Final Report
Impact Assessment and Evaluation of Ration Balancing Program of Northern and Western Regions
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List of Abbreviations

AHD	Animal Husbandry Department
AI	Artificial Insemination
APL	Above Poverty Line
ATT	Average Treatment on Treated
BPL	Below Poverty Line
Ca	Calcium
CP	Crude Protein
DCS	Dairy Cooperative Societies
EIA	End Implementation Agencies
FCM	Fat Corrected Milk
FGD	Focus Group Discussions
FPO	Farmer Producer Companies
INAPH	Information Network for Animal Productivity and Health
LRP	Local Resource Person
MD	Managing Director
MIS	Management Information System
MM	Mineral Mixture
NDDB	National Dairy Development Board
NDP I	National Dairy Plan I
P	Phosphorous
PSM	Propensity Score Matching
PSM	Propensity Score Matching
RB	Ration Balance
RBP	Ration Balancing Program
SAU	Standard Animal Unit
SC	Scheduled Caste
SNF	Solid Not Fat
SOL	Stage Of Lactation
ST	Scheduled Tribe
TDN	Total Digestible Nutrients
TO	Technical Officers
VAP	Village Awareness Programme

Executive Summary

The Ration Balancing Program (RBP) a key component in the National Dairy Plan I (NDP I) provides advisory service to the dairy farmers about the optimal quantity of dry fodder, green fodder, concentrate and supplements that should be fed to dairy animal depending upon animal specific particulars of age, weight, lactation order and stage of lactation. Since the RBP is first of its kind in the Indian context, the present study evaluates the impact of the program in two important milk producing states of India, viz. Gujarat and Punjab. The study is based on both primary data from 800 dairy farm households in Surat, Banaskantha, Ludhiana and Ropar Milk Unions and secondary data from the INAPH database. The study uses econometric quantitative approach and qualitative analysis to evaluate the program. Survey schedules were designed to cover all the aspects of RBP, namely, extent of coverage, outreach, quality of services, their timeliness, mode of implementation, quantitative and qualitative impact on productive, health and reproductive performance of the animals, broad outcome of RBP on the economy of farm households and performance of Dairy Cooperative Societies, the sustainability aspects of the programme after withdrawal of NDP I support, constrains faced by various stakeholders in the implementation of the program, their views to enhance the effectiveness and sustainability of the program, etc. Besides eliciting information on the structured schedules, discussions, personal interactions with farmers, LRPs, functionaries of DCS, program implementing officials were held to understand and analyze the various aspects of RBP.

In Gujarat, the analysis based in INAPH database for six-month period showed that the ration balancing intervention enhanced the productivity of cows by around 13 per cent and that of buffaloes by nearly 5.5 percent. In case of crossbred cows, the productivity enhancement has been as high as 24 per cent in Banaskantha. The effect of the programme in one month period is more appealing than six month period, particularly in case of buffalo with almost tripling the percentage gain in milk yield. The quantum of increase discernible from the with-without approach after controlling for the confounding factors is higher than its estimate based on before-after approach using a much larger sample. In Gujarat, the gain in milk productivity from primary data analysis for both, cows and buffaloes was about 19.5 and 18 per cent, respectively among the adopter households. As per the qualitative analysis, in Gujarat, about 80 per cent farmers perceive that productivity has improved. The quantum of productivity increase as

reported by the farmers was in the range of 9.7-16.5 per cent 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 per cent.

In Punjab, based on INAPH data, the estimates of productivity gain due to RBP intervention are also similar to Gujarat in case of cows (about 13 per cent), and much higher in case of buffaloes (17 per cent). However, the results of impact analysis from field data and 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 ¾ of the sample farmers in Ludhiana reported an average increase in milk productivity of about 12-13 per cent while only 19 per cent farmers in Ropar were of the opinion that RBP has contributed to productivity enhancement.

RBP was found cost effective in terms of percentage reduction in feed cost and feed cost/litre Fat Corrected Milk (FCM) of both, cattle and buffalo, with the cost efficiency being more pronounced in cows. In cattle, the feed cost per litre FCM reduced in between 5.76 to 9.86 per cent in Gujarat and by 10.83 to 18.53 per cent in Punjab. The field level data also indicated clear impact in reducing the feed cost per liter of milk by about 18-19 per cent in case of cows in both the states and about 2.6 per cent 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 milk-feed ratio, i.e. the ratio of gross returns from milk output per unit of feed cost.

In the perception of farmers and EIAs, the composition of milk has also improved especially in terms of fat percentage. Similar to the yield, the reported magnitude of increase in fat and SNF by the farmers was higher than informed by DCS and subsequently EIAs. The responses of the dairy farmers show encouraging effect of RBP on the health and reproductive performance of animals, for instance, at least 50 percent of the farmers reported reduced incidence of common problems like digestive disorders, repeat breeding, etc.

The efficacy of the program in terms of its coverage, outreach and the implementing and monitoring mechanism has been quite impressive in Gujarat and somewhat weak in Punjab. As on 31st May, 2015, the netbooks were purchased as per targets by all milk unions as these were the basic requirement of the programme. In Gujarat, 90 per cent of the targeted LRPs were selected and trained, but in Punjab, less than ¾ of the targets could be fulfilled end of May 2015. The average number of farmers covered per LRP was 64 and 70 in Surat and Banaskantha, respectively; while it was only 38 and 37 in Ludhiana and Ropar. The target assigned for animals to be covered under the progamme was forty thousand but all milk union were lacking in their achievements.

The targeting of the program has been quite fair and households from different socio-economic groups, including those below poverty line (BPL) are being covered. The socio-economic factors determining the adoption of RBP revealed that the dairy farmers with larger herd size and better exposure to mass media and extension services have higher probability of joining the RBP advisory services. LRPs relied more on the suggestions of DCS about selection of farmers for the programme as the societies were having prior information on productivity and reproductive status of animals on dairy farm households.

At household level, LRP was the major source of information on RBP for the dairy farmers in both Gujarat and Punjab, followed by the dairy cooperative societies (DCSs). The advice about ration balancing was given directly to the person feeding the animal, slip was handed over to the beneficiaries and practical weighment method by conversion into vessels/bundles was followed in most of the cases. About 84 and 73 per cent of the adopters in Gujarat and Punjab, respectively confirmed that they were briefed by the LRPs before adopting the RBP. More than ¾ adopters also confirmed that they were delivered RB advice slip also by the LRP. The proportion of responses to the follow-up and additional services was comparatively less.

The follow up actions in RBP recommendations were mainly through interaction and follow-up visits and there was least preference for verification on phone. On the basis of effectiveness, the LRP mechanism was rated a minimum of 6.5 on the scale of 10 which can be graded as good. The minimum score assigned to RBP was 7.5 in a scale of ten and the highest was 8.9 indicating that there is possibility to improve the performance of the project up to 10 to 11 per cent.

Several ancillary benefits have accrued to the stakeholders of RBP. Although there may be additional expenditure and/or labour involved in adopting the ration balancing advisory as

opined by 1/3 sample households, yet this additional expenditure may be more than compensated as more than ¾ sample households perceive that their monthly income has increased after RBP as the milk production of animals has gone up. The estimates of incremental gains to dairy farmers due to enhanced milk production and decreased feed cost worked out to be between Rs. 20-40 per day per animal in most cases. With improvement in income, their savings has also increased. Together with higher income and savings, some households also reported increase in milk consumption. The farmers expressed that their interest in dairy has gone up after the program. Except in Ropar, the majority RBP households are also willing to increase their herd size.

Nearly cent per cent of the LRPs in Gujarat felt that the RBP has brought about notable awareness on the benefits of ration balancing in the village and also corresponding changes in the feeding pattern of the animals. The DCS reported positive change in the membership, milk procurement, sale of mineral mixture at the DCS level due to the programme. There has been very sharp increase in the sale of mineral mixture and also bypass fat in both the EIAs of Gujarat.

After the withdrawal of the government support, about 2/3 of the dairy farms in Gujarat are even ready to pay for the ration balancing advisory at the rate of about Rs.15-20/animal/month. Nearly 26 per cent 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 per cent).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 opine that the program would continue after the project support. Except in Surat they are mostly not willing to provide the service after the end of the program. The DCS in all the four EIA overwhelmingly feel that the program should continue. On the issue of paying remuneration to the LRPs after the government support ceases, the DCS and EIAs at Gujarat were forthcoming and outlined that they were already paying a good remuneration to the LRPs from their kitty over and above the stipulated rates under the program. The EIAs from Punjab have also chalked out a plan to sustain the program, which includes payment to actively operational LRPs from Milk Union and commission on the sale of mineral mixture. However, the EIAs officials were not confident about the success of the proposed sustainability plan even

for the subsequent 2 year period after the project support ceases and were highly skeptical about the long run sustainability of advisory services.

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. Hence, the regions where the program has already been implemented, the current format of operation (EIA-TO-Trainer-LRP-Farmer) may not be workable in the longer run. The 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. In order to ensure willingness of the farmers to pay for the services, they need to be convinced about the economic benefits of RBP on the basis of firm empirical evidence and this information should be put across in the manner that it is easy to comprehend by the farmers. There is a wedge between the perception of the farmers regarding the benefits and the actual quantified gains, with former as an underestimate. The farmers can be motivated to demand ration balancing advisory through massive advertising of the benefits of ration balancing through print and digital media, screening of documentary in villages about successful case studies, etc. For widespread dissemination of the service, the choice of advisers/source of advice need to be broadened, rather than keeping the entire focus on one LRP in the village. Alternate service delivery channels need to be explored such as creating the expertise of ration balancing advisory with private suppliers of the prepared cattle fed, Krishi Vigyan Kendras and other extension functionaries, developing user-friendly mobile app of ration balancing, periodic training of farmers groups about using the app, keeping a netbook at DCS, where farmers can access the facility free of cost, etc. As long as the program is able to create enough awareness among the famers to feed balance ration to their animals even without seeking any regular formal advisory services, the program shall be considered sustainable at the field level. The accountability of service providers to the users is one aspect that has not been addressed adequately in the program. Like the mechanism of customer feedback in case of services rendered for repair and maintenance of consumer durables, mobile SMS service should be used by EIA/monitoring agency to get feedback of dairy farmers on the quality of service rendered. This information should than be analysed periodically to address the weaknesses and build-up on the strength of the advisory service.

In the regions where the program has not been implemented, the existing mechanism can be replicated to set the ball rolling. Some desired changes in exploring new regions would be, simplification of purchase mechanism, reducing documentation work and provisioning of mineral mixture and good quality concentrate by the DCS of the regions. The remuneration to the LRPs should be in consonance with the region-specific wage situation rather than a fixed amount at all-India level.

The farm advisory programs are more difficult to implement and monitor successfully in comparison to any other type of farmer oriented development program. The RBP has shown clearly quantifiable positive impact in Gujarat and Punjab, the two leading states in dairy. The experience in these states will provide useful learning lessons for further streamlining and inculcating the system of balancing the ration of dairy animals scattered in millions of small farm holdings in India.

1 Introduction

The Indian dairy sector has come a long way registering more than 9-fold increase in milk production, from 17 million tons in 1950-51 to anticipated 155.5 million tons in 2015-16. The decadal growth rates, ranging from of 3.5-4.5 per cent during the past six and a half decades, have been higher than the world average growth rate of about one per cent. However, as it is well-known that despite of holding number one position in milk production in the world for over a decade, the milk productivity in the country remains one of the lowest as compared to the many leading countries of the world. In the past one decade (2004/05-2013/14), 36.5 per cent of the increase in the buffalo milk production has been due to productivity increase and 55.5 per cent on account of increase in number of in-milk animals. In case of crossbred cows, the contribution of growth in average productivity to total growth in milk production is only 6 percent.

Three-pronged strategy focused on breeding, feeding and management interventions are key to addressing the challenge of enhancing animal productivity in the country. Animal feed is the most crucial input in livestock production. Empirical studies in India have shown that enhancing quality and quantity of feed input has greater impact than breed improvement on increasing milk productivity (Lalwani, 1989; Gaddi and Kunal, 1996). Over a period of time, with increase in agricultural production, although the animal feed availability has also improved (Singh et al., 1997; Sampath et al., 2005) yet its supply falls short of the aggregate nutritional requirement of feed by livestock population (Angadi et al., 2005; GoI, 2012). Besides feed shortage, poor nutritional quality of feed and imbalanced feeding are two key problems that impinge on the productivity growth in dairy sector.

The various feeds and fodder used in livestock feeding are broadly classified as (i) roughages; that are high in fiber content (>18 per cent crude fibre) (ii) concentrates; feedstuffs that contain less crude fiber and high level of total digestible nutrients and (iii) feed supplements and additives; that are the compounds and substances which improve the nutritional value of basal feed. The digestibility of concentrates is much higher than that of roughages and also being rich in energy and protein, it has a positive effect on the productive performance of the animal. However, the rumen physiology requires both roughages and concentrates in animal feed, in ratio ranging from 60:40 to 70:30 depending upon the productive potential of animals. A recent study in the dynamic milk producing states of

Punjab and Haryana brought out that more than 85 per cent of the dry matter was coming from roughage sources for the lactating animals which were not fed on prepared compound cattle feed. Even in case of adoption of compound cattle feed, the roughage to concentrate ration was about 72:25 on the rural dairy farm households (Sirohi et al. 2016).

Imbalanced feeding adversely affects not only the productivity of animals but also their health status. It hampers the growth of young animals delaying the age at first calving. The duration of lactation length and productive life of cows is shortened for the want of adequate nutrition. The deterioration in the productive and reproductive performance of the animals is detrimental for the economy of the dairy farmers. Expenditure on feed and fodder accounts for 60-70 per cent of the total cost of milk production. The productivity of feed input is inversely related to the cost of milk production. Field study in the semi-arid region of Rajasthan showed that an improvement in feed input productivity (defined as milk output per kg. dry matter intake) by 12 per cent decreased the cost of milk production by 18 per cent in case of crossbred cows (Chand and Sirohi, 2012).

1.1 Ration Balancing Program: an overview

Realizing the ardent need to promote adoption of balanced animal ration for enhancing the productive, reproductive and economic performance of the dairy animals, Ration Balancing Program (RBP) has been very aptly made a key component in the National Dairy Plan I (NDP I), a Central Sector Scheme for promoting dairy development in the country. The program which a sub-project during Phase I (2012/12-2017/18) of NDP I aims to create awareness amongst the milk producers on optimization of animal feeding by efficient utilization of locally available feed resources at the possible least cost. RBP is envisaged to deliver three short-term benefits, i) increase milk productivity, (ii) reduce cost of milk production, and (c) reduce methane emission.

The intervention provided in this program is in the form of advisory service to the dairy farmers about the optimal quantity of dry fodder, green fodder, concentrate and supplements that should be fed to dairy animal depending upon animal specific particulars of age, weight, lactation order and stage of lactation. The advisory support is provided at farmer's doorstep, through a Local Resource Person (LRP), preferably a resident of the target village. The LRP is provided necessary training by the implementation agency for carrying out the work and is equipped with a netbook preloaded with required software Information Network for Animal Productivity and Health (INAPH) for ration balancing.

The End Implementation Agency (EIAs) of RBP in each state is usually a Milk Union under the dairy cooperative setup. However, the selection of EIA is not limited to dairy cooperative institutions but this responsibility can also be taken up by the Farmer Producer Companies (FPOs) or research organizations like National Dairy Research Institute. The RBP is implemented in a modular approach by the EIAs in their project areas. Each module has around 200 villages and is supervised by a Technical Officer. A LRP is appointed in each village. These modules are to be managed and coordinated by the Project Coordinator of the EIA.

1.2 The Present Study

Since the RBP is first of its kind in the Indian context, the Project Management Unit, NDDB, has commissioned this study for an on-course program evaluation in the two important milk producing states of India, viz. Gujarat and Punjab. The broad objective of the exercise is to draw useful learning about the impact, efficacy and sustainability of the program. The specific objectives are:

- To evaluate the efficacy of RBP in increasing milk yield and/or reducing feed cost
- To examine the quality of service delivery by End Implementing Agencies (EIAs) and implementation of record keeping through use of the information technology (INAPH/MIS)
- To assess the reporting & monitoring systems and institutional capacity building at various levels in the context of the RBP for ascertaining the provisioning of these services on a sustainable basis to the milk producers
- To document the innovative practices followed by EIAs to implement and make the RBP sustainable.
- To identify the bottlenecks, if any, in the implementation of this on-going program and take the remedial measures accordingly, for a successful completion by the end of project period.

The Methodology followed for quantitative and qualitative impact assessment of the RBP has been detailed out in the next Chapter followed by the discussion on the results of the study in the subsequent Chapters. The analysis of techno-economic impact of the program is presented in Chapter 3. The next Chapter focuses on the effectiveness of the RBP from the perspective of its coverage and the implementation mechanism. Chapter 5 deals with the

issues relating to the outcome and sustainability of the program and the last Chapter synthesises the key strengths and weaknesses of the program and suggests remedial measures for overcoming the constraints.

2 Methodology

The study is based on both, primary and secondary data. The details of the coverage, sampling framework, database and analytical techniques are elaborated below:

2.1 Coverage and Sampling Framework

The study has been carried out in two highly progressive states from the perspective of dairy development, i) Gujarat and ii) Punjab. In terms of coverage of RBP, these two states have been the leader in Western and Northern India, respectively.

As it is well-known that Gujarat has been the seat of White Revolution and an unparalleled leader of dairy cooperative movement in the country. The RBP was initiated in the state in 2012, and till Dec., 2013 it was implemented in 4 Milk Unions of Gujarat (Banaskantha, Mehsana, Sabakantha and Surat). Two of these End Implementation Agencies (EIAs) were selected, namely Banaskantha, (the first EIA to start the programme in the state) and Surat (geographically distant for Banaskantha).

In Punjab, the dairy cooperative network is not as widespread as in Gujarat. The initiation of RBP in the state was made in 2013, and by end of the year, two Milk Unions, Ludhiana and Ropar had started the RBP in their milkshed areas. The study has been conducted in both these EIAs.

After the purposive selection of the states and EIAs, random sampling was done for the selection of villages, local resource persons (LRPs) and the households for detailed study. The sampling framework for the same is as follows:

Selection of villages: 10 villages under each EIA were selected randomly out of the villages where RBP was being implemented. The twin criterion followed was : i) RBP programme should be implemented at least for a period of 6 months at the time of village selection, ii) the villages should geographically well represent the study area, that is should not be concentrated in one tehsil or area of the district/milk shed area. The list of selected villages is given in Appendix Table A1.

Selection of households: A sample of 10 beneficiary and 10 non-beneficiary dairy farmers from each village were selected randomly. In case the number of beneficiaries or non-beneficiaries in the selected village was less than 10, a cluster of proximate villages constituted the sample frame for selection of respondents.

Selection of milch animals: All the milch animals on the sample households (both beneficiary and non-beneficiary) were covered for impact assessment.

Selection of LRP: The LRP operating in each of the selected villages were interviewed for fulfilling the objectives of the study. The list of LRP is given in Appendix Table A2.

Schematic Presentation of Sampling Framework
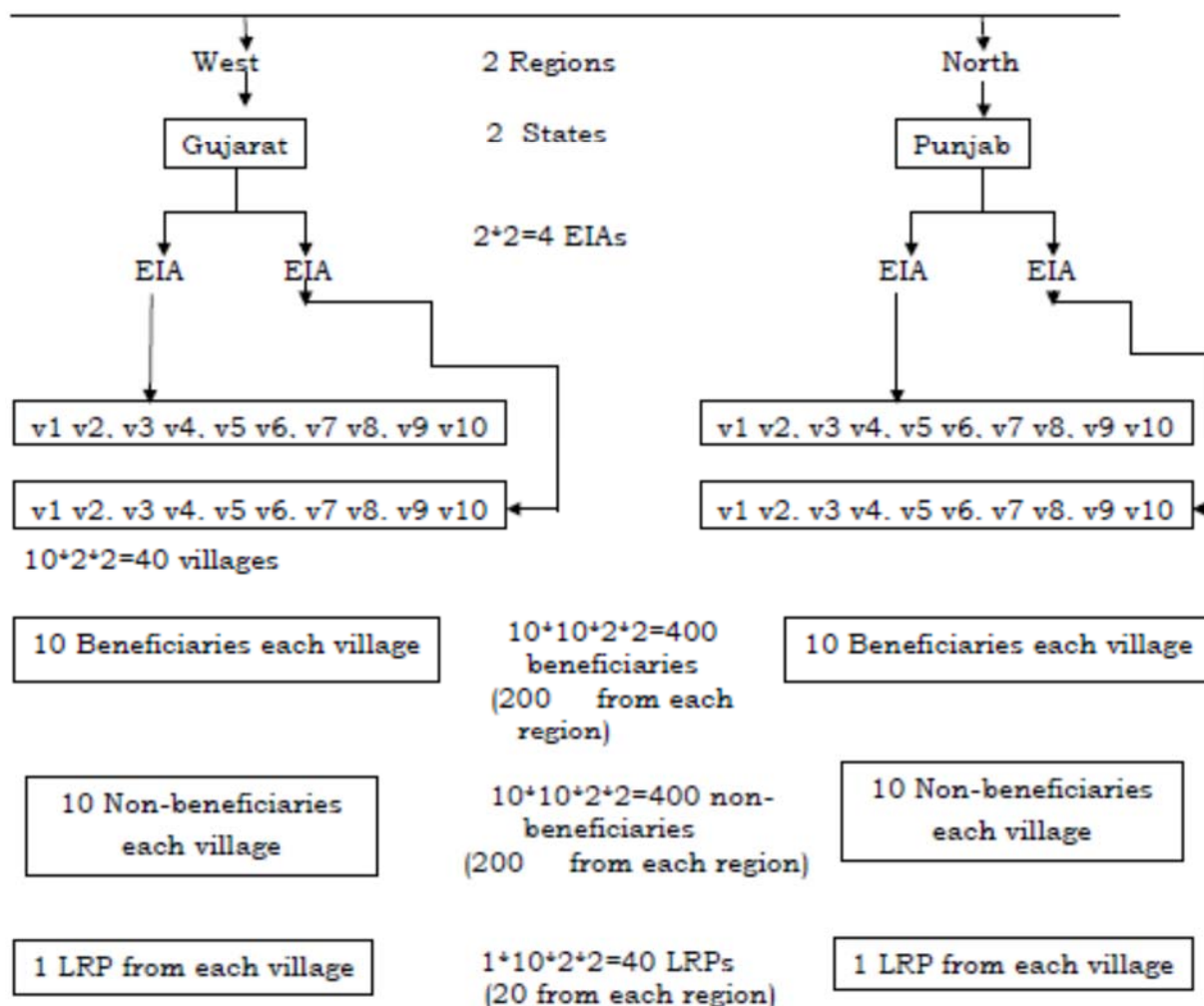
2.2 Database

The study is based on both, the secondary and primary data. The secondary data pertains to the INAPH database wherein animal-wise information is stored for all the animals covered under the RBP. Besides the identification variables (viz. name of EIA, state, district, tehsil, village, owner and animal identification tag), the animal specific information about species, breed, age, weight, calving date, order of lactation, daily milk production, fat composition of milk, daily feed and fodder intake on the basis of fresh matter, dry matter and nutrient intake (TDN, CP, Ca, P), prices of different feed fodder fed to animals, date of providing Ration Balancing Advisory, etc. are available in the database. This data for the four EIAs under study was used to analyse the effect of RBP on the milk productivity, and feed cost as per the methodology detailed out in the next section.

As mentioned in the sampling framework, the data were also collected in the 4 regions. Four types of survey schedules were canvassed in the study area:

- **Village Schedule 1.0:** pertaining to general information about the village regarding demographic particulars, dairy related infrastructure, basic information about the dairy cooperative society covering the village, etc. (see Appendix 1).

- **Household Schedule 2.0:** for collecting detail information about the feeding pattern, constraints, perception, awareness about RBP, etc. from the sample beneficiary and non-beneficiary farmers (see Appendix 2).

- **LRP Schedule 3.0:** for getting information on the functioning of LRP, constraints faced by him/her, etc. (see Appendix 3).

- **EIA Schedule 4.0:** semi-structured schedule to discuss the overall implementation of the RBP programme with the officials of EIA (see Appendix 4).

The schedules were designed to cover all the aspects of RBP, namely, extent of coverage, outreach, quality of services, their timeliness, mode of implementation, quantitative and qualitative impact on productive, health and reproductive performance of the animals, broad outcome of RBP on the economy of farm households and performance of Dairy Cooperative Societies, the sustainability aspects of the programme after withdrawal of NDP I support, constrains faced by various stakeholders in the implementation of the program, their views to enhance the effectiveness and sustainability of the program, etc. Besides eliciting information on

the structured schedules, discussions, personal interactions with farmers, LRPs, functionaries of DCS, program implementing officials were held to understand and analyse the various aspects of RBP.

2.3 Analytical Framework

The analytical framework of the study has been discussed under different sub-heads covering various aspects of RBP programme.

2.3.1 Impact and Outcomes: The goal in performing an impact analysis for a technological innovation or intervention is to estimate the total effect of the new technology on a set of outcome variables, after some amount of diffusion has taken place (Maredia, 2009). The impact evaluation studies whether the changes in well-being are indeed due to the program intervention and not to other factors, while the operational evaluation examines how effectively programs were implemented and whether there are gaps between planned and realized outcomes.

The study has taken a comprehensive approach to analyse the impact and outcome of the RBP making use of data generated at various level and at different points of time. The impact on two important outcome variables, viz. milk productivity and feed cost per litre of milk has been attempted in quantitative terms with analytically rigorous econometric techniques, while the impact assessment on several other parameters, such as health status of animals, reproductive performance, consumption and saving of farm households etc. is based on the perception of farmers, and other functionaries.

There are two well established approaches of an ex-post impact assessment exercise, i) Before and after approach, wherein a comparison is made of the outcome variable before the treatment (here RBP advisory) and after the treatment/intervention has been received and ii) with and without approach, wherein the comparison is between the treated and the control group (Khandker et al., 2010). The study has used both these approaches to bring out the RBP effect with empirical firmness. The various stages/ levels of impact assessment, either quantitative or qualitative that has been carried out is as follows:

INAPH Database: First and foremost, INAPH database is a rich source of information on animals covered under RBP, the data on all the available animal specific variables were taken for two points of time, 1) on the date of first RBP advisory (t=0) and 2) after a period of at least

180 days of first RBP advisory (t=1). Thus, the dataset was restricted to those lactating animals that have received advisory services for at least 180 days and are milking at both the points of time. The database was not limited to the beneficiary households sampled for primary data collection, but all the animals of the selected district for which records are available

The following regression equation was estimated in the base period (t=0) for cows and buffaloes separately in each of the two states (Gujarat and Punjab). Separate regression was not attempted to the two EIAs within a state rather dummy variables were used to capture the differences in EIAs.

$$Y_{tis} = \beta_k X_{tisk} + \delta_k Z_{tisk} + \gamma_k S_{tisk} + \varepsilon_{tis}$$

where: t= 0, i= cows, buffaloes, s= Gujarat, Punjab

Y = Milk Yield

X_k = Variables related to feeding of animals

(k= Total Dry Matter Intake, Mineral mixture, TDN, CP, Ca, P, Prepared Animal Feed, Dry Fodder, Green Fodder, tree leaves and grasses, Home-prepared Concentrate mix, unconventional feed resources)

Z_k = Variables related to animal characteristics

(k= lactation order, stage of lactation (in days), breed dummy)

S_k = Control variables related to seasonal and locational aspects

(k= seasonal dummy, EIA dummy)

Several alternative specifications of regression analysis were attempted to control the effect of changes in animal parameters, season, difference in breed, location and thereby quantify the effect of change in feeding patters under RBP on the milk productivity of animals. The final specification has been discussed along with the results of the regression.

Based on regression results of the base period, the predicted yield in period 1 was worked out by changing only the relevant animal (stage of lactation) and seasonal parameters that would change in period 180 days. The predicted yield thus, gave the production without altering the feeding pattern but as affected by the changes in season and stage of lactation. The difference between the predicted yield so obtained for period 1 (Y_1^p) and the observed yield (Y_1) in the same period can thus be attributed to the effect of RBP on the animal productivity.

$$Y_1^p \ (Z = \text{Stage of lactation} = 1, \text{Season}_{t=1}) - Y_1 = \text{Change in Y due to RBP}$$

Besides taking milk productivity as the outcome variable to assess the impact, effect on feed cost per day and per litre of FCM was also studied. From the data on prices and quantity of different feed and fodder fed to the animals in the two time periods, feed cost was worked out and the differences in the same were computed for the final sample of observations that were also used it the regression equation.

Household Survey: Together with the quantitative methods of impact evaluation, the data collected from the RBP beneficiary and non-beneficiary households was also analysed to discern the impact of RBP in qualitative terms. Qualitative studies are useful because they typically elicit information on the impacts of a new technology directly from the people affected (de Janvry et al. 2011).

Quantitative assessment: The Propensity Score Matching Technique, propounded by Rosenbaum and Rubin (1983) was used for quantifying the impact on milk productivity and feed cost. This statistical matching technique attempts to estimate the effect of a treatment, policy, or other intervention by accounting for the covariates that predict receiving the treatment. PSM attempts to reduce the bias due to confounding variables that could be found in an estimate of the treatment effect obtained from simply comparing outcomes among units that received the treatment versus those that did not. A number of studies have used this technique for impact evaluation (Kumar and Quisumbing, 2010; Kassie et al., 2010). The basic premise of the approach is to work out the average treatment effect on the treated (ATT):

$$ATT = E(\Delta \mid X, T = 1) = E(Y_t^1 - Y_t^0 \mid X, T = 1) = E(Y_t^1 \mid X, T = 1) - E(Y_t^0 \mid X, T = 0)$$

Where Y is the outcome variable of interest at time t between two treatments, denoted by the superscripts 1 and 0 (i.e. T=1 implies received RBP intervention and T=0 no intervention). Since the RBP beneficiary households also had animals that were not explicitly covered under the advisory services, hence the X was taken as a vector of animal characteristic, rather than household characteristic. To estimate the effects of RBP, propensity scores were estimated to match animals with similar observable characteristics, varying only the treatment, which is RBP intervention.

Qualitative assessment: In addition to the quantitative assessment of the two outcome variables, the effect on following will also be evaluated on the basis of the primary data collected from the

beneficiary households: i) milk fat (ii) animal health (iii) milk consumption (iv) employment opportunities (v) income and savings (vi) capacity of households to scaled up dairy activities, etc.

DCS and EIA Survey: The information from the DCS and EIA on the key variables such as membership status, milk procurement, fat composition, mineral mixture sale, cattle feed sale, etc. before and after RBP was examined.

2.3.2 Effectiveness: Commensurate with the second objective of the study, the effectiveness of the programme was evaluated in terms of the program status with respect to its coverage, outreach, quality of services, their timeliness, mode of implementation, etc. Here again this aspect has been looked into at various levels of program implementation, viz. the household, LRP, DCS and EIA.

2.3.3 Sustainability: The sustainability of the program was also studied based on the Focus Group Discussions (FGDs) involving the farmers, LRPs and EIA, and in-depth observations of the mechanism that has been put in place under the RBP. The host of issues that were attempted to be highlighted in the context of sustainability were:

- What mechanisms have been put in place to ensure sustainability of program results, for instance, has the capacity of DCS and other EIAs improved for delivering better goods and services to dairy farmers; what is the extent of institutional capacity building a various levels in the context of the RBP for ascertaining the provisioning of these services on a sustainable basis to the milk producers?
- Have any innovative practices been adopted by the EIA in implementing the programme?
- Do the stakeholders have a sense of ownership of the program? Are beneficiary households likely to continue receiving RBP advisory services after the program ends as a paid service?
- Are LRPs likely to continue operating and remain financially viable after the program ends?

2.3.4 Lessons learned: The delineation of constraints faced in each stage of the RBP and the suggestions made by the various stakeholders in improving the program formed the basis of highlighting the lessons learned for its further improvement.

3 Impact of Ration Balancing Program

The Chapter is divided into two major sections, the first section discusses the results of quantitative analysis and the second section focuses on the qualitative aspects of the impact analysis.

3.1 Impact on Milk Productivity and Feed Cost: Quantitative Assessment

As has been mentioned in the methodology section, the quantitative analysis has been done from both, before-after approach, using INAPH data and with-without approach, using field survey data of selected households.

3.1.1 Before- After Approach: INAPH Database: Information was available (up to June 2015) on 4489 cows and 4956 buffaloes from Banaskantha and Surat Milk Unions of Gujarat. The corresponding numbers were 2105 cows and 3767 buffaloes from Ludhiana and Ropar Milk Unions of Punjab. These lactating animals fulfilled the selection criterion of being under RBP advisory for a period of at least 180 days from the date of first RBP advisory.

There were a number of outliers in the dataset, perhaps due to errors in data collection or entry by the LRP. All such observations were deleted from the dataset as they unduly affected the regression results.

As feed is the most important variable input influencing milk productivity, and also the "treatment" variable under the RBP, the selection of appropriate specification of this variable was crucial for the robustness and logical consistency of the results. Several specifications of regression equation were tried with alternate forms of variable relating to the feed input, such as quantity of dry fodder, green fodder, concentrate and supplements fed to animals; or in terms of total dry matter intake from roughage and concentrates, or as nutrient availability from the feed and fodder (i.e. TDN, CP, Ca, P). Based on the econometric tests and common knowledge of animal nutrition, the final specification in the regression equations of both cattle and buffaloes in Gujarat and Punjab included two feed related variables, daily total dry matter intake (TOTALDM) and quantity of mineral mixture fed to the animals (MM).

The original dataset did not provide for the information of stage of lactation (SOL) in days, and the same was generated from the data of date of calving and that of RBP. The log specification of this variable was included to capture the established shape of the lactation curve. The state wise results are presented below:

Gujarat: The regression results (Table 3.1) had the expected signs for the coefficient of animal parameter (SOL) and the difference on breed. The productivity of the animal declines with the increase in the stage of lactation after the animal achieves its peak yield by about 70 days after calving. Hence, this is a very important control variable for impact assessment of RBP.

The breed dummy for cows and buffaloes is positive and significant establishing that among the animals of various breeds covered under RBP, the Holstein Friesian and Jersey crosses and Mehsana buffaloes are higher yielding animals.

In terms of location, the productivity of animals in the milk shed area of Banaskantha was higher than that of Surat and hence, the sign of regression coefficient of DM_DISTRICT is negative and significant.

The seasonal effect on milk production was captured through a dummy variable of flush season. The negative and significant sign of the flush season coefficient was in contrast to the *a-priori* expectations, but a detailed examination of the data set revealed that this variable is dominated by the location effect. In the Surat district, where average yield was lower there were more observations in the lean season than flush season because of which the expected results were distorted. For the overall data, the average productivity of cows in flush season was 9.73 kg. as against 8.84 kg. in the lean season, while the corresponding figures for buffaloes were 7.22 kg. in flush and 6.90 kg. in lean season.

The positive effect of feeding on productivity is well discernible in the regression results. The quantum of mineral mixture fed to the buffaloes was low and hence, though the regression coefficient has a positive sign, it does not show significant influence on milk productivity.

Table 3.1: Determinants of Milk Productivity in Gujarat

Cattle		
Variables	**Dependent Variable: LOG(YIELD)**	
	Coefficient	t-Statistic
C	0.7502	14.45
SOL	-0.0010*	-8.14
LOG(SOL)	-0.0033	-0.31
FLUSH_A	-0.0221	-2.33
DM_HFJRS	0.2338*	13.48
MM	0.0201**	2.49
TOTALDM	0.1189*	40.89
DM_DISTRICT	-0.1377*	-12.35
R^2	0.5478*	
n	3994	
Buffalo		
Variables	**Dependent Variable: LOG(YIELD)**	
	Coefficient	t-Statistic
C	0.7182	11.21
SOL	-0.0011*	-7.79
LOG(SOL)	0.0112	0.74
TOTALDM	0.1000*	39.01
MM	0.0099	0.94
FLUSH_B	-0.0133	-1.39
DM_DISTRICT	-0.0792*	-5.54
DM_MEH	0.0158	0.96
R^2	0.4730*	
n	4293	

Note: *, ** Significant at $p<0.01$ and $p<.005$, respectively.

FLUSH _A = 1 for Oct. to March, =0 otherwise;

FLUSH _B = 1 for Sept.. to Feb., =0 otherwise

DM_HFJRS=1 for Holstein Friesian and Jersey crosses, = 0 otherwise;

DM_MEH= 1 for Mehasana Buffaloes, = 0 otherwise.

DM DISTRICT, =0 for Banaskantha, =1 for Surat

Based on the above regression results that pertain to the base period and hence can be considered as the scenario without RBP intervention, the predicted yield after 180 days was worked out by changing only the seasonal and stage of lactation variables. The difference between the predicted yield so obtained for the impact period and the observed yield in the same

period that can be attributed to the effect of RBP on the animal productivity is summarized in Fig. 3.1a, Fig. 3.1b and Table 3.2.

Fig. 3.1a: Average Milk Productivity of Cows With and Without RBP Intervention: Gujarat

Fig. 3.1b: Average Milk Productivity of Buffaloes With and Without RBP Intervention: Gujarat

Table 3.2: Effect of RBP in Period of Six Months on Animal Productivity in Gujarat

Particulars	N	Percentage Gain in Yield
Cows		
Banaskantha All	1969	22.42
HF Jersey	1573	24.33
Others	396	11.25
Surat All	2025	1.80
HF Jersey	1927	0.85
Others	98	24.47
Gujarat All	**3993**	**12.76**
HF Jersey	**3499**	**12.64**
Others	**494**	**13.82**
Buffaloes		
Banaskantha All	3219	5.26
Mehasana	3202	5.31
Others	17	
Surat All	1074	6.04
Mehasana	485	5.16
Others	589	6.79
Gujarat All	**4293**	**5.44**
Mehasana	**3687**	**5.29**
Others	**606**	**6.43**

The results show that there have been positive gains in productivity of dairy animals due to the ration balancing intervention provided to them. As expected, the productivity enhancement has been higher for cows (around 13 per cent) as compared to buffaloes (nearly 5.5 per cent). In case of crossbred cows, the productivity enhancement has been as high as 24 per cent in Banaskantha. Similar kind of gains have been discernible in Surat also for the local cows, but their number is far too less (<100) to establish the robustness of results. In case of buffaloes the extent of productivity gains has been little higher for buffaloes of breeds other than Mehsana.

The impact of any technological intervention at the field level is conditional upon the initial condition of the treated group (here dairy animals) and the intensity of technology adoption by the dairy farmers. Ration Balancing Program is an advisory service and hence it is likely that in longer time frame the advisory is either not delivered or followed in real earnest due to several possible internal or external inhibiting factors. This would dampen the potential gains from the intervention. The analysis of productivity gains to animals in first month of ration balancing advisory substantiates this fact (Table 3.3). The effect of the programme in one month

period is more appealing than six month period, particularly in case of buffalo with almost tripling of the percentage gain in milk yield. The difference between the short term (one month) and longer term (six months) productivity gains are very profound in Surat, while Banaskantha has been more consistent in terms of the realised gains from RBP, suggesting that there has been effective implementation and constant adoption of the programme by the farmers of the region. This emphasises the need of extension services to motivate farmers to gain long term benefits from RBP.

Table 3.3: Effect of RBP in Period of One Month on Animal Productivity in Gujarat

Particulars	Estimated milk yield without RBP (kg./day)	Actual milk yield with RBP (kg./day)	Percentage Gain
Cattle			
Banaskantha	7.81	9.50	17.87
Surat	6.53	7.61	14.20
Gujarat	7.14	8.52	16.17
Buffaloes			
Banaskantha	5.87	6.83	14.03
Surat	4.40	5.59	20.19
Gujarat	5.83	6.79	14.14

Punjab: The results of the regression analysis in Punjab are broadly similar to that in case of Gujarat. The negative effect of stage of lactation, positive effect of DMI and Mineral mixture feeding is significant on the milk yield (Table 3.4). The breed dummies are in consonance with the a–priori hypothesis of higher productivity of crossbred cows and Murrah buffaloes in the region. The locational dummies are not significant implying that the base level productivity differentials are not notable in the two milk unions under study.

Table 3.4: Determinants of Milk Productivity in Punjab

Variables	Dependent Variable: LOG(YIELD)	
	Coefficient	t-Statistic
Cattle		
C	0.3825	6.33
TOTALDM	0.1468*	43.31
MM	0.0948**	2.29
SOL	-0.0007*	-6.12
LOG(SOL)	0.0123	1.03
DM_HFJRSY	0.1487*	5.40
DM_WINTER	0.0044	0.29
DM_DIST	0.0033	0.27
R-squared	0.6389*	
n	2018	
Buffalo		
C	0.4387	11.72
TOTALDM	0.1148*	46.55
MM	0.1034*	4.81
SOL	-0.0011*	-14.88
LOG(SOL	0.0230*	4.54
DM_MURRA	0.0220	1.73
DM_WINTER	0.0036	0.34
DM_DIST	0.0070	0.87
R-squared	0.6015*	
n	3566	

Note: *, ** Significant at p<0.01 and p<.005, respectively.

DM_WINTER= 1 for Nov.-Feb., =0 otherwise;

DM_HFJRSY=1 for Holstein Friesian and Jersey crosses, = 0 otherwise;

DM_MURRA= 1 for Murrah Buffaloes, = 0 otherwise.

DM_DIST, =0 for Ludhiana, =1 for Ropar

The estimates of productivity gain due to RBP intervention are also similar to Gujarat in case of cows (about 13 per cent), and much higher in case of buffaloes (Fig. 3.2a, Fig. 3.2b and Table 3.5). The number of local cows are far too few in the region but the results of the productivity gains are quite encouraging. In case of buffaloes, the effect of RBP in terms of productivity gains is more pronounced in Murrah buffaloes. Across Milk Unions, the programme appears to be more effective in Ropar than in Ludhiana.

Fig. 3.2a: Average Milk Productivity of Cows With and Without RBP Intervention: Punjab
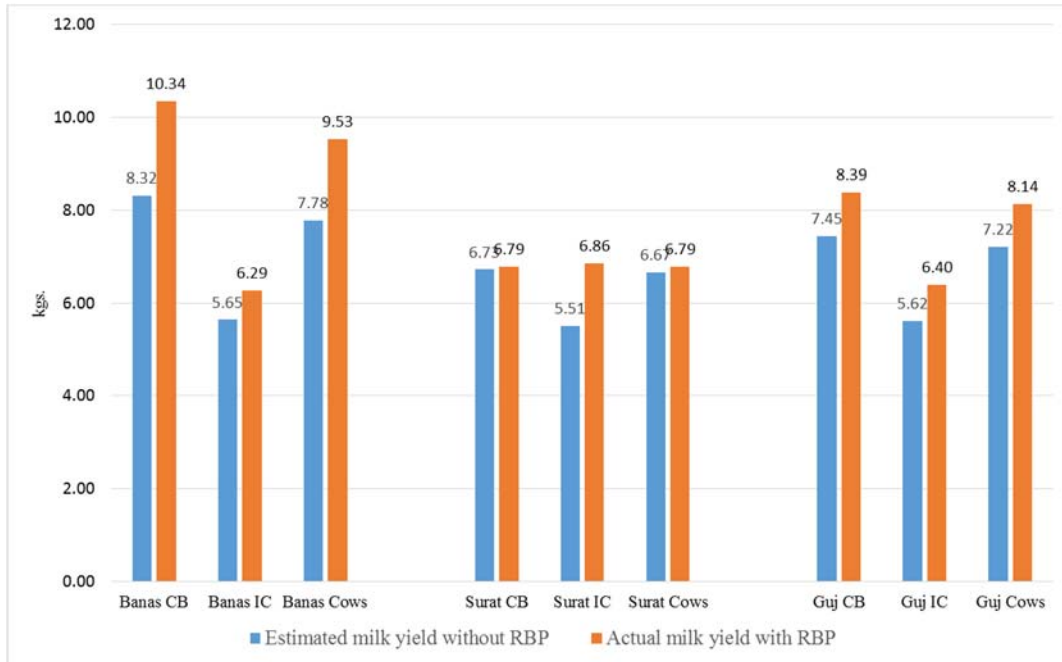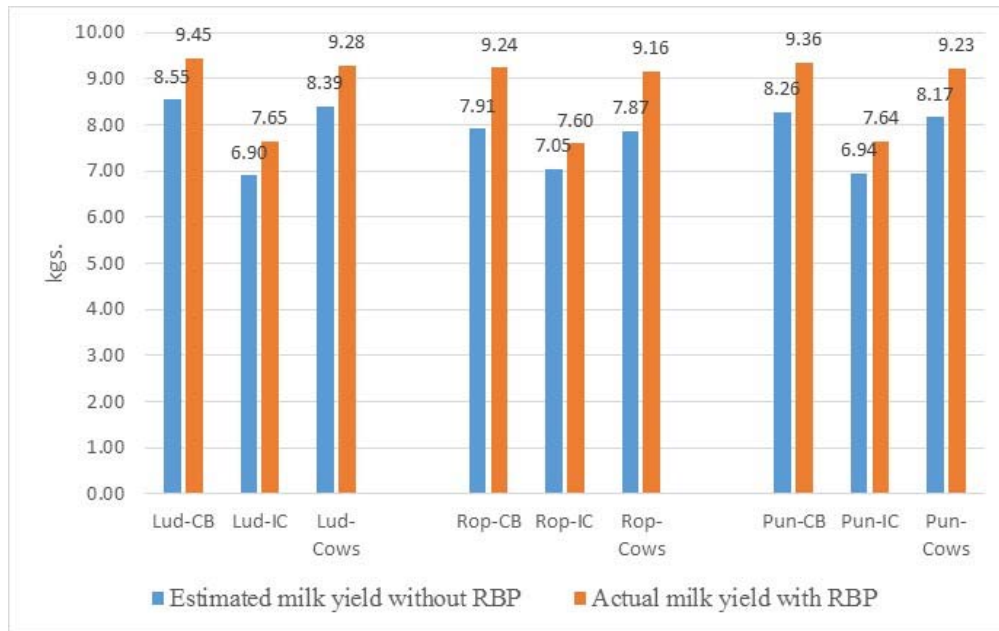

Fig. 3.2b: Average Milk Productivity of Buffaloes With and Without RBP Intervention: Punjab
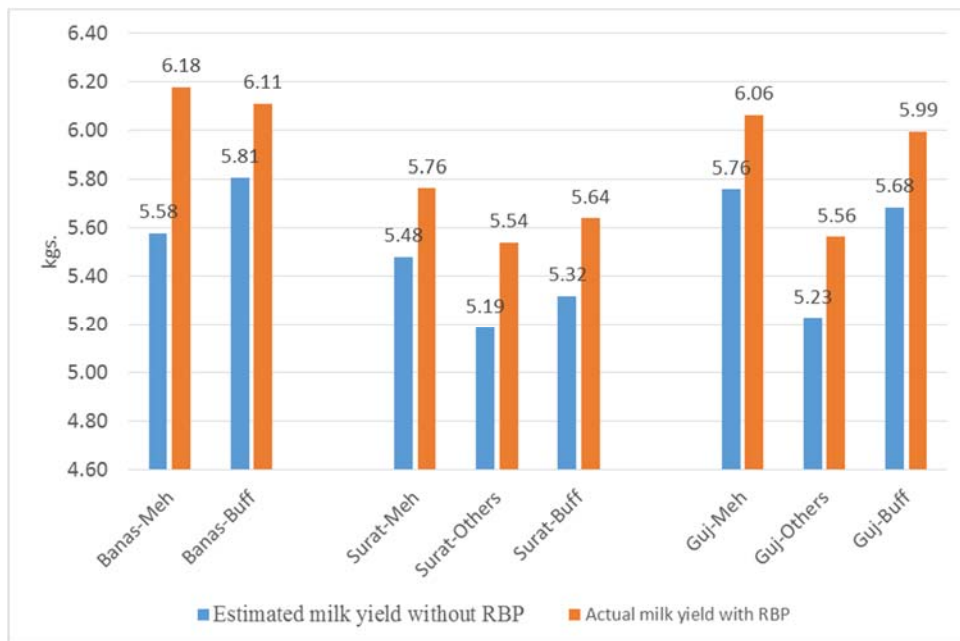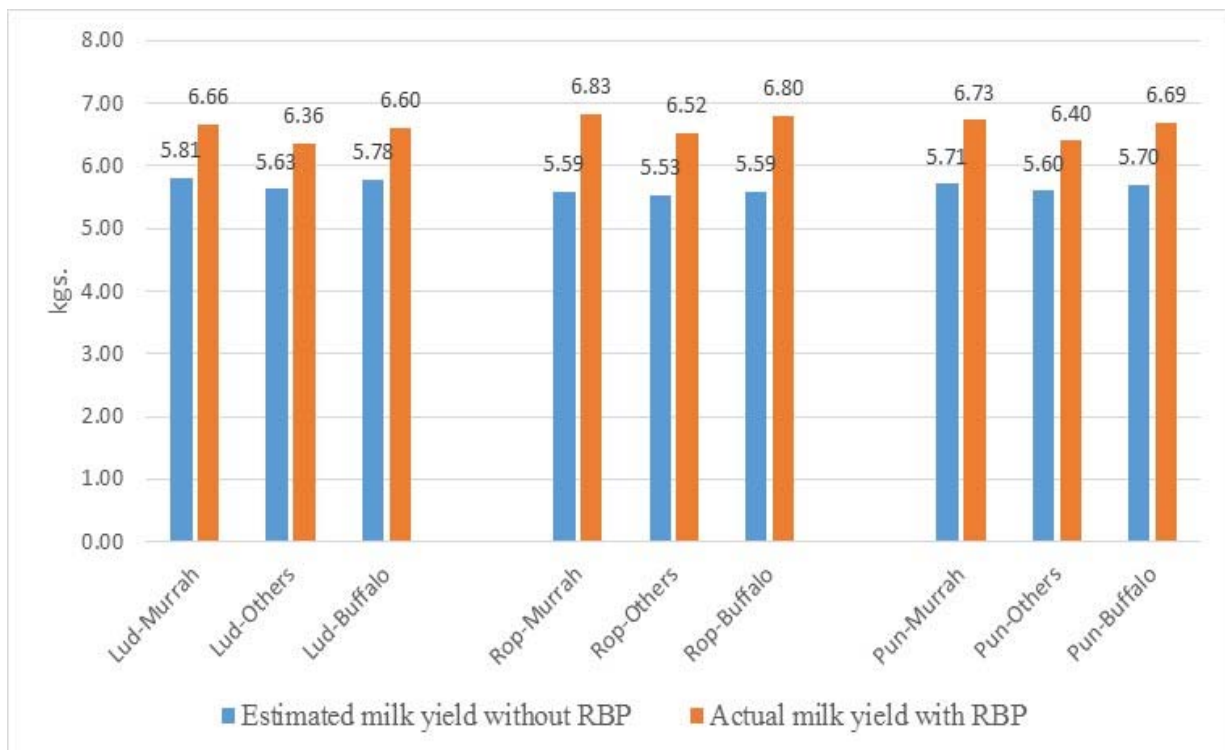
Table 3.5: Effect of RBP in Period of Six Months on Animal Productivity in Punjab

Items	N	Percentage Gain in Yield
Cattle		
Ludhiana All	1143	10.57
HF Jersey	1036	10.54
Others	107	10.95
Ropar All	875	16.42
HF Jersey	830	16.83
Others	45	7.87
Punjab All	**2018**	**13.01**
HF Jersey	**1866**	**13.22**
Others	**152**	**10.03**
Buffaloes		
Ludhiana All	2035	14.2
Murrah	1660	14.48
Others	375	12.91
Ropar All	1529	21.68
Murrah	1400	22.03
Others	129	17.95
Punjab All	**3564**	**17.35**
Murrah	**3060**	**17.86**
Others	**504**	**14.18**

Effect on Feed Cost: Having quantified the effect of RBP on milk productivity, the impact of the intervention on the feed cost has also been worked out (Table 3.6). The results clearly show the cost effectiveness of RBP in terms of percentage reduction in feed cost and feed cost/lit. FCM of both, cattle and buffalo, with the cost efficiency being more pronounced in cows.

Table 3.6: Decrease in Feed Cost from RBP intervention

Particulars	Feed cost per day			Feed cost/lit. FCM		
	Before RBP (Rs.)	After RBP (Rs.)	% Change	Before RBP (Rs.)	After RBP (Rs.)	% Change
Gujarat: Cattle						
Banaskantha	101.97	92.93	-8.87	12.52	11.29	-9.86
Surat	100.43	79.84	-20.50	13.17	12.41	-5.76
State	101.19	86.29	-14.72	12.85	11.86	-7.73
Gujarat: Buffalo						
Banaskantha	85.45	77.36	-9.47	9.88	9.01	-8.76
Surat	84.16	76.20	-9.45	10.39	9.30	-10.42
State	85.13	77.07	-9.47	10.00	9.08	-9.19
Punjab: Cattle						
Ludhiana	156.73	138.89	-11.38	19.71	17.58	-10.83
Ropar	170.12	153.61	-9.70	22.02	19.44	-11.71
State	162.54	145.27	-10.62	20.71	18.38	-11.25
Punjab: Buffalo						
Ludhiana	144.82	131.45	-9.23	16.08	15.66	-2.61
Ropar	152.21	150.11	-1.37	16.37	16.10	-1.65
State	147.99	139.39	-5.81	16.20	15.85	-2.20

3.1.2: *With- without Approach: Field Survey*

The field survey data of 400 dairy farm households in each state, comprising of 50:50 beneficiary and non-beneficiary of RBP has been analysed using propensity score matching (PSM) method to quantify the effect of the program. PSM was proposed as a method to reduce the bias in the estimation of treatment effects with observational datasets by Rosenbaum and Rubin (1983). Since in observational studies assignment of subjects to the treatment and control groups is not random, the estimation of the effect of treatment may be biased by the existence of confounding factors. Propensity score matching is a way to "correct" the estimation of treatment effects controlling for the existence of these confounding factors based on the idea that the bias is reduced when the comparison of outcomes is performed using treated and control subjects who are as similar as possible. In other words, PSM is an algorithm that matches treated and nonparticipants on the basis of the conditional probability of participation (the propensity score), given the observable characteristics. If outcomes are independent of participation, conditional on

observables, then the use of the matched comparison group would yield an unbiased estimate of the mean impact of treatment. There are several matching algorithms such as nearest neighbor, radius matching, kernel, non-linear etc.. Each method requires the definition of a measure of proximity in order to identify nonparticipants who are acceptably close (in terms of the propensity score) to any given participant.

In the context of the present study, as all the dairy animals of the beneficiary households were not covered under the program, the control group of animals was available not only on the non-participating (untreated) households but also within the participating (Treated) households. Hence, the conditional probability of participation was not estimated at the household level but at the animal level, with order of lactation, stage of lactation, breed, location (district dummy) as the observational characteristics. Here the focus was on *nearest-neighbor matching* as this method assigns a weight of one to the nearest nonparticipant and zero to others. If there are more than one individual in the neighborhood then the method assigns equal weight to each and a zero weight to people outside the neighborhood. Hence, it is expected that this matching would have also picked up the locational effect of a village, since observations were arranged according to the sample village.

Based on the simple averages of the milk yield, the productivity of the RBP animals on the treated households worked out to be higher than the Non-RBP animals, except in case of buffaloes in Punjab (Table 3.7).

Table 3.7 Average Milk Yield of Lactating Animals on Sample Households (lits./day)

Households	Animals	Gujarat		Punjab	
		Cattle	Buffalo	Cattle	Buffalo
RBP	RBP	11.80	8.41	10.04	7.16
	Non RBP	8.52	7.12	6.69	4.20
Non RBP	Non RBP	9.47	6.63	9.25	8.33

Gujarat: A formal analysis of the data substantiates that in Gujarat, RBP has increased the milk productivity of both, cows and buffaloes by about 19.5 and 18 percent, respectively (Table 3.8). The quantum of increase discernible from the with-without approach after controlling for the

confounding factors is higher than the same estimated based on before-after approach using a much larger sample.

Punjab: The case of Punjab is somewhat different than that of Gujarat. The average productivity of cows was significantly higher for lactating animals under RBP as per both, the unmatched data and the estimation of Average Treatment on Treated (ATT). But unlike Gujarat, in Punjab the ATT effect was larger (16.7 per cent) than the unmatched difference (15.2 per cent). The productivity differentials in buffaloes that showed significantly lower productivity of RBP animals than non-RBP animals in the unmatched sample turns out to be non-significant after PSM (Table 3.8), implying that in buffaloes the effect of RBP has not been established based on the field survey. The results of impact analysis from field data and INAPH database are in consonance for cows but not for buffaloes, which indicated about 12 per cent gain in buffalo milk yield due to RBP intervention. There could be several reasons for this; one plausible reason that has been discussed later in this Chapter is poor performance of Ropar Milk Union that was largely dominated by the buffalo population in the sample.

Table 3.8: Milk Productivity Differentials of Lactating Animals With and With-out Ration Balancing Advisory

State	Animal	Sample	Treated	Controlled	Difference	Percentage Change
Gujarat	Cow	Unmatched	11.90 (n=274)	9.55 (n=354)	2.35* (S.E.= 0.41)	24.63
		ATT	11.90 (n=271)	9.95 (n=326)	1.94* (S.E.= 0.64)	19.54
	Buffalo	Unmatched	8.41 (n=135)	6.82 (n=226)	1.59* (S.E.= 0.37)	23.31
		ATT	8.41 (n=135)	7.11 (n=226)	1.30** (S.E.= 0.64)	18.31
Punjab	Cow	Unmatched	10.04 (n=109)	8.72 (n=244)	1.32* (S.E.= 0.33)	15.18
		ATT	10.04 (n=109)	8.61 (n=244)	1.43** (S.E.= 0.55)	16.66
	Buffalo	Unmatched	7.17 (n=191)	7.77 (n=161)	-0.60** (S.E.= 0.26)	-7.66
		ATT	7.17 (n=189)	7.42 (n=161)	-0.24 (S.E.= 0.50)	-3.26

ATT: Average Treatment on the Treated, * Significant at 1 per cent, ** Significant at 5 per cent

Effect on Feed Cost: The RBP also had a clear impact in reducing the feed cost per liter of milk by about 18-19 per cent in case of cows in both the states and about 2.6 per cent for buffaloes in Gujarat (Table 3.9). 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.

Table 3.9: Effect of RBP on Feed Cost and Milk-Feed Ratio: Evidence from Sample Survey

State	Animal		Sample	Treated	Controlled	Difference	Percentage Change
Gujarat	Cow	Milk- Feed Ratio	Unmatched	1.76	1.54	0.21* (0.05)	13.69
			ATT	1.76	1.55	0.21** (0.08)	13.22
		Feed Cost/ Lit	Unmatched	17.66	21.67	-4.01* (1.12)	-18.51
			ATT	17.66	21.50	-3.84** (1.73)	-17.87
	Buffalo	Milk- Feed Ratio	Unmatched	2.33	2.06	0.27*** (0.16)	13.12
			ATT	2.33	2.21	0.12 (0.26)	5.64
		Feed Cost/ Lit	Unmatched	28.15	32.37	-4.21 (2.59)	-13.02
			ATT	28.15	28.90	-0.75 (3.78)	-2.60
Punjab	Cow	Milk- Feed Ratio	Unmatched	1.70	1.32	0.38* (0.07)	28.80
			ATT	1.70	1.27	0.43* (0.11)	34.08
		Feed Cost/ Lit	Unmatched	17.36	20.55	-3.20* (0.94)	-15.55
			ATT	17.36	21.47	-4.11** (1.62)	-19.16
	Buffalo	Milk- Feed Ratio	Unmatched	1.93	1.78	0.15*** (0.08)	8.43
			ATT	1.93	1.64	0.29** (0.13)	17.85
		Feed Cost/ Lit	Unmatched	24.38	25.92	-1.55 (1.47)	-5.97
			ATT	24.38	29.79	-5.41*** (2.95)	-18.16

Figures in parentheses are standard errors, * Significant at 1 per cent, ** Significant at 5 per cent, ** * Significant at 10 per cent

The decrease in feed cost and significant increase or non-significant change (Punjab buffaloes) in milk productivity has led to improvement in milk-feed ratio, i.e. the ratio of gross returns from milk output per unit of feed cost.

3.2 Qualitative Impact Analysis

Based on the perception of farmers, response of DCS and key village functionaries and information provided by the EIAs, the impact of RBP on milk production, composition, feed cost and health parameters of the animals has been delineated in this section.

3.2.1 Milk Production and Composition

The farmer's perception about the RBP effect on productivity of dairy animals brings to light some very interesting results (Table 3.10). In Gujarat about 80 per cent farmers perceive that productivity has improved and this proportion is more or less same across two milk unions. The quantum of productivity increase as reported by the farmers (9.7-16.5 per cent) for both, cows and buffaloes is also within the range that has been estimated using quantitatively rigorous techniques discussed in previous section. The information was also sought from the EIAs regarding the productivity changes in RBP villages during a span of about one year. The magnitude of increase in milk productivity was reported to be 3.8 – 5.3 per cent, which appears to be realistic as over longer time frame the effect is expected to be less profound due to a number of technical and implementation constraints.

The proportion of sample farmers perceiving a yield enhancing effect of RBP is much lower (47 per cent) in Punjab than in Gujarat and their distribution across two milk unions is highly skewed towards Ludhiana Milk Union. Nearly ¾ of the sample farmers in Ludhiana reported an average increase in milk productivity of about 12-13 per cent while only 19 per cent farmers in Ropar were of the opinion that RBP has contributed to productivity enhancement. The major reason for a poor response in Ropar is due to a number of issues in coverage and outreach of the RBP that have been discussed in detail in the next chapter. The observation of the researchers also confirm and substantiate the limited impact of RBP in this region. The quantitative analysis of insignificant effect of RBP on buffalo milk production in Punjab that was brought out on basis of field survey date can also be explained in terms of poor performance of Ropar Milk Union where buffalo population is predominant. In light of the farmers' response

and also a reported 2.2 per cent increase in milk productivity by the Ropar EIA (Table 3.10), it is indeed surprising that INAPH database has come up with strikingly contrasting results.

Table 3.10: Effect of RBP on Animal Productivity and Milk Composition

Particulars	Surat Milk Union	Banas Milk Union	Gujarat	Ludhiana Milk Union	Ropar Milk Union	Punjab
Farmers' Perception: Percentage of Positive Responses						
Increase in Milk Production	78	81	80	74	19	47
Quantum of Productivity Increase (%)	Bu-14.56 Cow-16.47	Bu-15.29 Cow-9.68		Bu-12.29 Cow-13.26	Bu-8.0 Cow-10.50	
Improvement in Milk Composition	83	79	81	68	20	44
Quantum of Fat Increase (%)	Bu- 7.38 Cow -11.14	Bu -9.48 Cow -15.27		Bu -6.24 Cow -9.28	Bu 14.81 Cow-22.79	
SNF Increase (%)	Bu -0.11 Cow -1.30	Bu -1.21 Cow -0.22		Bu -2.91 Cow -2.50	Bu-7.14 Cow-6.97	
Information from DCS						
Quantum of Fat Increase (%)	Cow 3.8 Bu 3.1	Cow 5.8 Bu 4.7		2.0	5.1	
SNF Increase (%)	0.0	0.0		-2.9	-3.0	
Information from EIA						
Quantum of Productivity Increase (%)	3.86	5.29		2.47	2.21	
Quantum of Fat Increase (%)	1.35	1.98		0.074	0.032	

The composition of milk has also improved especially its fat percentage (Table 3.10). Two notable features are (i) the improvement is more visible in Gujarat than Punjab and (ii) the reported magnitude of increase in fat and SNF by the farmers is higher than informed by DCS and subsequently EIAs. The DCS pool the milk at the village level and EIAs estimates are based on procurement from all RBP villages and hence subsequently these estimates are lower.

3.2.2 Feed Cost

Only about half the farmers in Gujarat felt that there has been a reduction in the feed cost after RBP intervention, while the corresponding proportion is about only 40 per cent in Punjab (Fig. 3.3)

Fig. 3.3: Proportion of Farmers Perceiving Decrease in Feed Cost from RBP
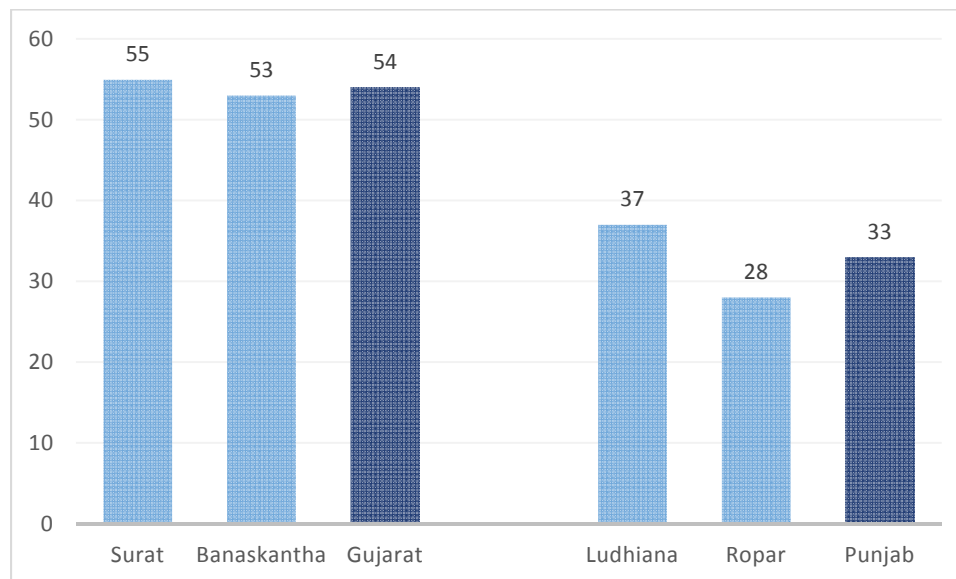
3.2.3 Health and Reproductive performance of Animals

The responses of the dairy farmers show encouraging effect of RBP on the health and reproductive performance of animals in three Milk Unions, except Ropar where the program had not been implemented properly (Table 3.11). The nature of response was similar from the DCS functionaries.

As per the information provided by the EIA, in Surat Milk Union the number of veterinary visits in RBP villages decreased by 10 per cent during June 2014 to June 2015. However, the corresponding percentage is negligible (1.67 per cent) in Banaskantha. The conception rate has been reported to increase from about 40 per cent to 45 per cent in Surat and marginally from 48.2 per cent to 48.5 per cent in Banaskantha during the above period.

Table 3.11: Effect of RBP on Animal Health and Reproductive Parameters

Particulars	Percentage of Positive Responses					
	Surat Milk Union	Banas Milk Union	**Gujarat**	Ludhiana Milk Union	Ropar Milk Union	**Punjab**
Perception of Farmers						
Increase in Conception Rate	69	76	73	94	9	52
Reducing Service Period	64	63	64	75	10	43
Increased Lactation Period	66	69	68	93	8	51
Reduced Inter Calving Period	52	67	60	92	7	50
Reduced Repeat Breeding	41	59	50	94	9	52
Controlled Anoestrous	9	21	15	86	8	47
Improvement in General Health of Animal	84	82	83	41	23	32
Decrease in Digestive Disorders	80	81	80.5	80	22	51
Perception of DCS functionaries						
Improvement in fertility	90	70	80	90	30	60
Reduction in disease in milch animal	80	80	80	20	10	15
Decrease in number of veterinary visit	70	40	55	20	40	30

4 Effectiveness of Ration Balancing Program

The effectiveness of the program has been studied in terms of the program coverage, its outreach and the implementing and monitoring mechanism that has been put in place.

4.1 Coverage of Ration Balancing Program

The efficiency of coverage can be gauged from the extent of targets achieved in rolling out the program by the EIA, and the nature of villages, households and animals selection under the program.

4.1.1 Achievements of End Implementing Agency (EIA): The end implementing agencies that is the milk unions implementing the ration balancing program have set targets related with staff position, net books purchased, LRP trained and functioning, VAP conducted, village and animals covered. The extent of achievement of these targets (as on 31st May, 2015) shows good coverage by the EIAs in Gujarat and a bit slow performance by the EIAs in Punjab (Table 4.1). The staff positioning was as per targets in Gujarat but target shortfalls occurred in Punjab. The netbooks were purchased as per targets by all milk unions as these were the basic requirement of the programme. The training and functioning of the LRP is the main determinant of RBP performance. The EIAs in Gujarat could achieve over 90 per cent of their target in terms of number of LRPs selected and trained, but in Punjab, less than ¾ of the targets could be fulfilled upto 31st May, 2015. The LRP functioning in all milk unions were less than the number trained. As the average education profile of LRPs was more than senior secondary level, they left for better employment, thus, retaining the trained LRPs in the programme pose major problem on sustainability. The information sought from the 10 LRPs in each EIA, the average number of farmers covered per LRP was 64 and 70 in Surat and Banaskantha, respectively; while it was only 38 and 37 in Ludhiana and Ropar.

The village awareness programs to explain the concept of balanced ration to the milk producers is the key mode to propagate the benefits of ration balancing to the farmers and elicit their interest in joining the program. Here again the EIAs of Gujarat achieved cent percent targets, but Punjab was way behind. Even considering for the fact that the program inception in

Punjab has been much later than that in Gujarat, especially with reference to Banaskantha, the average number of VAP per month are less in Punjab than Gujarat. The target assigned in animals to be covered under the progamme was forty thousand but all milk union were lacking in their achievements. The animal covered of their target was the least (51.25 per cent) in the Ropar milk union. In Surat and Banaskantha, the achievement were 72.10 (28841/40000) and 79.23 (31694/40000) per cent of the targets, respectively.

Table 4.1: Targets and Achievements of EIAs regarding RBP (as on 31st May, 2015)

Particulars	Surat Milk Union		Banaskantha Milk Union		Ludhiana Milk Union		Ropar Milk Union	
Date of official inception of RBP	February, 2013		July, 2012		Oct.., 2013		Oct., 2013	
	Target	Achieve-ment	Target	Achieve-ment	Target	Achieve-ment	Target	Achieve-ment
Staff Position- at Union level	6	6	6	6	6	4	6	4
Net-books purchased (no.)	420	420	420	420	420	420	420	420
LRPs trained (no.)	400	382	400	367	400	289	400	229
LRPs functioning (no.)	400	313	400	349	400	278	400	218
VAP Conducted (no.)	1000	1004	1000	1001	1000	366	1000	320
Villages covered (no.)	400	318	400	311	400	270	400	218
Animals Covered (no.)	40000	28841	40000	31694	40000	19687	40000	18455

4.1.2 Infrastructure and Facilities in Villages Covered: The availability of infrastructure facilities in the villages and provisioning of other dairy development programs has important bearing on the degree of progressiveness of the dairy farmers and eventually the success of advisory programs like RBP. A quick glance at the profile of sample villages shows that the road connectivity of the villages was good (Table 4.2). In Gujarat, most of the sample villages were located at a distance of over 10 km from the nearest town/city while in case of Punjab the majority of the sample villages were not too far from the urban areas as geographically Punjab is a smaller state and the extent of urbanization is much higher. As the RBP is primarily focused on the areas covered by the dairy cooperative network, the sample villages had DCS either

within village or in the neighboring village, but all of the villages had output service support in terms of milk collection center, chilling center/bulk milk cooler. However, in terms of input support services pertaining to breeding and health care, there were lot of variations across villages. Some villages had only an A.I centre but in others either a dispensary or hospital was available within the village.

By and large, the villages are reasonably well-endowed with infrastructure facilities. Additionally in the villages of Gujarat, other components of NDP I, such as fodder development, and animal health are also being implemented. In Punjab, the villages were not covered under any other development program either under the umbrella of NDP I or state AHD.

Table 4.2: Profile of Sample Villages covered under RBP

Particulars	Percentage of Sample Villages			
	Surat Milk Union	**Banas Milk Union**	**Ludhiana Milk Union**	**Ropar Milk Union**
All-weather road connectivity	80	90	100	100
Access to facilities within village				
Dairy co-operative society	90	100	60	70
Milk collection center	100	100	100	100
Chilling center/Bulk milk cooler	70	100	30	50
Artificial insemination center	60	100	30	70
Veterinary Hospital/ dispensary	20	10	60	60

4.1.3 Socio-Economic Profile of Households Covered: One of the important goals of the development programs should be to cover within its ambit all the sections of the society. A comparison of the socio-economic profile of the RBP *vis a vis* non-RBP households has been made to examine the equality in targeting the dairy farmers for ration balancing advisory (Table 4.3).

The average household size of all the sample households in the four milk unions was equal. Also, in terms of occupational distribution of the households according to their primary

occupation, the profile of RBP and non-RBP households is quite similar. In Punjab, the dairy farmers working as agricultural labourers have also been covered under the program.

The targeting of the program has been quite fair and households below poverty line (BPL) have been covered. In Punjab, the percentage of BPL families in villages is low (as reflected from low percentage of non RBP households also) and hence out of total sample about 5 per cent of RBP respondents in Ludhiana and 2 per cent in Ropar were BPL families. But in Gujarat where their incidence is high, a sizeable proportion of the sample RBP farms were economically vulnerable. Even in case of families that are above poverty line (APL), a higher proportion was of those with annual income upto 3 lakhs in Punjab and Surat. For Banaskantha, higher proportion of sample respondents were in relatively higher income group of more than Rs. 3 lakhs per annum.

Table 4.3: Socio-Economic Profile of Sample Households

Item	Gujarat				Punjab			
	Banaskantha		Surat		Ludhiana		Ropar	
	RBP	Non RBP	RBP	Non RBP	RBP	Non RBP	RBP	Non RBP
Average household size (no.)	6	6	5	5	4	4	4	3
Occupational Distribution (%)								
Crop Farming	50	54	55	54	73	73	24	23
Dairy Farming	47	45	41	39	5	3	49	24
Agril. Labour	-	1	1	1	2	1	22	33
Other	3	-	3	6	19	20	5	18
BPL households (%)	17	23	43	44	5	3	2	2
Income Groups of APL households (%)								
< 1 Lakh	12	12	32	29	6	14	30	55
1-3 Lakhs	28	29	44	30	58	56	30	26
3-5 Lakhs	39	29	19	29	28	27	25	14
>5 Lakhs	22	31	5	13	8	3	16	5
Education Index	3.71	3.31	4.27	4.13	5.13	4.88	4.44	4.45
SC/ST households (%)	20	14	90	83	4	8	9	8
Communication	0.84	0.72	0.82	0.61	0.71	0.56	2.06	1.79
Avg. Experience in dairying (years)	30	31	23	23	17	15	13	14
Land Holding size (acres)	4.6	4.52	1.64	2.04	5.37	4.62	3.10	3.3
Herd Size (SAU)	8	6	5	4	13	6	6	4

A logit analysis was attempted to examine the effect of 6 socio-economic variables, viz. education index of family (EDU), social group (SC/ST), communication characteristics and mass media exposure (COMMUN), experience in dairying (EXPER), size of land holding (LH) and herd size (SAU) on the participation of households in RBP. The results bring out some very interesting points (Table 4.4). Out of all the variables considered, two variables viz. communication and herd size had positive and significant coefficients for both Gujarat and Punjab. This implies that the dairy farmers with larger herds and better exposure to mass media and extension services have higher probability of joining the RBP advisory services. The other variables like education has a positive sign but its relationship to the RBP participation is insignificant. In Gujarat, the other three variables viz., experience in dairying, land holding and social group, all had negative though insignificant coefficient suggesting that more of relatively less experienced, smaller farmers belonging to the SC/STs were covered under RBP, strengthening the observation made earlier about the good coverage of the programme towards the vulnerable groups. In Punjab, the RBP farmers had somewhat larger land holding size and belonged to the non-scheduled social groups.

Table 4.4: Influence of Socio-Economic Factors on Participation in RBP

Explanatory Variables	Regression Coefficient	
	Gujarat	**Punjab**
Binary Logit Regression: Dependent variable Y=1 (RBP), Y=0 (Non RBP)		
Intercept	-1.563 (0.459)	-4.263 (0.739)
COMMUN	1.719* (0.384)	0.513* (0.156)
EDU	0.054 (0.079)	0.053 (0.091)
EXPER	-0.006 (0.008)	-0.005 (0.019)
LH	-0.021 (0.012)	0.004 (0.031)
SAU	0.113* (0.037)	0.731* (0.104)
SC/ST	-0.440 (0.230)	0.708 (0.414)
Log likelihood	-256.0205	-232.4323
n	400	395

Figures in parentheses are standard errors
* Significant at $p<0.1$

4.1.4 Profile of animals under RBP: Under the RBP, the animals that have been covered are mostly upto 3 lactation and yielding more than 2.5 kgs. milk per day (Fig. 4.1). This analysis based on the INAPH data also shows that for cows predominantly crossbred cows are covered. However, in Gujarat, good number of Indian breeds like Gir and Kankrej, and in Punjab very few Sahiwal cows are also under the RBP. In case of buffaloes also, the breed coverage is diversified in Gujarat where along with the major Mehsana breed, Jaffrabadi, Surti and Bhadawari buffaloes are in the ambit of the program. A few Nilli Ravi in Punjab are covered but here the predominant breed is Murrah.

Fig. 4.1: Profile of Animals under RBP: INAPH database
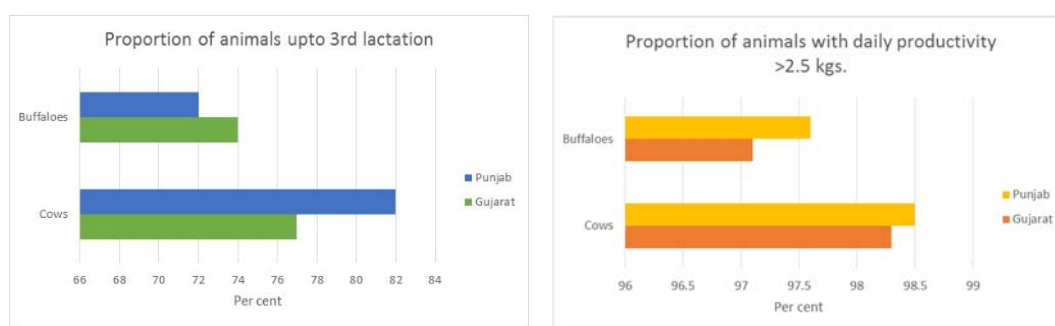
4.2 Outreach of the Program

The outreach of the program has been studied on the basis of the mode of information dissemination. The responses obtained from the sample households and LRPs in this regard are discussed below.

4.2.1 Household response

The LRP was the major source of information on RBP for the dairy farmers in both, Gujarat and Punjab followed by the dairy cooperative societies (DCSs) as revealed by the percentage of responses (Table 4.5). The percentage of adopters who got information from LRP was 80 per cent in Gujarat and 86 per cent in Punjab while it was 17 per cent and 13 per cent, respectively in case of DCSs as a source of information. The milk unions could not emerge as major source of information because the adopters were not contacted directly by the Union but through cooperative societies.

The table also shows that overall access to all type of information (documentary, poster, pamphlets, VAP) was significantly high in Gujarat as compared to Punjab. The information

disseminated through documentaries reached about 76 per cent of the respondents in the former state while it was only 44 per cent in Punjab. In Punjab, the access to RBP information was mainly through the pamphlets (56 per cent). The percentage of adopters who accessed information from posters/ banners was just half in Punjab (32 per cent) that of in Gujarat (66 per cent). The less emphasis on the posters/ banners in the former state may be the reason for less adoption of RBP. The result directs at further popularization of the programme through placement of posters and banners at various places as these are the effective means of information dissemination.

While in Gujarat, the adopters in Surat milk union were having higher access to all type of information than the Banaskantha milk union, the access in Punjab varied from one milk union to another. In Ropar milk union, majority of the adopters accessed information from documentary (45 per cent) and village awareness programme (54 per cent) while the information accessed by adopters were higher through poster/ banners (33 per cent) and pamphlets (58 per cent) in Ludhiana milk union. This may be due to variations in types of information emphasized by the milk unions.

Table 4.5: Outreach of Ration Balancing Program (RBP) to the adopters

Particulars	Responses (%)					
	Gujarat Milk Unions			**Punjab Milk Unions**		
	Surat	**Banas**	**Overall**	**Ludhiana**	**Ropar**	**Overall**
Sources of Information on RBP						
Milk Union	2	5	3	1	1	1
Dairy Cooperative Society	13	19	17	23	2	13
Local Resource Person	85	76	80	76	97	86
Access to type of Information on RBP						
Documentary	76	75	76	42	45	44
Poster/Banners	66	66	66	33	30	32
Pamphlets	70	59	65	58	52	56
Village Awareness Program (VAP)	72	63	68	32	54	43

The program was officially started in Banaskantha in July 2012 but by the end of 2013, only 29 per cent of the sample respondents had joined the program. The majority (51 per cent) started seeking the ration balancing advisory in 2014. In the areas of other EIAs as well, the outreach of the program at the field level was visible by 2014 as most of the dairy farmers in the primary survey reported to join the same in 2014.

Besides the RBP adopters, the non-RBP adopters were also asked about their awareness of this program. It was encouraging to notice that although these respondents had not joined the program yet, the majority of them (>65 per cent) were aware of it, largely through the LRPs

4.2.2 Local Resource Person (LRP) Response

The communication tools used to disseminate information about RBP were the literature, VAPs, posters and banners (Table 4.6). The percentage distribution of literature in Gujarat was more than double (85 per cent) as compared to Punjab (40 per cent) while the VAPs conducted per village were double in Punjab (6 number) than Gujarat (3). The display of posters and banners was 100 per cent in Gujarat and 80 per cent in Punjab. As can be seen from the table in the outreach, there is a mismatch between the use of communication tools by the LRP and information accessed by the adopter about RBP. For instance, the organization of VAPs and display of posters and banners in Punjab were either double or almost equivalent to Gujarat but the adopters accessed information from these tools were very less which may be due to not using proper place for display of posters & banner or organization of VAPs.

Table 4.6: Outreach of Ration Balancing Program: Perspective of LRP

Particulars	Responses					
	Gujarat Milk Unions			**Punjab Milk Unions**		
	Surat	**Banas**	**Overall**	**Ludhiana**	**Ropar**	**Overall**
No. of VAPs conducted per village	3	3	3	5	7	6
Documentary shown during VAP (%)	50	50	50	100	100	100
Distribution of literature (%)	90	80	85	80	0	40
Display of Poster/Banner (%)	100	100	100	90	70	80
Follow up actions/enquiry (%)						
By interaction	100	60	80	50	60	55
Verification on phone	20	0	10	0	0	0
Follow up visits	70	80	75	20	20	20

On the other hand, the distribution of literature was less in Punjab, but the adopters who accessed information from literature (documentary and pamphlets in Table 4.5) were more, which may be attributed to higher literacy and entrepreneurship among farmers in the state.

The follow up actions in RBP recommendations were mainly through interaction and follow-up visits and there was least preference for verification on phone. The proportion of follow-up actions was certainly high in Gujarat. More than 75 per cent LRP enquired the farmer about RBP advice only during their next visit.

4.3 Mechanism of Programme Implementation

There are several stakeholders/actors in the program implementation, hence the mechanism has been studied from actual implementation in the field through survey of dairy farmers and LRPs, and through the discussions with the officials of EIAs.

4.3.1 Mechanism followed at Household level

In this section, we study the mechanism as perceived by the respondents about the effectiveness of LRP and the ration balancing program. The questions asked from the respondents were whether LRP briefed about the program before giving the RB advice and was there any additional service or follow-up action? The affirmative responses obtained have been presented in Table 4.8 in the percentages. From the table, it can be observed that in majority of the cases LRPs were briefing the farmers about the program before giving them ration balancing advice. The 84 and 73 per cent of the adopters in Gujarat and Punjab, respectively, answered affirmatively. Similarly, 96 and 77 per cent of the adopters in Gujarat and Punjab, respectively, confirmed that they were delivered RB advice slip by the LRP. The proportion of responses to the follow-up and additional services was comparatively less. In Gujarat about 60 per cent respondents confirmed that LRP is following up with them on a regular basis about the RBP advisory, while the corresponding situation was very poor in Punjab, especially the Ropar milk union. This response of the LRP regarding follow-up advice actions/enquiry (Table 4.6) are hence, not corroborated by the farmers' response on the same aspect.

As regards the additional services rendered by the LRP, 52 per cent of the RBP households in Surat confirmed that they were getting mineral mixture supply through LRP. Some of them were also getting advisory on dairy /crop management from LRP. In Banaskantha, where perhaps, the mineral mixture and concentrate feed is regularly available at DCS, the additional services by LRP were limited. Here, only 10 per cent RBP households in reported getting such services, under the progeny testing programme.

The attitude of farmers in contacting the LRP for reformulation of feed ration when there was a change in the feed items was more forthcoming in Gujarat. In Punjab, several farmers opined that they are themselves knowledgeable enough to formulate and re-formulate the ration and hence they do not contact the LRP, while others complained that LRP was not responding timely to their requirements. On the basis of effectiveness, the LRP mechanism was rated 6.9 on the scale of 10 which can be graded as good. The constraints and issues of sustainability of the program through LRP model have been discussed in the subsequent Chapters.

Table 4.7: Adopters' Response about Mechanism of Ration Balancing Program

Particulars	Responses (%)					
	Gujarat Milk Unions			**Punjab Milk Unions**		
	Surat	**Banas**	**Overall**	**Ludhiana**	**Ropar**	**Overall**
Efficacy of LRP						
Provided briefing about RBP	86	81	84	89	56	73
Delivered RB advice Slip	97	95	96	98	56	77
Regular follow up by RBP	62	55	59	23	5	14
Additional service received	52	10	31	32	11	22
Contacted LRP for reformulation	47	40	44	27	7	17
Ranking of LRP on 10 Point Scale (Rank)	8.4	8.1	8.3	7.2	6.5	6.9
Efficacy of RBP						
Follow of recommendation correctly	95	88	92	75	46	61
Deviation from recommended ration	5	12	9	24	45	35
Ranking of RBP on 10 Point Scale (Rank)	8.4	8.6	8.5	7.5	8.9	8.2

About 92 per cent of the respondents in Gujarat and 61 per cent of the respondents in Punjab followed the recommendations correctly. The minimum score assigned to RBP was 7.5 in a scale of ten and the highest was 8.9, indicating that there is possibility to improve the performance of the project up to 10 to 11 per cent.

4.3.2 Mechanism at LRP level

The selection of farmers for the program was based on the interest of the farmers in Gujarat (Table 4.8). Some discretion that was used by the LRPs in Surat was also on the basis of the a-priori information on the productivity and reproductive status of animals on dairy farm households. The LRPs relied on the suggestion from DCS for selecting the farmers in Ludhiana.

The situation in Ropar was little alarming as the LRPs laid more emphasis on their convenience in selection of farmers.

The service delivery mechanism was satisfactory as the advisory was given to the member of the household responsible for feeding the animal, slip was handed over to the beneficiaries and practical weighment method by conversion into vessels/bundles was followed. The household survey had brought out that in Gujarat animal feeding was handled by females while in Punjab, it was mainly an activity by male workforce. The LRPs claimed that they were providing additional services mainly in form of mineral mixture supply to the farmers. But the farmers do not seem to endorse this claim, perhaps because they felt that providing mineral mixture was part of the LRP job and did not consider it an additional service.

Table 4.8: Ration Balance Advisory Mechanism: LRP Response

Particulars	Responses (%)			
	Gujarat Milk Unions		Punjab Milk Unions	
	Surat	Banas	Ludhiana	Ropar
Selection of RBP farmers				
■ First come first serve ■ Suggested by DCS ■ Personal preferences				
Service delivery				
RB recommendation directly to person feeding animal	100	100	80	60
Slip given	100	100	100	100
Weighment method (i) Kg (ii) Converted to vessels/bundles (iii) Both	0 20 80	40 10 50	10 90 0	60 20 20
Additional services	100	100	50	100
Review and Monitoring				
No. of review meeting attended	8	4	15	6
Visit of Milk Union Officers	14	6	39	10

The information on review and monitoring mechanism provided by LRP in Punjab seems to be exaggerated, such as LRPs attending 15 review meeting in a year and average 39 visits of milk union officials in the villages. The review and monitoring of LRP is well in place in Gujarat.

4.3.3 Mechanism at End Implementation Agency (EIA) level

The mechanism adopted the EIA has been studied in terms of incentives to LRP, innovative practices, monitoring and evaluation systems. All these aspects have been described in Table 4.9. Though there are guidelines regarding the incentives to be provided to the LRPs, but Banaskantha milk union made the incentives more progress oriented by linking it with the animals covered. The monetary incentive given to the LRP covering more than hundred animals was rupees three thousand per month. The innovative practice followed by Roper milk union is worth mentioning as it prepared the audio-visual of the beneficiaries of the programme to show to the non-adopter farmers. Almost all milk unions were conducting monthly meetings to review the progress of the project and performance of LRP. The review meetings of LRPs with officials of the project and MD have helped in improving the performance of the RBP in Banaskantha milk union. The mechanism set for evaluation was through records maintained by LRP about RB advice at village level and progress of the programme regularly loaded on Information Network on Animal Productivity and Health (INAPH) software in the central server.

Table 4.9: Implementation, monitoring and evaluation mechanisms of RBP at EIA level

Particulars	Surat Milk Union	B/Kantha Milk Union	Ludhiana	Ropar Milk Union
Incentives provided to LRP	• During first year, Sumul Dairy paid Rs 1500/month to each LRP • Second year increased to Rs 2250/month • Third year upto Rs 3000/month on transaction basis. • If LRP covers animal less than 30 per month then No payment. If transaction is : 30-59 transaction-Rs 1500/-, 60 & above- Rs 3000/month. • Commission on sale of Mineral Mixture @Rs 5/kg to LRP	• Rs.1500/month + additional incentive on basis of performance • Covering 60-79 Animals, then Rs 1000/month, 80-99 Animals, Rs. 2000/month, 100 and above animals Rs. 3000/month • Rs.5 / kg of banas mineral and chelated minerals. • Rs. 20 / 5 Kg of Banasdaan • Rs. 10/ 2Kg of Pashu Sanjivani	• Rs. 1500 from Project+ 1000 from Society • Second year: Rs.750 from project + 1000 from Society • Incentives on feed and mineral mixture sale	• First year Rs 1500 per month+ 750 from society • Second year Rs 750/- from project, Rs. 750/- from society and Rs. 750 from Union. Total 2250/-
Innovative practices for programme implementation	Additional incentives to LRPs as mentioned above to increase program coverage	Follow up of farmers Village Awareness Programme (VAP) for beneficiary	Animal camps along with VAP	Audio-visuals of beneficiary farmers were shown to other farmers
Monitoring system: provide information about review meetings, field visits	• Monthly LRP meeting conducted for problem solving through discussion (hardware, software and net connectivity queries). • Frequent field visit of Sumul Vet. Officers to improve LRP performance.	• LRP review meeting after every 2-3 months • Project progress meeting with staff at every first week of month and review meeting with MD and staff at every quarter • Regular field visit of 8-10 villages by 5 Veterinary officers	• Regular meeting and interaction with LRPs • Field visits by Milk Union Officials	• Monthly meeting of the farmers in RBP village • Number of meetings increased to more than one in weak societies
Evaluation system: provide information about record keeping system	• RBP Advice Register maintained by LRP • Stock maintained at RBP store (Union level)	• Data recorded in INAPH server • LRP maintain two registers- animal recommendation and number of farmers covered	• Records maintained at LRP level • INAPH software	• Village level records • On line progress submission to INAPH server

5 Outcome and Sustainability of Ration Balancing Program

In evaluation of any program or project it is useful to examine its outcome and sustainability. Besides the intended changes on the targeted aspects, the outcome that describes the changes on the development conditions of various stakeholders resulting from the intervention, has important reflection on the performance of the program. The sustainability of a program implies its continuance in the long run with positive impact and outcomes. As both outcome and sustainability are affected by various constraints in the program implementation at various stages, this Chapter also highlights the constraints and problems faced by the actors implementing the program and the beneficiary households.

5.1 Outcome of RBP

The program outcome has been examined in terms of ancillary benefits that have accrued to the households, LRPs, DCS and the EIA.

5.1.1 Benefits to Households: About 1/3 of the households opined that there is additional expenditure and/or labour involved adopting the ration balancing advisory (Table 5.1). However, this additional expenditure may be more than compensated itself as more than ¾ sample households perceive that their monthly income has increased after RBP as the milk production of animals has gone up. With improvement in income, their savings have also increased, which they could channelize mostly for education in case of Punjab and for nutrition and health of household in Gujarat. Together with higher income and savings, some households also reported increase in milk consumption. This proportion was particularly high in Punjab where there is a preference for more dairy based products.

Although as such the farmers did not see much increase in employment opportunity resulting from RBP but they overwhelmingly contended that their interest in dairy has gone up after the program. Except in Ropar, the majority RBP household are also willing to increase their herd size. The results from Ropar on the positive outcome of RBP on income, savings, milk consumption, employment etc. actually need to be taken with a pinch of salt as these responses

do not corroborate with the perception of farmers on increase in milk production after RBP discussed earlier.

Table 5.1: Perception of Farmers about Outcome of RBP

Particulars	Responses (%) in Yes					
	Gujarat Milk Unions			Punjab Milk Unions		
	Surat	Banas	Overall	Ludhiana	Ropar	Overall
Additional expenditure involved	25	29	27	32	35	33.5
Increase in employment opportunity	22	21	21.5	35	29	32
Increase in monthly income	73	75	74	89	67	78
Improvement in savings from dairy	78	83	80.5	93	79	86
Channelization of savings from dairy						
Education	17	12	14	62	46	54
Nutrition & Health	45	50	48	23	29	26
Expanding Dairy	32	35	34	14	23	19
Other	6	2	4	-	2	1
Increase in milk consumption	23	9	16	66	49	58
Enhanced interest in dairy	81	77	79	94	73	83
Like to increase herd size	62	71	66.5	55	30	42.5

Based on the results of, the productivity gain and decrease in daily feed cost before and after RBP, from the INAPH database, an attempt has been made to estimate the increase in income of the dairy farmers in all the four study areas. The daily incremental returns from increased milk yield were about Rs.56 per crossbred cow in Banaskantha at the prevailing producer prices of milk (Table 5.2). In Punjab, the same ranged from Rs.22.70-33 per animal. The monetary value of the incremental returns was higher for buffaloes in both the milk shed areas in Punjab as the prices of buffalo milk were more than that of cow milk. Together with decrease in daily feed cost ranging from Rs.7-24 for cows and Rs.2-13 for buffaloes, the incremental income per animal worked out to be about Rs. 21-22 per day in Gujarat (for crossbred cows in Banaskantha this was about 3 times higher) and Rs.40-50 in Punjab.

If such gains in milk yield and decrease in feed cost that have been observed during initial 6 months of RBP advisory for a dairy animal can be sustained over time (viz. productivity gains during entire lactation length and feed cost decline round the year), a dairy farmer can earn annually about Rs.10000/- additional net income per animal. Based on the coverage of lactating

animals as on 31 Oct., 2015, under the assumption that these dairy animals have either followed or would follow ration balancing advisory for one full year, the estimated gross surplus generated at the farm level would be about 233.35-237.82 million in Gujarat and 240.35-317.15 million in Punjab.

Table 5.2: Estimated Increase in Net Income of Dairy Farmers from Ration Balancing

Milk Union	Incremental monetary gains (Rs./day/animal) from								
	Higher milk produc-tion[@]	Decrea-sed feed cost	**Total**	Higher milk produc-tion[@]	Decrea-sed feed cost	**Total**	Higher milk produc-tion[@]	Decrea-sed feed cost	**Total**
	Crossbred Cows (CB)			**Indigenous Cows (IC)**			**Buffaloes (BU)**		
Surat	1.61	20.25	**21.86**	37.75	7.23	**44.98**	13.25	8.09	**21.34**
Banaskantha	56.47	9.61	**66.08**	17.73	8.79	**26.52**	14.32	7.96	**22.28**
Ludhiana	22.70	18.08	**40.78**	19.04	14.80	**33.84**	31.39	13.37	**44.76**
Ropar	33.29	15.63	**48.92**	13.86	24.14	**38.00**	47.45	2.10	**49.55**
	Additional returns per annum[#] (Rs./animal)			Number of lactating animals under RBP (as on 31st Oct., 2015)			Gross surplus* (Rs. million)		
	CB	**IC**	**BU**	**CB**	**IC**	**BU**			
Surat	7880	13210	6914	17730	1003	12272	237.82		
Banaskantha	20732	8173	6664	6553	1797	12425	233.35		
Ludhiana	13524	10734	13670	5295	690	11802	240.35		
Ropar	15858	12693	14053	7280	399	13993	317.15		

Notes: @ Producer price of milk (Rs./litre):- Cow: 28.00, 27.90, 25.20, 25.00; Buffalo: 44.60, 43.40, 38.25, 39.15 in Surat, Banaskantha, Ludhiana and Ropar, respectively.

Estimates of annual returns based incremental gains from enhanced milk production during lactation length (viz. 305 days for crossbred cows and 280 days for indigenous cows and buffaloes) + incremental gains due to decreased feed cost for 365 days.

*Gross surplus= annual additional returns x number of animals covered

5.1.2: Benefits to LRP, Village and DCS: The LRPs were also asked about the notable outcome of RBP for the village and on their own social status. Nearly cent percent of the LRPS in Gujarat felt that the RBP has brought about notable awareness on the benefits of ration balancing in the village and also corresponding changes in the feeding pattern of the animals. In Surat, 60 per cent LRPs felt that their own social status in the village has improved as the villagers know them as a useful person in the village. The corresponding percentage in Banas was a little lower at 40 percent.

The response of LRPs regarding the positive outcome for the village and their own prestige was equally fervent in Ludhiana but very lukewarm in Ropar, where only 10 per cent LRPs perceived any notable change in village and their own status.

The DCS have reported increase in their pourer membership and milk procurement as a result of RBP implementation in the villages (Table 5.3). There has been a very remarkable increase in the mineral mixture sale by the DCS, especially in Gujarat. The sale increase of a much lower magnitude in Punjab confirms the contention of the RBP farm households that the additional services received by them through LRPs have been limited. The DCS functionaries opine that the RBP has been instrumental in improving the financial position of the societies and income of the farmers.

Table 5.3: Changes in DCS activity before and after RBP

Particulars	Surat Milk Union	Banas Milk Union	Gujarat	Ludhiana Milk Union	Ropar Milk Union	Punjab
Quantitative change before and after RBP (%)						
Increase in pourer members	1.9	8.0	5.0	0.5	19.5	10.0
Increase in milk procurement	19.7	4.1	11.9	105.4	16.0	60.7
Monthly increase in mineral mixture sale	303.0	260.6	281.8	12.3	78.8	45.5
Perception of change: Affirmative response (%)						
Improvement in financial position of DCS	90	80	85	100	70	85
Increase in income of farmers	100	80	90	60	70	65

5.1.3 Benefits to Milk Unions: The reported positive change in the membership, milk procurement, sale of mineral mixture at the DCS level has also been substantiated by the milk unions (Table 5.4). There has been very sharp increase in the sale of mineral mixture and also bypass fat in both the EIAs of Gujarat.

Table 5.4: Outcome Indicators for EIA: Gujarat

Particulars	Average annual change (%): Before and After RBP (upto June 2015)	
	Surat	Banaskantha
Milk procurement	4.1	23.7
DCS members	11.0	3.6
Pourer members	8.5	14.8
Mineral mixture sale	1750.0	96.2
Cattle feed sale	19.7	14.3
Bypass Fat sale	1445.0	94.3
De-wormer sale	51.9	24.6

5.2 Sustainability

The continuation of the programme after the withdrawal of support is a very important aspect for any initiative. Once it is proved that the ration balancing programme is beneficial to both the farmers and animal, it needs to be continued on a long term basis which is possible only if all the stakeholders realize its importance and work towards sustainability of the programme. Hence, the sustainability of the program has been examined in terms of continuance of ration balancing at the field level after the official support is withdrawn. The response of the dairy farmers presently under RBP and also not covered by it, the possibility of retaining LRPs for advisory provisioning, etc. have been discussed to address the sustainability dimension of the program.

5.2.1 Perspective of Dairy Farmers: The involvement of the final stakeholders in a development program is essential for its sustainability. In case of RBP, an overwhelming proportion of dairy farmers adopting ration balancing feel a sense of involvement (Table 5.5) and try to feed balanced ration to the other dairy animals on their farms that are not explicitly covered under the program. Additionally, they also appraise the fellow farmers about the benefits of RBP and recommend its adoption to them. After the withdrawal of the project support, about 2/3 of the dairy farms in Gujarat are even ready to pay for the ration balancing advisory at the rate of about Rs.15-20/animal/month. Nearly 36 per cent of them feel that this service should be available free of cost through the DCS.

In Punjab, the sense of involvement of farmers in the program is less and they are more conservative in their approach in terms of recommending the RBP adoption to fellow farmers. Their willingness to pay for ration balance advisory is very poor. The farmers feel that they have

gained adequate knowledge about ration balancing and do not need any external service/support to practice the same. However, it is worth emphasizing that the ultimate objective of the programme is that the farmers feed balance ration to their animals. Hence, if they are able to do so after the programme intervention even without seeking any further formal advisory services, the programme can be considered sustainable at the field level.

Besides the adopters, the response of non-adopters was also sought and has implications for the sustainability for the programme. In Surat, Ludhiana and Ropar a large percentage of non-adopters were also interested in RBP (Table 5.5). Some of them interacted with the LRP or RBP farmers to learn about the benefits of the programme and also tried to apply ration balancing to their animals after learning about the same from the farmers covered under the programme. There has been a change in the attitude of farmers towards the balance feeding pattern of animals as is reflected from over one- third farmers responding positively to the query about thought of change in feeding pattern after RBP implementation in the village. Interestingly, a good number of non-adopters in Punjab reported to have approached the LRP for covering their animals also under the programme. The pattern of willingness to pay for availing the services across two regions is similar as in case of RBP adopters, the high willingness to pay in Gujrat and very low in Punjab.

Table 5.5: Sustainability of RBP: Farmers' perspective

Particulars	Positive Responses (%)			
	Surat	Banaskantha	Ludhiana	Ropar
Adopters of RBP				
Feel Involved in the program	80	85	41	22
Feed balanced ration to non RBP animals	44	65	55	27
Recommend fellow farmers to join RBP	92	88	29	24
Ready to adopt RB on payment basis	63	65	11	6
Non Adopters of RBP				
Interested in RBP	82	24	65	81
Think program is beneficial	85	60	26	80
Interact with LRP or RBP farmers to learn about RBP benefits	14	8	21	80
Try to learn from RBP farmers and apply RB	38	18	7	33
Thought about change in feeding pattern after RBP implementation in village	48	33	69	78
Approached LRP for covering animal	10	6	53	82
Selection of beneficiaries biased under RBP	1	5	22	8
Willing to avail service on payment basis	59	47	6	11

5.2.2 At LRP Level: The LRP are the key person on whom the sustainability of the program rests. The EIA have employed young LRP (average age about 30 years) who are educated approximately up to secondary level (Table 5.6). The LRPs were reasonably well endowed with assets as is reflected in terms of average milch animals owned by them and the size of operational land holding. Except two sample LRPs in Ludhiana and one in Ropar, all of them owned milch animals which is a very important aspect as only a person who himself/herself has some experience in dairying will be better equipped to give Ration Balancing advisory in practical terms.

From the social aspect of sustainability, the LRPs belong not only to the non-scheduled group but also to the scheduled group depending upon relative population of scheduled/non-scheduled groups in the study area. Except for Surat, LRPs were by and large males. In Surat 40 per cent of the sample LRPs were females and also in Ropar one female LRP came up in the sample.

Table 5.6: Socio- Economic Profile of LRPs

Particulars	Gujarat Milk Unions		Punjab Milk Unions	
	Surat	Banas	Ludhiana	Ropar
Average age (yrs)	30	29	28	31
Male (%)	60	100	100	90
Married **(%)**	50	90	60	60
Educational Qualification (%) Up to Higher Secondary Diploma/Graduate Post-graduation and above	50 40 10	70 30 -	90 10 -	80 20 -
Social Group (%) Gen/OBC SC/ST	- 100	80 20	100 -	80 10
Average milch animals owned (no.)	3	6	6	5
Avg. Operational Land Holding (Acre)	2	8.92	6	3.6
Household electrification (%)	90	90	100	100
Distribution according to Total Annual Income (%) Upto 3 Lakhs 3 Lakhs and above	90 10	60 40	60 40	100 -

The total annual income of the LRPs in most cases was up to Rs. 3 lakhs. They were engaged in occupation other than providing RBP advisory. In Gujarat the monthly income as

LRP was nearly twice that in Ludhiana and Ropar (Table 5.7) although on an average there was not much difference in the average time spent for RBP (14 day/month in Gujarat vis a vis 13 days/month in Punjab). Considering the monthly time spent and monthly earnings from RBP in Ludhiana and Ropar, the daily earnings as LRP work out to be less than even the minimum wage rate in the state. Low remuneration is one of the major reasons for high attrition rate of LRPs which adversely affects the sustainability.

Table 5.7: Monthly Income of LRP and Time Spent for RBP

	Gujarat Milk Unions		Punjab Milk Unions	
	Surat	Banas	Ludhiana	Ropar
Average monthly income from other occupation	14770	6200	6333	7889
Average Monthly income as LRP	5230	4206	2514	2296
Time of starting working as LRP	Oct 2013-Aug 2014	Nov 2012-July 2014	Jan 2014-Oct 2014	Jan 2014-Oct 2014
Average time spent for RBP (Days/month)	17.5	10.5	10.5	15.5

Very few LRPs opine that the program would continue after the project support. Except in Surat they are mostly not willing to provide the service after the end of the program (Fig. 5.1). In the EIA of Surat and Banas a large number of LRPs were already associated with DCS in one way or the other, while in Punjab they were largely unemployed youth working as LRP as stop gap arrangement. This explains the differences in the willingness of the LRPs to provide services after the end of the program.

Fig. 5.1: LRP Opinion about Program Sustainability
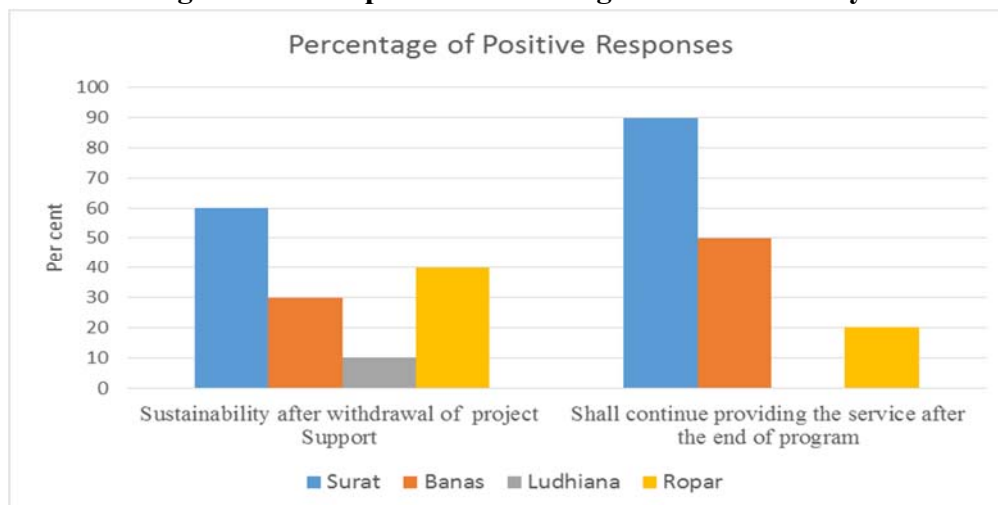
5.2.3 Response of DCS and EIA: The DCS in all the four EIA overwhelmingly feel that the program should continue. As mentioned earlier the LRPs are already being utilized for DCS activities in Gujarat, while the DCS in Punjab also agree that same could be done in their villages, by training them for say A.I. services, keeping animal record, animal health camps, linking up with services under other government livestock programs or other components of NDP, etc.

On the issue of paying remuneration to the LRPs after the project support ceases, the DCS and EIAs at Gujarat were more forthcoming and outlined that they were already paying a good remuneration to the LRPs from their kitty over and above the stipulated rates under the program. For instance, Surat Milk Union reported to provide an incentive of Rs. 1500/- monthly to LRP in first year, Rs. 2250 in second year and Rs. 3000 in the third year. Banas dairy is willing to pay Rs.5/transaction to LRP in future after the official program period besides incentives and commission on the sale of feed supplements. The DCS in Gujarat were also willing to pay Rs. 2500-3000/month to the LRP in future.

The key points of the sustainability plan in Ludhiana Milk Union include continuance of payment of Rs.1500/- per month to the LRP from the EIA in the 3rd and 4th year of the project provided the LRP has been actively operational during first two years of the project operation. Also, the DCS that are running in profit have plans to contribute Rs. 500-1000 per month in salary payment to the LRP. In Ludhiana Milk Union, already about 300 DCS are making this contribution. The contribution of Union to LRP salary is proposed to be Rs.1500/- upto 40 RB transactions. For the ones with better performance (upto 60 transactions) the salary of Rs.2000/- from the Union would be payable with an additional incentive of Rs.20/- per transaction beyond 60. Besides the contribution from Union, the DCS would provide financial support of Rs. 750/- per month to the LRP. In both, Ropar and Ludhiana Milk Unions, the internet usage charge amounting to Rs.250 per month is also proposed to be paid to the LRPs.

The commission on mineral mixture sale in both Ropar and Ludhiana and also on cattle feed sale (only in Ludhiana) is part of the agenda for incentivizing the LRPs. Based on the additional demand of cattle feed that would be generated by the LRP a nominal incentive of 10 paise per kg. of additional sale would be provided to him/her. In addition to providing financial incentives to the LRP, those who have proved to be consistent in their performance shall be

given the advantage of training in artificial insemination and animal health care services through EIA in order to increase their working horizon in the future.

5.3 Program Implementation and Adoption Constraints

The major constraints faced by the EIAs and LRPs in the implementation of the program are:

1. Tedious purchase procedure due to which netbook purchase by the EIAs was delayed substantially and there was considerable delay in the actual inception of the program.

2. There is too much reporting in the program which hinders carrying out field work with limited staff.

3. Frequent transfer of the EIA staff (in Punjab) has led to lot of uncertainty and had hampered continuity of program implementation.

4. High attrition rate of Technical Officer, Trainers and LRPs due to inadequate remuneration and bleak long term prospects for workers.

5. The targets allotted are far too much to be covered effectively, especially in Punjab where cooperative network is not as strong as in Gujarat.

6. Poor internet connectivity in several parts in rural areas.

7. LRPs report that the netbook often hangs due to which their smooth conduct of work becomes difficult. However, this may be due to virus problem due to use of netbook for other than RBP software.

8. LRPs in Punjab report lack of support from the farmer in accepting their advisory services. The farmer feels he already knows more than the LRP, or is not easily convinced that the program can be beneficial for him/her. In several instances they discontinue the services after 1-2 months on the pretext of having understood the way the ration can be balanced.

9. In some areas, lack of adequate and prompt technical support to LRPs from the EIA has also been reported.

10. Low remuneration compared to the mandays involved in the work is the major constraint reported by the LRP.

The major constraints faced by the farmers in adoption of advisory are:

1. In some remote villages of Surat, the mineral mixture supply is not available regularly.

2. The famers feel that it is not possible to measure everything in exact terms for the animals on daily basis and hence they just use the approximations.

3. There is too frequent change in the ingredients suggested by LRP which become difficult to follow.

4. The farmers in Punjab had somewhat not really pleasant views about the advisory given by LRPs. They felt that most LRPs may be owing milch animals but the young lads have no experience in dairying and so their advisory is not based on practical experience and hence not worthwhile to adopt in several instances.

5. Another common complaint of the farmers in Punjab cited as their disinterest in ration balancing was non-remunerative prices of milk. The farmers in rural Punjab said they are reducing the size of their herd primarily to cater only to family consumption as the price of milk was too low. This however, cannot be considered as a constraint in adoption of ration balance *per se* but is certainly a larger issue effecting the status of Indian dairy farmers.

6 Summary and Conclusions

Realizing the ardent need to promote adoption of balanced animal ration, the Ration Balancing Program (RBP) has been very aptly made a key component in the National Dairy Plan I (NDP I). It is envisaged to deliver three short term benefits, i) increase milk productivity, (ii) reduce cost of milk production, and (c) reduce methane emission. The intervention provided in this program is in the form of advisory service to the dairy farmers about the optimal quantity of dry fodder, green fodder, concentrate and supplements that should be fed to dairy animal depending upon animal specific particulars of age, weight, lactation order and stage of lactation. Since the RBP is first of its kind in the Indian context, the present study evaluates the impact of the program in two important milk producing states of India, viz. Gujarat and Punjab and draw useful learning on the efficacy and sustainability of the program. The specific objectives are:

- o To evaluate the efficacy of RBP in increasing milk yield and/or reducing feed cost
- o To examine the quality of service delivery by End Implementing Agencies (EIAs) and implementation of record keeping through use of information technology (INAPH/MIS)
- o To assess the reporting & monitoring systems and institutional capacity building at various levels in the context of the RBP for ascertaining the provisioning of these services on a sustainable basis to the milk producers
- o To document the innovative practices followed by EIAs to implement and make the RBP sustainable.
- o To identify the bottlenecks, if any, in the implementation of this on-going program and take the remedial measures accordingly, for a successful completion by the end of project period.

The study is based on both primary and secondary data. The first objective has been analyzed using INAPH data maintained by NDDB and by applying both before- after and with-without approaches. The database was available (up to June 2015) on 4489 cows and 4956 buffaloes from Banaskantha and Surat Milk Unions of Gujarat. The corresponding numbers were

2105 cows and 3767 buffaloes from Ludhiana and Ropar Milk Unions of Punjab. In before-after approach, milk productivity in the base year was regressed on related independent variables- feed and fodder, stage of lactation, season and breed. Based on the econometric tests and common knowledge of animal nutrition, the final specification in the regression equations of both cattle and buffaloes in Gujarat and Punjab included two feed related variables, daily total dry matter intake (TOTALDM) and quantity of mineral mixture fed to the animals (MM). The original dataset did not provide for the information of stage of lactation (SOL) in days, and the same was generated from the data of date of calving and that of RBP. The log specification of this variable was included to capture the established shape of the lactation curve. Based on the above regression results that pertain to the base period (considered as the scenario without RBP intervention), the predicted yield after 180 days was worked out by changing only the seasonal and stage of lactation variables and compared with the observed yield in the same period to estimate the effect of RBP on the animal productivity.

In with-without approach, field survey data of 400 dairy farm households in each state, comprising of 50:50 beneficiary and non-beneficiary of RBP was analyzed using propensity score matching (PSM) method to quantify the effect of the program. PSM is an algorithm that matches treated and nonparticipants on the basis of the conditional probability of participation (the propensity score), given the observable characteristics. For field survey, 10 villages under each EIA were selected randomly out of the villages where RBP was being implemented. The twin criterion followed was : i) RBP programme should be implemented at least for a period of 6 months at the time of village selection, ii) the villages should geographically well represent the study area, that is should not be concentrated in one tehsil or area of the district/milk shed area. To meet other objectives of the study, four types of survey schedules were canvassed in the study area as mentioned below:

- **Village Schedule 1.0:** pertaining to general information about the village regarding demographic particulars, dairy related infrastructure, basic information about the dairy cooperative society covering the village, etc.
- **Household Schedule 2.0:** for collecting detailed information about the feeding pattern, constraints, perception, awareness about RBP, etc. from the sample beneficiary and non-beneficiary farmers.

- **LRP Schedule 3.0:** for getting information on the functioning of LRP, constraints faced by him/her, etc.
- **EIA Schedule 4.0:** semi-structured schedule to discuss the overall implementation of the RBP programme with the officials of EIA.

The schedules were designed to cover all the aspects of RBP, namely, extent of coverage, outreach, quality of services, their timeliness, mode of implementation, quantitative and qualitative impact on productive, health and reproductive performance of the animals, broad outcome of RBP on the economy of farm households and performance of Dairy Cooperative Societies, the sustainability aspects of the programme after withdrawal of NDP support, constrains faced by various stakeholders in the implementation of the program, their views to enhance the effectiveness and sustainability of the program, etc. Besides eliciting information on the structured schedules, discussions, personal interactions with farmers, LRPs, functionaries of DCS, program implementing officials were held to understand and analyze the various aspects of RBP.

6.1 Program Impact on Milk Productivity, Feed Cost and Animal Health
The salient findings of the program impact on key parameters are:
- In Gujarat, the analysis based in INAPH database for six-month period showed that the ration balancing intervention enhanced the productivity of cows by around 13 per cent and that of buffaloes by nearly 5.5 per cent. In case of crossbred cows, the productivity enhancement has been as high as 24 per cent in Banaskantha. The effect of the programme in one month period is more appealing than six month period, particularly in case of buffalo with almost tripling the percentage gain in milk yield. The difference between the short term (one month) and longer term (six months) productivity gains are very profound in Surat, while Banaskantha has been more consistent in terms of the realised gains from RBP, suggesting that there has been effective implementation and constant adoption of the programme by the farmers of the region. This emphasises the need of extension services to motivate farmers to gain long term benefits from RBP.
- The quantum of increase discernible from the with-without approach after controlling for the confounding factors is higher than the same estimated based on before-after approach using a much larger sample. In Gujarat, the gain in milk productivity from primary data

analysis for both, cows and buffaloes was about 19.5 and 18 per cent, respectively among the adopter households.

- As per the qualitative analysis, in Gujarat, about 80 per cent farmers perceive that productivity has improved. The quantum of productivity increase as reported by the farmers was in the range of 9.7-16.5 per cent 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 per cent.

- In Punjab, based on INAPH data, the estimates of productivity gain due to RBP intervention are also similar to Gujarat in case of cows (about 13 per cent), and much higher in case of buffaloes (17 per cent). However, the results of impact analysis from field data and 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 ¾ of the sample farmers in Ludhiana reported an average increase in milk productivity of about 12-13 per cent while only 19 per cent farmers in Ropar were of the opinion that RBP has contributed to productivity enhancement.

- RBP was found cost effective in terms of percentage reduction in feed cost and feed cost/litre FCM of both, cattle and buffalo, with the cost efficiency being more pronounced in cows. In cattle, the feed cost per litre FCM reduced by 5.76 to 9.86 per cent in Gujarat and by 10.83 to 18.53 per cent in Punjab. The field level data also indicated clear impact in reducing the feed cost per liter of milk by about 18-19 per cent in case of cows in both the states and about 2.6 per cent 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 milk-feed ratio, i.e. the ratio of gross returns from milk output per unit of feed cost.

- In the perception of farmers and EIAs, the composition of milk has also improved especially in terms of fat percentage. Similar to the yield, the reported magnitude of increase in fat and SNF by the farmers was higher than informed by DCS and subsequently EIAs.

- The responses of the dairy farmers show encouraging effect of RBP on the health and reproductive performance of animals. In Surat, the number of veterinary visits in RBP villages decreased by 10 per cent during June 2014 to June 2015. However, the corresponding percentage is negligible (1.67 per cent) in Banaskantha. The conception rate has been reported to increase from about 40 per cent to 45 per cent in Surat and marginally from 48.2 per cent to 48.5 per cent in Banaskantha during the above period.

6.2 Efficacy and Effectiveness of the Program

The efficacy of the program in terms of its coverage, outreach and the implementing and monitoring mechanism has been quite impressive in Gujarat and somewhat weak in Punjab. The key areas of strengths and weaknesses are:

- As on 31st May, 2015, the netbooks were purchased as per targets by all milk unions as these were the basic requirement of the programme. In Gujarat, 90 per cent of the targeted LRPs were selected and trained, but in Punjab, less than ¾ of the targets could be fulfilled upto this date. The LRP functioning in all milk unions were less than the number trained as several of them left the program. The average number of farmers covered per LRP was 64 and 70 in Surat and Banaskantha, respectively; while it was only 38 and 37 in Ludhiana and Ropar.

- Among the strategies used in RBP, Gujarat achieved cent percent targets in village awareness programs, but Punjab was way behind. The target assigned in animals to be covered under the progamme was forty thousand but all milk union were lacking in their achievements.

- The villages selected for RBP are reasonably well-endowed with infrastructure facilities. Additionally in the villages of Gujarat, other components of NDP I, such as fodder development and animal health are also being implemented. In Punjab, the villages were

not covered under any other development program either under the umbrella of NDP I or state AHD.

- The targeting of the program has been quite fair and households from different socio-economic groups, including those below poverty line (BPL) are being covered. The socio-economic factors determining the adoption of RBP revealed that the dairy farmers with larger herd size and better exposure to mass media and extension services have higher probability of joining the RBP advisory services. LRPs relied more on the suggestions of DCS about selection of farmers for the programme as the societies were having prior information on productivity and reproductive status of animals on dairy farm households.

- The animals covered under RBP were mostly upto three lactations and yielding more than 2.5 liters milk per day. Among cattle, crossbred was predominantly covered. However, in Gujarat, good number of Indian breeds like Gir and Kankrej, and in Punjab, very few Sahiwal cows were also covered under the RBP. In case of buffaloes also, the breed coverage was diversified in Gujarat where along with the major Mehsana breed, Jaffrabadi, Surti and Bhadawari buffaloes are in the ambit of the program. A few Nilli Ravi in Punjab were also covered but the predominant breed was Murrah.

- At household level, LRP was the major source of information on RBP for the dairy farmers in both, Gujarat and Punjab followed by the dairy cooperative societies (DCSs). The overall access to all tools of information (documentary, poster, pamphlets, VAP) was significantly high in Gujarat as compared to Punjab. The information disseminated through documentaries reached about 76 per cent of the respondents in the former state while it was only 44 per cent in Punjab.

- The advice about ration balancing was given directly to the person feeding the animal, slip was handed over to the beneficiaries and practical weighment method by conversion into vessels/bundles was followed in most of the cases. About 84 and 73 per cent of the adopters in Gujarat and Punjab, respectively confirmed that they were briefed by the LRPs before adopting the RBP. More than ¾ adopters also confirmed that they were delivered RB advice slip also by the LRP. The proportion of responses to the follow-up and additional services was comparatively less.

- About 92 per cent of the respondents in Gujarat and 61 per cent of the respondents in Punjab followed the recommendations correctly.

- The follow up actions in RBP recommendations were mainly through interaction and follow-up visits and there was least preference for verification on phone. The proportion of follow-up actions was certainly high in Gujarat

- On the basis of effectiveness, the LRP mechanism was rated 6.5 on the scale of 10 which can be graded as good. The minimum score assigned to RBP was 7.5 in a scale of ten and the highest was 8.9 indicating that there is possibility to improve the performance of the project up to 10 to 11 per cent.

- EIA regularly reviewed and monitored the RBP through review meeting of the LRPs. Almost all milk unions were conducting monthly meetings to review the progress of the project and performance of LRP.

6.3   Outcome and Sustainability

Several ancillary benefits have accrued to the stakeholders of RBP:

- Although there may be additional expenditure and/or labour involved in adopting the ration balancing advisory as opined by 1/3 sample households, yet this additional expenditure may be more than compensated itself as more than ¾ sample households perceive that their monthly income has increased after RBP as the milk production of animals has gone up. The estimates of incremental gains to dairy farmers due to enhanced milk production and decreased feed cost worked out to be between Rs. 20-40 per day per animal in most cases. With improvement in income, their savings has also increased. Together with higher income and savings, some households also reported increase in milk consumption.

- The farmers expressed that their interest in dairy has gone up after the program. Except in Ropar, the majority RBP households are also willing to increase their herd size.

- Nearly cent per cent of the LRPs in Gujarat felt that the RBP has brought about notable awareness on the benefits of ration balancing in the village and also corresponding changes in the feeding pattern of the animals.

- The DCS reported positive change in the membership, milk procurement, sale of mineral mixture at the DCS level due to the programme. There has been a very sharp increase in the sale of mineral mixture and also bypass fat in both the EIAs of Gujarat.

The key points from the perspective of sustainability of the program that emerge from the study are:

- After the withdrawal of the project support, about 2/3 of the dairy farms in Gujarat are even ready to pay for the ration balancing advisory at the rate of about Rs.15-20/animal/month. Nearly 26 per cent 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 per cent). 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 opine that the program would continue after the project support. Except in Surat they are mostly not willing to provide the service after the end of the program. In the EIA of Surat and Banas a large number of LRPs were already associated with DCS in one way or the other, while in Punjab they were largely unemployed youth working as LRP as stop-gap arrangement till they find a regular job. This explains the differences in the willingness of the LRPs to provide services after the end of the program
- The DCS in all the four EIA overwhelmingly feel that the program should continue. The EIAs have chalked out a plan to sustain the program for 2 years after the withdrawl of the project support. Provisions have been proposed for paying remuneration to the actively operational LRPs from the kitty of DCS and/or EIAs and enhanced emphasis on bundling of services for improving availability of quality feed, health care and breeding services to the dairy farmers on one hand, and increasing income avenues to the LRPs as delivery agents of these inputs/services, on the other. However, the EIAs officials were not confident about the success of the proposed sustainability plan even for the subsequent 2 year period after the project support ceases and were highly skeptical about the long run sustainability of advisory services.

6.4 Constraints and Suggestions

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. There is clear-cut reluctance on part of the dairy farmers to pay for the services. The EIAs do not clearly analyze and comprehend the investable surplus that can be generated to make the program self-sustainable. Hence, in the regions where the program has already been implemented, the current format of operation (EIA-TO-Trainer-LRP-Farmer) may not be workable in the longer run. The two key learning lesson for this are: One, in order to ensure willingness of the farmers to pay for the services, they need to be convinced about the economic benefits of RBP on the basis of firm empirical evidence and this information should be put across in the manner that it is easy to comprehend by the farmers. There is a wedge between the perception of the farmers regarding the benefits and the actual quantified gains, with former as an underestimate. Two, the 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.

The farm advisory programs are more difficult to implement and monitor successfully in comparison to any other type of farmer oriented development program. For the success of the program it must be demand driven. The development of demand driven advisory services emerge when the farmers are motivated, they have adequate capacity and organisations to formulate their demands, there is a good choice of advisers available to deliver the service and the delivery systems make service providers accountable to the users. Motivation of the famers is linked to availability of reliable and profitable market opportunities and as stated earlier requires unambiguous evidence that service serves the interest of the users. The farmers can be motivated through massive advertising of the benefits of ration balancing through print and digital media, screening of documentary in villages about successful case studies, etc. In order to enhance the choice of advisers/source of advice, rather than keeping the entire focus on one LRP in the village, support should be forthcoming through developing a mobile app of the ration balancing as part of Digital India campaign, dissemination of information about use of app, periodic training of farmers groups about using the app, keeping a netbook at DCS, where farmers can access the facility free of cost, creating the expertise of ration balancing advisory with private

suppliers of the prepared cattle fed, Krishi Vigyan Kendras and other extension functionaries. The accountability of service providers to the users is one aspect that has not been addressed adequately in the program. Like the mechanism of customer feedback in case of services rendered for repair and maintenance of consumer durables, mobile SMS service should be used by EIA/monitoring agency to get feedback of dairy farmers on the quality of service rendered. This information should than be analysed periodically to address the weaknesses and build-up on the strength of the advisory service.

The regions where the program has not been implemented, the existing mechanism can be replicated to set the ball rolling. Some desired changes in exploring new regions would be, simplification of purchase mechanism, reducing documentation work and provisioning of mineral mixture and good quality concentrate by the DCS of the regions. The remuneration to the LRPs should be in consonance with the region specific wage situation rather than a fixed amount at all-India level.

It is worth emphasizing that as long as the program is able to create enough awareness among the famers to feed balance ration to their animals even without seeking any regular formal advisory services, the program shall be considered sustainable at the field level. The RBP has shown clearly quantifiable positive impact in Gujarat and Punjab, the two leading states in dairy. The experience in these states will provide useful learning lessons for further streamlining and inculcating the system of balancing the ration of dairy animals scattered across millions of small farm holdings in India.

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Table A1: List of Selected Villages

Northern region

EIA	District	Tehsil	Village	Code*
Ludhiana Milk Union	Ludhiana	Khanna	Bilaspur	032948
			Bathan Khurd	032931
			Mohan Majra	032932
		Jagraon	Bhagpur	033429
			Gobindgarh	033734
		Raikot	Dadahur	033736
			Jalaldiwal	033735
			Pakhowal	033706
		Payal	Sihan Daud	033282
			Daulatpur	033278
	S A S Nagar	Kharar	Bajheri	039100
			Radiala	039057
		S A S Nagar	Chuhar majra	039134
Ropar Milk Union	Fatehgarhsahib	Bassi pathana	Kishanpura	032608
	Rupnagar	Chamkaur sahib	Bassi gujjran	038834
			Bhurara	038867
			Pipal Majra	038871
			Bhoje majra	038845
			Fatehgarh viran	038813
			Mohan majra	038814

Western region

EIA	District	Tehsil	Village	Code*
Surat Milk Union	Surat	Bardoli	Allu	524327
			Tajpore Bujrang	524320
		Mahuva	Machhisadada	524405
			Vaheval	524412
		Mandvi	Naren	524019
		Kamrej	Shekhpur	524094
		Olpad	Kadrama	523694
	Tapi	Songadh	Dhajamba	524574
		Valod	Kaher	524870
		Kamrej	Umarkui	524779
Banaskantha Milk Union	Banaskantha	Palanpur	Ruppura	508206
		Deesa	Genaji Rabari Golia	508285
			Jasara	508274
			Gela	507601
		Vadgam	Malosana	508033
		Dhanera	Nana meda	507658
		Dantiwada	Vagor	507699
		Deodar	Haripura	507379
		Tharad	Bhordu	507568
			Khengarpura	507560

*Village code as per Census India 2011

Table A2: List of Sample LRPs

Milk Union	Village	Name of LRP
Ludhiana	Bilaspur	Sandeep Singh
	Bathan Khurd	Jaswinder Singh
	Mohan Majra	Davinder Singh
	Bhagpur	Manoj Kumar
	Gobindgarh	Gyon Singh
	Dadahur	Gurjant Singh
	Jalaldiwal	Kuldeep Singh
	Pakhowal	Ravinder Singh
	Sihan Daud	Charanjeet Singh
	Daulatpur	Tejpal Singh
Ropar	Bajheri	Darshan Kumar
	Radiala	Jagdeep Singh
	Chuhar majra	Sukhjinder Singh
	Kishanpura	Harmel Singh
	Bassi gujjran	Sukhjinder Singh
	Bhurara	Jatinder Singh
	Pipal Majra	Satwinder Singh
	Bhoje majra	Harpal Singh
	Fatehgarh viran	Surinderpa; Kaur
	Mohan majra	Raghuveer Singh
Surat	Allu	Bakulchandra Patel
	Tajpore Bujrang	Smrutiben Kokani
	Machhisadada	Ankit Kumar Patel
	Vaheval	Ranjeetbhai Patel
	Naren	Bakulbhai Chaudhary
	Shekhpur	Kalpanaben Patel
	Kadrama	Leelavatiben Patel
	Dhajamba	Nikhilbhai Chaudhary
	Kaher	Jeetubhai Chaudhary
	Umarkui	Amitaben Gamit
Banskantha	Ruppura	Bhikhabhai Alliya
	Genaji Rabari Golia	Hanspuri
	Jasara	Jogabhai Rabari
	Gela	Dineshbhai
	Malosana	Bhimjibhai
	Nana meda	Patabhai Patel
	Vagor	Rahul Bhai Chaudhary
	Haripura	Harishbhai
	Bhordu	Jivraj Patel
	Khengarpura	Vaghjibhai Chaudhary

Appendix I–IV

Survey Schedules

MILK UNION		MONTH	

NATIONAL DAIRY RESEARCH INSTITUTE, KARNAL (HARYANA)
NDDB Funded Project: "Impact Assessment and Evaluation Ration Balancing Program of Northern &Western Regions"
VILLAGE SCHEDULE: 1.0

[0] descriptive identification of sample village			
particulars	**name**	**particulars**	**name**
1. district		5.name of respondent	
2. tehsil/taluk		6. designation in dcs	
3. village		7. mobile number	
4. dcs*			

***dcs*-dairy co-operated society**

[1] general information of village						
1.total number of household				6.net geographical area (code)		
2.number of dairy farmers				7.total cultivated area (code)	irrigated	unirrigated
3.number of dairy animals	IC	CB	BU		rabi	
				8.major crops		
4.number of dcs members					kharif	
5.profile of dcs members (number)	male		female		summer	
	SC		OBC			
	ST		GEN			

code: hectare - 1,   acres - 2,   other (specify) - 3

[2] availability of some facilities		
item no.	item	distance from village (code)
1.	road connectivity *kaccha- 1, pucca- 2*	
2.	name of nearest town/city	
3.	dairy cooperative society	
4. 4.1 4.2	milk collection centre co-operative private sector	
5.	chilling centre/bulk milk cooler	
6.	KVK/extension institution	
7.	artificial insemination centre	
8.	semen collection centre	
9.	panchayati breeding bull	
10.	veterinary hospital/ dispensary	
11.	stockmen centre	
12.	markets for purchase of cattle feed	
13.	market for sale and purchase of livestock products	
14.	Any other specify	

CODE FOR BLOCK 2

within village-1,
outside village less than 2 km-**2**, 2 to 5 km-**3**, 5 to 10 km-**4**, 10 km or more-**5**

[3] details of development programmes/support	
name of the development programme	code
1. productivity enhancement components of national dairy plan that are in operation *RBP-1, fodder cultivation-2, animal breeding- 3, animal health-4* 1.1 give month and year of start for each programme	
2. support presently provided by DCS for RBP *supply of mineral mixture-1, LRP remuneration-2, awareness campaign-3, other-4 (specify)*	
3. national project for cattle and buffalo breeding (npcbb) *yes-1, no-23*	
4 feed and fodder development *yes-1, no-2*	
5. special livestock breeding project *yes-1, no-2*	
1. any other development programme/facility by co-operative or other agency (specify) *yes-1, no-2*	

[4] any outbreak of disease of livestock during the past one year					
particulars	number of animals				
	local	crossbred	buffalo	goat	sheep
1. animals affected (also specify name of the disease) • • • •					
2. number of prophylactic vaccinations made for • FMD • BQ • HS • Others					
3. animals died (specify name of the disease) • • • • •					

[5] effect of RBP on key variables	*Before RBP*	*After RBP*
1. dcs membership		
2. pourer membership		
3. average daily milkprocurement		
4. average milk fat%		
5. average SNF%		

6. average monthly mineral mixture sale		
7. average monthly cattle sale		

[6] general opinion, perception, constraints and suggestions regarding RBP	**code**
1. is there any change in financial status of DCS after RBP(from milk or input sales) *no-1,improved-2, can't say-3*	
2. what is the general opinion about RBP in the village *beneficial-1, not beneficial-2, can't say-3*	
3. any significant change noticed in the village after RBP in *no-1,yes-2, can't say-3* a. improvement in fertility status of animals b. reduction in disease incidence among milch animals c. increase in income levels of farmers d. decrease in number of veterinary visits per year for treatment	
4. do you feel RBP to be continued in the village *no-1,yes-2* if *no* specify why	
5. do you feel LRPs can be utilized for some DCS activities also in future *no-1,yes-2* if *yes* specify activities	
6. is DCS ready to pay some remuneration to LRP from own fund (Rs/month) *no-1,yes-2* if *yes* specify average monthly remuneration to LRP, that DCS can bear	
7. what are the constraints in implementation of RBP in the village	
8. would you like to give suggestion for improvement in RBP	

NATIONAL DAIRY RESEARCH INSTITUTE, KARNAL (HARYANA)
NDDB Funded Project: "Impact Assessment and Evaluation Ration Balancing Program of Northern &Western Regions"
HOUSEHOLD SURVEY SCHEDULE: 2.0

[0] identification of sample household

particulars	name	particulars	number	code
1. district		5. sample household		
2. tehsil/taluk		6. name of household head		
3. village		7. name of informant		
4. dcs*		8. mobile number		

***dcs*-dairy co-operated society**

[1] socio- economic characteristics

1. household size			5. operational land holding (area)　　code:	irrigated	
				unirrigated	
2. religion (code)			6. experience in dairy farming (year)		
3. social group (code)			7. income group (bpl-1, apl-2) if apl than annual total income (code)		
4. occupation	principal (code)				
	subsidiary (code)		8. dwelling structure (pucca-1, semi-pucca-2, kuccha-3)		

9. details of family members

s. no.	age (yrs)	Sex (code)	education (code)	s. no.	age (yrs)	Sex (code)	education (code)
1. respondent							

CODE FOR BLOCK 1

religion: *hinduism - 1, islam - 2, christianity - 3, sikhism - 4, other - 5*

social group: *scheduled tribe - 1, scheduled caste - 2, other backward class - 3, general - 4.*

occupation: *cultivator- 1, ah & dairying - 2, agri. labour-3, nonfarm labour – 4, own non-farm establishment - 5, trade - 6, employee in service - 7, other (specify) - 8*

annual income: *below 1 lakh - 1, 1 to 3 lakhs - 2, 3 to5 lakhs - 3, above 5 lakhs - 4*

**sex*:* *male - 1, female - 2*

education qualification: *illiterate - 1, literate without formal schooling - 2, primary - 3, middle - 4, secondary - 5, higher secondary - 6, diploma/certificate course - 7, graduate - 8, post graduate and above- 9*

**land holding code*:* *hectare - 1, acre - 2, other (specify) – 3*

[2] communication characteristics					
2.1 frequency of extension contact (in past one year)					
particular	code	particular	code		code
1. stockman/lrp		5. scientist from k.v.k.		9. output buyer	
2. vety. asstt. surgeons		6. progressive farmers		10. any other (specify)	
3. dairy extension officers		7. neighbors/friends			
4. c.d.o/ b.d.o.		8. input dealer			
2.2 mass media exposure (in past one year)					
source	code	source	code	source	code
1. radio		3. film (educational)		5. newspaper	
2. t.v.		4. magazine		6. pamphlets	
2.3 did you or any family member attend the following during last year?					
particulars	no - 1 yes - 2	source	no - 1 yes - 2	source	no - 1 yes - 2
1. dairy mela/cattle show		4. farmer's day		7. group meeting	
2. dairy exhibition		5. demonstration		8. any other (specify)	
3. educational tour		6. dairy training			

CODES FOR BLOCK 2

code: *never - 0, sometime - 1, regularly – 2*

[3] cropping pattern of sample farm				unit code:		
seasons	**cereals**		**cash crops**		**fodder crops***	
	name	area	name	area	name	area
Rabi						
Kharif						
summer						

note:- * if the crop is used for feeding the animals, report it as fodder crop

CODES FOR BLOCK 3

unit code: *hectare - 1, acre - 2, other (specify) – 3*

[4] herd strength						
items	**covered under RBP**			**not covered under RBP**		
	number of cattle		number of buffaloes	number of cattle		number of buffaloes
	local	Crossbred		local	crossbred	
1. in milk not pregnant						
2. in milk and pregnant						
3. dry and pregnant						
4. dry and not pregnant						
5. not calved even once						
6. pregnant heifer						
7. calves male female						
8. adult male						

[5] details of breedable animals on survey date

ear tag no.	animal		age at first calving (month)	last calving (month)	calving due (month)	date of dry (month)	lactation order@	stage of lactation (month)	days in milk during last 15 days*	peak yield (kg)		calf at heal (yes 1 no 2) if 1 milk fed to calf (gms)	milk drawn in pail (kg)		
	type	breed								previous lactation	present lactation		morn.	even.	total
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
								covered under RBP							
s.no.								not covered under RBP							

instructions: 1. @ *for animals in milk record running order of lactation, for dry animals record completed lactation.*
2. *if the animal did not give milk for some days during the fortnight the reason should be given in the column.*

CODES FOR BLOCK 5

column no.2 **animal type:** *local cow - 1, crossbred cow - 2, buffalo - 3.*

3

[6] feed and fodder per animal at the time of survey

ear tag no.	animal type	stall-feeding quantity fed (kg)														supplements
		dry fodder name & source code			green fodder name & source code			concentrates source code				name
			morn.	even.	total	morn.	even.	total	morn.	even.	total	
		i.											
		ii.											
		iii.											

covered under RBP

not covered under RBP

s.no.		morn.	even.	total	morn.	even.	total	morn.	even.	total		

*instruction: * follow the same sequence in listing the animals as in block 5.*

CODE FOR BLOCK 6

feeding mode: *only stall fed* **dry fodder source code:** *self-cultivated - 1, purchased - 2.*
green fodder source code: *self-cultivated - 1, purchased - 2, collected (e.g. grass, tree leaves, etc.) - 3.*
concentrates source code: *home prepared - 1, prepared cattle feed - 2.* **supplements:** *mineral mixture, salt, molasses, mustard oil, any other (specify)*

4

[7] prices		unit code	Prices/wages (Rs.)
Items			
1. dry fodder (as in Block 6) 1.1 1.2 1.3			
2.green fodder (as in Block 6) 2.1 2.2 2.3			
3.concentrate 3.1. prepared cattle feed 3.2. home prepared	brand		
4.supplements 4.1. mineral mixture 4.2. 4.3. 4.4.	brand		
5. labour wages 5.1. men 5.2. women 5.3. child			
6. permanent labour 6.1 cash 6.2 kind			
7. salvage value of adult animals 7.1. crossbred cow 7.2. local cow 7.3. buffalo			
8. rental value of land			
9. present value of adult animals 9.1. crossbred cow 9.2. local cow 9.3. buffalo			
10.dung* % of dung used as			
10.1. manure 10.2. dung cakes			

*instruction: record the percentage of dung used as manure and dung cakes
CODE FOR BLOCK 7
item no. *1, 2, 3,4 & 10: kg - 1,   quintal - 2,   tones - 3,   other (specify) - 4.*
item no. *5&6: mandays - 1, weekly - 2, monthly - 3.*
item no. *8: hectare - 1, acres - 2,   other (specify) - 3.*
item no. *7 & 9: Rs./animal*

ear tag no*.	animal type	vaccinations**	medicines + doctor	av.no. of visits by vet. per year	service		no. of AI per conception
					code	amount	
		expenditure on (Rs.)					

[8] veterinary and breeding expenditure during last one year

ear tag no*.	animal type	vaccinations**	medicines + doctor	av.no. of visits by vet. per year	code	amount	no. of AI per conception

animal covered under RBP

animal not covered under RBP

instruction: *follow the same sequence in listing the breedable animals as in block 5.
** mention disease HS, BQ, FMD etc

CODE FOR BLOCK 8

service code: *artificial insemination - 1, natural service-2*

[9] labour use pattern

type of labour	no. of workers		average no. of days labour hired	total hours worked per person per day	distribution of total hours work		
	male	female			dairy activities	agri. operations	other (household etc.)
family							
hired casual			in month:				
hired permanent			in year:				
who handles animal feeding : family/hired worker					adult male/female/children		
who handles income from dairying: adult male/female							

6

[10] production and disposal of milk	buffalo*		cow*		total*	
quantity of milk drawn in pail (liters)	RBP	Non-RBP	RBP	Non-RBP	RBP	Non-RBP
1. on the day of visit fat (%) SNF (%)						
2. total during the last 15 days						
3. during the last 15 days avg. fat (%) avg. SNF(%)						

milk disposal	buffalo			cow			total		
	agency code	quantity (lit.)	prices (`./lit)	agency code	quantity (lit.)	prices (`./lit)	agency code	quantity (lit.)	prices (`./lit)
3. on the day of visit									
4. total during the last 15 days									

*instruction: * if milk is sold on fat and snf basis, record the average fat and average snf % also.*
CODE FOR BLOCK 10

agency code: *consumer - 1, vendor/middlemen - 2, sweet shop/creameries - 3, cooperative society - 4, private milk plant - 5, other (specify) - 6*

7

[11] outreach, perception and constraints regarding RBP		
	response	**specify**
1. have you heard of RBP *no-1, yes-2*		
2.source of information on RBP *milk union-1, dcs-2, lrps-3, others-4 specify*		
3. have you seen any documentary on RBP *no-1, yes-2*, if *yes* specify where		
4.have you seen any poster/banner on RBP *no-1, yes-2*, if *yes* specify where		
5.have you received any pamphlet on RBP *no-1, yes-2*		
6.have you attended village awareness program (VAP) *no-1, once-2, twice-3, thrice-4, more-5*		
11.1 **For RBP adopters**		
7.were you aware about ration balancing before adopting RBP *no-1, somewhat-2, well aware-3*		
8.number of RB recommendation received till date		
9. has milk production of your animal increased after RBP *no-1, yes-2*	*Before RBP*	*After RBP*
if *yes* than specify avg. milk yield (lit./day)		
10. has milk composition improved *no-1, yes-2*	*Before RBP*	*After RBP*
if than specify fat(%)		
snf(%)		
11.any change in general health of animal after RBP *no-1, yes-2, can't say-3*		
12. in your experience have the digestive disorders of animals decreased *no-1,yes-2,can't say-3*		
13.has RBP benefited in following	*Before RBP*	*After RBP*
a. increasing conception rate *no-1, yes-2*		
if *yes* than specify avg. of inseminations		
b. reducing service period *no-1, yes-2*		
if *yes* than specify avg. service period (in months)		
c. improving lactation length *no-1, yes-2*		
if *yes* than specify avg. lactation length (in months)		
d. reducing inter calving period *no-1, yes-2*		
if yes than specify avg. inter calving period (in months)		
e. reducing repeat breeding *no-1, yes-2*		
g. controlling prolapsed of uterus *no-1, yes-2*		
h. controlling anestrous *no-1,yes-2*		
f. any other (specify) *no-1, yes-2*		
14. do you think that the feed cost of your milch animal has changed after RBP *decreased-1,increased-2,unchanged-3*		
15. do you feel that additional expenditure (money/labour) is involved in adopting RBP *no-1,yes-2, can't say-3*		
16. do you find change in employment opportunity after RBP *decreased-1,increased-2,unchanged-3*		
17.do you think that your monthly income from dairy has changed *decreased-1,increased-2,unchanged-3*		
18. do you feel that your savings from dairy have increased after adopting RBP *no-1,yes-2, can't say-3*		
19. if *yes* in above additional saving from dairying utilized for *education-1,nutrition & health-2, expanding dairying-3,others-4 specify*		
20. after adopting the RBP do you think that milk consumption has increased *no-1, yes* if *yes* specify		
21. .have benefits of RBP increased your interest in dairy *no-1,yes-2,can't say-3*		
22. would you like to increase your herd strength *no-1, yes-2, maybe-3*		

23. do you feel involved in the program *no-1,yes-2,somewhat-3*		
24. name of the LRP who gave RB advice		
25.did LRP brief you on benefits of RB initially *no-1,yes-2,somewhat-3*		
26.whether RB advice slip was given by LRP *no-1, yes-2*		
27. whether advice slip is kept & displayed properly *no-1, yes-2*		
28.are you following the recommended ration correctly *no-1,yes-2,* if *no* give reason		
29. constraints in regular feeding of recommended ration *mineral mixture shortage-1, frequent change in feed items-2,lrp not visit timely-3,not convinced about the recommendations-4,any others-5,*specify		
30. is LRP visiting after giving RB recommendation to follow up *never-1,sometimes-2,always-3*		
31.have you contacted LRP anytime for ration re-formulation when there was a change in feed items *never-1,sometimes-2,always-2*		
32.do you get any additional service from LRP *no-1,yes-2,sometime-3* if *yes* specify		
33. on a 10 point scale how many points you will give to LRP		
34.are you trying to feed balanced ration to animals which are not covered under RBP *never-1,sometimes-2,most often-3*		

35. would you like to adopt RB on payment basis after the end of programme
          no-1,yes-2,can't say-3
          if *yes* specify how much payment per animal per ration balancing		

36. do you recommend other farmers also join RBP *no-1,yes-2* if *no* specify reason		
37.on a 10 point scale how many points you will give to RBP		
38.would you like to give suggestion for improvement in RBP 		
11.2 **for non RBP adopters**		
39. are you interested in RBP *no-1,yes-2*		
40.do you think it is a beneficial program *no-1,yes-2,can't say-3*		
41.do you interact with LRP or RBP farmers to learn about benefits *no-1,yes-2* if *yes* specify		
42.do you try to learn from RBP farmers and apply ration balancing on your animals *no-1,yes1*		
43.have you thought about any change in feeding pattern after RBP is implemented in your village *no-1,yes-2*		
44. have you been approached by LRP for covering your animal *no-1, yes-2* if *yes* than why you did not adopt the program		
45. do you think selection of beneficiaries under RBP is biased *no-1, yes-2* if *yes* specify		

46. are you willing to avail this service on payment basis
          no-1,yes-2,can't say-3
          if *yes* specify how much payment per animal per ration balancing		

[12] particulars of field operation

1. enumerator name:

2. date of survey:

3. reviewed by:

    supervisor name……………………….…………….date…………………..

    if sent back for verification/correction:

    i.   date sent back to enumerator…………………………………………….

    ii.   date corrected and returned…………………………………………

    iii. reviewed again by……………………………………………………..

MILK UNION			MONTH	

NATIONAL DAIRY RESEARCH INSTITUTE, KARNAL (HARYANA)
NDDB Funded Project: "Impact Assessment and Evaluation Ration Balancing Program of Northern &Western Regions"

LRP SCHEDULE: 3.0

[0] descriptive identification of sample LRP				
particulars	**name**	**particulars**	**name**	
1. district		5.name of LRP		
2. tehsil/taluk		6. user id for INAPH		
3. village		7. mobile number		
4. dcs*				

dcs-**dairy co-operated society**

[1] socio-economic profile of LRP			
1. age (years)		11. monthly income as LRP	
2. sex *male -1, female-2*		a. fixed salary	
3. marital status (code)		b. incentives	
4. social group (code)		c. commission	
5. education (code)		i.feed sale	
6. occupation other than LRP		ii.mm sale	
		iii.any other(specify)	
7. milch animal owned (no.)		d. fees from farmers	
8. operational land holding (area)		e. others specify	
9. total annual income (code)		10. dwelling structure *pucca-1, semi-pucca-2, kuccha-3*	
10. monthly income from other occupation		11.household electrification *no-1,yes-2*	

CODE FOR BLOCK 1

social group: *scheduled tribe - 1, scheduled caste - 2, other backward class - 3, general - 4.*

education qualification: *illiterate - 1, literate without formal schooling - 2, primary - 3, middle - 4, secondary - 5, higher secondary - 6, diploma/certificate course - 7, graduate - 8, post graduate and above- 9*

annual income: *below 1 lakh - 1, 1 to 3 lakhs - 2, 3 to5 lakhs - 3, above 5 lakhs - 4*

[2] functioning under RBP			
1. time of starting working as LRP	Year :	Month:	
2. average time spent for RBP			
a. hours/day			
b. days/month			
3. total farmers covered under RBP so far		Male	Female
4. total animals covered under RBP			
5. handling of RBP software *difficult-1,easy-2,very easy-3*			
6. while doing RB, with whom do you interact *house owner-1,person who feeding animal-2,both-3*			
7. do you give RB advice slip to farmer *no-1,yes-2*			
8. how do you give recommendation of feed items to farmers in *kg-1,converted to vessels/bundles-2,both-3*			
9. how do you ensure that farmers are following RBP *no-1,yes-2*			
a.by interaction with farmer during next visit			
b. follow up visit before due date of RB			
c. verifying over phone			
d. any other-specify			
10.do you give any additional advice/supply to farmers other than RBP *no-1,yes-2*			
a. mineral mixture supply			
b.de-wormer supply			
c.any other supply specify			
d.advice on animal management –chaffing fodder, drinking water etc.			
e.advice on animal healthcare & vaccination			
f.calf & heifer care			
g.other- specify			

[3] coverage and efficiency of RBP			
1. no. of VAPs conducted in your village		7. do officers from Milk Union visit you for monitoring work after initiation of RBP *never-1, sometimes--2, frequently-3 (specify no. of visits in past 1 year)*	
2. whether the documentary on RBP was shown during VAP *no-1,yes-2*			
3. no. of review meetings you have attended in last one year		8. how do you select farmers for RBP advice *first come first serve-1 suggested by DCS officials-2 personal preferences-3 any other-4 (specify)*	
4. whether you distribute any literature on RBP to farmers *no-1,yes-2*			
5. is RBP poster/banner displayed in your village/DCS *no-1,yes-2*		9. as per your understanding what are the benefits of RBP	
6. awareness of farmers on RBP in your village *less-1, good-2, excellent-3*			

[4] constraints	
1. do you face problems with software *no-1, sometimes-2, frequently-3*	
2. last software problem faced by the LRP *specify approximate days*	
3. when you have some problems with software operation how do you handle it *mostly set it right by self-1, mostly seek the help of other LRPs-2, mostly seek the help from milk union-3*	
4. are there any hardware problems in netbook *no-1, sometimes-2, frequently-3*	
5. is internet connectivity a problem *no-1, sometimes-2, frequently-3*	
6. do RBP farmers cooperate easily problem *no-1, often-2, always-3*	
7. do non-RBP farmers create any hurdles in programme *no-1, sometimes-2, frequently-3*	
8. is lack of support from DCS a constraint *no-1, sometimes-2, frequently-3*	
9. is lack of support from milk union a constraint *no-1, sometimes-2, frequently-3*	
10. is mineral mixture supply adequately available *no-1, often-2, always-3*	
11. are you satisfied with the financial incentive that you receive *no-1, somewhat-2, yes-3*	
12. any other constraints in RBP implementation	

Instruction: note down the details about the nature of the problem face in space provided

[5] opinion and suggestions	
1.do you see any notable impact of RBP in your village *no-1, yes-2, (specify)*	
2. what prompted you to work as an LRP	
3. do you feel any change in your social status after working as LRP *no-1, somewhat-2, yes-3 (specify)*	
4. do you think programme would be sustainable after withdrawal of government/NDDB support *no-1, yes-2, can't say-3*	
5 would you like to continue providing the service after the end of programme *no-1, yes-2, can't say-3* if *yes* what remuneration do you expect	
6. do you feel, RBP adoption has reduced the wastage of feed and fodder *no-1, yes-2, can't say-3*	

7. what is the general practice of farmers to dispose of packaging materials of cattle feed, mineral mixture etc *(specify)*	
8. how manure is utilized by the farmers *burrning-1, as fertilizer-2, wastage-3, other-4 (specify)*	
9. any suggestions for improvement in RBP	

NATIONAL DAIRY RESEARCH INSTITUTE, KARNAL (HARYANA)
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EIA QUESTIONNAIRE: 4.0

[0] basic information about EIA

particulars		particulars	
1. milk union (name)		7. key informants	
2. districts covered (no.)		name	designation
3. villages covered (no.)			
4. dcs* (no.)			
5. milch animals (no.)	LC: CB: BU:		
6. annual milk procurement (lakh lit.)			

***dcs*-dairy co-operated society**

[1] coverage of RBP (as on 31ˢᵗ May, 2015)

1. date of official inception of RBP	month:		year:	
		target		*achievement*
2. staff position				
3. netbooks purchased (no.)				
4. LRPs trained (no.)				
5. LRPs functioning (no.)				
6. VAP conducted (no.)				
7. villages covered (no.)				
8. animals covered (no.)				

[2] implementation, monitoring and evaluation of RBP

1. incentives provided to LRPs

2. innovative practices for programme implementation

3. monitoring system: provide information about review meetings, field visits

4. evaluation system: provide information about record keeping system

5. any mechanism put in place to ensure sustainability of the programme

[4] impact of RBP

particulars	before RBP		after RBP	
	annual average	june 201….*	annual average#	june 2015
1. milk procurement (lit.)				
2. dcs members (no.)				
3. pourer members (no.)				
4. milk fat (%)				
5. daily milk yield (litre)				
6. mineral mixture sale (kg.)				
7. cattle feed sale (kg.)				
8. bypass fat sale (kg.)				
9. de-wormer (doses)				
10. veterinary visits				
11. conception rate				

note: information to be taken for the total RBP villages only
instruction : * in the month of june for the year before starting the RBP
 # average of past one year

[5] constraints
1. manpower constraints (eg. problems in recruiting staff, lrp, etc.)
2. technical constraints: (eg. problems in availability of inputs, net connectivity, shortfall in technical assistance provided, etc.)
3. governance issues: (eg. procedure of procurement, shortcomings in monitoring and evaluation system, etc.)
4. financial constraints
5. any other

[6] opinion and suggestions
1. has program improved the capacity of DCSs for delivering goods and services to farmers
2. most critical components to achieve programme objectives

3. do you plan to extend coverage of RBP beyond the mandatory targets. if yes what will be source of funds
4. are beneficiary households likely to continue receiving RBP advisory services after the program ends
5. are LRPs likely to continue operating and remain financially viable after the program ends
6. how the RBP would be implemented by the EIA after the financial support from NDP-I is withdrawn
7. does gender of LRP make difference to effectiveness of programme especially in ensuring retention of LRPs for longer period with the programme
8. what are the main lessons that can be drawn from the program experience since its inception
9. what has been the main lessons learned regarding targeting and working with vulnerable households
10. what actions are recommended to follow up or reinforce initial benefits from the program

11. what corrective actions are recommended regarding the program
    11.1   design
 	
    11.2   implementation
 	
    11.3   reporting
 	
    11.4   monitoring
 	
    11.5   evaluation

Appendix V
Glimpses of Field Visit