—even the packaging had been transformed. Most of the milk is now packaged in plastic sachets and the machines that make the small sachets are produced indigenously. Also, a major innovation by the NDDB was the development of in the bulk vending of milk—an indigenous system using gravity milk feeding and a syphon technique to provide consistent quantities of milk. Retail sales resulting from the Operation Flood cooperatives increased throughout its various phases. As of 1970, about only 1 million liters per day were sold, but as OF II was picking up, sales increased to about 5 million liters per day and were nearly 10 million liters per day toward the end of the twentieth century (Candler and Kumar 1998). In urban areas alone, the amount of milk marketed by cooperatives increased more than 50 times between 1970-71 and 1990-91 (Fulton and Bhargava 1994). At

the end of Operation Flood, the dairy cooperatives were meeting 60 percent of urban milk demand and were 22 percent of all milk marketed in India overall (Candler and Kumar 1998). Table 1.4 provides summary data for procurement and marketing advances throughout Operation Flood.

Table 1.4. Peak procurement and peak marketing of Operation Flood dairying

Phase of Intervention	Peak Procurement (liters per day)	Peak Marketing (liters per day)
Operation Flood I (1970-81)	3.4 million	2.8 million
Operation Flood II (1981-85)	7.9 million	5.0 million
Operation Flood III (1985-96)	1.3 million	9.4 million

Source: Dairy India 1997.

In isolation, these technological breakthroughs would have been largely irrelevant, but since a year-round market also supported the producers, the technology was put into practice and Operation Flood—through direct and indirect pathways— positively affected food security in India. To its critics, however, the centralization of dairy has led to homogenization and hence failed to take into account the unique needs, challenges, and opportunities found throughout India (George 1990). Again, only a small proportion of the dairy market is dominated by cooperatives, and little evidence indicates that cooperatives have driven India's dairy growth ; however, according to one study, data suggests that dairy co-operatives have impacted the supply of milk because they have promoted the introduction of new technology and in particular, enhanced dairy cattle (Staal, Pratt and Jabbar 2008b) India's growth in dairying in absolute numbers is quite remarkable but what stands out even more is that India's population was growing at the same time; taking this context into account truly magnifies how drastic the increases in per capita availability are. Based on all the evidence and expert opinions, it can be surmised that this large-scale ambitious and innovative development program remains controversial among the scholars. Yet while it is true that all of the increases in the production, procurement, processing and marketing of milk cannot be attributed to Operation Flood, this intervention was instrumental in setting up a new approach to dairying in India. Unfortunately, a review of the literature reveals a dearth of microstudies on the subject as well as a serious lack of independent data collection and impact evaluation. Further data collection and analysis on both microlevel and macrolevel impacts would help to clarify Operation Flood's impacts on poverty and food security.

Improved Nutritional Intake

With increased incomes from dairy sales, smallholder dairy farmers could spend more on nutritious foods. Overall growth in Indians' daily consumption of milk before Operation Flood and throughout the intervention is presented in Table 1.5. Average per capita consumption of dairy rose from about 132 grams per day in 1951 to around 200 grams by the end of Operation Flood (Aneja 1994a, Bhide and Chaudhari 1997). Total per capita consumption of milk by dairy farmers increased in Operation Flood areas from 290 grams per day in 1988-89 to 339 grams day in 1995-96 at the aggregate level (Shukla and Brahmankar 1999). Village-level studies have revealed that consumption of milk and other food stuffs was substantially higher in rural Operation Flood areas compared to rural non-Operation Flood areas, an indication that this program improved the dietary diversity and nutritional status of its participants.

Importantly, milk is a primary source of animal protein for Indians; hence, if production increases reach a larger number of people in a more consistent manner, it stands to reason that their protein levels will improve. According to Mergos and Slade's studies (1987), food expenditure was positively correlated with Operation Flood's introduction into certain areas of India, and at least in the area studied,

it had a positive impact on the caloric and protein levels of the rural population chaya and Huria's analysis (1986, a) of Operation Flood noted dietary improvements in higher levels of vitamin A and C intake, in addition to caloric and protein intake. In addition, according to Singh and Das' microlevel studies in the three districts of Bikaner, Periyar, and Sabarkantha and in all cooperative villages, nutritionally vulnerable populations received a higher percentage share of milk than the percentage share in the total village populations. Furthermore, looking at vulnerable subcategories, per capita protein intake and higher consumption levels were seen in expectant and nursing mothers as well as children two to six years old (Singh and Das 1984). Of the milk produced in the OF areas, about 65 percent was traded, and 35 percent was consumed by the producing household (Bhide and Chaudhari 1997). This is significant because a poor persons' nutritional status can be dramatically improved by consuming even marginal amounts of milk; dairy consumption is vital, especially for children and mothers who are nursing or expectant. Additionally, in most developing countries, soil fertility is a major agricultural limitation, but manure from dairy cows provides organic matter and nutrients. This can augment a smallholder's crop yields for farmers with limited access to chemical fertilizer (Staal, Pratt, and Jabbar 2008b).

Table 1.5. Growth of daily consumption of milk in India, 1951-1996

Years	Daily Consumption (Avg Grams/Day)
1950-1951	124
1960-1961	124
1973-1974	112
1981-1982	136
1991-1992	178
1995-1996	197

Source: Government of India. Department of Animal Husbandry Development and Fisheries, Ministry of Agriculture, various sources.

Development of Extension Services The development of extension services and their accompanying advances in technology were broad and important. One goal of these services was to improve overall cattle health and nutrition, thus ensuring more productive dairy cattle, and as such Operation Flood brought about new standards for livestock. Some of the ways in which Operation Flood promoted technological advances included artificial inseminations, crossbreeding, vaccinations, improvements in cattle feeds, urea treatment of straw (to improve digestibility of straw), and the use of fans and sprinklers to cool cows in the summer and biogas plants for production and processing (Candler and Kumar 1998).

As market competition expanded, the producer price of milk shifted upwards, resulting in an increased use of concentrate feed and a higher demand for superior animal husbandry, such as veterinary services and artificial insemination (Mergos and Slade 1987). Artificial insemination, a big change for rural producers, grew throughout India as a result of Operation Flood: about 18 million artificial inseminations were performed annually at the village-level by paraprofessionals, who were supported by trained professionals running semen banks and stud stations (Kurien 1996). Through Operation Flood, an additional 16,280 dairy cooperative societies were involved in artificial insemination (Gupta 1997). Although the number of artificial inseminations increased, member households using this service only marginally increased between 1988 and 1996—contributing factors to this small increase may have been an underdeveloped infrastructure and extension services (Shukla and Brahmankar 1999). According to the Government of India (2008), growth in artificial insemination continued after Operation Flood: between 1999-2000 and 2006-07, artificial inseminations increased from 20 million to 34 million (See Annex 1). Extension activities, such as education in cattle breeding, meetings for knowledge sharing and tours of dairy plants were and still remain an essential component of milk cooperatives. Important to note is that

women play a vital role in caring for the milch animals and therefore these extension services significantly impact women's knowledge confidence and societal status.

Also, to increase milk production without increasing the overall cattle populations, it was important to increase the productivity of milch animals. Therefore, a notable, and also contentious, aspect of Operation Flood was to crossbreed exotic cows with indigenous cows and to improve the productivity of buffaloes. With crossbred cows, reproductive efficiency improved. During Operation Flood, 100 indigenous cows provided only about 150 kg of milk a day, whereas 100 crossbred cows provided about 400 kg per day (Guha 1980). While crossbreeding increased the breeding capacity and milk yield of cows, critics argue that higher feed requirements and an inability of these breeds to adapt to Indian conditions led to India's slow adoption of it. For example, Atkins (1988) argues that although using domestic cattle would not have been as efficient as crossbred cattle, the crossbred animals suffered heat stress, were disease-prone, and required greater feed inputs. In addition, crossbreeding is thought to privilege larger farmers, eliminate indigenous Indian animals, and increase reliance on advanced feed. Mergos and Slade (1987) respond to critical opinions by showing that India was not overly dependent on crossbred cattle and new technologies. Achaya and Huria (1986a, 1986b) argue that the nearly doubling of milk production after Operation Flood's inception should have put an end to the speculation of problems associated with adopting crossbreeding. The reality is that the theoretical objections are faulty: landless milk producers did acquire crossbred animals, only a small percentage of Operation Flood's strategy was focused on crossbred animals and the Indian government also had a strategy for improving productivity through crossbreeding and cattle upgrading, without exterminating well-known Indian cattle breeds. Therefore, even if crossbreeding has problems, harsh criticisms are indeed exaggerative.

Societal Development

Operation Flood had significantly altered rural India in other positive ways, external to the dairy and food security realms. The intervention required an effective infrastructure and hence improved the existing one by setting up about 175 dairy plants, 45 cattle feed plants, about 15,000 centers for artificial insemination, 100 rail milk tankers and more than 1,500 road milk tankers (Tikku 2003). Accessing major cities in India needed to be easier for those in the dairy industry so transportation systems, such as railways and roads, were improved. As a result of Operation Flood, an increase in demand for access between rural and urban areas occurred and as this need was demonstrated, roads were constructed (Candler and Kumar 1998). Furthermore, all population sectors participated in the intervention: for example, at the milk collection centers, men and women lined up together. In this way, Operation Flood helped to eliminate social barriers as both men and women milked their animals and marketed their milk at the cooperative twice daily. Community development was enhanced as gender differences and social class divisions were broken down (FAO 1978). Finally, discussions could be heard among beneficiaries as they shared ideas of sanitation and cleanliness, which was an increased desire by many. Despite these broad social achievements, the impacts of Operation Flood were not felt equally by all: one's gender caste class and landownership status played a role in how one was impacted by these changes in dairy farming. Growth in the smallholder livestock sector, according to Mellor (2003), has a direct positive contribution on poverty reduction, employment growth, and eventually, demand for employment in the rural nonfarm sectors "In sharp contrast to crop income the Gini coefficient for dairy production, which is very important to the poor in India because of its labor intensity, is 0.11. That is an extraordinarily low Gini coefficient. And, the Gini coefficient for off-farm work in rural areas is a still low 0.22" (Mellor 1999, 3). Therefore, investments in dairy over investments in crop production seem to promote income equality (Birthal, Taneja, and Thorpe 2006). Some scholars, such as Verhagen (1990), argue that poor and marginalized farmers (for example, the landless) were underrepresented and that barriers, such as a lack of access to credit and fodder, prevented many from accruing potential program benefits from Operation Flood. He argues that in the Kheda district, poverty and inequality continued to increase in the late 70s and early 80s despite the presence of the Anand cooperatives. However, even if this charge is true, it is also true that it was not Operation Flood's primary aim to improve income distribution by reaching out to

small, marginal farmers and landless milk producers. Nevertheless, by promoting universal access to a strong milk market, balanced cattle feed, animal healthcare, and artificial insemination service, it stands to reason that this intervention would have some positive impact on income distribution between the rich and the poor. Empirical evidence shows that Operation Flood did not merely help rich farmers get their milk to urban consumers, but it also directly engaged poor people. Atkins noted that in 1984, 72 percent of cooperative members were small and marginal farmers or operated less than 5 hectares of land, and the majority of these were also from minority castes and tribes Landless farmers' incomes doubled after the organization of milk collection through cooperatives (FAO Information Division 1978). Thirunavukkarasu Prabaharan and Ramasamy's later studies (1991) showed that among landless households milk production's contribution to income generation was considerable and confirmed a greater potential for economically weaker households to use milk production to increase their income levels. Studies conducted by Singh and Das (1984) also indicate that the landless fare better in cooperative villages for milk yield per milch animal. The average profit in 1985-86 for a year's supply of milk was Rs 1 845 with an additional Rs 400 in bonuses. Simply put, dairy farming can minimize poverty and even enhance incomes for poor households.

Additionally, the impact of livestock-based programs—such as Operation Flood—on women can vary. On the one hand, livestock interventions can be an opportunity to generate income, but it also can increase workloads without truly altering women's level of control over resources. Were the cooperatives established under Operation Flood truly beneficial to women's health employment, and income? Given that poverty is gendered in myriad ways, did Operation Flood increase or decrease segregation? Why were women incorporated in larger numbers in the later stages of the intervention? In India women's workloads tend to be quite intense as they handle housework and much of the agricultural chores, especially in dairying. Despite having double and triple work burdens, societal structures ensure that they maintain subordinate roles. But although gender disparities are clearly oppressive, it is overly simplistic to analyze in isolation the role that gender plays in Operation Flood.

What is certain is that the way in which gender intersects with one's class sexual orientation and race is a major determinant for how one's life is lived. For example, in dairying, poorer women do not keep the milk within their households— it mainly goes to the males of the house; however, this scenario may or may not be true for women who are better off socioeconomically. Some critics of Operation Flood initially argued that increased demand to procure milk twice daily for the cooperative would force women to use agricultural resources for fodder crops instead of food crops—with the result that milk would become an inaccessible luxury for poor women. Another concern was the potential male opposition to the female cooperatives increasing in the countryside. At the end of the day, these scholars argue the case that, even if Operation Flood helps poor women farmers, broader gender disparities within the dairy industry, such as a division of labor and women stereotypes remain intact (Sharma and Vanjani 1993).

Although some of these criticisms may be valid, and while it is true that Operation Flood cannot dismantle centuries-old patriarchal traditions and structures, data indicate that women did benefit from this intervention. Studies by Thirunavukkarasu, Prabaharan, and Ramasamy (1991) illustrate that employment rates, including those of female workers, were higher among Operation Flood beneficiaries than among non-beneficiaries. Overall employment in milk production was markedly higher in cooperative villages than in control villages and in the former, female family members contributed more. In fact, when comparing landless households and landowning households in six different villages, the share of female labor out of total labor for dairying was bigger in the landless households (Singh and Das 1984). In other words, Operation Flood uniquely increased employment for landless female dairy farmers in relation to all female dairy farmers. Equally important, Terhal and Doornbos (1983) note that for women who were already engaged in dairy prior to Operation Flood, it is highly unlikely that their workload increased; however, for women that took up dairying because of Operation Flood, their workload has increased. On a related note, extension activities that were essential components of the milk cooperatives— such as education in cattle breeding, meetings for knowledge sharing and tours of dairy plants—have increasingly engaged women, improving their dairy know-how, self-assurance, and in turn, social status . Training sessions on a wide variety of dairying topics have increased women's participation

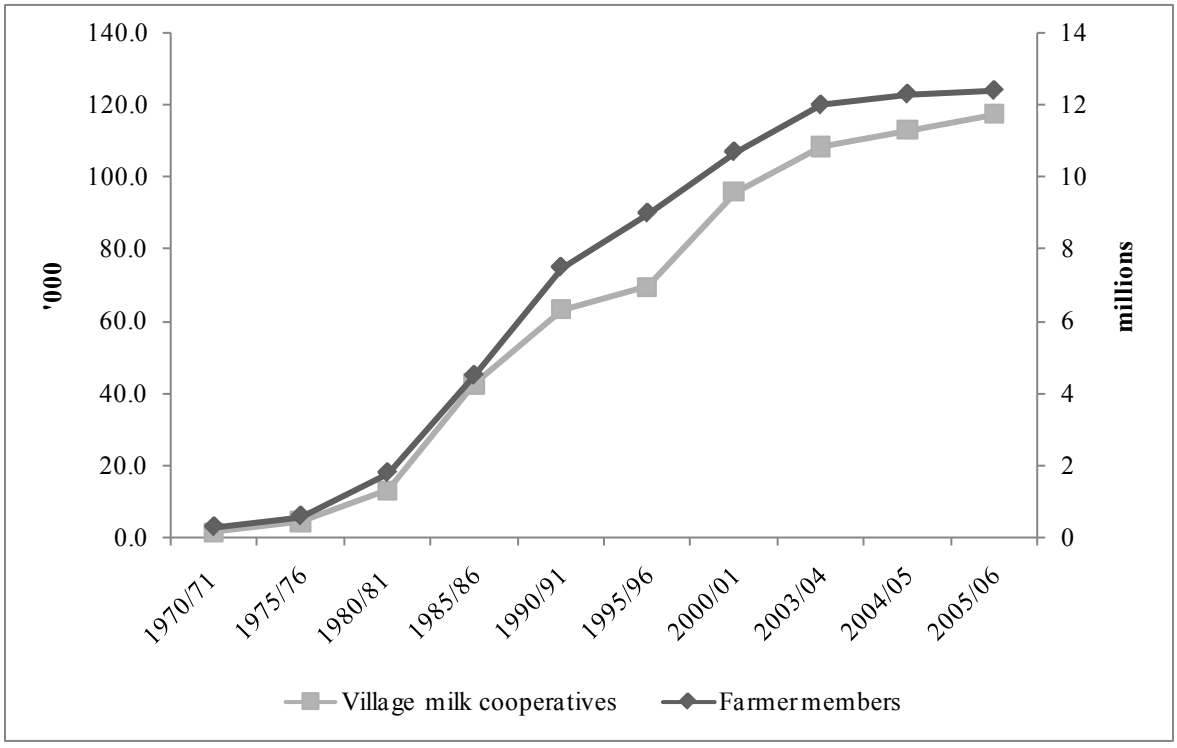
and built confidence in their participation in dairy development. Women are not only increasingly depositing milk in the cooperatives, but also seeing the benefits of higher prices, information sharing, and access to healthcare for livestock. Women now make up over 25 percent of cooperative members and more than 2,700 all-women cooperatives are functioning. However, women continue to play a small role in running the dairy cooperative societies: less than 3 percent of board members are women (Nehru 2005; NDDB 2008).

6. OPERATION FLOOD: A SUSTAINABLE INTERVENTION

The consistently large number of members, volumes of milk produced annually by cooperatives, and the increasing access to larger quantities and higher-quality milk products provide evidence of this intervention's sustainability. Since the 1970s, total output of milk and milk products has continuously risen faster than crop production. Between 1970-71 and 1990-91, village milk producers' cooperatives increased almost 40 times and the number of producers with cooperative membership increased almost 27 times in the same time period (Fulton and Bhargava 1994). The NDDB, currently chaired by Amrita Patel, continues to expand India's dairy development, and the program's cooperative way of dairying gives millions of rural producers the opportunity to use dairying as a way out of poverty and hunger.

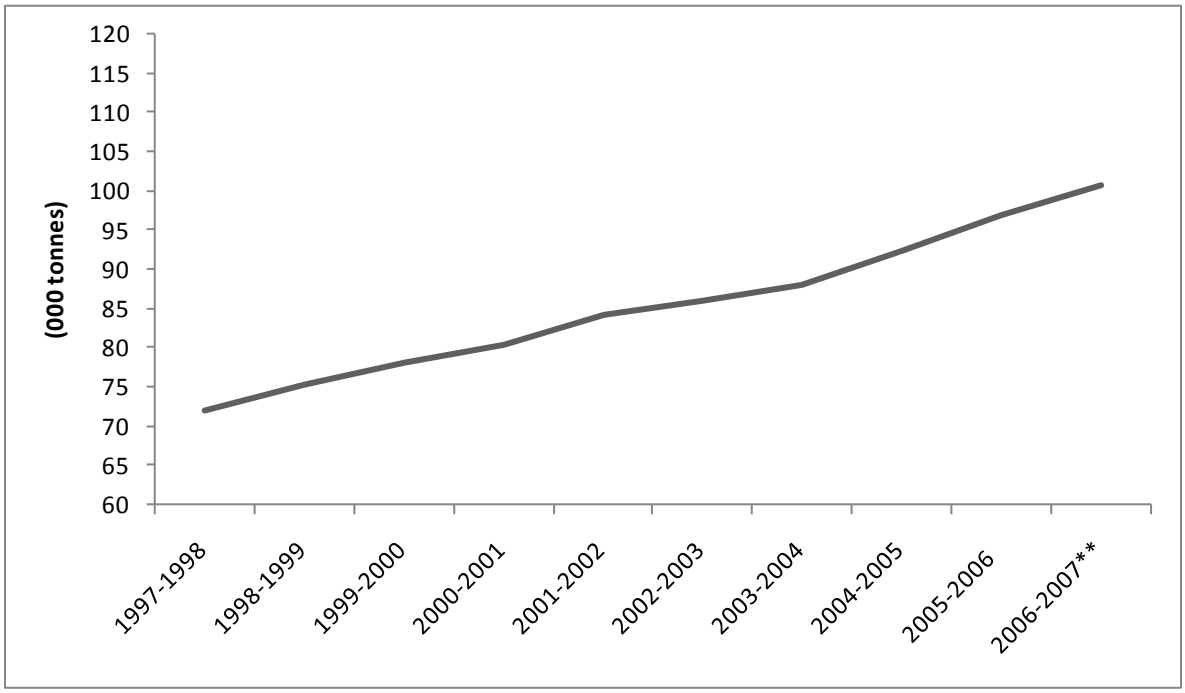
The sustainability of dairy cooperatives is revealed: in more than a decade after Operation Flood ended, the dairy cooperative network continues to grow, as does production, marketing and innovation in the milk sector: presently more than 13 million Indian farmers, including 3.7 million women farmers, belong to India's thousands of village-level dairy cooperatives (NDDB 2009). The dairy industry overall and cooperatives in particular, even after Operation Flood, has also been impressive. In fact, the average daily procurement of dairy has reached 21.5 million liters, and the annual production of dairy has reached more than 100 million tons. Furthermore, the daily per capita availability of milk is near 250 grams (Government of India 2008). Cooperative membership has continually grown between 1970 and 2008 (Figure 1.5) and has been accompanied by overall growth in India's milk production (Figure 1.6).

Figure 1.5. Growth in India's dairy cooperatives, 1970-2006



Source: Aneja 1994a; National Dairy Development Dairy Board 2007; National Development Dairy Board 2009.

Figure 1.6. India's milk production since Operation Flood, 1995-2008



Source: Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, Government of India, NDDB website, accessed 9/15/09.

Operation Flood's financial sustainability can be measured in various ways, including its rate of return, reliance on subsidies, and the durability of the business model. A cost-benefit analysis of dairying interventions reveals that this is a good sector of the economy not only for employment creation, but also for investment purposes. Investing one rupee into the dairy sector might spawn three rupees worth of employment (Shah 2000). Punjab Agricultural University completed a cost of milk production study in two milksheds and testified that in 1994-95, the average gross revenue was 9.30 Rs/liter, with a gross margin of 3.61 Rs/liter and a 33 percent net return (3.06 Rs/liter). The study included labor, capital, and land costs. The rate of return was high (45 percent) and the payback periods was low (25 years) (Candler and Kumar 1998).

To what extent was Operation Flood dependent on the considerable amount of foreign aid and how did this affect the overall sustainability of the intervention? The funding of Operation Flood and the debates surrounding the use of food aid for development were already covered in this paper. But in the context of sustainability, the subsidies point must be brought up again, given the large role food aid plays in this program. After a thorough review of the literature, it appears that the total public sector cost could be determined by finding the sum of the value of donated commodities, international aid, and government investments. All of these costs are detailed in Table 1.2 and they are the most common cost references throughout published materials about Operation Flood. During Operation Flood, donated commodities were marketed to dairies at the then-prevailing market rates, and the funds generated were used to set up cooperatives and other parts of the program. Doornbos (1987) argued that the difference between the price rural milk producers were willing to accept as payment from the cooperatives and the price urban consumers were willing to pay were too small to cover the various expenses associated with the processing and marketing of milk Therefore without commodity aid India's dairy industry would have been confronted with an unpleasant adjustment process. Atkins countered that between1982-83 and 1984-85 India imported 1.2 million tons of whole milk representing 17.7 percent of Operation Flood's total throughput in the same period. Needless to say, food subsidies were an integral part of Operation Flood in

all three stages, but the monetization of donated dairy commodities only partially financed this program. Member equity and reserves created with the income from member businesses with cooperatives also financially supported this intervention and ensured that the ultimate objective—self-sufficiency in milk production, not union and federation financial self-sufficiency—was obtained.

Operation Flood is to be commended as an approach that applied solid market and economic principles, starting with basic supply and demand fundamentals. The architects of the program continuously analyzed the rising demand for livestock in India, and devised a dairying program to supply dairy and dairy products to meet the new demand. In addition, the initial phase determined the economic viability of using dairy food aid to help jumpstart the reorganization of domestic dairying. Cooperatives were established with market incentives and infrastructural development, and economies of scale were emphasized in Operation Flood's design. Lastly Operation Flood focused on ensuring efficiency in supply-chain management, quality control by cooperatives, and effective markets for both inputs and services.

Environmental sustainability of dairy development, and specifically Operation Flood, should also be analyzed. Some of the questions that need to be answered focus on how land was used, how the intervention affects biodiversity, how climate change determines the life of the intervention, and what the other negative externalities are. Unfortunately, the environmental effects of Operation Flood have not been closely analyzed. However, one of the reasons that this intervention was brought about was in response to mid-twentieth century rapid urbanization in India. The lack of a reliable market for dairy was encouraging city dwellers to bring cattle into the city. This move not only created a nuisance, but also generated health hazards and environmental harms. As the cattle population was increasing in metropolitan areas, it also required that feed and fodder be brought into the city, which added to overall production costs. Anecdotal evidence points to the fact that the rural production of milk may have helped to get the cattle out of major cities, which in turn improved the environments of urban dwellers. The extent to which this has actually happened is unclear since many of these animal owners were reportedly milk dealers without plans of becoming farmers. (Jul 1988).

Another environmental benefit of traditional Indian dairy production (emphasized under Operation Flood) is that the cattle feed on crop residues and by-products and provide fertilizer to replenish the soil. Policies and strategies were implemented for all aspects of dairy development, including devoting resources to animals and their feed, health coverage, and breeding so as to reinforce the natural symbiotic relationship between humans and animals. Animal dung production provides organic manure, which helps to maintain soil fertility as well as provide fuel used by farm households for food preparation. Organic manure also helps in mitigating micronutrient deficiencies, which can be severe in areas of intensive irrigation and cultivation and in ensuring greater efficiency in inputs and savings from more costly and toxic chemical fertilizers (Patel 1993). Despite the fact that some worry about the trade-off in the production of crops at the expense of livestock-based food production, these two activities can be complementary: crops and crop residues provide feed for the animals while the animals provide manure and animal traction, which improves soil fertility (Steinfeld 2003). Operation Flood's approach to supporting indigenous, rather than Western, dairying was sustainable.

Critics of dairy development sometimes argue that dairying may adversely affect other agricultural developments, such as grain production, by changing the incentives for production or by reallocating land usage. However, claims about the negative ecological externalities from Operation Flood have been difficult to substantiate (Mergos and Slade 1987). A comprehensive assessment of ecological damage from the technological mechanization of dairy processes and other aspects of Operation Flood has not been conducted. Given that milk production in India is based on crop residues, it is unlikely that a dairy initiative resulted in competition between animals and humans.

Finally, reviewing how supportive the community and policymakers were of Operation Flood—whether or not it was a source of conflict in India, how non-beneficiary groups felt about the program, and how well the program adapted to constantly fluctuating external influences—will demonstrate its social and political sustainability. Given that this was a federally sponsored, but not federally dependent, intervention, it is interesting to note that this program had the backing of at least four different prime

ministers. Although local politics may have interfered with Operation Flood's cooperatives in some cases, overall the government was not in control of the program, but rather major aspects of it were in the hands of the local producers. Most importantly, the program appears to have impacted millions of rural milk producers and urban consumers, and the cooperatives and innovations that took place throughout it also seemed to raise awareness about how powerful collective action can be. Petty political differences were minimized and a spirit of cohesion was strengthened by the cooperatives' organizational structure. If such a cohesive spirit is fostered and can overcome the caste and class hierarchies that are so deeply embedded in Indian society, then rural development should be greatly enhanced now and in the future (Singh and Das 1984). In the end, Operation Flood followed a sustainable approach as strong linkages were made within the communities among the villagers from the very beginning; human resource investments of this type are vital if development initiatives are to be successful.

While the cooperative movement has steadily increased over the last several decades in India, its role in the dairy sector could diminish if certain challenges are not addressed. Cooperatives, protected for a long time, have faced challenges from the private sector since the economic liberalization of the early-1990s. For example, licensing restrictions, which affects the competition faced by cooperatives, have fluctuated over time. Governmental interference in cooperatives, a lack of strong member equity, inefficiencies and diseconomies resulting from the three-tiered structure, and a lack of professionalism among cooperative managers all present challenges and opportunities for the continued growth of the dairy cooperative movement. While the program itself follows a sustainable model, the long-term sustainability of the cooperative way of dairying in India is unknown. Various political, social, environmental, and economical factors will determine the future of cooperatives and dairying more broadly.

7. LESSONS LEARNED FROM OPERATION FLOOD

Operation Flood was a success: it met its end goal to establish the foundation for an enduring and durable cooperative dairy sector that in turn would ensure India's long-term self-reliance in milk with maximum benefits to dairy producers. Operation Flood successfully set up a stable, remunerative market for producers, who continued to invest in expanded production and improved productivity to meet growing demands for dairy. Some of the underlying principles of Operation Flood are applicable to similar interventions in other settings or with other commodities in India. For example, the design and implementation, the positives and negatives of the approach, as well as the myriad ways in which it generated impact, must be analyzed if the program is to be replicated. Imitations have already been spawned. In India alone, the Anand cooperative model is being replicated for other products, including oilseeds, trees, rural electricity, and fish (Shah 1996). The model is also being followed in other Asian nations, such as Sri Lanka, China, and the Philippines (Ali and Bhargava 1998). World Bank President Robert Zoellick recently announced that the World Bank will try to apply some of these best practices in Africa: for example, applying the low-input and low-output Anand model in Tanzania and Uganda. Although the list is not exhaustive, the following are many of the imperative lessons to be learned from Operation Flood.

Use Aid for Development

Up until Operation Flood and even in the twenty-first century, food aid has been used primarily for humanitarian purposes. However, Operation Flood used donated commodities to produce dairy products for prime markets and to generate funding to finance the creation of a dairy cooperative infrastructure. This system provides hope that food aid can be used to generate increased levels of domestic production. In addition to this straight-forward lesson, a related and more subtle message is the importance of a longer -term perspective. The foresight of several leaders enabled them to see what could happen if new avenues for dairy development were not pursued: mass quantities of cheap dairy imports were avoided as they would have tanked the local markets in India. This strategy of using food aid as a development investment was also an anti-inflationary economic measure that helped to ensure market stabilization and limit fluctuations in prices.

Invest in Local Markets

Economic leadership, policies, and institutions created the enabling environment for Operation Flood's successful implementation. From the outset, the intervention recognized that commodity production in the rural areas needs a strong marketing channel and the overall programmatic design therefore focused on both aspects. For years, market demand had shown that milk was a highly marketable commodity in India—urban markets were established to give dairy farmers the confidence to increase their investment. Operation Flood tackled the phenomenon of adverse selection—meaning, when access to different information leads to poor market choices— with information and incentives (Klitgaard 1997). Starting with basic supply and demand fundamentals, architects of Operation Flood continuously analyzed how the demand for livestock products was rising and devised a dairying program to supply products to meet this demand. Ultimately, the intervention used market incentives and infrastructural development to establish a successful new businesses model: cooperatives. Economies of scale, a proven economic principle of how costs are minimized as production levels are increased, were also emphasized in the design of Operation Flood. A concept behind this dairy intervention that should be learned: production can be increased by following market pull and restricting key imports so as not to disrupt domestic markets.

Support Collective Action

Cooperatives and the various innovations that took place throughout Operation Flood also seemed to raise awareness of how powerful collective action can be. Petty political differences were minimized, and a spirit of cohesion was strengthened by the cooperatives' organizational structure. Local ownership—dairy producers' control and ownership of the resources throughout the organizational structure—is partly what allowed for this grassroots mobilization to occur. Human resource investments, such as the way in which Operation Flood promoted involvement of villagers and community ownership and management of cooperatives, are vital if development initiatives are to be successful.

Adopt Complimentary Crop and Livestock Methods

Livestock convert useless crop residues and by-products into milk without increasing pressures on the land. Therefore, Operation Flood has shown that significant livestock investments can be made without interfering with land and resource demands for crop production. Milk production was highly integrated into farming and it enabled a virtuous cycle between the dairy system and farming. This method is an environmentally sustainable use of energy and nutrients.

Envision Creative Structures

The NDDB, through the Operation Flood program, revolutionized the way in which the dairy industry was perceived and organized. It concentrated on a single primary product and employed a vertically integrated, compact value chain approach encompassing every aspect of the chain from primary producer to final consumer. Horizontal integration by bringing inputs, extensions, and services all under the same program was also vital, and helped to ensure that the benefits of economies of scale were available and directly accessible for each producer. The cooperative infrastructure, significantly expanded and strengthened under this program, made adoption and use of products and processes easier for all. For example, a strong linkage between milk production enhancement and milk procurement agencies was established. Efficiency in the overall organization of milk collection, policymaking, concentrates of cattle feed, and other aspects were prioritized.

Invest in Evaluations

Analyzing Operation Flood's impact is difficult because of the numerous problems inherent in the program data and evaluations. A lack of data, biased evaluations, and methodological flaws abound when reviewing the literature. For example, George stated early on that since milk production in Indian dairy comes solely from buffaloes and cows and data on daily milk yields from these animals were missing, it was impossible to determine exactly which farmers could participate in Operation Flood (Terhal and Doornbos 1983).

Nevertheless, the WFP's *Terminal Evaluation Report* on OF I positively concluded that OF I was a successful example of dairy development and in particular of how to effectively use food aid and technical assistance for development purposes (FAO 1981). This evaluation effort was criticized, however, for an apparent lack of objectivity. As WFP was asked to assess the program within a month of its completion, most of the data collection was by necessity completed by the NDDB and IDC instead of an outside independent source. Reports on the impacts of the intervention also tend to be limited and inconsistent. One evaluation was completed by a research team based in Bombay, which concluded that OF I represented a successful contribution to the development of the Gujerat milk industry but fell short as a development mechanism in other areas of India (Centre for Education and Documentation 1982). Looked at another way, to what extent was success limited only to Gujarat? Doornbos (1987) also backs up the research team's claim by stating that there are strong regional differences in Operation Flood's overall performance. Additionally, while the EEC and the World Bank have predictably reported positively on Operation Flood, an EEC official published a scathing criticism of it, questioning the

impacts and sustainability of the program. Later, another article made it clear that the report was not an official EEC report and that the author did not speak on behalf of the EEC. Apparently, both the EEC and the World Bank felt positively about Operation Flood because they continued to fund the program for several decades.

While some evaluations of Operation Flood may be faulty, they do not necessarily indicate that Operation Flood also was faulty. Several recent publications— including an ex post facto evaluation by the World Bank entitled *India: The Dairy Revolution*, and two longitudinal studies by India's National Council for Applied Economic Research— more thoroughly review and report positively on the economic and social aspects of Operation Flood. However, it is true that the lack of independent meta-evaluations and inconsistencies among research methodologies for micro level impact studies make it difficult to know how much impact Operation Flood had on India's dairy development or food security. Studies have to be viewed cautiously because sample sizes may be small or varying, baseline dairy data may be missing, some causal factors may be unaccounted for, and poor research designs may influence the results (Fulton and Bhargava 1994).

What can be certain is that Operation Flood laid the foundation for a cooperative movement, owned by more than 13 million members today, and ensured these individuals a regular, remunerative return on their investments in dairy. Ultimately, this program can be considered a success story because Operation Flood was instrumental in augmenting the availability of dairy in India. Some of the factors that contributed to Operation Flood's success include collective action, extension services, an effective use of food aid, the creation of market institutions, a social entrepreneurship of leaders, the use of indigenous knowledge, and public policy adjustments. Some of the criticisms, even the extreme ones, shed light on the program's problem areas and provide guidance for future replication of this type of dairy scheme.

Other dairy and agricultural development experts can glean valuable information from these lessons. For instance, it is important that the implementation of a successful program in a new environment pay special attention to the particularities of that new environment. Local political, social, economic, and environmental dynamics will all play a role in how the intervention is replicated and how the intervention impacts the new beneficiaries. Of the Anand model, the basic objectives, structures, functions, and principles can be replicated; however, it is impossible to replicate the exact implementation because the sociopolitical desires, bureaucratic procedures, local institutions, and leadership are all location-specific and therefore require modifications to the model (Shah 1993).

For example, the Anand model was successful for dairying precisely because it provided a market for rural farmers, but the implementation of the model varied slightly because of the distance between the cooperatives and the difference in demand, which was higher in more densely populated areas. This is why all managerial and operational processes ought to be synchronized with marketing capabilities before the Operation Flood model is employed (Ali and Bhargava 1998). Marketing will not always be the way to go: Sri Lanka attempted to redesign their dairy markets based on the cooperative model and wasn't successful. The same failure is true for the dairy component of the Pakistan Livestock Project, another attempt to replicate Operation Flood (Candler and Kumar 1998). Some experts also warn dairy development enthusiasts against encouraging demand for a higher-valued good, such as milk, at the expense of providing basic nutritional needs. However, looked at another way, the production of rice and wheat to feed a population is insufficient to ensure that a population's basic needs are met—improving the purchasing power for villagers is just as vital.

The timing of an intervention can be an equally important factor in its success as, for example, the timing of Operation Flood was critical to its success and long-term political and social sustainability. Post-independent India was going through dramatic social changes and the promotion of animal husbandry complemented landholding and farming at the time. This environment meant that cooperative farming wasn't a threat, but a desired means of creating space for representative democracy to emerge at the village level (Patel 2003). In part, this intervention is also a multiplier effect of the Green Revolution, which developed the crop sector and agricultural infrastructure that laid the enabling conditions for dairy

development. For example, improvements in irrigation and fertilizer use that resulted from the Green Revolution increased a year-round availability of fodder (Staal, Pratt, and Jabbar 2008a, 2008b).

To claim that Operation Flood is a panacea for the development ills of India, or even that it is the best approach for developing a dairy industry, would be short-sighted; however, it has undeniably impacted India's rural development in a positive way Lessons from Operation Flood are vital given the recent focus on livestock products as a means of addressing protein and micronutrient deficiencies in developing countries. Fortunately, in many countries, demand for livestock products is rapidly growing, and this livestock revolution not only allows smallholder farmers to benefit economically from expanding markets but also provides their families with energy-dense calories and micronutrients. Failure to act could promote that this revolution be of such a manner to not promote poverty alleviation, enhanced nutrition and health and environmental preservation (Delgado 2003). Specifically, market-oriented milk production has proven to be a key income-generating livestock activity available to poor and marginal households. It generates a steady flow of income and also has been shown to play a role in capital accumulation among resource-poor households, which fosters their investments in education as well as other productive activities and assets. Oftentimes, women of the household are the ones accruing this income and a subsequent positive investment in child welfare and nutrition can be observed (Staal, Pratt and Jabbar 2008).

Overall, regarding the lessons gleaned from Operation Flood, the message to the world is one of guarded optimism (Scholten and Basu 2009, Hindu Business Line 2009). New challenges, such as rising competition from investor-owned firms will continue to emerge and must be addressed. However, at the end of the day, Operation Flood established a reliable, profit-generating market for smallholder farmers that engendered confidence and increased investment in the dairy sector: the result was an expansion of production and improved productivity to meet the growing demand for dairy and in turn, enhance the dietary quality of millions of Indians who could not consume greater quantities of milk and milk products.

ANNEX 1. ARTIFICIAL INSEMINATION PERFORMED BY STATE IN '000, 1991-2006

States	1991-1992	1993-1994	1995-1996	1997-1998	1999- 2000	2001- 2002	2003- 2004	2005- 2006
Andhra Pradesh	1,564	1,701	1,747	2,045	2,328	2,670	3,104	3,404
Arunachal Pradesh	3	1	2	3	-	-	-	-
Assam	127	50	-	28	35	91	109	-
Bihar	828	661	-	-	13	26	59	-
Goa	7	8	-	-	7	9	11	10
Gujarat	501	488	1,613	1,528	540	645	717	578
Haryana	713	700	654	609	475	802	935	1,422
Himachal Pradesh	263	269	335	325	412	394	419	498
Jammu & Kashmir	223	230	-	-	147	160	207	-
Karnataka	1,167	1,380	2,033	2,074	1,533	1,867	2,108	-
Kerala	1,367	1,353	1,240	1,200	3,641	1,249	1,231	-
Madhya Pradesh	349	355	305	189	265	292	398	597
Maharashtra	1,387	1,700	1,779	1,671	1,944	1,960	3,425	-
Manipur	7	8	11	12	13	15	40	-
Meghalaya	15	20	24	22	20	29	26	26
Mizoram	2	1	10	10	4	6	5	5
Nagaland	5	5	5	8	3	5	30	-
Orissa	262	319	535	1,000	478	334	497	654
Punjab	989	1,168	1,377	1,909	2,108	2,229	3,012	2,834
Rajasthan	501	583	-	-	638	638	877	1,057
Sikkim	7	1	1	2	-	-	-	-
Tamilnadu	2,274	2,524	2,573	2,682	3,147	3,235	3,102	3,287
Tripura	42	50	63	70	65	63	66	78
Uttar Pradesh	2,638	2,932	3,055	2,651	2,498	1,703	1,784	2,334
West Bengal	634	690	701	628	744	1,006	1,183	-
A & N Island	1	2	4	4	5	7	9	-
Chandigarh	9	10	10	10	10	10	8	9
D & N Haveli	1	1	1	1	-	-	-	-
Daman & Diu	0	0	0	0	-	-	-	-
Delhi	0	0	0	0	12	12	14	16
Lakshadweep	17	17	17	18	0.411	0.5	0.55	0.6
Pondicherry	87	89	90	94	89	96	80	-
Chhattisgarh					85	122	270	-
Uttaranchal					-	92	109	-
Jharkhand								
Total	15,990	17,316	18,185	18,793	21,260	19,766	23,835	16,809

Sources : Basic Animal Husbandry Statistics 1999, 2002, and 2006.
Notes: To indicate that data was not available, the symbol (-) has been used.

ANNEX 2. INDIA AGRICULTURAL AND DAIRY STATISTICS

Indicator	Statistic	Citation
Total population (billion)	1.13	Banerjee 2007
Village dwellers (percent)	70	Banerjee 2007
Agricultural population with dairy animals (million)	350	Banerjee 2007
Rural milk producers (million)	70	Banerjee 2007
Milk produced rurally (percent)	90	Banerjee 2007
Small, marginal and landless milk producer households (millions)	52	Banerjee 2007
Small, marginal and landless milk producers (percent)	75	Banerjee 2007
OF households with small and marginal farmers (percent)	72	Shah 1993
OF households of backward classes (percent)	73	Shah 1993
Dairy contribution to gross income for rural producers(percent)	25	Shah 1993
Dairy contribution to gross income for landless household (percent)	50	Shah 1993
Women members of dairy cooperatives (millions)	3.3	Patel 2007
Female dairy cooperative membership (percent)	29	Patel 2007

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