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IMPLEMENTATION COMPLETION AND RESULTS REPORT

IDA-50740

ON A

CREDIT

IN THE AMOUNT OF SDR 218.8 MILLION

(US\$ 352 MILLION EQUIVALENT)

TO THE

REPUBLIC OF INDIA

FOR A

NATIONAL DAIRY SUPPORT PROJECT

July 31, 2020

Agriculture and Food Global Practice
Sustainable Development
South Asia Region

CURRENCY EQUIVALENTS

Exchange rate effective November 29, 2019

Currency Unit = Indian Rupee (INR)

INR 71.742 = USD 1.00

USD 1.00 = INR 0.0139

SDR 1.00 = USD 1.3729

FISCAL YEAR

April 1 – March 31

Regional Vice President: Hartwig Schafer

Country Director: Junaid Kamal Ahmad

Regional Director: John A. Roome

Practice Manager: Mary Kathryn Hollifield

Task Team Leader(s): Edward William Bresnayan, Shanker Lal

ICR Main Contributor: Anna F. Roumani

**ABBREVIATIONS AND ACRONYMS**

AI	Artificial Insemination
AMCU	Automated Milk Collection Units
BCR	Borrower Completion Report
BMC	Bulk Milk Chillers
BV	Breeding Value
CF	Challenge Feeding
CPF	Country Partnership Framework
CPS	Country Partnership Strategy
DADF	Department of Animal Husbandry, Dairying and Fisheries (formerly DAHD)
DAHD	Department of Animal Husbandry and Dairying
DCS	Dairy Cooperative Society
DPC	Dairy Producer Company
EBV	Estimated Breeding Value
EFA	Economic and Financial Analysis
EIA	End Implementing Agency
EIRR	Economic Internal Rate of Return
ERP	Enterprise Resource Planning
ESAP	Environment and Social Action Plan
FA	Framework Agreement
FD	Fodder Development
FIRR	Financial Internal Rate of Return
FM	Financial Management
FMD	Foot and Mouth Disease
FPCM	Fat and Protein-Corrected Milk
FUC	Funds Utilization Certificate
GHG	Green House Gas
GoI	Government of India
GRM	Grievance Redressal Mechanism
HF	Holstein Friesian
HGM	High Genetic Merit
IBR	Infectious Bovine Rhinotracheitis
IEG	Institute of Economic Growth
INAPH	Information Network for Animal Productivity and Health
IPM	Integrated Pest Management
IRMA	Institute of Rural Management, Anand
IUFR	Interim Unaudited Financial Report
LRP	Local Resource Person
MAIT	Mobile Artificial Insemination Technician
MBRT	Methylene Blue Reduction Test
M&E	Monitoring and Evaluation
ME&L	Monitoring, Evaluation and Learning
MIS	Management Information System



MPP	Milk Pooling Point (see VBMPS)
MTR	Mid-term Review
MU	Milk Union
NDDB	National Dairy Development Board
NDP	National Dairy Plan
NDS	NDDB Dairy Services
NDSP	National Dairy Support Project
NPV	Net Present Value
PDO	Project Development Objective
PIP	Project Implementation Plan
PS	Pedigree Selection
PMU	Project Management Unit
PT	Progeny Testing
RBP	Ration Balancing Program
SC	Scheduled Caste
SDR	Special Drawing Right
SESA	Strategic Environmental and Social Assessment
SNF	Solids Non-Fat
SOP	Standard Operating Procedure
SS	Semen Station
SSMS	Semen Station Management System
ST	Scheduled Tribe
SWS	Smart Weighing Scale
TMR	Total Mixed Ration
VBMPS	Village-based Milk Procurement System



TABLE OF CONTENTS

DATA SHEET

I. PROJECT CONTEXT AND DEVELOPMENT OBJECTIVES	1
A. CONTEXT AT APPRAISAL.....	1
B. SIGNIFICANT CHANGES DURING IMPLEMENTATION (IF APPLICABLE)	4
II. OUTCOME.....	5
A. RELEVANCE OF PDOS	5
B. ACHIEVEMENT OF PDOS (EFFICACY)	6
C. EFFICIENCY.....	13
D. JUSTIFICATION OF OVERALL OUTCOME RATING	14
E. OTHER OUTCOMES AND IMPACTS (IF ANY).....	14
III. KEY FACTORS THAT AFFECTED IMPLEMENTATION AND OUTCOME.....	17
A. KEY FACTORS DURING PREPARATION.....	17
B. KEY FACTORS DURING IMPLEMENTATION	18
IV. BANK PERFORMANCE, COMPLIANCE ISSUES, AND RISK TO DEVELOPMENT OUTCOME.....	20
A. QUALITY OF MONITORING AND EVALUATION (M&E).....	20
B. ENVIRONMENTAL, SOCIAL, AND FIDUCIARY COMPLIANCE	22
C. BANK PERFORMANCE	23
D. RISK TO DEVELOPMENT OUTCOME	24
V. LESSONS AND RECOMMENDATIONS	25
ANNEX 1. RESULTS FRAMEWORK AND KEY OUTPUTS	27
ANNEX 2. BANK LENDING AND IMPLEMENTATION SUPPORT/SUPERVISION	42
ANNEX 3. PROJECT COST BY COMPONENT	44
ANNEX 4. EFFICIENCY ANALYSIS.....	46
ANNEX 5. BORROWER, CO-FINANCIER AND OTHER PARTNER/STAKEHOLDER COMMENTS.....	55
ANNEX 6. SUPPORTING DOCUMENTS	56
ANNEX 7: PROJECT EVALUATIONS AND ASSESSMENTS	58
ANNEX 8: ANALYSIS OF DAIRY PRODUCER COMPANIES	76
ANNEX 9: NDSP TRAINING AND CAPACITY-BUILDING.....	84
ANNEX 10: INNOVATION UNDER NDSP	89
ANNEX 11: SUPPORTING DATA AND INFORMATION.....	92
ANNEX 12: MAP	104



DATA SHEET

BASIC INFORMATION

Product Information

Project ID	Project Name
P107648	National Dairy Support Project
Country	Financing Instrument
India	Investment Project Financing
Original EA Category	Revised EA Category
Partial Assessment (B)	Partial Assessment (B)

Organizations

Borrower	Implementing Agency
Republic of India	National Dairy Development Board

Project Development Objective (PDO)

Original PDO

The Project Development Objectives are to increase the productivity of milch animals and improve market access of milk producers in project areas.

FINANCING

	Original Amount (US\$)	Revised Amount (US\$)	Actual Disbursed (US\$)
World Bank Financing			
IDA-50740	352,000,000	254,785,793	218,542,088
Total	352,000,000	254,785,793	218,542,088
Non-World Bank Financing			
Borrower/Recipient	39,100,000	28,309,533	24,282,454
Local Communities	62,800,000	45,469,019	51,755,458
Total	101,900,000	73,778,552	76,037,912
Total Project Cost	453,900,000	328,564,345	294,580,000

KEY DATES

Approval	Effectiveness	MTR Review	Original Closing	Actual Closing
15-Mar-2012	22-Jun-2012	13-Apr-2015	31-Dec-2017	29-Nov-2019

RESTRUCTURING AND/OR ADDITIONAL FINANCING

Date(s)	Amount Disbursed (US\$M)	Key Revisions
07-Apr-2014	5.03	Cancellation of Financing
03-Sep-2015	41.54	Change in Loan Closing Date(s)

KEY RATINGS

Outcome	Bank Performance	M&E Quality
Highly Satisfactory	Satisfactory	High

RATINGS OF PROJECT PERFORMANCE IN ISRs

No.	Date ISR Archived	DO Rating	IP Rating	Actual Disbursements (US\$M)
01	07-Jun-2012	Satisfactory	Satisfactory	0



02	29-Oct-2012	Satisfactory	Satisfactory	0
03	18-May-2013	Satisfactory	Satisfactory	.21
04	07-Dec-2013	Satisfactory	Moderately Satisfactory	2.73
05	27-May-2014	Satisfactory	Moderately Satisfactory	5.03
06	29-Nov-2014	Satisfactory	Moderately Satisfactory	17.88
07	08-Jan-2015	Satisfactory	Moderately Satisfactory	23.40
08	24-Feb-2015	Satisfactory	Moderately Satisfactory	23.40
09	20-Jul-2015	Satisfactory	Moderately Unsatisfactory	41.54
10	02-Nov-2015	Satisfactory	Moderately Satisfactory	49.03
11	22-Jan-2016	Satisfactory	Moderately Satisfactory	64.49
12	16-Jun-2016	Satisfactory	Satisfactory	89.80
13	08-Dec-2016	Satisfactory	Satisfactory	107.74
14	16-May-2017	Satisfactory	Satisfactory	117.34
15	27-Oct-2017	Satisfactory	Satisfactory	135.04
16	01-May-2018	Satisfactory	Satisfactory	145.70
17	08-Nov-2018	Satisfactory	Satisfactory	163.04
18	29-Mar-2019	Satisfactory	Satisfactory	181.97
19	21-Nov-2019	Satisfactory	Satisfactory	203.43

SECTORS AND THEMES

Sectors

Major Sector/Sector

(%)

Agriculture, Fishing and Forestry

86

Agricultural Extension, Research, and Other Support Activities

4

Livestock

82

Industry, Trade and Services	14
Agricultural markets, commercialization and agri-business	14
Themes	
Major Theme/ Theme (Level 2)/ Theme (Level 3)	(%)
Finance	9
Finance for Development	9
Agriculture Finance	9
Urban and Rural Development	92
Rural Development	92
Rural Markets	9
Rural Infrastructure and service delivery	83
Environment and Natural Resource Management	26
Climate change	26
Mitigation	26

ADM STAFF

Role	At Approval	At ICR
Regional Vice President:	Isabel M. Guerrero	Hartwig Schafer
Country Director:	N. Roberto Zagha	Junaid Kamal Ahmad
Director:	John Henry Stein	John A. Roome
Practice Manager:	Simeon Kacou Ehui	Mary Kathryn Hollifield
Task Team Leader(s):	Deepak Ahluwalia	Edward William Bresnyan, Shanker Lal
ICR Contributing Author:		Anna F. Roumani



I. PROJECT CONTEXT AND DEVELOPMENT OBJECTIVES

A. CONTEXT AT APPRAISAL

- 1. When the National Dairy Support Project (NDSP) was appraised in 2012, the Indian economy was growing rapidly but was challenged to make growth more inclusive and improve service delivery in rural and urban areas.** The agriculture sector was identified as a target for inclusive development given its pivotal importance in generating income for over one-half of the national population. Dairying was a major economic activity, at that time generating 18 percent of agricultural GDP. Milk was the single largest agricultural commodity in output value and India was the world's largest dairy producer at around 112 million metric tons (MT) per year, most of which was consumed domestically. Smallholder dairy households consumed around 50 percent of their own milk production.
- 2. The dairy sector had seen several decades of growth most notably under the “white revolution” - from 1970 to 1996 national milk production quadrupled and per capita milk availability doubled.** The Bank played a key role in this expansion, supporting five operations under the Operation Flood programs led by the National Dairy Development Board (NDDB) through its nationwide promotion of dairy cooperatives.¹ Policy changes were also important - de-licensing of the dairy industry in 1991 and elimination of milk sheds in 2002² – along with rapid growth in private sector participation in the milk processing sector. Also, political intervention in dairy cooperatives and changes in the Companies Act opened the door for “new generation cooperatives” such as Dairy Producer Companies (DPC).³
- 3. Consumer demand for milk and milk products was rising, along with milk prices, and consumption of milk was expected to increase.** Dependence on milk for food and nutritional security was high, largely due to the predominance of vegetarians in India. Dairying was/is a primary source of income for well over half the rural population and was (and remains) a smallholder phenomenon. About 80 percent of dairy farmers typically owned one to three milk producing animals and they accounted for 70 percent of total milk production; overall, 95 percent of milk producing households had less than five milch animals. Women were – and remain - a high proportion of the dairy labor force, making the dairy sector an important vehicle for inclusive development.
- 4. Despite decades of expansion, the dairy industry faced demand-supply imbalances.** While demand continued to rise due to increasing incomes and changing food preferences, milk production was slowing, and milk productivity was stagnant. Estimates by the Government of India (GoI) projected domestic demand of up to 180 million MT by 2021/22, requiring annual growth in production of 5.5 percent to avoid significant dairy imports. Increased domestic production and productivity were deemed essential. Consumer milk prices were also rising, contributing to food price inflation and potentially to food and nutritional insecurity given milk's importance in the national diet. However, average daily milk yields of Indian cows

¹ Karnataka Dairy Development Project (Cr. 482-IN); Rajasthan Dairy Development Project (Cr. 521-IN); Madhya Pradesh Dairy Project (Cr. 522-IN); National Dairy Project (Cr. 824-IN); and, National Dairy II Project (Cr. 1859/Ln.2893-IN). A 1997 Operations Evaluation Department (OED) study concluded that the Bank's assistance had a large and positive impact, especially on employment, increased leadership opportunities for women, education, nutrition, and poverty reduction.

² Milk “sheds” were areas controlled by dairy cooperatives where the private sector's establishment of milk plants was restricted. GoI in 2002 scrapped the associated legislation (the Milk and Milk Products Order) to promote competition in the dairy sector.

³ Dairying, like agriculture sector-wide, is a “State Subject” in India, i.e., a State responsibility under the Constitution.



were barely 50 percent of the global average: 3.4 kg/day vs 6.3 kg/day, while buffaloes, accounting for over one-half of Indian milk production, yielded some 4.6 kg/day. To counter low productivity, milch cattle and buffalo numbers continued to increase, giving India the world's largest dairy herd.

5. **Specific factors challenged dairy productivity and its sustainability.** These included: (a) poor animal nutrition and health, undermined by shortages of feed, fodder and water, and by farmers' lack of knowledge of how to exploit existing feed sources; (b) lack of dairy extension services for feeding and breeding, and low uptake of yield-boosting technologies; (c) low genetic potential of the national dairy herd - under 20 percent of Indian cattle were cross-breeds which have relatively higher milk yields - and lack of well-run genetic improvement programs including Artificial Insemination (AI) services, with dependence on natural service with disease/other risks; (d) low vaccination rates including Foot and Mouth Disease (FMD); (e) limited access of dairy producers to organized milk marketing and processing, especially women who are responsible for over 70 percent of primary dairy production. Less than 30 percent of milk produced was marketed through organized channels, and farmers' profit margins were limited by informality; (f) poor access to the cold chain, limiting processing options and food safety; (g) deteriorating environmental sustainability of dairying: methane/GHG emissions, over-grazing of fodder lands and poor animal waste and water management; and, (h) lack of a science-based, business-oriented and data-driven approach to dairying/animal management.

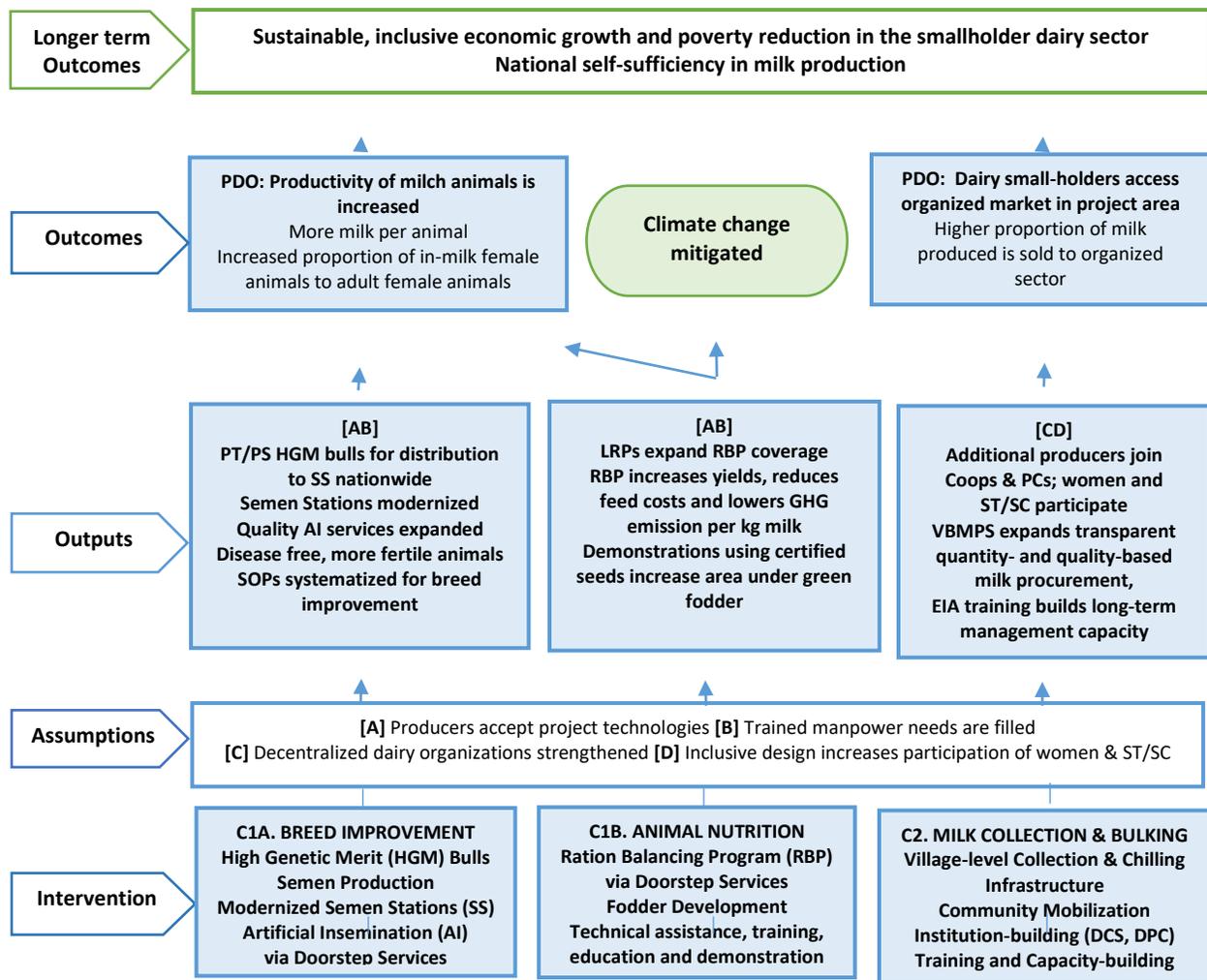
6. **National priorities and strategies:** The GoI's 11th Five Year Plan (2007-2012) sought annual growth of 5 percent in the dairy sector. Several complementary, existing government schemes were already supporting this target, but performance varied, and funding and support services were inadequate. Meanwhile, the NDDB had proposed the multi-state National Dairy Plan (NDP) to invest US\$3.5 billion over 15 years to meet dairy demand and develop the industry. The NDP focused on increasing dairy productivity through scientific and systematic processes - using standard operating procedures (SOP) - in animal breeding and feeding, investment in multi-state, village-level milk procurement infrastructure, milk processing and marketing, a supportive policy/regulatory framework, and computerized information systems to capture and assess field-level data. The National Dairy Support Project (NDSP) financed 90 percent of and operationalized, the NDP's first phase.

7. **Higher level objectives and rationale for Bank support:** The NDSP was well-aligned with World Bank country and sector strategies, specifically the India Country Strategy (2013-2017, Report #91199) seeking inclusive growth, sustainable development, and improved effectiveness of service delivery, the latter an area where transformative influence was expected. NDSP was viewed as an opportunity for the Bank to re-engage with the dairy sector and at national scale, especially given the global/Indian emphasis - after the 2008 food crisis - on agricultural productivity to combat food price inflation and boost food security. The case for public intervention in dairy productivity was strong: animal breed improvement is longer-term, and its benefits are broad-based, i.e. it is a public good and, the private sector had little incentive to invest in village-level milk collection and bulking. Also, increasing dairy productivity inherently entailed investing in smallholder dairy producers, with the potential to help stabilize milk prices and raise the incomes of millions, including women. NDSP's potential environmental co-benefits were also significant: increasing milk production through improved productivity rather than herd increases; and, supporting animal feeding programs for *inter alia*, reduced methane emissions and carbon and water footprints, with climate mitigation implications at scaled-up levels, longer-term. The project acknowledged the importance of the policy and regulatory enabling environment and was designed to be a "process-focused initiative" offering a more scientific, systematic, data-driven approach to dairy productivity enhancement, and a reference for other government (and private) sector programs. Finally, an influential World Bank study (2009) on the Indian



livestock sector under-scored the need for demand-led transformation, including in dairying.⁴

8. **Theory of Change:** The figure below was constructed retroactively from the PAD.



Project Development Objective

9. The PDO was “to increase the productivity of milch animals and improve market access of milk producers in the project area”.

Key expected outcomes and outcome indicators

10. Key expected NDSP outcomes and outcome indicators used for assessment were: (a) *Increased productivity of milch animals:* (i) the increase in per animal daily milk production; and (ii) the increase in the proportion of “in-milk” female animals to adult female animals; (b) *Improved market access of milk producers in project areas:* (iii) proportion of total milk sold to total production; and, (iv) increase in the share of milk sold to the organized milk processing sector.

⁴ Demand-led Transformation of the Livestock Sector in India: Achievements, Opportunities and Challenges, Report # 48412-IN, 2009. The study urged further investment to attract private sector milk processing to poorer regions and identified breeding and feeding as vital support services to boost productivity: genetic improvement, AI services, feed manufacturing/production of quality seeds, and animal health and veterinary services.



11. **Targeted beneficiaries:** The project sought to reach 40,000 villages across 14 major dairying states, and direct beneficiaries totaling 1.7 million rural milk-producing households, the majority being smallholders. The 14 States accounted for over 90 percent of India's milk production and 87 percent of breedable cattle and buffalo.⁵ Doorstep services delivery was a design feature expected to benefit the 90 percent of dairy farmers with five or less dairy animals. The project also targeted 20,000 villages in six new (DPC) and another 12,000 villages not yet reached by existing Milk Unions. Women, Scheduled Tribes (ST) and Scheduled Castes (SC) were explicitly targeted.

Components

12. **Component A: Productivity Enhancement** (Estimated cost US\$258.3 million of which Bank financing US\$227.9 million or 88.2 percent. Actual at closing, total US\$ 132.4 Million of which Bank US\$ 99.1 million, 90 percent). Sub-component 1 - Animal Breed Improvement: (a) High Genetic Merit (HGM) bulls produced using: (i) progeny testing (PT) of selected breeds, (ii) pedigree selection (PS) in indigenous breeds, and (iii) import of bulls, embryos and frozen semen; (b) Semen production increased via refurbishment of existing Semen Stations (SS); and, (d) Artificial Insemination (AI) services delivered (on pilot basis) via trained, mobile AI technicians (MAIT) at farmer's doorstep. Sub-component 2 - Animal Nutrition: (a) Local Resource Persons (LRP) trained in Ration Balancing Program (RBP) advisory services (animal feed and nutrition, with methane reduction goals), and those services delivered to dairy farmers; and, (b) Fodder Development technologies demonstrated, trained and delivered.

13. **Component B: Milk Collection and Bulking** (Estimated cost US\$166.3 million of which Bank financing US\$97.7 million or 58.7 percent. Actual at closing, total US\$151.3 million of which Bank US\$ 93.2 million, 62 percent). This component financed village-level milk collection and bulking facilities to improve farmers' access to markets. Activities included: (a) communities mobilized and dairy producers trained (expansion of existing dairy cooperative societies (DCS) and establishment of six new DPCs; (b) training and capacity-building of milk producers and functionaries; and, (c) village-level infrastructure, facilities and equipment purchased for milk collection and bulking.

14. **Component C: Project Management and Learning** (Estimated cost US\$29.3 million of which Bank financing US\$26.4 million or 90 percent. Actual at closing, total 10.9 million of which Bank US\$ 9.8 million, 90 percent). This component financed: (a) Project Management Unit (PMU); (b) computerized information systems at the PMU and End Implementing Agencies (EIA) to collect/disseminate information on animal breeding, nutrition, health services, milk collection and bulking. Key system was the Information Network on Animal Health and Production (INAPH); (c) external services for baseline, mid-term and completion evaluations and other special studies as needed; (d) third party quality assurance of civil works; and (e) implementation of technical assistance and training.

15. **Reasons for cost deviations:** Overall expenditure at closing was INR 2,034 Crore (US\$ 294.5 million equivalent), 99.6 percent of the appraisal estimate and Gol-sanctioned value of INR 2,042 Crore. Cost differences in US Dollars are explained mainly by: the cancellation of US\$97 million in 2014 (see para 20); lower than expected expenditures stemming from procurement-related cost savings; exchange rate effects over time (see Annex 3); and, under-delivery of pilot AI services. See Annex 3, Section I B, II B and E.

B. SIGNIFICANT CHANGES DURING IMPLEMENTATION (IF APPLICABLE)

⁵ Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal.



16. **Revised PDOs and Outcome Targets:** Neither the PDOs nor their outcome targets were changed.
17. **Revised PDO Indicators:** The PDO Indicators did not change.
18. **Revised Components:** Activities were added post-effectiveness in response to challenges and/or opportunities: (a) **Component A:** (i) Fast progress on cutting-edge performance recording under the NDSP's flagship Information Network for Animal Productivity and Health (INAPH) enabled the piloting of genomics, an advanced breeding technology; (ii) An imported, inactivated marker vaccine for Infectious Bovine Rhinotracheitis (IBR) was field-tested for the first time in India,⁶ and Foot and Mouth Disease (FMD) vaccination was also included in priority areas in agreement with NDSP participating states, each committing to prioritize, organize, monitor and report vaccination in project villages; (iii) Innovative pilots on fodder enrichment and biogas generation were added; (iv) Capacity building for embryo transfer contributed to its practicality; (v) SOP for AI supported the feasibility of using sexed semen, and the ability through milk recording to identify the best cows for embryo transfer, and HGM bulls for sexed semen; and, (b) **Component C:** Model Farm Demonstrations, to showcase larger herd size closer to the economic optimal (e.g., 8 cows milking 10-15 liters/day), enabled economically-viable, labor-saving and productivity-enhancing technologies such as machine milking to be demonstrated. NDDDB had traditionally focused on farmers with 1-2 milch animals.
19. **Other changes:** (a) **Restructuring:** (i) April 7, 2014: authorized the cancellation of US\$97 million equivalent of the IDA Credit; and, (ii) September 3, 2015: authorized a 23-month extension of the Closing Date to November 29, 2019; and (b) **Additional states:** The States of Uttarakhand, Telangana, Jharkhand and Chhattisgarh were added in 2014, bringing the total states participating to 18.

Rationale for changes and their implication for the original Theory of Change

20. Changes are explained as follows: (a) **Cancellation:** This reflected mainly cost savings from exchange rate fluctuations. At approval, the exchange rate was INR 45/USD 1 and by 2014, INR 60/USD 1, a depreciation of 33 percent; (b) **Extension of the Closing Date:** The 2015 Mid-term Review (MTR) showed that initial project mobilization and associated start-up activities entailed an 18-month "incubation" period not envisaged at appraisal. A 23-month extension enabled completion/fulfillment of the Project Implementation Plan (PIP), achievement of the PDO, and planning for post-project consolidation; and (c) **Addition of States:** The State of Uttarakhand was notionally included at appraisal as contributing to genetic improvement only; Telangana joined when it bifurcated from the new State of Andhra Pradesh in 2014; Jharkhand and Chhattisgarh sought participation as they were newly-formed States inhabited primarily by tribal populations with substantial milch animal herds and thus potential for NDSP coverage. None of these changes affected the Theory of Change.

II. OUTCOME

A. RELEVANCE OF PDOs

Assessment of Relevance of PDOs and Rating

21. NDSP was appraised under the World Bank Group's (WBG) India Country Strategy (CS, 2009-2012, Report #46509), implemented mainly under the WBG Country Partnership Strategy (CPS, 2013-2017, Report # 91199),⁷ and completed under the WBG Country Partnership Framework for India (CPF, FY18-22)⁸.

⁶ This paved the way for possible commercial production in India.

⁷ See Country Partnership Strategy FY13-17, World Bank Group, Report No. 91199-IN, undated.



Relevance of the PDO remained **High** throughout, as discussed below.

22. **Under the CPS (2013-2017), PDO relevance was consistent with all three themes for strategic engagement: integration, transformation and inclusion.** The emphasis shifted to economic and social integration of India's 14 low income states (of which NDSP covered eight), and to market insertion. CPS support targeted projects which transformed and modernized public policies, institutions and systems, and piloted new and innovative development approaches. Goals included increasing agricultural productivity focusing on smallholders and animal husbandry. Special value was placed on services delivery, transfer of knowledge, international good practices and measurable results. To promote economic inclusion and access to services, projects would strengthen collective action, especially among women. Attention would focus on labor-intensive sectors and on the development of small and medium enterprises to create employment. In agriculture, five "operational business lines" were identified, well-aligned with the PDO and project activities.

23. **At closing, the PDO maintained high relevance to the CPF (FY18-22).** Three themes were defined for WBG engagement: (a) sustainable, resource-efficient growth; (b) improving competitiveness and enabling job creation; and, (c) investing in human capital. Priorities under resource efficiency include agricultural transformation expected to double farmers' income by 2022. Competitiveness entails food safety, food processing, and food/commodity supply and distribution infrastructure, and improving land and water use efficiencies in agriculture. Similarly, improving the business environment through innovation, quality standards and managerial skills is directly relevant to the PDO's "productivity" and "organized markets" themes. Enabling more quality jobs for women - given the NDSP experience - still resonates, along with financial inclusion.

24. **Also relevant, the Department of Animal Husbandry and Dairying (DAHD) prepared a National Action Plan (Vision 2024) to support sustainable growth of the dairy sector and double farmers' dairy income by 2023-24.** This would pave the way for nutritional security, economic prosperity and livelihood support. The Plan calls for increasing the number of productive animals and per animal productivity, thus increasing milk production and marketable surpluses. The Plan assumes that productivity-boosting activities under NDSP would continue to mature/emerge, complementing the GoI's farm income objective. The Borrower Completion Report (BCR, 2020) states: "The long-term outcome of the NDSP remains compatible with the country's national priorities and development policies".

B. ACHIEVEMENT OF PDOs (EFFICACY)

Assessment of Achievement of each Objective/Outcome

25. The account of project results draws on the following: Borrower Completion Report (BCR, 2020), Endline Survey (DRS, 2019), specialized studies (summarized in Annex 7), Annual Progress Reports, project databases, Aide Memoires and insights provided by NDDDB, Bank specialists and field experiences. The PDO is unpacked into its two objective outcomes and evidence of achievement is presented, with causal links to project investments. At closing, 172 End Implementing Agencies (EIAs)⁹ had implemented 477 subprojects across 18 states at a total cost of US\$276 million equivalent, benefiting 3.7 million organized, mostly smallholder, milk producers, versus the 1.7 million estimated at appraisal, an increase of 118 percent. Some 52,509 villages were newly organized and/or strengthened for dairy activities, enrolling an additional 1.7 million milk producers in DCSs and DPCs versus the 1.2 million projected. Further information/data are found

⁸ See Country Partnership Framework FY18-22, World Bank Group Report No. 126667-IN, July 25, 2018.

⁹ End Implementing Agencies (EIAs) reported to NDDDB and were selected to implement NDSP activities at the decentralized level. EIAs were diverse, comprising district cooperative milk unions, state cooperative dairy federations, Dairy Producer Companies, Dairy Cooperative Societies, registered societies and trusts, and institutions engaged in animal breeding.



in Annexes 1A, 7 and 11.

Objective Outcome 1: Increase the productivity of milch animals (rated High)

26. Productivity improvements were expected from technologically advanced practices in dairy animal nutrition and, over a longer timeframe, genetic improvement. These are treated as two streams of investment with similar objectives which intersected during implementation through the portion of the breeding program promoting pilot delivery of AI and its impact on animal conception and milk productivity.

PDO Indicator 1: Percentage increase in milk production per animal

(Target: 10%; Actual: 21%; Exceeded: 210 %)

A. Animal Nutrition

27. **Average milk production per animal increased.** This achievement was the culmination of a complex seven-year process integrating streams of investment in technically sophisticated feeding and breeding practices (primarily through AI within the project lifetime) not used before in India for smallholder dairying. The result was measured using the weighted average of the daily milk yield per in-milk animal for indigenous cows, crossbreds and buffaloes. The Endline Survey (DRS, 2019) shows that average milk yields across all 18 participating states increased 21 percent, from a baseline of 5.03 liters/day to 6.09 liters/day (vs. target of 5.53 liters/day, or 10 percent).¹⁰ In a separate household-level study, average milk production for milk-producing households was 14.5 liters/day vs. 11.7 liters/day in intervention and control villages, respectively, and for buffalo, averaged 9.4 liters vs 6.0 liters/day, respectively.¹¹ The effect across intervention villages was significant, even after adjusting for socio-economic variables in a linear regression model. Modern data systems permitted continuous monitoring, recording and analysis of the status and performance of individual animals. See summaries of both studies, Annex 7.

PDO Indicator 2: Proportion of “in-milk” female animals to adult female animals

(Target 66%; Actual 68%; Exceeded: 103%)

28. **The proportion of in-milk female animals to adult female animals increased to 68 percent** (vs. target of 66 percent, and baseline of 63 percent).¹² The in-milk to adult female ratio is an indicator of scientific animal management practices focused on animal nutrition and health care, and scientific breeding. The higher the ratio, the higher the number of animals “in-milk” (i.e., under lactation) at any point and higher the milk production. Change was envisaged coming mainly from the RBP intervention as genetic improvement through animal breeding is longer-term and its impact on the so-called “wet ratio” of the herd was not envisaged within the project lifetime.¹³ Adoption of RBP resulted in better-nourished cows/buffaloes and more days in milk (i.e., greater persistence of lactation).¹⁴ Higher conception rates in herds where AI was piloted also increased the days in milk, i.e., increasing the conception rate (percentage of AIs performed

¹⁰ Endline Survey: External Monitoring and Evaluation of NDP - Phase 1 (NDSP), Development Research Services (DRS), 2019. As the genetic merit of the herd increases from investments in breed improvement, the expression of outcomes through RBP will also increase.

¹¹ Evaluation: Contribution of the National Dairy Plan I to the Inclusion, Equity and Income of Dairy Farmers. Institute of Economic Growth (IEG), Delhi, 2019. The study was based on a cross-sectional design but available impact analysis methods for such design were used to draw analytical inferences. Average # of cows per intervention and control household was 2.7 and 1.8, respectively.

¹² Measured using the weighted average of the daily milk yield per in-milk animal for local cows, cross-breeds and buffaloes.

¹³ Farmers were advised on how to balance their animals’ diet using locally available feed resources (grasses, residues) with addition of supplements and minerals, complemented by fodder development. A user-friendly computer software was developed to derive balanced, least-cost rations.

¹⁴ Impact Assessment and Evaluation of RBP in the Southern Region, IRMA/NDDB, 2016; and, Impact Assessment and Evaluation of RBP in Northern and Western Regions, ICAR-National Dairy Research Institute, 2017. See summaries Annex 7.



which result in conception) from baseline 35 percent to 46 percent under AI resulted in around one additional month of milk per animal.

29. **Improving animal nutrition through the RBP was a major causative factor in productivity outcomes.** RBP covered 2.86 million milch animals (106 percent of target) in 33,374 villages (86 percent of target), in all 18 participating states where 90 percent of India's milk is produced, over 87 percent of the country's cattle and buffalo population apt for breeding are found, and 98 percent of fodder resources exist.¹⁵ RBP was intensively promoted and efforts to expand/continue this program were evident in several states at closing, including its popularization using *Pashu Poshan*, an android app for farmers.

30. **RBP increased the quantity and quality of milk produced per animal per day.** Regional evaluation studies of RBP impact showed results averaging 7.33 liters after RBP, compared with 7.06 liters before RBP. Significantly, RBP increased the average lactation period by an additional 26 days for cows and 50 days for buffaloes. Milk quality also increased: average fat content increased from 4.70 percent to 4.78 percent, and Solids-non-Fat (SNF) rose from 7.86 to 8.54 percent in cows, and from 8.12 to 9.12 percent in buffaloes, increasing milk market value, which puts a premium on fat content. See RBP studies, Annex 7.

31. **RBP reduced feeding costs by 10.2 percent per liter of milk** (146 percent of target). The cost of production was reduced from INR 19.49/liter of milk to INR 17.19/liter (11.8 percent for DCS and 8 percent for DPCs vs. the combined target of 7 percent). Higher milk production at lower cost represents a major productive/adoptive incentive to producers since feed is about 70% of dairy production cost.

32. **Project studies also show that RBP increased net income per lactation period per animal by INR 7,777 (US\$ 108).** Further, an NDSP initiative introduced a Challenge Feeding (CF) option in the INAPH/RBP software.¹⁶ Data on 1,611 animals in 288 villages showed an increase in average daily milk yields of 0.82 liters and milk fat of 13 percent. The average net daily income of CF producers increased by some INR 36.92/animal (US\$ 0.51), an incremental income benefit of 35 percent over the regular RBP regime.

33. **NDSP's network of trained LRPs - reporting to the EIAs - were effective agents for RBP delivery.** NDSP trained some 33,411 LRPs (averaging 17 percent women per EIA) and covered 2.86 million animals in 33,774 villages, delivering services to the farmer's doorstep using INAPH software, which recorded all information on a central server. Progress on RBP coverage and impact was extracted through the INAPH MIS tool. The EIAs also entered monthly achievement data in the Enterprise Project Management (EPM) system. The quantitative/physical achievements were verified using MIS and EPM tools. The importance of this decentralized "army" of LRPs cannot be over-stated; their future status and role (post-project) presents challenges and opportunities. See also Sections III B and IV D.

34. **Fodder development technologies, many with environmental co-benefits, garnered the participation of over 2.0 million producers.** The project achieved all fodder demonstration targets (including 6,000 demonstrations for silage and mowers) and financed the construction of seven fodder seed production plants. Adoption was highest for mowers (227 percent based on demonstration targets), followed by silage production (198 percent adoption vs target). At closing, over 4,333 dairy farmers had adopted silage production based on NDSP demonstrations, and manpower trained to support fodder activities is benefiting the DCSs ex-post. NDSP also financed two plants for pelleting and enrichment/densification of crop residues, which reduces residue burn-off. Large-scale fodder demonstrations created national awareness on adoption

¹⁵ RBP started pre-NDSP with a small proof-of-concept in Banas Milk Union (State of Gujarat) envisaging that trained Local Resource Persons (LRP) would deliver RBP as a fee-for-service, subsidized for the first three years to establish the business model.

¹⁶ INAPH: Information Network for Animal Productivity and Health. Challenge feeding means that cows with higher milk production potential are fed an increased quantity of concentrate to "challenge" them to produce to the maximum.



of quality seeds for cultivation, fodder conservation to tide farmers over lean periods, and reduced fodder wastage (BCR, 2020).

35. **The proportion of area under green fodder with certified/truthfully labeled seed increased.** Some 629,240 ha were covered by certified fodder seed (284 percent vs target of 80 percent), enabled by the construction of seven seed processing plants which produced 14,025 MT of Certified/truthfully-labeled fodder seed. NDSP supported the sale of 31,462 MT of certified fodder seed overall. Evidence shows an increasing trend for participating producers with own land/access to land to grow their own fodder, and increased capacity to store fodder against leaner periods to await price improvement. Area under fodder in participating villages increased 157 percent, and average fodder yields in those villages went from 40 to 55.58 MT/ha/year.

36. **RBP reduced average methane emissions in lactating cows and buffaloes by 13.8 percent** (138 percent vs target of 10 percent). Two external studies evaluated the impact of RBP on methane emissions in two villages in the Ludhiana district of Punjab State and two villages in the Anand District of Gujarat State. In Punjab State, average baseline methane emission was 22.40 g/liter milk yield (22.71 g/liter Fat and Protein-Corrected Milk/FPCM), reduced by 13.6 percent to 19.36 g/liter milk yield (19.82 g/kg FPCM) in lactating cows, post-RBP. In buffaloes, methane was reduced by 11.2 percent to 27.87 g/liter of milk yield (20.85 g/liter FPCM). The average methane emission reduction in cows and buffaloes was 12.4 percent. In Gujarat State, average methane emissions were reduced by 10.2 percent to 192.73 g/day, in buffaloes. Methane emissions per g/liter milk yield were reduced by 15.2 percent to 21.63 (15.5 g/liter FPCM), post-RBP. See Annexes 7 and 11.

B. Genetics/Breeding

37. **NDSP delivered a complex, large-scale breed improvement program, with results expected mostly longer-term.** The program exceeded expectations: adoption of genomic breeding; promoting broad awareness of breed improvement; massive progress in upgrading the physical and scientific infrastructure and practices in 28 of the nation's 54 SS; demonstrating that India could achieve globally-comparable conception rates; and, introducing a sophisticated system for recording all breeding, health, feeding and lactation information by individual animal, in real time/over time using tablet technology (SSMS and INAPH). Project design acknowledged that breeding results would begin to emerge in about 15 years (i.e., by 2027). NDSP met or exceeded all breeding targets, except for the production of indigenous bulls under the PS Program, the result of inter alia, over-ambitious assumptions on AI uptake. HGM bull production was especially commendable given DADF's announcement mid-way of a policy prohibiting IBR-positive bulls, resulting in the culling of project HGM bulls. NDDB responded rapidly, testing an inactivated IBR vaccine for control of IBR in bull production areas. Further, NDDB overcame challenges facing bull importation, resulting in the first bull imports in 20 years; and, Gol appointed India's first-ever Genetic Evaluation Committee.

38. **The PT/PS Program produced 2,456 higher genetic merit young bulls (cattle and buffalo) which are now available for semen production** (98.2 percent of an aggregate target). The PAD did not define "High" Genetic Merit, no value was assigned and there was no uniform understanding of its meaning. That said, the program was designed to increase genetic merit through rigorous selection based on progeny performance. INAPH data shows improvement over a baseline, with variations between breeds. Genetic improvement via PT/PS and performance recording paved the way for genomic approaches.¹⁷ The differences in genetic potential should start to become significant by 2027. The 2,456 bulls were available for distribution to the 54 SS nationwide, replacing up to 33 percent of the 7,406 existing breeding bulls in collection and rearing. Prior

¹⁷ BCR (2020) estimates that genomics technology would increase by 20 percent the rate of genetic progress vs that of PT/PS.



to NDSP, less than 10 percent of bulls in all SS had any genetic evaluation. All bulls produced were subjected to performance testing. Gol established a Breeding Value Estimation Committee which adopted a policy of distributing HGM bulls based on breeding value (BV); before, NDSP bulls were selected based on limited observations of dams' (i.e., calf's mother) daily milk yield. The estimated BV of all bulls with reliability of >70 percent (cattle) and >60 percent (buffalo) is now published on the NDDDB website. See Tables 18-19, Annex 11.

39. **The impact of breed improvement was evaluated.** The accuracy of selecting sires based on estimated BV was compared to estimated genetic rates of improvement from the accelerated program established. The BCR (2020) reports that selecting bulls based on published, estimated BV for production better-predicts daughters' milk yield compared to the traditional approach where bulls are selected on their dam's yield (usually subjective, not based on milk recording). NDSP put India on a trajectory for annual increases in production yield from genetic improvement ranging from 38 liters to over 66 liters, depending on breed. With genomics, increases can range from over 47 liters to nearly 84 liters annually. NDSP also provided genetic evaluations beyond milk production, e.g., fat, protein and other functional traits like fertility, calving ease, feet and legs, and mammary system. Initial progress was also made in developing a selection index to identify the "all round" bulls able to contribute to farmer profitability.

40. **Semen Stations (SS) were strengthened and availability of semen doses rose sharply.** Across the 54 SS, total semen doses produced in 2018-19 were over 119 million (119 percent of target). Prior to NDSP there were 54 SS producing 65.8 million doses annually, not enough to cover 35 percent of the breeding population targeted. Most SS had poor infrastructure, no biosecurity, limited processing capacity and no SOP, with high risk of spreading disease through the semen produced. NDSP invested US\$43.0 million in upgrading 28 SS which, at closing, were producing over 88 million semen doses annually, i.e., 52 percent of all SS nationwide were producing 74 percent of total annual semen doses. The main challenge is to match producers' AI breed demands, using state-level breeding policies supported by INAPH-based analytics, to maximize productivity and minimize risk.¹⁸ Increased demand for indigenous breeds (IB) was substantiated using INAPH data: numbers of IB under semen collection doubled from 2012-2019; the share of IB in total semen production increased from 12.3 percent to 16.5 percent; and, IB semen sales went from 8.0 million to over 20.0 million.

41. **The AI pilot demonstrated that a conception rate of 46 percent can be obtained under Indian conditions** (102.2 percent of target). With a strong program of AI training and SOP, 1,330 Mobile AI Technicians (MAITs) completed over 2.67 million AIs (about 0.8 million annually) and reached a 46 percent conception rate. While the coverage achieved (12,322 villages, 51.3 percent) fell short of the 24,000 villages envisaged and the quantity of inseminations (783,000) under the AI pilot was just over 20 percent of the appraisal estimate, the 46 percent conception rate confirmed that the quality of AI can significantly improve in India with clear rules of the game and capacity building. See Section III.¹⁹

Objective Outcome 2: Improve market access of milk producers in project areas (rated High)

42. **The Village-Based Milk Procurement System (VBMPs) linked millions of smallholder milk producers to organized markets based on a stable, transparent, merit-based approach.** VBMPs efficiency was/is dependent on the integration of better AI services, veterinary care and cattle feed services to increase animal productivity and milk supply. In turn, the demand stimulus provided by DCSs and village milk pooling points under the DPCs has increased the supply of milk and reduced waste during handling and

¹⁸ NDDDB supported the development of four state-level breeding policies (Bihar, Gujarat, Himachal Pradesh and Uttar Pradesh).

¹⁹ INAPH data also shows that 15 million inseminations were conducted outside the NDSP pilot program.



transportation, strengthening the incentive to adopt RBP/fodder development practices and to engage with breeding services. VBMPS also demonstrated that dairy development in India depends on building farmer-owned institutions which approach dairying as an integrated production, processing and marketing operation culminating in improving the producer's productivity and income (BCR, 2020). Improved market access is discussed below.

PDO Outcome 1: Proportion of total milk sold to total production

(Target: 65%; Actual: 74.3%; Exceeded: 114.3%)

43. **The proportion of total milk sold to total production increased to 74.3 percent.** The indicator was intended to track milk sales relative to domestic consumption of own production, with the former expected to rise as productivity per milch animal increased. Incremental milk production under NDSP interventions would garner higher income for a family without compromising family nutrition. The Endline Survey found a more substantial increase than expected in sales relative to total production. The proportion of average production per family sold by intervention producers was 74.3 percent vs the baseline and target of 65 percent. Control producers showed only marginally lower sales relative to total production, of 72.3 percent. Average production and sale by intervention producers was 10.9 liters/8.1 liters respectively, and for the control, 9.4 liters/6.8 liters respectively. Sales are actually moving in the direction to be expected under higher productivity, but there is no indication that milk producer families are trading sales for household consumption. See Annex 1.

PDO Outcome 2: Percentage increase in share of milk sold to the organized sector (as a share of production)

(Target: 56%; Actual: 75%; Exceeded: 134%)

44. **Technological innovation resulted in more milk being procured through organized market channels.** The Endline Survey reports that the share of milk sold to the VBMPS was 75 percent - 134 percent of the targeted 56 percent - while the share sold to organized markets in the control areas was 51 percent. The income from cow and buffalo milk was significantly higher among intervention than control villages, even with adjustment of socio-economic variables in a linear regression model. Equipping DCSs and DPCs with capital items such as Bulk Milk Chilling Units (BMC), Automated Milk Collection Units, and Data Processor Milk Collection Units, increased milk procurement overall. Automation of the milk procurement process substantially increased procurement transparency and producer confidence since they could view the weight and fat content of their milk and knew that the price received was merit-based.²⁰

45. **The price per liter received by milk pourers from their DCSs increased an average 8-11 percent over five years in intervention areas, attributed mainly to improved milk quality.** Results showed INR 24/liter vs INR 29/liter at NDSP closing. In intervention villages, better milk price was considered the main advantage of the VBMPS system: the BCR states that 88 percent of VBMPS beneficiaries reported increased milk prices. Beneficiaries also reported reduced milk wastage (74 percent) and reduced milk marketing time (43 percent). Many households reported increasing the number of dairy animals owned as a direct result of VBMPS and their membership of a DCS or DPC. Also, due to VBMPS intervention, the DCS/DPC became the yardstick for milk price-setting in the beneficiary village and its vicinity: other milk procurement channels/agents followed suit.

46. **Milk quality based on methylene blue reduction (MBR) time varied, ranging from 58 to 280**

²⁰ The system comprises a data processor integrated with an electronic milk analyzer, electronic weighing scale, printer, display indicator and GPRS. Milk value is calculated based on a rate chart emitted by a centralized server. A receipt is generated for the member producer at the pouring point. Data on the quantity, quality and value of milk is transmitted to the central server. Member also receives SMS with details of the milk poured.



minutes across EIAs, and averaging 126 minutes (105 percent of target). This test measures the bacteriological quality of milk and was conducted at the BMC level. Results show DCSs with a range of 60 to 280 minutes, and DPCs 58 minutes to 133 minutes. There is marked variation in MBR performance among EIAs and between winter and summer months when, during the hottest time of the year, milk quality is reduced. Water scarcity in the hot season also affects the washing of cans and animals, increasing the bacteria load. This was the first time India established targets for milk quality and significant progress was made. Training and demonstration created awareness of clean milk production, especially for milk processing, food safety and market standards.

47. **EIAs' selection of BMC capacity considered current milk production volumes and expected growth.** By 2019-20 the project had installed aggregate BMC capacity of 12.5 million liters/day compared to the targeted 1.36 million (918 percent of target), with ample ability to absorb future volume growth. The BCR reports that increasingly, Milk Unions have 100 percent of their milk coming through the BMCs, with positive implications for downstream processing, potential value-added products and food safety. Installation of BMCs also helped to sustain milk quality by filling gaps in existing milk routes and creating new BMC milk tanker routes. The development of "cold chains" bolstered the operational efficiency of the DCSs, Milk Unions and DPCs. Milk pickup routes were optimized for cold chains to maximize quality and control transport costs.

48. **Additional milk procurement from newly organized producers is 2,950 MT/day (97 percent of target) with annual turnover exceeding US\$350 million equivalent.** An additional 1.67 million producers were organized by the project into DCSs/Milk Unions and DPCs (130 percent of target). Two thirds of these were smallholders and 45 percent women. The six DPCs created/supported under NDSP account for 834,400 producers (139 percent of target). Some 853,154 producers were organized in DCSs across 39,259 villages of which 14,371 (121 percent of target) were new villages. Outside NDSP, another nine DPCs were established based on the multiplier effects of systematic, nation-wide information dissemination by NDDDB.

Other supporting information

49. **Recording of field-based breeding performance was a major project achievement.** For the first time in India, through INAPH, large data became available on field-based performance records of individual dairy animals. NDSP created a nation-wide pool of trained manpower skilled in performance recording under smallholder conditions. Such records enabled, for example, the introduction of genomic breeding technology in cattle and buffalo breeds. Also, introduction of GPS enabled use of the Smart Weighing Scale for performance recording, improving data quality and overall supervision, while real-time recording of field events using the smartphone-based INAPH app enhanced database quality and facilitated the use of SOP. Timely information ensured proper follow-up. Nationwide build-up of uniquely identified, individual animal records in INAPH was rapid: at closing, INAPH contained records on 24 million dairy animals and 14 million producers in over 183,000 villages across 29 states; and, there were 47,000 registered INAPH users including veterinarians, EIAs and technicians. Data reveal huge variability between breeds, with potential to inform state-level breeding policies.

50. **Training and capacity building were essential to the achievement of project results.** The first 18 months of the project were largely incubational. Roles and responsibilities of stakeholders were well-defined in the PAD, but not reflected in notable progress until 2014 - confirmed by the 2015 Mid-term Review. The galvanizing factor was NDDDB's leadership of a massive training, capacity-building and promotion/dissemination program to position the project for the full investment phase and to manage the expected metamorphosis. The intensity of this effort was sustained throughout. NDDDB's program was well-conceived and relevant, comprehensive, inclusive, geared short-term to project implementation and longer-term to sustainability and expansion. Training techniques were creative: digitalized via ICT tools and virtual



classrooms; use of social media platforms to respond to producer concerns and information needs, deliver dairy extension messages and provide systematic training feedback; producer field workshops and demonstration events, hands-on experiences, cross learning forums/exposure, and peer-to-peer learning; and, micro-training centers, a unique and effective dairy extension model for technical knowledge dissemination. Some 3.2 million client days of training were delivered. See Annex 9 on training topics and participation.

51. **Efficacy rating:** Efficacy is rated **High**. PDO 1 and 2 exceeded their objectives/intended outcomes with all PDO Outcome Indicators exceeded and most Intermediate Indicators met or exceeded.

C. EFFICIENCY

52. Similar to the ex-ante Economic and Financial Analysis (EFA), project benefits for the ex-post EFA were measured for Component A. *Productivity Enhancement*: increased milk productivity through improved animal breeding, nutrition, and delivery of AI services (48 percent of total project cost); and, Component B. *Milk Collection and Bulking*: improved access to markets by investing in VBMPs facilities and formation of DPCs and DCSs (50 percent of total project cost). (Exchange rate conversion used USD 1: INR 75, as at June 9, 2020).

53. **Results of Economic and Financial Analysis:** The project’s cost-benefit analysis was conducted separately for major project interventions: breed improvement and AI service delivery, animal nutrition management, and milk collection and bulking investments. Benefits were then aggregated and compared to overall project costs, including contingencies and costs associated with project management. Costs and benefits are estimated at 2018 prices over a 20-year horizon with 10 percent opportunity cost of capital.

54. Under Component A: Productivity Enhancement, the *financial rate of return (FRR)* is 50 percent for breed improvement supported by the PT/PS program, SS strengthening, along with AI delivery services. Investments in animal nutrition including the RBP resulted in an FRR of 83 percent. Under Component B: Milk Collection and Bulking, investments in improved market access infrastructure for DPCs and DCSs resulted in an FRR of 46 percent. Aggregating the analysis at a project level, the FRR was 57 percent and the financial Net Present Value (NPV) was USD 492 million at 2018 prices over 20 years. Similarly, economic analysis was completed to assess the *economic rate of return* of the project. The internal rate of return (IRR) for breed improvements is 53 percent, for animal nutrition a much higher 87 percent, and for milk collection and bulking, the IRR is 46 percent. The NPV is USD 475 million at the aggregated project level. The overall project IRR is 60% compared to 23% ex ante. See Table 1 below, and Annex 4 for the full EFA including implementation efficiency.

Table 1: Economic and Financial Analysis Summary (USD Million)

Ex-post Analysis								
Project Interventions	Financial				Economic			
	PVC	PVB	NPV	FRR	PVC	PVB	NPV	IRR
Productivity Enhancement								
- Breed Improvement	54	332	248	50%	49	292	243	53%
- Animal Nutrition	28	170	142	83%	25	165	140	87%
Milk Collection and Bulking	173	275	102	46%	155	247	92	46%
Overall Project	255	747	492	57%	230	705	475	60%
Ex-Ante Analysis								
Project Interventions	Financial				Economic			
	PVC	PVB	NPV	FRR	PVC	PVB	NPV	IRR



Productivity Enhancement								
- Breed Improvement	82	134	50	18%	74	144	70	21%
- Animal Nutrition	139	306	167	25%	125	342	219	29%
Milk Collection and Bulking	83	129	45	20%	74	85	10	14%
Overall Project	236	433	197	22%	213	428	215	23%

Assessment of Efficiency and Rating

55. Efficiency is rated **High**, reflecting: strong economic and financial results, far exceeding expectations; positive sensitivity analysis; achievement of more than originally planned at lower cost; and, low administrative costs and cost per beneficiary. The additional 23 months compensated for an unanticipated but crucially important incubation period. Overall implementation was efficient.

D. JUSTIFICATION OF OVERALL OUTCOME RATING

56. Overall outcome is rated **Highly Satisfactory**. This is based on ratings of **High** for Relevance: There were no shortcomings in relevance to the current Bank CPF. Clear evidence was provided by the operation for alignment of PDOs to current CPF objectives; **High** for Efficacy: The operation fully achieved - and in key aspects exceeded - its objectives/intended outcomes; and, **High** for Efficiency: Results far exceeded expectations.

E. OTHER OUTCOMES AND IMPACTS (IF ANY)

57. **Gender: The project explicitly targeted and measured women’s participation.** This focus resulted in the formation of 4,400 women-only DCSs, and *Shreeja Mahila*, an all-women DPC. By closing, the EIAs had trained 2.4 million milk producers, DCSs/Milk Unions/DPC management, LRPs, MAITs and field technicians, covering vulnerable groups including 784,000 women (45 percent) and 271,000 SC/ST farmers (10 percent). Greater focus is needed in such projects on women as cooperative members and service providers (e.g., LRP), and in the case of DPCs, to involve female shareholders.²¹As evidenced by the Equity and Inclusion Study,²² women’s involvement in NDSP showed significant evolution with potential to be leveraged in new operations. NDSP women were more likely to access one/more of the three project extension services: AI, animal health and nutrition, devote additional time to improving milk quality and participate in milk selling decisions. Women as service providers significantly affected their standing in the village and contributed to their empowerment and income. However, the frequency of extension services use by women needs improvement, and women would benefit from more training on RBP and VBMPs. Women-only DCSs and DPCs are a striking example of a community institution working towards women’s economic independence.²³

58. **Institutional Strengthening: Project design focused on building multi-level institutional capacity to support successful execution of complex, large scale programs while boosting sustainability.** Accordingly, a massive and well-conceived program of training and capacity-building - touching on every aspect and level of subprojects and programs - for EIAs, milk producers, board members, executives, LRPs, MAITs and NDDB personnel, was delivered. The well-defined learning process looked beyond training as a discrete event, to the long-term effectiveness of dairy institutions. The EIAs were the essential institutional driver of project execution, supported by NDDB and dependent on the LRPs and MAITs for key doorstep services. They

²¹ Impact of NDSP Interventions on Strengthening Women’s Empowerment in India’s Dairy Sector, IRMA, undated. See summary, Annex 7.

²² Contribution of the National Dairy Plan I to the Inclusion, Equity and Income of Dairy Farmers, IEG, 2019.

²³ The all-women *Shreeja Mahila* DPC (Andhra Pradesh State) was built on women’s self-help groups formed under the Bank-supported National Rural Livelihoods Project.



diligently implemented activities as trained/advised and using SOP and Enterprise Resource Planning (ERP) to build business management capacity. EIAs showed institutional ownership and leadership by investing own funds to advance their projects and to meet targets requiring additional resources. EIAs steadily gained institutional capacity through efforts to comply with complex operational and technical requirements. See Annex 9.

59. **Expansion of dairying in India means that the activities of cooperative unions and federations have become more complex, requiring professional management** (BCR, 2020). NDDDB motivated and facilitated DCSs and DPCs to bring in professional manpower and build capacity based on techno-managerial competencies, good governance and growth-promoting relationships with producers. Newly created DCS and DPCs successfully mobilized and organized smallholder milk producers within an institutional setting. NDDDB Dairy Services (NDS) played a pivotal role in establishing and nurturing the six DPCs under NDSP.²⁴ Their evolving institutional performance is analyzed in Annex 8.²⁵ Indian dairy development depends on building farmer-owned institutions which approach dairying as an integrated production, processing and marketing operation, not just a milk collection activity. In marketing, the VBMPS was a fully integrated and uniquely innovative approach to institutional dairy development, serving the full gamut of requirements. The installation of IT-based solutions for bulk milk pouring, testing and pricing promoted fairness/trust in milk procurement, an essential institutional advance. The VBMPS ensured accurate, timely, automatic payment to members, and for DPCs, facilitated the allocation of shares to producer members, captured the details of all services availed by farmers from the DPC, and supported “back office” business functions (BCR, 2020).

Mobilizing Private Sector Financing

60. **End Implementing Agencies contributed US\$ 51.8 million (114 percent of revised estimate) leading to higher than estimated numbers of producers participating through their Milk Unions and DPCs.** This is linked to the project requirement for a 50/50 cost-share in EIAs’ acquisition of Bulk Milk Chillers. At appraisal, beneficiary dairy producers were expected to contribute around US\$ 62.8 million under Component 2 Milk Collection and Bulking, revised in 2014 to US\$ 45.5 million. Actual equity participation by EIAs far exceeded other GoI programs in dairy development at that time, which were 100 percent subsidized. Further, during NDSP, the GoI officially aligned its other dairy programs with the NDSP’s 50/50 parameter, with positive fiscal implications.²⁶ The project was unable to move to full cost recovery for AI services, and this coincided with the area of weaker policy commitment by many participating states (see Section III and Annex 11, Table1).

Poverty Reduction and Shared Prosperity

61. **The project had positive impacts on poverty through effective targeting of project benefits to poor populations.** Of the 1.7 million new producer members enrolled in DCSs and DPCs, 67 percent were smallholders/landless. Poor households cited RBP and VBMPS as important factors in increasing their incomes.²⁷ While SC/ST households, due to lower production volume, were less likely to report income benefits, the income from milk production was generally higher across NDSP intervention villages. Average income from cow milk production in intervention and control villages was INR 393/day vs INR 310/day (127 percent) respectively, and from buffalo milk was INR 276/day vs INR 198/day (139 percent), respectively.

²⁴ NDS, a not-for-profit Company registered under India’s Companies Act, is a wholly owned subsidiary of NDDDB and is the delivery arm for field operations to promote DPCs and Productivity Services.

²⁵ A Financial Performance Evaluation of the NDSP-supported Dairy Producer Companies in India, World Bank, 2020.

²⁶ Strong advocacy by the milk unions wanting to participate in NDSP and willing to accept the cost-sharing feature in return for the project’s technical support and innovation, supported a shift towards the principle of producer cost participation (BCR, 2020).

²⁷ Contribution of National Dairy Plan I to the Inclusion, Equity and Income of Dairy Farmers, IEG Research Report, undated.



Importantly, hunger was alleviated via an average 36 percent increase in per capita milk availability from 2012, to 394 g/day by closing. Given the large number of herds with 1-2 cows, RBP's impact on increased days in milk of 26 and 50 days respectively, for cows and buffalo, also meant significant additional milk income per day.

62. **The project mainstreamed the principles of equity, inclusiveness and participation.** The role of NDSP in sustaining the poor and landless in the village economy was important and effective. The project linked them to the organized sector for milk marketing (i.e., DCSs and DPCs), and improved their milk quality through investments in routine testing at the VBMPs point, and BMCs. Around US\$28.0 million of project resources helped improve DCS infrastructure, impacting positively over 4.0 million milk producers. Village communities were socially empowered, benefiting around 744,000 women (44 percent) and over 1.1 million small and marginal farmers of which 10 percent were SC/STs mobilized by their DCSs, thereby connecting them to government/formal institutions. Increased incomes *inter alia*, were the means to reducing risk and marginality, including via acquisition of more dairy animals. Jobs were also created: 31,148 LRPs; 4,400 trained female extension officers; 1,300 MAITs; and, 22,000 DCSs and VBMPs workers. Producers can now also share the financial benefits of value-addition to their milk from processing and marketing. Profits which would otherwise go to urban shareholders are plowed back to producers through their dairy institution. VBMPs also improved women's access to the market as they are often restricted from moving beyond their village. The result has been a "moderate shift in the distribution of income in favor of the rural sector" (BCR, 2020).

63. **Convergence:** Implementation sought the productivity benefits of converging several streams of NDSP investment. DPCs were the primary convergence vehicles but DCSs also benefited. Significant convergence was achieved, especially in the *Maahi* and *Paayas* DPCs. While the impact of convergence was not formally measured, the BCR reports that around 88 percent of EIAs implementing VBMPs also received RBP and FD investments, while 72 percent of total animals under the PT/PS program also received RBP. Under the DPCs, significant convergence occurred in the *Maahi* (Gujarat), *Paayas* (Rajasthan), *Saahaj* (Uttar Pradesh) and *Shreeja* (Andhra Pradesh) DPCs, involving 532,000 dairy producers (BCR, 2020). See Annex 10, Table 13.

Other Unintended Outcomes and Impacts

64. **Innovation Fund:** A Bank-initiated and National Steering Committee-approved Innovation Fund financed a core set of innovations.²⁸ Highlights were: (a) **Animal health:** (i) the first-ever trial of an internationally-proven IBR control vaccine under Indian conditions for Infectious Bovine Rhinotracheitis (IBR),²⁹led, *inter alia*, to mass IBR/vaccination awareness drives;³⁰ and, (ii) Foot and Mouth Disease (FMD) vaccination coverage in priority project areas increased from baseline 35 percent to 74 percent with 3.8 million FMD vaccinations, promoted/facilitated under NDSP; (b) **Genomic selection:** Pioneered by NDSP, genomic selection (GS) can potentially increase rates of genetic improvement by over 20 percent (i.e., annual increases in production of 47 to nearly 84 liters, depending on breed). NDSP implemented GS by: (i) using the INDUSCHIP developed by NDDB for genotyping recorded cows, and (ii) developing and validating the BUFFCHIP for buffalo, a genotyping, micro-array chip, in collaboration with the US Department of Agriculture (USDA); (c) **Total Mixed Ration (TMR) feeding:**³¹ NDSP financed a 50 ton/day crop residue-based TMR plant in

²⁸ The NDSP Innovation Fund financed competitively selected proposals for testing proof-of-concept for new and promising technologies contributing to higher dairy productivity and competitiveness.

²⁹ IBR is a contagious and economically costly disease. Under GoI Minimum Standard Protocols, SS must move towards IBR-free herds. NDSP introduced strict bull sampling, culling and quarantine for Tuberculosis, Brucellosis, John's disease etc.

³⁰ The Innovation Fund-supported pilot "Popularization of IBR Control using Inactivated Marker Vaccine" covered the cattle and buffalo population in three EIAs from 2017-19. An Indian firm is in early stages of manufacturing an affordable IBR marker vaccine. See Graph 5, Annex 11.

³¹ In India, some 140 million tons of crop residues are burned off annually in the field, at high environmental and economic cost (BCR, 2020).



Kolhapur Milk Union (Maharashtra State) to further demonstrate the genetic potential of dairy animals (fertility and productivity) through science-based feeding of enriched pellets during lactation. Significantly higher results were achieved for an intervention group. Pellet-based TMR also enables better feed storage; (d) **Data Loggers for Bulk Milk Coolers:** Pilot installation of Data Loggers in 69 DCS/MPCs nation-wide helped to monitor and control the performance of BMCs – vital for milk quality - in real time, including remote performance monitoring, preventative maintenance, and fast resolution of equipment failures; (e) **Clean energy pilots:** (i) Pilot rooftop solar panels: Installation of 61 rooftop solar PV systems supported the adoption of clean alternative sources at affordable cost and reduced dependence on the unreliable, grid-connected power supply; and, (ii) Pilot Flexi Biogas Plants: 1,000 biogas plants generated additional income for producers using biogas as a clean cooking fuel, and bio-digested slurry both as a fertilizer and for sale. Indicative results show GHG emissions declined by 817 metric tons (CO₂ equivalent), by replacing LPG use; and, (f) **Fodder demonstrations:** These catalyzed the emergence of a modern, competitively priced fodder management machinery industry in India, an important co-benefit of NDSP. Sales of mowers and related machinery reached 60,000 units over 5 years to project closing, and 200 commercial roughage management plants were established by private entrepreneurs using own funds. Custom fodder machinery rental centers were already being established at closing.

65. **Milk Fortification:** A grant from the South Asia Food and Nutrition Security Initiative³² successfully explored the potential for micro-nutrient fortification in the liquid milk supply chain, reaching Milk Federations, DPCs and Milk Unions in 20 States. Fortifying just 13,000 liters/day in 2017, the pilot reached 5.5 million liters of milk per day by 2019, and access for six million consumers. Early adopters included the large, integrated dairy firms Mother Dairy India, *Verka* and *Saras*. See Annex 10.

III. KEY FACTORS THAT AFFECTED IMPLEMENTATION AND OUTCOME

A. KEY FACTORS DURING PREPARATION

66. **Project objectives were clear, realistic and grounded in sound analytics.** The PDO identified targeted beneficiaries as “milk producers” and the PAD explained the demographics of Indian dairying so that stakeholders would understand that a high percentage of project beneficiaries would be poor smallholders. Importantly, climate change mitigation was a complementary “objective” tracked as an Intermediate Result and intended to signal that reduced methane/GHG emissions were an expected and crucial co-benefit of the project’s science-based feeding program.

67. **The Results Framework was well-designed with indicators clearly aligned to PDOs, and with a comprehensive monitoring plan.** Some baselines and indicator targets were adjusted/added following the Baseline Study, conducted by the contracted M&E specialists soon after effectiveness.³³The RF did not include poverty indicators but poverty and equity outcomes became part of the M&E framework/studies in practice, with results reported in Section II. The Monitoring Plan established the databases and analytical foundation for NDSP and future dairy planning and policies. See M&E discussion, Section IV A.

68. **Project design was technically and operationally complex but rational, linked to dairy sector needs, lessons/standards of global experience, key studies, and related in-country operations.** Components were well-structured in three complementary streams of activity aligned to the PDOs. The enabling policy and regulatory environment supporting project investments was acknowledged via the requirement that states commit to time-bound policy changes to trigger certain project investments (AI delivery, RBP/fodder development, and VBMPs).³⁴ To support implementation readiness, nine of the

³² Improved Nutrition through Micro-nutrient Fortification: Testing the Business Case under the NDSP India. TF 602001 Grant of USD 450,000 and multiple donors (World Bank, NDDB, Tata Trusts (Tata India Nutrition Initiative)). Final Report, June 10, 2019.

³³ External Monitoring and Evaluation of National Dairy Plan Phase I: Final Report - Baseline Study, DRS, 2013.

³⁴ Policy measures: (i) bovine breeding policy in place at state level; (ii) AI service not included as a Minor Veterinary Service at the state level; (iii)



proposed 14 states were pre-identified at appraisal for participation, along with a set of pre-approved investments.

69. **The PAD risk assessment was generally accurate in practice, but unexpectedly slow initial implementation revealed some gaps.** The PAD correctly foresaw wide geographic coverage, multiple states and EIAs, along with financial management (FM) and procurement capacities/practices as important risks (rating all as Medium except for inter-state and inter-EIA coordination, rated High). Suggested mitigation measures were well-conceived and reasonable. That said however, NDDB's responsibility was immense, reliant on its deep experience and capacity to convene/motivate multiple, geographically dispersed and decentralized stakeholders around a set of sophisticated technologies mostly untried in Indian smallholder dairying. Thus, technical manpower availability/recruitment and training needs were massive, implicitly expected to occur in parallel to and catalyze, the investment phase. This posed inherent risks not specified in the PAD.

B. KEY FACTORS DURING IMPLEMENTATION

Factors subject to control of government and/or implementing agencies:

70. **Participating States' made significant progress on policy reform supporting Indian dairy sector modernization.** The participating States broadly adhered to five of the six policy and regulatory measures over time (See Annex 11, Table 1). Differences in States' approaches to calculating AI cost constrained compliance with policy measure 3 (see footnote 34), despite NDDB's dissemination of a standard format. Private sector AI cost recovery, and a focus on quality of service delivery, were key project goals. NDDB established SOPs for AI, with data capture systems and an analytics-based approach, to strengthen assessment of policy reform, and sought to expand private AI delivery. The project met AI quality goals, but the political economy in most States hindered the quantity targets. Only Andhra Pradesh and Gujarat States complied fully with policy measure 3.

71. **The AI pilot proved challenging to implement but demonstrated its dairy productivity potential.** DPCs were initially not equipped to implement commercial-scale AI operations, manpower in the market for such AI was limited, and training hundreds of MAITs was hampered by the scarcity of accredited AI training centers. The *Shreeja* and *Baani* DPCs did not participate due to resistance from their State Animal Husbandry Departments. Policy support to create the enabling environment for AI was uneven; the public veterinarians appear to have prevailed despite the merits of private, doorstep delivery. Awareness of AI was low in states where buffalo dominated, while grazing practices, free-roaming bulls, and resistance to ear-tagging also affected AI uptake. The BCR cites several factors that proved crucial: (a) AI services delivery at farmers' doorstep by qualified MAITs using quality semen doses and SOP; (b) demonstrating that AI increased milk productivity; (c) mass campaigns and "calf rallies" to encourage ear tagging;³⁵ (d) organized efforts to change farmer perceptions about AI effectiveness in buffaloes; and, (e) demonstrating AI's benefits to induce farmers to pay the direct cost. Given the 130,000 AI technicians (public and private) in India today offering services of unknown/variable quality, wider adoption of NDSP's SOP for AI delivery – along with progress on adoption of the Breeding Bill Policy requiring that AI technicians be associated with an organization – could substantially improve nation-wide AI delivery, along with AI training, monitoring and certification.

semen for AI delivery to be sourced only from SS graded A or B by the Central Monitoring Unit, DADF; (iv) State to adopt common protocols and SOPs for all breeding activities as prescribed by DADF; (v) moving gradually to a charge for AI services closer to full cost; and (vi) state rules for implementing the Prevention and Control of Infectious Diseases in Animals Act and notification of control areas, within a reasonable period.

³⁵ Ear tagging was used to register dairy animals in INAPH. Producers associated ear tags with a bank lien on the animal. Resistance to ear tagging abated once farmers grasped that INAPH-registered and milk-recorded animals had higher market value.



72. **Upgrading and expanding SS to meet increasing demand for frozen semen doses for AI faced difficulties.** Due to ongoing upgrading/works at SS, new bulls could not be introduced in time, while many SS had young bulls under collection with lower productivity. Moreover, a 2017 change in government policy favoring indigenous breeds caused SS to reduce production from crossbreds and exotics. These limitations were surmounted by consolidating institutional support for establishing rigorous, science-based and data-driven processes within a network of modernized facilities. The results were state-of-the-art infrastructure for disease-free quality semen production, with biosecurity measurement; increased frozen semen storage capacity, minimizing the handling of doses; the infrastructure to accommodate a higher number of bulls and thus greater semen production capacity; introduction of mechanization and more efficient use of labor; and, the roll-out of SSMS in 28 SS Strengthening Projects, and modern, Computer-Aided Semen Analyzers for 20 SS.

73. **Institutional factors played a positive role in resolving breeding challenges.** Consistent support of DADF (now DAHD) fostered success through the timely notification of SOPs, guideline adjustments when needed, and timely release of funds to NDDDB. Technical expertise provided by World Bank missions promoted understanding of scientific breeding principles and shaped corrective measures. The chain of support from State Animal Husbandry Departments and Dairy Federations, Milk Unions, NGOs and Trusts, strong support of the EIAs and participation of dairy farmers, aligned implementation with technical guidelines, scientific principles and data analytics. The NDDDB's experience in field genetic improvement and leadership of the process were crucial. The growing availability of trained technical manpower in performance recording, genetic evaluation, and bull and semen production, supported successful experiences. Genetic improvement also succeeded due to data capture by INAPH and its capacity to strengthen implementation.

74. **Human resource issues including technical manpower availability and capacity challenged a project built around services delivery.** The EIAs' role was central, but their capacity was over-estimated at appraisal and their diverse type, skills and development needs added to the capacity-building challenge. Training, and ongoing coaching/monitoring by NDDDB's decentralized technical teams helped to counter weakness in EIAs' sub-project proposals and wider performance. Regular regional reviews convening EIAs also helped reaffirm best practices and created beneficial peer competition. Human resource issues also affected the LRPs, who were responsible for delivering RBP advisory services at the producer's doorstep using INAPH software to record information in the central server. Attrition affected LRP performance, attributed to low/variable income from sales to farmers of mineral supplements, but overall retention was still 70-80 percent. EIAs lacked the technical manpower to supervise large numbers of LRPs, causing EIAs in some states to relax LRP qualification standards, affecting field operations. Mechanisms were devised to minimize attrition and strengthen performance: motivating LRPs to expand village and animal coverage via an annual, project-financed incentive scheme,³⁶ rewards for high-performing LRPs and, regular LRP performance analysis and refresher training.

75. **Intensive farmer education, field demonstrations addressing manpower needs, technologies and storage, were the drivers of fodder technology adoption.** Key executors were the EIAs, trained by NDDDB. Demonstrations in diverse agro-climatic zones showed producers the utility of eco-friendly mowers, reapers and auto pick-up devices to ensure that straw residue in their fields was recovered and utilized. The project promoted the production/sale of improved fodder seeds (sorghum, oats, maize and berseem), and field demonstrations of mowers, silage-making, biomass storage silos, and re-vegetation of common grazing/fallow lands. These technologies were popularized, backed by training in fodder production and conservation, and advanced training in certified seed production. Producers received quality seeds from their

³⁶ Incentive: INR 1,000 for 60-79% coverage; INR 2,000 for 80-90% coverage; and INR 3,000 for 100% coverage.



DCSs, demonstrating the high latent demand for improved seeds, and that buy-back arrangements and monetary benefits could potentially motivate farmers to produce quality seeds (BCR, 2020).

76. **The successful VBMPS represents a viable, sustainable model.** Advent of the VBMPS led to surging demand for the automated equipment needed, pressuring suppliers to deliver capital investment items on time. Some EIAs lacked the manpower to implement VBMPS, and its vast scale required strong national leadership and immense capillarity. NDDDB established desk officers in all regions to liaise with EIA personnel monitoring individual VBMPS projects to resolve procurement, financing and coordination issues. NDDDB was also flexible regarding the evolving situation and constraints affecting EIAs and allowed EIAs to introduce technologies not originally part of VBMPS projects - data loggers, solar rooftop systems and flexi- biogas plants - observing that technology adoption builds trust in DCSs (BCR, 2020). Training and capacity-building were emphasized, magnifying the milk unions' extension efforts, and increasing their outreach and project impact.

Factors subject to World Bank control:

77. **Successful project outcomes were a direct consequence of strong Bank supervision in collaboration with NDDDB and DADF** (see Section IV C). The success factors included: (a) responsive, technically and operationally advanced engagement with NDDDB to define and resolve issues affecting implementation; (b) collaboration with NDDDB to strengthen/upgrade sector-related data systems to global standard, creating a platform for more rigorous analytics, and consistent attention to M&E quality, dissemination and development impact; (c) stable Bank team leadership (single turnover, preparation to closing), with similar stability in the extended team; (d) leveraging project research capabilities and multi-level commitment to technological change by piloting important, scalable innovations; and, (e) a consistently productive, collegial and forward-looking partnership with the client. See also para 90.

78. **NDDDB successfully pioneered Framework Agreements (FA) as the centerpiece of its strategy for improving value-for-money from public contracts under NDSP.** The Bank sanctioned the use of FAs for commonly-needed items and to alleviate delays stemming from EIAs' varied procurement capacity. Successful use prompted expansion of FAs to other Bank-financed projects both in India and other countries using the documents developed for NDSP. About 150 EIAs were using FA at closing, mostly to procure VBMPS-related equipment. World Bank reports (2015 and 2019) captured the FA experience as a learning example for future projects, finding:³⁷(a) EIAs preferred FAs over Shopping/NCB as bid document preparation and bid evaluation were simpler; (b) FA holders offered competitive prices due to the aggregation of requirements; and, (c) EIAs took only 18-25 days to place purchase orders, compared to 120 days for NCB and 30-45 days for Shopping.

Factors outside the control of government and/or implementing agencies: NA

IV. BANK PERFORMANCE, COMPLIANCE ISSUES, AND RISK TO DEVELOPMENT OUTCOME

A. QUALITY OF MONITORING AND EVALUATION (M&E)

79. **M&E Design: (a) The PDO and Theory of Change were clear, and the RF indicators were relevant, measurable and gender disaggregated.** Their meaning/measurement were generally well-described and appropriate for monitoring progress; (b) **M&E arrangements were comprehensive, with project and system**

³⁷ Use of Framework Agreements under National Dairy Support Project (NDSP) – An Evaluation, The World Bank, March 2015; and, Assessment of Framework Agreements under NDSP, World Bank, December 2019.



goals. M&E incorporated: participatory monitoring of physical and financial progress; surveys at baseline, mid-term and completion; and, special thematic studies as determined, as well as smaller, interim annual surveys. Surveys and studies would be conducted by a contracted, external M&E agency; and, monitoring would be decentralized and participatory. Clear institutional arrangements/responsibilities were outlined; (c) **The MIS framework was comparatively advanced, reflecting the project's science and data-analytics foundation and longer-term view.** The MIS included: (i) i-DIS, an Internet-based Dairy Information System used by dairy cooperatives for reporting data on milk procurement; (ii) INAPH, an information network to record data on breeding, nutrition, AI delivery, calf rearing, bull production and RBP; (iii) SSMS, a centralized database under development in NDDDB to report on the activities of SS; and, (iv) the EPM financial database for FM reporting.

80. **M&E Implementation:** M&E implementation performance exceeded expectations: (a) **Data collection, analysis and reporting achieved high standards and multi-level institutional buy-in.** NDDDB (i) collected and organized data in sector-specific data systems; (ii) trained field personnel to conduct decentralized, methodologically sound data collection/entry for the MIS; (iii) facilitated planning and decision-making based on data-driven progress reporting; and (iv) developed and deployed a web-based, single-platform Integrated NDSP Portal using dashboards/user-rights;³⁸ (b) **All studies/reports were delivered and special studies were conducted.** The Baseline was completed in Year 1 and several RF targets were adjusted. Quality Mid-term and Final evaluation reports (End-line Survey) were delivered, and a strong Borrower Completion Report (BCR) supported ICR preparation. Performance of the external monitoring agency (DRS) was exceptionally good throughout. The 16 methodologically sound thematic studies financed are an important analytical legacy for future dairy operations and public policymaking. See Annexes 6 and 7; (c) **Important ICT systems were developed and operationalized.** INAPH is a Desktop/Netbook/Windows/Phone-based field IT application enabling real-time capture of comprehensive data on individual dairy animals. The SSMS monitors supply, demand, production, pricing, revenue and biological parameters (bull fertility, dilution rates); and, (d) **MIS systems (comprising INAPH, SSMS and ERP) are assured of sustainability post-project.** NDDDB mainstreamed the NDSP approach to M&E – evidentiary decision-making based on data-analytics - improving its overall M&E capacity. INAPH was adopted formally as India's National Dairy Information System and its deployment is required for Central Sector Schemes related to animal husbandry and health. INAPH is also the backbone of the National Animal Disease Control Program (NADCP).³⁹

81. **M&E Utilization:** (a) **M&E data, products and best practice cases were utilized extensively by NDDDB** to: monitor and report project implementation progress to the Bank, to other central-level institutional stakeholders and to the IEAs/local stakeholders; support targets and activities for annual project planning; and, to promote knowledge dissemination at workshops and seminars, internally within NDDDB and with partner implementing institutions along the dairy chain and nation-wide, and internationally. NDSP used ICT-enabled tools to replace aging technologies and systems; (b) **Performance and results data had immediate, practical application.** Important examples include: PT/PS, where INAPH monitoring data proved fundamental to complete test inseminations under PT, milk recording, and numbers of daughters/contemporaries evaluated. Without INAPH data, an accurate PT/PS program was not feasible; and, SS biosecurity, where initial coverage rates for FMD were substandard and monitoring these results guided vaccination campaigns (BCR, 2020); and (c) **External studies supported and complemented project implementation,** providing: project-level indicators of progress; evaluation of outcomes/impacts; validation of project progress and course corrections; and, the knowledge supporting national and external

³⁸ The Portal provided Progress Reports and a forum page/help desk. Participatory M&E helped NDDDB to engage EIAs in preparing Subprojects and holding them accountable for M&E.

³⁹ NADCP is an ambitious 5-year project launched by the Prime Minister of India to control FMD and Brucellosis in bovines.



dissemination of NDSP technologies and results.

Justification of Overall Rating of Quality of M&E

82. **The quality of M&E is rated High, with very minor shortcomings in design, implementation and utilization.** The system enabled clear tracking towards achievement of the PDO, went far beyond what was envisaged at appraisal in terms of databases and systems, and produced a body of methodologically sound, well-targeted studies. NDSP ICT systems have been formally mainstreamed/deployed as part of Gol's planning and operational arsenal for dairy industry modernization and mandated as models for other key sectors.

B. ENVIRONMENTAL, SOCIAL, AND FIDUCIARY COMPLIANCE

83. The project was classified as Category B and triggered: Environmental Assessment (OP/BP 4.01), Pest Management (OP 4.09), and Indigenous Peoples (OP 4.10). Compliance is discussed below.

84. **Environment:** Overall environmental compliance was **satisfactory**. A Strategic Environmental and Social Assessment (SESA) was prepared and disclosed in-country on June 14, 2011 and in the Bank's Infoshop on July 4, 2011. An Environmental and Social Management Framework was formulated with suggested mitigation and enhancement strategies.⁴⁰ Mitigation was mainstreamed into project implementation through the RBP and FD programs to manage *inter alia*, livestock-based methane production and the potential for increased free-grazing to harm natural habitats. Some 253 Environment and Social Action Plans (ESAP) out of 477 EIA subprojects, were implemented and monitored regularly. Subproject appraisal included an environmental risk-based categorization. Safeguards best practices were documented, capacity-building was provided to EIAs for managing animal waste and animal health care waste. Regular field visits and awareness programs helped EIAs understand environmental safeguards procedures/practices including safe use by fodder farmers of permissible pesticides under the Pest Management safeguard policy, which showed full compliance. Strategies were identified and discussed with the EIAs for post-project compliance and wider replication.

85. **Social:** NDSP posed no serious social safeguards issues and overall, compliance was **Satisfactory**. The project established a robust institutional mechanism for safeguards implementation covering the project life cycle. Sub-projects were screened for impact categorization, and included mitigation measures, and monitoring and capacity building of stakeholders (including NDDDB and EIAs). Social safeguards were an integral part of sub-projects at the village level, i.e., base-level accountability. The project applied due diligence and no adverse social impacts were reported. NDDDB contracted studies to evaluate NDSP's impact on vulnerable communities, rural youth, women's empowerment and social inclusion of SC and ST (Annex 7).⁴¹ A Bank-recommended social exit strategy was prepared/discussed at a workshop in 2019. The Indigenous Peoples (IP) policy was triggered but set no targets, adopting an inclusive approach and providing equal opportunity for IP to participate in and benefit from, the project. The 2017 Equity Action Plan (EAP) focused on the vulnerable (SC/ST), and set a combined target of 17 percent. At closing, 302,309 producers had benefited from awareness programs on dairy livelihood options, and the SC/ST target of 17 percent was met.⁴²

86. **Grievance Response Mechanism (GRM):** NDSP successfully mainstreamed grievance reporting and

⁴⁰ Strategic Environmental and Social Assessment (SESA) for National Dairy Support Project (NDSP), NDDDB/ERM, June 2011.

⁴¹ Empirical Study on the Impact of Cooperative Development Interventions under the National Dairy Plan I on the Socio-Economic Status of Tribal Milk Producers in Sabarkantha Region. R. Seshapathy/NDDDB, December 2018. See Annex 7.

⁴² The Bank's policy on land was not triggered; all civil works took place on existing land (land data was collected and physically verified during field visits) and followed required steps to ensure due-diligence.



response with a Grievance Redress Officer (GRO) at NDDDB and EIA levels. An online web portal was established and widely publicized at the national, state and village levels and was accessible to all project-affected people (<<http://grs.nddb.coop/>>). The Bank ICR mission noted the prominent display of GRM contact information at all MPPs visited and saw the system in action at the *Shreeja Mahila* DPC, in Andhra Pradesh. All complaints were registered in writing and verbally to the EIA-level GRO who acted in consultation with NDDDB.

87. **Procurement:** Performance and compliance were rated **Satisfactory** throughout. The NDDDB Project Management Unit conducted frequent procurement training for EIAs to build capacity. NDDDB was authorized by the Bank in certain circumstances to assume the procurement of civil works on EIAs' behalf. NDDDB also ranked the EIAs to focus attention on those with highest allocation and lowest percentage funds utilization to resolve procurement problems. NDDDB's contracted global accounting firm by closing had completed 12 rounds of semi-annual procurement post reviews (PPR), none of which identified serious procurement issues/discrepancies. PPRs commonly tagged some areas for improvement. NDDDB follow-up, working with the EIAs, was prompt and effective. Third party quality assurance was contemplated at appraisal and used for both Civil Works and Goods, appropriately given NDSP's vast, decentralized structure. Some 102,000 items were inspected (mostly BMC, milk cans and frozen semen containers) of which about 100,000 were cleared for release. For civil works, inspectors made 175 visits to 15 states and 45 site locations.

88. **Financial Management (FM):** FM performance/compliance were consistently rated **Satisfactory**. FM reviews determined that an adequate FM system was in place to provide accurate and timely information verifying that WB credit proceeds were being used as intended. Reviews also verified that FM staffing was adequate, and that accounting and internal control systems, and maintenance of supporting project documents, were satisfactory. Annual, audited financial reports were submitted on-time to the WB with Unqualified opinions. Any recommended follow-up was prompt. Audits were hosted on the project website for public disclosure. Factors supporting strong FM compliance included: (a) FMS technology, enabling effective management of complex accounts for 477 projects covering 172 EIAs, rapid retrieval of subproject-related financial information, and better monitoring and control over project funds; (b) decentralized, multi-layered audit structure, well-suited for micro-management of a large-scale project with multiple EIAs and project accounts, ensuring that FM practices adopted by the EIAs were on a similar platform and compliant with project guidelines; and (c) frequent, multi-level manpower training/capacity building on project FM guidelines/processes ensuring smooth and relatively problem free FM (BCR, 2020).

C. BANK PERFORMANCE

89. **Quality at Entry:** Quality at entry was sound, resulting from: (a) **close strategic alignment with Gol's defined vision for the dairy industry**. The technical strategy was forward-looking and well-integrated, reflected expert inputs, global experiences, and analyzed needs, and was guided/managed by India's pre-eminent dairy sector institution which had collaborated closely on preparation; (b) **top priority for M&E and specifically, data-analytics**, including devising a plan to strengthen/upgrade existing data systems/structures to support dairying both under the project, and longer-term, and financing an independent M&E agent to manage analytical work; (c) **well-grounded measures to ensure progress**, via rational implementation arrangements and overall support strategy. The framework embedded strong national leadership supporting decentralized implementation. Risks were correctly identified/rated and suggested mitigation was sound, but the issue of qualified manpower needs for a services-oriented project was not mentioned, and the capacity of the pivotally important EIAs was over-estimated (para 69);⁴³ (d) **implementation readiness**, including written

⁴³ Potential start-up delays were barely mentioned. Disease in dairy animals was not mentioned - likely because the PAD envisaged the



commitment in advance from nine states to comply with the project’s policy requirements for participation, plus a set of pre-approved investment subprojects ready for implementation; and, (e) **Bank inputs and processes were timely and substantive, adding value to and validating, final project design.** Quality was also ensured by close engagement of Bank safeguards, fiduciary and sector specialists in ensuring the analytical, technical and operational integrity of project design. The challenges of launching NDSP were under-estimated at appraisal but also largely unavoidable and, as evidenced in project results, were successfully overcome.

90. **Quality of Supervision:** Strong features of Bank supervision included: (a) **19 regularly scheduled supervision missions with appropriate mix of specialists** and field visits to participating States. Intensive Bank supervision and follow-up accelerated progress after incubation-related delays, and continuous contact was maintained with NDDDB headquarters in Anand, Gujarat; (b) **efficient, effective and timely actions** to cancel project funds, extend the Credit closing date to enable the project to succeed, support intensified investment activities to ensure PDO achievement and full disbursement, and activate FA-based procurement to alleviate EIA-level bottlenecks and promote efficiency; (c) **priority attention to development impact and results.** Bank collaboration with NDDDB, the contracted M&E firm and Indian research and consulting bodies helped to ensure high quality analytical products, setting an M&E benchmark. Supervision reporting was candid, closely tracking progress to ensure links with results/impact; (d) **collaborative, technically advanced working partnership with NDDDB.** This inspired mutual confidence and trust, enabling the Bank team *inter alia*, to collaborate with NDDDB on framing a potential NDSP follow-on. The BCR (2020) commends Bank supervision, highlighting: timely, appropriate support stressing problem-solving; consistently timely release of project funds; clear/detailed project reporting; strong, multi-level procurement support including FA facilitation and rapid resolution of issues; “phenomenal” technical support including at the field level; and, focus on innovative solutions and a longer-term perspective; (e) **crucially important, the project had just two Bank Task Team Leaders from preparation through closing.** The multi-disciplinary team assembled for preparation also experienced little turnover throughout (as the PAD intended), as did the extended, India-based Bank team. Similar stability in NDDDB cemented the strong/durable working relationship; and, (f) **exploiting opportunities to leverage innovative activities** with longer-term implications and demonstration effects (Section II), and collaboration with NDDDB on mainstreaming NDSP’s cutting-edge data analytics and ICT applications in the dairy industry.

Justification of Overall Rating of Bank Performance

91. **Bank performance is rated Satisfactory.** Project preparation/design, which leveraged the experiences and lessons of similar operations, was closely aligned to the expressed needs of Indian smallholder dairy farmers, and strategically well-anchored. Supervision was highly effective, responsive and focused on results and sustainability. Close Bank supervision follow-up and technical guidance supported NDDDB’s heavy responsibility under this complex and important operation, to fully achieve NDSP objectives.

D. RISK TO DEVELOPMENT OUTCOME

92. The risk to development outcome post-NDSP is moderated by the following: (a) **NDSP provides a roadmap for the National Dairy Plan, Phase II.** The policy and strategic environment remains broadly supportive, along with the strong social and economic rationale for consolidation and continued expansion of NDSP’s proven technologies beyond the 10 percent of dairy producers, mostly smallholders, supported under the first stage; (b) **Sustainability of NDSP’s decentralized institutions/structure and village-level operations is likely.** Studies analyzed the sustainability of the DCS, and of the EIAs (Milk Unions), with generally positive

“integration of veterinary support” across all breeding and feeding activities.



outlooks tempered by recommendations for focused attention. See Annex 7; ⁴⁴ (c) **EIAs grew their business side rapidly and acquired modern equipment, systems and skills.** The project invested in data systems – INAPH, SSMS and ERP - and built capacity to support EIAs as dairy businesses. However, their staffing strength has been depleting for lack of HR plans and strategies and this needs close attention; ⁴⁵ (d) **Sustainability of the LRPs appears positive, compared to earlier, more negative forecasts.** The reasons for attrition are understood. Much depends on expanded functions like an extension agent, e.g., combining the LRP, MAIT and milk recorder functions to provide a livable income. Women LRPs may be more sustainable because they seek part-time income, are less likely to out-migrate for jobs, and their performance is highly rated. To increase retention based on expanded roles, NDDDB trained 1,203 LRPs in dairy animal management late in the project, equipping them to offer a wider range of services including CF; (e) **Future engagement of youth in dairying as an occupation may depend on women.** A 2017 study showed that knowledgeable youth are concerned about dairy sector prospects.⁴⁶ The local context and agro-climatic environment are the main influencing factors; (f) **RBP has proven effectiveness and its sustainability is likely.** While NDSP made financial provision for two years, most Milk Unions ran the RBP until end-of-project and were keen to continue. Some used their own resources while others scaled-up by deducting a small sum per liter of milk procured or bag of cattle feed sold. Producers are demanding that EIAs continue RBP and many are doing so, e.g., the State of Maharashtra allocated funds to implement RBP in 3,000 villages, post-project; (g) **DPCs established under NDSP demonstrate promising financial sustainability.** A World Bank study (2020) asserts that the liquidity, solvency and efficiency of new DPCs is average with an overall upward trend. Recommendations are made to boost financial strength and viability. See Annex 8; and, (h) **Sustainability and expansion of the NDSP breeding program is likely.** Sustainability of AI depends on farmers' willingness to pay for doorstep delivery of AI services, the conception rates achieved, and continued adherence to SOP. Gol/DAHD is continuing the PT/PS projects under the *Rashtriya Gokul* Mission Scheme.⁴⁷

V. LESSONS AND RECOMMENDATIONS

93. **NDSP demonstrated the transformational potential of a tightly focused, science-based project led by an experienced, technically sophisticated apex institution.** As a corollary, NDSP represents a persuasive argument for doing large-scale projects in India when the lead agency has national capacity, and when a disciplined approach limits project scope to a set of essential, proven and well-integrated activities. This construct – especially at scale and in dairying - is highly dependent on trained manpower at all levels and along the dairy chain, the goal being to professionalize smallholder dairying and its support services. A well-executed strategy for bringing more women into the manpower equation, complemented by learning applications accessible from smartphones, can support the human resource coordination and management effort involved.

94. **Data collection and analytics can successfully drive project implementation, anchor needed course correction and allow transparent and objective assessment of impact.** INAPH, with its multi-million data records, is now at national scale and officially mainstreamed. This system permits the calculation of EBVs and estimation of genetic progress. Milk recording and production costs captured in INAPH on 2.85 million milch animals support the business case for optimal nutrition management as a least-cost, productivity-enhancing approach. NDDDB's use of INAPH data in scheduled regional review meetings with EIAs allowed objective assessment of implementation progress and the formulation of action plans to prevent and recoup delays. It is recommended that opportunities for replication/adaptation of this system in new, similar

⁴⁴ Report on Sustainability of Dairy Cooperative Societies Organized under National Dairy Plan I, IRMA Anand, April 2019.

⁴⁵ Study of Human Resource Needs of the End Implementing Agencies (Milk Unions) in NDSP, IRMA Study Team, 2019.

⁴⁶ Research Report: Understanding Existing Knowledge/Skill Level and Attitude/Motivation of Rural Youth towards Dairying as an Employment Activity in NDP I Intervention Villages, IEG, Anand Gujarat, 2017

⁴⁷ Gol scheme – implemented at State level - to conserve and develop indigenous breeds (cattle and buffalo) in a focused, scientific manner.



projects be explored.

95. **The benefits of RBP and Fodder Development transferred to a receptive clientele cannot be overstated and are supported by the results in milk productivity and quality.** Tangible, measurable gains emerge rapidly when the RBP regime is correctly delivered, adopted and practiced, and *en masse* when channeled through the DCSs and DPCs. The resulting boost in producer incomes motivates further growth in DCS/DPC membership and producers' commitment to the wellbeing of their animals and to milk quality. A major co-benefit of RBP is reduced GHG emissions and water footprint, a message which needs constant reiteration. Animal nutrition should figure prominently in efforts to modernize smallholder dairying; the instruments for delivering such services/messages must be both financially and technically sustainable.

96. **Access to the organized market is the basic initial requirement to promote increased productivity.** Unless a producer sees increased direct remuneration from selling more and higher quality milk, there is little incentive to invest in productivity-enhancing technologies. The VBMPs unequivocally provided this incentive. That said, the enabling conditions for the VBMPs as designed may not be easily replicated outside India, as they depend on a well-established system of cooperatives, village and matrix organizations, a technically and operationally advanced and well-connected lead institution, IT connectivity and economies of scale. Careful consideration is needed of whether such system can be used/adapted to other conditions and contexts.

97. **The future sustainability of smallholder dairying – and hence the rationale for investment - rests on an expanded role for women and, attracting and retaining youth.** This hinges on making dairying a financially attractive profession. Research shows that women express the intention of either taking up or continuing in dairying at levels three-fold those of men, due to their cultural, social and economic status and degree of empowerment. It is recommended that the Bank's support to smallholder-focused dairy stress its modernization, i.e., science-based, data-driven and business-oriented, to dairy households and through DCSs and DPCs, and that women's engagement, inclusion, capacity building and leadership be a major focus.

98. **Policy reform as an element of project design can significantly strengthen the enabling environment for project execution.** The link between policy and the success of project activities should be explicit upstream to encourage adherence. The quantitative results of pilot doorstep delivery of AI demonstrate how resistance to needed policy reforms can hinder a project's ability to deliver innovation at scale. NDSP met the quality targets on pilot doorstep AI delivery but the political economy of state-level AI delivery is still evolving. In the face of COVID19, the Government of India is rethinking and retooling the agricultural policy agenda. It is advised that state-level policy dialogues be strengthened and linked to the business case for dairying to expedite needed reforms.

99. **Stability in the Bank and Borrower teams from preparation through closing deepened the dialogue in the dairy sector permitting more comprehensive solutions to emerge.** The collective institutional memory and mutual trust built up over time between the Bank and NDDP teams, generated/seeded complementary pilot actions and innovations such as biogas, milk fortification and cutting-edge breeding techniques with potentially wide application. The depth and stability of the relationship between the Bank and NDDP teams also permitted candid and sometimes difficult discussions to play out, leading to better quality responses to project needs and ultimately, strong project results. Informed consideration of the benefits of leaving a Bank TTL and/or team in place for longer than normally contemplated is recommended, based on a project's overall status, context and importance.



ANNEX 1. RESULTS FRAMEWORK AND KEY OUTPUTS

A. RESULTS INDICATORS

A.1 PDO Indicators

Objective/Outcome: increase the productivity of milch animals in the project areas

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Percent Increase in milk production per animal	Percentage	0.00	10.00		21.00
		29-Feb-2012	31-Dec-2017		29-Nov-2019

Comments (achievements against targets):

Target exceeded: 210 percent This result was measured using the weighted average of the daily milk yield per in-milk animal, for indigenous cows, cross-breds and buffaloes. The target was a 10 percent increase over the baseline average of 5.03 liters/day/dairy animal (i.e., 5.53 liters/day/animal). As per the Endline Survey (2019), average daily milk production per dairy animal increased from a baseline of 5.03 liters/day to 6.09 liters/day, an increase of 21 percent over baseline. The same study shows the control group averaging 5.68 liters/day/dairy animal, compared to the Treatment Group's 6.09, a difference of 7.2 percent. This PDO Indicator is linked mainly to the effects of the RBP intervention – complemented by the Fodder Development program - where the in-milk productivity of an animal was expected to increase due to the propagation and adoption of scientific feeding. The growth in animal productivity was noted across all categories of animals, but the crossbred cows contributed the most to achieving this growth. (The same species pattern was seen in the control group).

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
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Proportion of in-milk female animals to adult female animals	Percentage	63.00 29-Feb-2012	66.00 31-Dec-2017		68.00 29-Nov-2019
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Comments (achievements against targets):

Target exceeded: 103 %. The PAD baseline figure of 60 % was an estimate; the 2013 Baseline Survey calculated a baseline of 63% (as shown here) which (as foreshadowed in the PAD) led to the PAD target also being adjusted from 63% to 66% to reflect the three-percentage point change in the baseline. Baseline estimates were made for the entire project area, whereas Endline Survey (2019) estimates were adjusted for coverage differences to make them comparable to the project area. As explained in the Endline Survey, the in-milk to adult female ratio is an indicator of scientific animal management practices. The higher the ratio, the more animals that are in lactation at any point of time and thus there is more milk production. For improvement in this ratio, scientific animal breeding coupled with proper animal nutrition and health care are essential. Under NDSP, the change in this parameter was envisaged to come mainly from the RBP (feeding/nutrition) intervention as genetic improvement through animal breeding is a longer-term process. Thus, the impact of breeding interventions was not envisioned on the “wet ratio” of the herd within the project lifetime. The proportion of in-milk female animals - taking all categories together - to adult female animals, increased 5 % over the baseline value, compared to the targeted 3 percent. At the aggregate level, this ratio was 2 percent higher in the program (or treatment/intervention) area than the control area, which registered 66 %.

Objective/Outcome: improve market access of milk producers in project areas

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Percent increase in share of milk sold to the organized sector	Percentage	45.00 29-Feb-2012	56.00 31-Dec-2017		75.00 29-Nov-2019

Comments (achievements against targets):

Target exceeded: 134.0 %. The Baseline Survey resulted in adjustment of the original PAD target of 25 percent to 56 percent, on which the actual achieved outcome is based. The Baseline Survey of 2013 updated the baseline value to 45%. The organized milk processing sector includes cooperatives, Producer Companies and milk sold directly to the organized private sector and these were separately monitored by the project. The primary market was the VBMPS at village level which provided an organized, digital milk weighing, testing and pricing system based on merit and transparency. The Endline Survey (2019)



reports that this PDO indicator is related mainly to the Village-based Milk Procurement System (VBMPS) intervention. It was expected that improvement would come from increased institutional access for milk producers to sell their product. Data on the proportion of milk sold (as a share of production) to the organized sector by NDSP participants shows a result of 75 percent, higher by 19 percentage points over the expected value of 56 percent. This indicator was found to be much higher in the program (treatment/intervention) area (75 percent) compared to the control area (51 percent) by end-of-project.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Proportion of total milk sold to total production	Percentage	65.00 29-Feb-2012	65.00 31-Dec-2017		74.30 29-Nov-2019

Comments (achievements against targets):

Target exceeded: 114.3%. The original PAD baseline value was 54% but was increased to 65% following the 2013 Baseline Study. The Indicator was intended to help track milk sales relative to domestic consumption. The Endline Survey (2019) states that it was envisaged that the incremental milk production quantity due to planned NDSP interventions would proportionately increase milk consumption and sale at the Household level – meaning that the incremental milk production would fetch higher income for a family, but without compromising family nutrition. Survey findings showed that there was in fact, a more substantial increase than expected in sales relative to production. The proportion of average production sold by program (intervention) producers was 74.3% at completion compared to the baseline and target of 65%. Milk sales proportional to production by the control averaged only marginally less, at 72.3%. Average production and sale by the intervention group was 10.9 liters/8.1 liters respectively and for the control group 9.4 liters/6.8 liters respectively. Sales are actually moving in the direction to be expected under higher productivity, and there is no indication that milk producer families are trading milk sales for household milk consumption. Further, women are heavily involved in the smallholder dairy sector while simultaneously caring for children, and unlikely to sacrifice their nutrition for sales. Daily consumption of milk in India has stayed fairly stable at around 350-375 grams per day. A rough estimate indicates that a family of five would thus need some 1.5 to 2 kg (or liters) per day, indicating the quantity of milk notionally available for sale under the average daily production registered by the Endline Survey of 10.9 liters/day per household.



A.2 Intermediate Results Indicators

Component: Productivity Enhancement

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Number of genetically improved bulls produced through the Progeny Testing Program	Number	25.00	2025.00		2185.00
		29-Feb-2012	31-Dec-2017		29-Nov-2019

Comments (achievements against targets):

Target exceeded: 107.9%. The PAD target was an absolute number of bulls produced annually, totaling 2000. The target was increased to 2025 by the Baseline Survey (2013), as foreshadowed by the PAD as a potential outcome of the Baseline Survey to be done in Year 1.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Number of semen doses produced	Number	56000000.00	100000000.00		119070000.00
		29-Feb-2012	31-Dec-2017		29-Nov-2019

Comments (achievements against targets):

Target exceeded 119%. Target values shown in the PAD were annual. The indicator is explained as doses produced at existing and new Semen Stations (nation-wide, including NDSP-supported SS). The 2013 Baseline showed 56 million doses were produced India-wide, the project target was set at 100 million (India-wide, all Semen Stations) and the achievement was 119 million. Production of semen doses from the NDSP-approved subprojects (26 refurbished and 2 new Semen Stations) was 88.18 million compared to an annual target of 122.74 million (72%). However, while the number of semen



doses produced by the 28 NDSP-supported SS fell short of their internal target, the 88.18 million doses represented over 74 percent of total semen produced nationwide, compared to 26 percent produced by the other 26 SS.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
AIs done annually	Number	0.00	3800000.00		783000.00
		29-Feb-2012	31-Dec-2017		29-Nov-2019

Comments (achievements against targets):

Modest achievement: 20.6%. Target values were annual. This indicator was interpreted narrowly throughout project implementation as pertaining only to pilot AI doorstep delivery. The Main Text Section III of the PAD permits a broader interpretation of AI delivery. The reasons for weakness in AI delivery are explained in the Main Text, Section III B.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Animals covered by RBP	Number	10000.00	2700000.00		2865763.00
		29-Feb-2012	31-Dec-2017		29-Nov-2019

Comments (achievements against targets):

Target exceeded: 106.1%. PAD target values were cumulative.



Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Villages covered by RBP	Number	400.00	40000.00		33374.00
		29-Feb-2012	31-Dec-2017		29-Nov-2019

Comments (achievements against targets):
Substantial achievement: 83.4%. PAD target values were cumulative.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Number of genetically improved bulls produced through Pedigree Selection Programme	Number	0.00	500.00		271.00
		29-Feb-2012	31-Dec-2017		29-Nov-2019

Comments (achievements against targets):
Modest achievement: 54.2%. The PAD target value is annual (hence summed) over the project implementation period. Implementation difficulties limited achievement (see Main Text Section III), but the scale and results achieved are sufficient to validate proof of concept and approach under Indian conditions. Modest achievement is mainly due to less demand for the bulls of certain Indigenous (all indigenous breeds except Gir and Sahiwal) breeds for semen production.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
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Number of villages covered by Artificial Insemination	Number	0.00	24000.00		12322.00
		29-Feb-2012	31-Dec-2017		29-Nov-2019

Comments (achievements against targets):
 Modest achievement: 51.3%. PAD target values are cumulative. Reasons for this level of achievement are discussed in Main Text Section III B.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Artificial Insemination Conception Rate	Percentage	30.00	45.00		46.00
		29-Feb-2012	31-Dec-2017		29-Nov-2019

Comments (achievements against targets):
 Target exceeded: 102.2%. This was a major achievement in the Indian context and competitive with countries with older, more advanced AI programs. Target values - and results - are for AIs under the AI Doorstep Delivery pilot, implemented by Milk Producer Companies.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Reduction in cost of feeding per kg milk for animal under RBP	Percentage	0.00	7.00		10.20
		29-Feb-2012	31-Dec-2017		29-Nov-2019

Comments (achievements against targets):
 Target exceeded: 145.7%. The result of 10.2% is the average of Dairy Cooperatives (11.8%) and Milk Producer Companies (8.3%). Measurement refers to



cost per milch animal covered under RBP and reduction in cost after the first RBP intervention.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Trained MAITs in the project	Number	0.00	3000.00		1330.00
		29-Feb-2012	31-Dec-2017		29-Nov-2019

Comments (achievements against targets):

Modest achievement: 44.3%. This indicator measures MAITs under the pilot AI doorstep delivery that successfully completed the training and were inducted into the program. PAD target values are cumulative.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Trained Local Resource Persons (LRPs) in the project	Number	400.00	40000.00		32787.00
		29-Feb-2012	31-Dec-2017		29-Nov-2019

Comments (achievements against targets):

Substantial achievement: 82%. PAD target values are cumulative.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
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Reduction in methane release per kg milk for animals under RBP	Percentage	0.00 29-Feb-2012	10.00 31-Dec-2017		13.80 29-Nov-2019
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Comments (achievements against targets):

Target exceeded: 138%. This measures methane reduction in dairy animals covered under RBP (Ration Balancing Program). Reductions in enteric methane emission in lactating cows and buffaloes as a result of scientific feeding practices (RBP) are captured in two NDSP-financed studies summarized in Annex 7.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Increase in proportion of area under green fodder with certified/truthfully labeled seeds	Percentage	0.00 29-Feb-2012	80.00 31-Dec-2017		227.00 29-Nov-2019

Comments (achievements against targets):

Target exceeded: 284%.

Component: Milk Collection and Bulking

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Additional number of villages covered for milk collection	Number	0.00 29-Feb-2012	31900.00 31-Dec-2017		52509.00 29-Nov-2019



Comments (achievements against targets):

Target exceeded: 164.6%. PAD target values are cumulative. The PAD divided this target into 39,259 DCS villages and 13,250 DPC villages. Target DCS = 11,900, achieved 39,259 (330%); and Target DPC = 20,000, achieved 13,250 (66.25%). Results were monitored in aggregate.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Targeted clients who are members of an association (percentage)	Percentage	0.00 29-Feb-2012	100.00 31-Dec-2017		100.00 29-Nov-2019
Targeted clients who are members of an association - male (number)	Number	0.00 29-Feb-2012	1275000.00 31-Dec-2017		2760430.00 29-Nov-2019
Targeted clients who are members of an association – female (number)	Number	0.00 29-Feb-2012	425000.00 31-Dec-2017		998607.00 29-Nov-2019
Targeted clients - male (number)	Number	0.00 29-Feb-2012	1275000.00 29-Nov-2019		2760430.00 29-Nov-2019
Targeted clients - female (number)	Number	0.00 29-Feb-2012	425000.00 29-Nov-2019		998607.00 29-Nov-2019



Comments (achievements against targets):

Target achieved: 100%, of which: (i) Male members were 216.5% of target; and, (ii) female members were 235% of target. NOTE: Portals does not permit separate entry of achievement under sub-categories of male/female.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Direct project beneficiaries	Number	0.00	1700000.00		3759037.00
		29-Feb-2012	31-Dec-2017		29-Nov-2019
Female beneficiaries	Percentage	0.00	33.00		29.00
			08-Feb-2018		

Comments (achievements against targets):

Target exceeded: 221.1%, of which Female beneficiaries were 29% compared to the target of 33% (87.9%)

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Additional Milk producers organized or enrolled into Dairy Cooperative Societies (DCS)	Number	0.00	600000.00		853154.00
		29-Feb-2012	31-Dec-2017		29-Nov-2019



Comments (achievements against targets):

Target exceeded: 142.2%. PAD target values are cumulative. Smallholders are farmers with 3 or less milk-producing animals.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Milk Producers covered by Producer Companies (PCs)	Number	0.00	600000.00		834400.00
		29-Feb-2012	31-Dec-2017		29-Nov-2019

Comments (achievements against targets):

Target exceeded: 139.1% The PAD broke this total down into number of Females, and number of Smallholders. Female: Target 150,000, achieved 346,047 (230.7%). Smallholders: Target 450,000, achieved 498,570 (110.8%). PAD target values are cumulative. Smallholders are farmers with 3 or less milk-producing animals.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Milk Quality based on MBR time	Minutes	30.00	90.00		126.00
		29-Feb-2012	31-Dec-2017		29-Nov-2019

Comments (achievements against targets):

Target exceeded: 105%. MBR (methylene blue reduction) time is a test to indicate the bacteriological load in milk. It was conducted at the BMC level (Bulk Milk Chiller). Results show Cooperatives Min. 60/Max. 280 and Producer Companies Min. 58/Max. 133. MBR Timing was recorded in the NDSP MIS. Against a target of 90 minutes by end-of-project, more than 95% of Dairy Cooperative Societies covered by the VBMP program had exceeded the targeted 90 minute Methylene Blue Reduction Time (BCR, 2020).



B. KEY OUTPUTS BY COMPONENT

Objective/Outcome 1: Increase the productivity of milch animals	
Outcome Indicators	<ol style="list-style-type: none"> 1. Percentage increase in milk production per animal: 15 percent (original target: 10 percent) 2. Proportion of “in-milk” female animals to adult female animals: 67 percent (original target: 66 percent)
Intermediate Results Indicators	<p>Component A: Productivity Enhancement</p> <p>Component A1: Animal Breed Improvement</p> <ol style="list-style-type: none"> 1. No. genetically improved bulls produced through PT program: 2,185 (target: 2,025) 2. No. genetically improved bulls produced through PS program: 271 (target: 500) 3. No. semen doses produced: 119.2 million (target: 100 million) 4. No. villages covered by AI: 12,322 (target: 24,000) 5. No. AI done annually: 0.783 million (target: 3.8 million) 6. AI conception rate: 46 percent (target: 45 percent) 7. No. trained, mobile AI technicians (MAIT): 1,330 (target: 2,740) <p>Component A2: Animal Nutrition</p> <ol style="list-style-type: none"> 1. No. villages covered under RBP: 33,374 (target: 40,000) 2. No. animals covered by RBP: 2.87 million (target: 2.7 million) 3. Percent reduction in cost of feeding per kg of milk for animals covered by RBP: 10.2 percent (target: 7 percent) 4. Percent increase in proportion of area under green fodder with certified/truthfully-labeled seeds: 157 percent (target: 80 percent) 5. No. trained Local Resource Persons (LRP) in the project: 32,787 (target: 40,000) 6. Percent reduction in methane release per kg of milk through RBP: 13.8 percent (target: 10 percent)



<p>Key Outputs by Component (linked to the achievement of Objective/Outcome 1)</p>	<p>Component A1: Animal Breed Improvement</p> <ol style="list-style-type: none"> No. PT projects implemented: 14 (no target) No. PS Selection projects male calves distributed: 249 (target: 501) No. dairy animals put to Milk Recording: 28,830 (no target) No. Calf Rallies organized to promote AI: 44 (no target) No. Semen Stations strengthened by the project: 28 (target: 28) No. pure-bred bulls imported (Holstein, Friesian and Jersey): 171 (no target) No. of imported embryos (Holstein/Jersey) transferred: 824 (target: 835) No. resulting male (Holstein/Jersey) calves made available for distribution to SS: 88 (target: 108) No. village-level meetings to create AI awareness: 32,000 (no target) No. villages covered by MAITs: 12,322 (target: 23,800) <p>Component A: Animal Nutrition</p> <ol style="list-style-type: none"> No. villages covered by RBP: 33,389 (no target) No. smallholder farmers covered by RBP: 1.63 million (no target) No. women farmers covered by RBP: 572,548 (no target) No. ST/SC farmers covered by RBP: 300,312 (no target) No. dairy animals covered by RBP: 2.0 million (no target) No. LRPs inducted to deliver RBP doorstep Services: 32,787 (no target) Land brought under fodder production: 603,720 ha (no target) No. fodder seed processing plants established: 7 (target: 7) Fodder seed sales: 30,185 MT (target: 20,330 MT) No. farmers covered under Fodder Development program: 2,033 (no target)
<p>Objective/Outcome 2: Improve market access of milk producers in the project area</p>	
<p>Outcome Indicators</p>	<ol style="list-style-type: none"> Proportion of total milk sold to total production: 66 percent (target: 65 percent) Percentage increase in share of milk sold to the organized sector (as a share of production): 59 percent (target: 56 percent)
<p>Intermediate Results Indicators</p>	<p>Component B: Milk Collection and Bulking</p> <ol style="list-style-type: none"> No. additional milk producers organized into Dairy Cooperative Societies (DCS): 853,154 (target:



	<p>600,000)</p> <ol style="list-style-type: none"> 2. No. milk producers covered by Producer Companies (PC): 834,400 (target: 660,000) 3. Additional number of villages covered for milk collection:⁴⁸ 52,509 (target: 31,900) 4. Milk quality based on Methylene Blue Reduction time: 126 minutes (target: 120 minutes) 5. Targeted clients who are members of an association of which Male/Female: 100 percent (target: 100 percent) 6. Targeted clients – Male: 2.76 million (target: 1.28 million) 7. Targeted clients – Female: 998,607 (target: 425,000) 8. Direct project beneficiaries, of which Female: 3.76 million of which Female 1.1 million or 29% (target: 1.7 million of which women 33 percent or 561,000)
<p><u>Key Outputs by Component</u> (linked to the achievement of the Objective/Outcome 2)</p>	<p>Component B: Milk Collection and Bulking</p> <ol style="list-style-type: none"> 1. No. VBMPs subprojects implemented: 243 (no target) 2. No. Villages covered: 52,471 (target: 31,900) 3. No. New villages covered: 21,361 (target: 21,188) 4. No. Bulk Milk Chillers installed: 4,209 (target: 4211) 5. No. AMCU/DPMCU (VBMPs facilities) installed: 29,577 (target: 29,582) 6. Additional milk procured per day by EOP: 5.37 million kg/day (no target) 7. No. Additional producers enrolled in DCS and DPC: 1.686 million 9. No. Participating ST/SC: 1.135 million (no target)

⁴⁸ The PAD Results Framework divided this target into: (i) total villages under Dairy Cooperative Societies (DCS), target 11,900; and (ii) total villages under Dairy Producer Companies (DPC), target 20,000, but monitored results in aggregate.



ANNEX 2. BANK LENDING AND IMPLEMENTATION SUPPORT/SUPERVISION

A. TASK TEAM MEMBERS

Name	Role
Preparation	
Deepak Ahluwalia	Task Team Leader, Senior Economist
Rabih Karaky	Senior Economist
Severin Kodderitzsch	Country Sector Coordinator
Mohan Gopalakrishnan	Sr. Financial Management Specialist
Elliot Wamboka Mghenyi	Economist
Yash Gupta	Procurement Specialist
Nagaraju Duthaluri	Sr. Procurement Specialist
Mohammad Hasan	Sr. Social Development Specialist
Varun Singh	Social Development Specialist
Anupam Joshi	Environmental Specialist
Vijaysekar Kalavakonda	Sr. Insurance Specialist
Shruba Purkayastha	Sr. Private Sector Development Specialist
Juan Carlos Alvarez	Sr. Counsel
Henry K. Bagazonzya	Sr. Financial Sector Specialist
Helen Leitch	Sr. Agriculture Specialist
Jacqueline Julian	Operations Analyst
Deborah Lee Ricks	Program Assistant
Sarita Rana	Sr. Program Assistant
Supervision/ICR	
Edward William Bresnyan, Shanker Lal	Task Team Leaders (2015-2019)
Deepak Ahluwalia	Task Team Leader (Preparation- 2015)
Sreenivas Devarakonda	Procurement Specialist(s)
Mohan Gopalakrishnan	Financial Management Specialist
Ama Esson	Team Member
Lalita Srinivas	Team Member



Anupam Joshi	Team Member
Surbhi Dhingra	Social Specialist
Vanitha Kommu	Environmental Specialist
Amanullah Alamzai	Team Member
Helen Leitch	Sr. Livestock Specialist
Mishu Siddika	Agricultural Economist
Samjhana Thapa	Sr. Agricultural Economist
Francis Addeah Darko	Economist (Young Professional)
Anna Roumani	Main Contributing Author, ICRR

B. STAFF TIME AND COST

Stage of Project Cycle	Staff Time and Cost	
	No. of staff weeks	US\$ (including travel and consultant costs)
Preparation		
FY10	38.938	209,316.53
FY11	67.371	220,300.54
FY12	25.933	92,825.52
Total	132.24	522,442.59
Supervision/ICR		
FY11	0	9,239.20
FY12	10.360	36,232.44
FY13	42.384	146,159.29
FY14	26.968	136,046.59
FY15	14.355	92,217.22
FY16	15.647	90,334.44
FY17	17.264	112,226.04
FY18	15.113	316,399.22
FY19	14.049	287,652.95
FY20	25.518	190,351.01
Total	181.66	1,416,858.40



ANNEX 3. PROJECT COST BY COMPONENT

Components	Amount at Approval (US\$M)	Actual at Project Closing (US\$M)	Percentage of Approval (US\$M)
A. Productivity Enhancement	258.30	132.30	51.21
A.1 Animal Breed Improvement	164.30	89.37	54.40
<i>A1 (i) Bull Production</i>	65.90	36.86	55.93
<i>A1 (ii) Semen Production</i>	58.40	41.53	71.11
<i>A1 (iii) Artificial Insemination</i>	40.00	10.99	27.47
A.2 Animal Nutrition	94.00	42.93	45.67
<i>A2 (i) Ration Balancing Program</i>	79.70	32.97	41.37
<i>A2 (ii) Fodder Development</i>	14.30	9.96	69.65
B. Milk Collection and Bulking	166.30	151.33	91.00
Project Management and Learning	29.30	10.95	37.37
Total	453.90	294.58	65.00

Source: NDDB 2020

Graph 1: US Dollar to Indian Rupee Exchange Rate 2010-2020





Table 1: Project Financing in SDR

Entity	Original Amount (SDR)	Revised Amount (SDR)	Actual Disbursed (SDR)
World Bank Financing			
IDA-50740	218,715,049	155,868,049	155,868,000
Total:	218,715,049	155,868,049	155,868,000
Non-World Bank Financing			
Borrower/Recipient	24,294,768	15,586,800	15,586,800
Milk Unions & Producer Companies	39,020,753	24,938,880	43,377,610
Total:	63,315,521	40,525,680	58,964,410
Total Project Cost:	282,030,570	196,393,680	214,832,410

Source: World Bank 2020



ANNEX 4. EFFICIENCY ANALYSIS

1. **Scope of the analysis.** Similar to the ex-ante Economic and Financial Analysis (EFA), project benefits for the ex-post EFA are measured for two NDSP components: (a) Component A - *Productivity Enhancement*, which increased milk productivity through HGM bull production, semen station strengthening, pilot delivery of AI services and animal nutrition ; and (b) Component B - *Milk Collection and Bulking*, which improved access to markets by investing in village level milk collection and bulking facilities and formation of DPCs and DCSs.
2. The project covered 18 States in India: Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, Telangana, Uttarakhand, Jharkhand, and Chhattisgarh. These states together account for 90 per cent of the country’s milk production.
3. **Ex-post Economic and Financial Analysis.** The ex-post analysis calculates costs and benefits for each of the components separately and aggregates to derive net project benefits. The project’s benefits are quantified separately for indigenous and cross bred cattle and for buffaloes. The ex-ante EFA grouped participating States into two broad “zones”. In Zone 1 (i.e., five States where DPCs were promoted) all project activities including HGM bull production through PT/PS, SSS strengthening, pilot AI, RBP, and VBMPS were covered. The remaining States were classified under Zone 2, where only RBP and VBMPS’s benefits were included in the analysis. Actual project implementation showed EIA sub-projects had a wider coverage than expected at appraisal (Table 1), with RBP sub-projects supported in all participating States. VBMPS sub-projects were also included in virtually all participating States, while SSS sub-projects were financed in 16 of the 18 participating States. While PT/PS sub-projects were implemented in selected States, the benefits from these activities are nationwide. Hence, it was determined that for the ex-post EFA, separation of benefits across zones and States was considered unnecessary.

Table 1: EIA Sub-projects supported by State

Participating States	PT/PS	SSS	Pilot AI Delivery	RBP	FD	VBMPS	Import Bulls/ Embryos
Andhra Pradesh	1	1	1	5	2	10	
Bihar				10	9	13	
Centralized							4
Chhattisgarh		1		1		2	
Gujarat	3	5	1	12	7	27	2
Haryana	1	2		5	3	13	
Jharkhand	0			1		1	
Karnataka	0	2		13	5	29	
Kerala	0	3		5		8	
Madhya Pradesh	0	1		8	1	6	
Maharashtra	1	2		9	7	28	2



Odisha	0	1		6	3	12	
Punjab	2	1		5	3	20	
Rajasthan	4	1	1	10	5	21	
Tamil Nadu	0	3		11		14	
Telangana	0	1		3	1	6	
Uttar Pradesh	1	1	1	5	5	15	
Uttarakhand	0	1		4			1
West Bengal	0	2		4	1	18	1
TOTAL	13	28	4	117	52	243	10

4. **Component A: Productivity Enhancement** – This component accounted for 45 percent of total project cost, which included HGM bull production, semen production, pilot AI service delivery and animal nutrition, including fodder development.

5. HGM breed improvement, semen production and pilot AI services. The project supported PT and PS programs, which together made available 2456 HGM bulls of major dairy breeds of cattle and buffalo to the fifty-four SS nationwide. These HGM bulls were produced from four PT subprojects across six breeds (2,185 bulls) and nine PS subprojects covering eight breeds (271 bulls). Prior to NDSP, the majority of the 54 SS had poor infrastructure and lacked biosecurity measures, with risk of spreading disease through the semen produced. NDSP upgraded 27 SS through civil works and rehabilitation to produce high-quality, disease-free semen doses. In select States, DPCs implemented pilot AI Delivery services by recruiting and training 1,330 MAITs who followed SOPs. The MAITs also played a key role in raising awareness about IBR control and FMD vaccination. During project implementation, the semen strengthening program led to an average annual production of 88 million semen doses from the 27 SS. This resulted in an estimated 27 million AI from the frozen semen doses produced by the stations⁴⁹. These breeding activities under the SS programs led to *increased milk productivity through better genetics and, using SOPs, has increased the AI conception rate, which in turn reduced the inter-calving period.*

6. Increased milk productivity due to improved genetics. The ex-ante EFA stated that without the project (WOP), due to limited breed improvement programs in India, improved genetics would have made a negligible contribution - about 0.2% annual productivity growth. With project (WP), milk productivity due to greater emphasis on genetic improvement through HGM bull production has increased by 3% for daughters of indigenous cows and 1% for daughters of crossbred milking in 3rd year. For buffaloes milking in the 4th year, milk productivity due to improved genetics increased by 0.9%. From the animal breeding program through support to semen stations, milk productivity benefits started accruing on the 4th year. Average annual growth in milk productivity due to project-improved genetics up to the end of the project was 1.8% compared to only 0.2% WOP.

7. Reduced inter-calving period due to increased conception rate. Before the project, average AI conception rate for bovines was 35%. By adhering to SOPs and training of AI technicians, combined with improved the nutrition through RBP (see para 7), conception rate has increased to 43% (BCR, 2020). Since the start of RBP an average 4.5 million lactating bovines were inseminated annually, which resulted in reduction of inter-calving period by 12 days. Due to the reduced inter-calving period, annual

⁴⁹ This is an estimation based on breed wise percentage of frozen semen doses produced by the 27 semen stations strengthened under NDSP against total semen produced by the 54 semen stations nationwide (NDDDB internal compilation).



incremental milk production reached 0.16 million MT in 2019. With an average financial gross margin across lactating bovines of INR 3204, annual incremental financial benefits due to reduced inter-calving period reached to USD 7 million at project end. Reduced inter-calving period also increased producers' assets as they started accumulating new milch animals more rapidly.

Table 2: Benefits from reduced inter-calving period

With project	Animals calved, million	Benefits due to reduced inter-calving period	
		Million tons milk	USD million
2013-14	0	0.00	0.00
2014-15	1.0	0.07	2.98
2015-16	1.7	0.12	5.13
2016-17	1.6	0.11	4.82
2017-18	1.8	0.14	5.72
2018-19	2.0	0.15	6.19
2019-20	2.1	0.16	6.60

8. Animal nutrition: RBP has been an important and successful program under NDSP. RBP promoted optimal feed management for dairy animals from locally available resources and has improved health, productivity and fertility of milch animals. By project end, RBP covered 2.85 million milch animals and 31,148 trained LRPs had been employed to deliver the program. RBP covered 33,389 villages. LRPs will continue to be an integral part of the program going forward. Regional evaluation studies show that with RBP, average fat content increased from 4.70 percent to 4.78 percent, and Solids-non-Fat (SNF) rose from 7.86 to 8.54 percent in cows, and 8.12 to 9.12 percent in buffaloes. This led to increased milk market value where farmers can receive an additional premium price on average of INR 10/animal/day. The ex-post EFA - measured RBP benefits as follows: (a) *increased milk productivity*; (b) *reduced cost of milk production*; and (c) *reduced methane emission*.

9. Average daily milk yield in milch animals across the participating States was 5.04 liters at appraisal, which increased to 5.80 liters at project closing. Data from INAPH shows that, in areas where RBP was implemented, per-animal daily milk yields increased from 7.07 liters to 7.34 liters (INAPH 2019). Using this parameter, annual incremental milk production due to RBP reached 0.26 million MT at project end, with corresponding annual incremental financial benefits of USD 11 million. Further, a major benefit of RBP has been the reduction in cost for milk production, an important incentive for producers' adoption of the program. Prior to RBP, average per-kg cost of production⁵⁰ was INR 19.49, which decreased to INR 17.19/kg (11.8 percent for DCs and 8 percent for DPCs, compared to the combined target of 7 percent). Average cost of feeding was reduced to INR 136/animal/day from INR 143/animal/day which is, on average, a 5% reduction in cost of feeding per animal per day (INAPH 2019). Annual incremental financial benefits due to reduced milk production cost reached USD 96 million in 2019.

10. The project conducted several methane emission measurement studies in different regions of the country to assess RBP's impact on dairy's carbon footprint. These studies found that, on average, RBP reduced methane emission by 13.3% (compared to an estimated 10% in ex-ante EFA). Prior to RBP, average annual methane emission across milch animals was 72 kg per animal, which reduced to 62 kg

⁵⁰ Studies confirm that feed and fodder cost can be as high as 70 percent of total production cost for dairy cows and buffaloes (NDSP I BCR, 2020)



per animal. This reduced methane emission due to RBP amounted to 0.24 MT per animal per year of Certified Emission Reduction (CER). This has generated the potential for annual incremental economic benefits of methane emission reduction equal to USD 6.5 million at project end.

11. **Component B: Milk Collection and Bulking** – This component accounted for 51% of the total project costs and included creating new DCSs and DPCs, strengthening existing DCSs, investment in bulk milk coolers and automated milk collection systems.

12. VBMPs aimed at ensuring improved access to markets by investing in village-level milk collection and bulking facilities and supporting the institutional development of DPCs and DCSs, including increased producer membership in these institutions. VBMPs covered 52,509 villages and reached 2.7 million dairy producers. By end-project, installed bulk milk chilling (BMC) capacity reached 12.49 million liters per day against a target of 1.36 million liters per day envisaged at appraisal. There is a gestation period between the installation of capacity and its actual utilization which was 9.99 million liters per day at project end. Accordingly, utilization of chilling capacity would progressively increase over time. The organized marketing structure that new DPCs and DCSs provided gave farmers a stable and assured marketing channel, thereby eliminating malpractice such as holdouts and economic losses due to unfair trade practices by private vendors, while also reducing the wastage of milk during handling and transportation.

13. The benefits captured under this component are categorized into two groups: (a) *benefits due to BMC*, and (b) *benefits due to milk procurement*. The benefits due to BMC consist of saving in income due to reduced milk souring/curdling; reduced spillage and pilferage in cans during transportation as a percentage of milk procured; payment received from unions for milk chilling; saving in investment and repair of cans; and savings in milk transportation cost. At project end, annual incremental financial benefits accrued by the milk producers due to BMCs were USD 19 million. The costs associated with this component include milk transportation from the milk pooling points to BMC; power and fuel consumption; repairs and maintenance; manpower (manager, supervisor, tester, workers, watchman); and miscellaneous (general, printing and stationery, chemicals). On milk procurement, prior to DPC and DCS formation, a majority of dairy households sold milk to informal middlemen “dudhiyas” (53%). The average milk price received by these households was INR 24 per liter which has increased under the project to INR 29 per liter as a result of the new, transparent, and merit-based system for pricing milk and its efficient/timely transportation to the BMC facility (BCR 2020). This has resulted in incremental financial benefits to these households from price increases due to institutional milk procurement at USD 32 million at project end.

14. **Methodology and sources of data for Economic and Financial Analysis.** One key source of data for this analysis is the Information Network for Animal Productivity and Health (INAPH). This comprehensive database has been collecting and managing information on animal registration, artificial insemination, calving, ration balancing, milk recording and many other key activities of the project. INAPH is also able to collect information directly from animal owners as well as provide periodic alerts to them. In addition, data from several external studies on impact assessment and evaluation of RBP, methane emission measurement studies and external monitoring and evaluation undertaken for the project since 2012 have been used. *Financial analysis* was done at market prices, while *economic analysis* was conducted after making appropriate adjustments for financial benefits and costs. Similar to ex-ante EFA, economic parity prices were used for Anhydrous Milk Fat and Skimmed Milk Powder.



15. **Results of Economic and Financial Analysis.** The project’s cost-benefit analysis was conducted separately for major project interventions: breed improvement and AI service delivery, animal nutrition management, and milk collection and bulking investments. Benefits were then aggregated and compared with overall project costs, including contingencies and costs associated with project management. Costs and benefits are estimated at 2018 prices over 20 years with 10% opportunity cost of capital.

Table 3: Economic and Financial Analysis Summary (USD Million)⁵¹

Ex-post Analysis								
Project Interventions	Financial				Economic			
	PVC	PVB	NPV	IRR	PVC	PVB	NPV	IRR
Productivity Enhancement								
- Breed Improvement	54	332	248	50%	49	292	243	53%
- Animal Nutrition	28	170	142	83%	25	165	140	87%
Milk Collection and Bulking	173	275	102	46%	155	247	92	46%
Overall Project	255	747	492	57%	230	705	475	60%
Ex-Ante Analysis								
Project Interventions	Financial				Economic			
	PVC	PVB	NPV	IRR	PVC	PVB	NPV	IRR
Productivity Enhancement								
- Breed Improvement	82	134	50	18%	74	144	70	21%
- Animal Nutrition	139	306	167	25%	125	342	219	29%
Milk Collection and Bulking	83	129	45	20%	74	85	10	14%
Overall Project	236	433	197	22%	213	428	215	23%

16. Under the component for productivity enhancement, the *financial IRR* for breed improvement is 50%. Investments in animal nutrition resulted in an FIRR of 83%, while milk collection and bulking investments yielded an FIRR of 46%. When the analysis was aggregated at a project level, the FRR was 57% and the financial NPV was USD 492 million at 2018 prices for a project life of 20 years. Similarly, economic analysis was completed to assess the economic rate of return of the project. The economic IRR for breed improvements is 53%, and a much higher return of 87% is found for animal nutrition. For milk collection and bulking, the EIRR is 46%. The NPV is USD 475 million at the aggregated project level. Based on these positive and high economic and financial results, efficiency is rated as Substantial for the project.

17. Compared to the ex-ante EFA, the ex-post analysis shows higher net benefit from the project. Several factors contribute to these ex-post results. The actual scale of benefits derived from key project activities was higher than estimated in the ex-ante analysis. For example, the ex-ante analysis estimated a 5% reduction in feed and fodder cost (INR /liter milk produced) due to RBP. At project closing, impact assessment studies on actual RBP delivered show a higher average cost reduction of 12%. In addition, under VBMPS, the number of milk producers organized into DCSs and DPCs surpassed targets by 141% and 126%, respectively, meaning that more producers were organized at a lower unit cost. Furthermore, as mentioned in Paragraph 2, the ex-ante EFA had separated project activities into two zones (Zone 1

⁵¹ Converted INR to USD (1 USD=INR 75; Exchange rate of June 9, 2020)



and 2) with limited benefits calculated for Zone 2. This may have led to underestimation of benefits accrued by the project, which in practice exceeded its PDO targets.

18. **Implementation efficiency.** Implementation efficiency is assessed as Substantial. All PDO indicators, including intermediate level indicators for component on milk collection and bulking exceeded targets and most of the intermediate-level indicators were met or surpassed. Over the project period, financial management performance was satisfactory, and an efficient system was in place whereby the NDDDB PMU reviewed EIA subprojects and released funds on time to finance them. The project disbursed 100 percent of the IDA Credit. NDSP delays in the early stages of project implementation were reasonable understandable for a project of such massive scope and scale. The project received a 23-month closing date extension to compensate for the slow start of project activities. The extension boosted overall project efficiency by enabling it to gain momentum with training and systems in place, thereby exceeding its key targets and helping to derive additional benefits, including from innovative animal health and energy.

19. **Value for money.** Based on high economic and financial returns from investments (financial IRR: 57%; economic IRR: 60%), the project offers value for money. For example, under RBP which has been a successful program, studies show that project investments increased net income per lactation period per animal by INR 8,314 (INAPH, 2019). With a total project investment of \$32 million for RBP, cost per beneficiary was only USD 13 for the 2.2 million producers covered by the program. Overall, given project total cost of USD 294.58 million, average cost per beneficiary was US\$ 78. At project end, from the 2.85 million animals included in the program, net benefit in the form of aggregate profit for these producers amounted to USD 302 million, which was substantial. The project did not experience any cost overrun despite the closing date extension. Furthermore, the project was efficiently managed with a relatively low administrative cost of 4 percent, considering that it was a large-scale national program covering 18 States.

20. **Sensitivity Analysis.** To test the robustness of the FIRR and EIRR to changes in project costs and benefits, sensitivity analysis was performed. For the first component, reduction in project benefits could have occurred if LRPs did not perform satisfactorily. Similarly, on productivity improvement, if the AI delivery services, particularly the MAITs services, were unsatisfactory, there may be some loss of benefits. For the MAITs, an assumption was made that 25% performed below par, while for LRPs, the project's documented LRP attrition rate was used. In both these scenarios (Table 4,5), the NPV's IRR (financial) declined to 41% and 59%, while for IRR (economic), it only declined to 40% and 58% respectively.

21. Sensitivity analysis was also separately performed by changing the impact of DCS/DPC on milk price from 21% to 15% and 10%; and changing the BMC capacity utilized from 100% to 75% and 50%. The associated IRRs and NPVs are reported in the tables (Table 4, 5) below. The values in parentheses are the NPVs. The sensitivity analysis (financial) shows that decreasing the utilized BMC capacity from 100% to 75% and 50% resulted in a reduction in the IRR from 46% to 38% and 29% respectively; and a reduction in the NPV from USD 102 million to USD 74 million to USD 46 million respectively. The sensitivity analysis also shows that decreasing the impact of DCS/DPC on the milk price from 21% to 15% and 10% caused the IRR to decrease from 46% to 33% and 21% respectively; and caused the NPV to decrease from USD 102 million to USD 64 million and 32 million respectively. Similar results were found for the sensitivity analysis (economic). Despite the changes in the scenario in both the components, the



project continues to have high IRRs, confirming that the project was economically viable, and the benefits were substantial.



Table 4: Sensitivity Analysis Summary (Financial)

Productivity enhancement (USD Million)				
Sensitivity Scenarios		NPV	IRR	
Base Level:				
Breed improvement		248	50%	
Animal Nutrition		142	83%	
Project benefits limiting to:				
Milk productivity benefits (75%)		158	41%	
Nutrition benefits (67%)		82	59%	
Milk Collection and Bulking (USD Million)				
Sensitivity Scenarios		BMC capacity utilized*		
Impact of DCS/DPC on milk price	Change in Milk Price	100%	75%	50%
	21%	46%	38%	29%
		(102)	(74)	(46)
	15%	33%	24%	13%
		(64)	(36)	(8)
	10%	21%	12%	-2%
		(32)	(4)	(-24)

The percentage refers to actual BMC capacity utilization under the project, not the optimal utilization.

Table 5: Sensitivity Analysis Summary (Economic)

Productivity enhancement (USD Million)				
Sensitivity Scenarios		NPV	IRR	
Base Level:				
Breed improvement		243	53%	
Animal Nutrition		140	87%	
Project benefits limiting to:				
Milk productivity benefits (75%)		165	40%	
Nutrition benefits (67%)		83	58%	
Milk Collection and Bulking (USD Million)				
Sensitivity Scenarios		BMC capacity utilized*		
Impact of DCS/DPC on milk price	Change in Milk Price	100%	75%	50%
	21%	46%	38%	29%
		(92)	(67)	(41)
	15%	33%	24%	13%
		(58)	(32)	(7)
	10%	21%	12%	-2%
		(29)	(4)	(-22)



Supporting Data Tables:

A-1: Animals covered by RBP under NDSP (annual numbers, million)

Animals covered by RBP	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20 till Sep	Total
Cows	0.003	0.041	0.232	0.511	0.465	0.190	0.110	0.008	1.56
- Cross breed	0.002	0.038	0.179	0.432	0.370	0.157	0.090	0.006	1.27
- Indigenous	0.000	0.003	0.053	0.080	0.095	0.033	0.021	0.002	0.28
Buffaloes	0.004	0.032	0.264	0.457	0.346	0.116	0.077	0.009	1.30
Total	0.007	0.073	0.496	0.969	0.810	0.306	0.187	0.017	2.86

Source: INAPH

A-2: AI from the strengthened Semen Stations* (million)

Type of breed	12-13	13-14	14-15	15-16	16-17	17-18	18-19
Exotic	NA	1.93	2.98	2.70	0.86	1.07	1.00
Cross breed	NA				1.65	1.59	1.76
Indigenous	NA				0.77	0.80	0.93
Buffaloes	NA	0.65	1.45	1.48	1.68	1.88	2.02
Total	NA	2.58	4.43	4.18	4.96	5.34	5.70

* Based on breed-wise % of Frozen Semen Doses from semen stations strengthened under NDP I.

Source: NDSP Internal compilation

A-3: Bulk milk coolers financed under NDSP (Capacity, Million l/year)

Build-up of BMC Capacity	Capacity	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Cumulative	MLPD	0.01	0.3	1.02	2.18	4.25	5.12	8.33	12.49
Utilized	MLPD	0.01	0.24	0.7	1.67	2.86	3.61	6.65	7.92
Milk Procurement	MLPD	0.01	1.08	1.42	3.12	3.78	4.99	5.87	5.36

Source: NDSP I MIS

A-4: Milk Producer Price (median/average) in India (INR/l)

	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Producer price/ l	22.27	25.22	26.45	27.11	31.15	28.11	27.16

Source: Milk Unions & Federations; *Provisional; # Price at 4.5% FAT & 8.5 % SNF

A-5: NDSP: Basic assumptions

Particulars	Unit	Indig. cattle	CB cattle	Buffaloes
Age at first calving	Years	3.35	3.01	3.91
No. of lactations per animal	Nos	5	5	5
% AI done on	%	18.5%	46.8%	34.7%



ANNEX 5. BORROWER, CO-FINANCIER AND OTHER PARTNER/STAKEHOLDER COMMENTS



राष्ट्रीय डेरी विकास बोर्ड
National Dairy Development Board

EDO:WB:NDP-I: 2977

17 July 2020

Sub: P107648: NDSP (NDP-I) Draft Implementation Completion Review and Results Report (ICRR) for NDDB review

Dear Mr. Edward Bresnyan,

With reference to the mail dated 02 July 2020 sharing the Draft ICRR for review and the discussion held with the World Bank team through video conference (VC) on 09 July 2020, we have reviewed the ICRR report and two versions of the same are attached (with track mode and track accepted mode with comments) for your needful perusal. As discussed during the VC, the observations are classified into two broad categories:

- 1) Updation of project related data – due to reconciliation of data in NDP I MIS after project closure (updated data is provided in track change mode)
- 2) General comments/ observation - provided in comments form for suitable incorporation by the WB team

In addition to the above, the project and control data related to milch animal yield sought by Ms. Anna Roumani during the VC is also attached.

In the end, we on behalf of Mission Director & NDDB wish to express our profound gratitude to the World Bank team for the cooperation extended and the valuable feedback on various aspects of implementation throughout the NDP I project period, the results of which are aptly captured in the ICRR report. We look forward to receive the final ICRR report of NDP I from the World Bank at the earliest.

With regards,

Yours sincerely,

(Meenesh Shah)
Executive Director

Encl: As above



ANNEX 6. SUPPORTING DOCUMENTS

1. Project Appraisal Document, Report #63708-IN, February 17, 2012
2. Credit Agreement
3. Project Information Document (PID) – Concept Stage
4. Project Information document (PID) – Appraisal Stage
5. Project Concept Notes (Initial and Appraisal)
6. Supervision Aide Memoires
7. Implementation Supervision Reports (ISR)
8. Procurement Post Reviews (PPR)
9. Procurement Supervision Reports
10. Financial Management Supervision Reports
11. Restructuring Papers
12. Semester Progress Reports
13. Social and Environmental Strategy Assessment (SESA), World Bank 2011
14. Project Information Document (PID) – Concept Stage
15. Project Information document (PID) – Appraisal Stage
16. Project Concept Notes (Initial and Appraisal)
17. Grant Reporting and Monitoring (GRM) Report: SAFANSI Project, TFOA4103
18. Report on Sustaining the Efforts of Milk Fortification in India: SAFANSI Milk Fortification Project, June 10, 2019
19. Assessment of Framework Agreements (FA) under NDSP, World Bank, December 2019

Studies and Surveys⁵²

1. Borrower's Completion Report, Project Management Unit, NDDDB, 2019
2. NDSP Baseline Final Report – Development and Research Services Pvt. Ltd., (DRS), 2013
3. External Monitoring and Evaluation of the National Dairy Plan, Phase I (National Dairy Support Project) – Endline Survey, DRS, November 2019
4. Evaluation Report: Contribution of National Dairy Plan I to the Inclusion, Equity and Income of Dairy Farmers, Institute of Economic Growth (IEG)/NDDDB, undated.
5. NDSP: Final Progress Report for World Bank Mission, December 2019
6. Impact Assessment and Evaluation of Ration Balancing Program in the Southern Region, Institute of Rural Management Anand (IRMA)/NDDDB, Gujarat 2016
7. Impact Assessment and Evaluation of Ration Balancing Program of Northern and Western

⁵² Links to studies available at <https://www.nddb.coop/ndpi/about/ndpi-studies>



Regions, ICAR-National Dairy Research Institute, Karnal/NDDDB, April 2017

8. Report on Sustainability of Dairy Cooperative Societies Organized under National Dairy Plan I, Institute of Rural Management, Anand (IRMA)/NDDDB, Gujarat, April 2019
9. Study of Human Resource (HR) Needs of the End Implementing Agencies (Milk Unions) in NDP I, Institute of Rural Management Anand (IRMA Study Team)/NDDDB, undated.
10. Research Report: Understanding Existing Knowledge/Skill Level and Attitude/Motivation of Rural Youth towards Dairying as an Employment Activity in NDP I Intervention Villages, IEG/NDDDB Anand Gujarat, undated
11. Evaluating the Impact of Ration Balancing on Methane Emission in Dairy Animals under NDP I Northern Region – Final Report, National Dairy Research Institute (NDRI), undated.
12. Evaluating the Impact of Ration Balancing on Methane Emission in Dairy Animals under NDP I Western Region – Final Report, Anand Agricultural University, Gujarat, August 2016.
13. An Empirical Study on the Impact of Cooperative Development Interventions under the National Dairy Plan I on the Socio-Economic Status of the Tribal Milk Producers in Sanarkantha Region, R. Seshapathy, NDDDB, December 2018.
14. Impact of NDP I Interventions on Strengthening Women’s Empowerment in India’s Dairy Sector, Institute of Rural Management Anand (IRMA), undated.
15. Break-even Point Analysis in Dairy Enterprises and Strategies for Sustainable Growth, AERC, Anand, Undated
16. Impact Assessment and Evaluation of Fodder Seed Production and Sales under NDP-1, AERC, Anand, undated.
17. Analyzing the Socio-Economic Impact of the NDP-1, NCAER, Delhi, undated
18. Roadmap and Strategies to promote Export of Dairy Products for the Organized Sector, IIFT, Delhi, undated.
19. Demand for Milk and Milk Products in India, A. C. Nielson, undated.
21. Markets and Spill-over Effects of Political Institutions in Promoting Women's Empowerment: Evidence from India. <https://doi.org/10.1080/13545701.2020.1752394>



ANNEX 7: PROJECT EVALUATIONS AND ASSESSMENTS

Summary of Evaluations and Assessments under the National Dairy Plan Phase I (NDP I)

1. Endline Survey⁵³

Methodology:

1. The program area was stratified by types of interventions. A random sample of program Talukas and villages receiving major interventions – primarily RBP and VBMPs - was selected for study purposes. Equal sample size was taken from both programs to assess impact on PDO level indicators. However, the quantum of sample units covered in 15 states and 3 additional states, varied. Total sample size in 15 states was 14,256 households from 1,188 villages spread across 299 Talukas. The sampling units for both programs were equally divided in the program and control areas. The sample size for RBP and VBMPs programs in the 3 additional states – Chhattisgarh, Jharkhand and Uttarakhand comprised 864 households in 72 villages spread across 18 talukas. The sampling units were equally divided in the program and control areas. A three-stage sampling technique was adopted for both programs, RBP and VBMPs: (a) **VBMPs**: selection of talukas (147 selected), selection of villages (294 program and 294 control selected), and selection of households (12 from each sampled village using systematic sampling based on the total number of milch animals owned by them); and (b) **RBP**: selection of 10-11 Talukas from each state using Probability Proportion to Size (PPS) Systematic Sampling procedure in which size measure comprised the adult female bovine population (147 Talukas were selected). Selection of villages with and without RBP intervention, using PPS systematic random sampling procedure, resulting in selection of 294 program and 294 control villages. See full report in WB Docs for more detailed discussion of the methodology.

Main Conclusions:

2. Responses showed that for projects involving farmer-controlled institutions like DCS and MPCs, the proper role of government in project implementation must be carefully defined and understood. Although most State Governments were in principle ready to adopt the key policy and regulatory measures required for participation and provided assurances that they would do so, implementation proved to be a different story with some states not implementing those measures efficiently. In future, more emphasis is needed on policy and regulatory implementation.

3. Project design needs to be based on – especially in complex operations – an assessment of the existing situation and devise ways of overcoming existing impediments. The study asserts that under NDSP, this was done during the implementation phase based on feedback from EIAs regarding village level chilling and testing facilities to manage the increased flow of milk to DCS and MPC. Many interventions in animal genetics, health, feed and fodder and renewable energy were based on assessments of the overall dairy sector and its impediments during implementation.

4. **Animal ownership and milk production:** Possession of dairy animals was higher at 62% in

⁵³ External Monitoring and Evaluation of National Dairy Plan, Phase I (National Dairy Support Project), Development and Research Services (DRS) Pvt. Ltd., November 2019



program/intervention areas compared to the control areas (59%). Across species, buffalo constituted the major share, followed by crossbred cows and indigenous cattle in program and control areas. The NDP-I project area was better-endowed with high-yielding animals, i.e., crossbred cows and buffalo.

5. While Indigenous cows accounted for one-fourth of the animal population, they contributed only one-tenth of total milk production. However, about 75% of the milch animal population comprising crossbred cows and buffaloes together accounted for about 90% of total milk production. Marginal farmers dominated in both program and control areas (43-45%). They also accounted for the largest share of milch animals (41-44%). However, the average milk yield per in-milk animal was the highest for semi-medium farmers in both program and control areas. The average milk yield, in general, was better in the program area. The average in-milk yield of animals increased with the rise in herd size in the project area.

6. **Milk production, consumption and sale:** The average milk production and sale per milk producing household was better in program areas (production-10.9 liters and sale-8.1 liters) than in the control areas (production of 9.4 liters & sale of 6.8 liters). The average milk production and sale per household increased as herd size grew. Cash payment remained the major mode of payment to MAHs by both private dairies and the cooperative sector (around 85-86% and 73% respectively) in both areas. The milk payment cycle for Cooperatives and MPCs was significantly shorter than sales through *Dudhia* (Milk Vendor).

7. **Animal breeding services:** Out of all the animals that received any breeding service during the last two years, about 60% of animals received only AI service, about 30 percent received only Natural Service (NS) and around 10% received both AI service and NS in the study area. The coverage of AI reported under NDSP in the project area was more than double that at the national level. Given the proliferation of AI operators across India (now over 130,000), it is important to ensure widespread adoption of Standard Operating Procedures (SOP) and, more importantly, how the Breeding Bill will be implemented in the context of improved AI.

8. NDSP made significant progress with genomic breeding approaches and one EIA - ABRO/NDDB – in collaboration with the United State Department of Agriculture developed the first genotyping microarray chip for buffaloes (BUFFCHIP) for use in genomic selection. It is estimated that genomics nearly doubles the rates of genetic progress, compared to PT/PS programs.

9. **Feed and fodder interventions:** Under NDP I, across all MAHs, awareness about the certified / truthfully labelled seeds was higher in program areas (38%) compared to control areas (31%). However, if only fodder growing households are accounted, the awareness level reported is quite high. Almost 8 out of 10 fodder growing households reported that they had knowledge about Certified/ Truthfully labelled seeds. Among fodder cultivating households, almost all of them reported using certified/ truthfully labelled seeds in both program and control areas. Since the Baseline, this was a welcome change in the project area. It also indicates the willingness of the farmers to use truthfully labeled seeds if proper support and awareness-building are provided to them. Any future intervention in this regard should incorporate this knowledge.

10. **Sustainable model of Balanced Ration:** About 70% of the MAHs in RBP-surveyed villages reported that they knew about the RBP program. Almost all of them reported that they had been



approached by someone (LRP) to advise them to feed their animals as per RBP. Almost 79% of MAHs approached by LRP, reported coverage of their animals under RBP, i.e. adoption of the RBP practices. On average, 1.4 animals per MAH were covered under RBP.

11. **Milk yields:** Average milk yield per animal reported by the Endline Survey was 5.2 liters per day before RBP advisory, increasing to 6.3 liters per day post-advisory. Similarly, the average feeding cost per animal in the Endline Survey was Rs. 143/ per day before RBP advisory, reduced to Rs. 136/- per day post-advisory. The findings of the Endline Survey under NDP I indicate that the Ration Balancing Program under NDP I has established a viable model of balanced rations for animals which can be provided/done at the farmer's doorstep and this initiative needs to be taken forward in a sustainable manner by the EIAs.

12. **Village Based Milk Procurement System:** Benefits of VBMPs reported by MAH in the project areas included better milk price (88%); followed by no wastage of milk (74%); time saved in marketing of milk (43%); advantage of getting longer time for milk pouring (27%); availability of better AI service (27%); and subsidized cattle feed (20%).

13. The success of the intervention among the farmers was witnessed via the participation of more than 2.4 million farmer producers in the various training programs conducted under the component. The activity has firmly established the fact that multi-pronged benefits can be accrued through interventions at the village level, reflected in the participation of women under NDP I which was almost 45% of the total of around 1.7 million members enrolled. Greater social integration in terms of 67% small holder participation was achieved under the component. With the establishment of a fully functional dairy cooperative society at the village level, the overall economic activity of the area improves and in certain cases like the Milk Union of Odisha, it has also positively impacted by controlling out-migration from the area in search of better opportunities.

14. **Grievance Redressal Mechanism (GRM):** Non-discrimination, transparency, accountability, action plan and complaint redressal mechanism are the key components of good governance. In general, the governance and complaint redressal mechanism in the project was properly placed. The negligible proportion of complaints received itself indicates that the project was executed without discrimination.

15. **Project Monitoring and Control:** This is one of the most important aspects of successfully implementing a project of such magnitude and scale with diverse geographical locations and multitude of End Implementing Agencies. Under NDP I, a multi-layered approach was followed for project management both at the EIA and NDDDB levels. More than 17 meetings of National Steering Committee and 30 Project Steering Committee meetings in addition to more than 35 regional review meetings at the state level, were conducted. These meetings ensured that there were proper feedback mechanisms in place and the bottlenecks as highlighted by the EIAs were addressed immediately, duly supported by policy level interventions if required.

16. **Implementation:** Further, the Project Management Committee and Project Management Cell constituted as part of the sub projects ensured smooth implementation of the sub projects at the projects level. In addition to this, NDDDB followed a decentralized mechanism of monitoring through a network of Monitoring Officers who were assigned a set of projects for review and monitoring and providing necessary support. For any development sector project, it is important to ensure timely and



prompt policy and technical support for smooth implementation of the projects and the model adopted under NDP I testifies to the success of this approach.

2. Contribution of the National Dairy Plan I to the Inclusion, Equity and Income of Dairy Farmers, February 2019 (Final Evaluation).

Context

The study employed a multi-stage sampling strategy combining both quantitative and qualitative methods to enhance the quality of results, explain complex relationships and to understand the contribution of the NDP I to inclusion, equity and income of participating dairy farmers. Data were collected from 144 villages in 36 districts of 9 states. In the process of selecting districts, attention was given to districts in the study area where both the Ration Balancing Program (RBP) and Village-Based Milk Procurement System (VBMPS) were implemented. From each of these selected districts, two developmental blocks were chosen, and four villages were chosen from each of them. The selection of Control villages was based on the non-intervention of NDP-I.⁵⁴

Key findings

Dairy cooperatives are an important source of knowledge and motivation. Although parents and relatives are the most important source of knowledge and motivation for dairy farming (about 80%), it was observed that in intervention villages the Dairy Cooperatives have emerged as a second alternative for dissemination of knowledge and have also motivated farmers for adoption of dairy farming.

LRP coverage needs expansion but is effective: LRP coverage is currently at 58% and requires further improvement, particularly among the vulnerable populations. Training on RBP is inclusive and beneficial. Training on dairy-related activities and the receipt of mineral mixture and fodder at subsidized prices are among the important benefits reported by almost one-third of the dairy farmers in intervention villages. While the richer households continued to have greater access to loans and cash bonuses, the poor households had a greater share in training participation. The logistical regression analysis suggests that the vulnerable populations - particularly the SC/ST - are 1.6 times more likely than the non-SC/ST households - to receive any of these benefits.

Livestock holding size is higher in intervention villages. The mean herd size is greater among dairy producers in Intervention villages compared to Control villages. The average number of cows per household in Control vs Intervention villages is 1.8 and 2.7 respectively. Similarly, the average number of buffaloes per Control and Intervention household is 1.9 and 3.8 respectively.

The cost of animal rearing and milk production is high. Higher fodder prices and higher labor costs are identified as important constraints on milk production by the dairy farmers. The proportion of dairy farmers in Intervention villages reporting these challenges is lower than that of the Control villages. In Control villages, over 90% of dairy farmers said that the cost of milk production has increased because of

⁵⁴ Study authors note certain limitations: (i) study is based on a cross-sectional design but uses available impact analysis methods to draw analytical inferences; (ii) difficulty of ascertaining income-related parameters from household surveys; (iii) non-monetized income attributable to household consumption of milk produced is not taken into account, potentially leading to under-estimation of income levels across households; (iv) expansion of communication and transportation as well as development of private sector dairying, Control villages are likely to have received some awareness and information on dairy farming; and, (v) study is based on self-reported information on household income from dairy.



high fodder prices, which is about 19% higher than Intervention villages. In the case of labor costs, more than 15% of dairy farmers in Control villages complained about higher labor costs than in Intervention villages. Further, in Control villages, complaints about decreasing productivity of milch animals was 8% higher than Intervention villages.

Quality and quantity of milk produced has been improved. Around 30% of the dairy farmers reported improvement in quality as well as quantity of milk produced after the practice of RBP. The benefits are more or less equally distributed across the population and vulnerable groups. Importantly, around 50% of dairy farmers reported improvement in the local purchase of milk after VBMPS.

Quantity of milk production is higher in Intervention villages. The average cow milk production in Control and Intervention villages was 11.7 and 14.5 liters per day, respectively. The average buffalo milk production in Control and Intervention villages was 6.0 and 9.4 liters per day, respectively. The effect across Intervention villages is significant even after adjusting for socio-economic variables in a linear regression model. The Propensity Score analysis based Average Treatment effect on Treated (ATT) estimates also confirm the significant difference in milk production across Control and Intervention villages.

Income from milk production is higher in Intervention villages. The average income from cow milk production in Control and Intervention villages was Rs.310 and Rs.393 per day, respectively. The average income from buffalo milk production in Control and Intervention villages was Rs.198 and Rs.276 per day, respectively. The higher incomes accruing to the Intervention villages is significant even after adjusting for socio-economic variables in a linear regression model. Further, the ATT estimates also confirm these significant differences in income.

The overall level of satisfaction with dairy farming is relatively higher among Intervention villages. Dairy farmers in Control villages are 40% less likely to report such satisfaction. Poor dairy farming households are more likely to report satisfaction with the role of RBP and VBMPS in improving their family income. However, SC/ST households are less likely to report greater income benefits compared to non-SC/ST households. This is partly associated with overall lower production volume of these households that does not allow greater income gains.

Recommendations:

- (a) Strengthening the participation and involvement of women:** This includes particular attention to their credit needs. Cooperatives might work with banks to create special programs of financial services for women given their dominant role in rearing bovines.
- (b) Expansion of AI and extension services:** Currently, low productivity per animal hinders dairy sector development. Cattle and buffalo breeding programs were initiated under NDP-I but need expansion to overcome the shortage of AI workers or veterinary doctors, along with strengthening of livestock agencies to offer breeding services in the form of procurement, production and distribution of breeding inputs, training and promotion. Extension workers and dairy farmers need greater collaboration.
- (c) Strategies to support small land-holding dairy farmers:** Increased milk production and better livelihoods in small-scale dairy farms depend heavily on adoption of appropriate feed technologies,



which in turn need to be based on locally-available feed resources and improved support services. Further, efforts need to be made to improve the economic characteristics of indigenous cattle given their multi-purpose utility, usefulness and adaptation to local resources and the environment. The escalating price of feed ingredients is concerning. In many states, cooperatives produce feed concentrates and sell to farmers at subsidized rates. This should be done nationwide.

- (d) Access to formal and informal credit:** Lack of access to credit is a critical constraint on herd expansion. Commercial banks do not favor credit to livestock farmers and the cooperative credit system is weak. These distortions should be corrected, and ensure timely availability of inputs and services, including credit. Institutional credit should be intensified as dairy is one of the remunerative activities where cash flow is quite positive for farmers.
- (e) Availability of vets in all villages.** The lack of veterinary doctors in rural areas means farmers in remote villages do not get services in time. Doctors could be provided in a small group of villages. Further, there is a need for an independent agency of government to control the quantity and quality of vaccines. Free veterinary services are also recommended to cooperative member members to reduce the cost of cattle treatments and maximize cattle productivity.
- (f) Price stabilization of milk based on Fat and SNF level:** A suitable policy for fodder supply in all seasons to counter milk price fluctuations in lean vs peak seasons, and high cost of feeds and fodder, is needed, along with enforcing price setting based on fat and SNF content.
- (g) Capacity building and training:** Priority is needed for permanent vocational and outreach training facilities at the National Dairy Training Centre or state-level food technology colleges to develop dairy farming. Dairy farmers need better knowledge of feed management. Milk plants and provincial livestock departments can provide training and extension services to farmers and the dissemination of training knowledge needs special attention. Farmers also need help to improve their managerial skills.
- (h) School lunch and milk program:** Linking state and district milk producers to this program should be scaled up.
- (i) Strengthening cooperative milk procurement and services:** Organizational support for milk producers through the cooperative sector should be streamlined and expanded for primary dairy cooperatives for milk procurement. This should be extended to areas where the local market is unable to absorb the milk production and steps should be taken to reorganize and develop rural markets for milk.
- (j) Mass media outreach:** Mass media should be utilized to a greater extent for transfer of improved dairy practices to dairy producers/pourers to enrich their knowledge of dairy farming activities.

Dairy Cooperatives

3. An Empirical Study on the Impact of Cooperative Development Interventions under National Dairy Plan I on the Socio-Economic Status of the Tribal Milk Producers in the Sabarkantha Region, 2018

Context

1. This study analyzed survey data from households, village Dairy Cooperative Societies (DCS) and District-level Milk Unions in 9 villages (7 intervention villages and 2 control villages) with a total sample of 228 households, as well as secondary data, to evaluate the impact of NDP I on the socio-economic status of the tribal milk-producers in the Sabarkantha Region.



Key findings

2. Key findings were as follows:

- NDP I project had a significant positive impact on the livelihood opportunities for the tribal milk producers of the Sabarkantha region with the roll out of cooperative development interventions.
- **ST beneficiaries and non-beneficiaries differed markedly in land and livestock endowments.** ST non-beneficiaries owned more land while ST beneficiaries had more milch animals and livestock assets. Thus, ST non-beneficiaries earned more income from agriculture while ST beneficiaries earned more from dairying.
- **All categories of beneficiaries enrolled in NDP-I had access to all its benefits and opportunities:** enrolment as DCS members, provision of milk cans, training and capacity-building programs, pouring milk at the DCS, and, receiving fair/timely payment based on volume poured and quality. Training and capacity-building by NDP-I EIAs increased learning opportunities for ST households.
- **ST participating households had more income equality than ST households not participating.** Importantly, the income equality effect was more pronounced for ST beneficiaries than non-ST beneficiaries. Also, participating ST households increased their number of milch animals owned.
- **NDP-I cooperative interventions were instrumental in fostering women's participation** in dairy-related economic activities, especially in ST households.
- **Cooperative development initiatives provided additional, reliable income for tribal dairy farmers** and improved their overall socio-economic conditions – especially the marginalized and most vulnerable. More transparent procurement and payment under VBMPS led to better prices.
- **The study recommends that extensive village awareness programs can promote the benefits of cooperatives;** and, ST households lack the land and livestock to provide security for loans to purchase cattle and thus their access to credit is lower than non-ST households. Thus, a DCS should extend credit facilities to its members, especially the economically weaker STs.

Lessons

3. Low education and awareness level of ST households, and fewer credit facilities for ST households were identified as the major bottlenecks affecting the ability of NDP-I intervention benefits to reach them. Village awareness program should be undertaken extensively to make the new members aware about the benefits of the cooperative movement. It is suggested that DCS extend credit facilities to their members for various activities, especially economically weaker members like STs.

4. Report on Sustainability of Dairy Cooperative Societies Organized under National Dairy Plan I, April 2019

Context

The study applied a framework to evaluate the performance of the DCSs (which were categorized into low, medium and high performers) on the basis of five input indices (DCS Ability, Physical-Technical Support, Governance and Management, Allied Support, and Common Support) and two output indices (milk intensity and membership intensity). The study also employed welfare analysis based on household surveys of 300 DCS households to estimate the welfare impacts of NDP-I on them (estimate of the change in bargaining power of vulnerable groups), and in-depth case analysis of 20 case-studies to understand essential conditions to make DCSs sustainable and the circumstances and reasons that create obstacles.



Key findings

Performance Evaluation and Sustainability analysis were used to rank the DCSs which were evaluated. Among 100 randomly-selected DCS from six states, 17 DCS ranked as high performers, while 41 ranked medium and 40 ranked low. The top DCS were mainly from the States of Punjab, Karnataka and Bihar. The better-performing DCS would have higher probability of sustainability in the longer term. The analysis of inputs suggests that DCS ability and physical-technical support primarily from the Milk Unions have significant effects on the performance of the DCS. The effect on performance of the governance and management index shows effects only after persistent efforts in making governance and management parameters work, indicating that sustained effort on this parameter would give results in the longer run.

Welfare analysis suggests that the connection with the dairy cooperative societies has helped DCS households to increase their dairy income significantly, and as a result, the households' total income has also increased. The income from sale of milk is Rs. 14,205.190 for Program households as against Rs. 6,961.538 for Control households. DCS members are more likely to access loans for productive purposes rather than consumptive needs. Households associated with dairy cooperatives have shifted their rearing preference from indigenous cows to cross-breed cows for more productivity. Although no impact has been observed on women's intra-household bargaining power, it can be inferred that men associated with dairy farming are now more likely to include their women in household financial responsibility. Case studies show that successful DCS have been able to mobilize assets and maintain milk procurement. The governing body is quite active in these DCS. These DCS have been maintaining proper financial records and carried out audits regularly.

Lessons

The DCSs have to prioritize and pay attention to some aspects in the short-term while certain issues should be addressed in the long-term. Short-term priorities include developing necessary assets and adopting minimum but necessary technology in their operations, expanding their membership base (immediate attention can be given to non-members who pour milk to DCS), and encourage members to maintain milk production. Long-term attention must be focused on effective governance practices and the enhanced role of the DCS in non-dairy social and cultural matters, which ultimately provide validity to DCS in society.

Ration Balancing Program (RBP)

5. Evaluating the Impact of Ration Balancing on Methane Emission in Dairy Animals (two villages in Ludhiana district of Punjab State)

Context

Structured questionnaires and interviews collected data on feeding practices for thirty-six early lactating animals (cows and buffaloes) by dairy farmers in Ludhiana district of Punjab. The sulfur hexafluoride (SF6) tracer technique was used to measure the methane emission of milch animals before and after ration balancing under field conditions. Data was then analyzed by SAS software to evaluate the impacts.

Key findings



Ration balancing improved milk production while reducing enteric methane emission in lactating cows and buffaloes, as follows:

- Average daily milk yield before ration balancing was 8.20 and 7.08 kg in cows and buffaloes, respectively. When a balanced ration was fed, milk yield (kg/d) increased significantly from 8.20 to 9.05 ($P<0.01$) and from 7.08 to 7.79 ($P<0.05$) in cows and buffaloes, respectively. However, there was no statistical difference in fat content of milk before and after feeding a balanced ration in either species.
- Average baseline methane emission was 22.40 g/kg milk yield (22.71 g/kg FPCM) which was significantly reduced by 13.6% ($P<0.01$) after feeding a balanced ration (19.36 g/kg milk yield or 19.82 g/kg FPCM) in lactating cows. Similarly, in buffaloes, feeding a balanced ration significantly ($P<0.05$) reduced enteric methane emissions by 11.2% (31.40 vs. 27.87 g/kg milk yield or 23.75 vs 20.85 g/kg FPCM). Balanced feeding reduced average methane emission (g/kg milk yield) by about 12.1% in lactating cows and buffaloes.

6. Evaluating the Impact of Ration Balancing on Methane Emission in Dairy Animals (two villages in Anand district of Gujarat State)

Context

Structured questionnaires and interviews collected data on feeding practices for 37 early lactating buffaloes by dairy farmers in two villages in the Anand District of Gujarat State. The sulfur hexafluoride (SF6) tracer technique was used to measure the methane emission from the buffaloes before and after ration balancing under field conditions. Data was then analyzed by SAS software to evaluate the impacts.

Key findings

Ration balancing helped in improving productivity of lactating buffaloes with concomitant reduction in enteric methane emission in the Western Region of India.

- In the present study, the daily average milk yield before ration balancing was 8.68 kg, which increased significantly ($P<0.05$) to 9.11 kg after feeding a balanced ration.
- Milk fat content also increased from 6.79 to 7.02% ($P<0.05$) after feeding a balanced ration.
- Average methane emission from buffaloes was 214.59 and 192.73 g/day before and after feeding a balanced ration, respectively.
- Average methane emission in terms of g/kg milk yield was reduced significantly from 25.51 to 21.63 in buffaloes (from 18.45 to 15.50 g/kg FPCM) after feeding a balanced ration. The balanced feeding reduced the average methane emission (g/kg milk yield) by about 15.21% in experimental buffaloes.

7. Impact Assessment and Evaluation of Ration Balancing Program in the Southern Region, Dec 2016

Context

The primary objective of the study was to conduct impact evaluation of RBP in terms of changes in milk-yield, feed cost, reporting, animal health, use of mineral mixture, frequency of artificial insemination and monitoring systems and institutional capacity building. Some 1000 household surveys (500 RBP and 500 non-RBP households) in 40 villages were conducted in two southern states of India (Kerala and Karnataka), and were analyzed using micro-econometric methods. Ten case studies were undertaken with project beneficiaries to document success stories. Two End-Implementing Agencies (EIAs) were



extensively interviewed to assess the use of INAPH for record keeping, to identify bottlenecks, and to document innovative EIA practices and their sustainability.

Key findings

The RBP has been able to target all categories of farmers, regardless of their land size, wealth and education level. RBP households have statistically higher annual income (INR 142,712) in comparison to non-RBP households (INR 125,594). Similarly, average monthly expenditure is higher in RBP households (INR 9,341) as compared to non-RBP households (INR 8,092). RBP households on average own 1.61 cows as compared to 1.40 in non-RBP households. Estimates from the program participation model indicate that documentary films, posters/banners, and pamphlets had a significant positive effect on program take up. The most successful method was the distribution of pamphlets.

The high percent (84%) of RBP households following recommended ration advice regularly, is a major outcome of the RBP program given that the farmers had various doubts at the start of the program. Major reasons for not following the ration advice regularly include shortage of mineral mixture and frequent changes in the animal feed. The RBP program had a positive impact on milk yields and animal health. The effect of RBP on average milk yield is positive but small. However, the difference is large and significant when accounting for the lactation stage of RBP animals at the time of joining the program: animals receiving RBP in the early stages of their lactation produced 520 ml/day more milk compared to animals in the middle of their lactation, while late stage animals produced 380 ml/day less than the middle category. Peak yield for RBP animals is 13.52 liters/day compared to 11.08 liters/day for non-RBP animals. The difference of 2.44 liters per day can be attributed to the RBP program. The RBP program had a positive impact on the number of inseminations required for conception. One out of every three RBP animals required one less insemination comparable unit. After joining RBP, 75 per cent of RBP households observed improvement in the health of their animals.

Lessons: Refresher training programs should be organized routinely and more frequently. Use of the local language would enhance the efficacy of training programs and ease out the necessary qualification for recruiting Local Resource Persons (LRPs). Those personnel who are already working with DCS in some remunerative role can be considered for the LRP role. EIAs should work out possible convergence with existing government schemes and programs to achieve sustainability.

8. Impact Assessment and Evaluation of Ration Balancing Program of Northern and Western Regions, April 2017

Context

1. The study employed econometric quantitative and qualitative approaches to analyze surveys and secondary data from two important milk producing states (Gujarat and Punjab) to evaluate the impacts of RBP.

Key findings

2. The ration balancing intervention enhanced the milk productivity of milch animals; however the magnitude of the increase varies according to different data sources.



- **Gujarat:** In Gujarat, the analysis based on Information Network for Animal Productivity and Health (INAPH) database for a six-month period showed that the ration balancing intervention enhanced the productivity of cows by around 13 percent, and that of buffaloes by nearly 5.5 percent. In the case of crossbred cows, the productivity enhancement has been as high as 24 percent in Banaskantha. In Gujarat, the gain in milk productivity from primary data analysis for both cows and buffaloes were approximately 19.5 and 18 percent respectively, and approximately 80 percent of farmers perceive the productivity increase. The quantum of productivity increases as reported by the farmers was in the range of 9.7-16.5 percent for both cows and buffaloes, while EIAs were of the opinion that the magnitude of increase in milk productivity was in the range of 3.8-5.3 percent.
- **Punjab:** In Punjab, based on INAPH data, estimates of the productivity gain due to RBP interventions are similar to Gujarat in the case of cows (about 13 percent), and much higher in the case of buffaloes (17 percent). However, the results of impact analysis from field data and the INAPH database are in consonance for cows but not for buffaloes. The productivity differentials in RBP and non-RBP buffaloes were non-significant after applying Propensity Score Matching, implying that in buffaloes, the effect of RBP has not been established based on the field survey. The proportion of sample farmers perceiving a yield enhancing effect of RBP was **much** lower (47 per cent) in Punjab. Nearly 75% of the sample farmers in Ludhiana reported an average increase in milk productivity of about 12-13 per cent while only 19 percent farmers in Ropar said that RBP has contributed to productivity enhancement.

RBP was found cost-effective in terms of percentage reduction in feed cost and feed cost/liter Fat Corrected Milk (FCM) of both cattle and buffalo, with the cost efficiency being more pronounced in cows. In cattle, the feed cost per liter FCM reduced in between 5.76 to 9.86 percent in Gujarat and by 10.83 to 18.53 percent in Punjab. The field level data also indicated clear impact in reducing the feed cost per liter of milk by about 18-19 percent in case of cows in both the states and about 2.6 percent for buffaloes in Gujarat. The unit cost of feed declined significantly ($p < 0.10$) in case of buffaloes also in Punjab, although the productivity differences between RBP and non-RBP animals were not significant. The decrease in feed cost and significant increase or non-significant change (Punjab buffaloes) in milk productivity has led to improvement in the milk-feed ratio. The estimates of incremental gains to dairy farmers due to enhanced milk production and decreased feed cost was between Rs. 20-40 per day per animal in most cases.

RBP has encouraging effects on milk quality improvement, health and reproductive performance of animals. In the perception of farmers and EIAs, the composition of milk has also improved especially in terms of fat percentage. At least 50 percent of the farmers reported reduced incidence of common problems like digestive disorders and repeat breeding.

The targeting of the program has been quite fair and households from different socioeconomic groups, including those below poverty line (BPL), are being covered. The efficacy of the program in terms of its coverage, outreach and the implementing and monitoring mechanism has been strong in Gujarat and somewhat weaker in Punjab. LRPs were the major source of information on RBP for the dairy farmers in both Gujarat and Punjab, followed by DCSs. In Gujarat, 90 per cent of the targeted LRPs were selected and trained, but in Punjab, less than 75% of the targets could be fulfilled by the end of May 2015. The advice about ration balancing was given directly to the person feeding the animal, slip was handed over



to the beneficiaries and practical weighing method by conversion into vessels/bundles was followed in most of the cases. The follow up actions on RBP recommendations were mainly through interaction and follow-up visits and there was least preference for verification on phone.

After the withdrawal of government support, about 2/3 of the dairy farms in Gujarat are ready to pay for the ration balancing advisory at the rate of about Rs. 15-20/animal/month. Nearly 26 percent of them feel that this service should be available free of cost through the DCS. The proportion of adopters ready to continue adoption on payment basis was very low in Punjab (9 percent). The farmers in Punjab feel that they have gained adequate knowledge about ration balancing and do not need any external service/support to practice the same. Very few LRPs opined that the program would continue after project support ends. Inadequate remuneration to the LRP, the key functionary in the RBP and other important functionaries such as Technical Officers and Trainers, is the major constraint that hinders the implementation and sustainability of the program.

Lessons

RBP should be demand-driven for the success of the program. The economic benefits of RBP based on firm evidence are needed to ensure willingness of the farmers to pay for the services. EIAs need to make evidence-based decisions based on INAPH analytics so that funds can be allocated judiciously for the upscaling and sustaining ration balance advisory services at the field level. LRP remuneration should be in consonance with the region-specific wage situation rather than a fixed amount at all-India level.

Human Resources

9. Impact of NDP-I Interventions on Strengthening Women's Empowerment in India's Dairy Sector

Context

This study conducted an interim evaluation of the impact of NDP-I on women's empowerment in dairy households in six states (U.P., Punjab, Rajasthan, Gujarat, Karnataka, and Odisha), by using micro-econometric methods to analyze data from 2,423 households, 48 case studies, 37 Focus Group Discussions (FGDs), and 129 interviews with EIAs, project functionaries, village-level DCS functionaries, and project beneficiaries.

Key findings

NDP-I had a positive impact on women's participation in decisions related to selling milk. However, the program did not significantly influence women's participation in the use of dairy income as compared to women located in non-NDP areas. The most significant change was observed in the area of leadership. The program village women were found to be five percent more likely to participate in village level infrastructure discussions. A typical woman in a program household is six per cent more likely to demand fair wages for public works and protest misbehavior by authorities and elected representatives. NDP-I has helped women gain access to at least one of the three extension services (Artificial Insemination (AI), veterinary, and nutrition service). NDP women are eight percent more likely to access one or the other extension services. The program has significantly improved the breadth of coverage of extension services; however, the use of the extensions services by women members remains an area for improvement.



Both the Village Based Milk Procurement System (VBMPS) and RBP sub-components positively contributed to gender parity. Households with educated females, and individual bank accounts were the largest beneficiaries, while BPL households are still lagging on various dimensions of women's empowerment. A Women's Empowerment in Dairy Index (WEDI) was formulated and used, the results show there was a statistically significant difference in WEDI between NDP and non-NDP households as a whole. Among individual EIAs, there was no significant difference in gender empowerment between NDP and non-NDP villages. Main findings of the study are as follows:

- **Impacts on women's participation in decisions about milk sales were positive**, but the project did not significantly influence women's participation in the use of dairy income, compared to women in non-NDP areas. Male household members tended to retain use and decisions over the income.
- **Leadership impacts were the most significant change observed.** Program village women were five percent more likely to participate in village infrastructure discussions, and six percent more likely to demand fair wages for public works and protest misbehavior by authorities and elected representatives.
- **NDP women were eight percent more likely to access one or more of the three project extension services:** AI, veterinary and nutrition. The study found that NDP-I had significantly improved the breadth of extension services coverage but, the frequency of their use by women members needs improvement.
- **Household-level gender parity impacts were positive from both the VBMPS and RBP.** Households with educated females and individual bank accounts were the largest beneficiaries while below poverty line households lagged on various dimensions of women's empowerment.
- **NDP-I positively influenced public speaking opportunities for women.** They are now more likely to use extension services, devote additional time to improve milk quality and participate in milk selling decisions.

10. Understanding the Existing Knowledge / Skill Level and Attitude / Motivation of Rural Youth towards Dairying as an Employment Activity in NDP I Intervention Villages, February 2019

Context

The study sought to understand the knowledge, awareness, skill, personal aspirations and willingness among youth to adopt dairy farming as an employment opportunity considering the present social inclusion, gender norms, entrepreneurship and infrastructure. Quantitative and qualitative data of youth between 18-35 years old were collected from 144 villages from 36 districts of 9 states. Case studies were also collected to reveal more information on the subject.

Key findings

- **Basic awareness of dairy-farming is high, but scope exists to boost Knowledge.** Awareness of the RBP was highest among youth already involved in dairy activities (67.5%) but on other specific elements, knowledge was more modest. Family and relatives are their main source of knowledge.
- **Youth from vulnerable populations benefited from training.** Higher percentages of youth from socially and economically under-privileged backgrounds benefited from NDP-I training in both



VBMPs and RBP, compared to better-off peers. There was a strong correlation between training and knowledge. Male and female youth seek training in: basic dairying, disease control, value-added products, animal waste management, milk storage, fodder cultivation, hygiene, infrastructure development and book-keeping.

- **Knowledgeable youth are concerned about dairy sector prospects.** This is explained as the result of their greater knowledge of the difficulties/problems in dairying. Importantly, 61.8% of males and 60.8% of females thought it difficult to establish/start-up a dairy business venture.
- **Willingness to start a dairy venture was three-fold higher among females (65.2 percent) than males (23.1 percent).** Overall, one in three youth was willing to pursue dairy as an employment activity and willingness was greater among marginalized groups (SC/ST, 40 percent). Youth with secondary or higher education were less willing (25.2 percent) to become a full-time dairy producer compared to those with less than secondary education (41.7 percent).
- **Aspirations and contextual factors are critical to youth' perceptions of dairying.** Local context and agro-climatic environment – increasing input costs, declining prices, fodder and water shortages and land issues – are the factors influencing youth perceptions of dairying.

Lessons

Rural youth will be encouraged towards dairy farming profession only if it becomes economically viable and business-friendly. Commercial dairying across all dairy states needs to be strengthened.

11. Study of Human Resource (HR) needs of the End Implementing Agencies (Milk Unions) in NDP I, 2019

Context

This study employed various instruments (semi-structured interviews, survey questionnaires, FGDs etc.) to collect data from 18 selected EIAs to understand the present state of Human Resource Management (HRM) and Human Resource Development (HRD) in cooperative dairy unions (EIAs), and attempt to ascertain the critical competency requirements, human resources gaps, training, and capacity building issues. Extensive discussions were held with the Board members, Managing Directors (MDs), Department Heads, and a section of employees.

Key findings

While EIAs (Milk Unions/DCS) have grown their business side rapidly, their staffing strength is depleting. Most organizations canvassed in a 2019 study of DCS' human resource needs are losing their senior staff and few have an HR plan/strategy or capacity to adequately replace them – a sustainability issue. Human resource gaps in EIAs have increased, because recruitment in most of the EIAs stopped long ago, and because of the substantial increase in milk handling by the EIAs. To bridge the gap, most of the sample's EIAs have been employing workers and/or professionals on a short-term basis, often through labor contracts. The human resource gap, coupled with the increasing number of employees with short-term contracts, has resulted in EIAs finding it difficult to place adequate emphasis on skill development. In most of the EIAs there exists no HR department and the function, mostly transactional, is handled by non-managerial employees or those who have superannuated and are retained on short-term contracts. Inadequate on-boarding processes, the absence of a performance management system as well as rewards and incentives for higher performance, have led to lack of motivation among EIA staff



members. Recruitment also tends to be vulnerable to local political pressures.

Comprehensive professionalization of DCS including the HR function is recommended, and specific measures are defined for DCS to maintain a strong business footing:⁵⁵

- Support creation of an independent professional body to assess DCS' HR needs and test candidates for appropriate skills, knowledge, attitude and experience;
- Upgrade their ICT technology inter alia, to provide competent staff with the right professional ecosystem to motivate and retain/develop their skills, and adopt Enterprise Resource Planning, automating many processes while streamlining others;
- Shift from the see-saw of permanent employment vs short-term contract to longer-term contractual appointments to motivate DCS employees to invest in their job;
- Effect a cultural change where competent professionals adopt self-reliance to do their job and not rely on assistants;
- Create an HR department, adopt a strong onboarding system for new recruits to familiarize them with their work and organizational rules/policies but also the DCS' culture and values; and,
- Adopt a performance management system with standards, incentive systems, objective criteria and feedback; ensure career progression; and, develop training programs for both skills and managerial development.

12. Breakeven Point (BEP) Analysis in Dairy Enterprises and Strategies for its Sustainable Growth – (Consultant: AERC, Anand)

Objectives:

To analyse the fixed and operational expenses in dairy farming, and use this data to compute the break-even output for milk for cows and buffaloes.

To examine the constraints in milk production and feeding management and suggest suitable measures for sustainable growth in dairy.

Conclusions:

- Break-even output of milk was lowest for buffaloes and was the highest for cross bred cows during the lactation period.
- Inadequate finance, low milk yields, high feed cost and low prices of milk were major constraints affecting the viability of the dairy business. Feeding cost is the major cost in total milk production.
- Sensitivity analysis shows that feeding interventions by feeding balanced feed applying the Total Mixed Ration (TMR) concept can significantly improve the net income of farmers and lower the breakeven point.

Fodder Development

13. Impact Assessment and Evaluation of Fodder Seed Production and Sales under NDP I (Consultant: AERC, Anand)

⁵⁵ Study of Human Resource Needs of the End Implementing Agencies (Milk Unions) in NDP-I, IRMA Study Team, 2019.



Objectives:

Estimate the % increase in area under green fodder with certified/truthfully labeled seeds.

Evaluate the increase in green fodder yield by using certified/truthfully labeled seeds with improved genetics in comparison to local /non-descript varieties of seeds.

To estimate the reduction in cost of milk production as a result of higher green fodder yield obtained through fodder seed production and sale activities.

Conclusions:

- On an average, 157% increase in area under fodder crops (using certified/truthful labeled seed) was estimated (over base year 2011-12), which indicates the success of the planning and execution of this sub component under NDP I.
- The Seed Replacement Rate (SRR) was reported to be 95.77% during Rabi season while same was reported as 96.97% in Kharif season. The SR was done on the basis of 100% replacement. Overall, SRR was estimated to be 98.18%.
- The yield of fodder seed growers where quality foundation seed was received by them from respective milk union for multiplication was 80% higher as compared to local seed.
- On an average, the availability of fodder increased by around 43% over base year. The fodder seed growers have noted around 33% increase in productivity of fodder.
- Around 87% of total selected households have reported that due to availability of fodder after the implementation of FDP, milk productivity has increased by 43%.

14. Analysing Socio-Economic Impact of the NDP-1, Consultant: NCAER, Delhi

Objectives:

Identify and measure indicators demonstrating the impact of dairy involvement in socio-economic development, family welfare, and income generation;

Assess the social impact of the project in terms of provision of livelihoods, especially for vulnerable groups, and empowerment of women;

Carry out an ex-post economic and financial evaluation of the design and delivery of the project.

Conclusions:

- The expenses on feed and fodder for the milch animals declined in the RBP villages during the NDSP period. The expenses incurred on milch animals per month in the project villages decreased from 18.4% during the Middle of the Project (MIDP) to 15.5% on end of the project, whereas the corresponding figures rose from 12% to over 27% during the corresponding period in the control villages.
- The availability of AI services in the project villages stood at around 59% vis-à-vis 26.3% in the control villages before the advent of NDP-I, with the figures going up to 67 % in the project villages and 33 % in the control villages after the NDP intervention.



- The availability of milk during the NDP-I period had perceptibly increased considerably in the project villages (55.9 per cent) as compared to their control counterparts (33.7 per cent).
- Milk consumption in the project villages also showed a steady increase from 1.5 litres per day per household to 1.7 litres per day per household over the NDP-I period while in the control villages, the average milk consumption remained almost constant during this period.
- The average household income in the project area (Rs. 43,710 per annum) was higher than the control area (Rs. 39,646 per year).
- The Financial Rate of Return (FRR) for the project was 52.4% and the Economic Rate of Return (ERR) was 67% as against the ex-ante FRR of 22.1% and ERR of 23.5%.

15. Roadmap and Strategies to Promote Export of Dairy Products for the Organized Dairy Sector (Consultant: IIFT, Delhi)

Objectives:

Analysing India's domestic production and market challenges for Dairy products from Stakeholder's Perspective and suggesting a future roadmap

Analysis of India's International Trade in Dairy Products

Examining challenges in International Markets faced by Indian Dairy Products and suggesting future export promotion strategies

Conclusions:

Two product categories have been identified on the basis of India's dairy product positioning in the world market and trade value. These categories are named "Potential Thrust Products" and "Retain Existing Products"

With the aim of increasing India's dairy exports to 5% of total world trade (USD 5.5 billion) by 2030, market expansion in 3 different phases is envisaged viz:

Initiation phase (2020-2022),

Transition phase (2023-2026) and

Expansion phase (2027-2030) ranging from 2021-2030





16. Demand for Milk and Milk Products in India (Consultant: AC Nielson)

Objectives:

To estimate the current consumption (2019) of milk and milk products at the State/ UT level and also at the country level for both rural and urban areas separately

To estimate the current consumption of milk and milk products for 65 million plus cities and UAs (Urban Agglomerations as defined by the Census of India) (as per 2018) exclusively in the country

To project the demand for milk and milk products at the State/ UT level (Rural/Urban) and also at the country level separately for the million plus cities and UAs for 2030.

Conclusions:

Total consumption (2019): 161 MMT

Total household consumption:

Rural (96MMT) 60% and Urban (65 MMT) 40%

Consumption

65+ million cities: 30 MMT (19%)

Total demand in 2030:

267 MMT

Urban: 152 MMT (57%) and Rural: 115 MMT (43%)



ANNEX 8: ANALYSIS OF DAIRY PRODUCER COMPANIES

Summary: A Financial Performance Evaluation of the NDSP-supported Dairy Producer Companies in India (World Bank, 2020)

1. In India approximately half of the milk produced is consumed in the production area or used domestically. However, half of the surplus milk is sold by the organized sector (Cooperative and private organizations). Milk producers often struggle for their fair share in terms of milk price and income. The formation of the Dairy Producer Company (PC) is a recent phenomenon, made possible by Annexure 9A of the Companies Act (2013). The PC accommodates the characteristics of both cooperative principles as well as private corporations. In a DPC, producer members are the owners. They can engage in activities related to milk collection and marketing and share knowledge that can increase the productivity of the milch herd. Six Dairy Producer Companies (DPC) were supported under NDSP, implemented by the National Dairy Development Board (NDDB).
2. This study evaluated DPCs' performance in terms of their financial viability as well as other social contributions. To assess their financial performance, financial ratios were analyzed by using the performance scoring method.⁵⁶ Four variables of ratio analysis were used: liquidity ratio, solvency ratio, efficiency ratio and profitability ratio. Financial statements for each year from 2013 to 2019 (Balance sheet and Profit-Loss statements) were used to do the evaluation. These ratios were then calculated based on their performance.
3. Overall, the six DPCs are performing at an average or moderate level (designated Yellow Zone) based on liquidity, solvency, efficiency and profitability variables for ratio analysis. Prima facie, the profitability ratio is poor in this analysis, however, since DPCs sacrifice their profits by distributing the surplus as a form of patronage-based price incentive and dividend on share capital to the producer members and also by increasing the share value, earnings per share is a better estimate for measuring the profitability status. The estimation of the earnings per share ratio for all the DPCs studied is in a better position and shows an upward trend. In addition, the DPC is a new concept in India, all six DPCs studied were quite recently-established, and there are other strong competitors and challenges.
4. The overall trend for all these financial ratios is upward, suggesting that the DPCs are achieving a more sustainable position in terms of all the four variables, over time. An upward trend is a positive sign and indicates opportunities for improvement with certain interventions. These DPCs are also contributing in several training programs, productivity-enhancing programs and incentivizing female participation in dairying. An assessment of DPCs' social contribution was also made in this analysis to investigate how the DPC business model aligns with the World Bank's twin goals of poverty reduction and shared prosperity.
5. DPCs were created to establish an alternative organizational structure to the cooperative Milk Union that can help producers to adopt good management practices and good administration. For maintaining efficiency and transparency of operation, it is necessary to evaluate DPC's overall performance. DPCs are business enterprises which are broadly similar to the cooperative principals with some enabling features. Given are the key differentiating features of DPC and Dairy Milk cooperatives.

⁵⁶ Kakati and Roy, "A Study on the Financial Performance of Farmer Producer Companies with Special Reference to Northeast India."



Table 1: Distinguishing features of a producer company and dairy cooperative

Feature	Producer Company	Dairy Cooperatives
Legal Framework	Central Act, enabling in nature	State Act, restrictive in nature
Area of operation	Not restricted	Restricted
Shareholders	Only user members can hold shares	Non-users can hold shares
Voting Rights	One member, one vote	One member, one vote
Audits	Regular audit by a chartered accountant as per provision of the Companies Act.	Audit by the Cooperative Audit Department or in some states by an auditor from a panel of auditors approved by government.

Source: "NDDDB Dairy Services Annual Report 2013-2014"

6. DPCs deal with the members only, where member’s equity is equivalent to their patronage. Only members can engage in milk pouring, where testing quality and weighing are done at the village-level Milk Pooling Point (MPP). The DPCs' financial performance has a direct bearing on the benefit generated for the producer members. On the other hand, poor business performance indicates DPC inefficiency in management and inadequate return on investment. By assessing the financial performance through Financial Ratio Analysis (FRA), this report investigates how DPCs are performing in terms of liquidity, solvency, efficiency, and profitability. The second part of this assessment focuses on how the DPC structure is contributing to inclusive development, pro-poor growth, and better management practices.

Methodology:

7. Under NDSP, six DPCs were established with the support of NDDDB Dairy Services (NDS). In this analysis, a financial performance evaluation was done for six DPCs. All the financial statements from their incorporation to the present were analyzed for the FRA.

8. The financial statements (Balance Sheet and Profit Loss Statement) were collected from the DPCs’ annual reports, most of which are publicly available. An amendment has been made to the Companies Act 2013 (read with Part IX A of the Companies Act 1956) that all producer companies are required to publish their annual report. The annual report should contain the financial statements which can be used to measure company’s financial performance and position.⁵⁷ The performance scoring method used in this assessment is inspired by research literature.⁵⁸ The ratio used in this analysis is given below.

⁵⁷ Kakati and Roy, Ibid.

⁵⁸ Blocker, Ibendahl, and Anderson, "Interpreting Farm Financial Ratios."



Table 2: Variables and Financial Ratios

Variables	Ratio Used
Liquidity	(i) current; (ii) quick; (iii) absolute
Solvency	(i) debt-equity; (ii) total asset to debt; (iii) proprietary
Efficiency	(i) capital turnover; (ii) net working capital turnover (iii) fixed asset turnover
Profitability	(i) net profit; (ii) earnings per share; (iii) return on investment

Source: Garg, T. (2012)

9. The result of each ratio is clustered based on the performance score. Five different performance clusters have been used based on the performance of each financial ratio ranging from '1' to '5' (ranges in association with each score are given with the respective formula of the certain ratio). Here, '5' is considered as the best score with '1' being the worst. The summation of the scores for liquidity, solvency, efficiency and profitability ratios are calculated for all the 6 DPCs individually. (See study for detailed explanation of the ratios).

10. Later on, the summation of all the liquidity variables for the 6 DPCs are calculated and assigned to a percentage point. This analysis shows a comparison of a certain variables among all six DPCs. In the latter part of the FRA, individual assessments for the 6 DPCs' Liquidity, Solvency, Efficiency and Profitability ratio are conducted. In this case, a summation for the four variables for each company is computed in terms of percentage points.

11. This analysis shows the overall status of the company in terms of all the four financial variables. However, the scores are also ranked in terms of the overall percentage point. With the performance score, it can be assessed whether a DPC's liquidity variable is "good" (Green Zone), "moderate" (Yellow Zone) or "poor" (Red Zone).

Table 3: Total Performance Score and assigned zone for the DPC

Performance score for individual company
a) Green Zone= 75 % or above the total performance score; Company's financial status is excellent
(b) Yellow Zone = 50% or above the total performance score; Company's financial status is out of risk but there is room for improvement by certain intervention.
(c) Below Yellow zone is Red Zone: Company's financial status is at risk and performance is unsatisfactory.

12. Before the analysis was initiated, visits were conducted to five out of the six DPCs to assess their overall condition. Field visits consisted of reviewing different sites where the milk is collected at the village-level (i.e., MPP), Milk Chilling Center (MCC)/Bulk Milk Chiller (BMC) processing plant and some other locations where several productivity enhancement activities are conducted (e.g. dairy demonstration farm, Semen Station, cattle feed and mineral mixture plant). Visiting these sites and talking to the producer members enhanced the overall understanding of how effectively these DPCs are working towards generating sustainable opportunities for income generation in rural areas.



Results of the analysis:

13. Liquidity, Solvency, Efficiency and Profitability ratios are analyzed to investigate the financial status of 6 DPCs under NDDB. For each variable and ratio, a performance score is also assigned.

14. **Liquidity ratio:** This ratio measures the ability to meet short-term debt obligations. This ratio also measures how credible the company is in terms of meeting short-term debt obligations. However, if this ratio is poor, the company may face bankruptcy and dissolution. Short-term creditors are mainly concerned about the liquidity ratio since the optimum liquidity ratio ensures that their claims and stake could be met in the short run.

15. **Solvency ratio:** The Solvency Ratio measures a company’s ability to meet and pay its long-term obligations. Long-term creditors are mostly concerned about the solvency ratio since it indicates if the company can meet their stakes and claims in the long run. In this study, three solvency ratios are being used. These are Debt-Equity Ratio, Total Assets to Debt Ratio and Proprietary Ratio.

16. **Efficiency or Activity ratio:** The Efficiency or Activity ratio estimates the effectiveness of resources utilized by the company. This ratio also shows the efficiency with which the company can manage its assets and the speed at which the resources are converted into revenue or sales. Net Working Capital Turnover Ratio, Capital Turnover Ratio and Noncurrent Asset Turnover Ratio were estimated here to measure the efficiency ratio.

17. **Profitability ratio:** Profitability ratios estimate the business’s overall effectiveness on returns generated by sales and investment. In this case, three profitability ratios are being used. They are net profit ratio and return on investment ratio (summarized in para 20 below) and earnings per share.

18. **Dividend Paid:** The MPCs are paying dividends and also increasing the share value of the company. This is a positive indication since by paying the dividends to the producer members, MPCs are generating income in rural households (Figure 1).

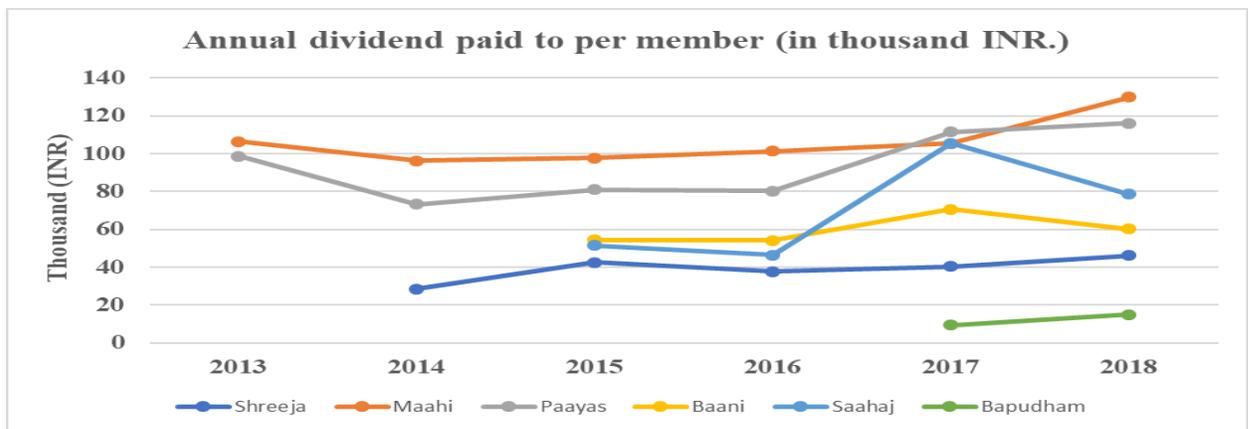


Figure 1

20. Performance of the 6 DPCs under NDSP:

(a) **The overall liquidity position of all 6 DPCs is average.** This indicates that there is a need for improvement in capital management. Although the liquidity position of the 6 DPCs is average, the liquidity performance shows an upward trend and indicates improvement over time. Since the



concept of the Producer Company is new in India and DPCs are a recent initiative in Dairy Development, time is an important factor in achieving sustainability. So, the liquidity or short-term position of the DPCs is in the safe zone and moving towards sustainability.

- (b) **The overall solvency position is also average**, and improvement is required. Only MAAHI and PAAYAS have a good solvency position, indicating that they can be sustained because they have enough capacity to cover long-term debt in their capital structure. Other companies still have to work on achieving sustainability for a better solvency position. Although the overall solvency position of the DPCs is average, there is an upward trend for all the variables. This indicates the DPCs' solvency position is improving over time. In other words, the DPCs are improving their capital structure over time by achieving more capacity to handle long term debt and liabilities.
- (c) **The overall efficiency position of all six DPCs under NDP-I is average**. This shows the average efficiency of management in generating sales per rupee of capital employed. This indicator is crucial for long term investors. The DPC's efficiency position indicates whether the investment in the company can be utilized in an effective manner or not. The overall efficiency position is average. But the analysis also shows over time that the DPCs' efficiency position is improving and making an optimum environment for further investment.
- (d) **The overall profitability position of the DPCs is poor**. Since milk is a perishable item, farmers have little control over the milk prices. Usually they sell milk at the existing market price at that specific time. DPCs are pursuing a management policy of prioritizing producer income over company profits.



21. Recommendations:

- (a) Income in dairying depends on the capital expenses. Capital expenses constitute land, equipment, labor cost, feeding cost and cost of purchasing animals. All the fixed costs such as land and equipment have depreciation. In that case, the fixed cost should be reduced and most of the investment should be made in purchasing high pedigree animals. On the other hand, variable costs constitute animal feeding and labor. In order to maximize the farmer's income, further initiatives should be taken to optimize/reduce the feeding costs as well as reducing overhead costs.
- (b) Financial institutions should be encouraged to lend more short-term and long-term debt to these DPCs.
- (c) It is imperative to strengthen the sales and marketing structure of the DPCs. Their milk and milk products should be more popular in the operational areas. There should be more initiatives to expand the sales and distribution network.
- (d) Initiatives should be taken to strengthen the procurement process, optimizing transportation cost, reducing losses at points along the dairy supply chain and creating awareness among members to supply more milk.

Social contributions of the DPCs:

22. The study attempts to investigate the company's overall financial status and how to ensure that the business model is sustainable. To make a more accurate assessment, the study looked at how the DPCs are contributing to gains in social parameters. Below is a brief overview of how the DPCs under NDSP are creating growth and sustainability through their interventions.

23. DPC growth in terms of membership: In the DPCs, members can sell their milk after fulfilling certain criteria. The companies are solely a producers' organization where the Board of Directors is also selected from among the milk producers. The growth rate of membership is an important factor. To be a DPC member one has to fulfill three minimum criteria: (i) Purchase at least 5 equity shares (at INR 100 per share); (ii) Pour minimum 200 days in a year; (iii) Pour minimum 500 liters of milk in a year with a ratio of the lean season to flush season of 1:3. In a country like India, where farmers are mostly smallholders and poor, it is extremely challenging to convince them to buy DPC shares and to fulfill some other conditions. Further, all members need to have a bank account since all the transactions are done online. Figure 2 below shows positive, steady membership growth under NDSP.

24. In Indian villages, the bank account is not a very prevalent practice among farmers. Membership growth is a good indicator of how the DPCs are achieving trust over time. Also, there are several other organized sectors and unorganized (milk collection man) players in Indian villages. Thus, DPCs have many competitors. Since this is a new concept, it is not easy to increase participation. But the result from the analysis suggests that the number of members is increasing over time despite many challenges. Since MAAHI and PAAYAS are the oldest companies among the six DPCs studied, they also have the largest number of members. Figure 4 below shows the milk producer membership growth rate under NDSP.

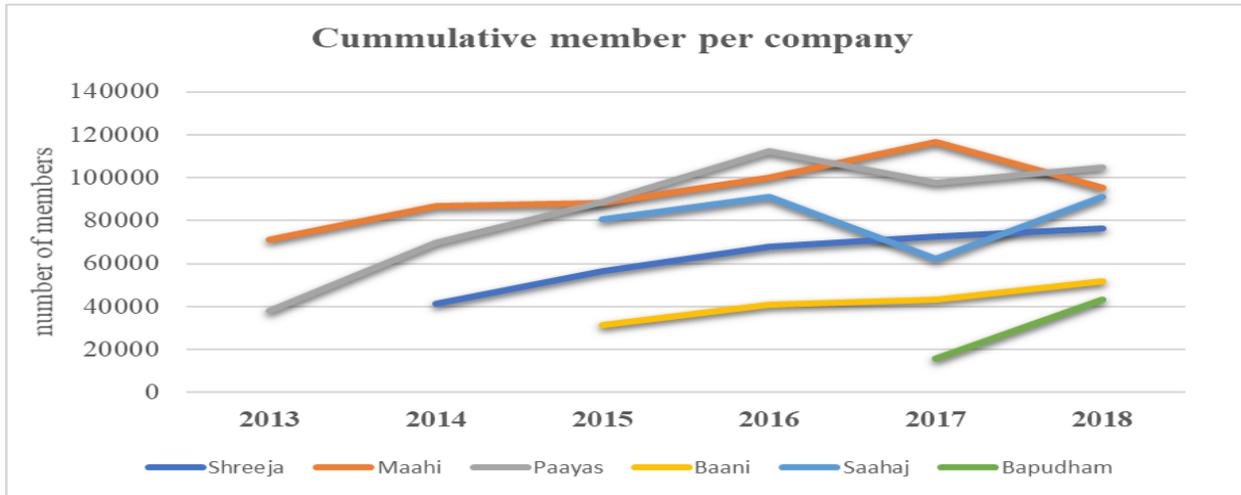


Figure 2

25. Growth rates of membership for the DPCs are trending upward and downward over time. There is a steady growth in membership of BAANI, SAAHAJ and SREEJA but declining numbers in PAAYAS and SAAHAJ in 2017, as shown. The companies were doing screening 2-3 years post-conception and found that some producer members were not fulfilling the membership criteria religiously. Consequently, during screening, those members lost their membership. Once membership is revoked, milk producers must wait at least two years to renew membership. Figure 3 shows that although there was a decline in the membership growth rate in 2015 and 2017, increases were registered in 2016 and 2018.

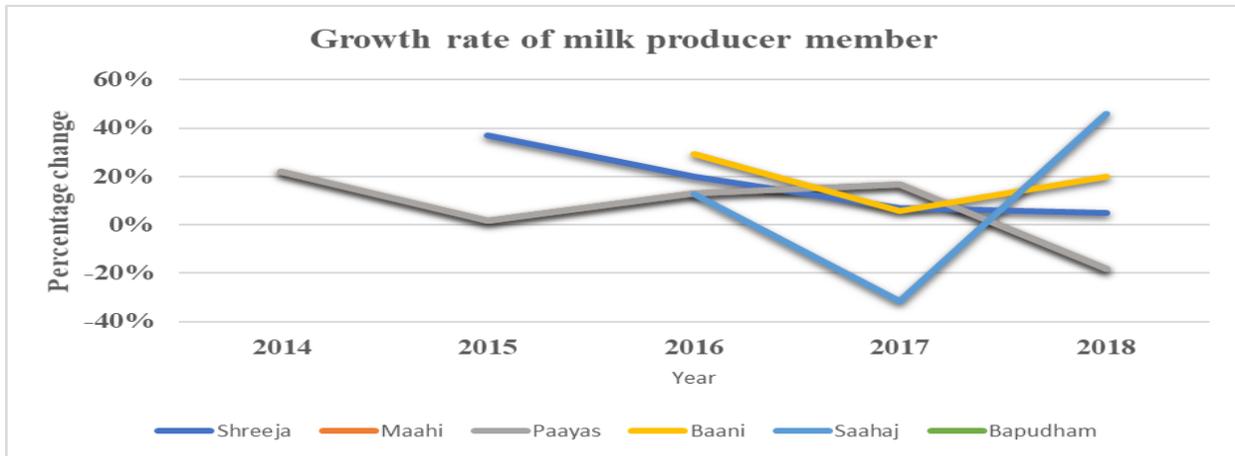


Figure 3

26. **Inclusive development for women and smallholders:** The role of women is very important in the dairy sector since they do most of the work. SHREEJA is an all-women DPC, where the money is paid directly to the bank account. Women's participation enhances their asset accumulation, which they devote to better education for children. Figure 4 indicates that BAAPUDHAM, PAAYAS and SAAHAJ have a higher rate of women's participation. The DPCs should target a women's participation rate of at least 50% and incentivize accordingly. Women's participation also depends on cultural norms, so diverse efforts are required to encourage and increase their participation.

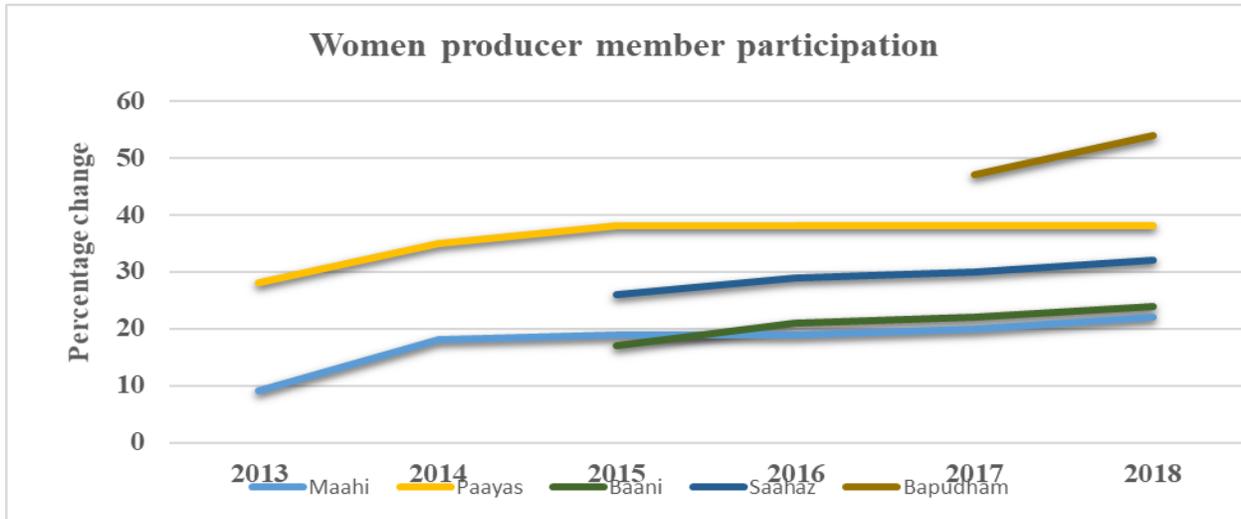


Figure 4

27. Milk producers can be classified in India in terms of the number of animals they hold. They can be classified as (i) holding 3 or less milch animals (smallholder), (ii) holding 3 to 10 milch animals, or (iii) holding more than 10 milch animals (Figure 5). Participation of smallholder producers in DPCs indicates opportunities for income generation among the lower stratum of the pyramid and ensuring sustainable development among poor farmers. In PAAYAS and SAAHAZ, the smallholder's participation rate was falling over time as members increased herd size. In DPCs, all transactions are made through a bank account, making it easier for the producers to accumulate wealth over time and borrow money from the bank due to their increased credibility. Purchasing more animals – owning more than 3 animals - helps dairy producers elevate their status above smallholder.

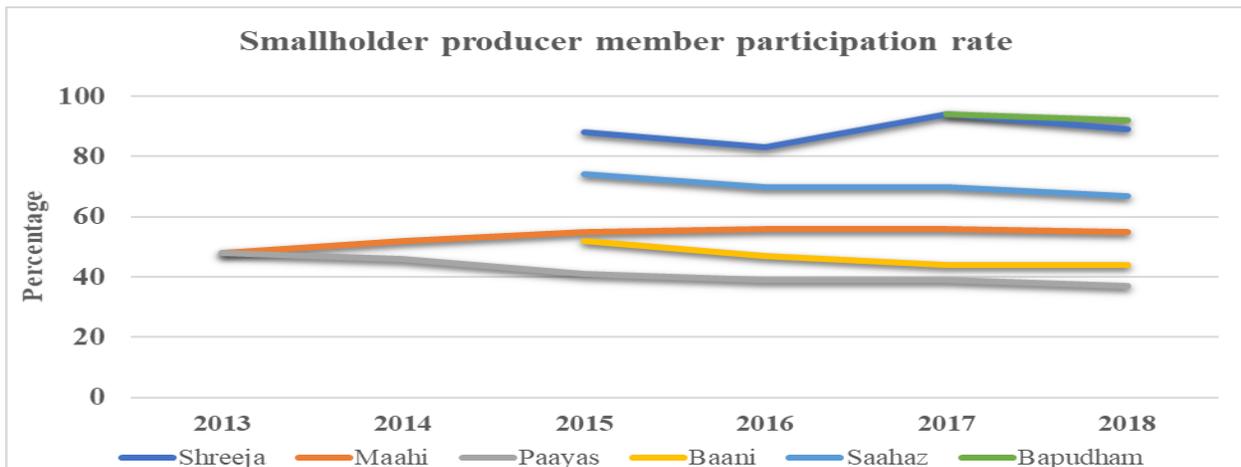


Figure 5



ANNEX 9: NDSP TRAINING AND CAPACITY-BUILDING

1. The following tables show the scope and scale of NDSP training and capacity building programs.

Table 1: Training Organized by NDDB

Activity/ Training Programme	Component	Category of Participants	Cumulative	
			SPP Target	Actual
Farmers Induction*	VBMPs-Coops	Milk Producers	27,274	30,499
Farmers Orientation*			17,281	17,454
Board Orientation		Board of Directors	1,603	1,216
Business Appreciation		Executives	2,362	2,033
Training of Trainers			291	267
New Supervisors Training			1,021	874
Sub-total				49,832
Training of Technical Officers on RBP	Ration Balancing Programme-Coops	Executives	344	615
Refresher training on training of trainers			131	93
Training of Information Technology on RBP			109	89
Sub-total			584	797
Training of Technical Officers on RBP	Ration Balancing Programme-PC	Executives	67	114
Refresher training on training of trainers			24	15
Training of Information Technology on RBP			15	21
Sub-total			106	150
Fodder production & conservation practices	Fodder Development-Coops	Executives	253	254
Sub-total			253	254
Fodder production & conservation practices	Fodder Development-PCs	Executives	48	48
Sub-total			48	48
Orientation/refresher to AIOs	Progeny Testing	Executives	60	45
Orientation/refresher to Project Coordinators			23	20
Orientation/refresher to District Coordinators			75	67
Orientation/refresher to Calf Rearing In-charges			25	20
Sub-total			183	152
Orientation/refresher to Project Coordinators	Pedigree Selection	Executives	21	16
Orientation/refresher to Area Coordinators			15	11
Sub-total			36	27
Total			51,042	53,771

* FIP and FOP trainings are organized by both NDDB & EIA

Table 2: Other NDP I Training Organized at NDDB, Anand - State of Gujarat

Activity/ Training Programme (Executives)	Actual
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Training of Trainers on INAPH	46
Customised Ration Balancing programme	33
Animal Health Officers training	84
Training on Environment and Social aspects	213
NDP induction	943
Lady Extension officers training	56
Total	1,375

Table 3: Training Organized by End Implementing Agencies

Activity/ Training Programme	Component	Category of Participants	Cumulative	
			EOP Target	Actuals
New DCS Secretaries training	VBMPs (Coops)	Village Resource Persons	13,592	12,816
Existing DCS Secretaries			16,630	17,513
TOT on operation & maintenance of BMC,DPMCU and AMCU			149	159
Clean Milk Production		Milk Producers	552,600	528,772
Management Committee Members		Board	133,948	117,046
Sub-total				716,919
Producer Awareness Programme	VBMPs (PC)	Milk Producers	653,468	682,787
Awareness programme on quality & clean milk production			564,808	558,708
Women awareness programme			324,617	354,914
Awareness program for rural youth			31,112	35,517
Awareness/competition for children			43,724	44,598
MRG Orientation			58,866	64,205
Business & Governance strategy workshop for BODs			Board members of DCS	255
Exposure visit for BODs		300		284
Pre-Board training		1,060		1,083
Training of MCC staff on O&M			2,603	3,102
Sahayak Orientation prog		Village Resource Persons	23,528	29,225
Sahayak Refresher prog			4,702	5,871
IB trainers training		Executives	605	939
Training on Proc, producer relation & QA for facilitator			1,343	1,452
Training on Proc, producer relation & QA for area officers			272	323
Skill Development prog for assistance			643	728
Motivational prog for assistance			685	955



Activity/ Training Programme	Component	Category of Participants	Cumulative	
			EOP Target	Actuals
Team Building and leadership development			487	900
Training prog for QA officers			39	55
Training prog for QA assistants			1,887	2,022
Sub –total			1,715,004	1,787,867
LRP trainings	<i>RBP (Coop)</i>	<i>Village Resource Persons</i>	26,014	24716
Refresher LRP trainings			5,431	4290
Sub –total			31,445	29006
LRP trainings	<i>RBP (PC)</i>	<i>Village Resource Persons</i>	10,885	8695
Refresher LRP trainings			1,872	1751
Sub-total			12,757	10446
Seed production technology	<i>Fodder Development (Coop)</i>	<i>Executives</i>	53	50
Sub-total			53	50
Seed production technology	<i>Fodder Development (PC)</i>	<i>Executives</i>	0	0
Sub-total			0	0
Orientation/refresher to AI	<i>Progeny Testing</i>	<i>Village Resource Persons</i>	4,091	3,713
Orientation/refresher to Milk Recorders			3,619	3,082
Orientation/refresher to Supervisors		<i>Supervisors</i>	451	393
Orientation/refresher on DEOs			50	41
Overseas training		<i>Managers</i>	6	7
Sub-total				8,217
Orientation/refresher to supervisors	<i>Pedigree Selection</i>	<i>Supervisors</i>	67	59
Orientation/Refresher on Livestock supervisors			10	9
Orientation/Refresher on DEOs on INAPH			15	19
Orientation/Refresher on AI on MAIT		<i>Village Resource Persons</i>	578	375
Orientation/refresher on MAIT			468	358
Sub-total				1,138
Laboratory techniques for GM	<i>Strengthening of Semen Station</i>	<i>Managers</i>	27	25
Laboratory techniques for QCO		<i>Executives</i>	33	29
Modern cryopreservation technology for QCO 7 VO			115	104



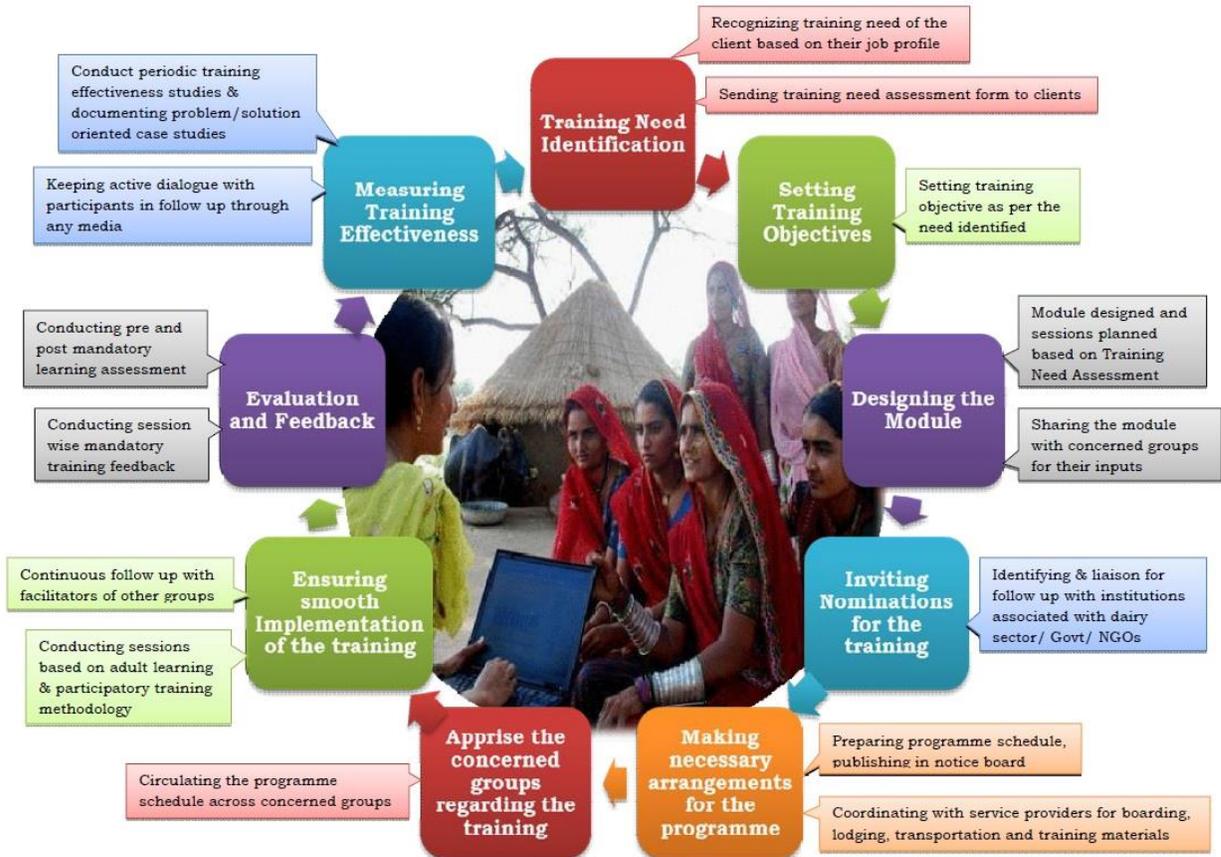
Activity/ Training Programme	Component	Category of Participants	Cumulative	
			EOP Target	Actuals
Bull breeding Soundness for QCO 7 VO			109	97
Lab techniques for Lab technicians		<i>Technicians</i>	134	117
Orientation of Lab attendant		<i>Village Resource Persons</i>	174	177
Orientation of Bull attendant			707	692
ISO first aid and safety works			1,183	1,343
Sub-total			2,482	2,584
Basic AI training for MAITs	<i>Pilot AI Delivery Systems (PC)</i>	<i>Village Resource Persons</i>	2,480	2,052
Refresher AI training		<i>Village Resource Persons</i>	966	927
Head Breeding Services Training		<i>Executives</i>	9	3
BS/VE Training			108	92
MAIT INAPH training			2,548	1,844
Sub-total			6,111	4,918
Total			2,494,126	2,519,233

Source: Borrower Completion Report (NDDP, 2020)

2. National and international training was essential to project outcomes and sustainability. NDDB personnel attended technical courses in the Netherlands, Australia, USA, Italy and Thailand in dairy animal breeding and nutrition, and NDDB was itself, responsible for recruiting, training and initially paying the Local Resource Persons (LRP) to deliver the RBP, while the PMU was trained in project management, Bank procurement and M&E. The EIAs, pivotal agents in project implementation, were trained to implement PT and PS, biosecurity, bull management, semen processing, as well as recruiting and training the MAIT in SOPs for AI. Further, AI technicians and MAITS, milk recorders and Semen Stations were trained into their responsibilities, and in the use of netbooks and data entry systems. The schematic below shows the concept and planning framework supporting NDSP training at all levels.



NDSP Training Schematic (NDDDB, 2020)





ANNEX 10: INNOVATION UNDER NDSP

A. The Innovation Fund:

1. A core set of innovations was financed under a Bank-initiated and National Steering Committee-approved Innovation Fund.⁵⁹ Pilot activities included animal health, genomic selection, feed/fodder innovations, data management/ICT applications, renewable energy, and milk fortification, as below.
2. **Animal Health:** Progress in animal health was among NDSP's notable achievements, contributing to improved milk productivity. NDSP made major strides in the following: (a) **Infectious Bovine Rhinotracheitis (IBR).**⁶⁰ The first-ever trial of an internationally-proven IBR vaccine under Indian field conditions saw the vaccine administered to over 9,500 animals in 10 villages.⁶¹ The vaccine proved safe even in pregnant animals and no significant reduction in milk yield was recorded. This work was accompanied by mass IBR/vaccination awareness drives, disposal of affected animals, and an IBR awareness film in ten Indian regional languages (<https://youtu.be/w2Fm6marwnY>).
3. **Genomic selection:** Genomic selection, pioneered by NDSP, has the potential to increase rates of genetic improvement by over 20 percent e.g., annual increases in production of over 47 to nearly 84 liters, depending on breed. NDSP sought to establish a channel for biological sample collection from performance-recorded animals under NDSP subprojects for future use; and, develop genomic selection procedures for several cattle breeds, using genomic Breeding Values (GEBV) for the accurate selection of bulls and at a younger age. The project developed: (a) the INDUSCHIP for genotyping recorded animals, creating a genotyping facility which processed 9,768 cattle samples in 12 months; and (b) the BUFFCHIP for Buffalo, a medium-density, micro-array chip developed in collaboration with the US Department of Agriculture (USDA) and validated for genotyping. Whole Genome Sequencing was conducted on 296 buffaloes of 10 major Indian breeds to study variations. Scientific papers were presented in Auckland, New Zealand in 2018, and San Diego, USA in 2020 (BCR).
4. **TMR feeding using enriched, pelletized crop residues.**⁶² Under NDDB guidance, NDSP financed a 50 ton/day crop residue-based TMR plant in Kolhapur Milk Union (Maharashtra State) using sugarcane tops, straw and other inputs to further demonstrate the genetic potential of dairy animals (fertility and productivity) through science-based feeding of nutritious, enriched pellets in lactation. Analysis of a Treatment and Control group based on nine months of data showed: (a) average milk yield of treated animals was 7.91 kg/day compared to the control's 6.43 kg/day; (b) total milk yield over nine months was 2,136 kg vs 1,736 kg respectively; (c) nine-month income from sale of milk was INR 85,428 versus the control's INR 69,444; (d) the treatment's lactation increase for nine months was 24.8 percent compared to the 15 percent expected for the entire lactation; and, (e) the return over feed cost for the treated group was INR 31,404 versus the control's INR 21,816. Pellet-based TMR also better enables feed storage.

⁵⁹ The NDSP Innovation Fund financed competitively-selected proposals for testing proof-of concept for new and promising technologies contributing to higher dairy productivity and competitiveness.

⁶⁰ IBR is a contagious disease causing reproductive disorders and early embryonic death, respiratory distress and loss of milk production potential. Under Gol Minimum Standard Protocols, SS must move towards IBR-free herds only, through progressive controls. Bull losses under NDSP were high due to Gol's new IBR-related culling policy. NDSP introduced strict bull sampling, culling and quarantine for several key diseases including Tuberculosis, Brucellosis, John's Disease etc.

⁶¹ The Innovation Fund-supported pilot "Popularization of IBR Control using Inactivated Marker Vaccine" covered the cattle and buffalo population in three EIAs from 2017-18 and 2018-19. An Indian firm is manufacturing an affordable IBR marker vaccine.

⁶² In India, some 500 million tons of crop residues are generated annually, of which 92 million tons are burned off in the field at high cost in lost potential for year-round and cheaper animal feed, and massive pollution (BCR, 2020).



5. **Pilot provision of Data Loggers for Bulk Milk Coolers at village level DCS.** The installation of 69 Data Loggers in 69 DCS/MPCs nation-wide helped to monitor and control the performance of BMCs in real time. Provision of SMS alerts and web portal-based information through data loggers supported remote performance monitoring, preventative planning for possible breakdowns, and resolution of equipment failures with minimal delay. Such BMC technology contributes to increasing milk quality.

6. **Clean energy pilots were financed.** (a) Pilot rooftop solar panels: Installation of rooftop solar PV systems with back-up battery and inverter promoted the adoption of clean alternative sources at affordable cost: 61 such systems were installed by DCSs to reduce dependence on the grid-connected and often irregular power supply; and (b) Pilot Flexi Biogas plants: Installation of these plants under the manure management pilot generated additional income for producers using biogas as a clean cooking fuel, and bio-digested slurry both as a fertilizer and for sale. Some 1,000 biogas plants were provided to 32 Milk Unions. Indicative results *inter alia*, showed the intervention helped reduce GHG emissions by 817 metric tons (CO₂ equivalent), by replacing LPG use.

7. **Fodder demonstrations catalyzed the emergence of a significant fodder management machinery industry in India, an important co-benefit of NDSP.** Sales of mowers and related machinery reached 60,000 units over 5 years. The BCR reports that modern fodder machines like mowers, reapers, choppers, loaders, rakers, balers and baggers are now manufactured in India and priced competitively. Over 200 commercial roughage management plants have been established by private entrepreneurs using own funds. The BCR notes that to scale up coverage and economic benefits of fodder development, custom rental centers could be established by implementing agencies (e.g., EIAs). Some Milk Unions had already established such centers under NDSP by closing.

8. **NDSP implemented a successful milk fortification pilot under the South Asia Food and Nutrition Security Initiative (SAFANSI).**⁶³ Milk fortification was only minimally used in India despite its inclusion in Gol's 5-Year Plans. Reasons included lack of champions, evolving standards and dairy industry risk aversion. The pilot explored the potential for large-scale milk fortification in India through micro-nutrient fortification in the liquid milk supply chain, consumer advocacy, and enabling scale-up and institutionalization. From 2017-2019, the pilot reached 25 Milk Federations, DPCs and Milk Unions across 20 States, starting with Vitamin A and D fortification of 13,000 liters/day and reaching 5.5 million liters of milk per day by 2019, providing access to around 6 million consumers. Pioneered by the Jharkhand Milk Federation (Jharkhand State suffers high rates of malnutrition), early adopters included the large, integrated dairy firms Mother Dairy India, Verka and Saras.

B. Other Innovations:

Foot and Mouth Disease (FMD) vaccination coverage in priority project areas (SS and PT/PS villages) increased from 35 percent at baseline to 74 percent as a direct result of NDSP, with almost 3.8 million FMD vaccinations. Periodic FMD outbreaks threatened the viability of all NDSP productivity enhancement activities and highlights the importance of NDSP's close collaboration with India's State Animal Husbandry Departments.

⁶³ Improved Nutrition through Micro-nutrient Fortification: Testing the Business Case under the NDSP India, TF 602001 Grant of USD 450,000 and multiple donors (World Bank, NDDDB, Tata Trusts and India Nutrition Initiative). Final Report, June 10, 2019



Data to better inform herd management and breeding policy. NDSP is building a multi-lactation dataset to quantitatively compare indigenous/ buffalo/ crossbreds/ exotics.

Genetic improvement of indigenous breeds. NDSP's focus on improving the genetic merit of indigenous breeds promotes adaption, resilience and productivity. Breeds like the Rathi, Kankrej and Tharparkar offer unique genetics not only for India but globally.

Genetic improvement of buffalo breeds. Buffalo breeding had long been neglected, even though they provide the largest (and increasing) share of India's dairy animals.

Using strategic imports to increase genetic merit. NDSP imports of live bulls, embryos and semen allow India to tap into dairy's elite global gene pool, thereby raising genetic potential for milk production several fold.

Selection of bulls for AI use. NDSP significantly expanded the program of genetic selection of bulls for AI, through progeny testing and performance recording of sire and dam, respectively. The application of scientifically proven approaches to genetic improvement will underpin future production potential of dairy animals.

AI bull stations. NDSP brought in a new era in facilities for bull housing, management and the production and processing of semen. The current state-of-the-art facility – SAG – will soon be less the exception and more the rule.

Fertility assessed on quantitative field data. Bull fertility based on field level conception data, rather than previous reliance of lab-based morphological assessments.

Ration balancing and fodder management. Improved rations offer the potential to not only increase milk production, but also optimize the use of available feed resources – decreasing also the cost of production. Improved feed quality also reduces methane emission and the environmental footprint of dairy.

Animal recording. INAPH – the Information Network for Animal Productivity and Health – is the first ever national database on the performance of individual animals for a number of production, health, breeding, reproduction, and performance metrics. INAPH promotes unique individual animal identification (another first for India) and provides an invaluable dataset to better understand production performance at the animal level and ultimately highlight areas needing further research and development.

Dairy Producer Companies. NDSP promoted innovative, inclusive enterprises such as Dairy Producer Companies which seek to increase ownership and profitability of dairying for farmers.



ANNEX 11: SUPPORTING DATA AND INFORMATION

A. TABLES

General:

Table 1: State Compliance with Policy Measures

Measure/ State	1: Having in place an appropriate breeding policy	2: AI delivery services not being notified as a Minor Veterinary Service	3: Charges for AI delivery being raised gradually to cover full cost	4: Semen for AI delivery in the state being sourced only from semen stations graded A or B	5: Adoption of common protocols and SOPs issued by DADF for all breeding activities	6: Notification of State Rules under the PCICDA Act, 2009
Andhra Pradesh	Complied	Complied	Complied	Complied	Complied	Complied
Telangana	Partially Complied	Complied	Not Complied	Complied	Complied	Complied
Bihar	Complied	Complied	Not Complied	Complied	Complied	Partially Complied
Gujarat	Complied	Complied	Complied	Complied	Complied	Complied
Haryana	Complied	Complied	Not Complied	Complied	Complied	Complied
Karnataka	Complied	Complied	Not Complied	Complied	Complied	Complied
Kerala	Complied	Not Complied	Not Complied	Complied	Complied	Complied
Madhya Pradesh	Complied	Complied	Partially Complied	Complied	Complied	Complied
Maharashtra	Complied	Complied	Partially Complied	Complied	Complied	Complied
Odisha	Complied	Complied	Not Complied	Complied	Complied	Complied
Punjab	Complied	Complied	Not Complied	Complied	Complied	Complied
Rajasthan	Complied	Complied	Partially Complied	Complied	Complied	Complied
Tamil Nadu	Complied	Complied	Not Complied	Complied	Complied	Complied
Uttar Pradesh	Complied	Complied	Not Complied	Complied	Complied	Complied
West Bengal	Complied	Complied	Not Complied	Complied	Complied	Partially Complied
<u>Uttarakhand</u>	Complied	Complied	Complied	Complied	Complied	Complied
Chhattisgarh	Complied	Complied	Not Complied	Complied	Complied	Complied
Jharkhand	Complied	Not Complied	Not Complied	Complied	Complied	Complied

Source: BCR, 2020

**Table 2: Categories of EIAs eligible for NDSP Activities**

Activity	End Implementing Agencies
Bull Production	EIAs having own semen stations graded A or B or an arrangement with a semen station graded A or B in their latest evaluation.
Semen Production	Semen stations awarded grade 'A' or 'B' by DADF's CMU (Central Monitoring Unit) in their latest evaluation
Ration Balancing Programme	Milk Unions/ Federations/ Producer Companies /ICAR Institutes
Fodder Development Programmes	Milk Unions/ Federations/ Producer Companies/ Trusts (NGOs)/ Regional stations for forage production and demonstration/ ICAR institutes/ Veterinary Universities
Village Based Milk Procurement Systems	Milk Unions/ Federations/ Producer Companies

Source: BCR, 2020

Table 3: Approved Sub-projects, by Activity

Activity	# Approved Subprojects
A. Animal Breeding	65
- Progeny Testing Program	14
- Pedigree Selection Program	9
- Strengthening of Semen Stations	28
- Pilot AI Delivery Services	4
- Import of Bulls	2
- Import of Embryos, Semen, BPTIE	8
B. Animal Nutrition	169
- Ration Balancing Program	117
- Fodder Development	52
C. VBMPS	243
Subtotal:	477
D. Project Management and Learning	100
Total:	577

Source: BCR, 2020



Table 4: Share of NDSP Grant Financing by Participating State

State	Grant Assistance	% total
Andhra Pradesh	82.00	5%
Bihar	60.68	4%
Chhattisgarh	12.56	1%
Gujarat	350.71	21%
Haryana	62.85	4%
Jharkhand	4.68	0%
Karnataka	169.58	10%
Kerala	42.73	3%
Madhya Pradesh	21.79	1%
Maharashtra	114.81	7%
Odisha	27.72	2%
Punjab	114.67	7%
Rajasthan	220.46	13%
Tamil Nadu	108.14	6%
Telangana	24.50	1%
Uttar Pradesh	153.44	9%
Uttarakhand	19.72	1%
West Bengal	42.41	3%

Ration Balancing Program:

Table 5: Ration Balancing - Milk Unions/Dairy Cooperatives

Intermediate Outcome Indicator	End of Project	
	Target	Actual
LRPs Inducted (No)	0	23,257.00
Villages covered (No)	0	20,553.00
Animals covered (No)	0	2,005,205.00
Reduction in feed cost per kg milk (%)	7	11.80
Reduction in methane emission (%)	10	13.80

Source: INAPH 2019

Table 6: Ration Balancing Program - Dairy Producer Companies

Intermediate Outcome Indicator (Producer Companies)	End of Project	
	Target	Actual
LRPs Inducted (No)	0	7,981.00
Villages covered (No)	0	12,821.00
Animals covered (No)	0	860,558.00
Reduction in feed cost per kg milk (%)	7	8.61

Source: INAPH 2019

Table 7: Ration Balancing Program - Impact on Farmers' Income

Parameter	Before RBP	After	Change	% Change
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		RBP		
Average milk production (kg/animal/day)	7.06	7.33		3.8
Average fat % in milk	4.69	4.77	0.08	1.7
Average SNF %	Not available			
Average cost of feeding (Rs.kg milk)	19.49	17.19	(2.30)	(11.8)
Average cost of feeding (Rs.kg animal/day)	135.42	119.09	(16.33)	(12)
Increase in net daily income (Rs./animal)			27.52	
Per cent feed cost reduction per kg of milk			11.80%	
Increase in net income/lactation - $305 * 25.52 = \text{Rs } 7777.5$				

Source: INAPH 2019

Table 8: RBP - Impact of Challenge Feeding on Farmers' Income

Parameter	Before RBP	After RBP	Change	% Change
Average milk production (kg/animal/day)	8.57	9.39	0.82	9.6
Average fat % in milk	5.03	5.16	0.13	2.6
Average SNF %	NA			
Average cost of feeding (Rs.kg milk)	19.24	17.16	(2.08)	(10.8)
Average cost of feeding (Rs.kg animal/day)	164.88	160.03	(4.85)	(2.9)
Increase in net daily income (Rs./animal)			36.92	
Percent feed cost reduction per kg of milk			10.81%	
Increase in net income/lactation - $305 * 36.92 = \text{Rs } 11,260$ Advantage over normal RBP - $\text{Rs } 25.52 \text{ vs } \text{Rs } 36.92 = 11.44$ (44% more)				

Source: INAPH, 2019

Fodder Development

Table 9: Fodder Development – Dairy Cooperatives

Intermediate Outcome Indicator	End of Project	
	Target	Actual
Fodder seed production support (MT)	0	14,026
Fodder seed sale support (MT)	0	31132
Silage demonstration (No)	0	1,862
Procurement of Mowers (No)	0	626
Construction of Biomass bunkers (No)	0	119



Re-vegetation of common/fallow lands (Hs)	0	136
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Source: NDSP, 2019

Table 10: Fodder Development – Dairy Producer Companies

Intermediate Outcome Indicator	End of Project	
	Target	Actual
Fodder seed production support (MT)	0	330
Silage demonstration (No)	0	281
Silage making adopted by farmers (No.)		357
Procurement of Mowers (No)	0	43
Mower Demonstrations (No)		443
Construction of Biomass Bunkers (No)	0	9

Source: NDSP, 2019

Dairy Cooperative Societies (DCS) and Dairy Producer Companies (DPC)

Table 11: Enrolment of Additional Producers in Dairy Cooperative Societies under NDSP

Intermediate Outcome Indicator	End of Project	
	Target	Actual
Villages covered (No)	11,900	39,259
Additional producers enrolled (No)	600,000	853,154
of which women members	150,000	418,089
of which small holders	450,000	636,623
Milk quality based on MBR time (in minutes)	120.00	Min: 60, Max: 280

Source: NDSP, 2019

Table 12: Enrolment of Producers in Dairy Producer Companies

Intermediate Outcome Indicator	End of Project	
	Target	Actual
Villages covered (No)	20,000	13,250
Additional producers enrolled (No)	600,000	813,440
of which women members	40,000.00	334,347.00
of which small holders	450,000	498,570
Milk quality based on MBR time (in minutes)	120.00	Min: 58 Max: 133

Source: NDP-I MIS

Table 13: Overview of Dairy Producer Companies at End-Project

State	Rajasthan	Gujarat	AP	Punjab	UP	TOTAL
Name	Paayas	Maahi	Shreeja	Baani	Saahaj	
No. of Members	104,603	95,535	76,413	51,590	91,034	419,175
Women Members	40,232	25,025	76,413	13,083	31,618	186,371
Women membership (% of total members)	38%	26%	100%	25%	35%	44%
Small holders as members %	34%	52%	92%	35%	64%	55%
Average Milk	856	812	351	277	594	2,890



Procurement (TKgPD)						
Paid up Share Capital (in millions)	374.09	347.20	155.30	97.80	230.30	1,204.69
Turnover (in millions)	13,040.00	23,330.00	4,370.00	3,690.00	7,860.00	52,290.00

Source: NDP-1 MIS

Table 14: Total Coverage – Dairy Cooperatives and Dairy Producer Companies

Parameter	Cumulative		
	PIP Target	SPP Target	Actual EOP
Villages Covered (#)	31,900	52,856	52,471
New Villages Covered (#)	-	21,188	21,361
Additional Producers Enrolled (#)	1260000	1308646	1685517
- Of which women (#)	462,000	502,781	763,698
- Of which smallholders (#)	820,000	849,947	1134892
- Of which SC/ST (#)	-	-	158,031
Beneficiaries Covered (#)	-	-	2732400
Additional Milk Procurement (TKgPD)	-	6348	5365
Bulk Milk Coolers (#)	-	4211	4209
AMCU/DPMCU (VBMPS) (#)	-	29,582	29577
MBR Time of BMC Milk in minutes (at receiving dock)	-	-	Coop: Min 60, Max 280; PC: Min 58, Max 133

Source: NDDB 2019

Convergence

Table 15: Convergence – Subprojects approved for NDSP Dairy Producer Companies

Milk Producer Company	Approved sub projects (activity wise)				
	FD	Pilot AI	RBP	VBMPS	Total
Baani MPC (Punjab)			1	2	3
Bapudham MPC (Bihar)				1	1
Maahi MPC (Gujarat)	1	1	1	1	4
Paayas MPC (Rajastha)	1	1	1	2	5
Saahaj MPC (Uttar Pradesh)		1	1	2	4
Shreeja MPC (Andhra Pradesh)		1	1	2	4



Total	2	4	6	10	22
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Breeding Program**Table 16: Annual Semen Doses by Final Year (NDSP-upgraded Semen Stations)**

Intermediate Outcome Indicator	End of Project (millions)	
	Target	Actual
Exotic	31.00	28.35
Crossbred	27.00	22.94
Indigenous	11.00	12.74
Buffalos	31.00	24.05
Total	100.00	88.08

Source: NDP-I MIS

Table 17: Pilot Doorstep AI Delivery Services

Intermediate Outcome Indicator	End of Project	
	Target	Actual
MAITs Deployed	0.00	1,330.00
Villages covered	0.00	11,681.00
Als carried out (Lakh) Annual	38.20	7.83
Conception Rate (%)	0.45	0.42

Source: NDP-I MIS

Table 18: Average Milk Yield of Daughters when Sires are categorized based on Dam's Yield

Set A Bulls			Set B Bulls		
Bull No.	Dam YLD Kg	AVG daughter YLD Kg	Bull No.	Dam YLD Kg	AVG daughter YLD Kg
Bull A	8768	3846	Bull 1	4010	3202
Bull B	7819	3476	Bull 2	4000	3648
Bull C	7591	2903	Bull 3	3917	3222
Bull D	7591	2855	Bull 4	3907	2662
Bull E	7591	3292	Bull 5	3625	2661
Bull F	7591	2628	Bull 6	3604	2676
Bull G	7427	3778	Bull 7	3463	2684
Bull H	7381	3025	Bull 8	3441	3137
Bull I	7381	2938	Bull 9	3328	2512
Bull J	7164	2622	Bull 10	3250	4089
Average	7631	3136		3655	3049



Table 19: Average Milk Yield of Daughters when Sires are categorized based on their Breeding Values for Milk Yield

Set A Bulls				Set B Bulls			
Bull No.	BV Milk	Dam Yield	AVG dtr yld	Bull No.	BV Milk	Dam Yield	AVG dtr yld
Bull A	1684	4571	3711	Bull 1	-510	4300	2691
Bull B	1020	6065	3553	Bull 2	-520	6187	3006
Bull C	764	6684	3362	Bull 3	-520	4583	2605
Bull D	663	5821	3195	Bull 4	-541	4794	2750
Bull E	655	8768	3846	Bull 5	-554	4304	2564
Bull F	580	7427	3778	Bull 6	-592	4465	2785
Bull G	571	6831	4067	Bull 7	-722	4378	2452
Bull H	566	5213	4166	Bull 8	-734	5332	2572
Bull I	505	5078	3062	Bull 9	-749	4728	2484
Bull J	505	3441	3137	Bull 10	-952	4644	2305
Avg	751	5990	3588		-639	4772	2621

Table 20: Import of Bulls and Embryos and Distribution of HGM Bulls from Projects

Item	Holstein	Jersey	Total
Bulls imported and supplied to Semen Stations	76	95	171
Embryos Imported	324	511	835
Bulls produced from imported embryos, supplied to Semen Stations	42	27	69

Source: PPT/NDDDB/December 2019

Table 21: Beneficiary Coverage and Social Inclusion under NDSP

Sl. No.	Activity	Level of beneficiaries	Type of beneficiaries	No. of beneficiaries		
				Achievement End of Project		
				Cooperatives	Producer companies	Total
1	Fodder Development	Direct beneficiaries (Silage preparation)	Total	55,290	5,390	60,680
			Women	9,280	1,193	10,473
			Small holders	235,549	1,976	25,525
			SC/ ST	4,367	431	4,798
			SC	3,137	259	3,396
		ST	1,230	172	1,402	
		Functionaries (FDO)	Total	50	6	56
Women	3	0	3			
2	Ration Balancing Program	Direct beneficiaries (Households receiving doorstep RBP service)	Total	1,524,287	635,503	2,159,790
			Women	479,623	101,103	580,726
			Small holders	1,209,330	443,083	1,652,413
			SC/ ST	22,589	72,194	298,003

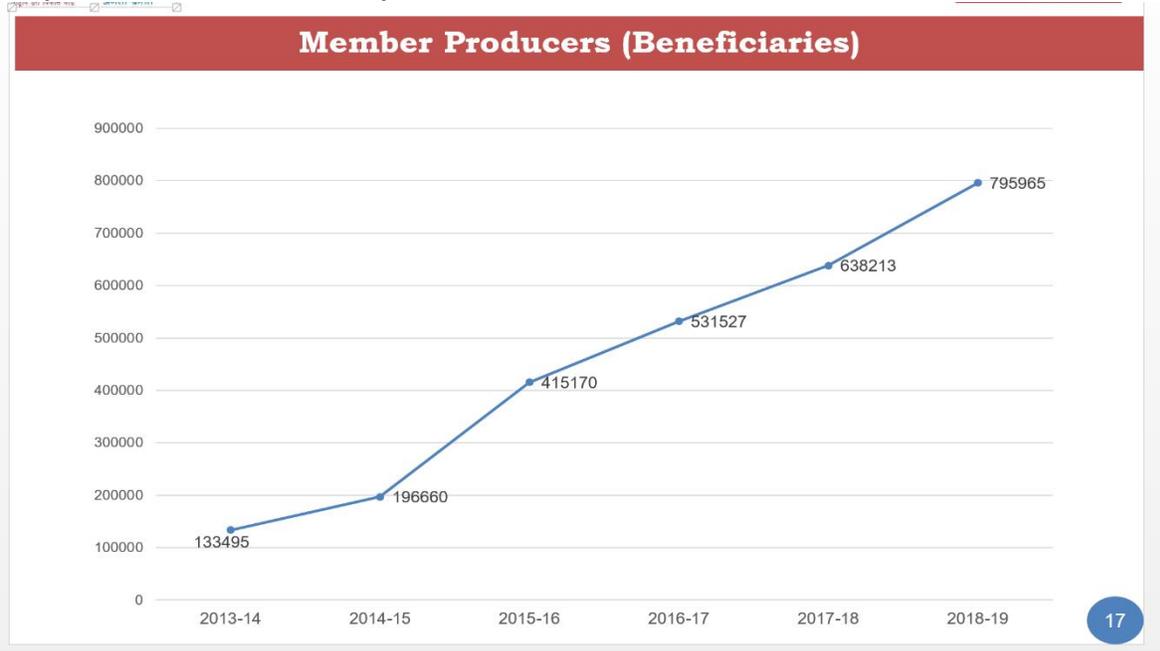


Sl. No.	Activity	Level of beneficiaries	Type of beneficiaries	No. of beneficiaries		
				Achievement End of Project		
				Cooperatives	Producer companies	Total
			SC	113,535	52,536	166,071
			ST	112,274	19,658	131,932
		Functionaries (LRPs)	Total	23,257	7,891	31,148
			Women	3,667	1,192	4,859
3	Village Based Milk Procurement System	Direct beneficiaries (Total milk producer members enrolled)	Total	851,117	834,400	1,685,517
			Women	417,651	346,047	763,698
			Small holders	636,322	498,570	1,134,892
			SC/ ST	124,296	33,735	158,031
			SC	83,905	24,747	108,652
			ST	40,391	8,988	49,379
		Functionaries (New DCS secretaries/ LEO)	Total	13,478	8,396	21,874
			Women	4,419		4,419
4	Pilot Model AI Delivery	Direct beneficiaries (Households receiving doorstep AI service)	Total	0	180,721	180,721
			Women	0	10,654	10,654
			Small holders	0		0
			SC/ ST	0	7,763	7,763
			SC		5,685	5,685
			ST		2,078	2,078
		Functionaries (MAITs)	Total	0	1,367	1,367
			Women	0	22	22
GRAND TOTAL	Direct beneficiaries	Total	2,427,627	1,656,014	4,083,641	
		Women	713,083	458,997	1,172,080	
		Small holders	1,297,333	943,629	2,240,962	



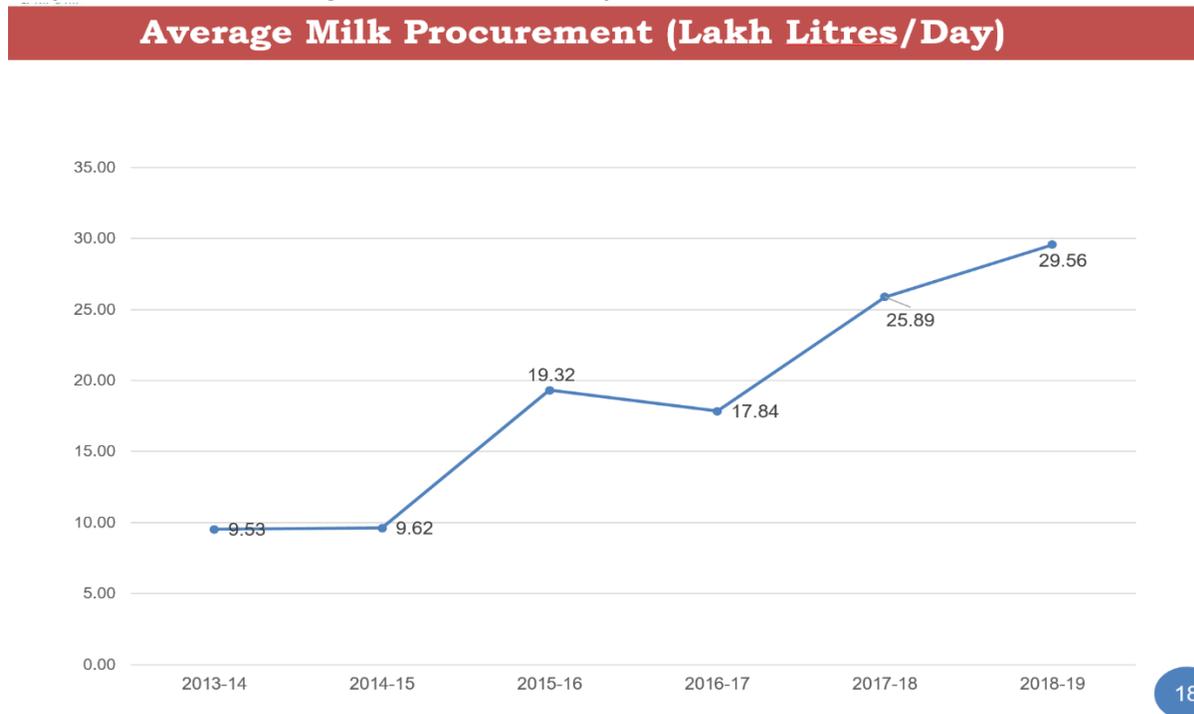
B. Graphs and Diagrams

Graph 1: Growth of Membership in DPCs 2012-2019



Source: NDDB 2019

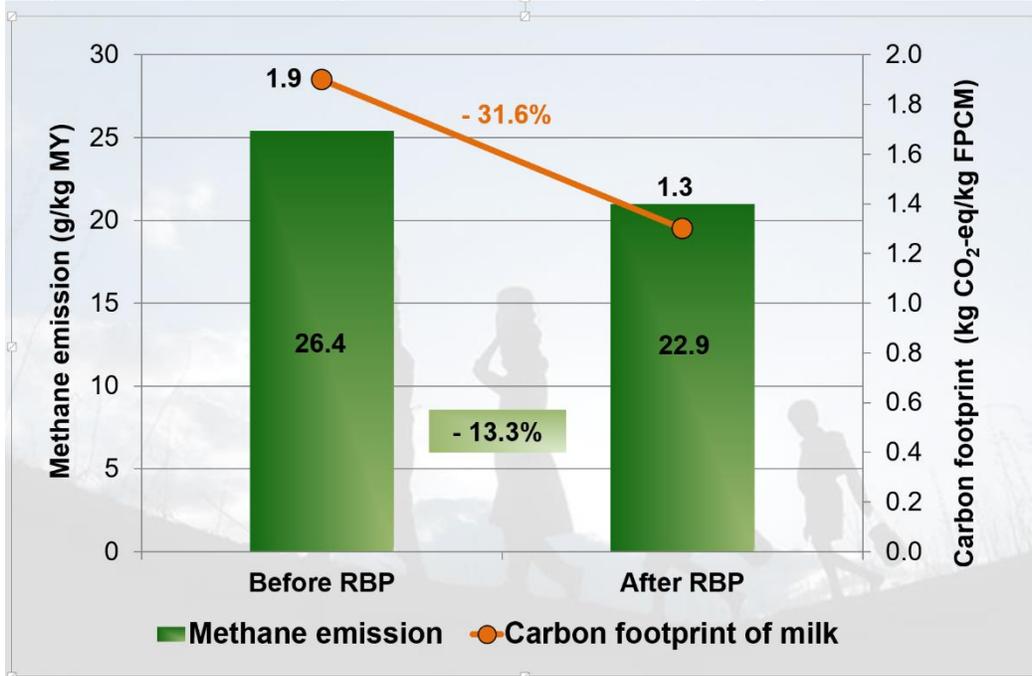
Graph 2: Growth in Average Milk Procurement by DPCs, 2013-2019



Source: NDDB 2019

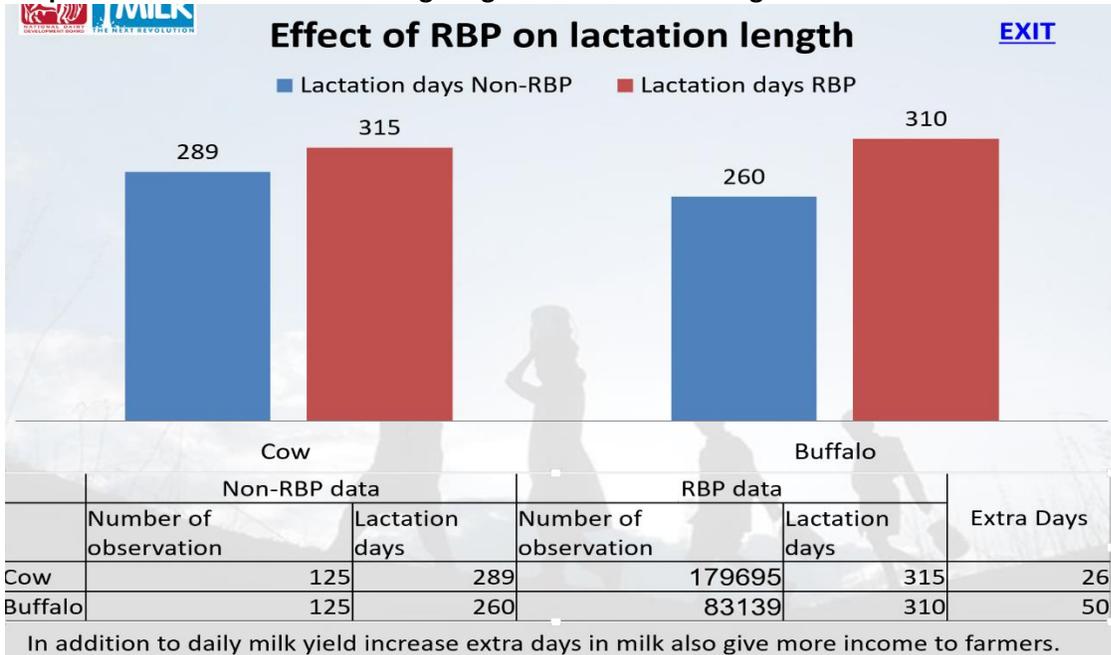


Graph 3: Environmental Impact of NDSP Ration Balancing Program



Source: NDDB December 2019

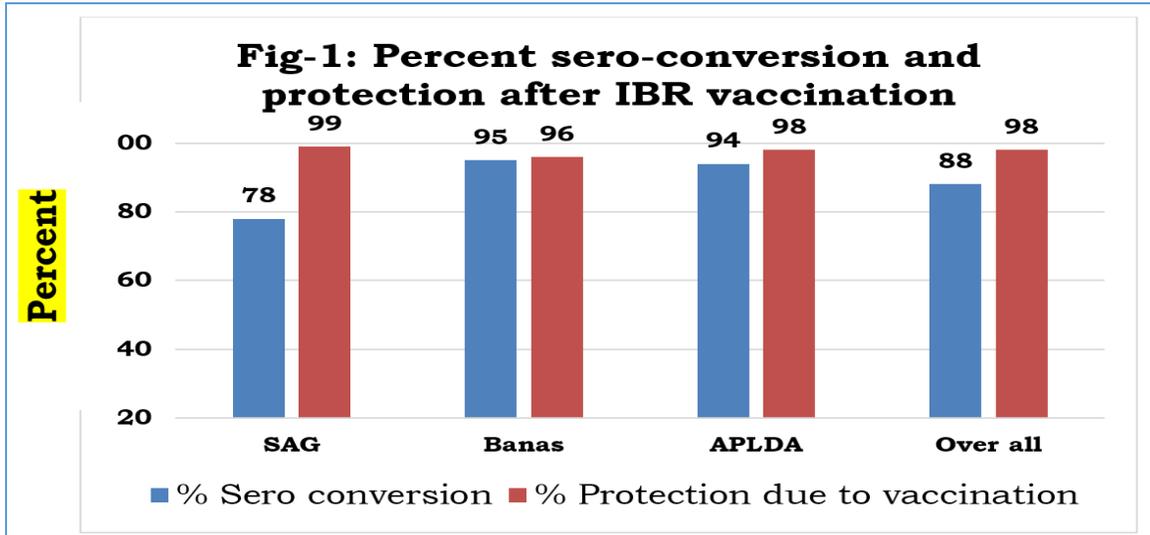
Graph 4: Effect of Ration Balancing Program on Lactation Length – NDSP



Source: NDDP BCR, 2020



Graph 5: Impact of IBR Vaccination in selected EIAs



Source: NDDB Final Progress Report, 2019

Diagram 1: Typical Dairy Cooperative Society Value Chain



Source: NDDB Progress Report (PPT), 2018



ANNEX 12: MAP

Map of India in three regions showing participating states and other information⁶⁴

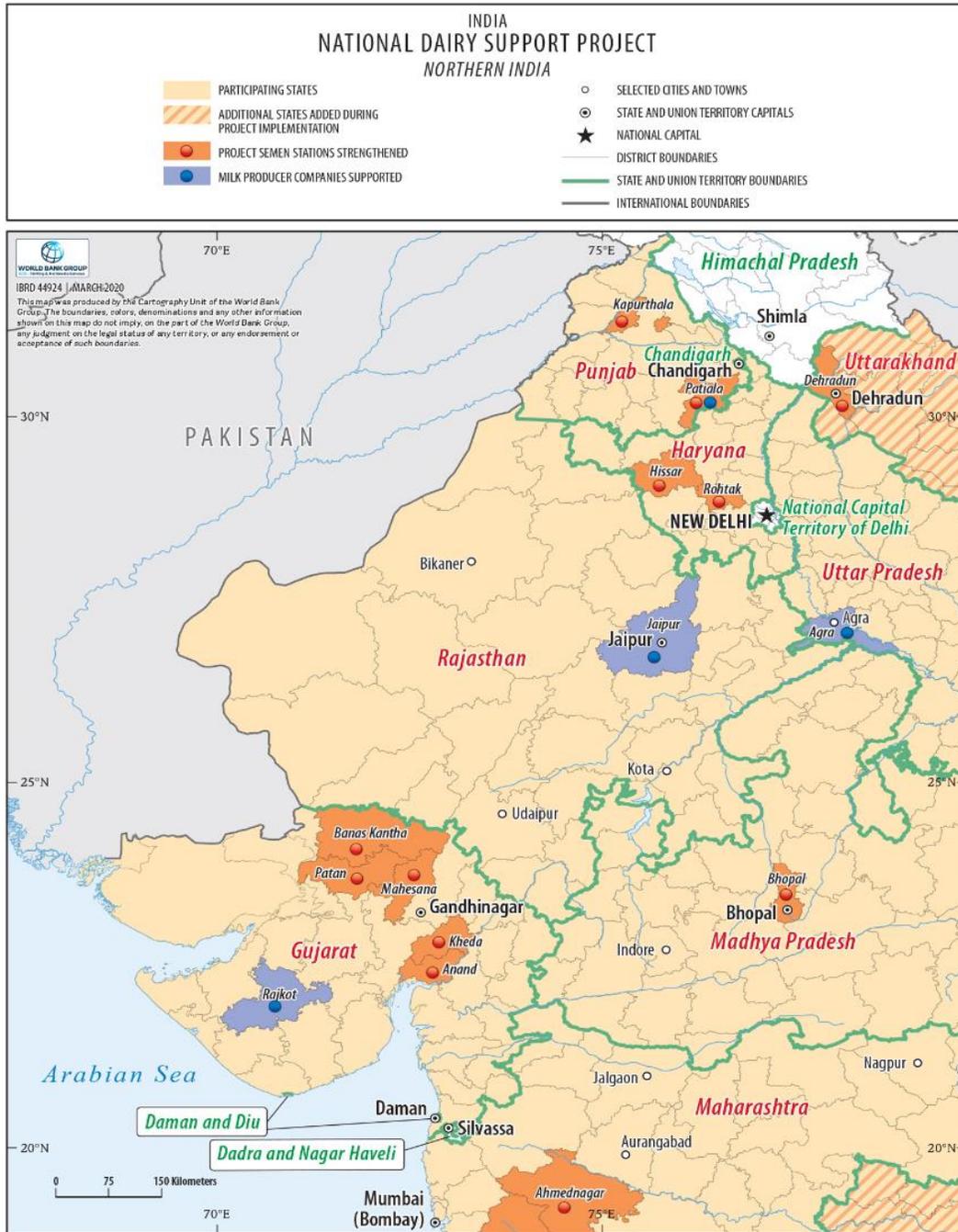
A. Eastern India



⁶⁴ The Bank is required to present the map of India in this manner.



B. Northern India





C. Southern India

